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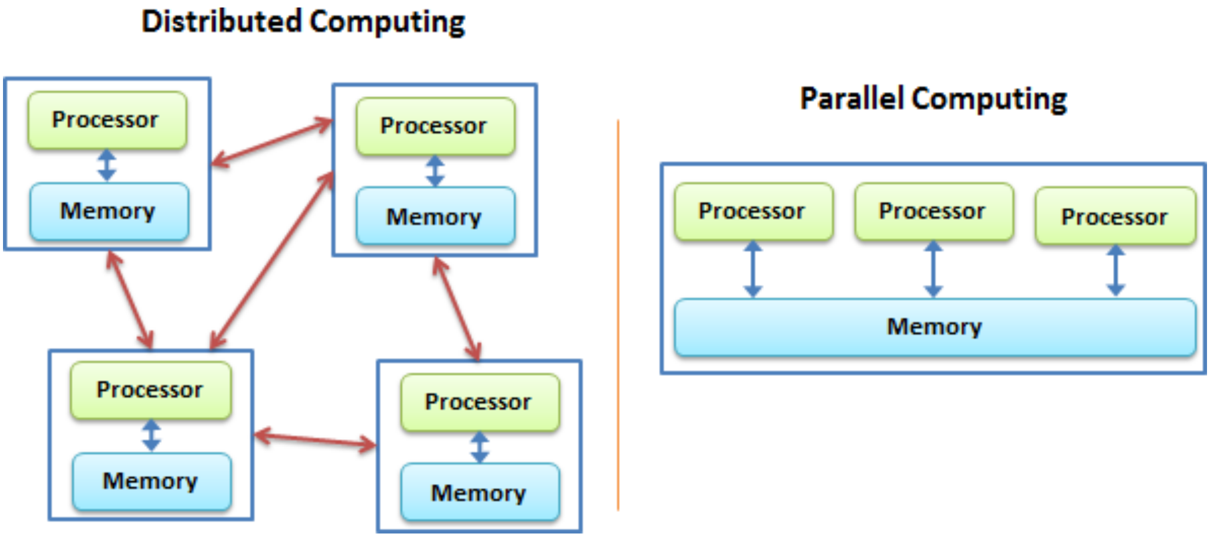
1. **Distributed System Versus Parallel System**
   https://www.youtube.com/watch?v=-bVg1S6Wp9A



Distributed Computing	Parallel Computing
In distributed computing, a number of unified computers work towards a common task while communicating with each other with the help of message passing	In parallel computing, a task is divided into multiple sub-task which are then allotted to different processors on the same computer system.
Number of Computer Systems Involved	
Multiple physical computer systems are present in the same computer system.	A single physical computer system hosts multiple processors.
Dependency Between Processes	
There might not be much dependency between the processes.	There is more dependency between the process. Output of one might be the input of another.
Scalability	
The systems are easily scalable as there is no limitation on how many systems can be added to a network.	The systems that implement parallel computing have limited scalability.
Resource Sharing	
Computers have their own memory and processors.	All the processors share the same memory.
Synchronization	
The computers in the network have to implement synchronization algorithms.	All processors use the same master clock for synchronization.
Usage	
Generally preferred in places requiring high scalability.	Generally preferred in places requiring faster speed and better performance.

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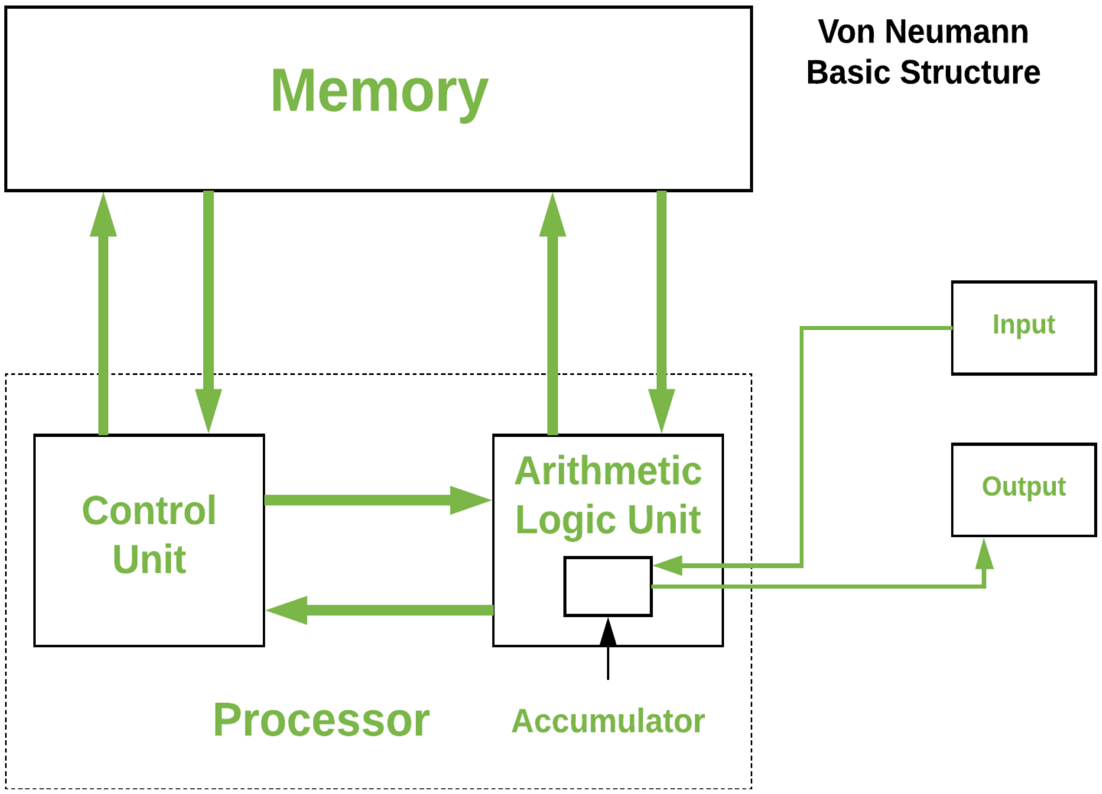
2. **Parallel Computing**
   https://www.youtube.com/watch?v=q7sgzDH1cR8

It is the use of multiple processing elements simultaneously for solving any problem. Problems are broken down into instructions and are solved concurrently as each resource which has been applied to work is working at the same time.
Advantages:-

- It saves time and money as many resources working together will reduce the time and cut potential costs.
- It can be impractical to solve larger problems on Serial Computing.
- It can take advantage of non-local resources when the local resources are finite.
- Serial Computing 'wastes' the potential computing power, thus Parallel Computing makes better work of hardware.

<u>Von Neumann Theory</u>



- **Control Unit –**
  A control unit (CU) handles all processor control signals. It directs all input and output flow, fetches code for instructions and controlling how data moves around the system.

- **Arithmetic and Logic Unit (ALU) –**
  The arithmetic logic unit is that part of the CPU that handles all the calculations the CPU may need, e.g. Addition, Subtraction, Comparisons. It performs Logical Operations, Bit Shifting Operations, and Arithmetic Operation.

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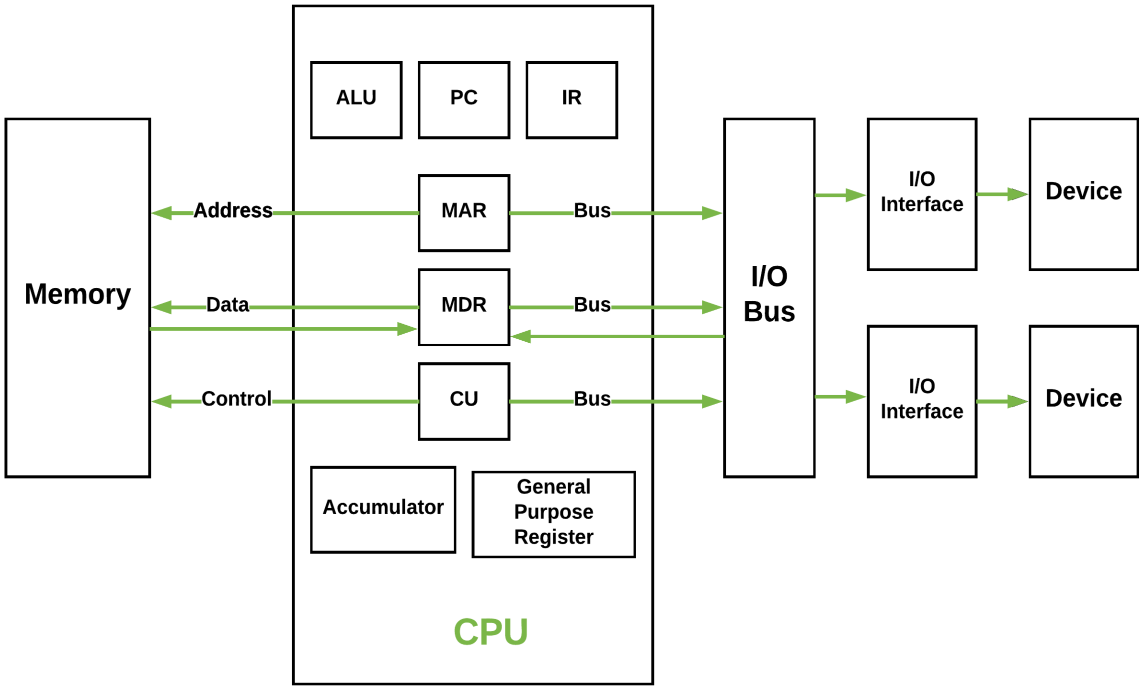
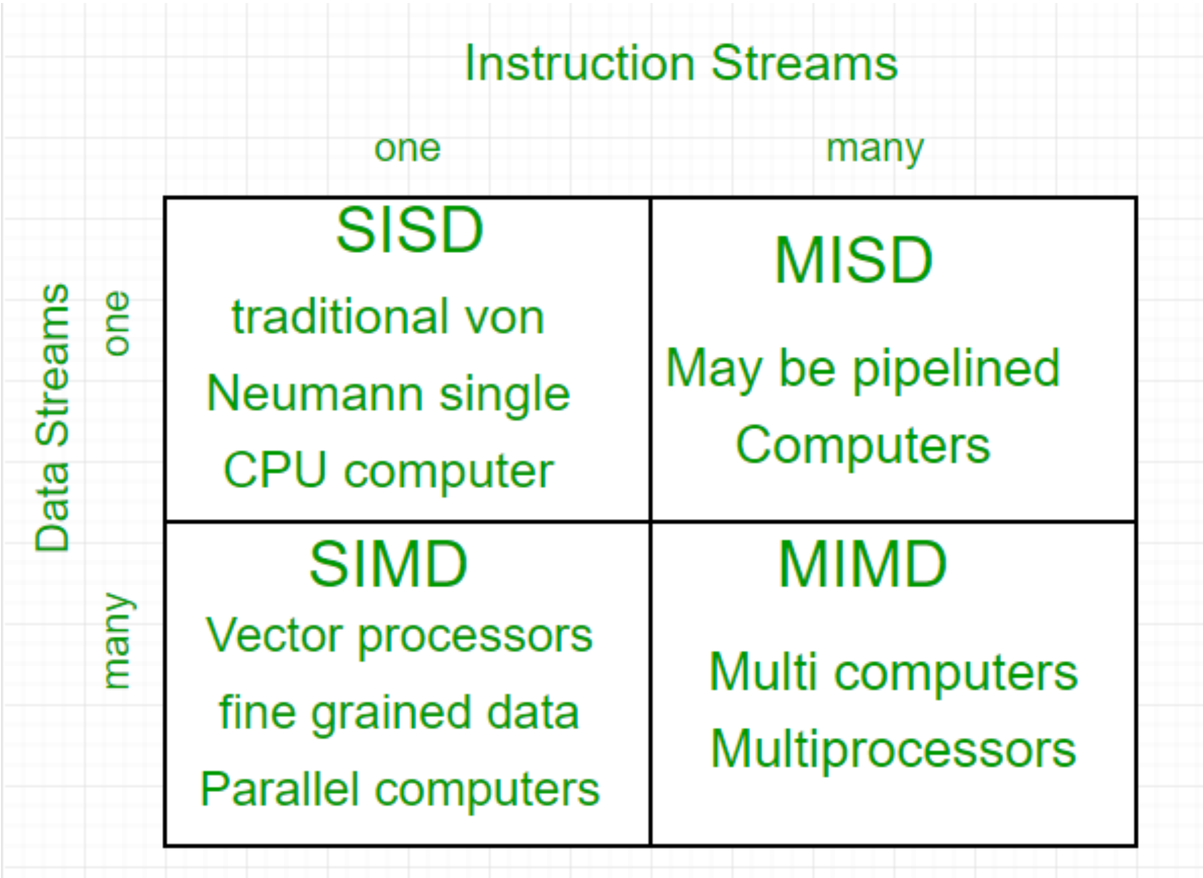


- **Main Memory Unit (Registers) –**
  - **Accumulator:** Stores the results of calculations made by ALU.
  - **Program Counter (PC):** Keeps track of the memory location of the next instructions to be dealt with. The PC then passes this next address to Memory Address Register (MAR).
  - **Memory Address Register (MAR):** It stores the memory locations of instructions that need to be fetched from memory or stored into memory.
  - **Memory Data Register (MDR):** It stores instructions fetched from memory or any data that is to be transferred to, and stored in, memory.
  - **Current Instruction Register (CIR):** It stores the most recently fetched instructions while it is waiting to be coded and executed.
  - **Instruction Buffer Register (IBR):** The instruction that is not to be executed immediately is placed in the instruction buffer register IBR.
- **Input/Output Devices –** Program or data is read into main memory from the *input device* or secondary storage under the control of CPU input instruction. *Output devices* are used to output the information from a computer. If some results are evaluated by computer and it is stored in the computer, then with the help of output devices, we can present it to the user.
- **Buses –** Data is transmitted from one part of a computer to another, connecting all major internal components to the CPU and memory, by the means of Buses. Types:

- **Data Bus:** It carries data among the memory unit, the I/O devices, and the processor.
- **Address Bus:** It carries the address of data (not the actual data) between memory and processor.
- **Control Bus:** It carries control commands from the CPU (and status signals from other devices) in order to control and coordinate all the activities within the computer.

Flynn's taxonomy



Flynn's classification –

- **Single-instruction, single-data (SISD) systems –**
  An SISD computing system is a uniprocessor machine which is capable of executing a single instruction, operating on a single data stream. In SISD, machine instructions are processed in a sequential manner and computers adopting this model are popularly called sequential computers. Most conventional computers have SISD architecture. All the instructions and data to be processed have to be stored in primary memory.

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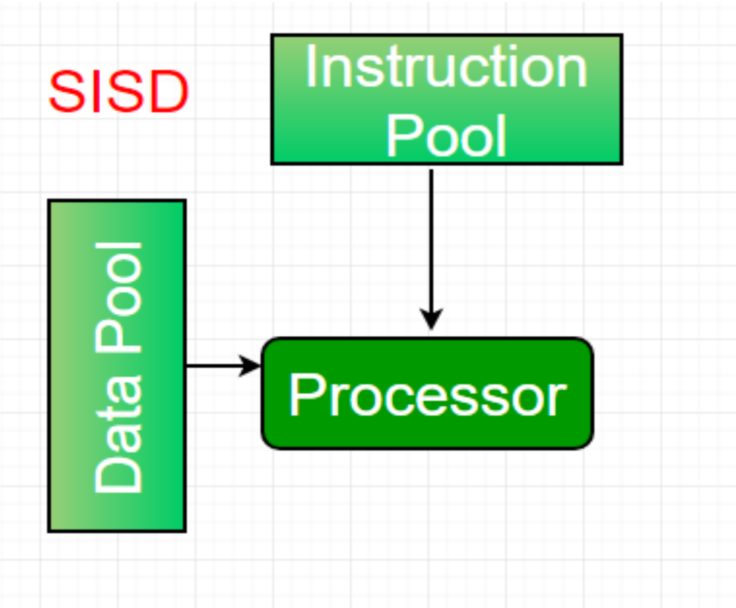
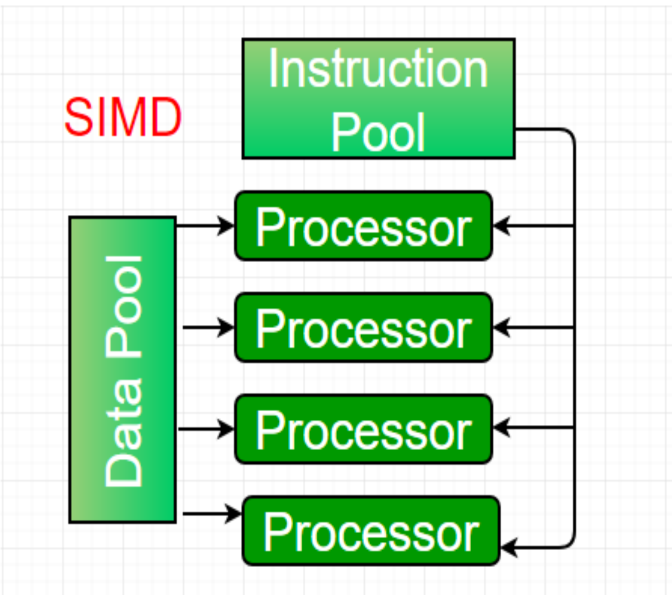


The speed of the processing element in the SISD model is limited(dependent) by the rate at which the computer can transfer information internally. Dominant representative SISD systems are IBM PC, workstations.

- **Single-instruction, multiple-data (SIMD) systems –**
  An SIMD system is a multiprocessor machine capable of executing the same instruction on all the CPUs but operating on different data streams. Machines based on an SIMD model are well suited to scientific computing since they involve lots of vector and matrix operations. So that the information can be passed to all the processing elements (PEs) organized data elements of vectors can be divided into multiple sets(N-sets for N PE systems) and each PE can process one data set.



Dominant representative SIMD systems is Cray's vector processing machine.

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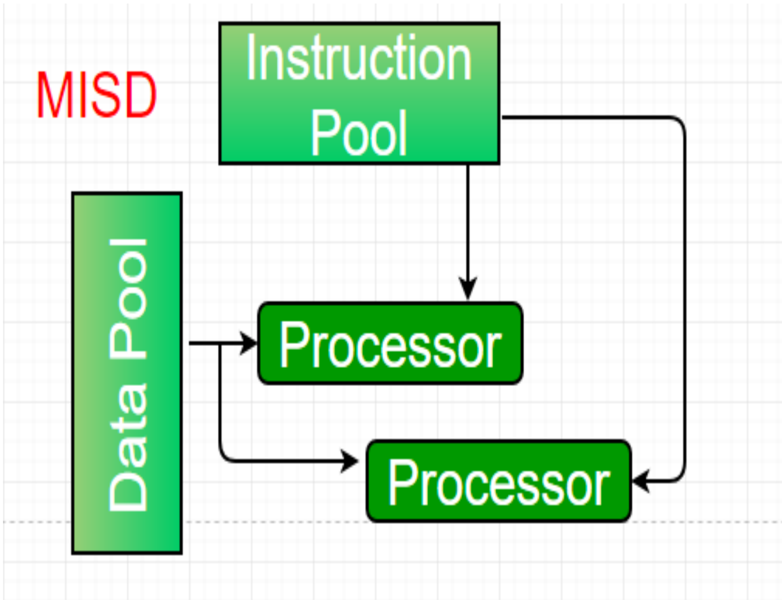
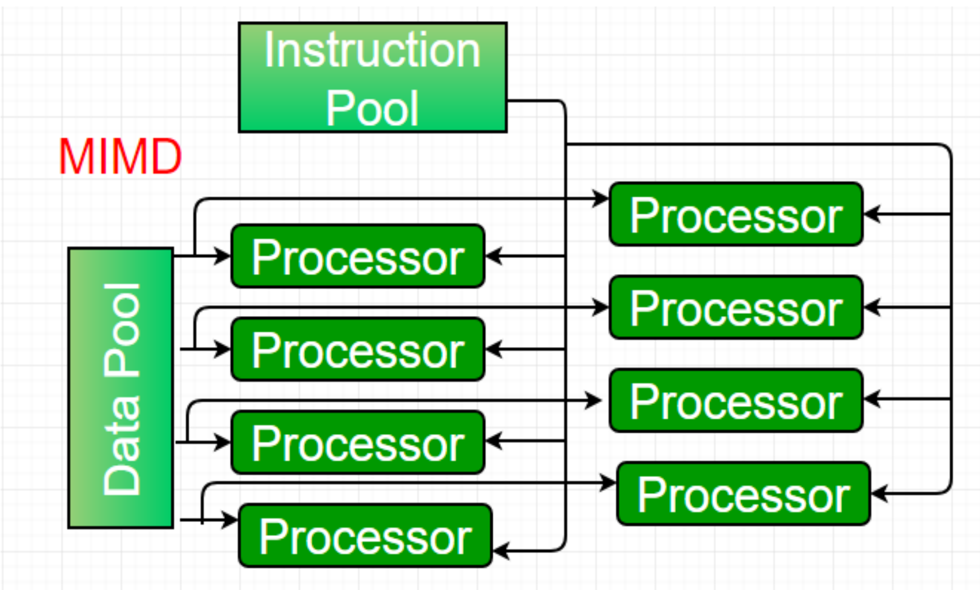
- **Multiple-instruction, single-data (MISD) systems –**
  An MISD computing system is a multiprocessor machine capable of executing different instructions on different PEs but all of them operating on the same dataset .



Example Z = sin(x)+cos(x)+tan(x)
The system performs different operations on the same data set. Machines built using the MISD model are not useful in most of the application, a few machines are built, but none of them are available commercially.

- **Multiple-instruction, multiple-data (MIMD) systems –**
  An MIMD system is a multiprocessor machine which is capable of executing multiple instructions on multiple data sets. Each PE in the MIMD model has separate instruction and data streams; therefore machines built using this model are capable to any kind of application. Unlike SIMD and MISD machines, PEs in MIMD machines work asynchronously.



MIMD machines are broadly categorized into **shared-memory MIMD** and**distributed-memory MIMD** based on the way PEs are coupled to the main memory.

In the **shared memory MIMD** model (tightly coupled multiprocessor systems), all the PEs are connected to a single global memory and they all have access to it. The communication between PEs in this model takes place through the shared memory, modification of the data stored in the global memory by one PE is visible to all other PEs. Dominant representative shared memory MIMD systems are Silicon Graphics machines and Sun/IBM’s SMP (Symmetric Multi-Processing).

In **Distributed memory MIMD** machines (loosely coupled multiprocessor systems) all PEs have a local memory. The communication between PEs in this model takes place through the interconnection network (the inter process communication channel, or IPC). The network connecting PEs can be configured to tree, mesh or in accordance with the requirement.

The shared-memory MIMD architecture is easier to program but is less tolerant to failures and harder to extend with respect to the distributed memory MIMD model. Failures in a shared-memory MIMD affect the entire system, whereas this is not the case of the distributed model, in which each of the PEs can be easily isolated. Moreover, shared memory MIMD architectures are less likely to scale because the addition of more PEs leads to memory contention. This is a situation that does not happen in the case of distributed memory, in which each PE has its own memory. As a result of practical outcomes and user’s requirement , distributed memory MIMD architecture is superior to the other existing models.

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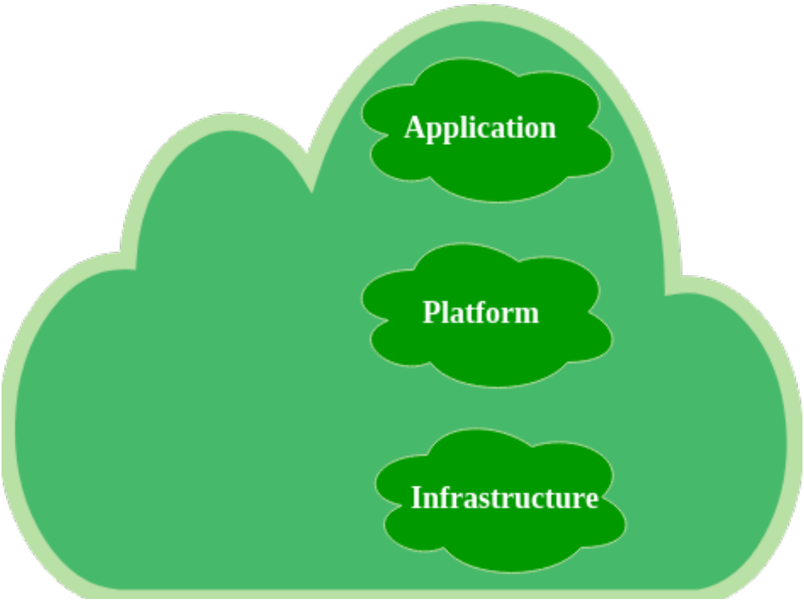
3. **Cloud Computing**
   https://www.youtube.com/watch?v=M988_fsOSWo

   Storing and accessing the data and programs on remote servers that are hosted on internet instead of computer's hard drive or local server. Cloud computing is also referred as Internet based computing.



Benefits of Cloud Hosting :

- **Scalability:** With Cloud hosting, it is easy to grow and shrink the number and size of servers based on the need.
  This is done by either increasing or decreasing the resources in the cloud.This ability to alter plans due to fluctuation in business size and needs is a superb benefit of cloud computing especially when experiencing a sudden growth in demand.
- **Instant:** Whatever you want is instantly available in the cloud.
- **Save Money:** An advantage of cloud computing is the reduction in hardware cost. Instead of purchasing in-house equipment, hardware needs are left to the vendor. For companies that are growing rapidly, new hardware can be a large, expensive, and inconvenience. Cloud computing alleviates these issues because resources can be acquired quickly and easily. Even better, the cost of repairing or replacing equipment is passed to the vendors.
  Along with purchase cost, off-site hardware cuts internal power costs and saves space. Large data centers can take up precious office space and produce a large amount of heat. Moving to cloud applications or storage can help maximize space and significantly cut energy expenditures.
- **Reliability:** Rather than being hosted on one single instances of a physical server, hosting is delivered on a virtual partition which draws its resource, such as disk space, from an extensive network of underlying physical servers. If one server goes offline it will have no effect on availability, as the virtual servers will continue to pull resource from the remaining network of servers.
- **Physical Security:** The underlying physical servers are still housed within data centres and so benefit from the security measures that those

facilities implement to prevent people accessing or disrupting them on-site