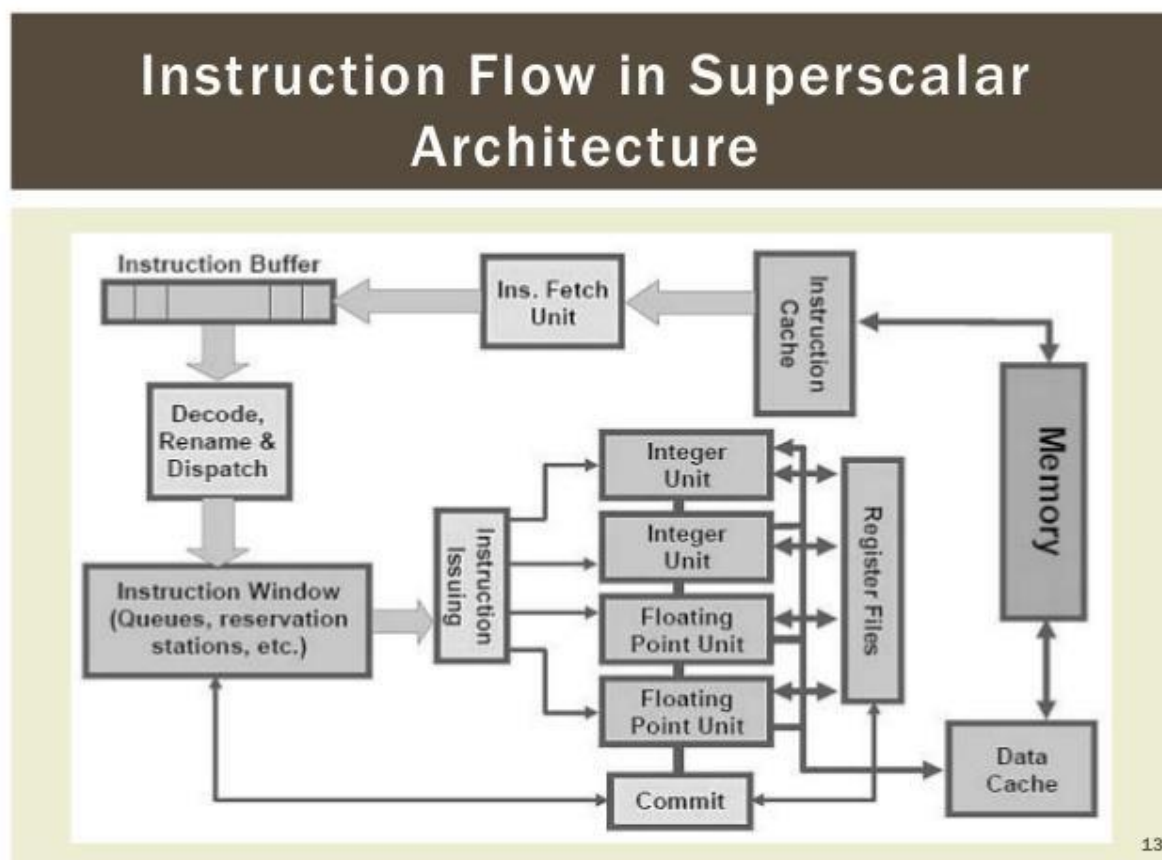


Parallel processing is a method in computing in which separate parts of an overall complex task are broken up and run simultaneously on multiple CPUs, thereby reducing the amount of time for processing.

- For the purpose of increasing the computational speed of computer system, the term 'parallel processing'.
- Computation requirements are ever increasing and Sequential architectures reaching physical limitation. So we need to process them simultaneously to achieve faster execution times.
- As an example, the next instruction can be read from memory, while an instruction is being executed in ALU. The system can have two or more ALUs and be able to execute two or more instructions at the same time.
- Hardware improvements like Pipelining, Superscalar, etc., are non-scalable and requires sophisticated Compiler Technology.
- Vector Processing works well for certain kind of problems.

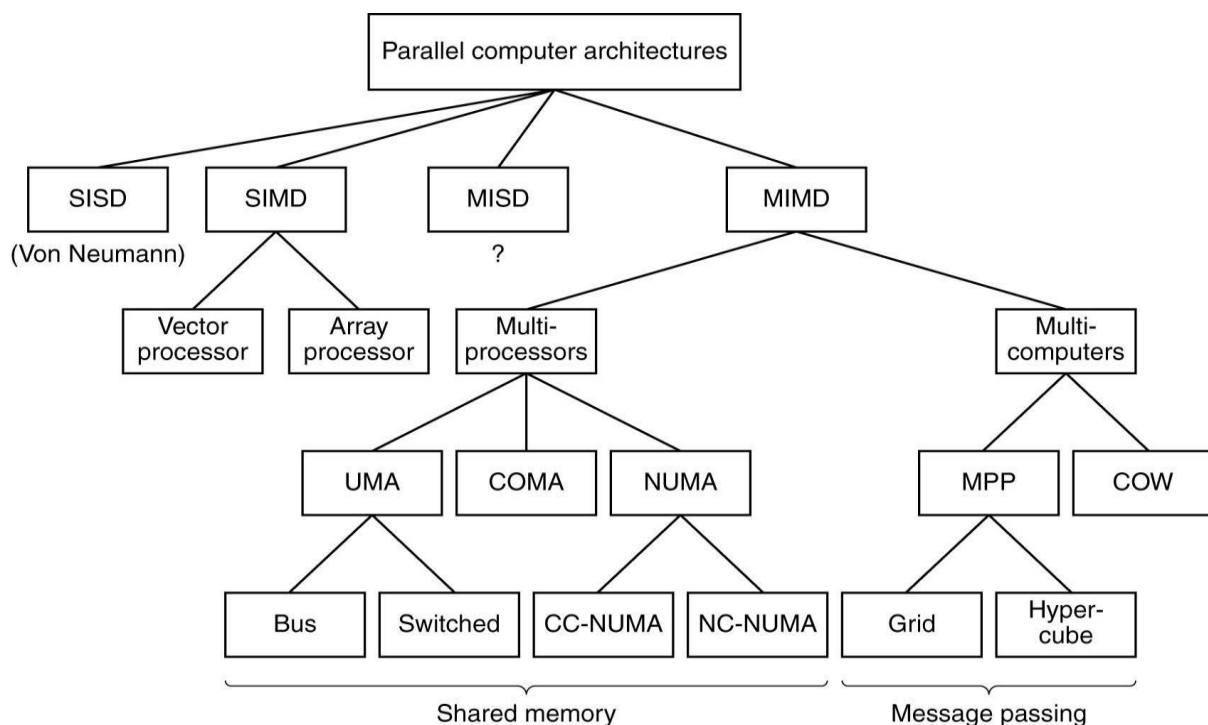
Super Scalar Architecture :



- Instead of performing serial instructions/operations we can process them simultaneously.

- **Superscalar architecture** is a method of parallel computing used in many processors. In a **superscalar** computer, the central processing unit (CPU) manages multiple instruction pipelines to execute several instructions concurrently during a clock cycle.
- A **superscalar processor** is a [CPU](#) that implements a form of [parallelism](#) called [instruction-level parallelism](#) within a single processor. In contrast to a [scalar processor](#) that can execute at most one single instruction per clock cycle, a superscalar processor can execute more than one instruction during a clock cycle by simultaneously dispatching multiple instructions to different [execution units](#) on the processor.

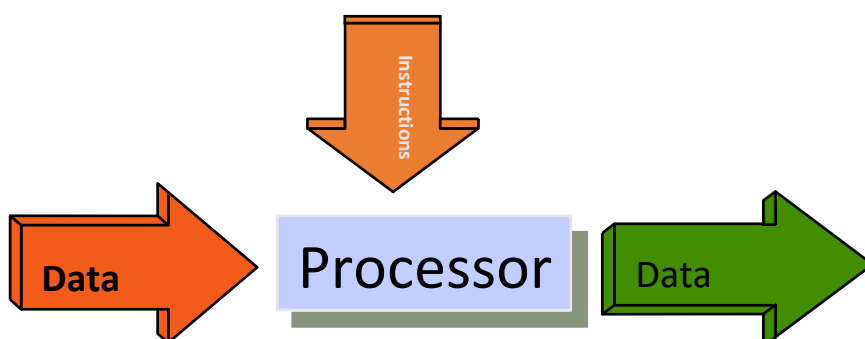
Taxonomy of Parallel Computers:



Flynn's classification –

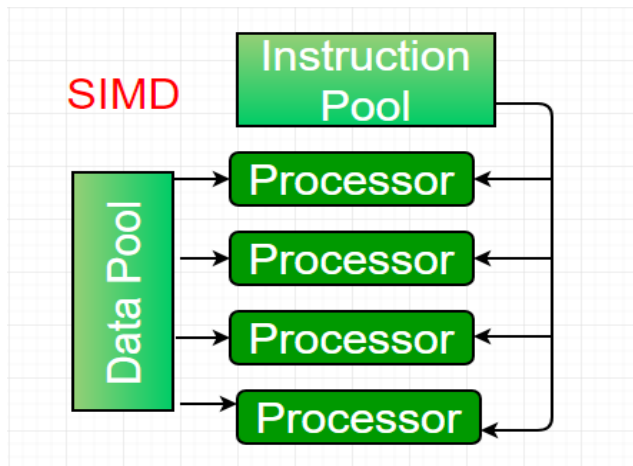
1. Single-instruction, single-data (SISD) systems –

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.



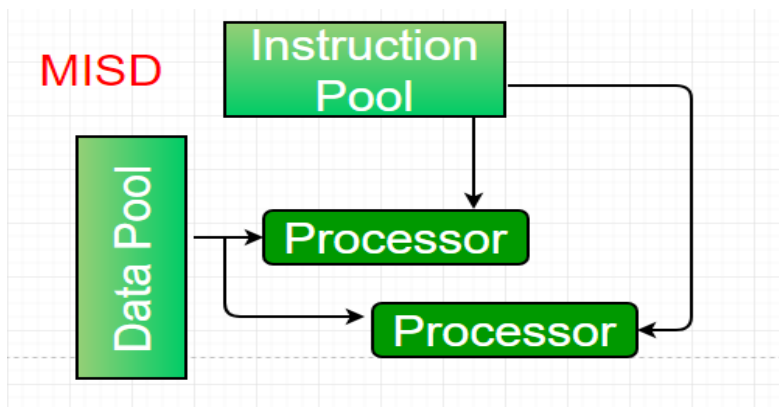
2. Single-instruction, multiple-data (SIMD) systems –

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.



3. 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.

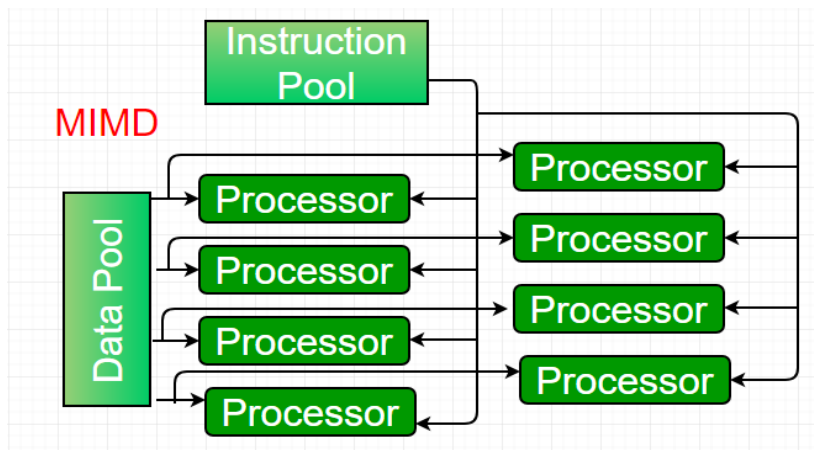


- Machines built using the MISD model are not useful in most of the application, a few machines are built, but none of them are available commercially.

4. 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.



- In the **shared memory MIMD**, Multiple processors can operate independently but share the same memory resources. Changes in a memory location effected by one processor are visible to all other processors.
- In **Distributed memory MIMD**, unlike shared MIMD every processor has own memory and are highly reliable. **Because each processor has its own local memory, it operates independently. Changes it makes to its local memory have no effect on the memory of other processors.**