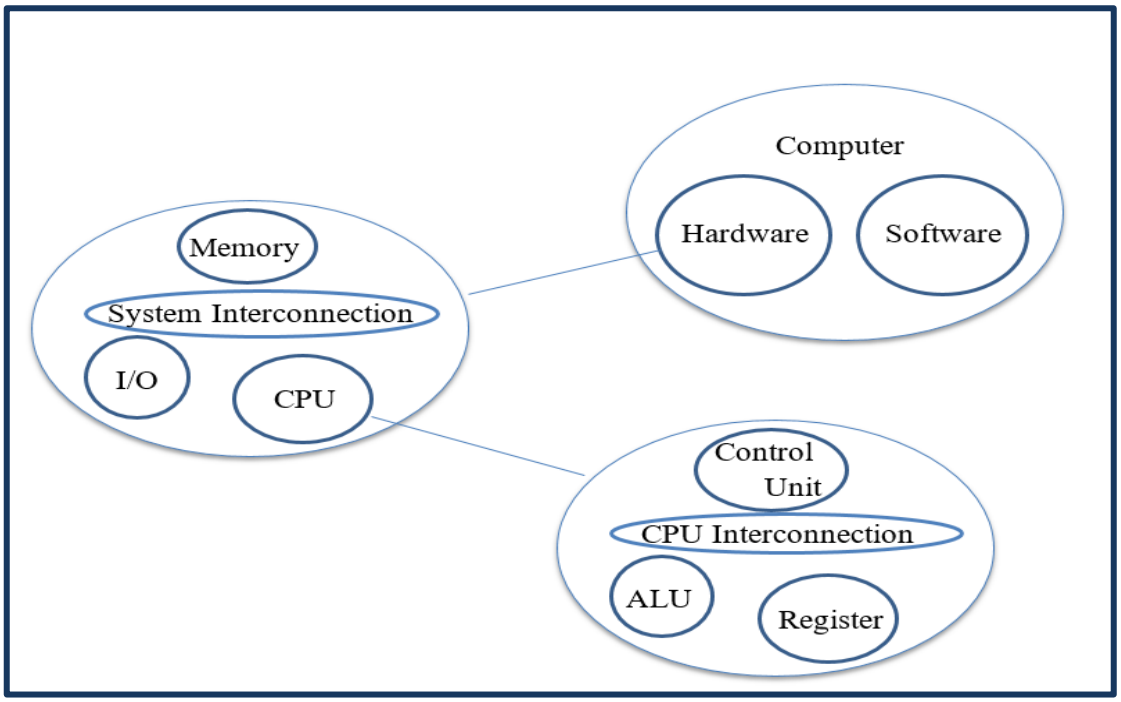
❖ Computer System

A computer along with additional hardware and software together is called a computer system.

A computer system primarily comprises a central processing unit (CPU), memory, input/output devices and storage devices.

All these components function together as a single unit to deliver the desired output.



Basic Components of a Computer System

❖ CPU Main Parts:

A **central processing unit** (**CPU**) is the electronic circuitry within a computer that carries out the instructions of a computer program by performing the basic arithmetic, logic, controlling, and input/output (I/O) operations specified by the instructions. It consists three main parts:

- **Arithmetic and Logic Unit (ALU)** that performs arithmetic and logic operations.
- **Registers set** that supply operands to the ALU and store the results of ALU operations.
- **Control Unit (CU)** that directs the operation of the processor. It tells the computer's memory, arithmetic and logic unit and input and

output devices how to respond to the instructions that have been sent to the processor.

❖ A classification of computer architectures:

There are basically two type of digital computer architecture. These two processor architecture can be classified by how they use memory.

- **Von Neumann architecture**
- **Harvard architecture**

Booth architectures have the three basic hardware subsystems:

- ❖ CPU.
- ❖ Main Memory.
- ❖ I/O system

➢ Von Neumann architecture

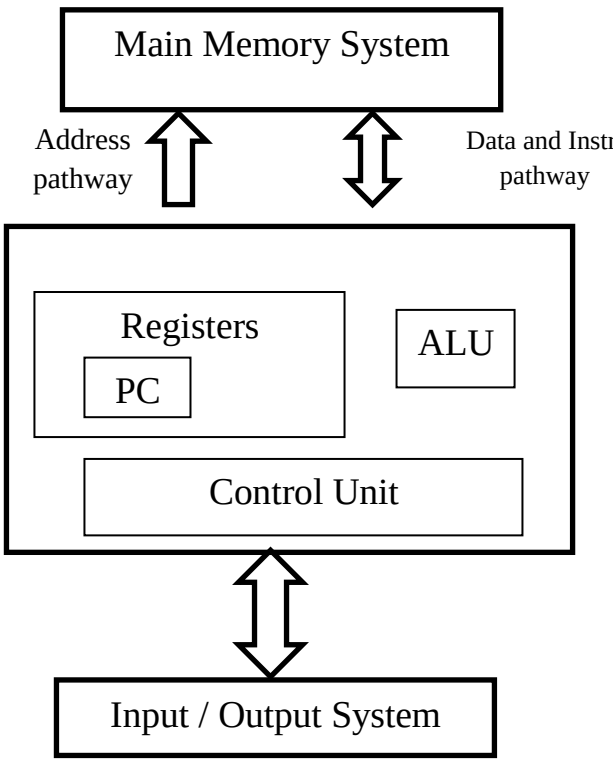
- It has a stored-program computer.
  The Main memory system holds the program that controls the computers operation.
- It carries out instructions sequentially.
  The CPU executes one program at a time.
- It has a single path between the main memory system and control unit of the CPU.
- Von Neumann machines provide one pathway for addresses and a second pathway for data and instructions. It means that instruction fetch and a data operation cannot occur at the same time because they share a common bus.

➢ Harvard architecture

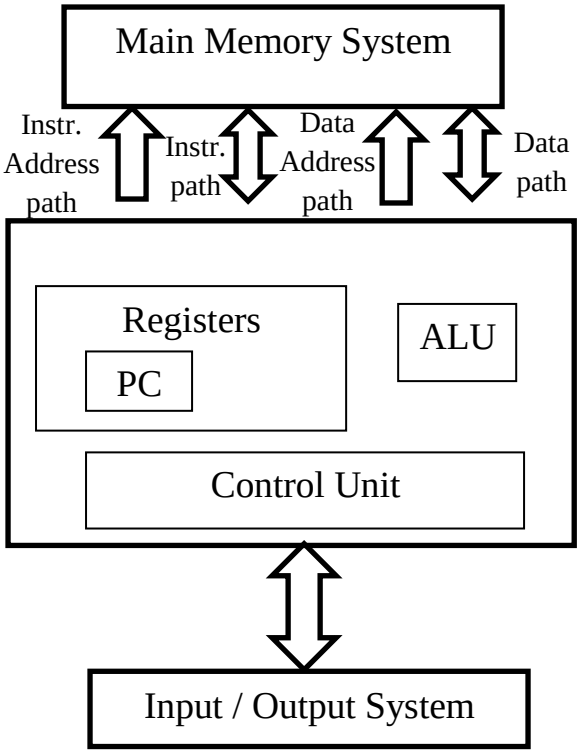
- Harvard architectures are similar to conventional Von-Neumann computers except that they provide independent pathways for data addresses, data, instruction address, and instructions.

- Harvard architectures allow the CPU to read an instruction and perform a data memory access at the same time.

- A Harvard architecture computer can thus be faster because instructions fetch and data access do not occurred in a single memory pathway.



A- Von-Neumann Architecture



B- Harvard Architecture

✓ Comparison between Von and Harvard Architecture

Von – Neumann Architecture	Harvard Architecture.
• Codes and data in the same memory	• Codes and data in separate memory
• Require less space	• Require more space
• CPU cannot access data and instructions in same time	• CPU can access data and instructions in same time
• Comparatively slower	• Comparatively faster
• Only a single memory connected to the CPU	• Data memory (RAM) and Program memory (ROM) are separately connected to the CPU
• Using only one channel/bus	• Using separate busses (two busses)

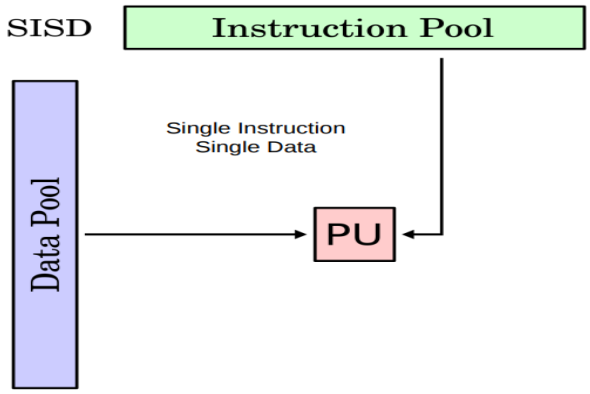
❖ Flynn's Classification of Computer Architectures

Flynn's Classification of Computers: M.J. Flynn proposed a classification for the organization of a computer system ***by the number of instructions and data items that are manipulated simultaneously***.

1. Single-Instruction, Single-Data (SISD) systems

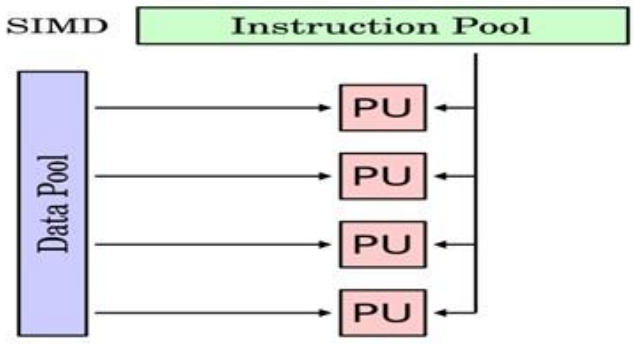
SISD computing system is a uniprocessor machine which is capable of executing a single instruction, operating on a single data stream. In SISD, machine instructions are processed in a sequential manner. The Von Neumann belongs to this classification.

The speed of the processing element (PE) in the SISD model is limited (dependent) by the rate at which the computer can transfer information internally.



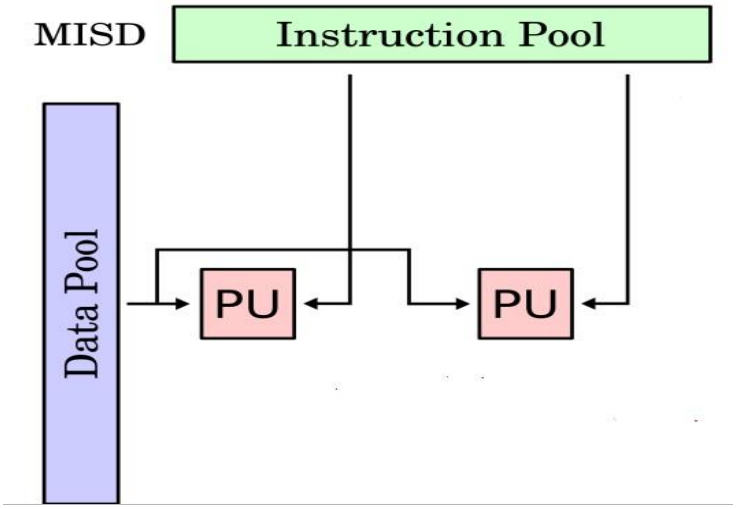
2. Single-Instruction, Multiple-Data (SIMD) systems

SIMD system is a multiprocessor machine capable of executing the same instruction on all the CPUs but operating on different data streams.



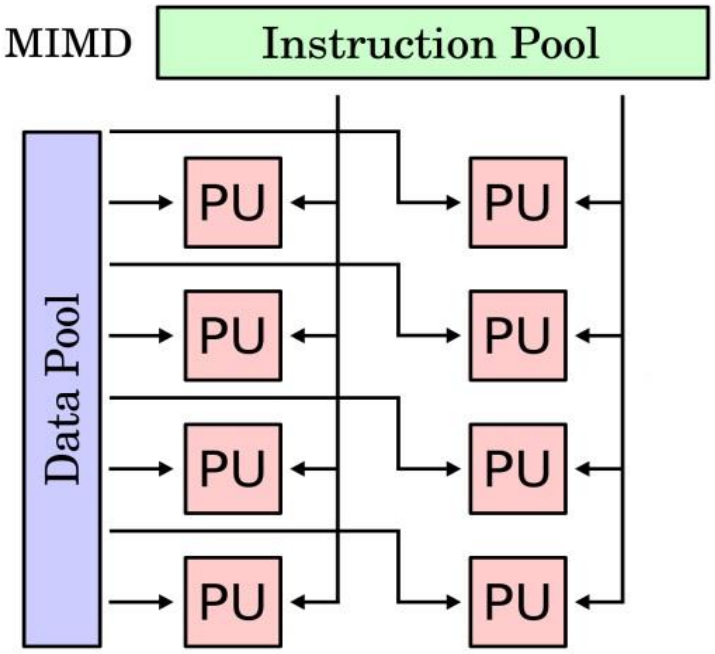
3. Multiple-Instruction, Single-Data (MISD) systems

MISD computing system is a multiprocessor machine capable of executing different instructions on different PEs but all of them operating on the same dataset.



4. Multiple-Instruction, Multiple-Data (MIMD) systems

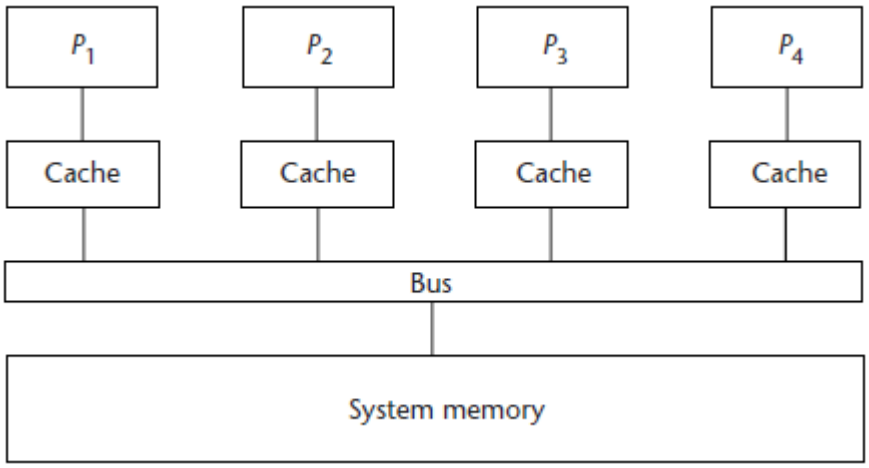
A MIMD system is a multiprocessor machine which is capable of executing multiple instructions on multiple data sets. Each PE in the MIMD model has separate instruction and data streams.



Types of MIMD Architecture:

1. **Shared Memory**

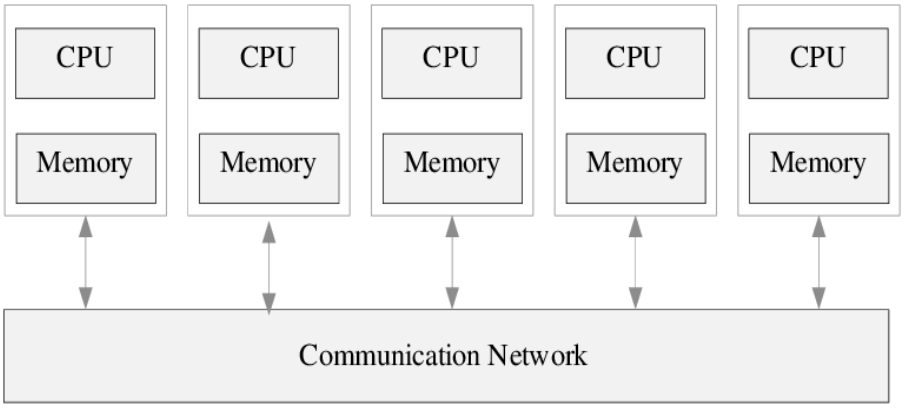
All Processing Elements (PE) share a common memory address. Every processing element can access any module via interconnected network directly. They communicate by writing into common address space. PE's are separate but they have a common memory.



Shared Memory Architecture

2. **Distributed Memory**

In distributed memory all Processing elements have their own address space. They communicate with each other through ***message passing***.



Distributed Memory Architecture

HW: Which is better? Compare in some words!