2.VON-NEUMANN MODEL

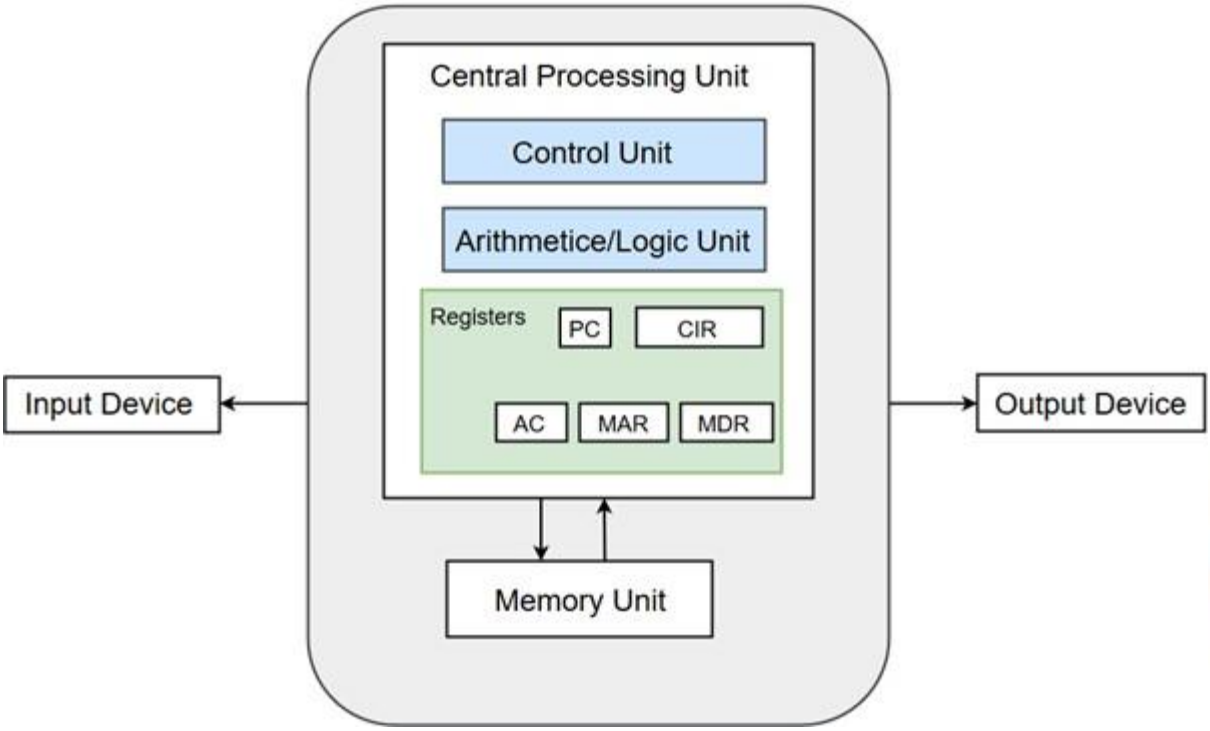
Von-Neumann proposed his computer architecture design in 1945 which was later known as Von- Neumann Architecture. It consisted of a Control Unit, Arithmetic, and Logical Memory Unit (ALU),Registers and Inputs/Outputs.

Von Neumann architecture is based on the stored-program computer concept, where instruction data and program data are stored in the same memory. This design is still used in most computers produced today

A Von Neumann-based computer:

- Uses a single processor Uses one memory for both instructions and data Execute Programs following the Execute-fetch-Executer Cycle.

Von-Neumann Basic Structure:



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Components of Von-Neumann Model:

- Central Processing Unit
- Buses
- Memory Unit

Central Processing Unit

The part of the Computer that performs the bulk of data processing operations is called the Central Processing Unit and is referred to as the CPU.

The Central Processing Unit can also be defined as an electric circuit responsible for executing the instructions of a computer program.

The CPU performs a variety of functions dictated by the type of instructions that are incorporated in the computer.

The major components of CPU are Arithmetic and Logic Unit (ALU), Control Unit (CU) and a variety of registers.

Arithmetic and Logic Unit (ALU)

The Arithmetic and Logic Unit (ALU) performs the required micro-operations for executing the instructions. In simple words, ALU allows arithmetic (add, subtract, etc.) and logic (AND, OR, NOT, etc.) operations to be carried out

Control Unit

The Control Unit of a computer system controls the operations of components like ALU, memory and input/output devices.

The Control Unit consists of a program counter that contains the address of the instructions to be fetched and an instruction register into which instructions

are fetched from memory for execution.

Registers

Registers refer to high-speed storage areas in the CPU. The data processed by the CPU are fetchedfrom the registers.

Following is the list of registers that plays a crucial role in data processing.

S.NO	NAME	SYMBOL	FUNCTIONING
1	Accumulator	AC	An accumulator is the most often utilized register, and it is used to store information taken from memory.
2	Memory address registers	MAR	Address location of memory is stored in this register to be accessed later. It is called by both MAR and MDR together
3	Memory data registers	MDR	All the information that is supposed to be written or the information that is supposed to be read from a certain memory address is stored here
4	General-purpose register	GPR	Consist of a series of registers generally starting from R0 and running till Rn - 1. These registers tend to store any form of temporary data that is sent to a register during any undertaking process. More GPR enables the register to register addressing, which increases processing speed.

This register contains the current instruction during processing.

Buses

Buses are the means by which information is shared between the registers in a multiple-register configuration system.

A bus structure consists of a set of common lines, one for each bit of a register, through which binary information is transferred one at a time. Control signals determine which register is selected by the bus during each particular register transfer.

Von-Neumann Architecture comprised of three major bus systems for data transfer.

Computer System Bus Functions

BUS TYPE	BUS FUNCTION
Internal Buses	To connect the internal components of computer system such as processor , RAM , chipset , hard disk .
External Buses	To connect the external components with computer system such as monitor , keyboard , printer .
Data Bus	To connect the CPU (Processor) with main memory RAM and other components connected to computer system .
Address Bus	To connect the CPU (Processor) with main memory RAM . Carries memory addresses for read or write operations
Control Bus	To connect the CPU (Processor control unit) with main memory RAM and other components connected to computer system .Carries control signals for components .
System Bus	To connect the CPU (Processor) with main memory RAM and other important components .System bus is also referred as FSB - front side bus or memory bus. It Consist of data , address and control buses together .
Expansion Bus	To connect the CPU (Processor) with PCI OR PCI Express slots where add on cards such as graphics card , sound card can be installed to enhance system performance
Input / Output Bus	To connect the CPU (Processor) with main memory RAM and input output devices through Southbridge (input output controller)

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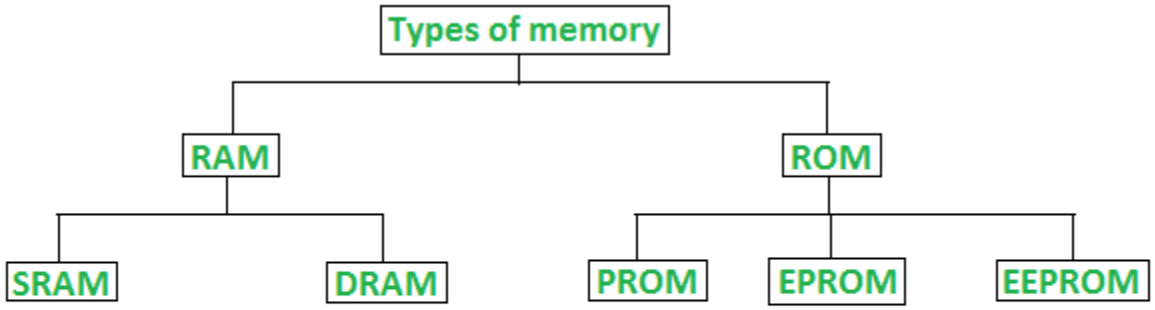
Memory Unit

A memory unit is a collection of storage cells together with associated circuits needed to transfer information in and out of the storage. The memory stores binary information in groups of bits called words. The internal structure of a memory unit is specified by the number of words it contains and the number of bits in each word.

Two major types of memories are used in computer systems:

1. RAM (Random Access Memory)
2. ROM (Read-Only Memory)

Memory is the most essential element of a computing system because without it computer can't perform simple tasks. Computer memory is of two basic types – Primary memory(RAM and ROM) and Secondary memory (hard drive, CD, etc). Random Access Memory (RAM) is primary-volatile memory and Read-Only Memory (ROM) is primary-non-volatile memory



Classification of computer memory

Random Access Memory (RAM) –

- It is also called read-write *memory* or the *main memory* or the *primary memory*.
- The programs and data that the CPU requires during the execution of a program are stored in this memory.
- It is a volatile memory as the data is lost when the power is turned off.
- RAM is further classified into two types- *SRAM (Static Random Access Memory)* and *DRAM (Dynamic Random Access Memory)*.

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

Read-Only Memory (ROM)

- Stores crucial information essential to operate the system, like the program essential to boot the computer.
  - It is non-volatile.
  - Always retains its data.
  - Used in embedded systems or where the programming needs no change.
  - Used in calculators and peripheral devices.
  - ROM is further classified into four types- M*ROM*, *PROM*, *EPROM*, and *EEPROM*.

Types of Read-Only Memory (ROM)

- **PROM (Programmable read-only memory)** – It can be programmed by the user. Once programmed, the data and instructions in it cannot be changed.
- **EPROM (Erasable Programmable read-only memory)** – It can be reprogrammed. To erase data from it, expose it to ultraviolet light. To reprogram it, erase all the previous data.
- **EEPROM (Electrically erasable programmable read-only memory)** – The data can be erased by applying an electric field, with no need for ultraviolet light. We can erase only portions of the chip.
- **MROM(Mask ROM)** – Mask ROM is a kind of read-only memory, that is masked off at the time of production. Like other types of ROM, mask ROM cannot enable

the user to change the data stored in it. If it can, the process would be difficult or slow.

RAM	ROM
1. Temporary Storage.	1. Permanent storage.
2. Store data in MBs.	2. Store data in GBs.
3. Volatile.	3. Non-volatile.
4.Used in normal operations.	4. Used for startup process of computer.
5. Writing data is faster.	5. Writing data is slower.

Difference between RAM and ROM