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COMPUTER MEMORY

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Computer Memory

Processing
Storage

Binary → 0 and 1
0 → OFF / FALSE
1 → ON / TRUE

The computer memory is one of the most important elements in a computer system. It stores data and instructions required during the processing of data and output results.

Storage may be required for a limited period of time, instantly or for an extended period of time.

It also relates to many devices that are responsible for storing data on a temporary or a permanent basis.

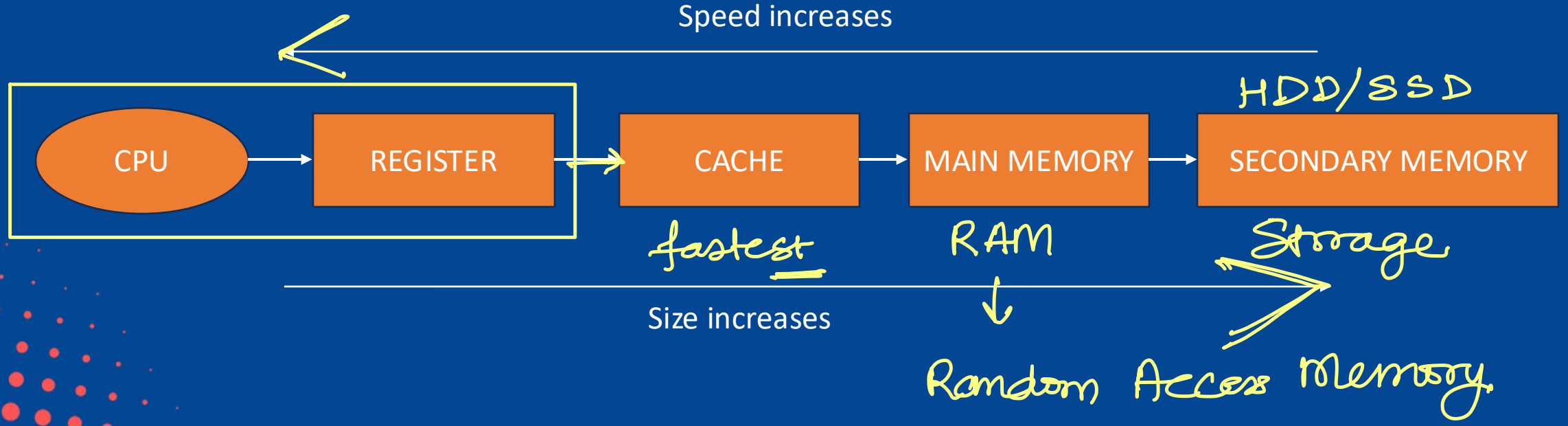
Language of Data in Computer

Computer Memory Size

Name	Equal To	Size (In Bytes)
Bit ← Smallest	1 Bit	1/8
Nibble	4 Bits	1/2 (rare)
Byte	8 Bits	1
Kilobyte	1024 Bytes	1024
Megabyte	1, 024 Kilobytes	1, 048, 576
Gigabyte	1, 024 Megabytes	1, 073, 741, 824
Terabyte	1, 024 Gigabytes	1, 099, 511, 627, 776
Petabyte	1, 024 Terabytes	1, 125, 899, 906, 842, 624
Exabyte	1, 024 Petabytes	1, 152, 921, 504, 606, 846, 976
Zettabyte	1, 024 Exabytes	1, 180, 591, 620, 717, 411, 303, 424
Yottabyte	1, 024 Zettabytes	1, 208, 925, 819, 614, 629, 174, 706, 176

Memory Hierarchy

The hierarchical arrangement of storage in current computer architectures is called the memory hierarchy. The computer uses a hierarchy of memory that is organised in a manner to enable the fastest speed and largest capacity of memory as shown in figure. The memory is characterised on the basis of two key factors; capacity and access time.



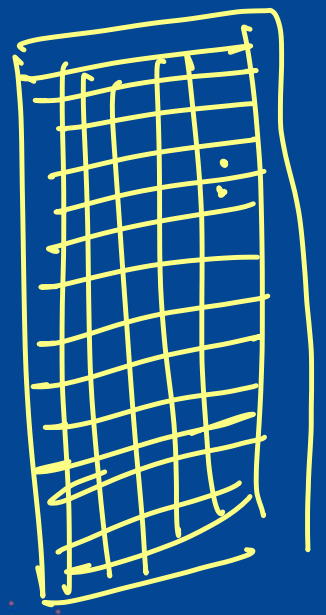
Registers → part of CPU

- Registers temporarily hold data for execution and are a part of CPU (not main memory)
- Length of register is equal to number of bits it can store.
- Most computers today have 32-bit, 64-bit or 128-bit registers.
- Larger the size faster the computer.
- Length of register of computer also called as WORD SIZE.

Memory Address Register (MAR)

PC Register

- It holds the address of the active memory location
- It is loaded from Program Control when the system reads instruction from memory.



Function:

- When reading from memory: The MAR contains the address of the memory location from which data is to be fetched.
- When writing to memory: The MAR contains the address of the memory location where data is to be stored.

Memory Data Register (MDR)

Also known as Memory Buffer Register (MBR)

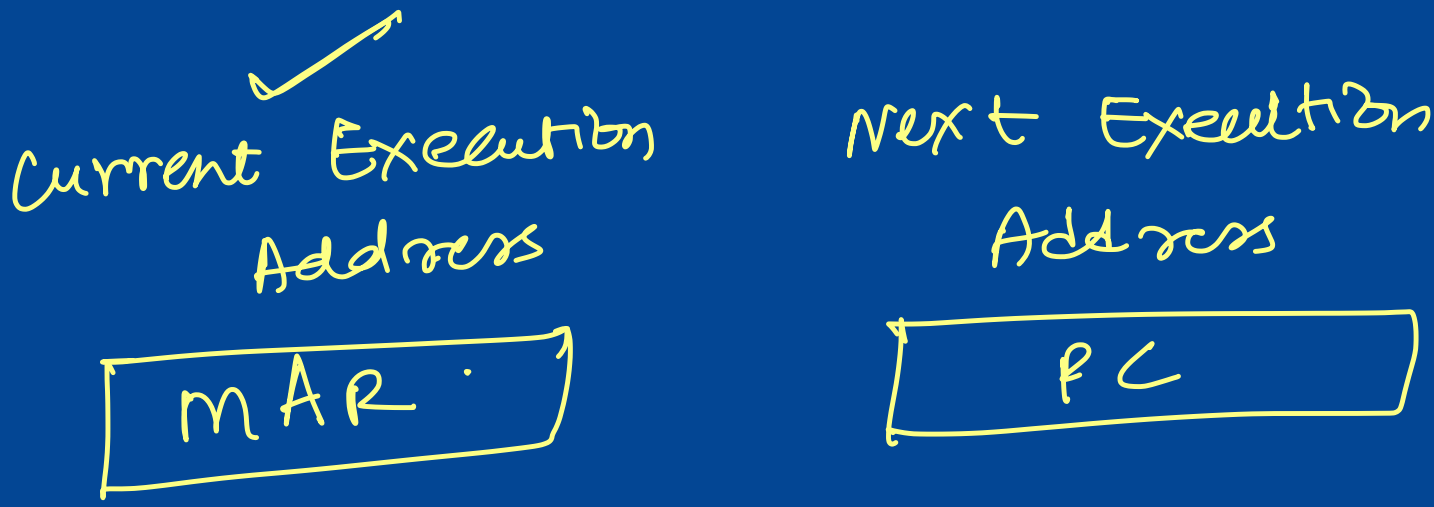
- Holds the actual data being transferred to or from memory.
- Acts as a buffer for data during read/write operations.

Function:

- When reading from memory: The MDR stores the data fetched from the memory location specified by the MAR.
- When writing to memory: The MDR holds the data that needs to be written to the memory location specified by the MAR.

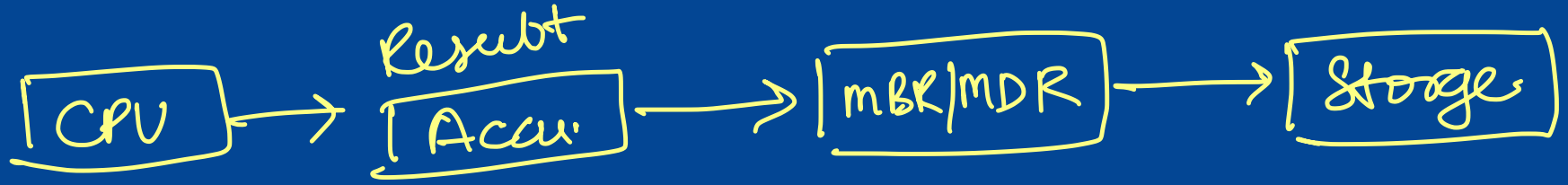
Program Control Register (PC)

- The PC holds the memory address of the next instruction to be fetched and executed by the CPU.
- It ensures that the CPU executes instructions in the correct sequence, enabling the proper functioning of programs.



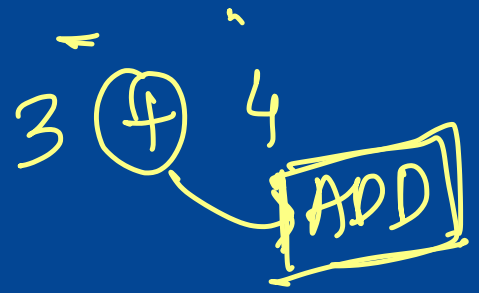
Accumulator Register (A)

- The Accumulator is primarily used to store intermediate results of arithmetic and logic operations.
- It acts as a "workspace" for the CPU, holding data that is being processed.
- The system returns the result of arithmetic operation to Accumulator register for transfer to the main memory through MBR or MDR.
- In many computer more than one accumulator register are present.



Instruction Register (I)

- The holds the current instruction fetched from memory.
- It serves as a temporary storage location for the instruction while the CPU decodes and executes it.



Input/Output Register (I/O)

- I/O registers act as a bridge between the CPU and peripheral devices.
- They temporarily store data, control signals, and status information during input/output operations.
- They enable the CPU to interact with external devices in a controlled and efficient manner.

Register	Purpose
Program Counter (PC)	Holds the address of the next instruction.
Instruction Register (I)	Holds the current instruction being executed.
Memory Address Register (MAR)	Holds the address of the memory location being accessed.
Memory Data Register (MDR) / Memory Buffer Register (MBR)	Temporarily holds data during memory read/write operations.
Accumulator (A)	Stores intermediate results of arithmetic/logic operations.
I/O Registers	Facilitate communication between the CPU and peripheral (I/O) devices.

Memory

What is the smallest unit of memory in a computer?

a) Byte

b) Bit

c) Nibble

d) Word

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power off → data erase

Which of the following is a volatile memory?

a) ROM

b) HDD

c) RAM

d) SSD

CPU — Cache — RAM

Cache memory is placed between:

a) CPU and RAM

b) RAM and HDD

c) CPU and Registers

d) ALU and CU

↓

Control Unit

Which memory type is used for permanent storage of firmware?

a) DRAM

b) SRAM

c) ROM

d) Cache

What is the full form of DRAM?

a) Dynamic Read Access Memory

b) Data Random Access Memory

c) Dynamic Random Access Memory

d) Digital Random Access Memory

The memory hierarchy from fastest to slowest is:

a) Registers → Cache → RAM → HDD

b) Cache → Registers → RAM → SSD

c) RAM → Registers → Cache → HDD

d) HDD → RAM → Cache → Registers

Which memory type is used in CPU caches?

a) DRAM → RAM

b) SRAM Static RAM

c) ROM

d) EPROM

Main Memory
RAM

Virtual Memory

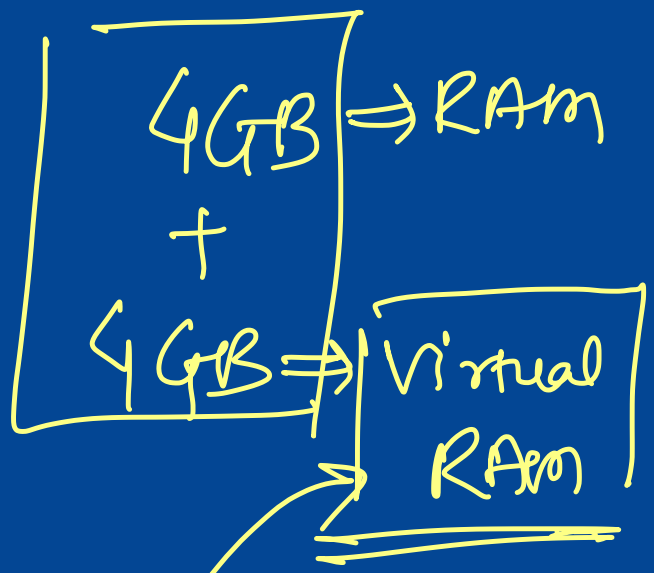
Virtual memory is implemented using:

a) RAM

b) Hard Disk

c) Cache

d) Registers



Auxiliary memory → HDD / SDD

What is a register in a CPU? → execution

a) A type of RAM

b) A high-speed storage location

c) A part of the hard disk

d) A backup memory

Which register holds the address of the next instruction to be executed?

a) Accumulator

b) Program Counter (PC)

c) Instruction Register (IR)

d) Memory Address Register (MAR)

The MAR (Memory Address Register) holds:

a) Data to be written to memory

b) The address of memory to be accessed

c) The current instruction

d) The result of ALU operations

Which register temporarily stores data during ALU operations?

a) Instruction Register (IR)

b) Accumulator (ACC) → workspace

c) Memory Buffer Register (MBR)

d) Stack Pointer (SP)

What is the function of the Instruction Register (IR)?

a) Stores the address of the next instruction ✗ PC

b) Holds the current instruction being executed ✓

c) Stores intermediate arithmetic results ALU.

d) Points to the top of the stack

The Memory Buffer Register (MBR) is used to:

a) Store the memory address ✗ MAR

b) Hold data being transferred to/from memory ✓

c) Keep track of CPU operations ✗

d) Store program instructions ✗

Which register holds the result of arithmetic operations?

a) Instruction Register (IR)

b) Accumulator (ACC)

c) Memory Address Register (MAR)

d) Program Counter (PC)

Which memory type is fastest but smallest in size?

a) RAM

b) Registers

c) Cache

d) SSD

Which of the following is NOT a type of ROM?

a) PROM

b) EPROM

c) EEPROM

d) SRAM

What is the benefit of multi-level cache (L1, L2, L3)?

a) Increases memory size

b) Reduces memory access time

c) Decreases CPU speed

d) Increases power consumption

Which memory type is used in USB drives?

a) SRAM

b) DRAM

c) Flash Memory

d) EPROM

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