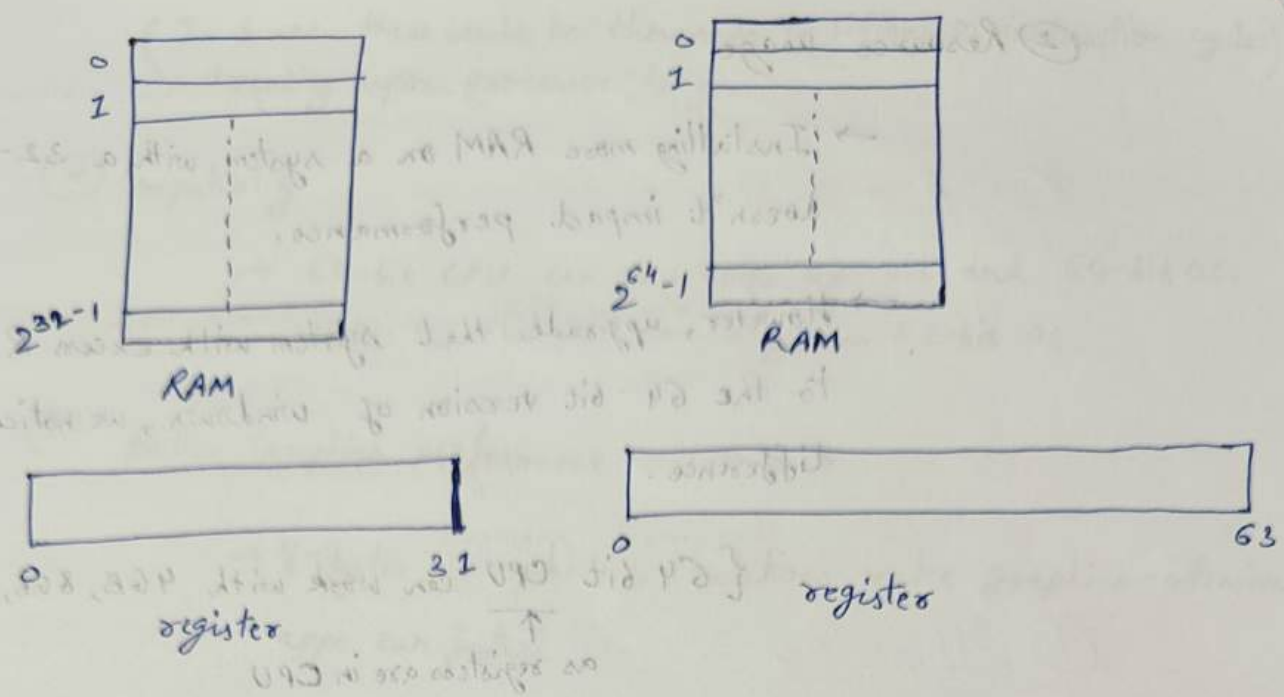
32 bit vs 64 bit OS

→ A 32-bit OS has 32-bit registers and it can access 2^{32} unique memory address i.e 4GB of physical memory.

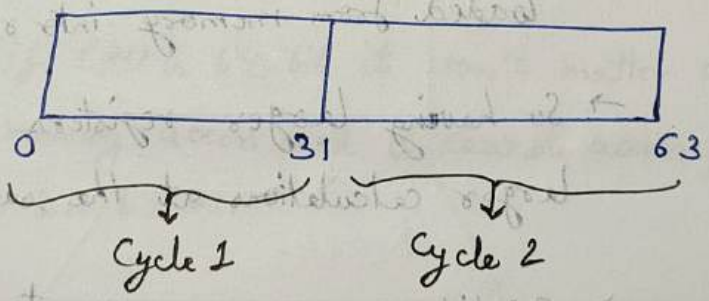
→ A 64-bit OS has 64-bit registers and it can access 2^{64} unique memory address i.e 17,179,869,184 GB.



→ 32-bit CPU architecture can process 32 bits of data & information

→ 64-bit CPU architecture can process 64 bits of data & information.

eg :- for 32 bit CPU to process a 64 bit data or information will be needed to do in two cycles



Advantages of 64-bit over the 32-bit OS

(1) Addressable memory

→ 32-bit CPU → 2^{32} memory addresses

64-bit CPU → 2^{64} memory addresses

(2) Resource usage

→ Installing more RAM on a system with a 32-bit doesn't impact performance.

→ However, upgrade that system with excess RAM to the 64-bit version of windows, we notice a difference.

{64 bit CPU can work with 4GB, 8GB, 16GB, etc.} RAM

↑ as registers are in CPU

↳ So 64 bit CPU can work with 32 bit or 64 bit OS.

(3) Performance

→ All calculations take place in the registers. When you're performing math in your code, operands are loaded from memory into registers.

→ So having larger registers allows you to perform larger calculations at the same time.

→ 32-bit processor can execute 4 byte of data in 1 instruction cycle while 64-bit processor can execute 8 bytes of data in 1 instruction cycle.

{8 × 4 = 32} ↳ 4 byte {8 × 8 = 64} ↳ 8 byte

1 byte = 8 bits

(In 1 sec there could be thousands to billions of instruction cycles depending upon processor design)

④ Compatibility

→ 64-bit CPU can run both 32-bit and 64-bit OS. While 32-bit CPU can only run 32-bit OS.

⑤ Better Graphics performance

→ 8-bytes graphics calculations make graphics-intensive apps run faster.

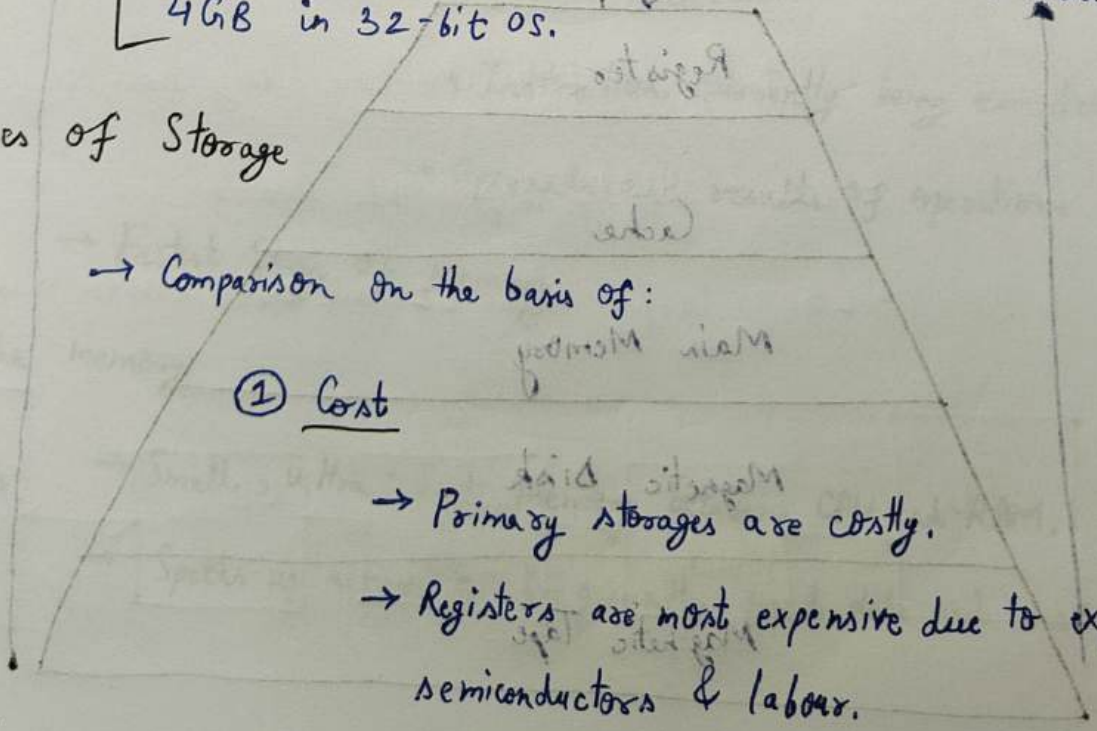
* Note :- 32 bit OS => 2^{32} unique address => 4,294,967,296 bytes
=> 4 GB

This means OS can only "see" or "point to" up to 4GB of memory.

So even if we add extra RAM, it would be invisible.

So even if CPU is 64 bit it won't matter as OS controls memory access and it cannot access more than 4GB in 32-bit OS.

Types of Storage



→ Comparison on the basis of:

① Cost

→ Primary storages are costly.

→ Registers are most expensive due to expensive semiconductors & labour.

→ Secondary storages are cheaper than primary

② Access speed

→ Primary has higher access speed than secondary memory

→ Registers has highest access speed then comes cache then main memory.

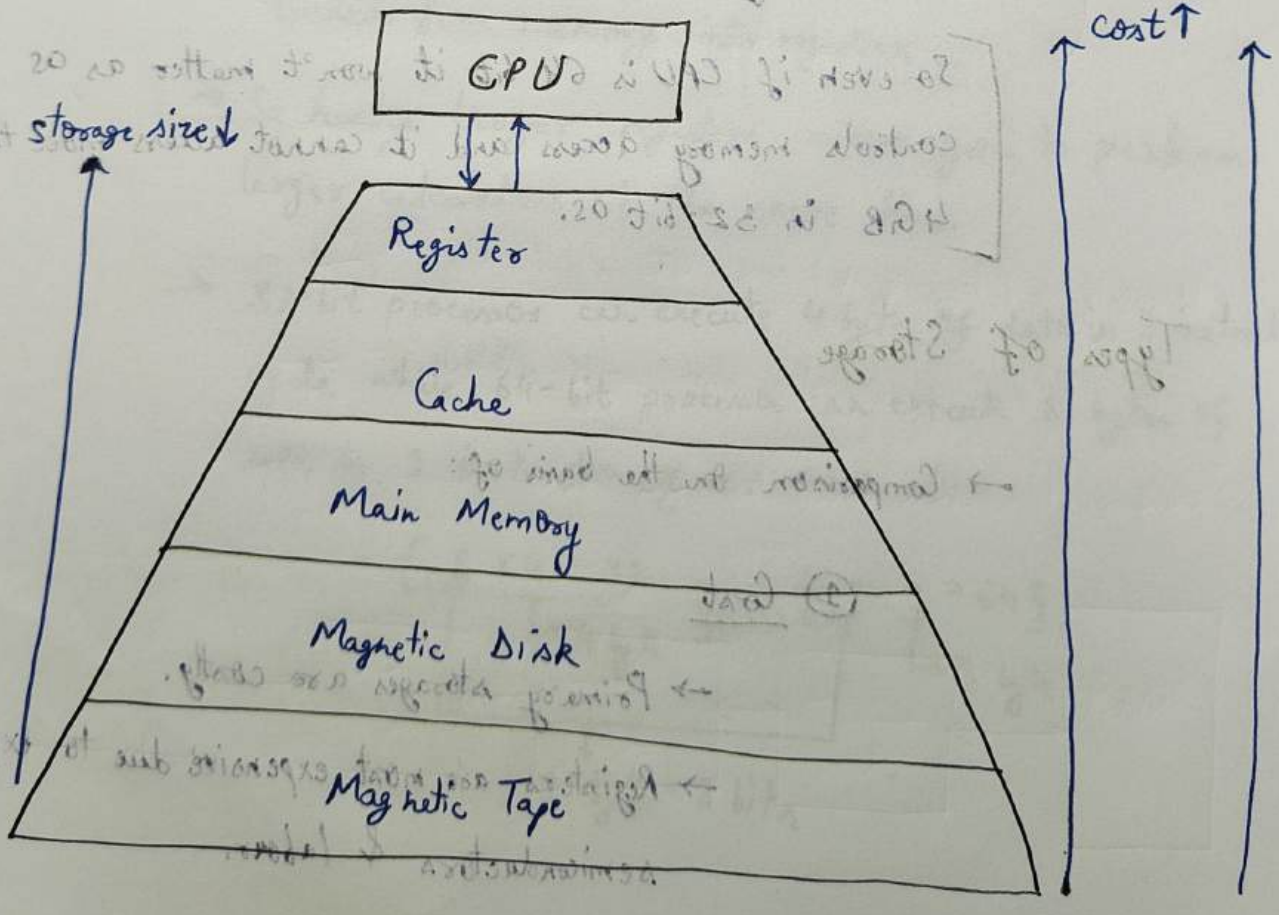
③ Storage size

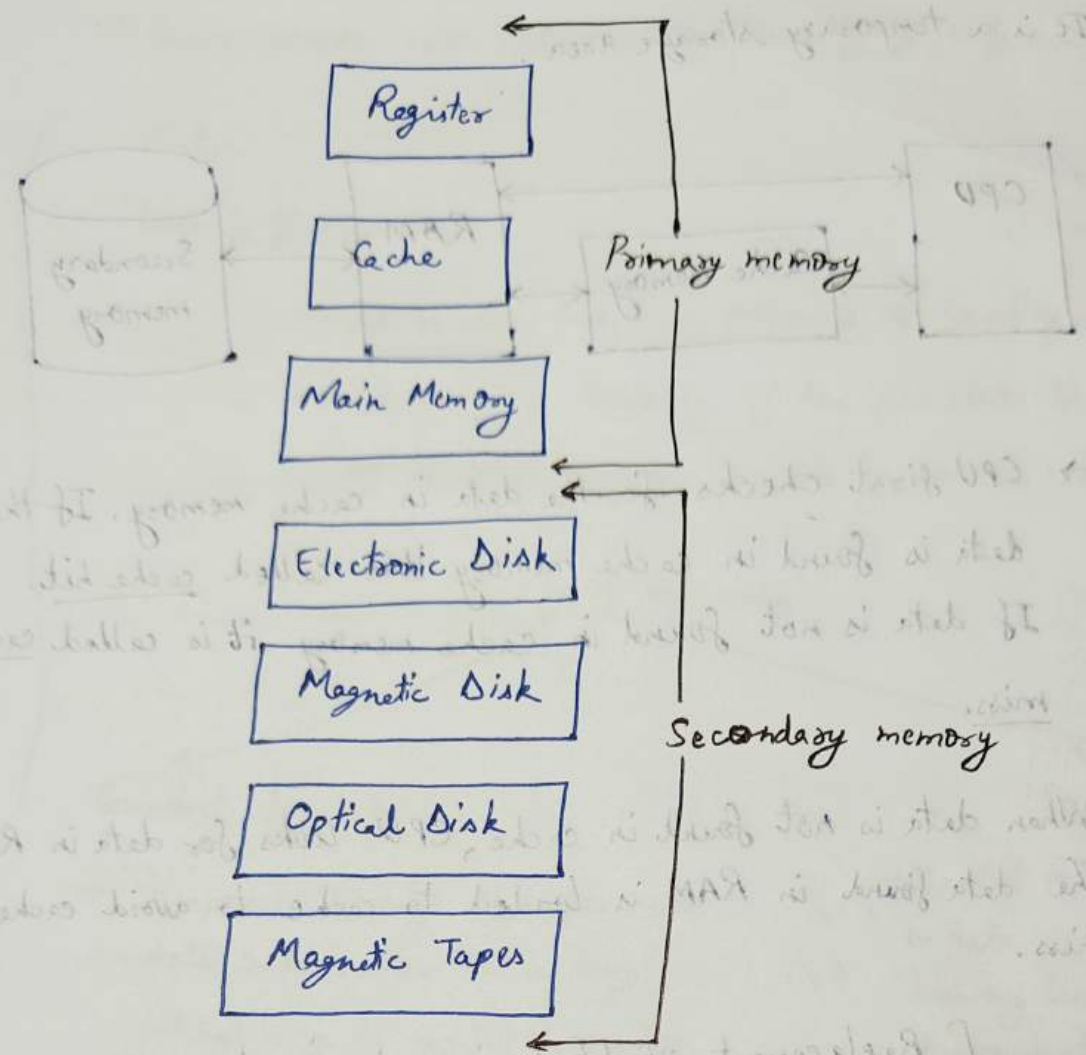
→ Secondary has more space

④ Volatility

→ Primary memory is volatile

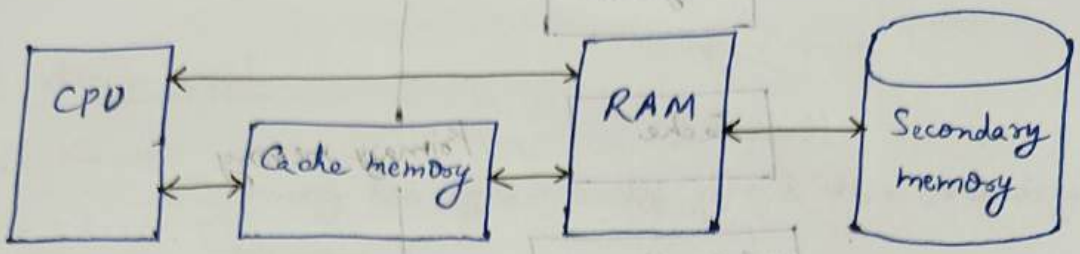
→ Secondary memory is non-volatile.





- Register
  - → Tiny memory units inside the CPU
  - → Hold immediate data like:
    - Instruction currently being executed
    - Operands and results of operations
  - → Fastest form of memory
- Cache memory
  - → Small, ultra-fast memory between CPU and RAM.
  - → Speeds up access to frequently used data and instructions

→ It is a temporary storage area.



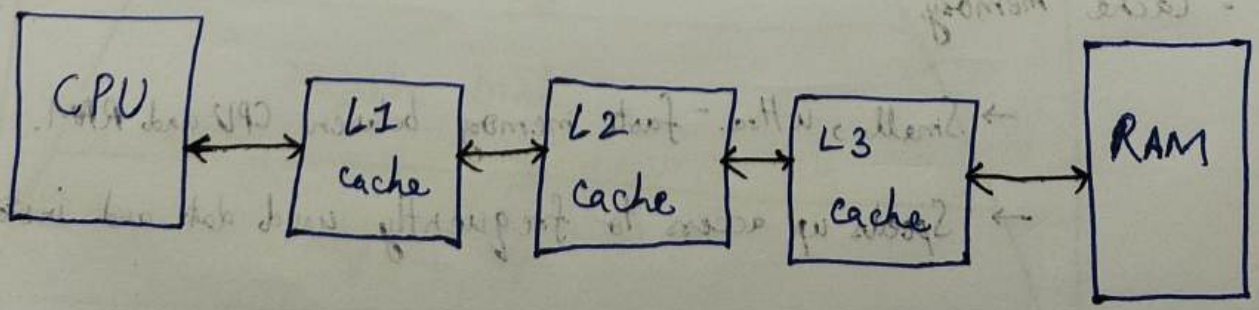
→ CPU first checks for the data in cache memory. If the data is found in cache memory it is called cache hit. If data is not found in cache memory it is called cache miss.

→ When data is not found in cache, CPU looks for data in RAM. The data found in RAM is loaded to cache to avoid cache miss.

{ Replacement of blocks in cache are done by FIFO (First In First Out), LRU (Least Recently Used), Optimal }

→ Cache is usually divided into :

- L1 - Closest to CPU core (very fast, very small)
- L2 - Slightly larger and slower
- L3 - larger than L2 and slower than L2.



→ Cache memory also satisfies the locality of reference.

Extra

Locality of reference

→ It is also known as principle of locality.

→ It is the tendency of the processor to access the set of memory location repeatedly over a short period of time.

Locality of reference

Temporal locality

→ Temporal locality means current data or instruction that is being fetched may be needed soon. So we should store that data or instruction in the cache memory so that we can avoid searching in main memory for the same data.

Spatial locality

→ Spatial locality means instructions or data near to the current memory locations that is being fetched may be needed soon in the near future.

→ In spatial locality we are talking about nearly located memory locations while in temporal locality we were talking about the actual memory location that we being fetched.

• Main memory

→ Main memory is the computer's central working memory that directly interacts with the CPU.

→ It holds data and instructions currently needed by the CPU.

Main memory

RAM (Random Access Memory)

→ Data is lost when power is off. (volatile)

→ Used for holding currently running programs. Storing data being used by those programs.

RAM

DRAM (Dynamic RAM)

→ Needs constant refreshing used as main memory.

SRAM (Static RAM)

→ Faster and costlier, used in cache

ROM (Read Only Memory)

→ Data is retained even when power is off. (non-volatile)

→ Stores firmware (eg:- BIOS, etc.)

→ Cannot be modified easily.

Types of ROM

- PROM
- EPROM
- EEPROM

• Secondary memory

→ Storage media, on which computer can store data & programs.

→ Used to store data permanently.