

# Chapter 4

## Primary Memory

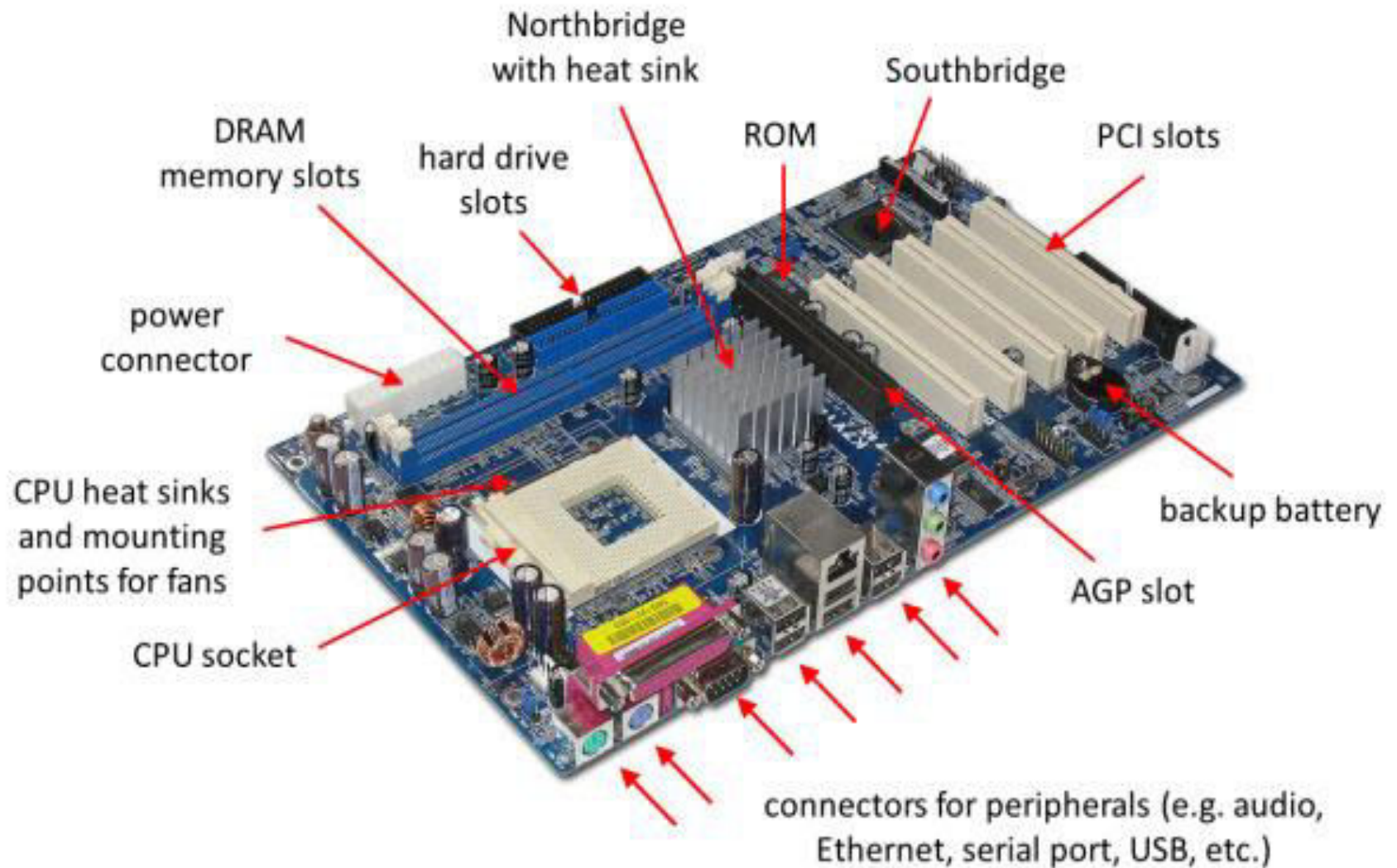


# Introduction

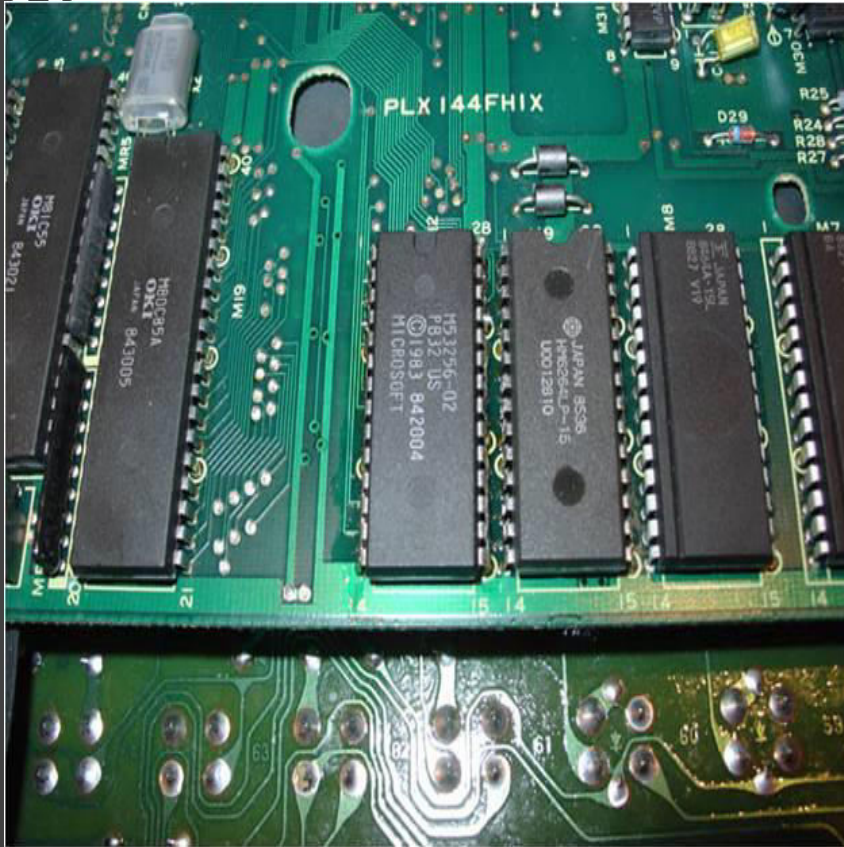
- Computer Memory Refers to electronics holding place for instruction and data where the processor can reach quickly.
- Memory can be classified into two broad categories:
  - (1) Primary Memory (to handle the data).
  - (2) Secondary Memory (to store the output).



# Motherboard



# ROM, RAM



# Memory Representation

- The basic unit of memory is bit. Memory can be represented in the bit and bytes..
  - 1 Bit = Binary Digit
  - 8 Bits = 1 Byte
  - $2^{10} = 1024$  Bytes = 1 KB (**Kilo Byte**)
  - $2^{20} = 1024$  KB = 1 MB (**Mega Byte**)
  - $2^{30} = 1024$  MB = 1 GB (**Giga Byte**)
  - $2^{40} = 1024$  GB = 1 TB(**Terra Byte**)



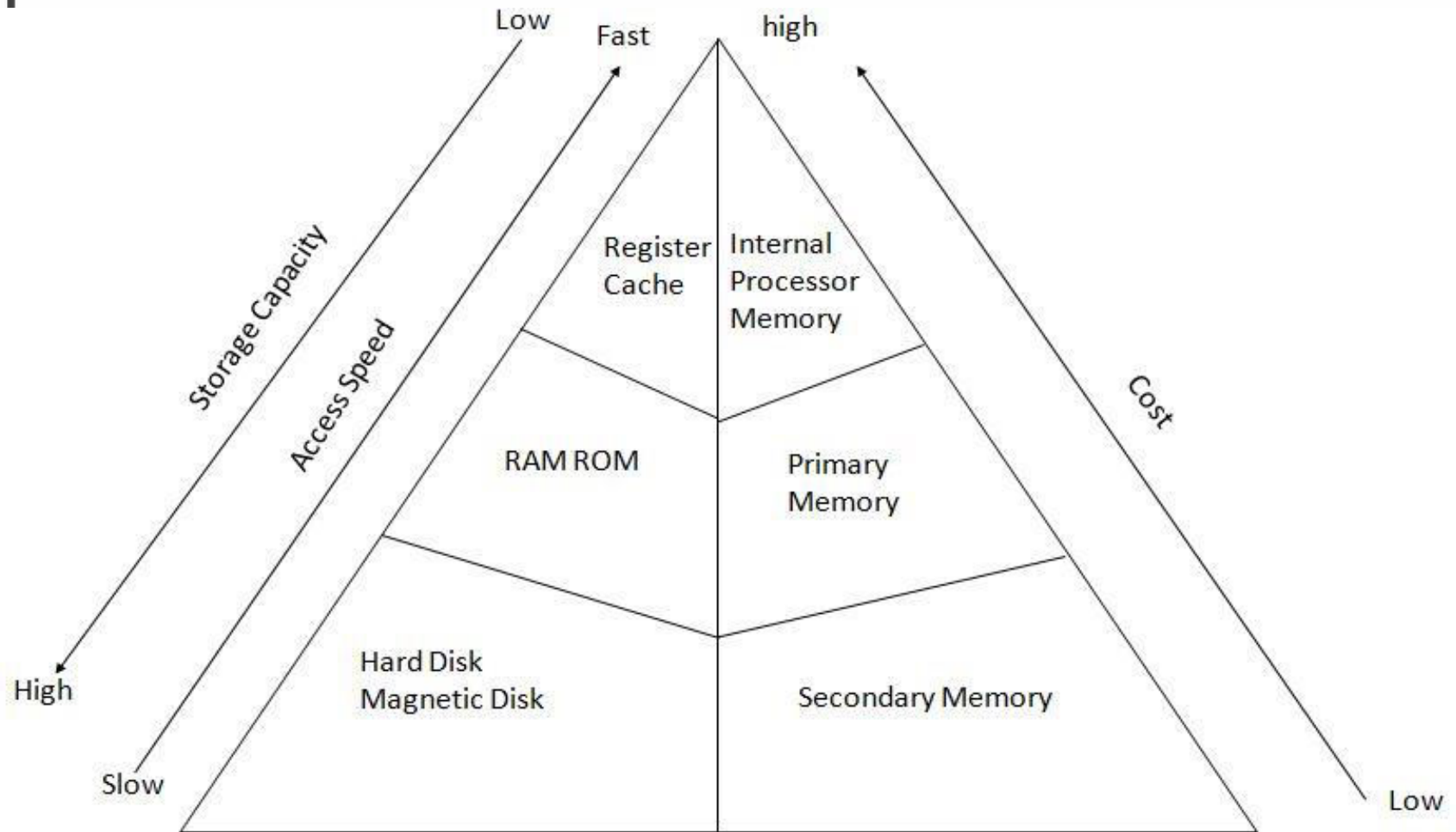
# Memory Hierarchy

- The memory is characterized on the basis of two key factors— capacity and access time.
- Three fundamental types of memory:
  - Internal processor Memory
    - This memory is placed in CPU and it includes cache memory and special registers, both of which can be directly accessed by processor.
  - Primary Memory
    - RAM and ROM fall in the category of primary memory, also known as main memory.
  - Secondary Memory
    - Also known as auxiliary memory, secondary memory provides backup storage for instructions and data.
    - Most commonly used secondary memory devices are hard disk, magnetic disk, and magnetic tapes.





# Memory Hierarchy



# Storage Evaluation Criteria

- Storage Capacity
  - It refers to size of memory.
- Cost
  - Estimated by the cost per bit of storage.
- Access Time
  - Time required between the request made for read/write operation and time it takes for completion of the request.
- Physical Characteristics
  - Four parts namely, electronic, magnetic, mechanical and optical
- Permanence of Storage
- Access Mode
  - Sequential
  - Random
  - Direct





# READ ONLY MEMORY (ROM)

- ROM stands for Read Only Memory.
  - we can only read but cannot write on it.
  - It is non-volatile. The information is stored permanently in such memories during manufacture.
- A ROM, stores such instructions that are required to start a computer. This operation is referred to as bootstrap.
  - ROM chips are in the computer, other electronic items like washing machine and microwave oven.
- BIOS(Basic Input Output System) is the responsible for the startup of computer so it can be considered as a Read only memory.
- ROM for each and Every computer may be different that's what the compatibility issue of platform generating while we use a different platform.
- Also can said OTP(One time programmed) means if it is programmed once it cannot be reprogrammed.



# Types of ROM

## 1. Masked ROM:

- The very first ROMs were hard-wired devices,
- It contained a pre-programmed set of data or instructions. These kind of ROMs are known as masked ROMs.

## 2. Programmable ROM (PROM):

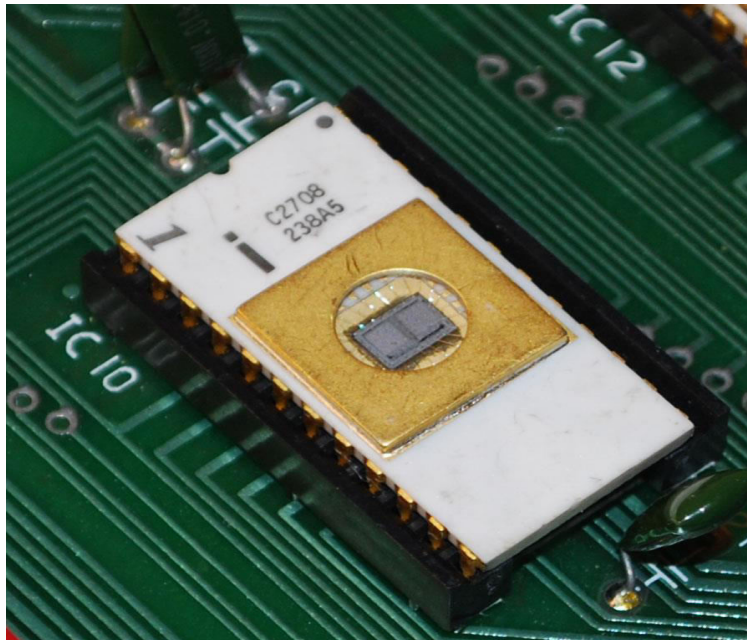
- The user buys a blank PROM and enters the desired contents using a PROM program, also known as one-time programmable (OTP) device
- Inside the PROM chip there are small fuses which are burnt out during programming.
- It can be programmed only once and is not erasable.



# Types of ROM (cont..)

## 3. Erasable Programmable ROM (EPROM):

- EPROM can be erased by exposing it to ultra-violet light for a duration of up to 40 minutes.
- This process will erase the entire EPROM and then it reprogrammed.
- EPROMs are more expensive than PROMs.



# Types of ROM (cont..)

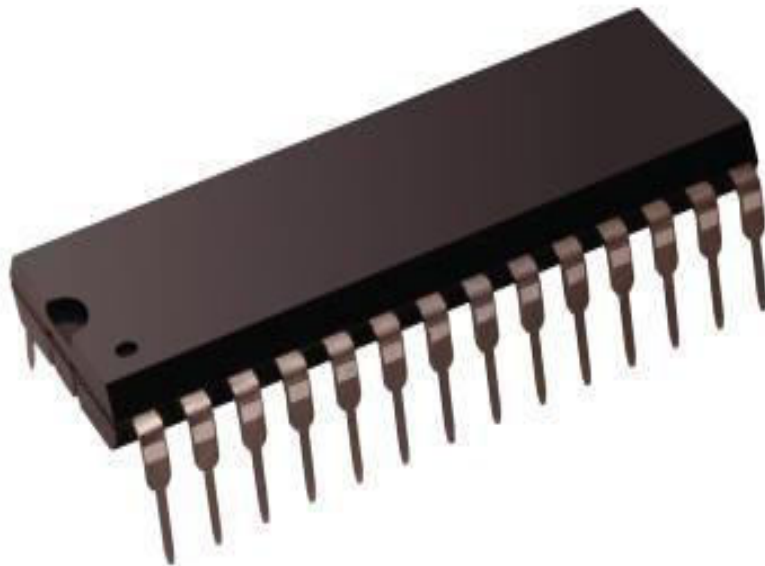
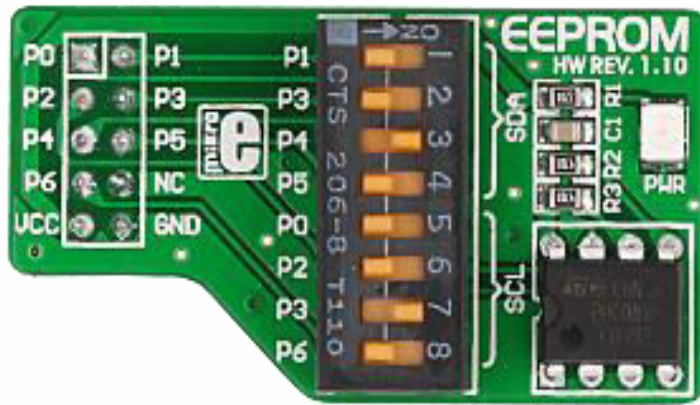
## 4. Electrically Erasable and Programmable Read Only Memory (EEPROM):

- EEPROM can be erased by an electrical charge and then written to by slightly higher-than-normal voltage.
- In EEPROM, any location can be selectively erased and programmed.
- EEPROMs can be erased one byte at a time, rather than erasing the entire chip. Hence, the process of re-programming is flexible but slow.

## 5. Flash ROM:

- Flash ROM, also called flash BIOS or flash memory, is a type of constantly powered non-volatile memory that can be erased and re-programmed in blocks.
- It is a variation of EEPROM.





# Advantages of ROM

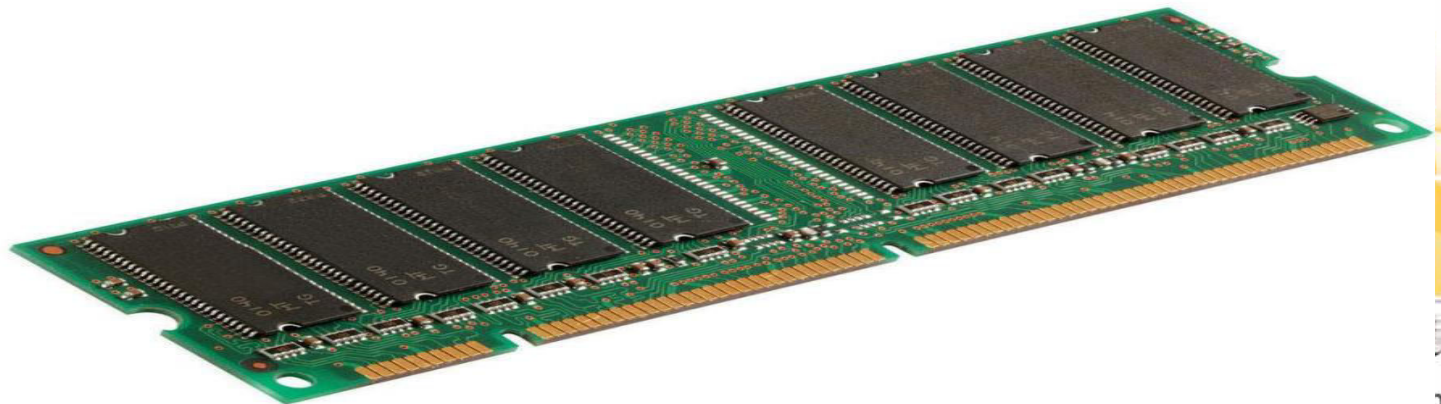
- ❖ The advantages of ROM are as follows:
  - Non-volatile in nature
  - These cannot be accidentally changed
  - Cheaper than RAMs
  - Easy to test
  - More reliable than RAMs
  - These are static and do not require refreshing
  - Its contents are always known and can be verified



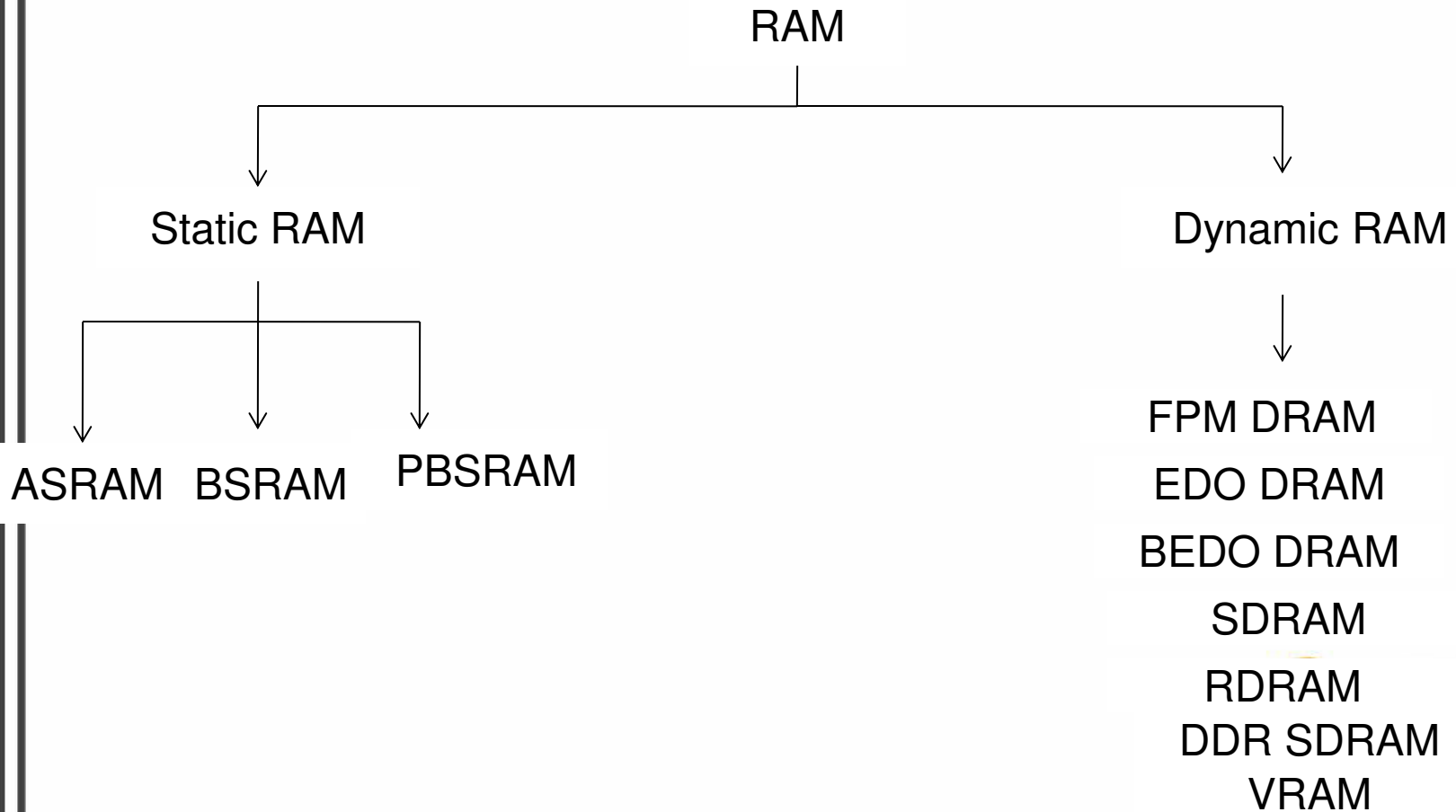


# Random Access Memory (RAM)

- RAM(Random Access Memory) is the primary memory of the CPU for storing data, program and program result.
  - It is read/write memory which stores data until the machine is working. As soon as the machine is switched off, data is erased.
- RAM is volatile, i.e. data stored in it is lost when we switch off the computer or if there is a power failure.
- RAM is small, both in terms of its physical size and in the amount of data it can hold.
- Data in the RAM can be accessed randomly but it is very expensive.



# Types Of RAM



Types of RAM



# Static RAM

- The word **static** indicates that the memory retains its contents as long as power is being supplied.
- However, data is lost when the power gets down due to volatile nature.
- It does not need to be **refreshed** periodically.
- SRAM chips use a matrix of 6-transistors and no capacitors.
- SRAM is very fast but more expensive than DRAM.
- SRAM uses more chips than DRAM for the same amount of storage space, thus making the manufacturing costs higher.
- It is often used as cache memory due to its high speed.



# DRAM

- DRAM, unlike SRAM, must be continually **refreshed** in order to maintain the data.
- This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second.
- DRAM is used for most system memory because it is cheap and small.
- All DRAMs are made up of memory cells which are composed of one capacitor and one transistor.



# SRAM versus DRAM

- Primary difference => lifetime of the data they store.
  - SRAM retains its contents as long as power is applied on the chip.
  - DRAM has an extremely short data lifetime.
- Total number of cells in the SRAM chip is less than DRAM
- SRAM is fast, has low latency (time gap between request and the action being performed), and does not need to be refreshed.
- SRAM is large and expensive. It requires more power to operate so it produces a lot of heat.



# SRAM versus DRAM

- DRAM is simple, small and space efficient. It is slower and have longer latency than SRAM.
- SRAM has lower access time as compared to DRAM.

