**INTERNAL MEMORY EXTERNAL**

ROM (4-8mb) HDD(160 gb – 2TB)

Prom, Eprom, EEprom SDD ( 10 TB RANGE)

RAM(1-256gb) USB

SRAM ,DRAM CDs , SD cards

**Communication protocol memory**   **hardwares**

EEPROM - I2C OLED , RTC & Acelerometer – I2C

HDD (Hard disk drives) - SATA GPS ,Bluetooth , GSM & GPRS – UART

SPI FLASH – SPI Mouse – RS 232C Protocol

Micro SD CARD – SPI bus mode & SD Graphics card – GDDR5

SSD – SATA SSD / SAS SSD Keyboard – Human interface device

CACHE – MESI Protocol Motherboard – hyperbus , xccela

**Random access memory (RAM)** is the best-known form of computer memory. This is what allows your computer to surf the internet and then quickly switch to loading an application or editing a document.

RAM is considered "random access" because you can access any memory cell directly if you know the row.  
RAM is basically your computer's short-term memory. integrated circuit (IC) made of millions of transistors and capacitors. In the most common form of computer memory, dynamic random access memory (DRAM), a transistor and a capacitor are paired to create a memory cell, which represents a single bit of data. The capacitor holds the bit of information — 0 or 1.The transistor acts as a switch that lets the control circuitry on the memory chip read the capacitor or change its state.and column that intersect at that cell.

**TYPES OF RAM**

SRAM (Static RAM)

DRAM(Dynamic RAM)

FPM DRAM( Fast page mode dynamic random access memory)

EDO DRAM (Extended data-out dynamic random access memory)

SDRAM (Synchronous dynamic random access memory)

DDR SDRAM (Double data rate synchronous dynamic RAM)

VRAM( VideoRAM)

**SRAM**: Static random access memory uses multiple transistors, typically four to six, for each memory cell but doesn't have a capacitor in each cell. It is used primarily for cache. Cache means a temperory memory.

**DRAM**: Dynamic random access memory has memory cells with a paired transistor and capacitor requiring constant refreshing.

**FPM DRAM:** Fast page mode dynamic random access memory was the original form of DRAM. It waits through the entire process of locating a bit of data by column and row and then reading the bit before it starts on the next bit. Maximum transfer rate is approximately 176 Mbps.  
  
**EDO DRAM**: Extended data-out dynamic random access memory does not wait for all of the processing of the first bit before continuing to the next one. As soon as the address of the first bit is located, EDO DRAM begins looking for the next bit. It is about 5-20 percent faster than FPM DRAM. Maximum transfer rate is approximately 264 Mbps.

**SDRAM:** Synchronous dynamic random access memory to greatly improve performance. The idea is that most of the time the data needed by the CPU will be in sequence. SDRAM is about 5 percent faster than EDO RAM  
  
**DDR SDRAM**: This is the next generation of SDRAM. Double data rate synchronous dynamic RAM is just like SDRAM except that is has higher bandwidth, meaning greater speed. The most recent generation in widespread use is DDR4,

**VRAM**: VideoRAM, also known as multiport dynamic random access memory (MPDRAM), is a type of RAM used specifically for video adapters or 3-D accelerators.

**Read-only memory (ROM**), also known as firmware, is an integrated circuit programmed with specific data when it is manufactured. ROM chips are used not only in computers, but in most other electronic items as well. ­   
  
Data stored in these chips is nonvolatile -- it is not lost when power is removed.  
  
Data stored in these chips is either unchangeable or requires a special operation to change (unlike RAM, which can be changed as easily as it is read).  
Similar to RAM, ROM chips (Figure 1) contain a grid of columns and rows. But where the columns and rows intersect, ROM chips are fundamentally different from RAM chips. While RAM uses transistors to turn on or off access to a capacitor at each intersection, ROM uses a diode to connect the lines if the value is 1. If the value is 0, then the lines are not connected at all.

**TYPES OF ROM**

 PROM (Programmable ROM)

EPROM (Erasable PROM)

EEPROM (Electrically EPROM)

**PROM (Programmable ROM)**

Creating ROM chips totally from scratch is time-consuming and very expensive in small quantities. For this reason, mainly, developers created a type of ROM known as programmable read-only memory (PROM). Blank PROM chips can be bought inexpensively and coded by anyone with a special tool called a programmer. Intersection of row and column is has fuses.  
Prom is only once programmed

**EPROM (Erasable PROM)**

Erasable programmable read-only memory (EPROM) addresses this issue. EPROM chips can be rewritten many times. Erasing an EPROM requires a special tool that emits a certain frequency of ultraviolet (UV) light. EPROMs are configured using an EPROM programmer that provides voltage at specified levels depending on the type of EPROM used.  
Intersection between rows and colums are by two transistors

**EEPROM (Electrically EPROM)**

Though EPROMs are a big step up from PROMs in terms of reusability, they still require dedicated equipment and a labor-intensive process to remove and reinstall them each time a change is necessary. Also, changes cannot be made incrementally to an EPROM; the whole chip must be erased. Electrically erasable programmable read-only memory (EEPROM) chips remove the biggest drawbacks of EPROMs.  
The chip does not have to removed to be rewritten.

The entire chip does not have to be completely erased to change a specific portion of it.  
Changing the contents does not require additional dedicated equipment

**EXTERNAL STORAGE DEVICES**

External storage enables users to store data separately from a computer's main or primary storage and memory at a relatively low cost. It increases storage capacity without having to open up a system.

For PCs, an external storage device often consists of stationary or portable hard disk drives (HDD), or solid-state drives (SSD)attached via a USB or CDs, or wirelessly.

external storage devices include **HDD**s, a type of magnetic storage, and **SSDs**, which use flash technology with capacities starting in the gigabyte range to 10 terabytes (TB) and higher.HDDs are still considerably cheaper to buy. Because there are no moving parts to flash SSDs, they are significantly faster and more durable than HDDs

 **Optical storage** , which writes and reads digital content using a laser. This category includes removable media, such as compact discs (CDs) in formats such as CD-ROM, CD-R and CD-RW,   
DVDs with a capacity of 4.7 GB single- and 9.4 GB double-sided; and Blu-ray, with a capacity of 5 GB single-layer and 50 GB dual-layer.

Small and removable **USB drives** and media cards for smartphones, tablets, cameras and so on.  
A memory card is also known a s a flash memory card or **SD Card** (Secure Digital Card), is an external storage medium that allows us to save and delete information