

Random Access Memory (RAM)

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Random Access Memory (RAM) is a type of computer memory that stores data temporarily while a computer is running. It's called "random access" because the computer can access any part of the memory directly and quickly. RAM (Random Access Memory) is very similar to memory in the Human Brain. The human brain's memory is the most essential part played by the brain. Memory helps in remembering things, and people remember their past due to the memory present in the brain, similarly, computers have memory too.

RAM helps your computer run programs and process information quickly. When you turn off your computer, the data in RAM is lost, unlike data on your hard drive which is stored permanently. In this article, we are going to discuss about RAM and types of RAM in detail.

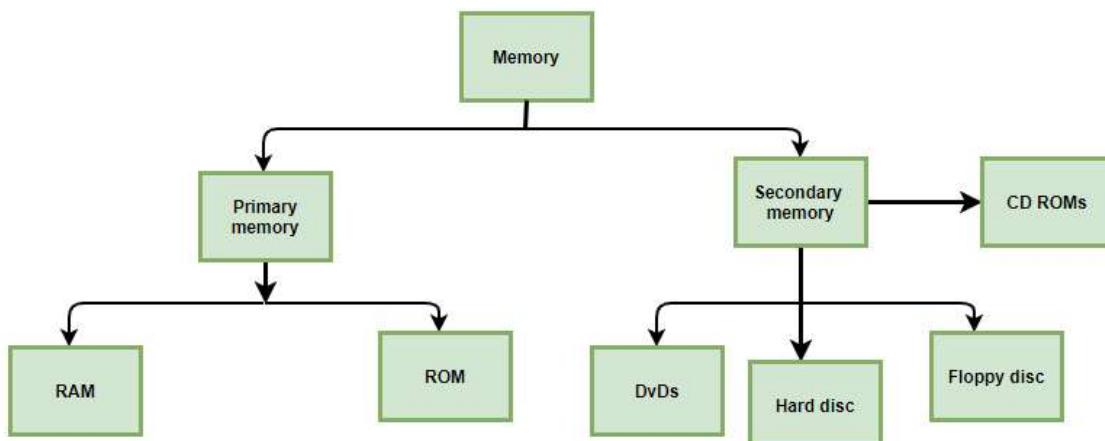
What is a Computer Memory?

To save data and instructions, memory is required. Memory is divided into cells, and they are stored in the storage space present in the computer. Every cell has its unique location/address. Memory is essential for a computer as this is the way it becomes somewhat more similar to a human brain.

In human brains, there are different ways of keeping a memory, like short-term memory, long-term memory, implicit memory, etc. Likewise, in computers, there are different types of memories or different ways of saving memories. They are cache memory, primary memory/main memory, and secondary memory.

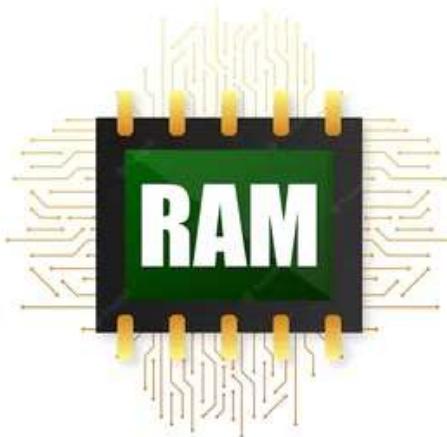
Types of Computer Memory

There are three types of memories. Cache memory helps speed up the CPU as it is a high-speed memory, It consumes less time but is very expensive. The next type is the main memory or primary memory which is used to store or hold the current data, It consists of RAM and ROM, RAM is a volatile memory while ROM is non-volatile. The third type is Secondary memory, which is non-volatile, it is used to store data permanently in a computer.



What is RAM (Random Access Memory)?

It is one of the parts of the Main memory, also famously known as Read Write Memory. Random Access memory is present on the motherboard and the computer's data is temporarily stored in RAM. As the name says, RAM can help in both Read and write. **RAM is a volatile memory, which means, it is present as long as the Computer is in the ON state, as soon as the computer turns OFF, the memory is erased.**



Random Access Memory

In order to better understand RAM, imagine the blackboard of the classroom, the students can both read and write and also erase the data written after the class is over, some new data can be entered now.

History of RAM

In 1947, the Williams tube marked the debut of the first RAM type. The data was saved as electrically charged dots on the face and was used in cathode ray tubes. A magnetic-core memory was the second type of RAM, which was created in 1947. RAM was made of small metal rings and each ring connected with wires. A ring stored one bit of data, and it can be easily accessible at any time.

The RAM as solid-state memory, was invented by Robert Dennard in 1968 at IBM Thomas J Watson Research Centre. It is generally known as dynamic random access memory (DRAM) and has many transistors to hold or store bits of data. A constant power supply was necessary to maintain the state of each transistor.

In October 1969, Intel launched its first DRAM, the Intel 1103. In 1993, Samsung launched the KM48SL2000 synchronous DRAM (SDRAM). similarly In 1996, DDR SDRAM was commercially available. In 1999, RDRAM was accessible for computers. In 2003, DDR2 SDRAM began ready to sold. In June 2007, DDR3 SDRAM ready to being sold. In September 2014, DDR4 became ready to be sold in the market.

How Does RAM Work?

RAM is constructed of small transistors and capacitors, much like CPUs and other computer components, which can stored an electric charge that corresponds to data bits. electrical charge is necessary to regular charge of it. If not, the data removed from RAM and the capacitors lose their charge.

Saving any modified data to the hard disc or SSD is crucial because data can be lost so rapidly when the battery is gone. Additionally, it explains why so many programmes include autosave options or cache unfinished work in the event of an unplanned shutdown. Data from RAM can be retrieved by forensic experts in some situations. However, the majority of the time, after finishing a file or your computer shuts down, the information in RAM is gone.

How Computer And Laptop RAM Works Together?

Whenever you play a game from your laptop hard drive or stream a movie from the internet, your computer loads the data from the Hard Drive into the RAM for processing the data. The CPU then uses this memory to solve the complex tasks required to deliver your preferred experience.

That's why RAM needs to be fast—faster than the other storage devices like a Hard Drive offered by your computer's disk drive. The speed of your RAM defines how fast the data flows in and out of your CPU. If your RAM is slow, you will get the result late.

You can think RAM is like short-term memory, which helps to store the immediate data you need for processing like remembering your items in a shopping list. If you lose your short-term memory, you won't be able to remember anything for more than a few seconds. however having more short-term memory would allow you to do additional simultaneous tasks, and those tasks can be more complicated.

Higher the capacity of your RAM, the CPU can complete tasks quickly and your experience will be smoother. RAM enables you to open larger files, and demanding applications like video editing software.

Difference Between Hard Drive And RAM

Hard Drive	RAM
Non-volatile storage device for long-term data storage	Volatile memory used for temporary storage
Non-volatile (data retained when power is off)	Volatile (data lost when power is off)
Slower access times (HDD slower than SSD)	High-speed access
Typically larger (several TB)	Typically smaller (several GB)

ROM vs RAM

ROM	RAM
Non-volatile memory used for permanent storage	Volatile memory used for temporary storage

ROM	RAM
Generally slower than RAM	High-speed access
Primarily read-only	Read and write operations
ROM generally holds only megabytes of storage	RAM can store in gigabytes
Data accessible is not easy	Data accessible is easy
Cheaper than RAM	High cost as compared to ROM
Used for the temporary storage of data	Used for permanent storage of data

RAM vs Virtual Memory

RAM	Virtual Memory
RAM is a physical device or memory installed in the computer or laptop and is used by the CPU to store data temporarily during program execution.	While virtual memory is the memory management technique used by the operating system that uses parts of the storage drive to supplement physical RAM and extend the computer's memory capacity.

Features of RAM

- RAM is volatile in nature, which means, the data is lost when the device is switched off.
- RAM is known as the Primary memory of the computer.
- RAM is known to be expensive since the memory can be accessed directly.
- RAM is the fastest memory, therefore, it is an internal memory for the computer.
- The speed of computer depends on RAM, say if the computer has less RAM, it will take more time to load and the computer slows down.

How Much RAM Do You Need?

The system's RAM requirements depend on what the user is doing. For editing videos, for instance, a machine should have at least 16 GB of RAM, though more is preferable. A machine needs also have **at least 3GB of RAM** in order to run Photoshop CC on a Mac for photo processing, according to Adobe. Even 8GB of RAM, meanwhile, can cause a slowdown if the user is using many apps at once.

Types of RAM

RAM is further divided into two types, SRAM – Static Random Access Memory and DRAM- Dynamic Random Access Memory. Let's learn about both of these types in more detail.

1. SRAM (Static Random Access memory)

SRAM is used for Cache memory, it can hold the data as long as the power availability is there. It is refreshed simultaneously to store the present information. It is made with CMOS technology. It contains 4 to 6 transistors and it also uses clocks. It does not require a periodic refresh cycle due to the presence of transistors. Although SRAM is faster, it requires more power and is more expensive in nature. Since SRAM requires more power, more heat is lost here as well, another drawback of SRAM is that it can not store more bits per chip, for instance, for the same amount of memory stored in DRAM, SRAM would require one more chip.

Function of SRAM

The function of SRAM is that it provides a direct interface with the Central Processing Unit at higher speeds.

Characteristics of SRAM

- SRAM is used as the Cache memory inside the computer.
- SRAM is known to be the fastest among all memories.
- SRAM is costlier.
- SRAM has a lower density (number of memory cells per unit area).
- The power consumption of SRAM is less but when it is operated at higher frequencies, the power consumption of SRAM is compatible with DRAM.

2. DRAM (Dynamic Random Access memory)

DRAM is used for the Main memory, it has a different construction than SRAM, it used one transistor and one capacitor (also known as a conductor), which is needed to get recharged in milliseconds due to the presence of the capacitor. Dynamic RAM was the first sold memory integrated circuit. DRAM is the second most compact technology in production (First is Flash Memory). DRAM has one transistor and one capacitor in 1 memory bit. Although DRAM is slower, it can store more bits per chip, for instance, for the same amount of memory stored in SRAM, DRAM requires one less chip. DRAM requires less power and hence, less heat is produced.

Function of DRAM

The function of DRAM is that it is used for programming code by a computer processor in order to function. It is used in our PCs (Personal Computers).

Characteristics of DRAM

- DRAM is used as the Main Memory inside the computer.
- DRAM is known to be a fast memory but not as fast as SRAM.
- DRAM is cheaper as compared to SRAM.
- DRAM has a higher density (number of memory cells per unit area)
- The power consumption by DRAM is more

Types of DRAM

- **SDRAM:** Synchronous DRAM, increases performance through its pins, which sync up with the data connection between the main memory and the microprocessor.
- **DDR SDRAM:** (Double Data Rate) It has features of SDRAM also but with double speed.
- **ECC DRAM:** (Error Correcting Code) This RAM can find corrupted data easily and sometimes can fix it.
- **RDRAM:** It stands for Rambus DRAM. It used to be popular in the late 1990s and early 2000s. It has been developed by the company named Rambus Inc. at that time it competed with SDRAM. Its latency was higher at the beginning but it was more stable than SDRAM, consoles like Nintendo 64 and Sony Play Station 2 used that.
- **DDR2, DDR3, AND DDR4:** These are successor versions of DDR SDRAM with upgrades in performance

Difference Between SRAM and DRAM

SRAM	DRAM
SRM stand for Static Random Access memory	DRAM stand for Dynamic Random Access memory
More power is required	Less power is required
More expensive	Less expensive
Faster	Slower

Advantages of Using RAM

- **Speed:** RAM is faster than other types of storage like ROM, hard drives or SSDs, allowing for quick access to data and smooth performance of applications.
- **Multitasking:** More RAM allows a computer to handle multiple applications simultaneously without slowing down.
- **Flexibility:** RAM can be easily upgraded, enhancing a computer's performance and extending its usability.
- **Volatile Storage:** RAM automatically clears its data when the computer is turned off, reducing the risk of unwanted data accumulation.

Disadvantages of Using RAM

- **Volatility:** Data stored in RAM is lost when the computer is turned off, which means important data must be saved to permanent storage.
- **Cost:** RAM can be more expensive per gigabyte compared to other storage options like hard drives or SSDs.
- **Limited Storage:** RAM has a limited capacity, so it cannot store large amounts of data permanently.
- **Power Consumption:** RAM requires continuous power to retain data, contributing to overall power consumption of the device.
- **Physical Space:** Increasing RAM requires physical space in the computer, which might be limited in smaller devices like laptops and tablets.

Conclusion

In conclusion, RAM (Random Access Memory) and ROM (Read-Only Memory) are two essential types of memory in a computer, each used for distinct purposes. RAM is a temporary, volatile memory used for storing data and instructions that the computer needs while it's running, making it crucial for the speed and performance of active tasks. In contrast, ROM is a non-volatile memory that permanently stores essential programs and instructions required for the computer to start up and perform basic functions.