COMPUTER APPLICATION

1st SEM

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COMPUTER ORGANISATION

➔ A **computer** is a programmable electronic device that accepts raw data as input and processes it with a set of instructions (a program) to produce the result as output.

First computer which was invented by **Charles Babbage** in 1837. It used punch cards as read-only memory. **Charles Babbage** is also known as the **father of the computer**.

➔ **The basic parts of a computer :**

- **Processor:** It executes instructions from software and hardware.
- **Memory:** It is the primary memory for data transfer between the CPU and storage.
- **Motherboard:** It is the part that connects all other parts or components of a computer.
- **Storage Device:** It permanently stores the data, e.g., hard drive.
- **Input Device:** It allows you to communicate with the computer or to input data, e.g., a keyboard.
- **Output Device:** It enables you to see the output, e.g., monitor.

➔ **Based on the size, a computer can be divided into five types:**

1. Micro Computer
2. Mini Computer
3. Mainframe Computer
4. Super Computer
5. Workstations

➔ **Hardware** is any part of your computer that has a **physical structure**, such as the keyboard or mouse.

➔ **Software** is any **set of instructions** that tells the hardware **what to do** and **how to do it**. Examples of software include web browsers, games, and word processors.

➔ Evolution of Computers

- The first counting device was used by the primitive people. They used sticks, stones and bones as counting tools.
- As human mind and technology improved with time more computing devices were developed. Some of the popular computing devices starting with the first to recent ones are described below;

1. Abacus:-

- The history of computer begins with the birth of abacus which is believed to be the first computer. It is said that Chinese invented Abacus around 4,000 years ago.
- It was a wooden rack which has metal rods with beads mounted on them. The beads were moved by the abacus operator according to some rules to perform arithmetic calculations. Abacus is still used in some countries like China, Russia and Japan.

2. Napier's Bones

- It was a manually-operated calculating device which was invented by John Napier (1550-1617)
- In this calculating tool, he used 9 different ivory strips or bones marked with numbers to multiply and divide. So, the tool became known as "Napier's Bones. It was also the first machine to use the decimal point.

3. Pascaline

- Pascaline is also known as Arithmetic Machine or Adding Machine. It was invented between 1642 and 1644 by a French mathematician-philosopher Biaise Pascal. It is believed that it was the first mechanical and automatic calculator.
- Pascal invented this machine to help his father, a tax accountant. It could only perform addition and subtraction. It was a wooden box with a series of gears and wheels. When a wheel is rotated one revolution, it rotates the neighboring wheel. A series of windows is given on the top of the wheels to read the totals.

4. Stepped Reckoner or Leibnitz wheel

- It was developed by a German mathematician-philosopher Gottfried Wilhelm Leibnitz in 1673. He improved Pascal's invention to develop this machine.
- It was a digital mechanical calculator which was called the stepped reckoner as instead of gears it was made of fluted drums.

5. Difference Engine

- In the early 1820s, it was designed by Charles Babbage who is known as "Father of Modern Computer". It was a mechanical computer which could perform simple calculations. It was a steam driven calculating machine designed to solve tables of numbers like logarithm tables.

6. Analytical Engine

- This calculating machine was also developed by Charles Babbage in 1830. It was a mechanical computer that used punch-cards as input. It was capable of solving any mathematical problem and storing information as a permanent memory.

7. Tabulating Machine

- It was invented in 1890, by Herman Hollerith, an American statistician. It was a mechanical tabulator based on punch cards. It could tabulate statistics and record or sort data or information. This machine was used in the 1890 U.S. Census.
- Hollerith also started the Hollerith's Tabulating Machine Company which later became International Business Machine (IBM) in 1924.

8. Differential Analyzer

- it was the first electronic computer introduced in the United States in 1930. It was an analog device invented by Vannevar Bush.
- This machine has vacuum tubes to switch electrical signals to perform calculations. It could do 25 calculations in few minutes.

9. Mark I

- The next major changes in the history of computer began in 1937 when Howard Aiken planned to develop a machine that could perform calculations involving large numbers.
- In 1944, Mark I computer was built as a partnership between IBM and Harvard. It was the first programmable digital computer.

➔ Generations of Computers

- A generation of computers refers to the specific improvements in computer technology with time.
- In 1946, electronic pathways called circuits were developed to perform the counting.
- It replaced the gears and other mechanical parts used for counting in previous computing machines.
- In each new generation, the circuits became smaller and more advanced than the previous generation circuits.
- The miniaturization helped increase the speed, memory and power of computers.

There are five generations of computers which are described below;

1. First Generation Computers

- The first generation (1946-1959) computers were slow, huge and expensive.
- Vaccum tubes were used as the basic components of CPU and memory.
- These computers were mainly depended on batch operating system and punch cards. Magnetic tape and paper tape were used as output and input devices in this generation;

Some of the popular first generation computers are;

ENIAC (Electronic Numerical Integrator and Computer)

EDVAC (Electronic Discrete Variable Automatic Computer)

2. Second Generation Computers

- The second generation (1959-1965) was the era of the transistor computers.
- These computers used transistors which were cheap, compact and consuming less power;
- it made transistor computers faster than the first generation computers.
- In this generation, magnetic cores were used as the primary memory and magnetic disc and tapes were used as the secondary storage.
- Assembly language and programming languages like COBOL and FORTRAN, and Batch processing and multiprogramming operating systems were used in these computers.

Some of the popular second generation computers are;

IBM 1620

IBM 7094

3. Third Generation Computers

- The third generation computers used integrated circuits (ICs) instead of transistors.
- A single IC can pack huge number of transistors which increased the power of a computer and reduced the cost.
- The computers also became more reliable, efficient and smaller in size. –
- These generation computers used remote processing, time-sharing, multi programming as operating system. Also, the high-level programming languages like FORTRON-II TO IV, COBOL, PASCAL PL/1, ALGOL-68 were used in this generation.

Some of the popular third generation computers are;

IBM-360 series

Honeywell-6000 series

4. Fourth Generation Computers

- The fourth generation (1971-1980) computers used very large scale integrated (VLSI) circuits;
- a chip containing millions of transistors and other circuit elements.
- These chips made this generation computers more compact, powerful, fast and affordable.
- These generation computers used real time, time sharing and distributed operating system. The programming languages like C, C++, DBASE were also used in this generation.

Some of the popular fourth generation computers are;

CRAY-1(Super Computer)

CRAY-X-MP(Super Computer)

5. Fifth Generation Computers

- In fifth generation (1980-till date) computers, the VLSI technology was replaced with ULSI (Ultra Large Scale Integration).
- It made possible the production of microprocessor chips with ten million electronic components.
- This generation computers used parallel processing hardware and AI (Artificial Intelligence) software.
- The programming languages used in this generation were C, C++, Java, .Net, etc.

Some of the popular fifth generation computers are;

Desktop

Laptop

➔ Classification of computers

- We can categorize computer in two ways: on the basis of data handling capabilities and size.

On the basis of data handling capabilities, the computer is of *three* types:

- Analogue Computer
- Digital Computer
- Hybrid Computer

1. Analogue Computer

- Analogue computers are designed to ***process analogue data***.
- Analogue data is continuous data that changes continuously and cannot have discrete values.
- We can say that analogue computers are used where we don't need exact values always such as speed, temperature, pressure and current
- Analogue computers directly accept the data from the measuring device without first converting it into numbers and codes.
- They measure the continuous changes in physical quantity and generally render output as a reading on a dial or scale. ***Speedometer*** and ***mercury thermometer*** are examples of analogue computers.

2. Digital Computer

- Digital computer is designed to perform calculations and logical operations at high speed.
- It accepts the raw data as input in the form of digits or binary numbers (0 and 1) and processes it with programs stored in its memory to produce the output.
- All modern computers like laptops, desktops including smartphones that we use at home or office are digital computers.

3. Hybrid Computer

- Hybrid computer has features of both analogue and digital computer.
- It is ***fast like an analogue*** computer and has memory and ***accuracy like digital computers***.
- It can process both continuous and discrete data.
- It accepts analogue signals and convert them into digital form before processing.
- So, it is widely used in specialized applications where both analogue and digital data is processed.
- For example, a processor is used in petrol pumps that converts the measurements of fuel flow into quantity and price. Similarly, they are used in airplanes, hospitals, and scientific applications.

On the basis of size, the computer can be of *five* types

1. Supercomputer

- Supercomputers are the ***biggest and fastest computers***.
- They are designed to process huge amount of data.
- A supercomputer can ***process trillions of instructions in a second***. It has thousands of interconnected processors.
- Supercomputers are particularly used in ***scientific and engineering applications*** .
- such as weather forecasting, scientific simulations and nuclear energy research.
- The first supercomputer was developed by ***Roger Cray in 1976***.

2. Mainframe computer

- Mainframe computers are designed to support hundreds or thousands of users simultaneously.
- They can support multiple programs at the same time. It means they can execute different processes simultaneously.

- These features of mainframe computers make them ideal for big organizations like banking and telecom sectors, which need to manage and process high volume of data.
- Mainframe computers is used in ***healthcare, field of defence***, ***field of education***, ***retail sector etc.***

3. Minicomputer

- It is a ***midsize multiprocessing computer***.
- It consists of two or more processors and can support ***4 to 200 users at one time***.
- Minicomputers are used in institutes and departments for tasks such as billing, accounting and inventory management.
- A minicomputer ***lies between the mainframe and microcomputer*** as it is smaller than mainframe but larger than a microcomputer.
- A minicomputer is mainly used to perform three primary functions, which are as follows.

    1. Process control.
    2. Data management.
    3. Communication portal.

4. Workstation

- Workstation is a ***single user computer*** that is designed for ***technical or scientific applications***.

- It has a faster microprocessor, a large amount of RAM and high speed graphic adapters.

- It generally ***performs a specific job with great expertise***; accordingly, they are of different types such as graphics workstation, music workstation and engineering design workstation.

5. Microcomputer

- Microcomputer is also known as a personal computer.

- It is a general-purpose computer that is designed for individual use.

- It has a microprocessor as a central processing unit, memory, storage area, input unit and output unit.

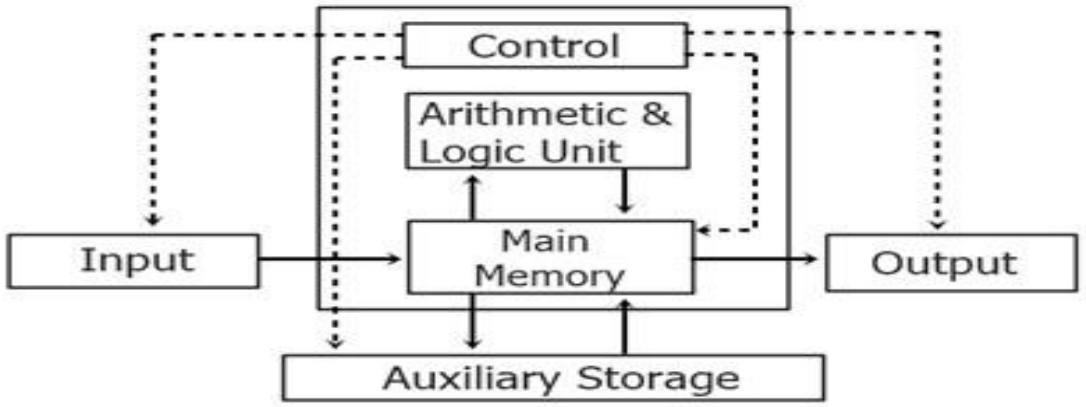
- Laptops and desktop computers are examples of microcomputers.

- They are suitable for personal work that may be making an assignment, watching a movie, or at office for office work.

-> Block Diagram of a Computer and Its Component

- The diagram that illustrates the primary components of the computer system is known as the **block diagram of the computer**.

- The basic definition of the computer system is that it takes some data then it processes it and then it produces the final outcome and this is what the block diagram shows.



Block Diagram of Computer

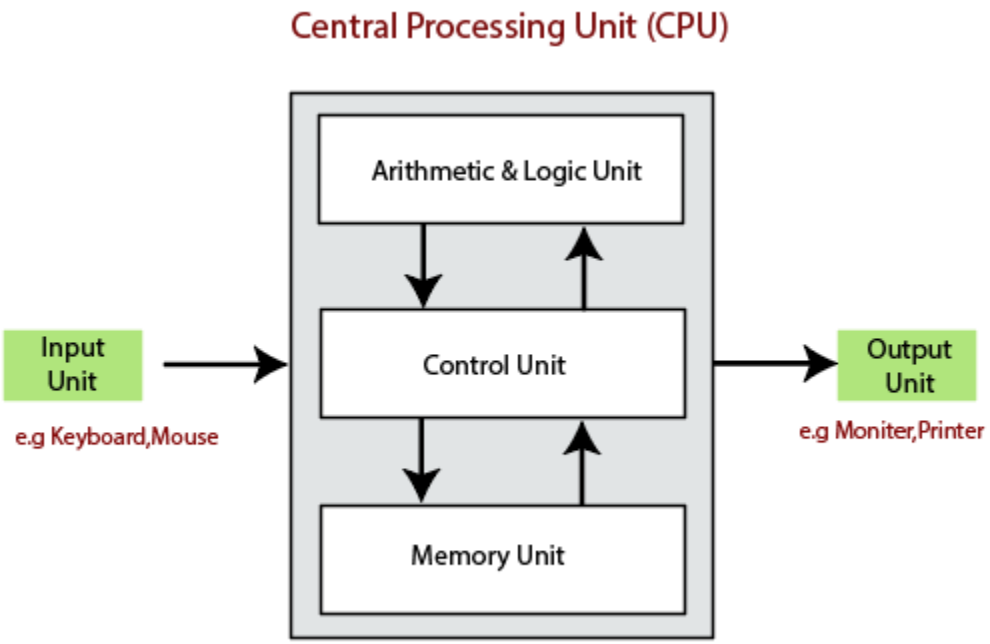
- The main components of the computer system are the **Central Processing Unit (CPU)**.
- The Central Processing Unit consists of two more parts the Arithmetic and Logical Unit(ALU), and the Control Unit(CU).
- For processing the data to give output, the computer needs some space to keep the data there and from here the Storage Unit takes the lead.

The Input Unit

- The input unit is the platform from where the raw data is passed into the computer system.
- The input can be in any form. For example, the mouse-clicked input, button-input, keyboard-input, etc.
- All the input data is passed from the input unit to the computer's storage unit.

Central Processing Unit (CPU)

- The CPU is the primary component that processes the input passed into the computer.
- It is also called the heart or brain of the computer without the CPU you just have the useless desktop.
- The CPU has two components Arithmetic Logical Unit (ALU) and Control Unit (CU).



Arithmetic Logical Unit (ALU)

- We all know that computer understands the language of the binary numbers that is 0 and the 1.
- The Arithmetic Logical Unit (ALU) is the digital circuit that takes these 0s and 1s and performs the necessary arithmetic operations on it and releases the results as the output asynchronously.

Control Unit

- The Control Unit (CU) is like the traffic guy.
- It controls the instructions flowing in and out of the CPU.
- The CU is smart enough to sense that when the CPU's central processor needs data and when not.
- If the data is required then it retrieves it from the Storage Unit and transfers it into the CPU. The CU converts the data into signals and passes it into the central processor.

Storage Unit - Primary and the Secondary Unit

- The raw data from the Input unit is saved in the Storage Unit.
- It is the place where the data that is to be processed and processed data is stored. The Storage
- Unit is further classified into two parts.

    - Primary Storage
    - Secondary Storage

Primary Storage

- This storage is also known as the main memory of the computer system.
- This part of the storage unit holds the data, programs, and instructions that are currently in use.
- This storage part resides in the motherboard.
- Primary storage contains the ROM and RAM of the computer system.

Secondary Storage

- It is a non-volatile and permanent data storage device.
- It is the place where the data is stored for a short or a long time.
- The secondary storage supports the primary storage.
- This device is also known as the hard drive of the computer. It is primarily used as a backup device.

Output Unit

- The output unit is the place through which the computer system outputs the data.
- The output unit is always hardware.
- The computer screen, speakers, printer, etc. are the output devices because

  from these devices users get their processed data.

➔ Computer Memory

- The computer memory holds the data and instructions needed to process raw data and produce output.
- It is the same as a human mind, where data, information, and instructions are stored.
- It is a data storage device or a data storage component where instructions for processing data are kept along with the data that has to be processed. Both the input and the output can be held here.

- The computer memory is divided into large number of small parts known as cells.
- Each cell has a unique address which varies from 0 to memory size minus one.
- *Computer memory is of two types: Volatile (RAM) and Non-volatile (ROM)*.
- The secondary memory (hard disk) is referred as storage not memory.
- categorize memory on behalf of space or location, it is of four types:

    - Register memory
    - Cache memory
    - Primary memory
    - Secondary memory

- A program is loaded from secondary memory to primary memory when it is opened.
- There are several types of memory and storage, for example, a program being moved from a solid-state drive (SSD) to RAM (Random Access Memory).
- The opened software will be able to communicate with the computer's processor at a faster rate because primary storage is accessed more quickly.
- The main or primary memory can be accessed quickly from storage locations such as temporary memory slots.
- Data in memory is only saved temporarily since memory is volatile.
- Data saved in volatile memory will be erased immediately whenever a computer is turned off.
- A file is transported to secondary memory for permanently storage when it is saved.

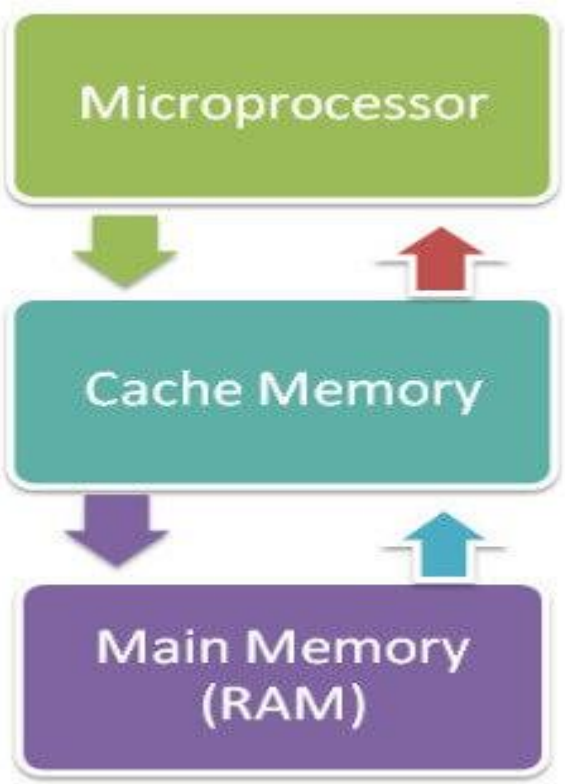
Register Memory

- Register memory is the smallest and fastest memory in a computer.
- It is not a part of the main memory and is located in the CPU in the form of registers, which are the smallest data holding elements.
- A register temporarily holds frequently used data, instructions, and memory address that are to be used by CPU.
- They hold instructions that are currently processed by the CPU. All data is required to pass through registers before it can be processed. So, they are used by CPU to process the data entered by the users.
- Registers hold a small amount of data around 32 bits to 64 bits.
- The speed of a CPU depends on the number and size (no. of bits) of registers that are built into the CPU.

- Registers can be of different types based on their uses. Some of the widely used Registers include Data Register or DR, the Address Register or AR, Program Counter (PC), I/O Address Register, and more.

Cache Memory

- Cache memory is a high-speed memory, which is small in size but faster than the main memory (RAM).
- The CPU can access it more quickly than the primary memory. So, it is used to synchronize with high-speed CPU and to improve its performance.



- Cache memory can only be accessed by CPU. It can be a reserved part of the main memory or a storage device outside the CPU.
- It holds the data and programs which are frequently used by the CPU. So, it makes sure that the data is instantly available for CPU whenever the CPU needs this data.
- If the CPU finds the required data or instructions in the cache memory, it doesn't need to access the primary memory (RAM)..it speeds up the system performance.

Types of Cache Memory

- **L1:** It is the first level of cache memory, which is called Level 1 cache or L1 cache. In this type of cache memory, a small amount of memory is present inside the CPU itself. The size of this memory ranges from 2KB to 64 KB.
- **L2:** This cache is known as Level 2 cache or L2 cache. This level 2 cache may be inside the CPU or outside the CPU. The memory size of this cache is in the range of 256 KB to the 512 KB. In terms of speed, they are slower than the L1 cache.
- **L3:** It is known as Level 3 cache or L3 cache. This cache is not present in all the processors; some high-end processors may have this type of cache. This cache is used to enhance the performance of Level 1 and Level 2 cache. It is located outside the CPU and is shared by all the cores of a CPU. Its memory size ranges from 1 MB to 8 MB. Although it is slower than L1 and L2 cache, it is faster than Random Access Memory (RAM).

Primary Memory

- Primary Memory is of two types: RAM and ROM.

1. RAM (RAM is Random access memory)

- It is a volatile memory. It means it does not store data or instructions permanently.
- When you switch on the computer the data and instructions from the hard disk are stored in RAM.
- CPU utilizes this data to perform the required tasks. As soon as you shut down the computer the RAM loses all the data.
- **Dynamic RAM:** A type of random-access memory that is used in computing systems (primarily PCs) is called dynamic random-access memory (DRAM). The data or program code required for a computer processor to operate is often stored in DRAM, which is a kind of semiconductor memory. Each piece of data is stored in DRAM in its own passive electrical component, which is located inside an integrated circuit board. Each electrical component has two value states, known as 0 and 1, in one bit.
- **Static RAM:** As long as SRAM receives power, it keeps data bits in its memory. It does not need to be refreshed on a regular basis, in contrast to DRAM, which stores bits in cells made up of a capacitor and a transistor.

- **Double Data Rate SDRAM:** Theoretically, DDR SRAM can increase the memory clock speed to at least 200 MHz. It is an SDRAM.
- **Double Data Rate 4 Synchronous Dynamic RAM:** DDR4 RAM is the successor to its preceding DDR2 and DDR3 iterations. It is a kind of DRAM that contains a high-bandwidth interface. Higher module density and lower voltage requirements are both possible with DDR4 RAM. It enables dual in-line memory modules (DIMMS) up to 64 GB; Also, higher data rate transfer speeds are paired with it.
- **Rambus Dynamic RAM:** A memory component called DRDRAM made a guarantee to transport up to 1.6 billion bytes per second.

2. ROM (Read only Memory)

- It is a non-volatile memory. It means it does not lose its data or programs that are written on it at the time of manufacture.
- So it is a permanent memory that contains all important data and instructions needed to perform important tasks like the boot process.
- **Programmable ROM:** PROM is ROM that a user can modify only once. Using a unique device known as a PROM programmer enables a user to customize a microcode program.
- **Erasable PROM:** EPROM is a type of computer memory that can be erased and re-used. It is programmable read-only memory PROM.
- **Electrically erasable PROM:** A user-modifiable ROM called an **EEPROM** can be repeatedly wiped and reprogrammed with the help of an using electrical voltage that is higher than usual. Unlike EPROM chips, EEPROMs can be changed without being taken out of the computer. However, an EEPROM chip must be completely deleted and reprogrammed, not just some parts of it.

Secondary Memory

- The secondary storage devices which are built into the computer or connected to the computer are known as a secondary memory of the computer. It is also known as external memory or auxiliary storage.
- The secondary memory is accessed indirectly via input/output operations.
- It is non-volatile, so permanently stores the data even when the computer is turned off or until this data is overwritten or deleted.

- The CPU can't directly access the secondary memory. First, the secondary memory data is transferred to primary memory then the CPU can access it.
- Some of the secondary memory or storage devices are described below.

  Hard Disk, Solid-state drive, pen drive, SD card etc.

NOTE:

➔ Memory vs. Storage

- storage is secondary memory, while memory is primary or main memory.
- Storage refers to where long-term data is stored, whereas memory refers to where short-term data is stored.
- Data in a computer is stored in secondary memory, which is referred to as storage. A hard drive (HDD), often known as a hard disk drive, is an example of storage.
- The amount of storage and memory space that is accessible differs as well.
- As compared to memory, a computer will often have greater storage capacity. For instance, a laptop may have 250 GB of storage space and 8 GB of RAM.
- The reason for the difference in space is that a computer will not need to quickly access all the data stored on it at once; therefore, assigning about 8 GB of space will be plenty to run programs.

➔ **Virtual memory:**

- A memory management method that enables the use of secondary memory just like it was a component of main memory.
- In order to compensate for physical memory shortages, virtual memory uses hardware and software to temporarily shift data from RAM to disk storage.

➔ **Four differences between RAM and ROM**

- Major four differences between RAM and ROM are given below:

RAM	ROM
The full form of RAM is Random access memory.	The full form of ROM is read only memory.

In terms of speed, it is fastest memory.	As compared to RAM, it is slower in speed.
It is volatile in nature, which means the data is lost when power is cut off.	It is non-volatile in nature, which means the data is retained even power is cut off.
Users can change and retrieve data that is stored in RAM.	Users can one read the data that is stored in ROM.