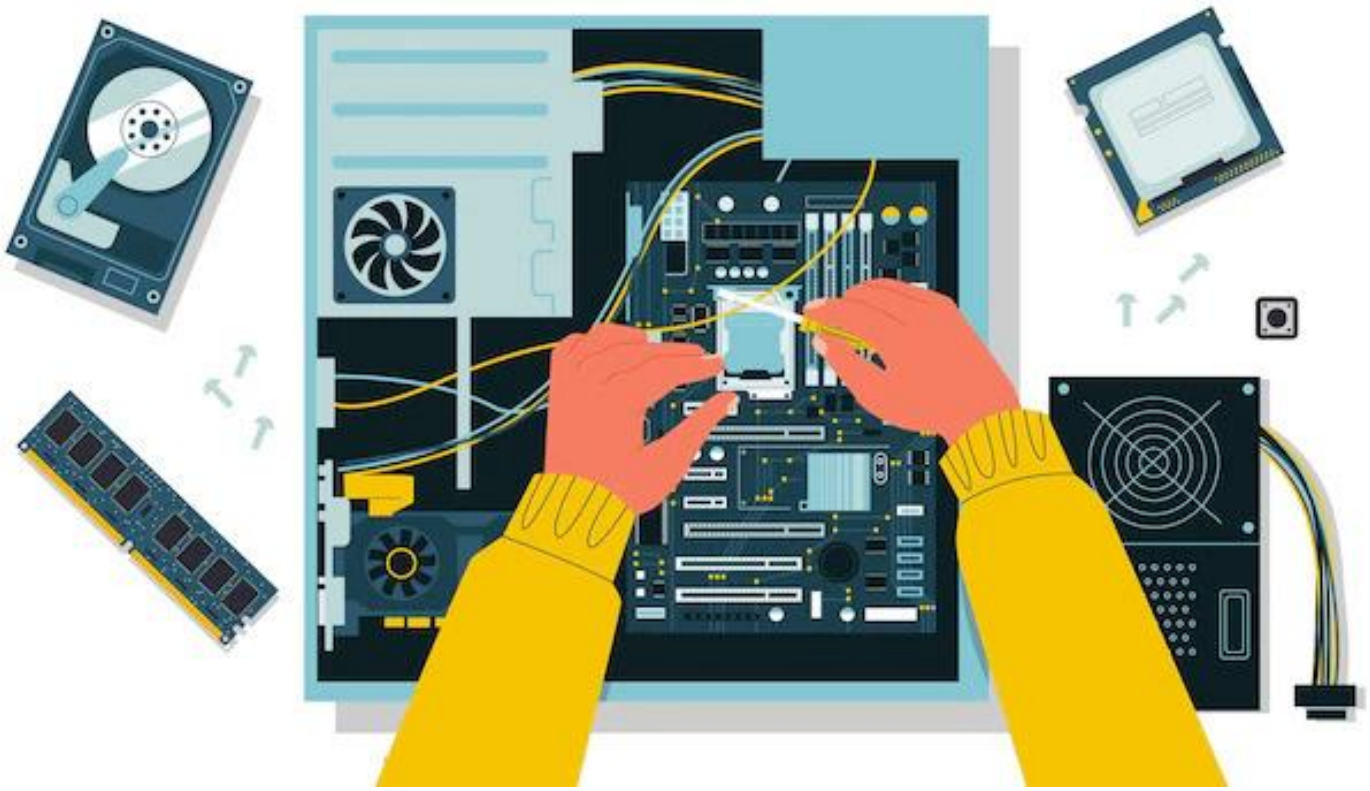
Introduction to Computer

A/L ICT – Lesson 2

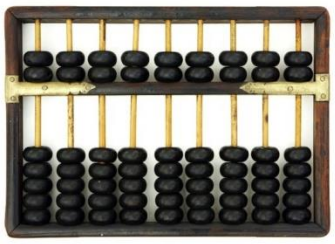


A computer is a digital electronic machine that can be programmed to carry out sequences of arithmetic or logical operations (computation) automatically. Modern computers can perform generic sets of operations known as programs. These programs enable computers to perform a wide range of tasks....

Competency 2: Explores the evolution of computing devices, so as to be able to describe and compare the performance of modern computers.

Competency Level 2.1: Elicits the significant changes occurred in the computers from generation to generation with more emphasis on the evolution of processors.

By now you would have understood that computers assist us in converting data into information. Even though at present, there are automated computer systems, the computer too has undergone a similar evolution process as human beings and has reached the advanced stage today. The computer was born with the attempt to make an adding machine. In order to perform addition of numbers, a device called **Abacus** was invented around 5000 ago.



Abacus

In due course many new inventions were made. The followings are few of them:

- In 1642, **Blaise Pascal** invented a machine called the **Adding Machine**. This was the world's first ever mathematical machine.
- In 1674, Gottfried Wilhelm Von Leibnitz improved the machine invented by Pascal. With these improvements the machine was able to perform multiplication and division too.
- A French Scientist named Joseph Jacquard invented a mechanical loom using Punch Card System.
- **Charles Babbage** started to make his **Analytical Engine** using the Punch Card System concept. This machine was based on the concepts input, process, output and store since this concept helped in the development of the computer, Charles Babbage is called the father of computing.
- **Madam Ada Augusta Lovelace** is considered as the **first programmer** since she tried to write programmes for the Analytical Engine.
- In the year 1944, a man named Howard Aiken invented the machine called Automatic Sequence Control Calculator at the Harvard University with the assistance of his companions and IBM Company. This was named MARK 1.

All the versions of early computers were mechanical in nature. From the time when the computers became automated they were categorized into various 'Generations' as below:

Generation	Major Hardware Technology	Software Used	Charateristics	Systems invented
First Generation Computers 1940-1956	**Vacuum Tubes** Punch Cards are used for input, process, output and storge of data	Machine language	• High Heat Generation • Slow in processing • Large in size • Not Portable • Consumes a lot of electricity • Expensive	ENIAC EDVAC EDSAC UNIVAC IBM 701
Second Generation Computers 1956-1963	**Transistors** Tape Floppy Disk, Tape for Secondary Storage	Assembly Language	• Smaller in size. • Less heat Generation • Low power consumption • Faster processing • Expensive	Honey well 400 IBM 7030 CDC 1604 U N I VA C
Third Generation Computers (1964-1975)	**Integrated Circuits (IC)** High capacity disks for secondary storage Keyboard and mouse for data input	high level computer languages	• Smaller in size • Less heat Generation • Faster processing • Expensive • Low power consumption • birth of Operating Systems (OS)	IBM360$370 PDP-8 PDP-11 CDC 6600
Fourth Generation Computers (1975-1989)	LSIC (Large Scale Integrated Circuits) and VLSIC (Very Large Scale Integrated Circuits **Microprocessor** Faster computer networks	OS with GUI (Graphical User Interface) UNIX OS	• Very small in size • Portable • Upgradable • Palm Tops • High Capacity hard disks • Floppy disk • Optical disk • Personal computers (PC)	IBM PC Apple II
Fifth Generation Computers (1989 to present)	**ULSI (Ultra Large Scale Integration)** Very High Capacity Hard disks and optical disks Internet	AI (Artificial Intelligence) Operating Systems with GUI Hand-writing recognition systems	• Portable • Less Expensive • Smaller in size • Easy operation • High reliability • High efficiency	IBM notebooks Pentium PCs SUN workstations

Classification of Computers

1. Based on the Technology

(i) Analog Computer - An analog computer is a form of computer that handles continuous values such as electrical, mechanical, or hydraulic quantities.

(ii) Digital Computer - A computer that performs calculations and logical operations with quantities represented as digits, usually in the binary number system.

2. Based on the Purpose

(i) Special purpose computer - Computers are designed to handle a specific problem or to perform a specific task.3 58

(ii) General purpose computer – These are designed to perform a range of tasks.

3. Based on Size

(i) Super Computer :- The fastest and most powerful type of computers Supercomputers are very expensive and are employed for specialized applications that require immense amounts of computing power. (Eg: TIANHE-1)

(ii) Mainframe Computer :- A very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously.

(iii) Mini Computer :– Mid size computers mainly used as small or midrange servers operating business and scientific applications.

(iv) Micro Computer :– Desktop – A personal computer sufficient to fit on a desk, Laptop – A portable computer, Palmtop – A hand size computer, Notebook - A portable computer small and thinner than Laptop. , Smart phone – This is a mobile phone used for mobile communication with an operating system and other advanced facilities, Tablet - A tablet is a wireless, portable personal computer with a touch screen interface. The tablet is typically smaller than a notebook computer, but larger than a smartphone, Phablet - A phablet is a small pocket sized mobile device that is a bit larger than the size of an average smartphone and smaller than tablet. (Eg: Apple 6Plus, Galaxy Note, etc)

Competency Level 2.2: Explores the functionality of a computer in relation to the hardware and their interfaces.

Input Devices - These are used to feed data and instructions to a computer system.

Output devices - displays the result of the processing of raw data that is entered in the computer through an input device

Storage Devices

1. Fixed internal magnetic hard disk Hard disk is a data storage device that uses magnetic storage to store and retrieve digital information using one or more rigid rapidly rotating disks (platters) coated with some magnetic material.
2. External hard disk An external hard drive is a portable storage device that can be attached to a computer through a USB Port
3. Magnetic tape is one of the oldest technologies for electronic data storage on a magnetic surface. Tape has largely been displaced as a primary and backup storage medium, but it remains well-suited for archiving because of its high capacity, low cost and long durability. It is a sequential recording system that is not good for random access. With tape archiving, there is no online copy for quick retrieval, as everything is vaulted for the long term.
4. Optical discs An optical disc is an electronic data storage medium that can be written to and read using a low-powered laser beam.
5. DVD-RAM - DVD-RAM is like ordinary Random Access Memory (RAM), it can be repeatedly read, written to, and erased. DVD-RAM discs can be rewritten 100 times more than a DVD-RW.
6. Flash drives and memory cards use Electrically Erasable Programmable Read Only Memory (EEPROM) technology to store data on one or more semiconductor chips.

		
CD ROM	FLASH DRIVE	FLOPPY DISK
		
HARD DISK	ZIP DRIVE	MAGNETIC TAPE

Parallel computing is a type of computation in which many programs or processes are done simultaneously. Large problems can often be divided into smaller ones, which can then be solved at the same time.

In simple terms, parallel computing is breaking up a task into smaller pieces and executing those pieces at the same time, each on their own processor or on a set of computers that have been networked together.

Grid computing is a distributed architecture of large numbers of computers connected to solve a complex problem. In the grid computing model, servers or personal computers run independent tasks and are loosely linked by the Internet or low-speed networks. Computers may connect directly or via scheduling systems. In Grid computing interconnected computer systems utilize the same resources collectively. Grid computing usually consists of one main computer that distributes information and tasks to a group of networked computers to accomplish a common goal. Grid computing is often used to complete complicated or tedious mathematical or scientific calculations.

Examples of Grid Applications

- Application partitioning that involves breaking the problem into discrete pieces
- Discovery and scheduling of tasks and workflow
- Data communications distributing the problem data where and when it is required
- Provisioning and distributing application codes to specific system nodes
- Results management assisting in the decision processes of the environment
- Autonomic features such as self-configuration, self-optimization, self-recovery, and self-management

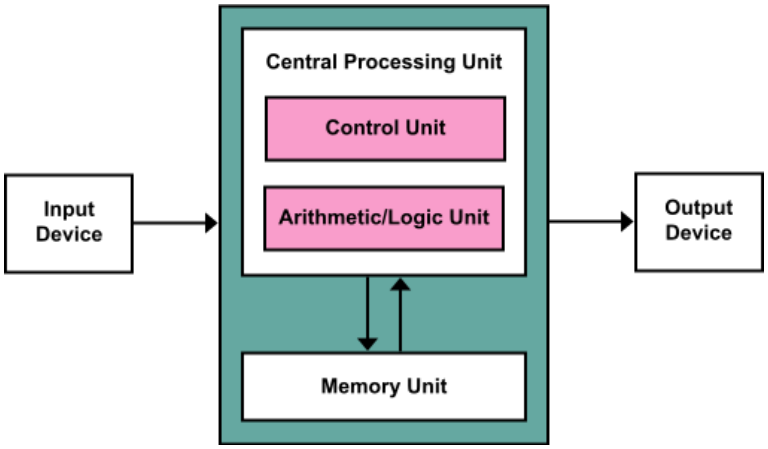
The following is an example for a grid application and its usage patterns.

Schedulers are types of applications responsible for the management of jobs, such as allocating resources needed for any specific job, partitioning of jobs to schedule parallel execution of tasks, data management, event correlation, and service-level management capabilities. These schedulers then form a hierarchical structure, with meta-schedulers that form the root and other lower level schedulers, while providing specific scheduling capabilities that form the leaves. These schedulers may be constructed with a local scheduler implementation approach for specific job execution, or another meta-scheduler or a cluster scheduler for parallel executions.

Competency Level 2.3: Explores the Von- Neumann Architecture.

Von-Neumann Architecture

Von Neumann Architecture consists of a CPU, memory and input output devices. The program is stored in the memory. The CPU fetches an instruction from the memory at a time and executes it.



Major components of this architecture:

1. Central processing unit- This is the main component of a computer system. It is also called the brain of the computer as well as it functions according to the given commands. CPU manages the operating system and application software. CPU consists of three main components. The functions of those are as follows;

- **Control unit (CU)** This unit controls signals of all devices of a computer system.
- **Arithmetic and logic unit (ALU)** It carries out mathematical and logical operations.
- **Memory register** A CPU register is one of a small set of data holding places which is part of the computer processor. A register may hold an instruction, a storage address, or any kind of data.

2. Memory

- Primary memory - RAM
- Secondary memory – Hard Disk, CD, DVD

3. Input device

4. Output device

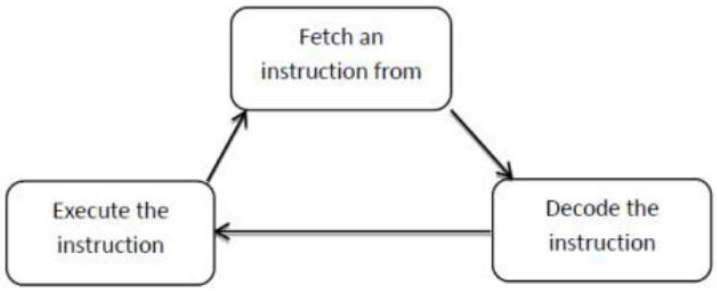
Data bus

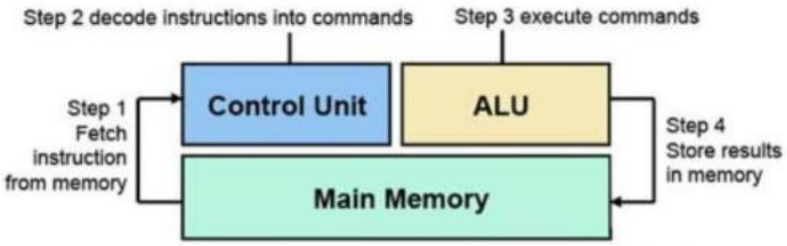
A data bus is a system within a computer or device, consisting of a connector or set of wires, that provides transportation for data.

Control bus

Control bus is used to transmit a variety of control signals to components and devices.

The fetch execute cycle is the basic operation (instruction) cycle of a computer (also known as the fetch decode execute cycle). During the fetch execute cycle, the computer retrieves a program instruction from its memory. It then establishes and carries out the actions that are required for that instruction.





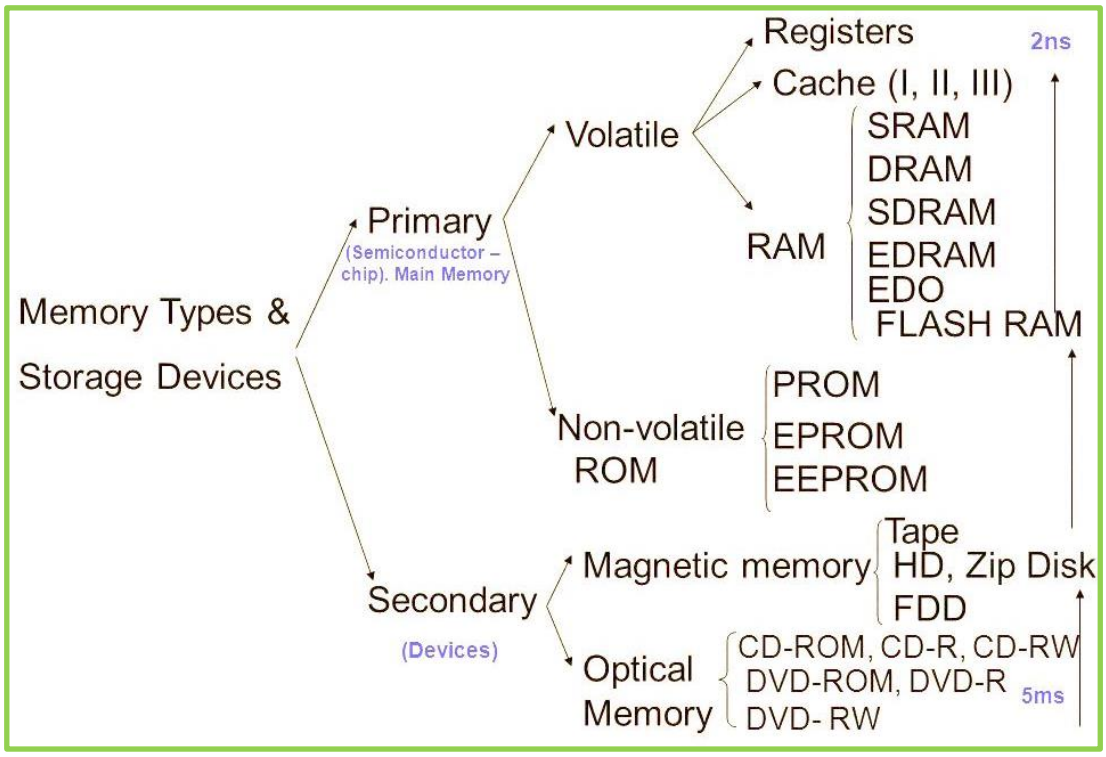
Multi-core processors

A multi-core processor is a single computing component with two or more independent actual processing units (cores), which are units that read and execute program instructions. Therefore, the single processor can run multiple instructions on separate cores at the same time.

Need of multi-core processor

1. Can be run a program by dividing some parts. So it gets executed fast.
2. It enables parallel programming.
3. To get the high performance from a single machine.

Competency Level 2.4: Examines PC memory system to identify different types of memory and their main characteristics.



Volatile memory

Volatile memory is a computer storage that only holds the data while the device is powered. Eg: Register, Cache memory, RAM

Cache memory

Though this is smaller in capasity than other memory, it is faster. This is also called CPU Memory. This acts as the mediator between CPU (Central Processing Unit) and Primary Memory. The data frequently used by are stored here. The Central Processing Unit checks cache memory first to see whether the required data is available for processing. However, if the required data is not available then the data is fetched to cache memory from RAM for processing.

- Level 1 (L1) cache is extremely fast but relatively small, and is usually embedded in the processor chip (CPU).
- Level 2 (L2) cache is often more capacity than L1. It may be located on the CPU or on a separate.
- Level 3 (L3) cache is typically specialized memory that works to improve the performance of L1 and L2. It can be significantly slower than L1 or L2, but is usually double the speed of RAM.

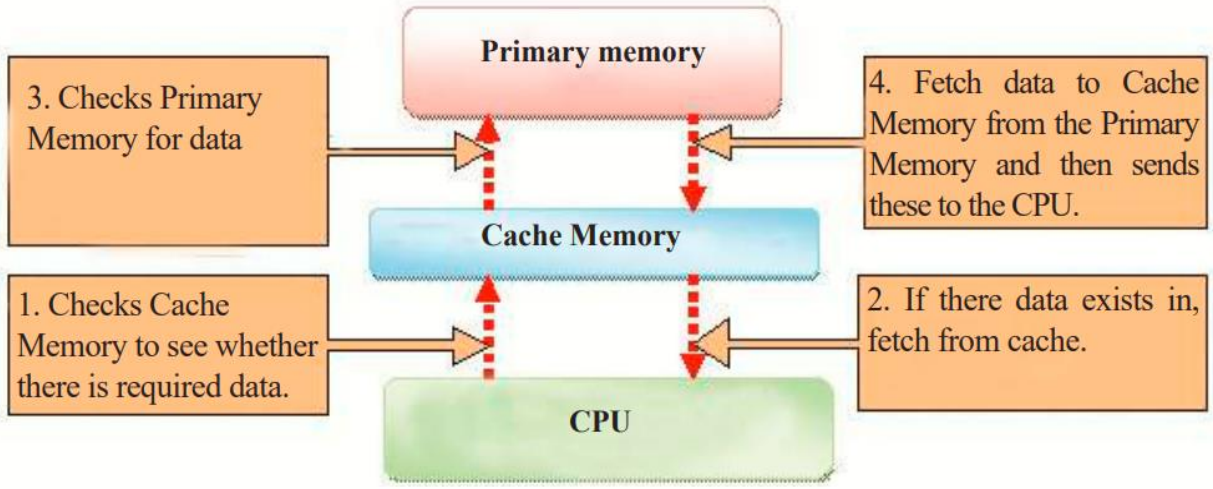


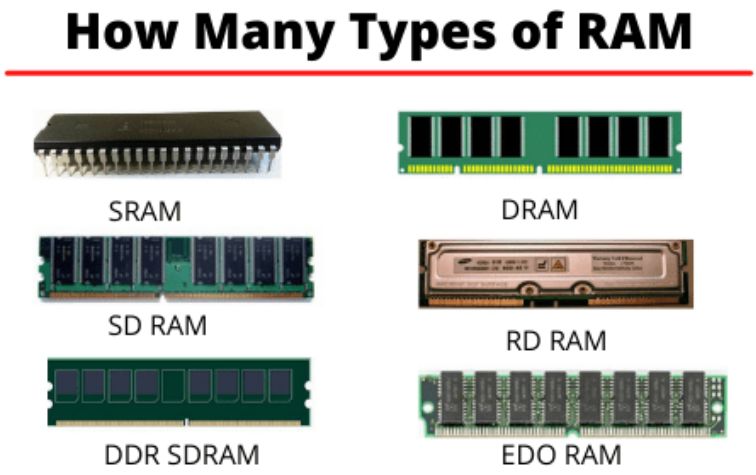
Figure 2.42 - Cache Memory

Random Access Memory (RAM)

RAM is the main memory of the computer that holds data for running applications and required data for a computer. The data stored in RAM will be deleted when the computer is switched off. Therefore this is also called volatile memory. Data coming from input devices as well as data sent to output devices are held in RAM.

Types of RAM

- SRAM – Static RAM SRAM is random access memory that retains data bits in its memory as long as power is being supplied. SRAM is used for cache memory and register memory.
- DRAM – Dynamic RAM This type of RAM is continuously refreshed or it will lose its contents.
- SDRAM - Synchronous DRAM It is a type of memory that synchronizes itself with the computer's system clock.

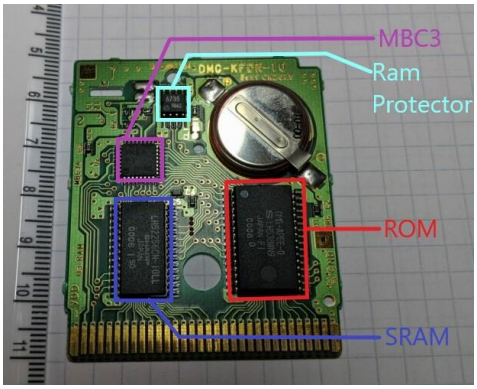


Non-volatile memory

The data in Read Only Memory is not erased when the computer is switched off. Therefore it is a Non-volatile Memory. The commands required for booting up a computer are stored in ROM. These commands are called BIOS (Basic Input Output System). Computer Manufacturing companies store these commands in a ROM with a smaller capacity and is connected to the mother boards.

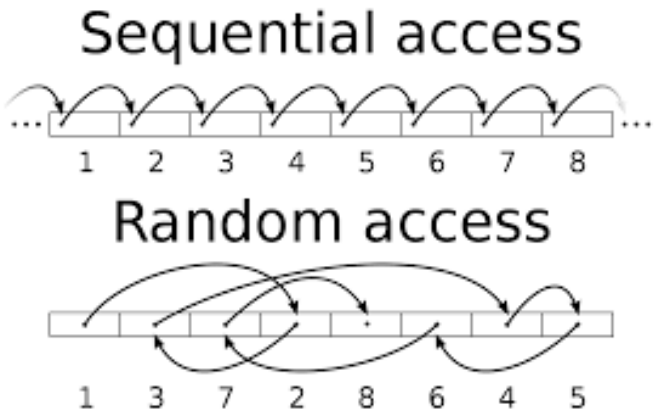
Types of ROM

- PROM (Programmable ROM) It is a memory chip on which data can be written only once. Once a program has been written onto a PROM, it remains there forever.
- EPROM (Erasable PROM) EPROM is a special type of memory that retains its contents until it is exposed to ultraviolet light. The ultraviolet light clears its contents, making it possible to reprogram the memory.
- EEPROM (Electrically Erasable PROM) IT can be erased by exposing it to an electrical charge.



Memory Access methods

- Sequential access Start at the beginning and read through in order. Eg: Tape
- Random access Individual addresses identify directly and access the data immediately, Eg: RAM



Secondary storage

Secondary Memory or the Secondary Storage is the device which stores data and information permanently. This is also called External Storage. There are internal storage devices as well as external portable secondary storage devices. Secondary memory is called non-volatile memory since it does not erase when electricity is not available.

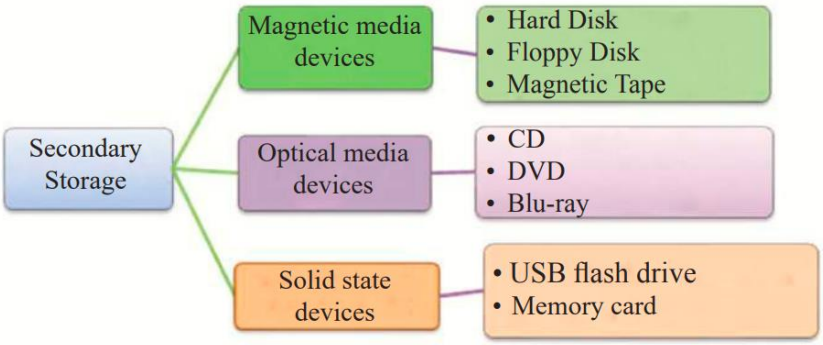


Figure 2.43 - Secondary Memory

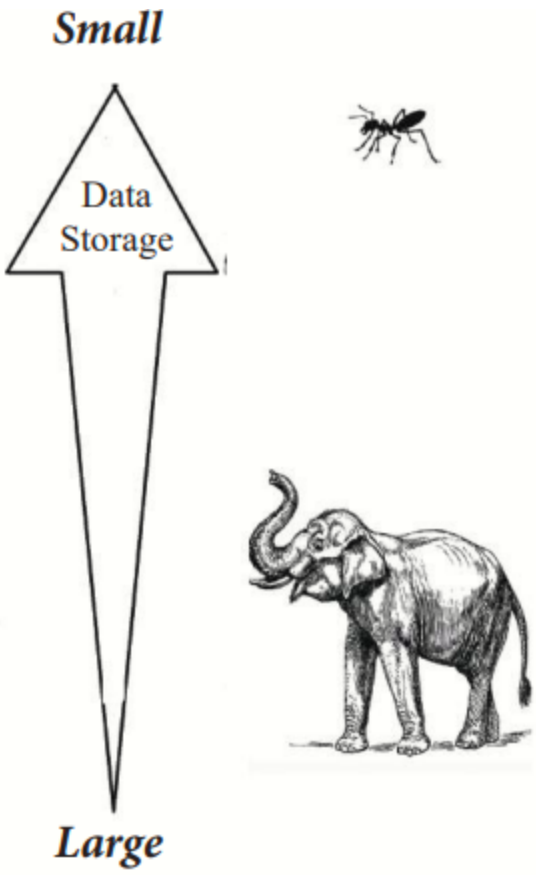
1. **Magnetic storage device** - Magnetic storage is the manipulation of magnetic fields on a medium in order to record audio, video or other data. In main computer storage mechanisms have generally involved a spinning disc or platter and read write heads on an armature. Many types of magnetic storage involve a tape medium ether on a real or in a cassette that is moved by read and write heads. **Eg: Hard disk, Floppy disk, Magnetic tape.**

2. **Optical storage device** - Optical storage is any storage method in which data is written and read with a laser for archival or backup purposes. Typically, data is written to optical media, such as CDs and DVDs. For several years, proponents have spoken of optical storage as a near-future replacement for both hard drives in personal computers and tape backup in mass storage. Optical media is more durable than tape and less vulnerable to environmental conditions. On the other hand, it tends to be slower than typical hard drive speeds, and to offer lower storage capacities. **Eg: CD, DVD, Blu-Ray disc**

3. **Solid state storage** - Solid-state storage (SSS) is a type of computer storage media made from silicon microchips. SSS stores data electronically instead of magnetically, as spinning hard disk drives (HDDs) or magnetic oxide tape do. Solid-state storage can be found in three form factors: solid-state drives (SSD), solid-state cards (SSC) and solid-state modules (SSM). An important advantage of solid-state storage is that it contains no mechanical parts, allowing data transfer to and from storage media to take place at a much higher speed and providing a more predictable lifespan for the storage media. Because there are no moving parts, SSDs produce far less heat than HDDs. Eg: Flash drive, Memory card. **Eg: Flash drive, Memory card**

Capacities of Data Storage Devices

Register Memory
1 KB
Cache memory
3 MB – 32 MB
Compact Disk (CD)
650 – 900 MB
Digital Versatile Disc
4.7 – 9 GB
Random Access Memory
01 – 64 GB
Read Only Memory (ROM)
Flash Memory
1 – 64 GB
Hard Disk
100 GB – 6 TB
Magnetic Tape
1 TB – 185 TB



Data Access Speed

Register Memory
Cache Memory
Random Access Memory
Read Only Memory
Flash Memory
Hard Disk
Digital Versatile Disc – DVD
Compact Disc (CD)
Magnetic Tape