Computer Fundamentals

Learning Objective

- To understand the basic concepts of computer system
- To know the uses of computers in various fields
- To understand the computing process
- To understand the characteristics of computers
- To do the classification of computers
- To discuss the various generations of computers
- To understand the various functions of CPU
- To know the concept of Virtual Memory
- To discuss about Various Memory

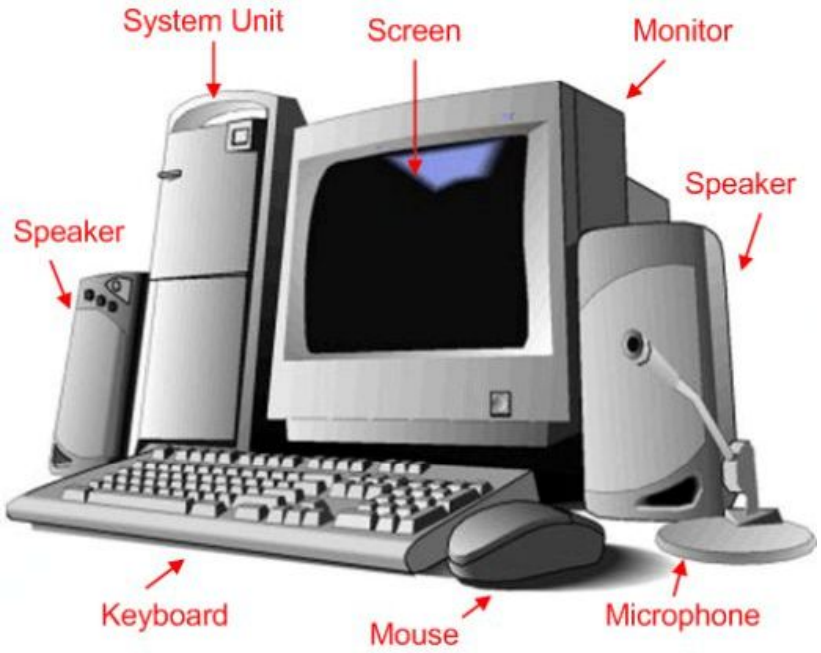
Computer – An Introduction

- In simple terms, computer is an electronic device that can manipulate data.
- Computers are machines that perform tasks or calculations according to a set of instructions, or programs.

A Computer System

Computer – An Introduction

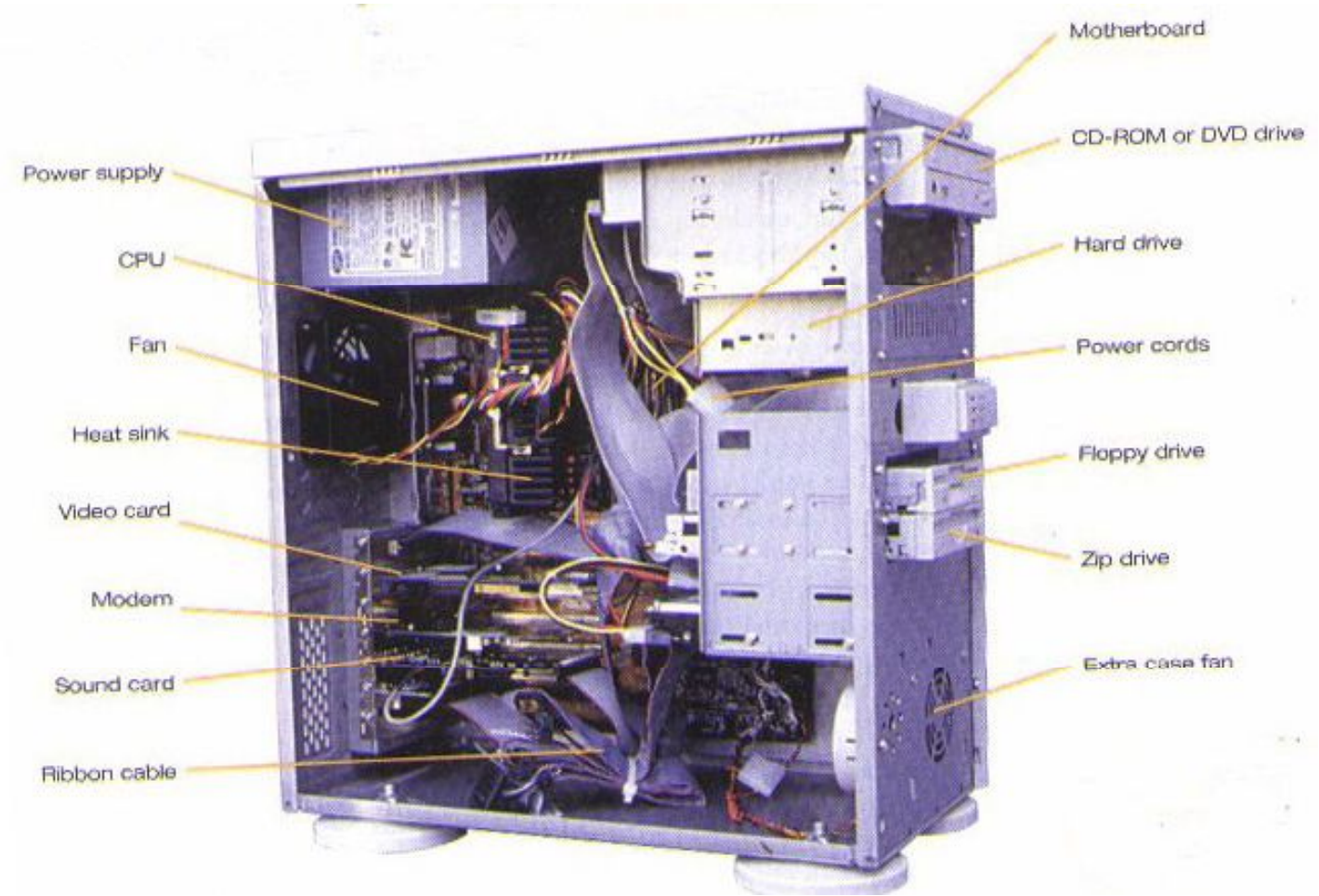
Computers work through an interaction of hardware and software.



Showing Various Hardware

Showing Various Software

Computer – An Introduction

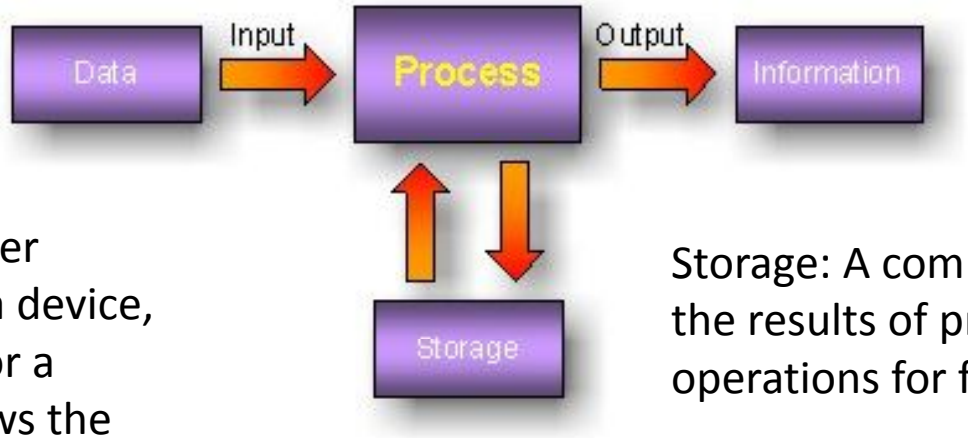


Internal View of Computer Parts

Computer Operations

Input: A computer accepts the data that is provided by means of an input device, such as a keyboard.

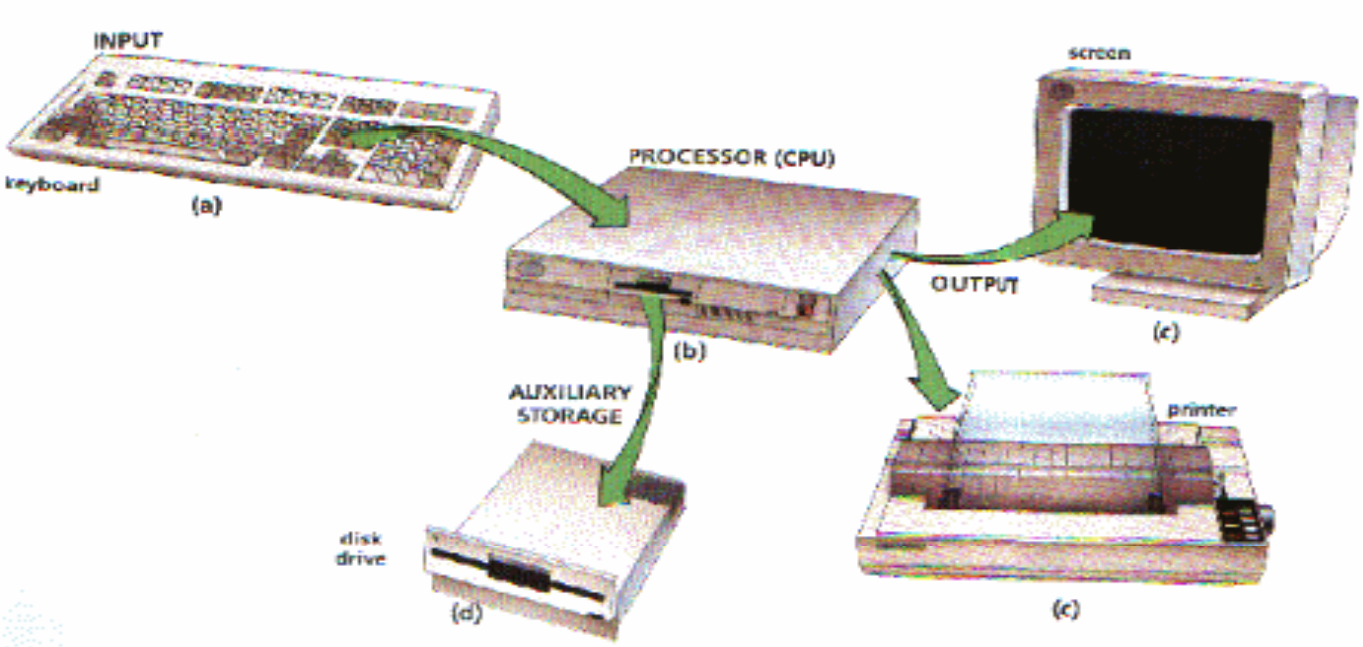
Processing: A computer performs operations on the data to transform it in some way.



Output: A computer produces output a device, such as a printer or a monitor, that shows the results of processing operations.

Storage: A computer stores the results of processing operations for future use.

Input-Process-Output- Storage Cycle



Uses of Computer

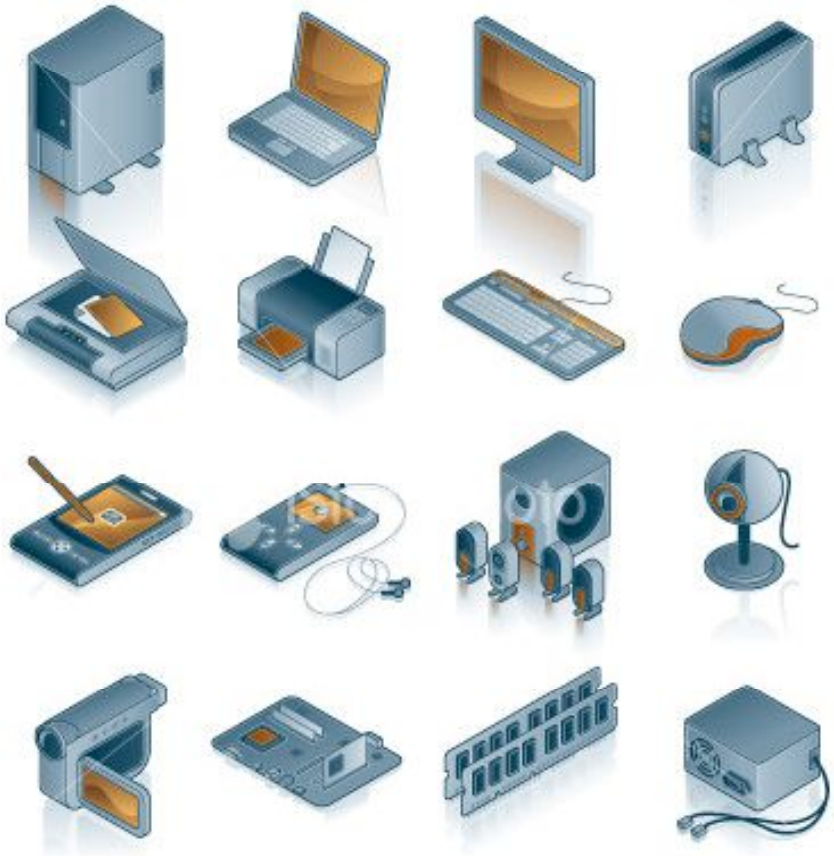
- Playing computer games
- For creating documents, spreadsheets, databases, presentations.
- Solving mathematics
- Looking for information on the Internet
- Watching TV and movies
- Listening to music
- Communicating with other people
- For weather forecasting
- Computers are used in banks, hospitals, military activities, etc.

Computing Process Elements

Computers consists of the following:-

- Hardware
- Software
- Data
- People
- Procedure

Hardware

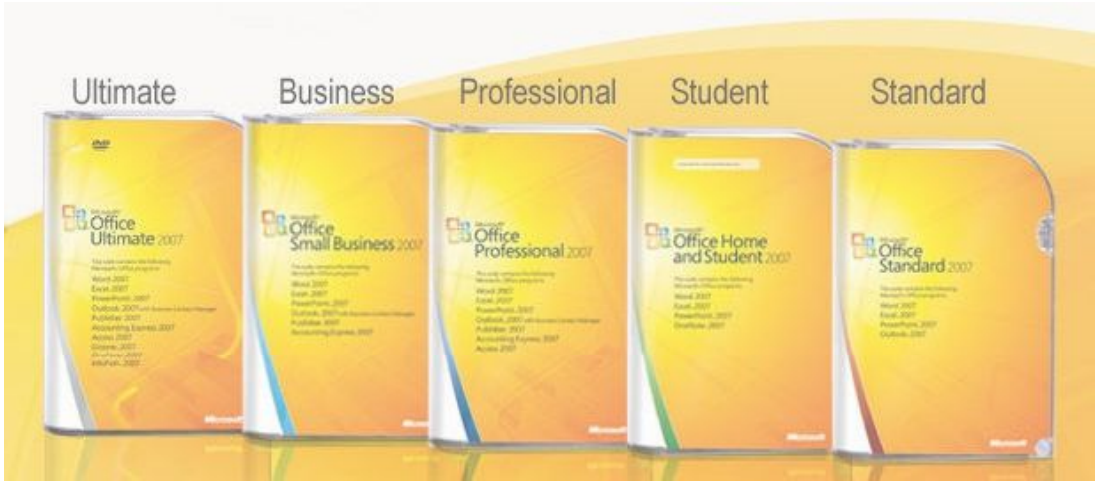


Hardware : The terms hardware refers to the physical part of the computer system.

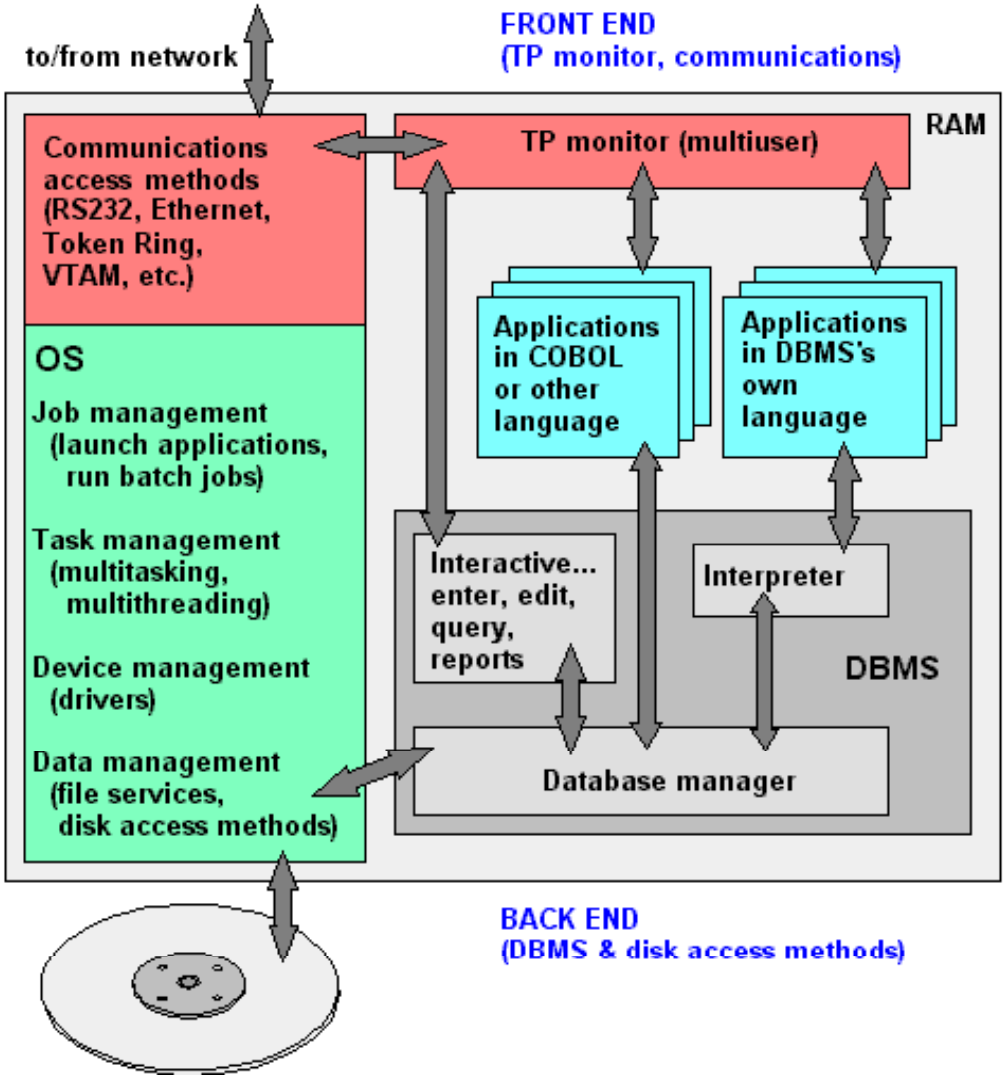
Software

Software: Software is the set of instructions that guides the hardware what to do. Software can be categorized into the following types:-

- System Software
  - Operating System
  - Translators
  - Languages
    - Low Level Languages
    - High Level Languages
- Application Software
  - Generalized Software
  - Customized Software
- Utilities



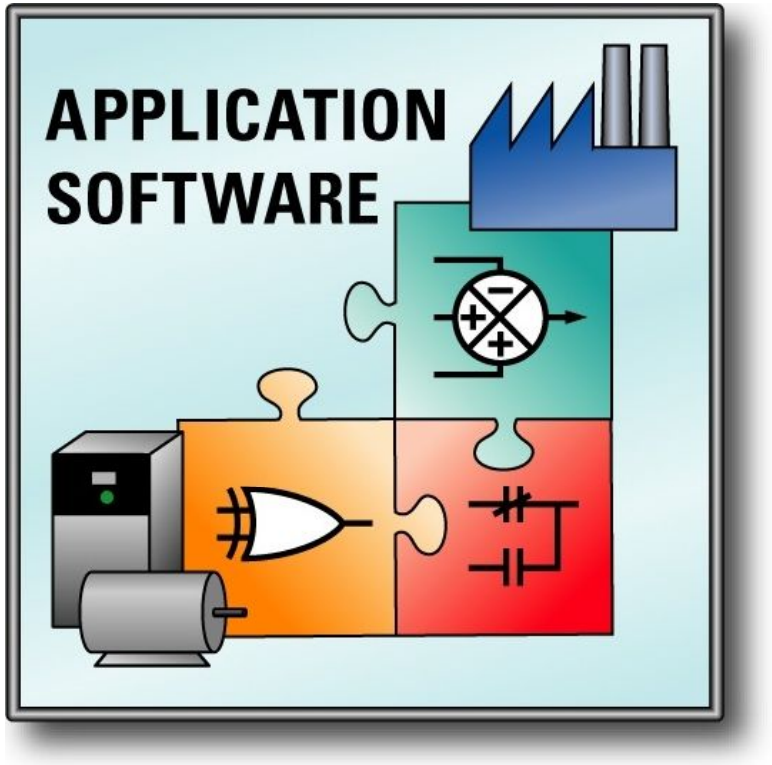
System Software



System software is any computer software that provides the infrastructure over which programs can operate, i.e. it manages and controls computer hardware so that application software can perform.

Application Software

Application software is a computer program that functions and is operated by means of a computer, with the purpose of supporting or improving the software user's work.



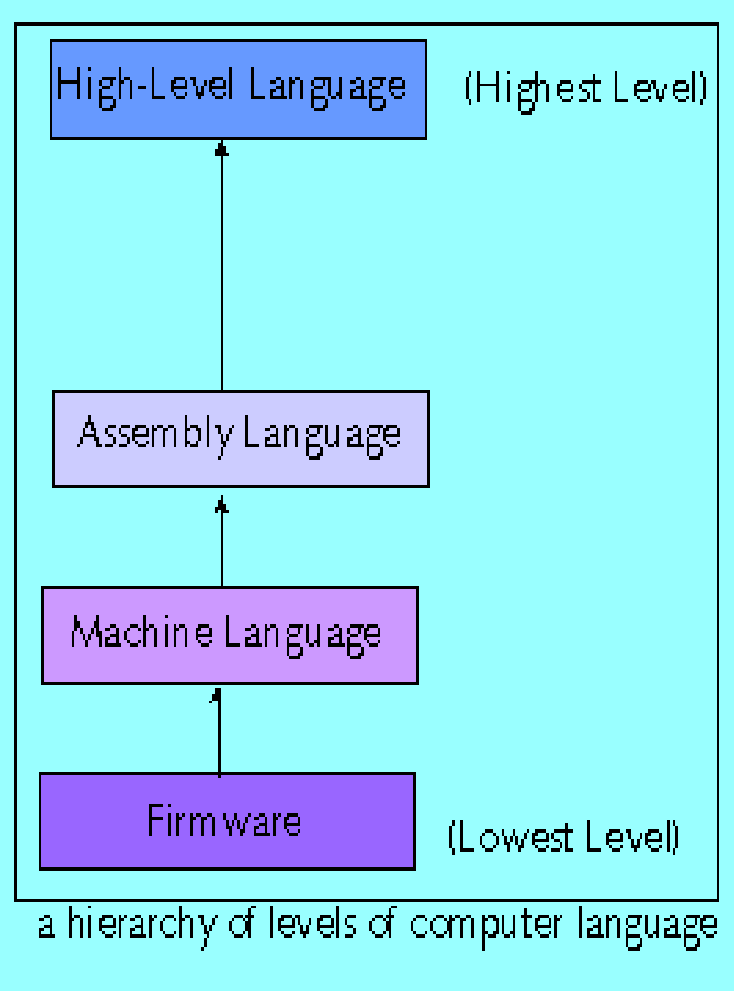
Generalized Software

Generalized software are those software that serves a changing environment. By allowing variable data to be introduced, the program can solve the same problem for different users, types of data or situations.

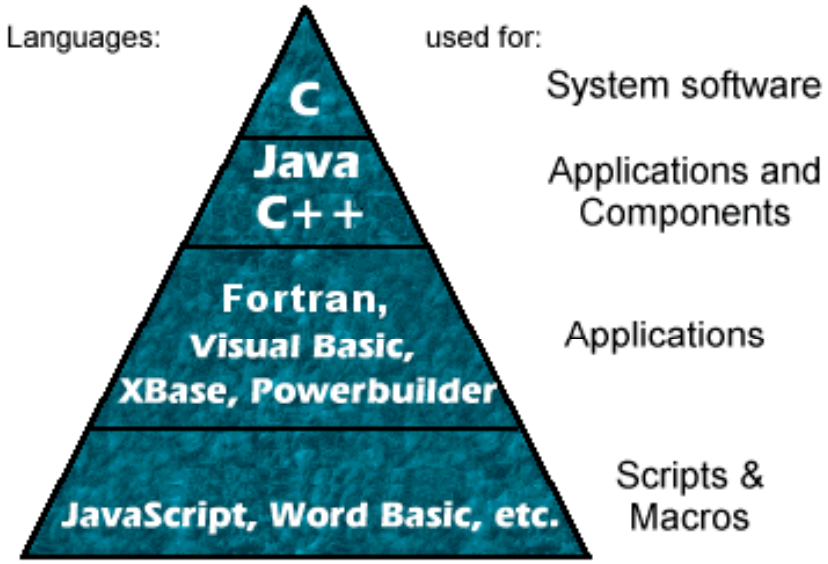
Customized Software

Customized software is a type of software that is developed either for a specific organization or function that differs from already available software. It is generally not targeted to the mass market, but usually created for companies, business entities, and organizations.

Languages



A programming language is an artificial language designed to express computations that can be performed by a machine, particularly a computer.



Low Level Languages

A low-level programming language is a language that provides little or no abstraction from a computer's instruction set architecture. A low-level language does not need a compiler or interpreter to run; the processor for which the language was written is able to run the code without using either of these.

Low-level programming languages are sometimes divided into two categories as follows:-

- First Generation
- Second Generation

1st Generation
Low Level Languages

The first-generation programming language, or 1GL, is machine code. It is the only language a microprocessor can understand directly. Currently, programmers almost never write programs directly in machine code.

Example: A function in 32-bit x86 machine code to calculate the nth Fibonacci number:

```
8B542408  83FA0077  06B80000  0000C383
FA027706  B8010000  00C353BB  01000000
B9010000  008D0419  83FA0376  078BD98B
C84AEBF1  5BC3
```

2nd Generation
Low Level Languages

The second-generation programming language, or 2GL, is assembly language. It is considered a second-generation language because while it is not a microprocessor's native language, an assembly language programmer must still understand the microprocessor's unique architecture (such as its registers and instructions). These simple instructions are then assembled directly into machine code. The assembly code can also be abstracted to another layer in a similar manner as machine code is abstracted into assembly code.

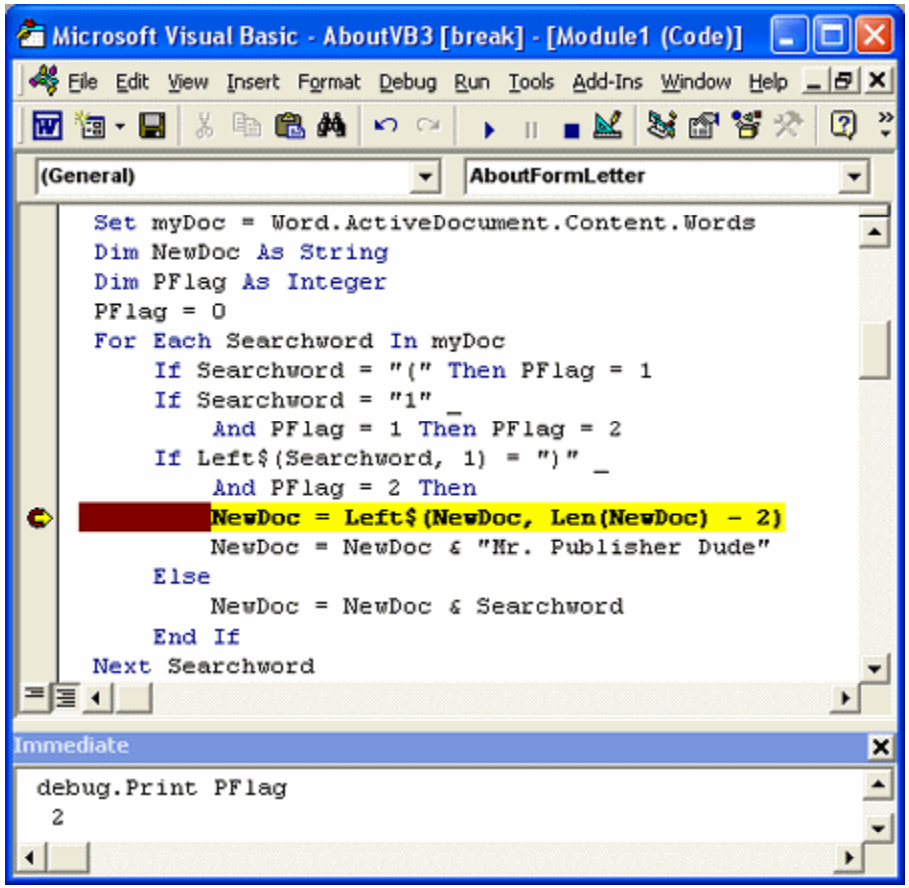
2nd Generation (Example) Low Level Languages

Example: Fibonacci number calculator in x86 assembly language using MASM syntax:

```
fib:
    mov edx, [esp+8]
    cmp edx, 0
    ja @f
    mov eax, 0
    ret

    @@:
    cmp edx, 2
    ja @f
    mov eax, 1
    ret

    @@:
    push ebx
    mov ebx, 1
    mov ecx, 1

    @@:
        lea eax, [ebx+ecx]
        cmp edx, 3
        jbe @f
        mov ebx, ecx
        mov ecx, eax
        dec edx
    jmp @b

    @@:
    pop ebx
    ret
```

A Computer System Showing Assembly Language Programming

High Level Languages



A high-level programming language is a programming language with strong abstraction from the details of the computer. In comparison to low-level programming languages, it may use natural language elements, be easier to use, or be more portable across platforms. Such languages hide the details of CPU operations such as memory access models and management of scope.

Data

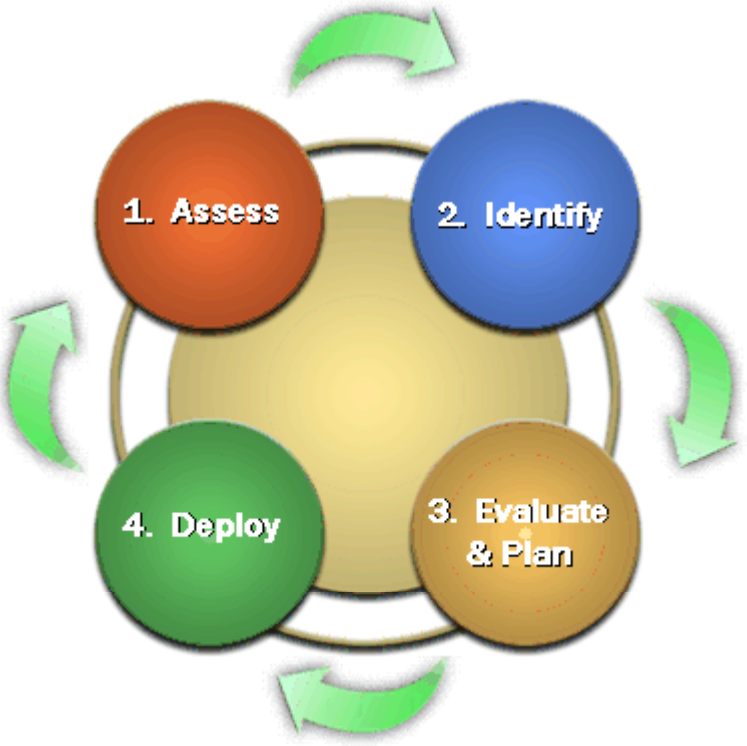
Data : Data is the raw material related with entities and events and their recording as facts and figures. Data is the input to the processing.

Customer Code	Customer Name	Address	Contact	E-mail
C001	Parag	101, Housing Board Colony, Shastri Nagar, N. Delhi		parag@gmail.com
C002	Vinod	150, Shanti Nagar, Hyderabad		vinodh@indiatimes.com
C003	Vishal	110, Prakash Building, Road No. 10, Indore		vishalr@yahoo.com
C004	Sanjay	210, Suresh Manson, Indira Bazar, Calcutta		sanjaykc@lycos.com
C005	Abhishek	333, C-Scheme, Jaipur		abhishek@htc.com

People

People: Most computers require people, who are called users.

Procedure

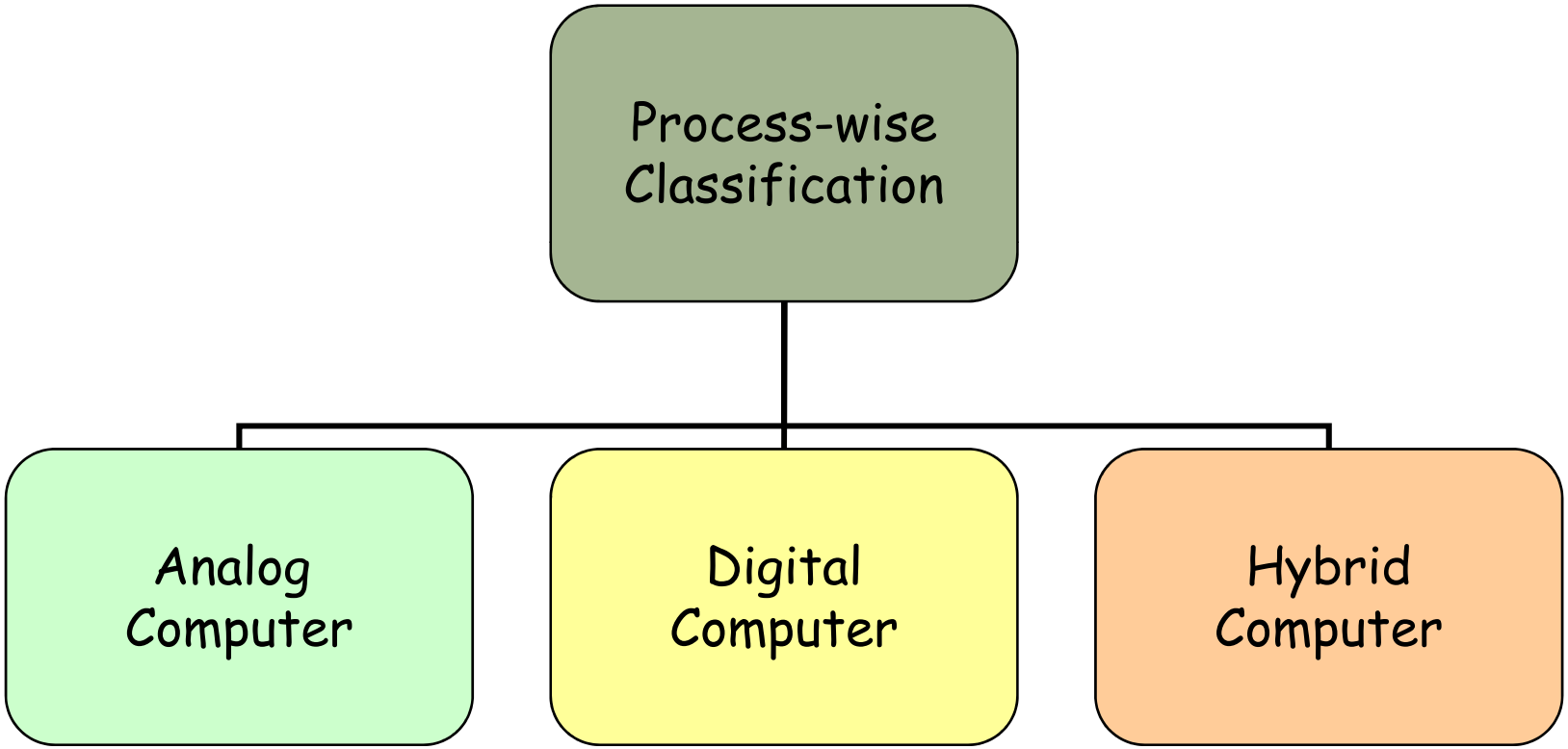


Procedure: Procedures are the steps that one must follow to accomplish a specific computer related task.

Characteristics of Computers

- Computers are fast and can perform hundreds of millions of processing operations in one second.
- Computers are accurate.
- Computers can perform very complex operations.
- Computers can store massive amount of information.
- Computers can move information very quickly from one place to another.

Classification of Computers



Analog Computers

Analog Computers are those computers which deals with analog signals (data). An example of analog computer is ECG (Electro Cardiogram).

An Analog Computer

Digital Computers

Digital computers are those computers which deals with digital data i.e., ‘1’ and ‘0’. An example of digital computer is Personal computer, laptop, etc.

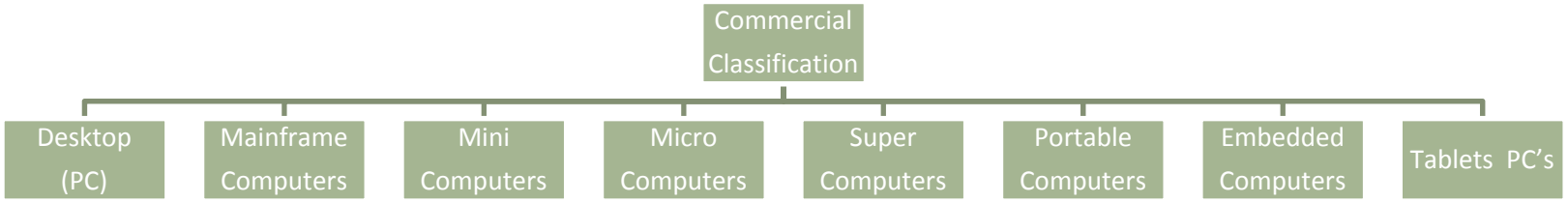
Showing Digital Data

Hybrid Computers

Hybrid computers are those computers which are combination of analog computer and digital computer. An example of hybrid digital computer is Super computer.

A Hybrid Computer

Classification of Computers



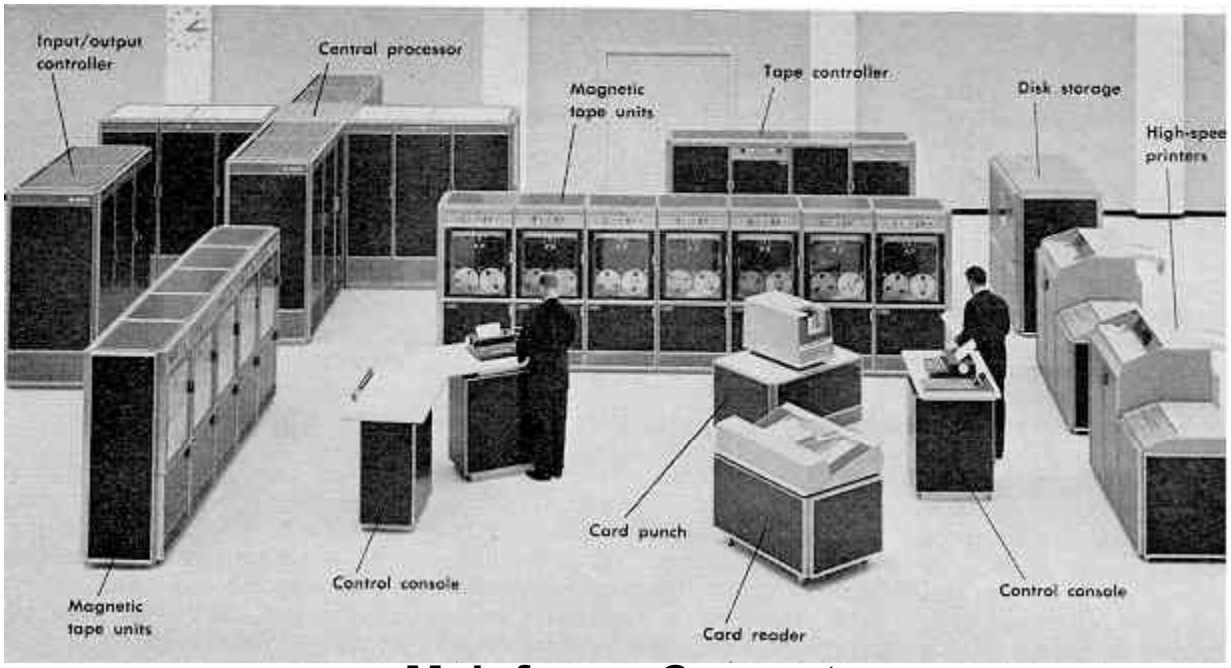
Desktop Computer

Desktop computer is a computer which is also called Personal Computer. Desktop computers are normally used by end users for performing simple as well as complex operations.

A Desktop Computer (PC)

Mainframe Computer

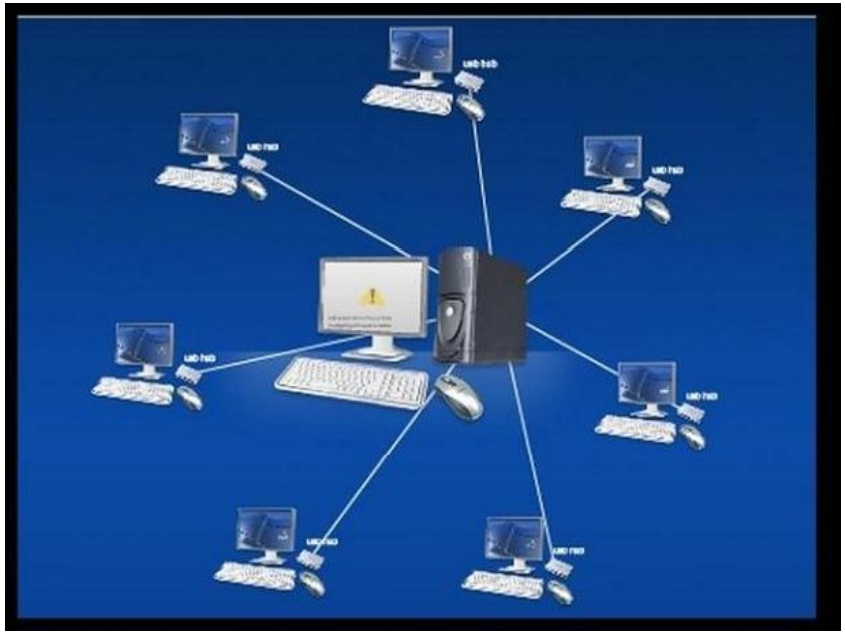
Mainframe computers are those computers which have multiprocessing and multiprogramming capabilities and they are composed of many computers. Mainframe computer systems are powerful enough to support several hundred users simultaneously at remote terminals.



Mainframe Computer

Mini Computers

Mini computers are those computers which are similar to mainframes but smaller in scaling. Mini computer can accommodate remote users, but mini computer are slightly less storage, and the processing is relatively slower as compared to mainframe computer.



Miniframe Computer

Micro Computer

Micro computers are those computers which are workstations. They use RISC (Reduced Instruction Set Computer) microprocessors. RISC processors are particularly useful in special purpose applications, such as graphics, in which speed is critical.

A Micro Computer

A Microprocessor

Super Computer

Super computers are those computers which are largest, fastest, most powerful, and most expensive computers. Super computers are used primarily for scientific applications that are mathematical intensive. workstations. The aerospace, automotive, chemical, electronics, and petroleum industries uses supercomputers extensively.

A Super Computer

Portable Computer

Portable computers are those computers which are smaller in size with good processing power and storage as micro computers and even workstation. Some of the examples of portable computers are laptop, palmtop, Personal Digital Assistants, etc.

Palmtop Computer

Laptop Computer

PDA
(Personal Digital Assistant)

Embedded Computer

Embedded computers are those computers which are built into special purpose devices, such as video game players, microwave ovens, washing machines, wrist watches, etc. They control the working and operation of electro-mechanical machine.

Embedded Computer

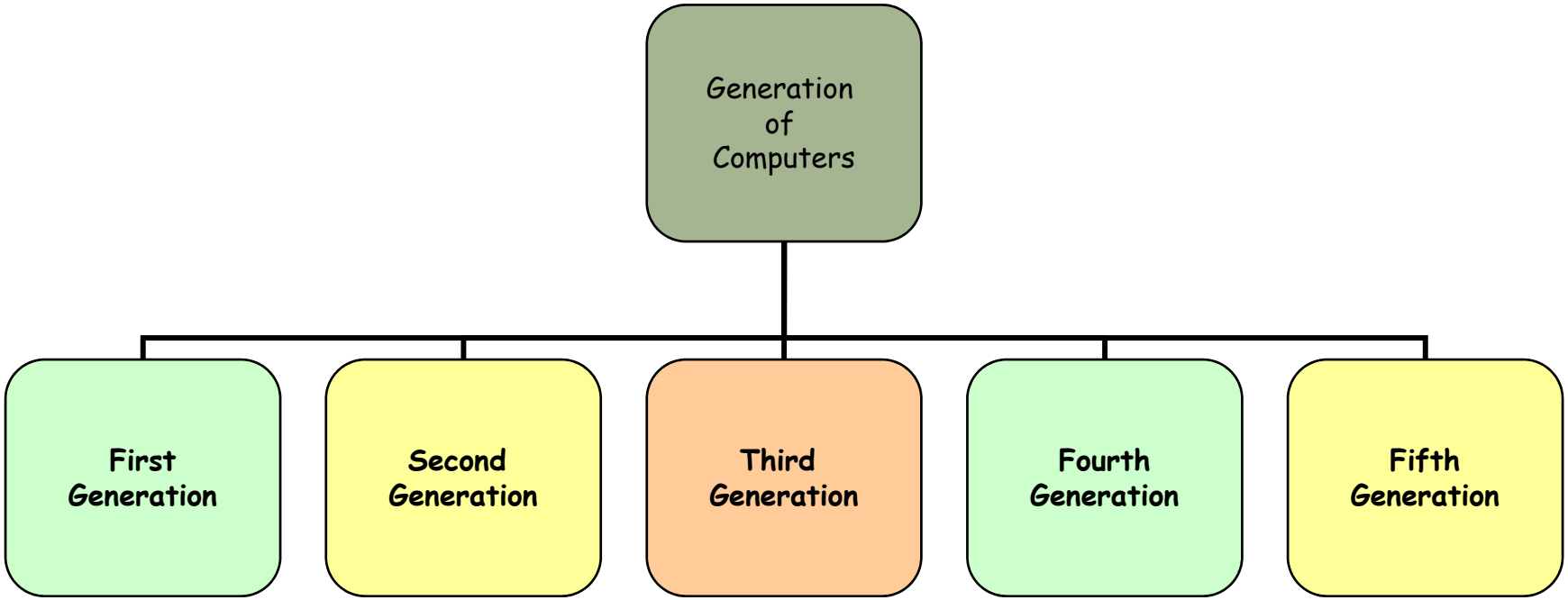
Tablet PC's

Tablet PCs are mobile PCs that combine features of laptops and handhelds. Like laptops, they're powerful and have a built-in screen. Like handhelds, they allow you to write notes or draw pictures on the screen, usually with a tablet pen instead of a stylus. They can also convert your handwriting into typed text. Some Tablet PCs are "convertibles" with a screen that swivels and unfolds to reveal a keyboard underneath.

Tablet PC

Generation of Computers

Based on the characteristics of various computers developed from time to time, they are categorized as generation of computers.



First Generation Computers

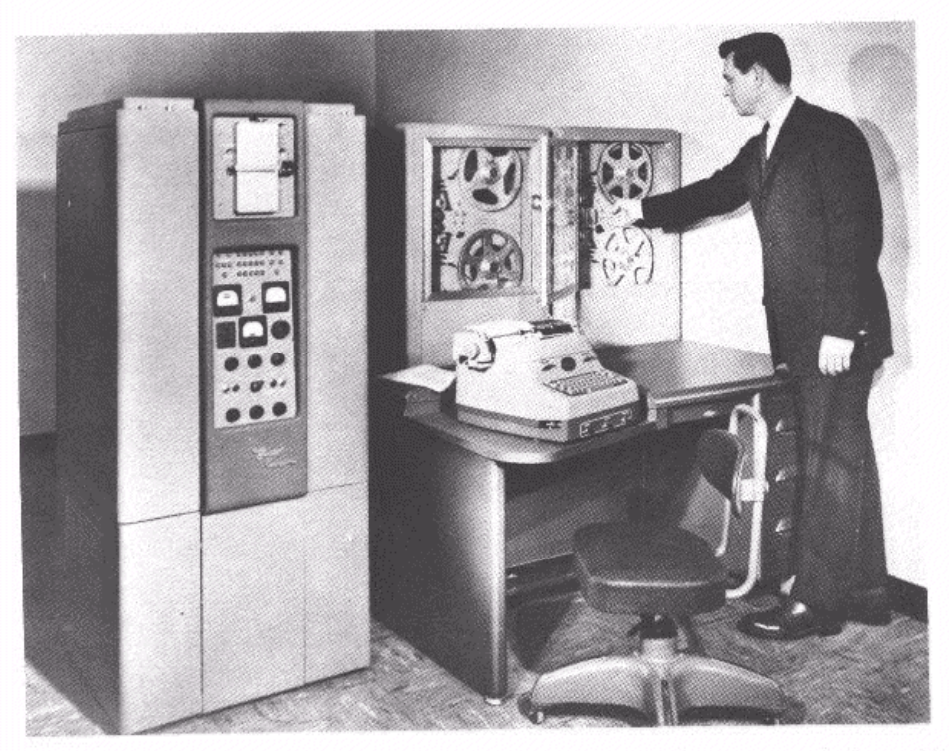
Time Period : 1951 to 1959 Technology : Vacuum Tubes
Size : Very Large System Processing : Very Slow

First Generation Computers

Characterized By:-
Magnetic Drums
- Magnetic Tapes
- Difficult to program
- Used machine language & assembly language

Second Generation Computers

Time Period : 1959 to 1963 Technology : Transistors
Size : Smaller Processing : Faster



Second Generation Computers

Characterized By:-

- Magnetic Cores
- Magnetic Disk
- Used high level language
- Easier to program

Third Generation Computers

Time Period	: 1963 to 1975
Technology	: ICs (Integrated Circuits) Incorporated many transistors & electronic circuits on a single chip
Size	: Small as compared to 2nd generation computers
Processing	: Faster then 2nd generation computers

IC (Integrated Circuit)

Characterized by:-

- Minicomputers accessible by multiple users from remote terminals.

Fourth Generation Computers

Time Period : 1975 to Today
Technology : VLSI (Very Large Scale Integration)
Incorporated many millions of transistors & electronic circuits on a single chip
Size : Small as compared to first generation computer
Processing : Faster then first generation computer

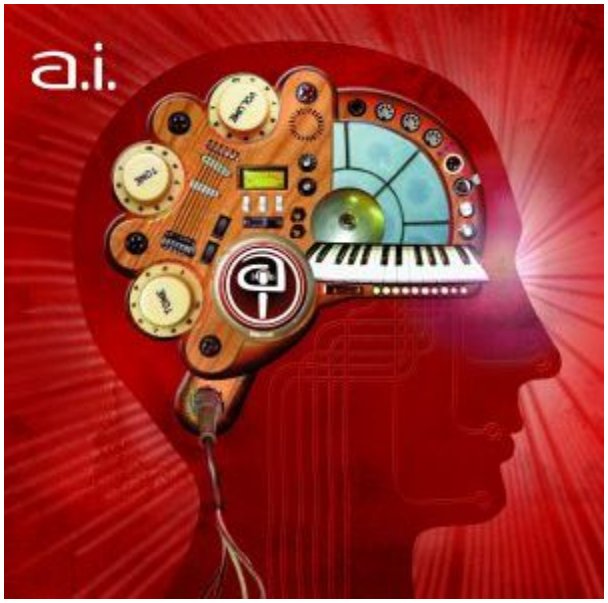
VLSI (Very Large Scale Integration)

Characterized by:
The personal computer and user friendly micro-programs, very fast processor chip high level language, OOP (Object Oriented Programming)

Fifth Generation Computers

Time Period : Future Technology
Technology : AI (Artificial Intelligence) and ULSI

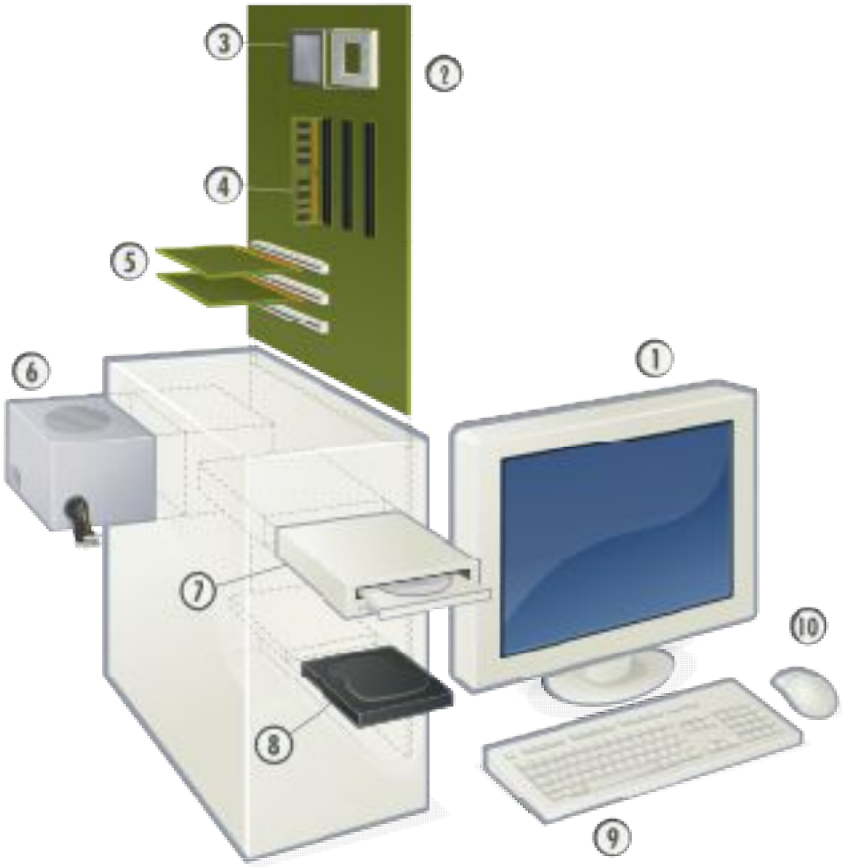
Fifth Generation Computer



AI (Artificial Intelligence)

Typical PC Hardware

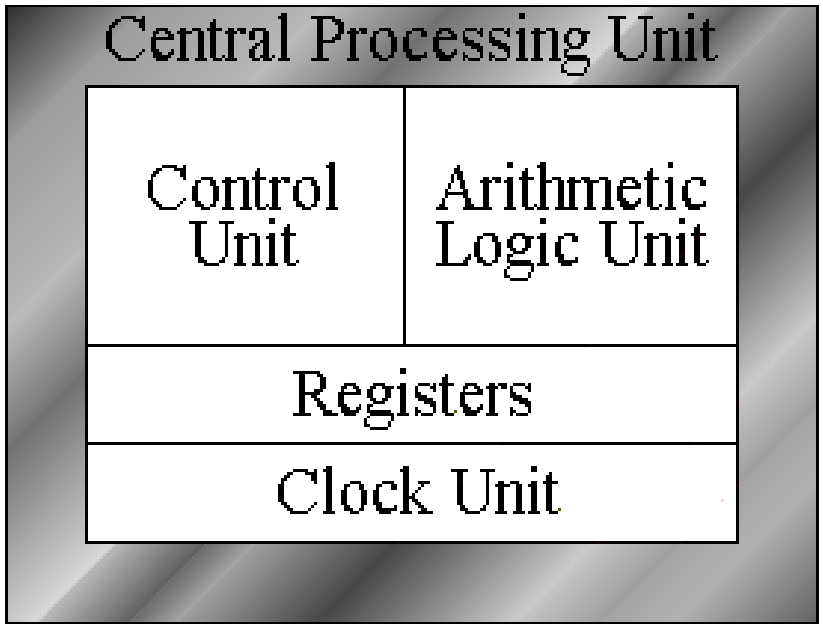
A computer is really a system of many parts working together. The physical parts, which you can see and touch, are collectively called hardware.



Hardware of PC:-

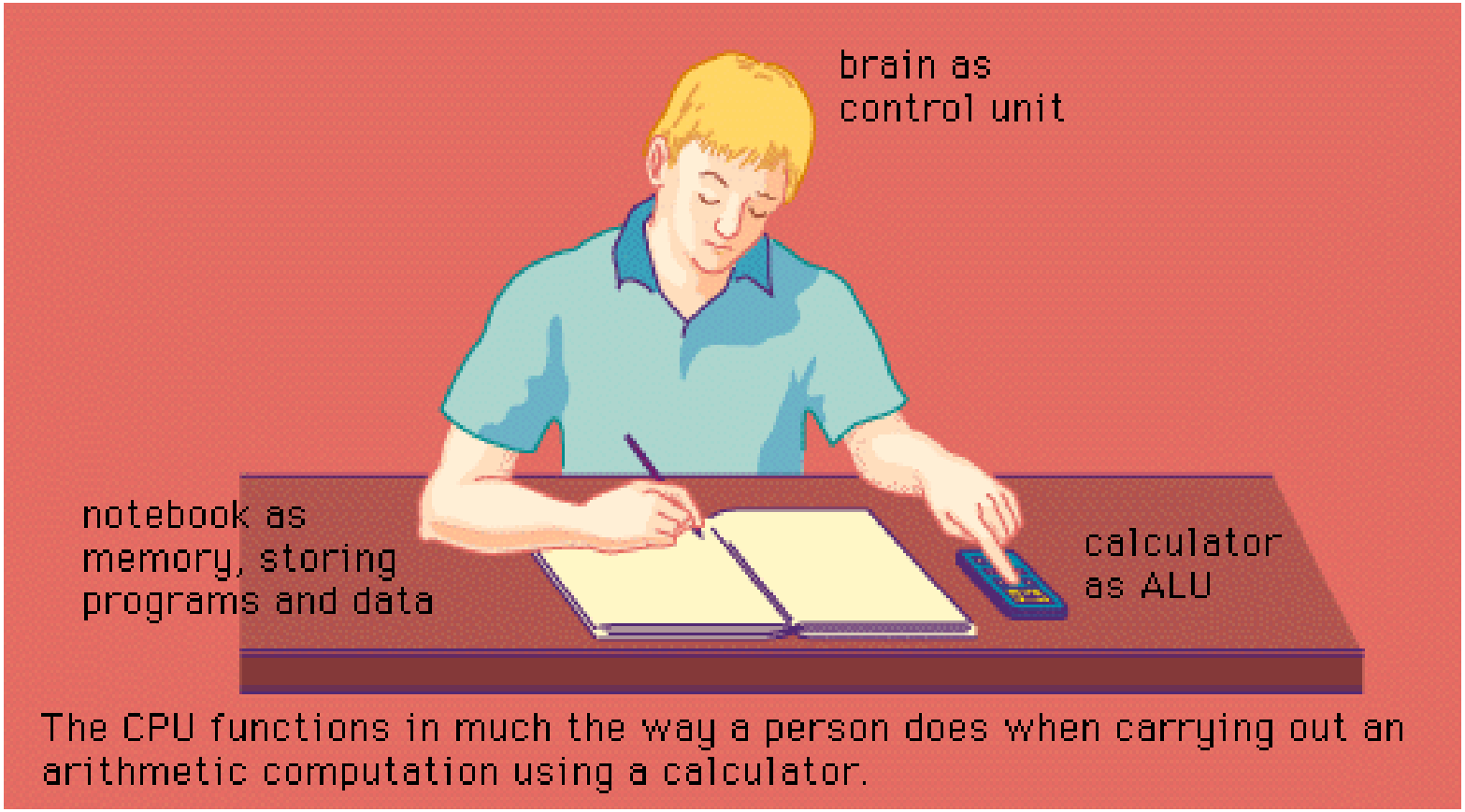
1. Monitor
2. Motherboard
3. CPU
4. RAM Memory
5. Expansion card
6. Power supply
7. CD-ROM Drive
8. Hard Disk
9. Keyboard
10. Mouse

CPU



- The Central Processing Unit is a brain or calculator (CPU) or processor is the portion of a computer system that carries out the instructions of a computer program, and is the primary element carrying out the computer's functions.
- It controls all internal and external devices, performs arithmetic and logic operations.
- It interprets and carries out, or processes, instructions and data contained in the software.

Explaining CPU
(A Real Life Example)



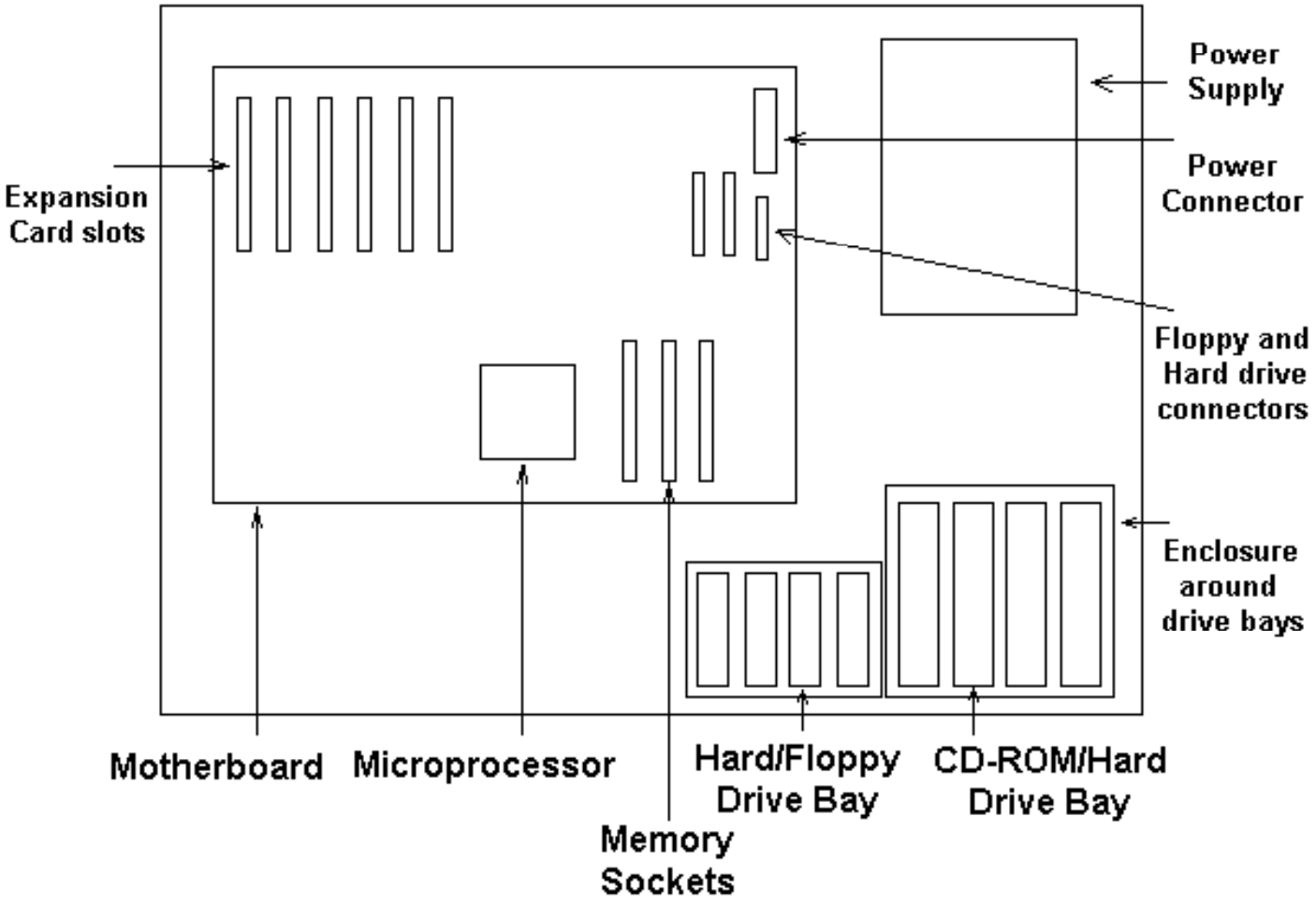
The CPU functions in much the way a person does when carrying out an arithmetic computation using a calculator.

CPU Operation

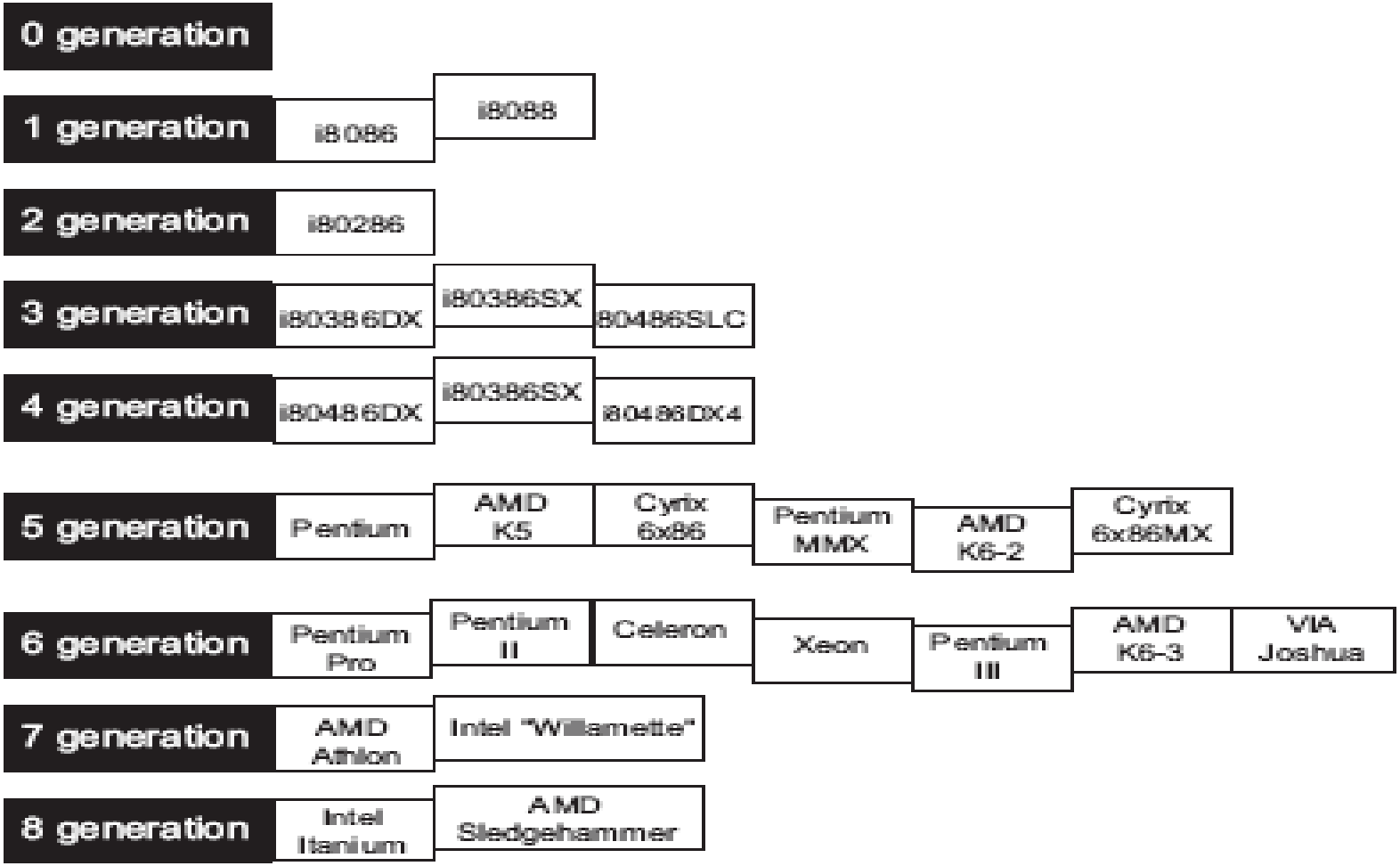
The fundamental operation of most CPUs is to execute a sequence of stored instructions called a program. The program is represented by a series of numbers that are kept in some kind of computer memory. There are four steps that nearly all CPUs use in their operation: fetch, decode, execute, and write back.

Step 1: The first step, fetch, involves retrieving an instruction from program memory.
Step 2: the decode step, the instruction is broken up into parts that have significance to other portions of the CPU.
Step 3: the execute step is performed during which the various portions of the CPU are connected so they can perform the desired operation.
Step 4: The final step, writeback, simply "writes back" the results of the execute step to some form of memory.

Inside the Case (Computer Cabinet)



Processors


0 generation
1 generation
i8086
i8088
2 generation
i80286
3 generation
i80386DX
i80386SX
80486SLC
4 generation
i80486DX
i80386SX
i80486DX4
5 generation
Pentium
AMD K5
Cyrix 6x86
Pentium MMX
AMD K6-2
Cyrix 6x86MX
6 generation
Pentium Pro
Pentium II
Celeron
Xeon
Pentium III
AMD K6-3
VIA Joshua
7 generation
AMD Athlon
Intel "Willamette"
8 generation
Intel Itanium
AMD Sledgehammer

Processor Manufacturer

American Micro Devices (AMD)

Intel

IBM

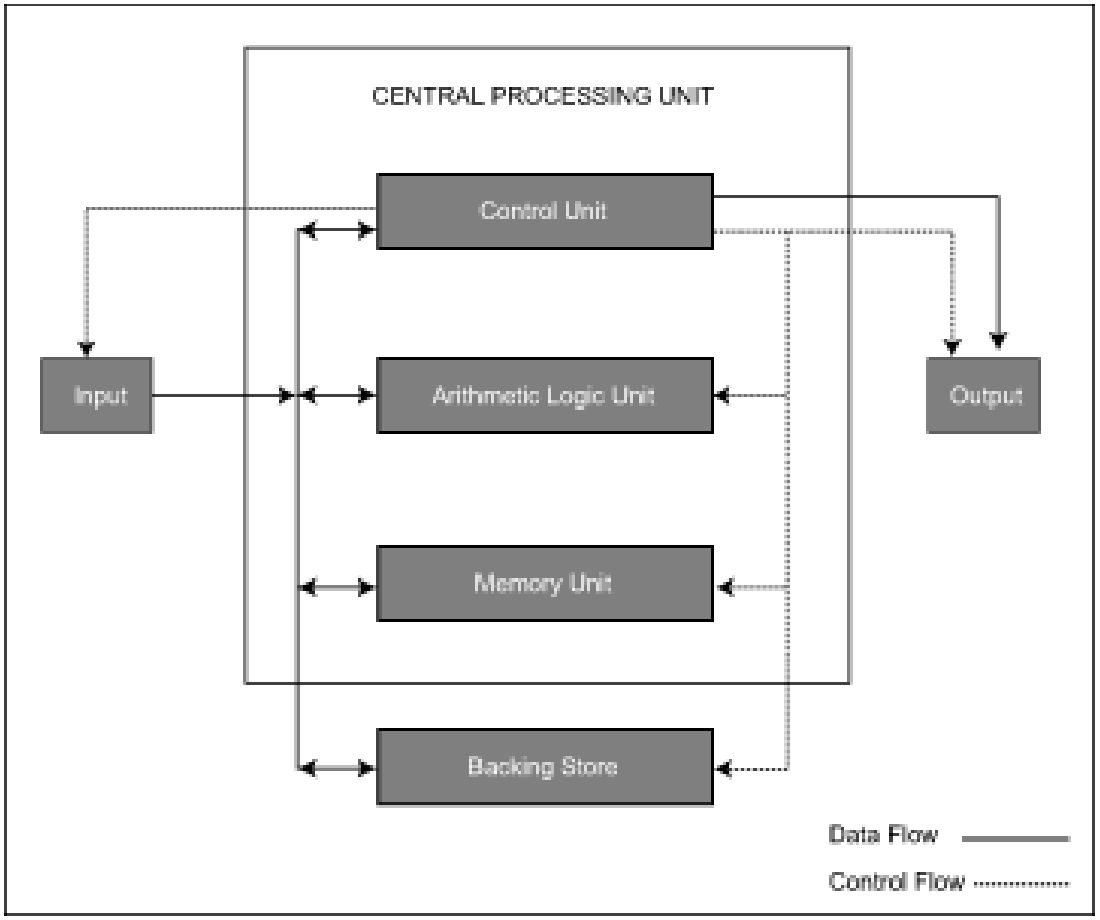
Motorola

Cyrix

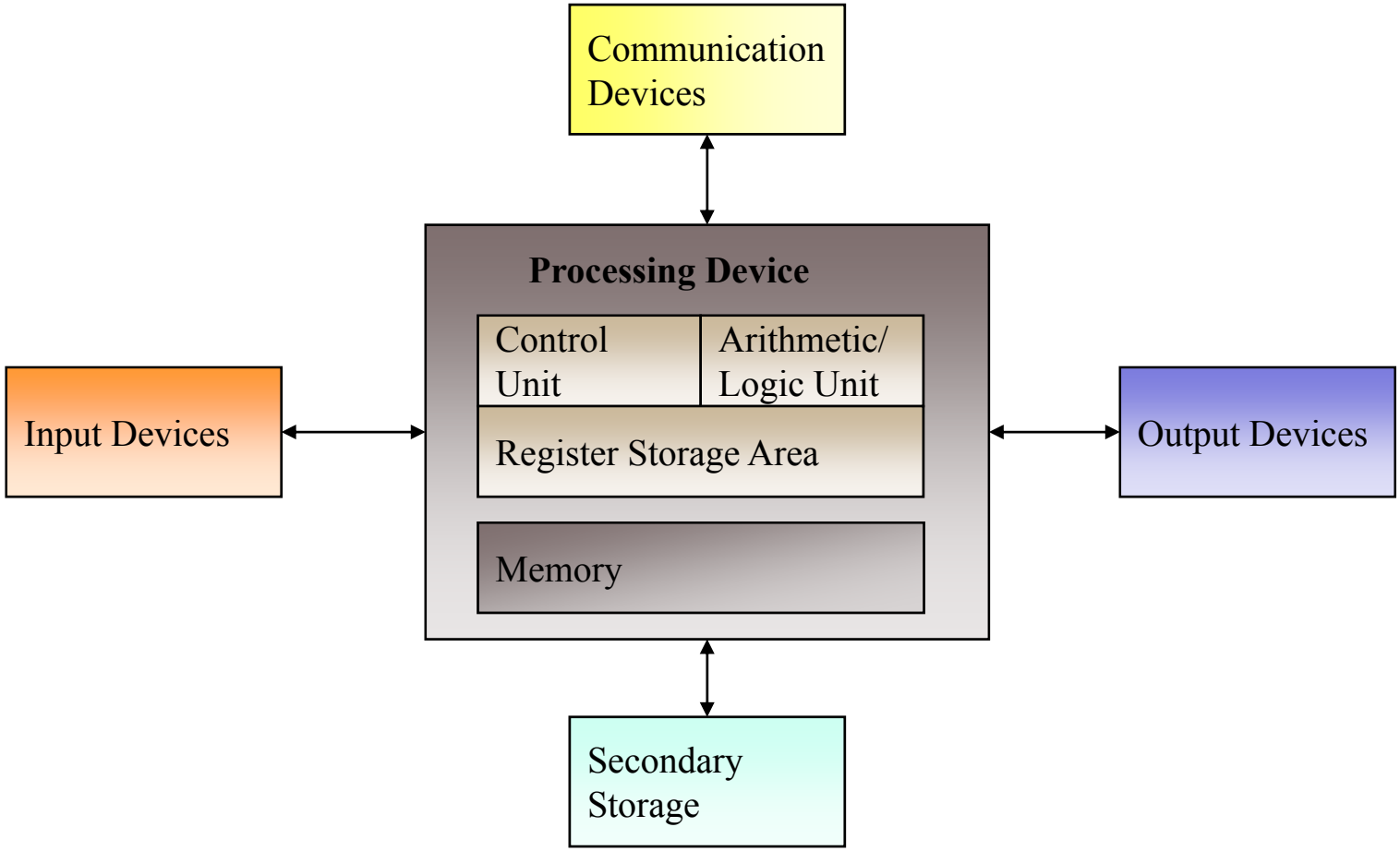
Texas Instruments

Functions of CPU

The CPU carries out instructions and tells the rest of the computer system 'what to do'. This is done by the Control Unit of the CPU which sends command signals to the other components of the system, as shown in Fig

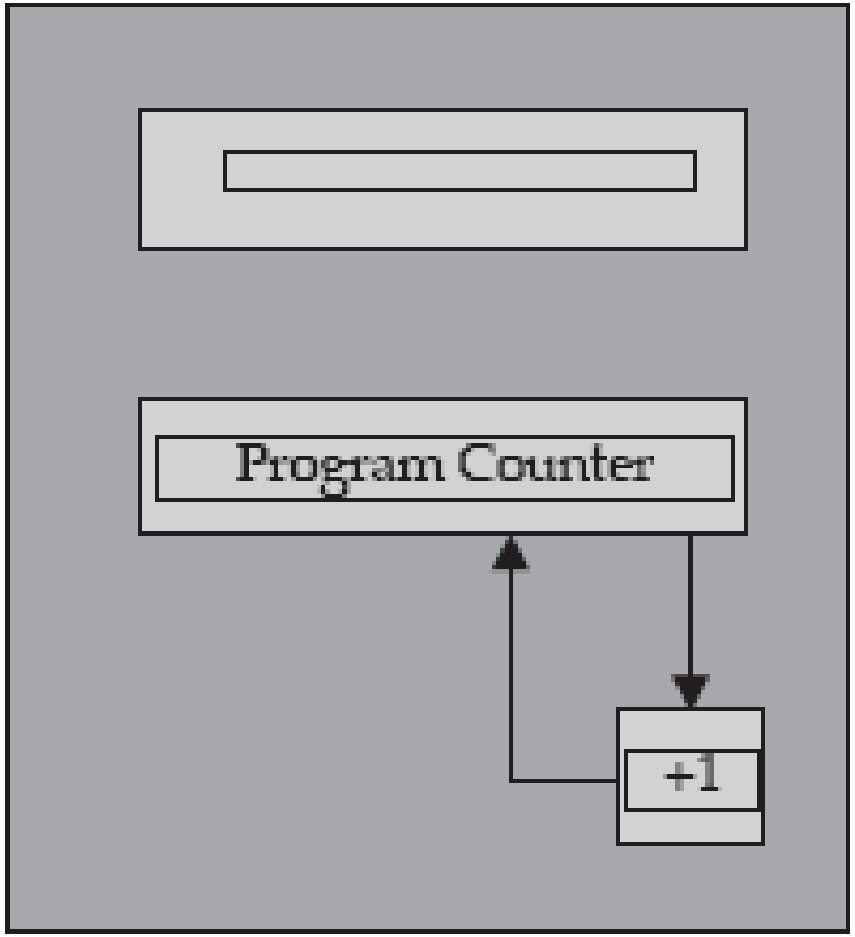


Computer Organization
(Specialized Approach)



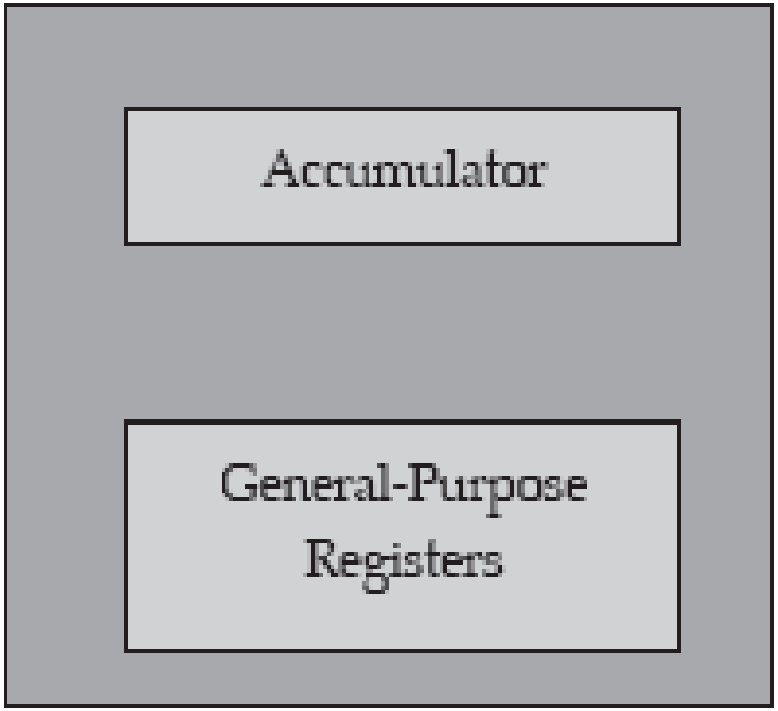
Control Unit

- The control unit directs the entire computer system to carry out stored program instructions. The control unit must communicate with both the arithmetic logic unit and main memory. The control unit uses the instruction contained in the Instruction Register to decide which circuits need to be activated. Specialized electronic circuitry in the control unit is designed to decode program instructions held in the main memory.

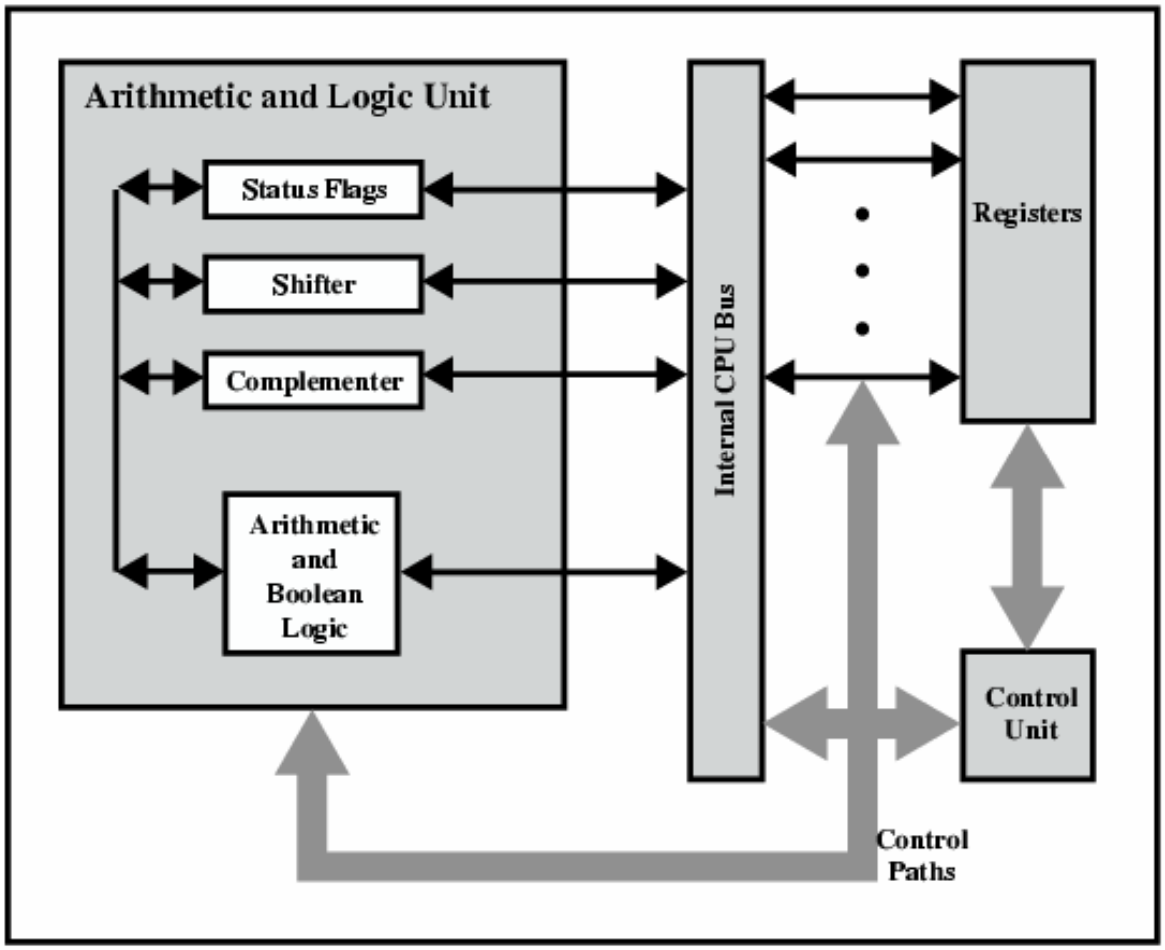


Arithmetic Logical Unit

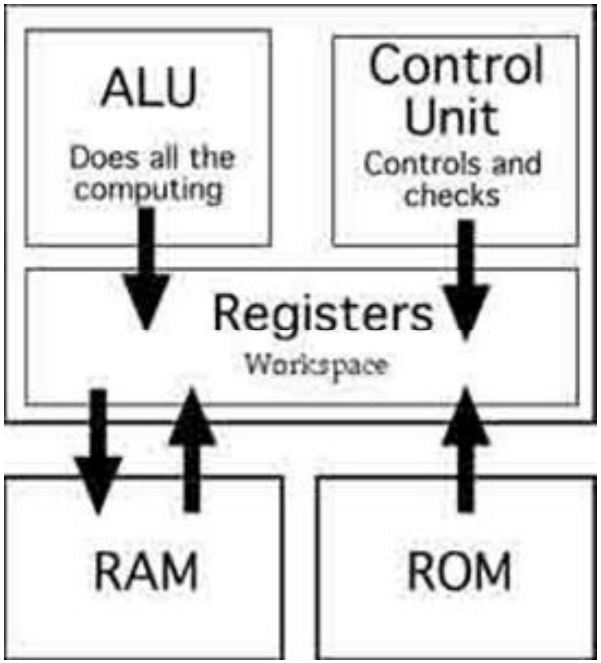
- The arithmetic and logic unit (ALU) is the part where actual computations take place. It consists of circuits which perform arithmetic operations (e.g. addition, subtraction, multiplication, division) over data received from memory and capable to compare numbers.
  - While performing these operations the ALU takes data from the temporary storage area inside the CPU named registers.



Diagrammatic View of Arithmetic Logical Unit



Registers



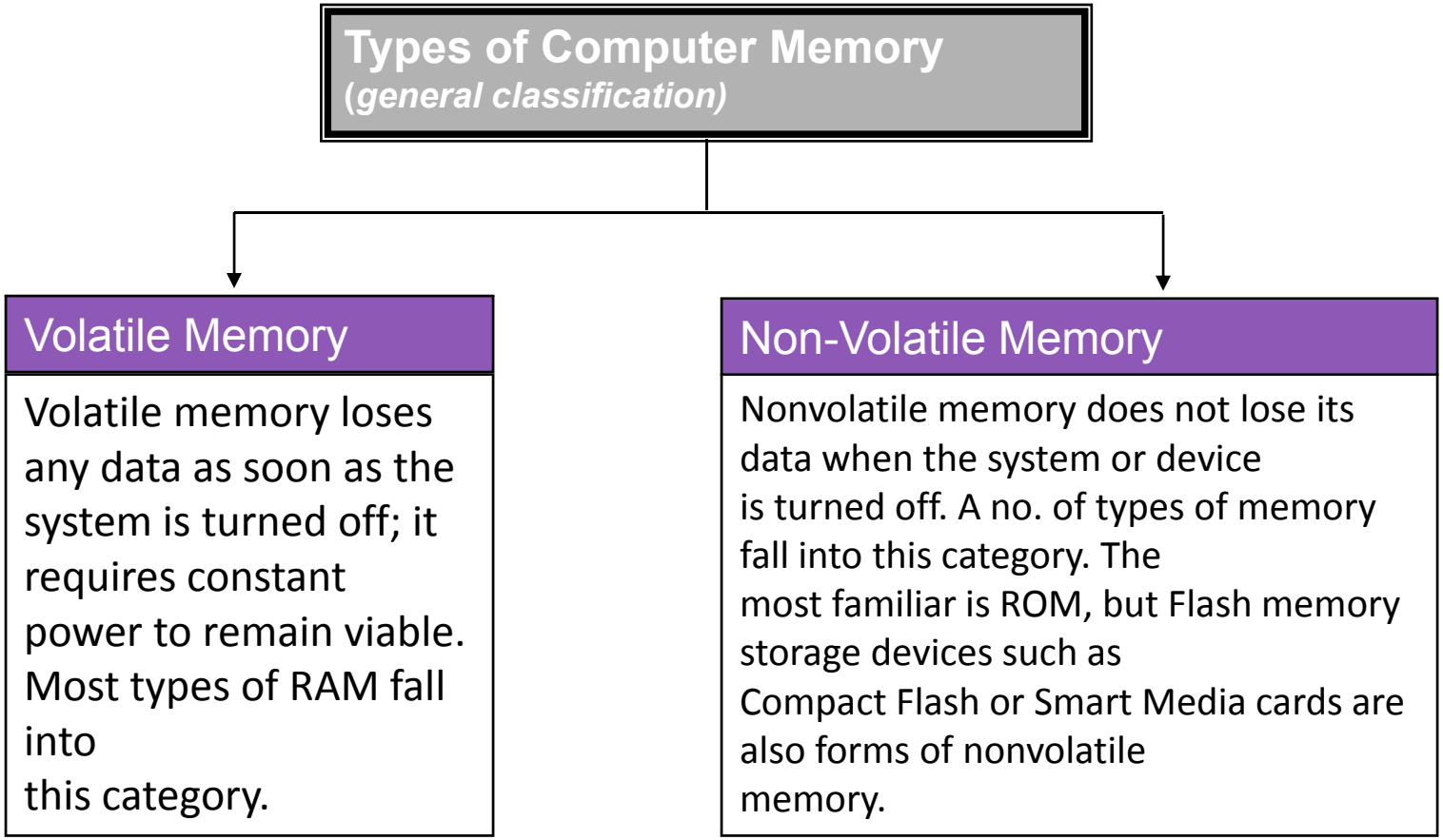
- Registers are a small amount of memory locations built into the CPU.
- Registers are a group of cells used for memory addressing, data manipulation and processing.
- Some of the registers are general purpose and some are reserved for certain functions.
- It is a high-speed memory which holds only data for immediate processing and results of this processing.
- If these results are not needed for the next instruction, they are sent back to the main memory and registers are occupied by the new data used in the next instruction.

Types of Memory Unit

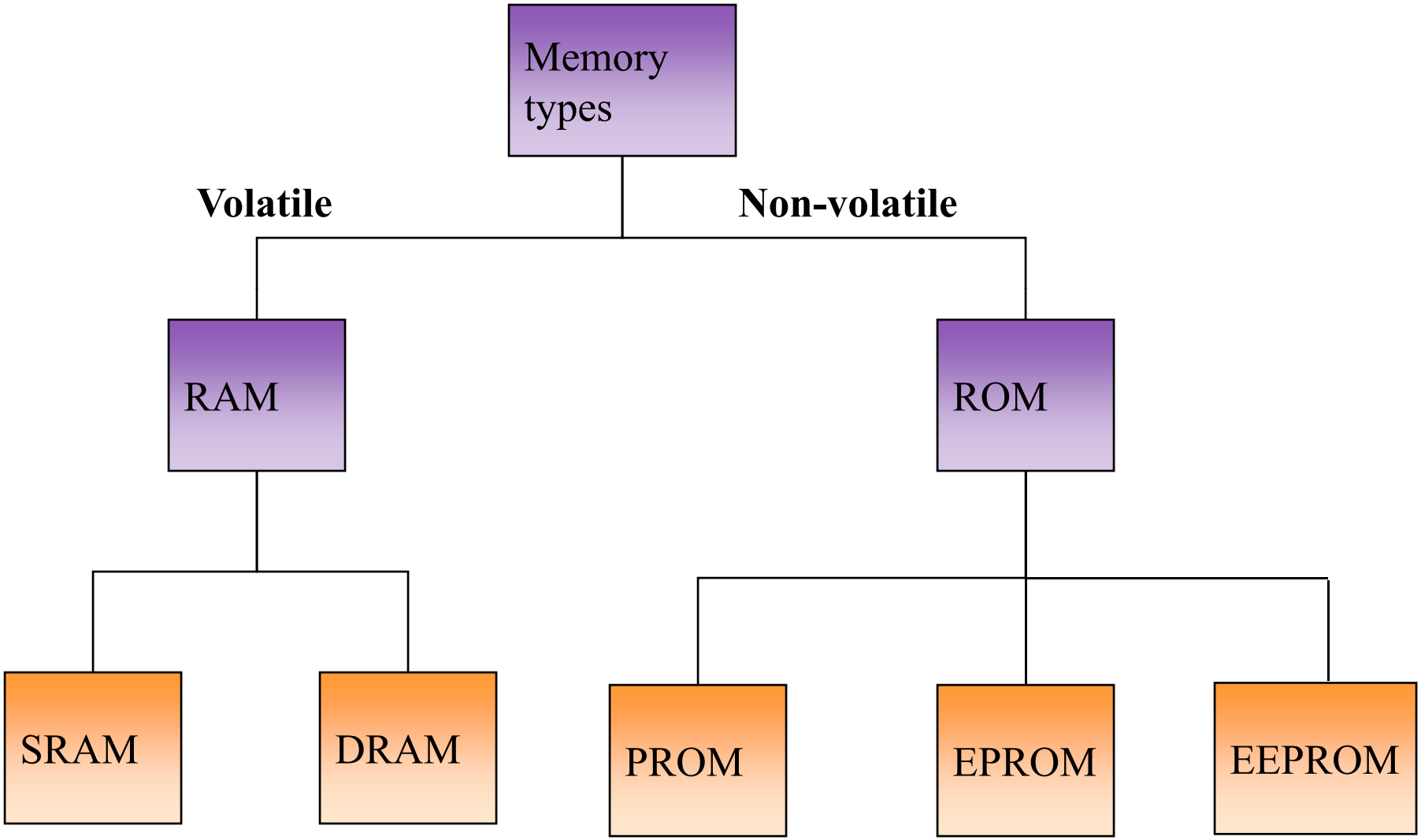
The Memory Unit is the part of the computer that holds data and instructions for processing. Although it is closely associated with the CPU, but in actual fact, it is separate. Memory associated with the CPU is also called primary storage, primary memory, main storage, internal storage and main memory. Theses are:-

- RAM
- ROM
- Cache
- Dynamic RAM
- Static RAM
- Flash memory
- Memory sticks
- Volatile memory
- Virtual memory
- Video memory
- BIOS

Sub Divided Memory Types



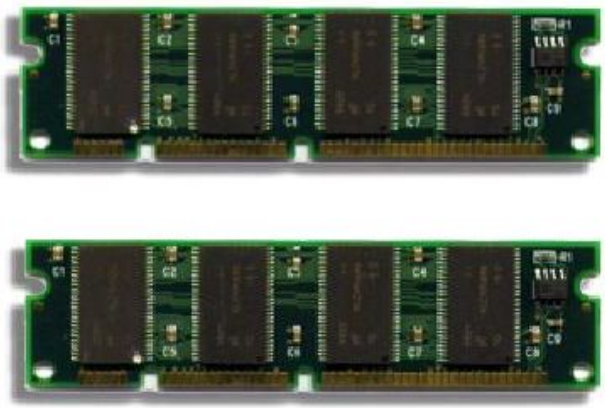
Volatile vs. Non-Volatile Memory



RAM

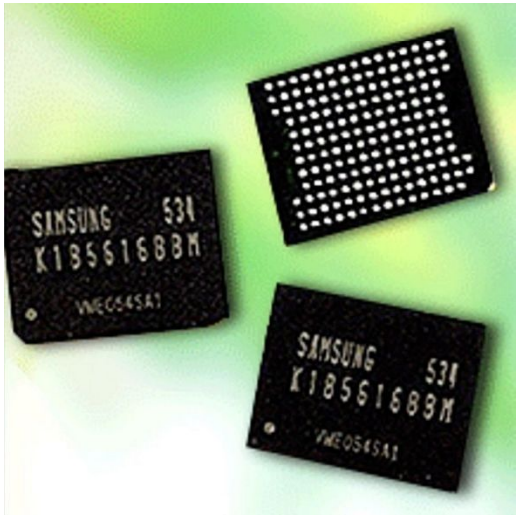
- RAM stands for Random Access Memory.
- It is the main memory of a computer which is used to store all of the working information of the computer such as the operating system, user programs and data.
- RAM is volatile.

Dynamic RAM and Static RAM



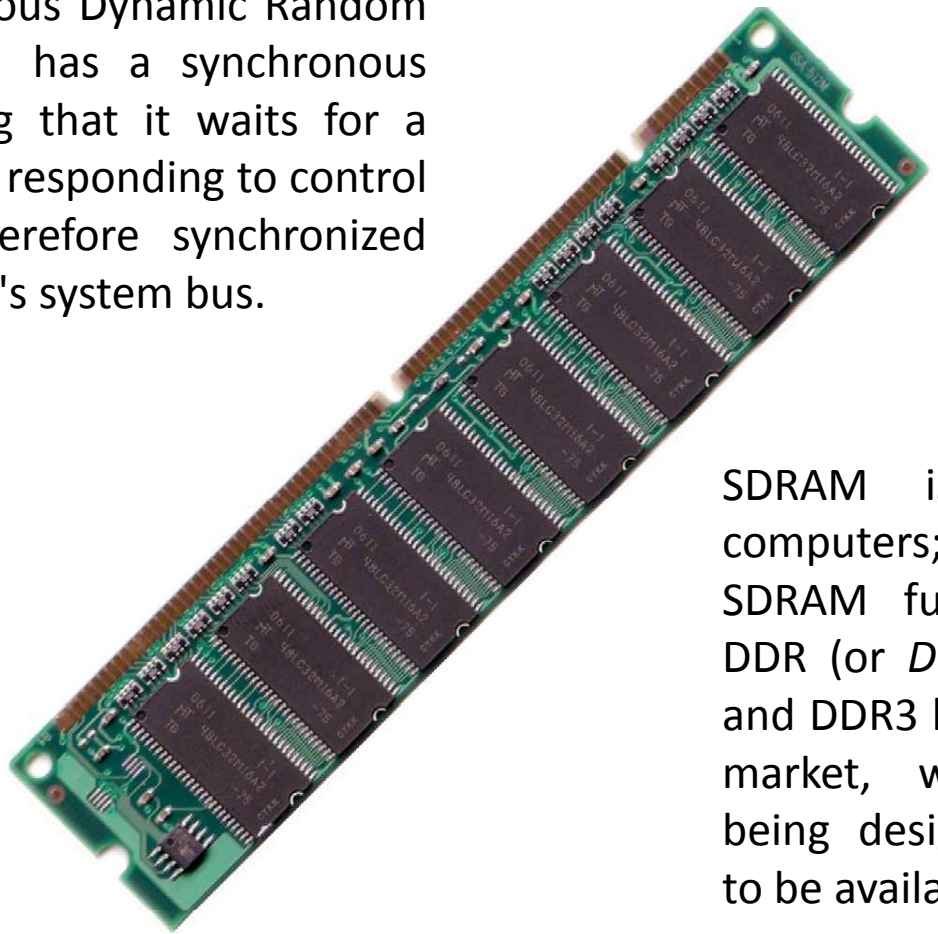
Dynamic RAM is the most common type of RAM used in computers. It is relatively easy to manufacture and so is cheap. However, DRAM contents must be continually refreshed. The process of refreshing the memory takes time and while the memory is being refreshed it cannot be read from or written to. This makes DRAM cheap but slow.

Static RAM is physically different to dynamic RAM as the memory contents do not have to be continually refreshed. This means that it can always be accessed and so SRAM is a faster type of memory. However the process of manufacturing the memory and the components used make it more expensive. For this reason SRAM is used in smaller quantities where fast memory is required, such as cache.



SDRAM

SDRAM (Synchronous Dynamic Random Access Memory) has a synchronous interface, meaning that it waits for a clock signal before responding to control inputs and is therefore synchronized with the computer's system bus.



SDRAM is widely used in computers; from the original SDRAM further generations of DDR (or *DDR1*), and then DDR2 and DDR3 have entered the mass market, with DDR4 currently being designed and anticipated to be available in 2012.

ROM

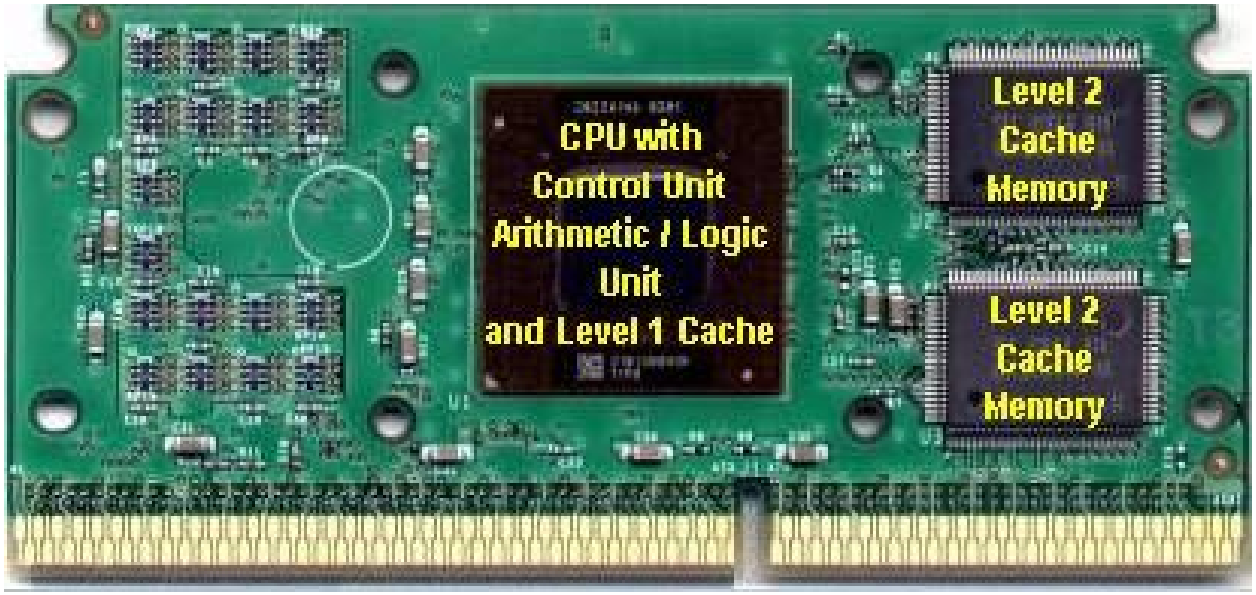
- ROM stands for Read Only Memory.
- Whereas RAM is volatile, ROM is non-volatile which is to say that the contents are not lost when power is removed.
- ROM chips come with instructions already burned into the chip. It is commonly used for computer BIOS chips.
- ROM is cheap in high quantities and is generally used for PC BIOSes.

Summary of Memory Characteristics

Memory Type	DRAM	SRAM	ROM	PROM	EPROM	EEPROM
Cost	Cheap	Expensive	Cheap in large quantities	Expensive	Expensive	Inexpensive
Speed	Slow	Fast	Fast	Fast	Fast	Fast
Use	Main Memory	Cache Memory	BIOS	Short run manufacturing	Testing	Flash Memory

Cache Memory

Caching is a technology based on the memory subsystem of the computer. The main purpose of a cache is to accelerate the computer while keeping the price of the computer low. Caching allows to do the computer tasks more rapidly.



Cache

L1 cache :- Memory accesses at full microprocessor speed (10 nanoseconds, 4 kilobytes to 16 kilobytes in size)

L2 cache:- Memory access of type SRAM (around 20 to 30 nanoseconds, 128 kilobytes to 512 kilobytes in size)

Main memory:- Memory access of type RAM (around 60 nanoseconds, 32 megabytes to 128 megabytes in size)

Hard disk:- Mechanical, slow (around 12 milliseconds, 1 gigabyte to 10 gigabytes in size)

Flash Memory

- Flash memory is a kind of semiconductor-based, non-volatile, rewritable computer memory; that is, it has many of the same characteristics as RAM, except that the data is not wiped out when the machine is turned off.

- Flash memory stores bits of data in memory cells, but the data remains saved even when electrical power is cut.

- Due to its higher speed, durability, and low energy consumption, flash memory is ideal for many applications, such as digital cameras, mobile phones, printers, PDAs, laptop computers, and mp3 players.

- Flash memory is considered a solid state storage device. Solid state means that there are no moving parts — everything is electronic instead of mechanical.

Example of Flash Memory

The most common Flash memory are as follows:-

- Computer's BIOS chip
- Compact Flash (most often found in digital cameras)
- Smart Media (most often found in digital cameras)
- Memory Stick (most often found in digital cameras)
- PCMCIA Type I and Type II memory cards (used as solid-state disks in laptops)
- Memory cards for video game consoles

Virtual Memory

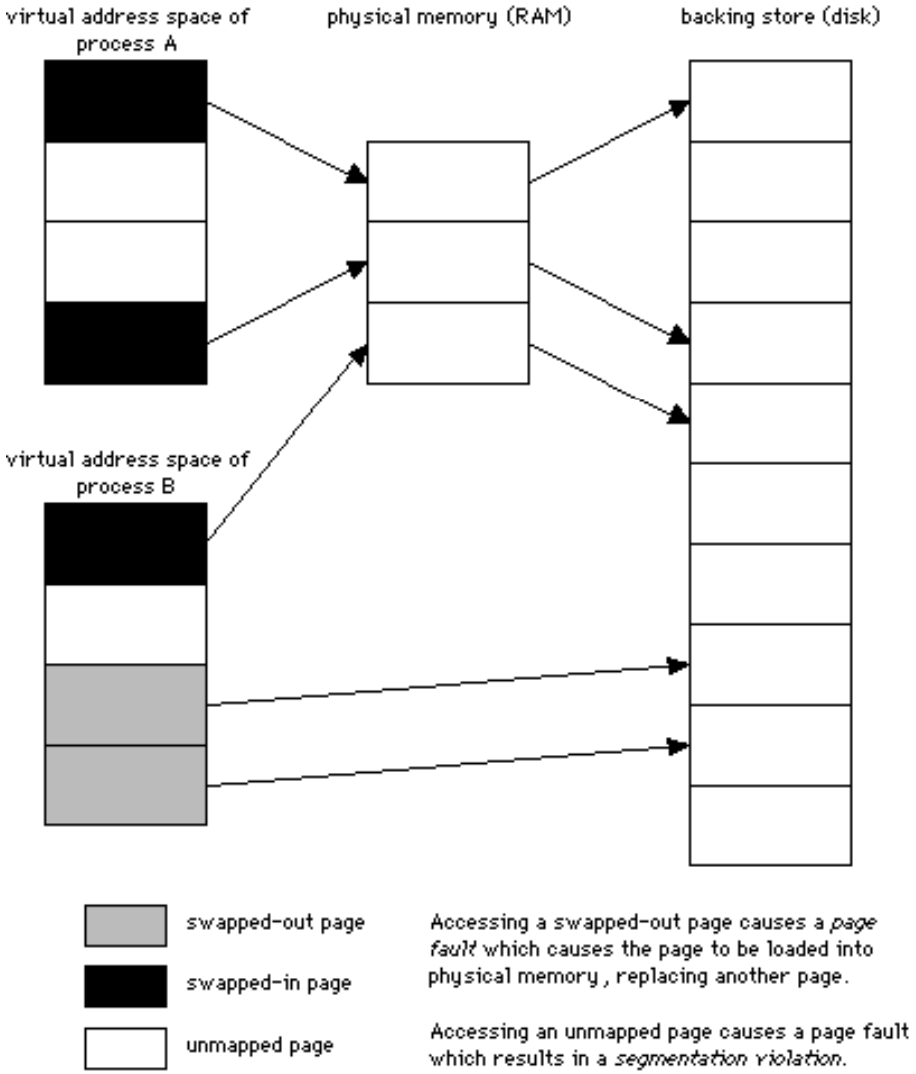
- Virtual memory is a computer system technique which gives an application program the impression that it has contiguous working memory (an address space), while in fact it may be physically fragmented and may even overflow on to disk storage.

- Systems that use this technique make programming of large applications easier and use real physical memory (e.g. RAM) more efficiently than those without virtual memory.

- Virtual memory differs significantly from memory virtualization in that virtual memory allows resources to be virtualized as memory for a specific system, as opposed to a large pool of memory being virtualized as smaller pools for many different systems.

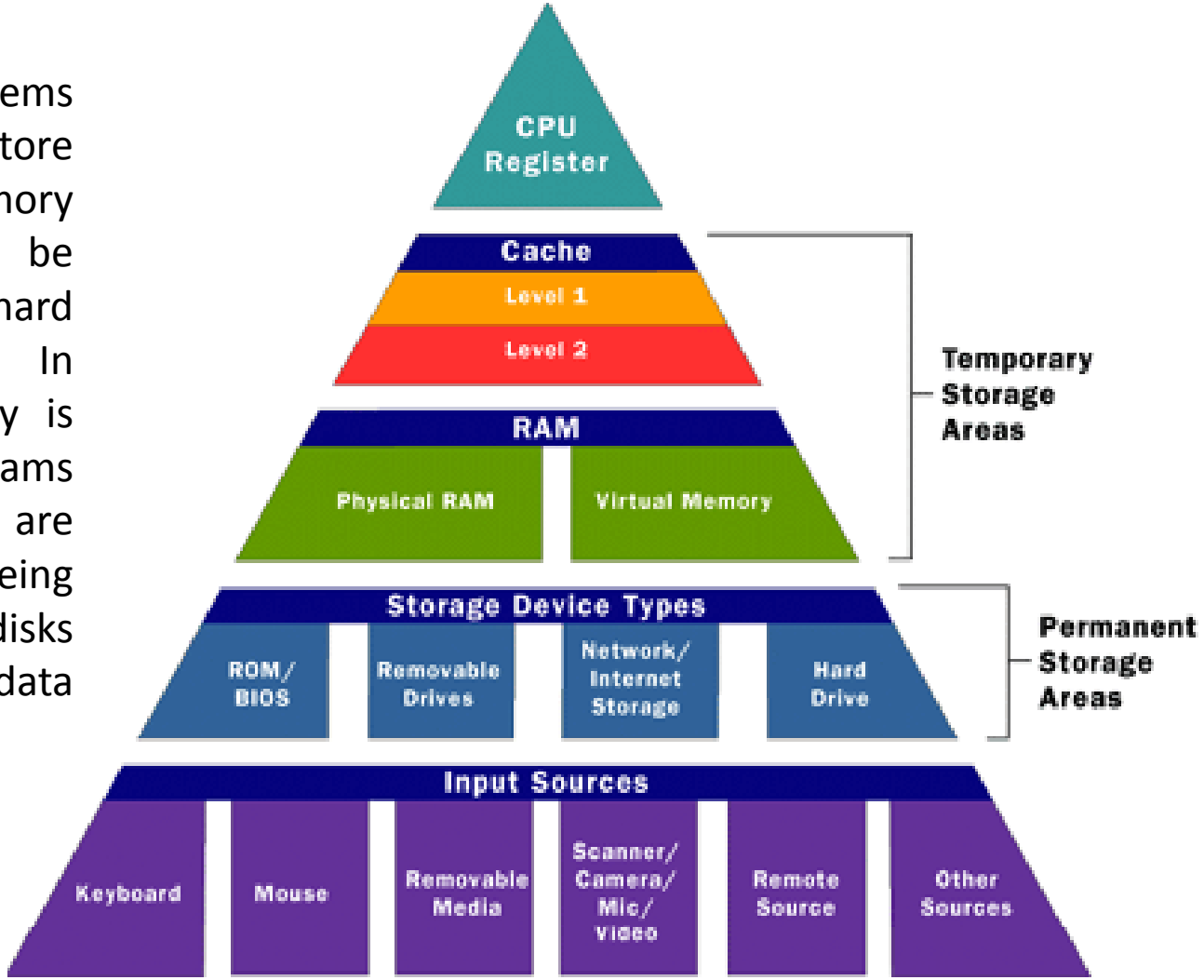
- All modern general-purpose computer operating systems use virtual memory techniques for ordinary applications, such as word processors, spreadsheets, multimedia players, accounting, etc.

Example of Virtual Memory



Computer Memory

Computer systems use memory to store data. Memory should not be confused with hard disk space. In general, memory is used for programs and data that are currently being used. Hard disks store data permanently.



Computer Fundamentals : Part#2
Input/output and Auxiliary Storage Devices

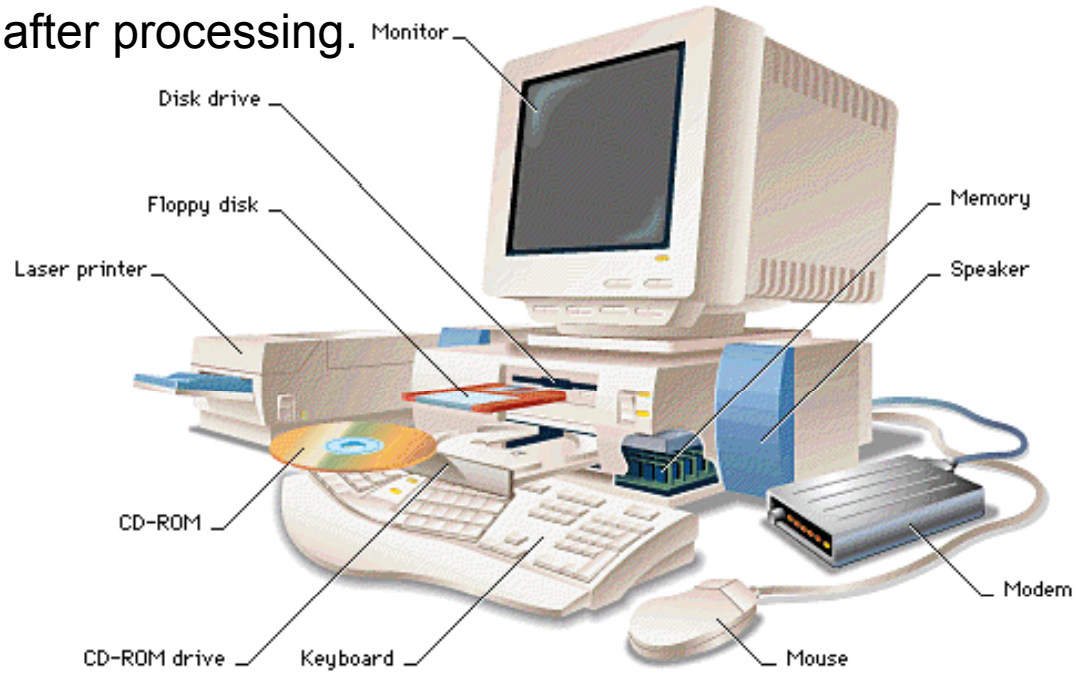
Learning Objective

- To know about various input devices like keyboard, mouse, trackball, etc.
- To discuss about various output devices like monitor, printer, etc.
- To understand the classification of monitor, printer, etc.
- To discuss about various Auxiliary Storage devices like Hard Disk ,DVD, Pen Drives etc.

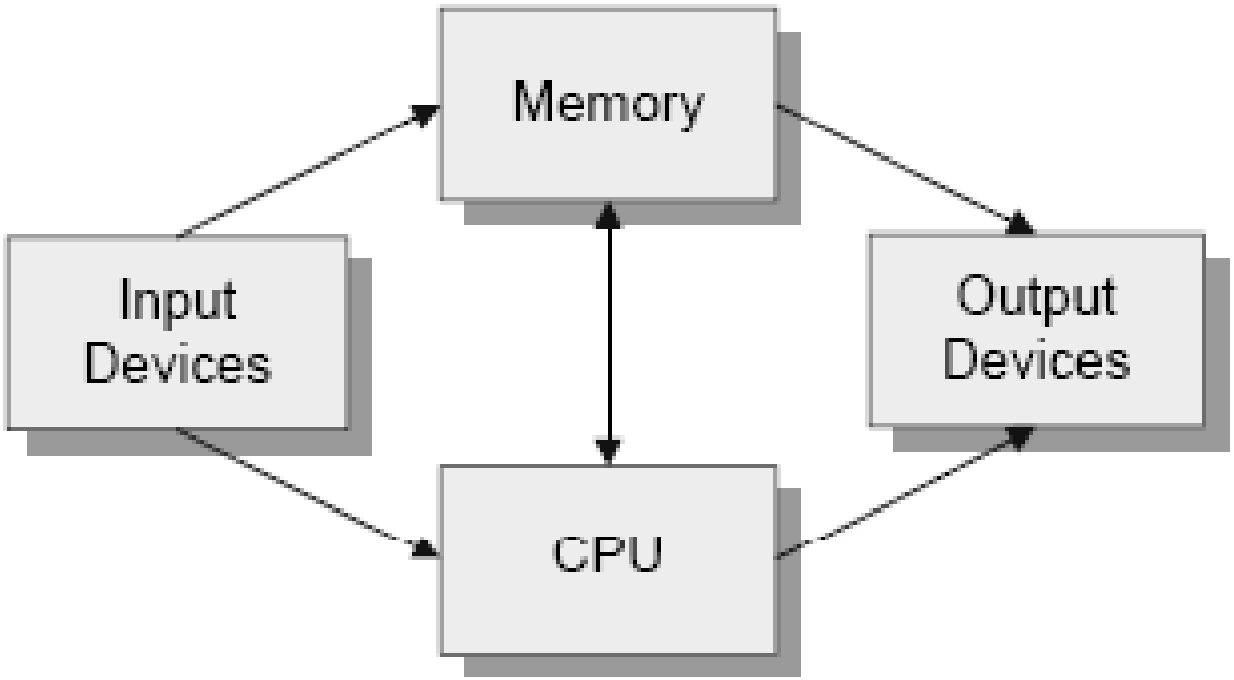
An Introduction

Input / Output devices are those devices that allows computer to perform specific tasks as follows:-

- Receive information for processing.
- Return information after processing.
- Store information.



Computer Organization
(Generalized Approach)



Input / Output Devices

Following categories of devices could be found in a computer:-

Input Devices : Input devices are those devices which are purely used for input purpose. For example, keyboard, mouse, etc. Input devices are used for entering data or instructions into a computer.

Output Devices: Output devices are those devices which are purely used for output purpose. For example, monitor, printer, etc.

Input and Output Devices: Input and Output devices are those devices which can act as input as well as output devices and can be used for both input and output purpose. For example, Hard Disk Drive, Magnetic Tape, Floppy Disk Drive.

Categories of Input Devices

- **Text Input Devices** : Keyboard, etc.
- **Pointing Devices** : Mouse, Light Pen, etc.
- **Gaming Devices** : Joystick, Gamepad, etc.
- **Image, Video Devices** : Image Scanner, Web Camera, etc.
- **Audio Input Devices** : Microphones

Examples of Input Devices

- Keyboard
- Mouse
- Trackball
- Speakers
- Scanner
- Joystick
- Web Camera
- Biometrics
- Graphical Tablet
- Touch Screen
- Digitized Tablet
- Digital Pen
- MICR Device
- OBR Device
- OCR Device
- OMR Device
- Voice / Speech Recognition Device
- Stylus

Keyboard

A keyboard is an input device, partially modeled after the typewriter keyboard.

Keys on Keyboard

Alphanumeric Keys

Alphabetical, numeric, and punctuation keys are used in the same fashion as a typewriter keyboard to enter their respective symbol into a word processing program, text editor, data spreadsheet, or other program.

Capital Alphabets	A – Z
Small Alphabets	a – z
Digits	0 – 9
Special Symbols	!, @, #, $, %, ^, &, *, (,), -, +, =, etc.

Keys on Keyboard

Modifier Keys

- Modifier keys are special keys that modify the normal action of another key, when the two are pressed in combination. For example, **<Alt> + <F4>** in Microsoft Windows will close the program in an active window.
- The most widely-used modifier keys include the **Control key, Shift key** and the **Alt key**.
- A **Control key** is a modifier key which, when pressed in conjunction with another key, will perform a special operation.
- The **Shift key** is a modifier key which is used to type capital letters and other alternate "upper" characters.
- The **Alt key** on a computer keyboard is used to change (alternate) the function of other pressed keys.
- The **Space bar**, spacebar, or space key, is a key whose main purpose is to conveniently enter the space, e.g., between words during typing.
- The **Enter key** causes a command line, window form or dialog box to operate its default function.

Special Keys

Navigation & Typing Mode

- **Cursor movement keys** / **Arrow keys** are buttons that are either programmed or designated to move the cursor in a specified direction.
- The **Page Up** & **Page Down** keys are used to scroll up or down in documents.
- The **Home key** is used to take the control to the start of the document.
- The **End key** is used to take the control to the end of the document.
- **Tab key** on a keyboard is used to advance the cursor to the next tab stop.
- The **Insert key** is used to switch between the two text-entering modes.
- The **Delete key** performs a function which discards the character ahead of the cursor's position, moving all following characters one position "back" towards the freed place.
- **Backspace** is the keyboard key that moves the cursor one position backwards, deletes the preceding character, and shifts back the text after it by one position.
- **Scroll Lock** is a key meant to lock all scrolling techniques.
- **Num Lock** which is used to convert part of the main keyboard to act as a numeric keypad rather than letters.
- The **Caps Lock** when pressed will set a keyboard mode in which typed letters are capitalized by default.

Special Keys

System Command Keys

- The Print Screen command used to capture the entire screen and send it to the printer, but in the present it usually puts a screenshot in the clipboard.
- The Escape key (often abbreviated Esc) is used to initiate an escape sequence.
- The Menu key / Application key is a key found on Windows-oriented computer keyboards. It is used launch a context menu with the keyboard rather than with the usual right mouse button.

Punctuation Keys

- comma, semicolon etc

Mouse

A mouse is a pointing device which is used to control & move the cursor on the screen.

“The first computer mouse underside view held by inventor Douglas Engelbart”

Mouse Buttons

This input device controls the cursor on the computer screen. It has two or three buttons and a cable connecting it to the computer. It is quite easy to operate a mouse, the user simply moves the cursor along the table. Once the cursor is at the desired location, the user can give instructions to the computer by clicking the button.

Types of Mouse Buttons

Single Button Mouse

Three Button Mouse

Five Button Mouse

Types of Mouse

USB Mouse

This type of mouse has a USB connector and requires a free USB port to connect to the computer.

Types of Mouse

Cordless Mouse

A cordless mouse (as the name suggests) has no cable, this type of mouse utilizes batteries for its power supply.

Types of Mouse

Laser Mouse

A laser mouse is a type of computer device that uses a laser beam rather than a ball to track the movement.

Types of Mouse

Optical Mouse

An optical mouse utilizes optical electronics to track the mouse's position and movement, they are preferred over standard mechanical mice as they tend to be more reliable and require less maintenance.

Common Mouse Operations

Click - pressing and releasing a button

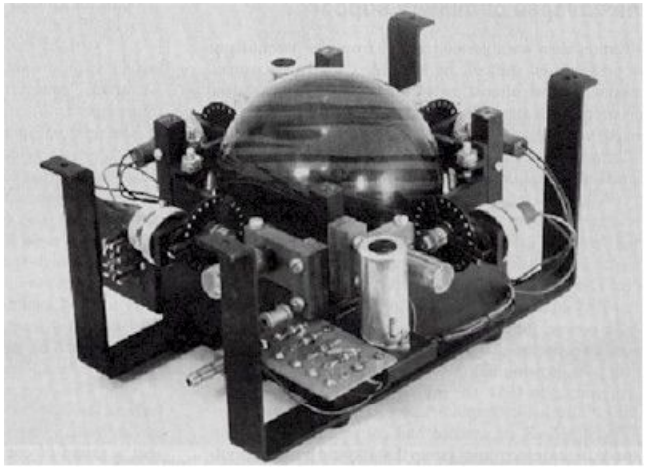
- **(left) Single-click** - clicking the main button.
- **(left) Double-click** - clicking the button two times in quick succession counts as a different gesture than two separate single clicks.
- **(left) Triple-click** - clicking the button three times in quick succession.
- **Right-click** - clicking the secondary button

Drag - pressing and holding a button, then moving the mouse without releasing.

MOUSEPAD

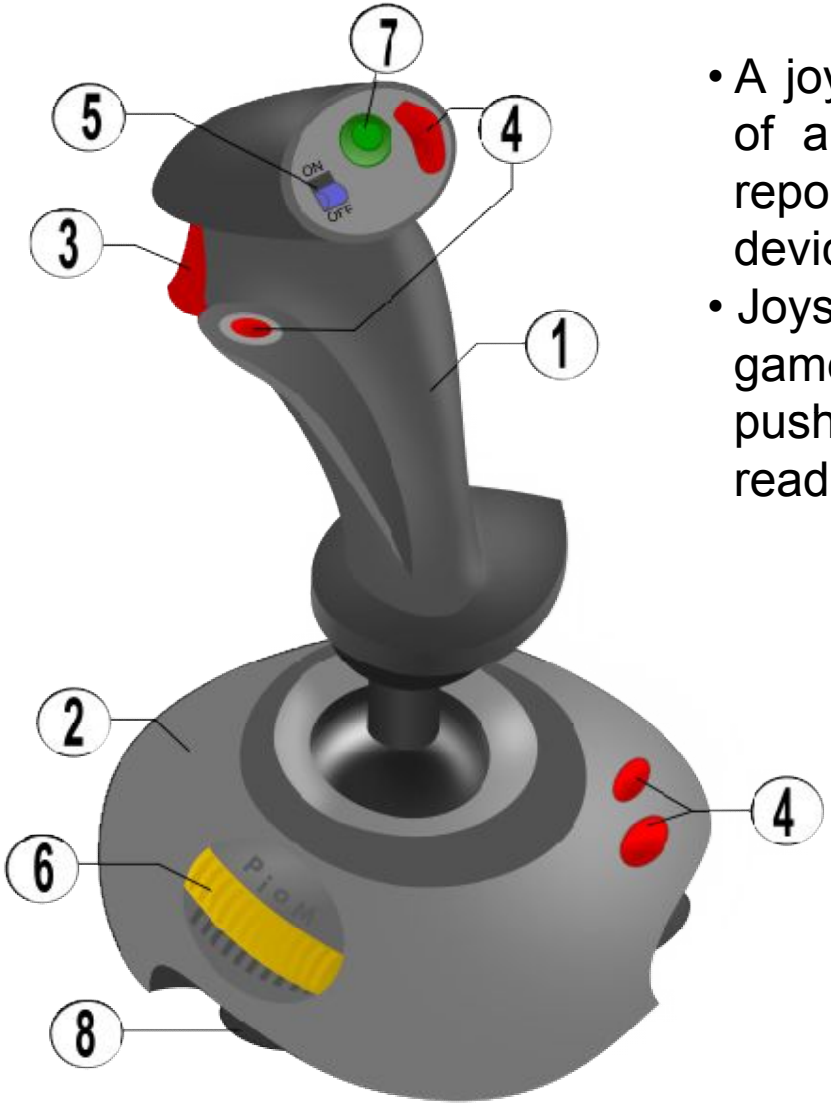
- It is a pad over which we can move a mouse.
- Optical mice require special mouse pads that have grid drawn on them.

Trackball



- A trackball is a pointing device consisting of a ball held by a socket containing sensors to detect a rotation of the ball about two axes like an upside- down mouse with an exposed protruding ball.
- The user rolls the ball with the thumb, fingers, or the palm of the hand to move a cursor.
- Large tracker balls are common on CAD workstations for easy precision.
- Trackballs have appeared in computer and video games.

Joystick



- A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling.
- Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer.

Joystick elements:

1. Stick
2. Base
3. Trigger
4. Extra buttons
5. Auto fire switch
6. Throttle
7. Hat Switch (POV Hat)
8. Suction Cup

Digitized Tablet

• A graphics tablet (or digitizing tablet, graphics pad, drawing tablet) is a computer input device that allows one to hand-draw images and graphics, similar to the way one draws images with a pencil and paper.

• A graphics tablet consists of a flat surface upon which the user may "draw" an image using an attached stylus, a pen-like drawing apparatus. The image generally does not appear on the tablet itself but, rather, is displayed on the computer monitor.

• These tablets may also be used to capture data or handwritten signatures.

• Tablets are also popular for technical drawings and CAD.

Scanner

- A scanner is a device that optically scans images, printed text, handwriting, or an object, and converts it to a digital image.
- Scanners typically read red-green-blue color (RGB) data from the array. This data is then processed with some proprietary algorithm to correct for different exposure conditions, and sent to the computer via the device's input/output interface

Types of Scanner

- Drum Scanner
- Flatbed Scanner
- Sheetfed Scanner
- Film Scanner
- Handheld Scanner
- Cardscan Scanner

Drum Scanner

- Drum scanners capture image information using photomultiplier tubes (PMT) technology unlike the charged coupled device (CCD) used in flatbed scanners and film scanners.
- In the drum scanner the reflective & transmissive originals are mounted to an acrylic cylinder, the scanner drum, which rotates at high speed while it passes the object being scanned in front of precision optics that deliver image information to the PMTs.

Flatbed Scanner

- A flatbed scanner is usually made of a glass pane, which is illuminated with a bright light found underneath, and a moving optical CCD or CIS array.
- In the flatbed scanner images to be scanned are placed face down on the glass and the sensor and light source move across the glass pane reading the entire area.

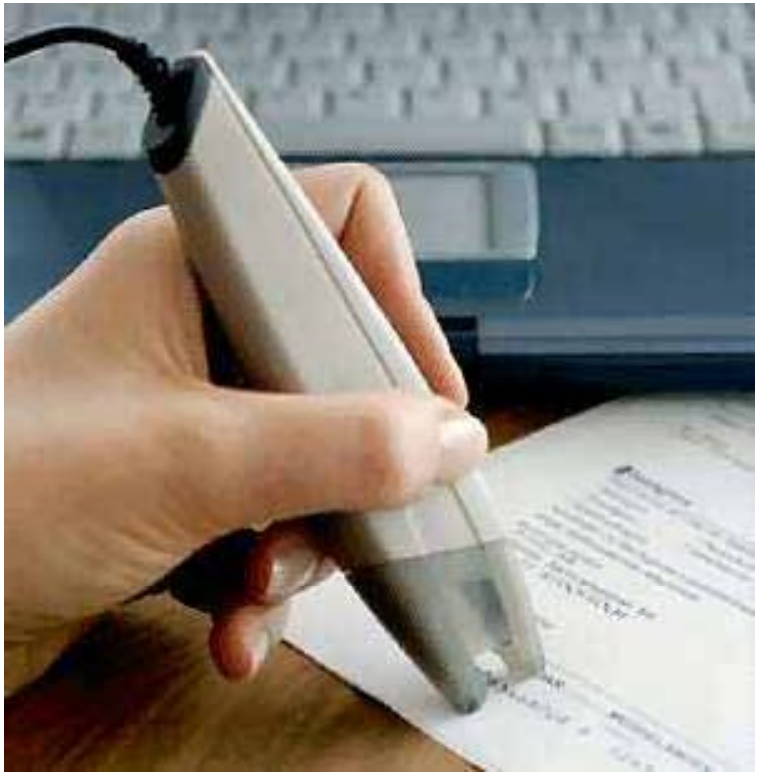
Sheetfed Scanner

- A scanner that allows only paper to be scanned rather than books or other thick objects.
- It moves the paper across a stationary scan head.

Film Scanner

- "Slide" (positive) or negative film can be scanned in equipment specially manufactured for this purpose.
- Usually, uncut film strips of up to six frames, or four mounted slides, are inserted in a carrier, which is moved by a stepper motor across a lens and CCD sensor inside the scanner.

Handheld Scanner



- A scanner that is moved across the image to be scanned by hand.
- Handheld scanners are small and less expensive than their desktop counterparts, but rely on the dexterity of the user to move the unit across the paper.
- Trays are available that keep the scanner moving in a straight line.

Cardscan Scanner

- A business card scanner is a scanner that has only one purpose and that is to scan business cards and store the information.
- A business card scanner scans business cards, separate out all their various types of information like name, title, address, phone number, e-mail address, URL, etc. and store that data, either with the help of a software that comes with the scanner, or in a personal information manager/address book packages such as Microsoft Outlook.

Digital Camera Device

Back View of a Digital Camera

A digital camera is a camera that takes video or still photographs, or both, digitally by recording images via an electronic image sensor.

Front View of a Digital Camera

Web Camera

- A webcam is a video capture device connected to a computer or computer network, often using a USB port or, if connected to a network, ethernet or Wi-Fi.
- Their most popular use is for video telephony, permitting a computer to act as a video conferencing station.

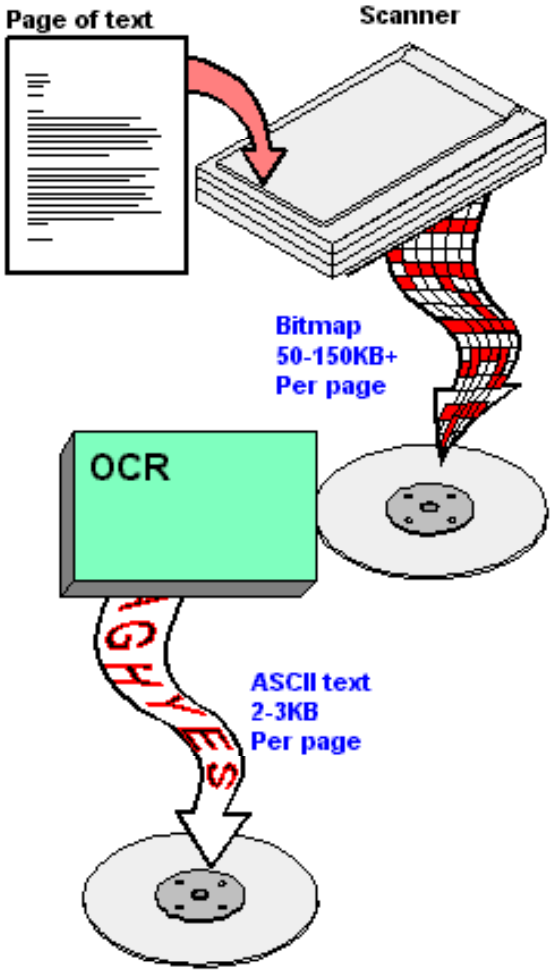
A deaf or mute person using a Video Relay Service to communicate with a hearing person.

MICR Device

- MICR stands for Magnetic Ink Character Recognition.
- The machine recognition of numeric data printed with magnetically charged ink. It is used on bank checks and deposit slips.
- It serves as a deterrent to fraud, because a photocopied check will not be printed with magnetic ink.

• MICR readers detect the characters and convert them into digital data. Although optical methods (OCR) became as sophisticated as the early MICR technology, magnetic ink is still used.

OCR Device



- OCR (Optical Character Recognition) is the mechanical or electronic translation of images of handwritten, typewritten or printed text (usually captured by a scanner) into machine-editable text. It is used to convert paper books and documents into electronic files, for instance, to computerize an old record-keeping system in an office, or to serve on a website.
- When one scans a paper page into a computer, it produces just an image file, a photo of the page . The computer cannot understand the letters on the page, so you cannot search for words or edit it and have the words re-wrap as you type, or change the font, as in a word processor. You would use OCR software to convert it into a text or word processor file so that you could do those things. The result is much more flexible and compact than the original page photo.
- OCR is a field of research in pattern recognition, artificial intelligence and computer vision.

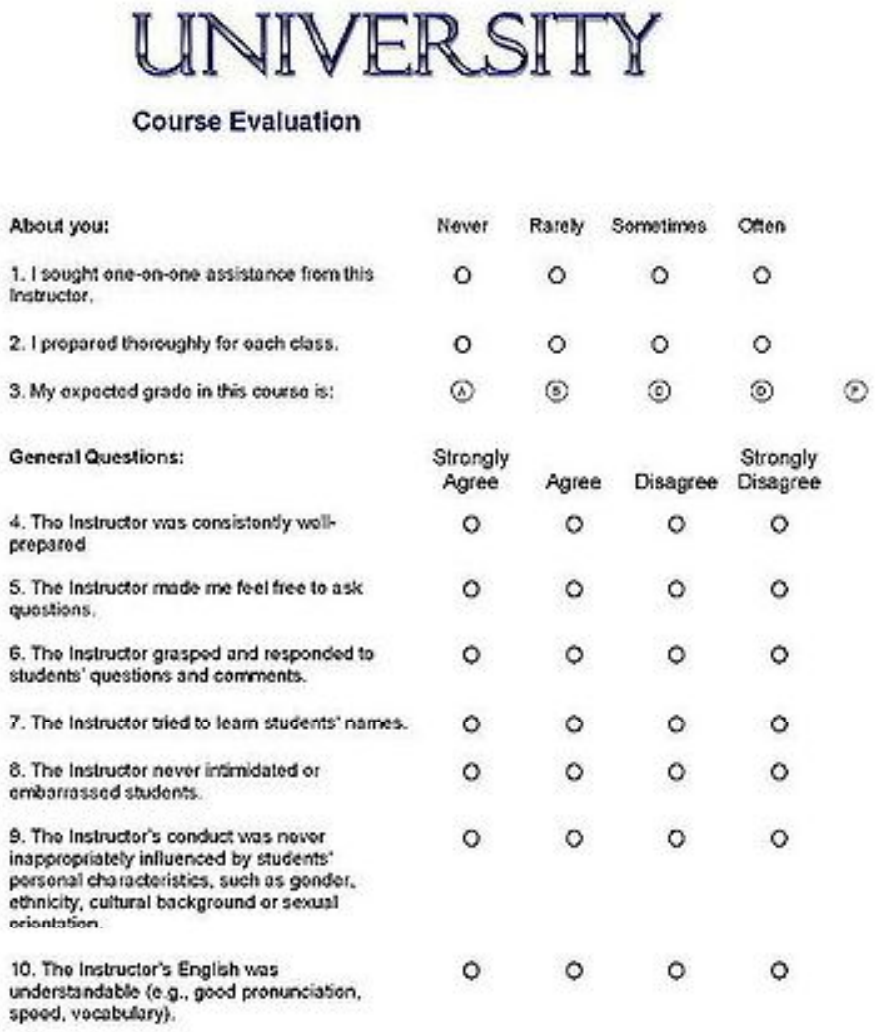
OMR Device

- OMR (Optical Mark Recognition) is the process of capturing human-marked data from document forms such as surveys and tests.
- OMR Software is a computer software application that makes OMR possible on a desktop computer by using an Image scanner to process surveys, tests, attendance sheets, checklists, and other plain-paper forms printed on a laser printer.

There are many other applications for OMR, for example:

- Process of institutional research
- Community surveys
- Consumer surveys
- Tests / Assessments
- Evaluations/ Feedback
- Data compilation
- Product evaluation
- Time sheets / Inventory counts
- Membership subscription forms
- Lotteries / Voting

An OMR Sheet



UNIVERSITY

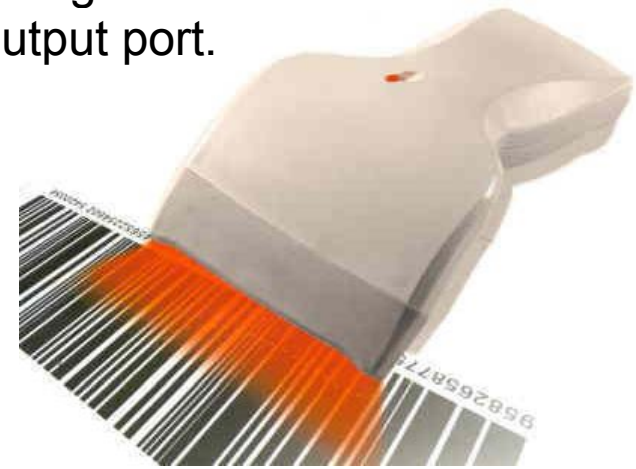
Course Evaluation

About you:	Never	Rarely	Sometimes	Often
1. I sought one-on-one assistance from this instructor.	O	O	O	O
2. I prepared thoroughly for each class.	O	O	O	O
3. My expected grade in this course is:	Ⓐ	Ⓑ	Ⓒ	Ⓓ Ⓕ

General Questions:	Strongly Agree	Agree	Disagree	Strongly Disagree
4. The instructor was consistently well-prepared	O	O	O	O
5. The instructor made me feel free to ask questions.	O	O	O	O
6. The instructor grasped and responded to students' questions and comments.	O	O	O	O
7. The instructor tried to learn students' names.	O	O	O	O
8. The instructor never intimidated or embarrassed students.	O	O	O	O
9. The instructor's conduct was never inappropriately influenced by students' personal characteristics, such as gender, ethnicity, cultural background or sexual orientation.	O	O	O	O
10. The instructor's English was understandable (e.g., good pronunciation, speed, vocabulary).	O	O	O	O

OBR Device

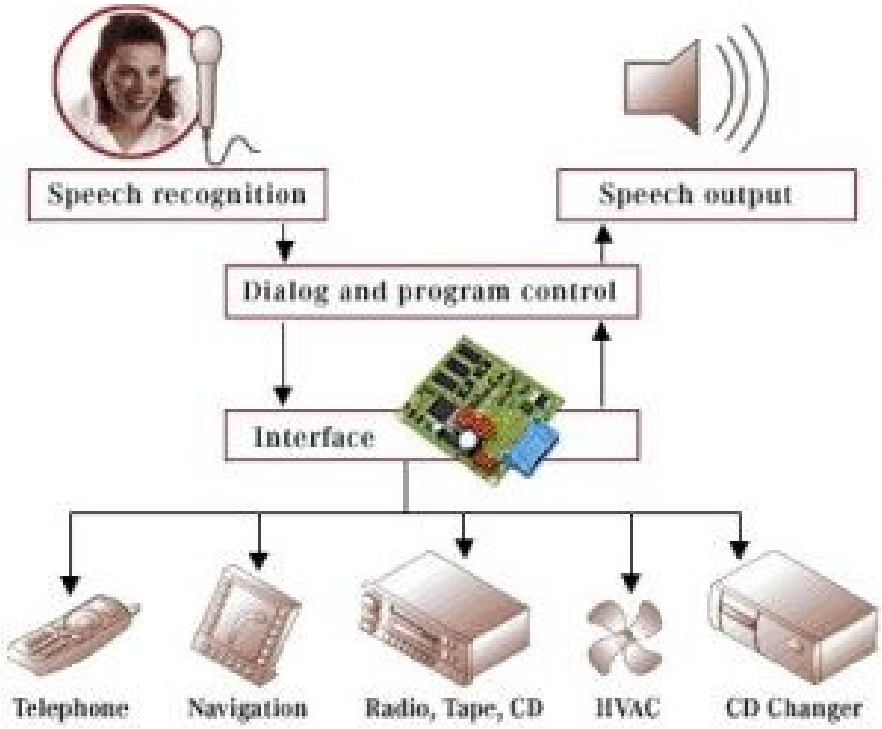
- A barcode reader (or barcode scanner) is an electronic device for reading printed barcodes. Like a flatbed scanner, it consists of a light source, a lens and a light sensor translating optical impulses into electrical ones.
- Additionally, nearly all barcode readers contain *decoder* circuitry analyzing the barcode's image data provided by the sensor and sending the barcode's content to the scanner's output port.



Microphones

• Microphone is an input device which acts as an instrument and converts sound waves into an electric current, usually fed into an amplifier, a recorder, or a broadcast transmitter.

Voice / Speech Recognition Device



- Speech recognition (also known as automatic speech recognition or computer speech recognition) converts spoken words to text.
- The term "voice recognition" is sometimes used to refer to speech recognition where the recognition system is trained to a particular speaker - as is the case for most desktop recognition software, hence there is an aspect of speaker recognition, which attempts to identify the person speaking, to better recognize what is being said.

Voice / Speech Recognition Device

Speech recognition applications include:-

- Voice dialing
- Call routing
- Home automation appliance control & content-based spoken audio search
- Simple data entry
- Preparation of structured documents
- Speech-to-text processing
- Aircraft cockpits
- Health Care
- Military Services

Touch Screen

- A touch screen is a display that can detect the presence and location of a touch within the display area.
- The term generally refers to touch or contact to the display of the device by a finger or hand.
- Touch screens can also sense other passive objects, such as a stylus.
- However, if the object sensed is active, as with a light pen, the term touch screen is generally not applicable.

Touch Pad Device

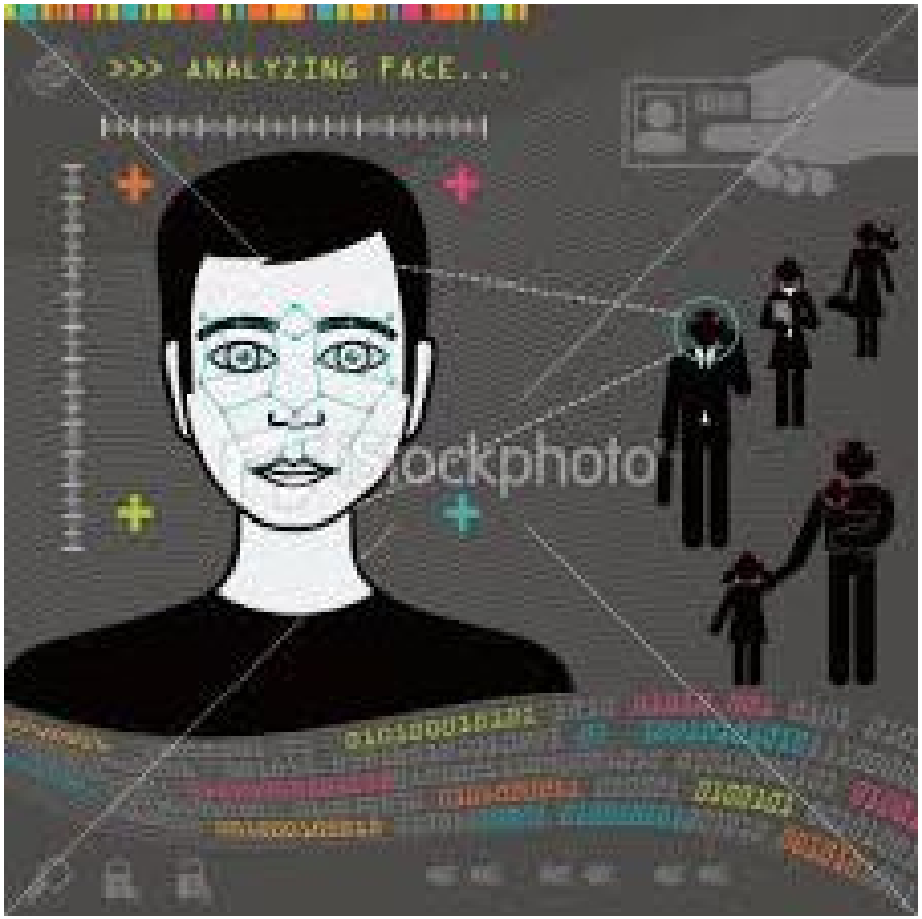
Close up of a touchpad with a locking button on a Laptop

- A touchpad (also track pad) is a pointing device consisting of specialized surface that can translate the motion and position of a user's fingers to a relative position on screen.
- They are a common feature of laptop computers and also used as a substitute for a computer mouse where desk space is scarce.
- Touch pads vary in size but are rarely made larger than 40 square centimeters (about 6 square inches).
- They can also be found on personal digital assistants (PDAs) and some portable media players.

Biometrics

When referring to computers and security, biometrics is the identification of a person by the measurement of their biological features. For example, a user identifying themselves to a computer or building by their finger print or voice is considered biometrics identification. When compared to a password, this type of system is much more difficult to fake since it is unique to the person. Below is a listing of some known biometric devices.

Types of Biometrics



Face scanner:-

Biometric face scanners identify a person by taking measurements of a person face.

Types of Biometrics

Hand scanner:-

Like your finger print, the palm of your hand is also unique to you. A biometric hand scanner will identify the person by the palm of their hand.

Types of Biometrics

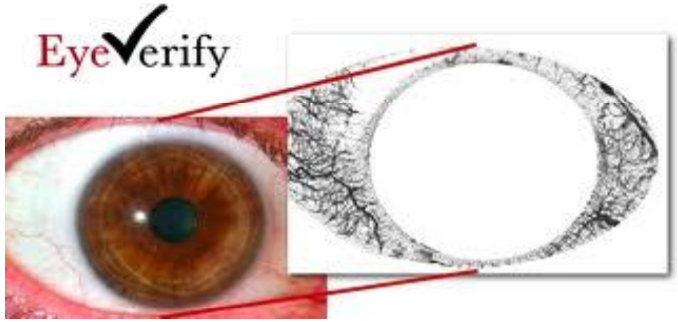
Finger scanner:-

A biometric finger scanner identifies the person by their finger print. These can be a secure method of identifying a person, however, cheap and less sophisticated finger print scanners can be duped a number of ways.

Types of Biometrics

Retina or iris scanner:-

A biometric retina or iris scanner identifies a person by scanning the iris or retina of their eyes. These scanners are more secure biometric authentication schemes when compared to the other devices because there is no known way to duplicate the retina or iris.



Types of Biometrics

Voice scanner:-

Finally, a voice analysis scanner will mathematically break down a person's voice to identify them. These scanners can help improve security but with some less sophisticated scanners can be bypassed using a tape recording.

Graphics Tablet

Alternatively referred to as a drawing tablet and pen tablet, a graphics tablet is a highly accurate hardware input device that enables an artist to draw or sketch easier than they would be able to do with a standard computer mouse.

Light Gun

A light gun is a pointing input device that detects light using a photodiode in the gun barrel. When the player of the game pulls the trigger on the gun, the screen is blanked out for a fraction of a second, which allows the photodiode to determine where the gun is pointed. Light guns were most widely used

Stylus

Stylus is a pen-shaped instrument used with graphics tablets or touch screen input devices to write or draw on the computer screen, similar to a sheet of paper.

Output Devices

- Monitors
- Printers
- Plotters
- Speakers
- Projector

Computer Monitor

- A monitor or display (sometimes called a visual display unit) is the screen on which words, numbers, and graphics can be seem. The monitor is the most common output device.

CRT Monitor

TFT Monitor

- The monitor comprises the display device, circuitry, and an enclosure.
- The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT-LCD), while older monitors use a cathode ray tube (CRT).

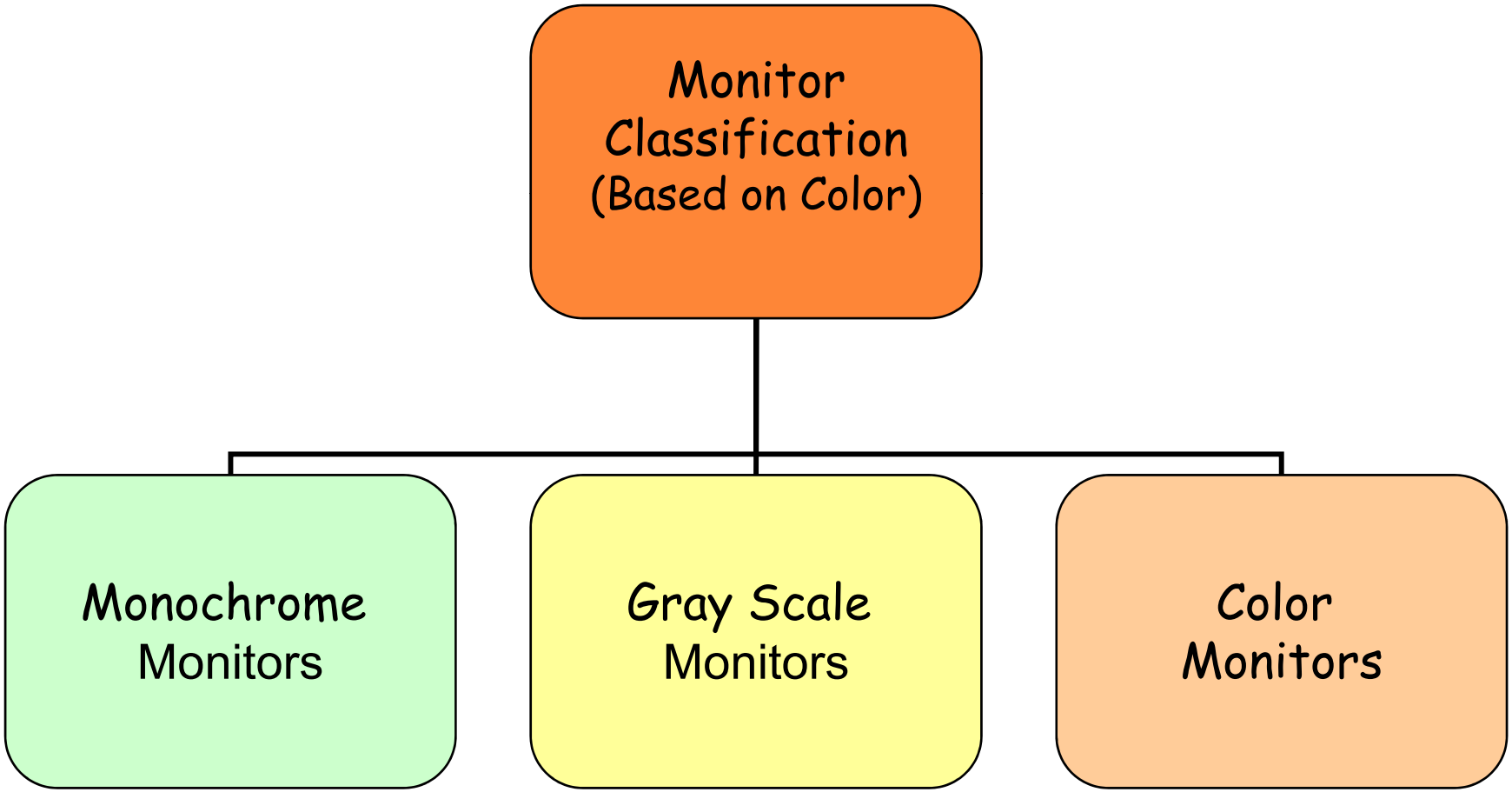
Imaging Technologies (Monitor)

As with television, many hardware technologies exist for displaying computer-generated output:

- **LCD (Liquid Crystal Display)**
- Passive LCDs are noted for poor contrast and slow response. They were used in laptops until the mid 1990s.
- Thin film transistor. Nearly all modern LCD monitors are TFTs.
- **CRT (Cathode Ray Tube)**
- Raster scan computer monitors produce images using pixels. These were the most popular display device for older computers.
- Vector displays, as used on the scientific & radar applications, & several early arcade machines such as Asteroids use CRT displays because of requirement for a deflection system, although a raster-based display may be used.
- Television sets were used by most early personal and home computers. Resolution & image quality were limited by its display capabilities.Penetron - military aircraft displays
- **Plasma display**
- **Video projectors** use CRT, LCD, DLP, LCoS, and other technology to emit light to a projection screen.
- **Surface-conduction electron-emitter display** (SED) and field emission display (FED)
- **Organic light-emitting diode (OLED) display**

Types of Monitor (Based on Color)

Monitors may be classified based on their color capabilities into three classes:-



Monochrome Monitor

- Monochrome monitors actually display two colors, one for the background and other for the foreground.
- The color can be black and white, green and black, or amber and black.

Grayscale Monitor

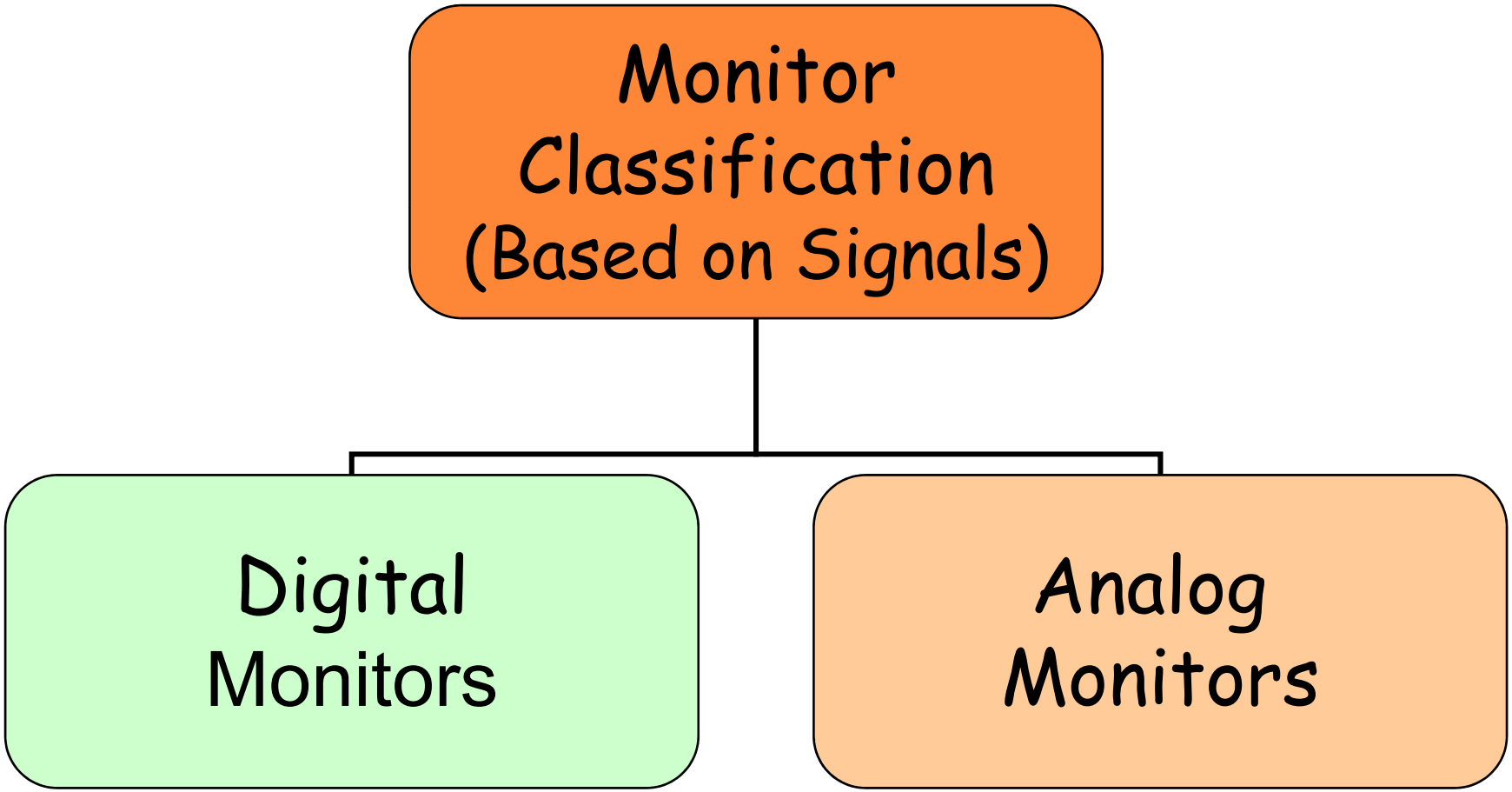
- A gray-scale monitor is a special type of monochrome monitor capable of displaying different shades of gray color.

Color Monitor

- Color monitor can display anywhere from 16 to over 1 million different colors.
- Color monitors are sometimes called RGB monitors because they accept three separate signals –red, green and blue.

Types of Monitor (Based on Signals)

Monitors may be classified based on the signals into two classes:-



Analog Monitor

- Analog monitors are traditional type of color display screen that has been for years in television.
- Monitor that is capable of accepting continuously varying or analog signals from the video adapter. This allows the monitor to display an infinite range of different colors. The majority of all CRT monitors are analog monitors where all flat panel displays are digital.

Digital Monitor

- Digital monitor accepts digital signals rather than analog signals.
- Computer monitor that uses a digital signal instead of an analog signal. Unlike an analog monitor, a digital monitor has a set color range and is incapable of displaying an infinite range of colors.

Performance Measurement (Monitor)

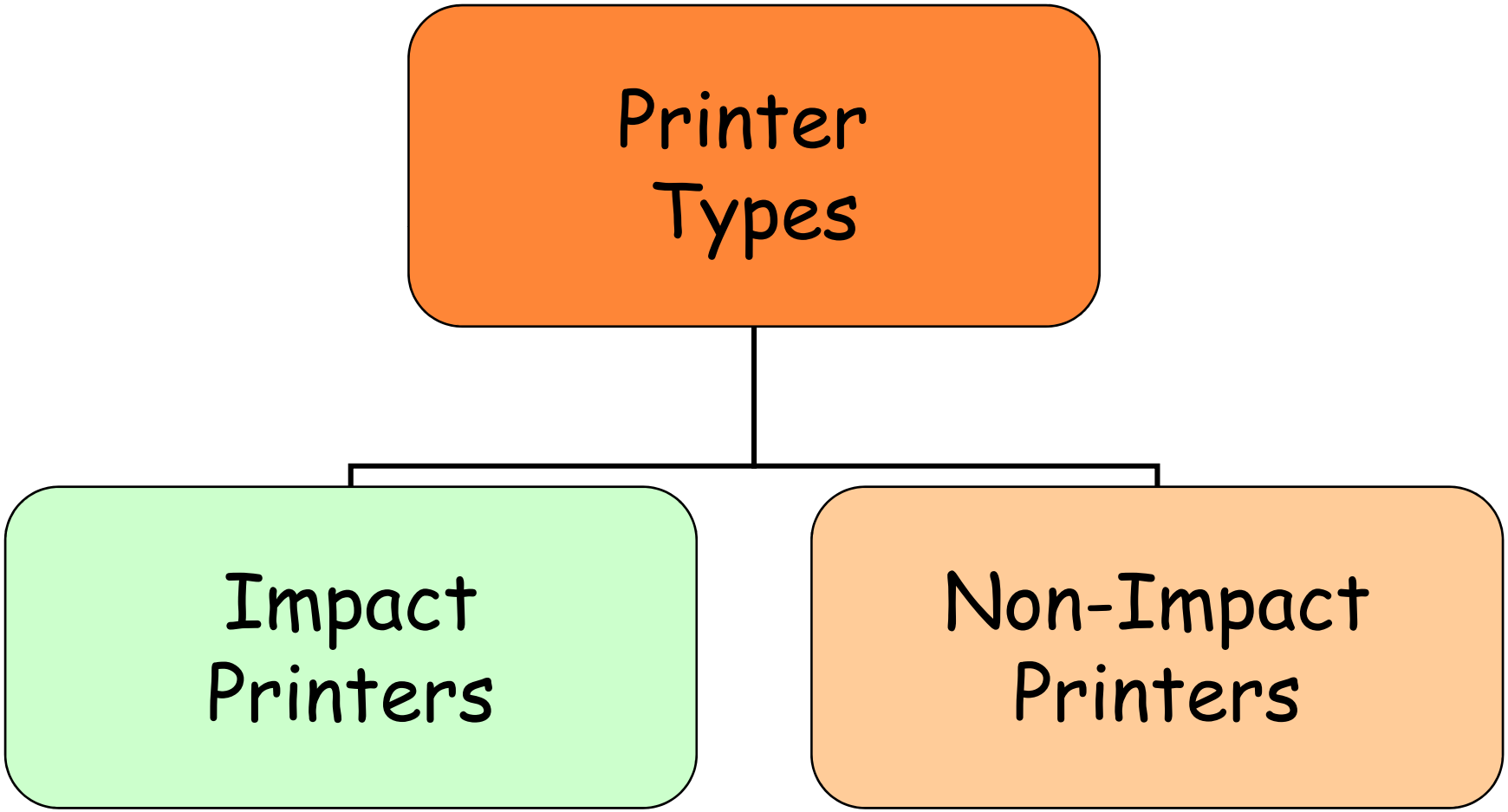
The performance of a monitor is measured by the following parameters:

- Luminance is measured in candelas per square meter.
- Viewable image size is measured diagonally. For CRTs, the viewable size is typically one inch (25 mm) smaller than the tube itself.
- Aspect ratios is the ratio of the horizontal length to the vertical length. 4:3 is the standard aspect ratio, for example, so that a screen with a width of 1024 pixels will have a height of 768 pixels. If a widescreen display has an aspect ratio of 16:9, a display that is 1024 pixels wide will have a height of 576 pixels.
- Display resolution is the number of distinct pixels in each dimension that can be displayed. Maximum resolution is limited by dot pitch.
- Dot pitch is the distance between pixels of the same color in millimeters. In general, the smaller the dot pitch, the sharper the picture will appear.
- Refresh rate is the number of times in a second that a display is illuminated. Maximum refresh rate is limited by response time.
- Response time is the time a pixel in a monitor takes to go from active (black) to inactive (white) and back to active (black) again, measured in milliseconds. Lower numbers mean faster transitions and therefore fewer visible image artifacts.
- Power consumption is measured in watts.

Printer

- Printer is a device that prints text or illustrations on paper and in many cases on transparencies and other media.
- It is a device that must be connected to a computer which allows a user to print items on paper, such as letters and pictures.
- It can also work with digital cameras to print directly without the use of a computer.

Types of Printer



Impact Printers

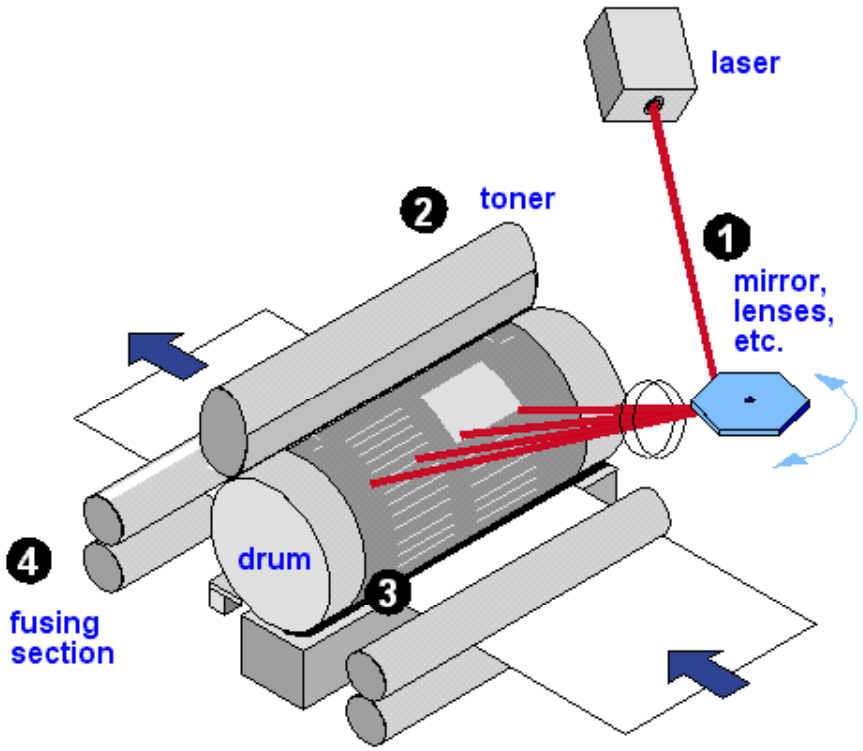
- Impact printers are those printer which produces text and images when tiny wire pins on print head strike the ink ribbon by physically contacting the paper.

- Impact printers are most functional in specialized environments where low-cost printing is essential. The three most common forms of impact printers are dot-matrix, daisy-wheel, and line printers.

Dot Matrix Printers

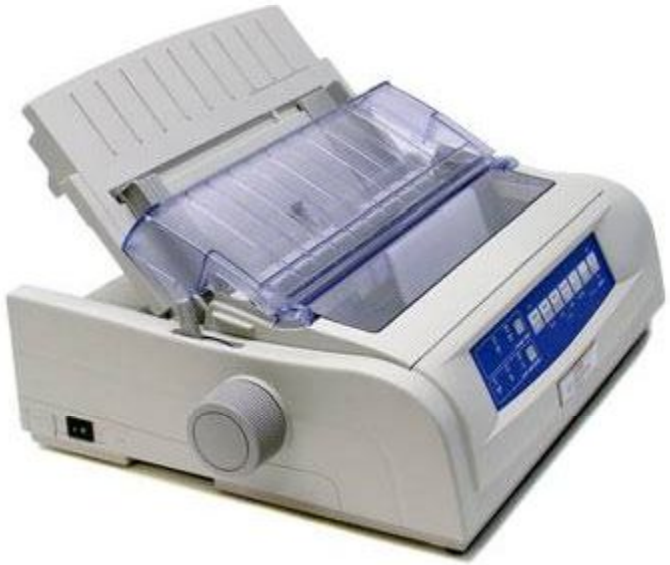
- The technology behind dot-matrix printing is quite simple. The paper is pressed against a *drum* (a rubber-coated cylinder) and is intermittently pulled forward as printing progresses. The electromagnetically – driven *printhead* moves across the paper and strikes the printer ribbon situated between the paper and printhead pin. The impact of the printhead against the printer ribbon imprints ink dots on the paper which form human-readable characters.
- Dot-matrix printers vary in print resolution and overall quality with either 9 or 24-pin printheads. The more pins per inch, the higher the print resolution. Most dot-matrix printers have a maximum resolution of around 240 *dpi* (dots per inch).

Daisy Wheel Printers



- Daisy-wheel printers have printheads composed of metallic or plastic wheels cut into *petals*. Each petal has the form of a letter (in capital and lower-case), number, or punctuation mark on it. When the petal is struck against the printer ribbon, the resulting shape forces ink onto the paper.
- Daisy-wheel printers are loud and slow. They cannot print graphics, and cannot change fonts unless the print wheel is physically replaced.
- With the advent of laser printers, daisy-wheel printers are generally not used in modern computing environments.

Line Printers



- Line printers have a mechanism that allows multiple characters to be simultaneously printed on the same line. The mechanism may use a large spinning print drum or a looped print chain. As the drum or chain is rotated over the paper's surface, electromechanical hammers behind the paper push the paper (along with a ribbon) onto the surface of the drum or chain, marking the paper with the shape of the character on the drum or chain.
- Because of the nature of the print mechanism, line printers are much faster than dot-matrix or daisy-wheel printers. However, they tend to be quite loud, have limited multi-font capability, and often produce lower print quality than more recent printing technologies.

Non-Impact Printers

- Non-impact printers are those which produces text and graphics on paper without actually striking the paper.
- The main types of non-impact printers are thermal printer, laser printer, inkjet printer.

Thermal Printers

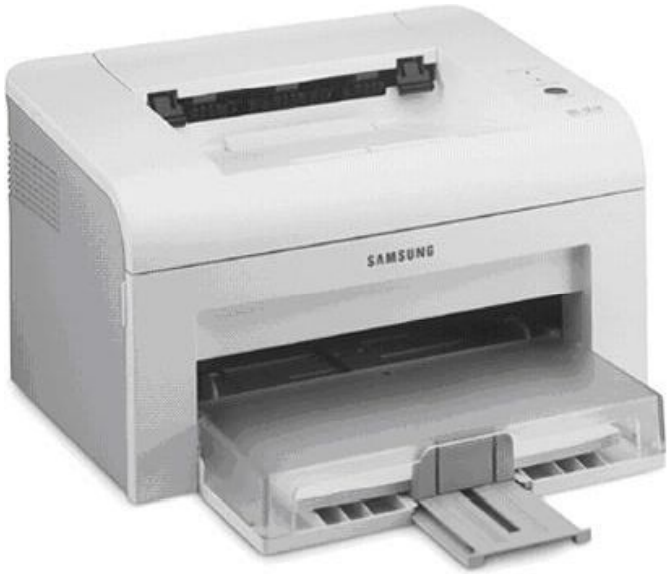
A Fax Machine uses a Thermal Printer

- Characters are formed by heated elements being placed in contact with special heat sensitive paper forming darkened dots when the elements reach a critical temperature.
- Thermal printer paper tends to darken over time due to exposure to sunlight and heat. The standard of print produced is poor.
- Thermal printers are widely used in battery powered equipment such as portable calculators.

Inkjet Printers

- Inkjet printers use quick-drying, water-based inks and a printhead with a series of small nozzles that spray ink onto the surface of the paper. The printhead assembly is driven by a belt-fed motor that moves the printhead across the paper.
- Inkjets were originally manufactured to print in *monochrome* (black and white) only. However, the printhead has since been expanded and the nozzles increased to accommodate cyan, magenta, yellow, and black. This combination of colors (called *CMYK*) allows the printing of images with nearly the same quality as a photo development lab

Laser Printers



- Laser printers are known for their high volume output and low cost-per-page. Laser printers are often deployed in enterprises as a workgroup or departmental print center, where performance, durability, and output requirements are a priority.
- Laser printers share much of the same technologies as photocopiers. Rollers pull a sheet of paper from a paper tray and through a *charge roller*, which gives the paper an electrostatic charge. At the same time, a printing drum is given the opposite charge. The surface of the drum is then scanned by a laser, discharging the drum's surface and leaving only those points corresponding to the desired text and image with a charge. This charge is then used to force toner to adhere to the drum's surface.
- The paper and drum are then brought into contact; their differing charges cause the toner to then adhere to the paper. Finally, the paper travels between *fusing rollers*, which heat the paper and melt the toner, fusing it onto the paper's surface.

Color Laser Printers

- Color laser printers aim to combine the best features of laser and inkjet technology into a multi-purpose printer package.
- The technology is based on traditional monochrome laser printing, but uses additional components to create color images & documents.
- Instead of using black toner only, color laser printers use a CMYK toner combination. The print drum either rotates each color and lays the toner down one color at a time, or lays all four colors down onto a plate and then passes the paper through the drum, transferring the complete image onto the paper.
- Color laser printers also employ fuser oil along with the heated fusing rolls, which further bonds the color toner to the paper and can give varying degrees of gloss to the finished image.
- Because of their increased features, color laser printers are typically twice (or several times) as expensive as monochrome laser printers.

LED / LCD Printers

- LED/LCD printers are types of electro photographic printers that are identical to laser printers in most ways. Both LCD (liquid crystal display) and LED (light-emitting diode) printers use a light source instead of a laser to create an image on a drum.
- In most contexts, "laser printer" covers LCD and LED printers as well.
- The print process is almost identical, but LED printers use Light Emitting Diodes to charge the drum, and the other uses Liquid Crystals.
- These printers produce a very high quality text and graphics print out.

Solid Ink Printers

- Solid Ink printers are page printers that use solid wax ink sticks in a "phase-change“ process. They work by liquefying wax ink sticks into reservoirs, and then squirting the ink onto a transfer drum, from where it is cold- fused onto the paper in a single pass.
- Solid-ink printers offer better color consistency than do most technologies, with little variation caused by changes in temperature, humidity, or type of paper.
- Solid ink machines have better reliability, because they have fewer components in comparison, for example with color laser printers .

Dye Sublimation Printers

• Dye Sublimation printers are professional devices widely used in demanding graphic arts and photographic applications. True these printers work by heating the ink so that it turns from a solid into a gas. The heating element can be set to different temperatures, thus controlling the amount of ink laid down in one spot. In practice, this means that color is applied as a continuous tone, rather than in dots, as with an inkjet. One color is laid over the whole of one sheet at a time, starting with yellow and ending with black. The ink is on large rolls of film which contain sheets of each color, so for an A4 print it will have an A4-size sheet of yellow, followed by a sheet of cyan, and so on.

• Dye sublimation requires particularly expensive special paper, as the dyes are designed to diffuse into the paper surface, mixing to create precise color shades.

Portable Printers

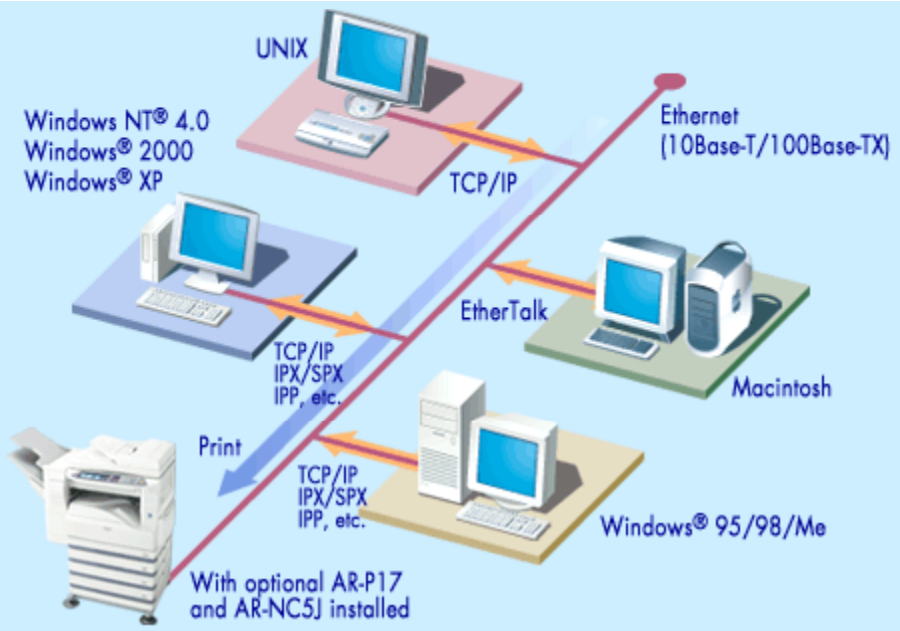
• Portable printers are usually fairly lightweight and sometimes carry the option of using a battery instead of drawing power from the computer.
• Usually they realize basic print resolutions suitable for plain text printing. In the market the following types of the portable printers are available: Thermal printer, Thermal transfer printer and Ink-Jet printer.
• The main advantage of thermal and thermal transfer printers is that they can be very small.
• The smallest thermal and thermal transfer printers weigh approximately one pound. Usually the ink-jet portable printer weighs more than 2 pounds. Thermal printers require a special type of paper.

Digital Photo Printers

- Digital Photo printers Many middle range printers are now able to print photo quality images.
- Usually an option with color printers, specialist photo print heads allow a greater resolution to be achieved to improve photo image quality.
- Photo ink jet printers expand their gamuts by adding additional ink colors, usually light cyan and light magenta.

Network Printers

- Network printer is a printer that provides output capabilities to all network users.



EZ CD / DVD Printer

- EZ CD/DVD Printers: provide a low cost way to create professional printed CD-Rs and DVD-Rs. Instead of writing on the CD or applying labels, you can print directly on the CD surface! With high speed capabilities, a full color image can be printed directly on the top surface of your CDs in less than 1 minute.

Label Printer

- Label Printers are the smartest way to print labels one at a time. The printers allow easy installation.
- High-quality, professional results is guaranteed every time.

VersaLaser Printer

- VersaLaser™ (Universal Laser Systems Inc.) is peripheral tool, that can transform images or drawings on your computer screen into real items made out of an amazing variety of materials… wood, plastic, fabric, paper, glass, leather, stone, ceramic, rubber… and it's as easy to use as your printer.

3D Printer

•3D Printers (Z corporation). The ZPrinter 310 System creates physical models directly from computer-aided design system ("CAD") and other digital data in hours instead of days. The printer is fast, versatile and simple, allowing engineers to produce a range of concept models and functional test parts quickly and inexpensively. The system is ideal for an office environment or educational institution, providing product developers easy access to a 3D Printer.

Characteristics of a Printers

- **Quality of Type**: The output produced by printer is said to be ether letter quality, near letter quality, or draft quality.
- **Speed**: Measured in characters per second or pages per minute, the speed of printer varies widely.
- **Impact or Non-Impact**: Impact printers include all printers that work by striking an ink ribbon. Non-impact printers work as per electro-chemical technology.
- **Graphics**: Some printers can print only text while other printers can print text as well as graphics.
- **Fonts**: Some printers are limited to one or few fonts while some printers are capable of supporting unlimited variety of fonts.

Speakers

- Speakers are used to play sound.
- They may be built into the system unit or connected with cables.
- Speakers allow a user to listen to music and hear sound effects coming from the computer system.
- Some computer displays have basic speakers built-in.
- Laptops come with integrated speakers.

Projector

An output device that can take the display of a computer screen and project a large version of it onto a flat surface. Projectors are often used in meetings and presentations to help make sure everyone in the room can view the presentation.

Auxiliary Storage Device

- The main memory construction is costly. Therefore, it has to be limited in size.
- The main memory is used to store only those instructions and data which are to be used immediately.
- However, a computer has to store a large amount of information. The bulk of information is stored in the auxiliary memory.
- Auxiliary memory is also called backing storage or secondary storage and also known as non-volatile memory .
- Auxiliary memory includes hard disk, floppy disks, CD-ROM, USB flash drives, etc.

Hard Disk

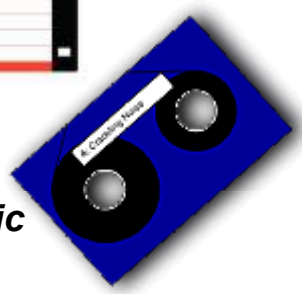
Flash Drive

Compact Disk

Digital Video Disk

Floppy Disk

Magnetic Tape



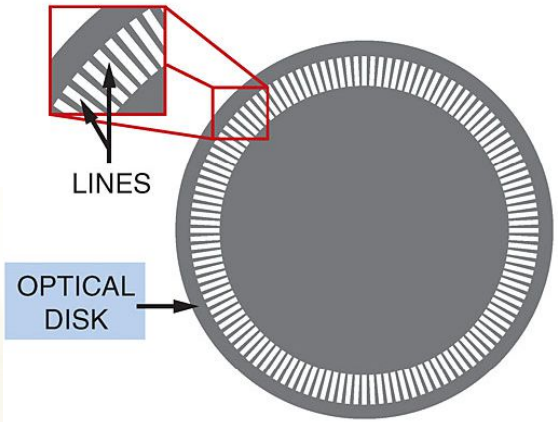
Secondary Storage Medium

Following are the mediums used as secondary storag

Magnetic Tapes

Magnetic Disk

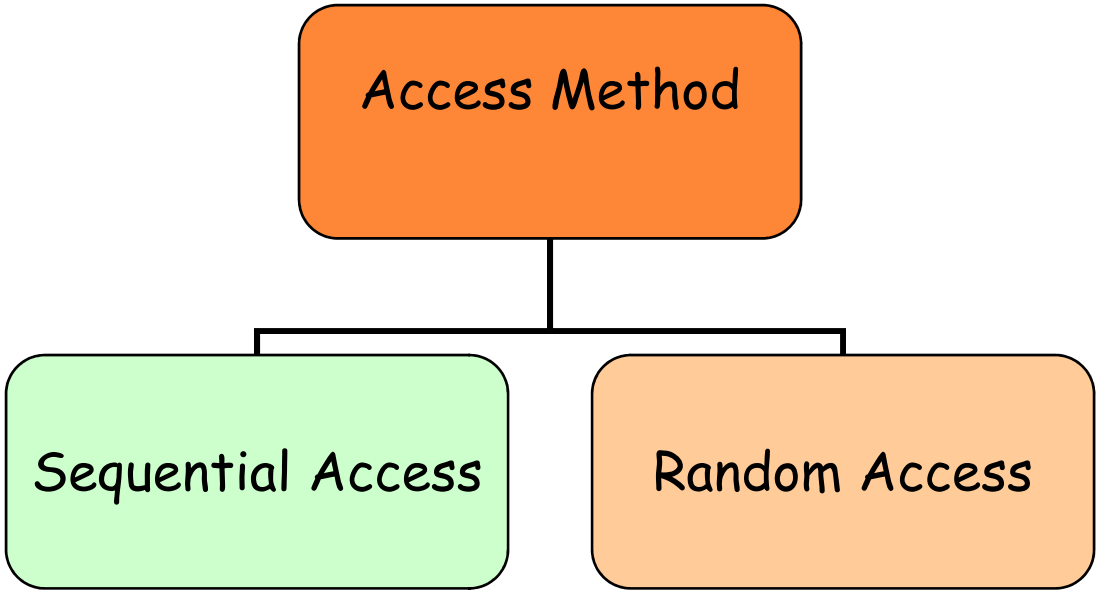
Magneto-Optical Disk



Optical Disk

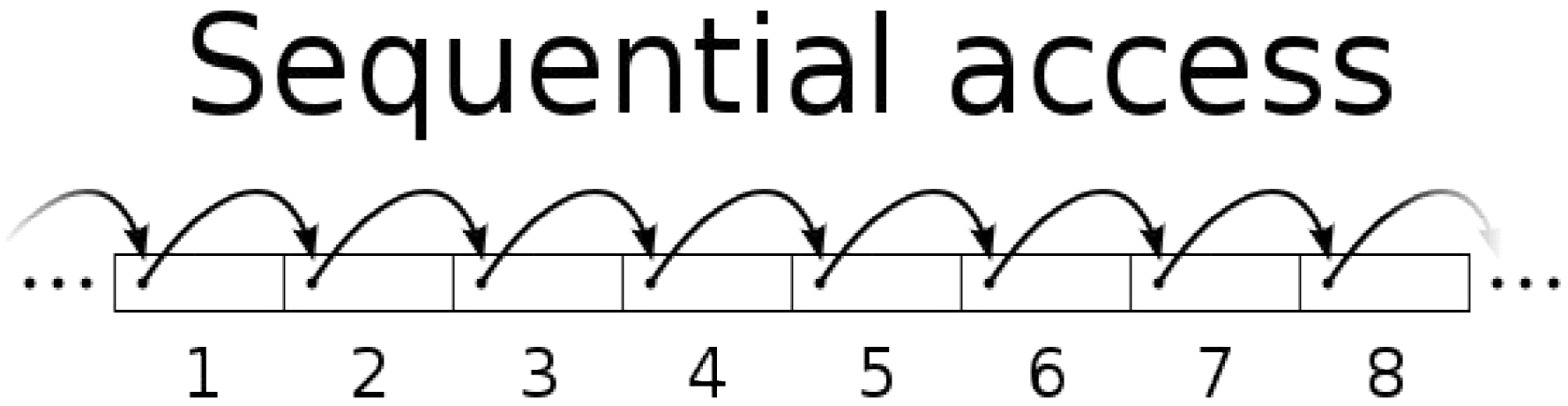
Secondary Storage Access

- The act of retrieving pieces of stored information is called access.
- Access time is the average time taken from the device to search and read the required data on the storage medium.
- Shorter access time means higher searching speed.



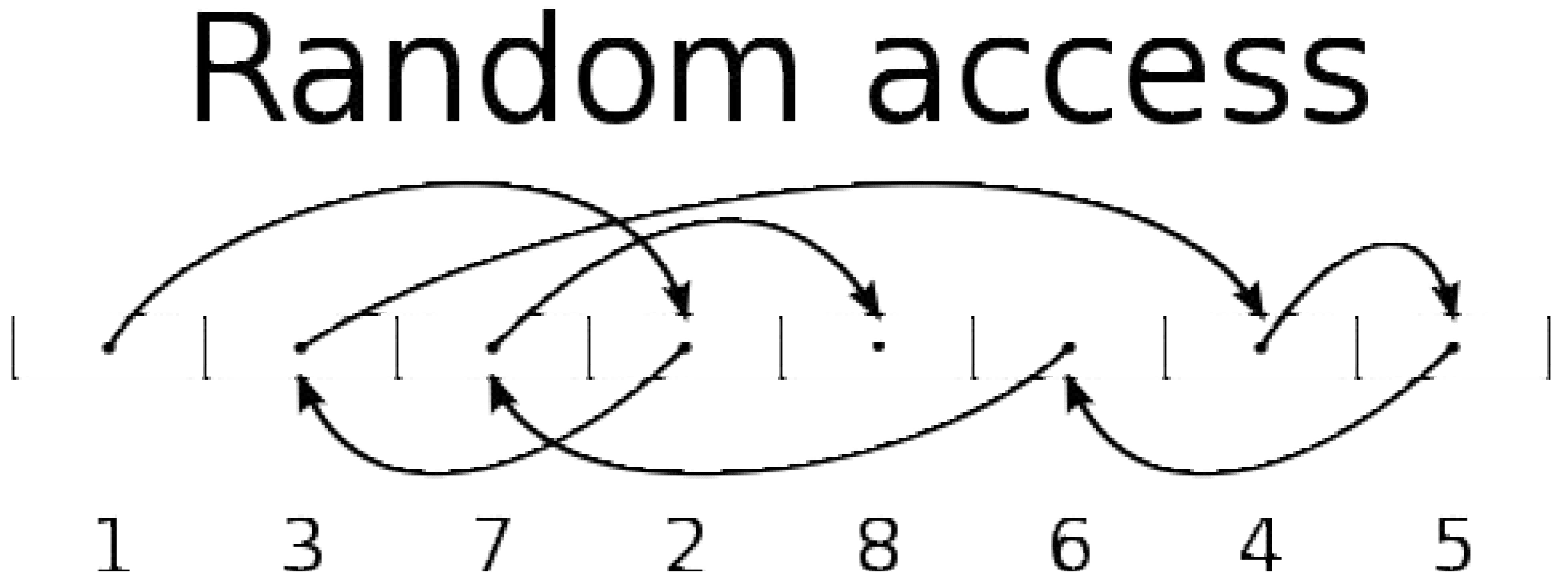
Sequential Access

In sequential access, the items are traversed one by one from the beginning of the sequence to the desired one.



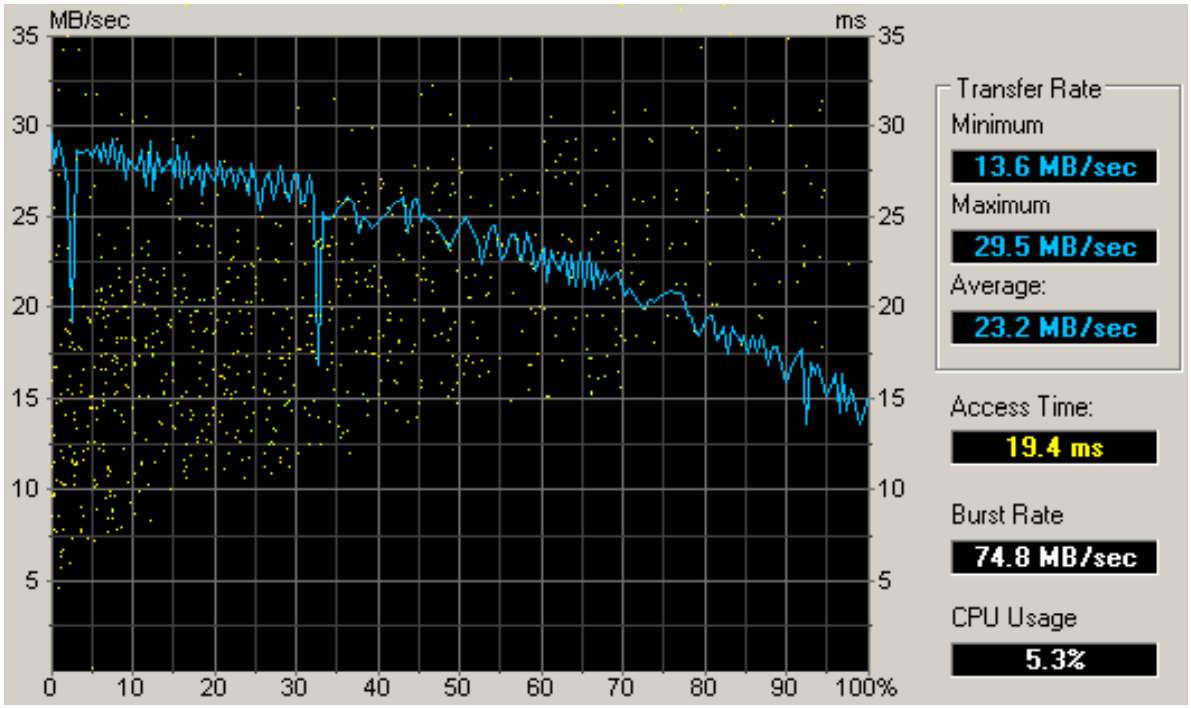
Random Access

In random access, also call direct access, any item can be accessed relatively independently of its location in the sequence.



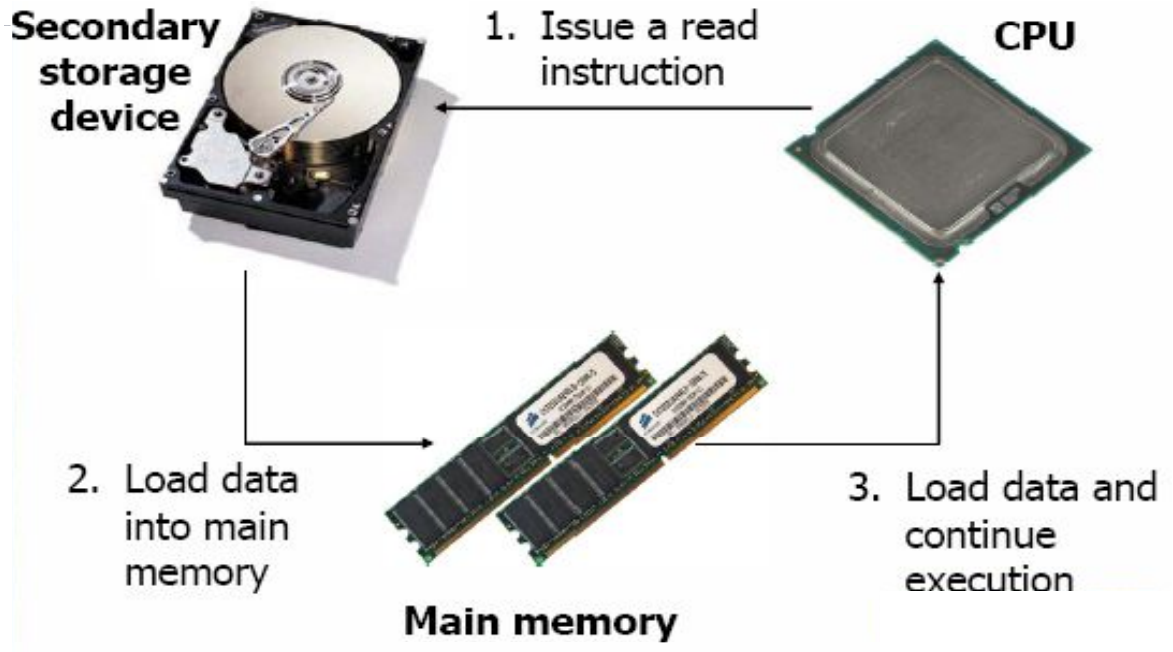
Data Transfer Rate

- Data transfer rate is the amount of data that can be transferred between the main memory and a storage device per second.
- The unit of data transfer rate is bps (bits per second).
- Higher data transfer rate means faster reading / writing process.



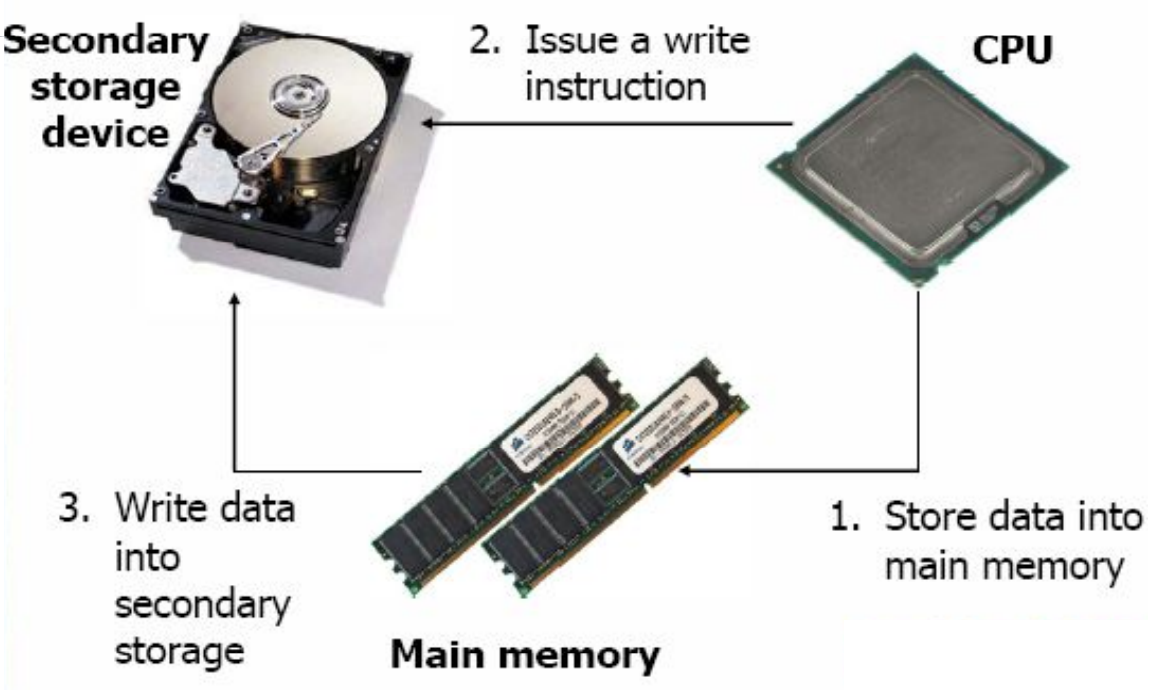
Reading Data

Steps for reading data from secondary storage devices is shown as follows:-



Writing Data

Steps for writing data into secondary storage devices is shown as follows:-



MAGNETIC TAPES

- Magnetic tape is the most popular and oldest storage medium used to store large amount of data and instructions permanently.
- Storing data on tapes are cheaper than storing data on disks.
- Tapes have large storage capacities
- Accessing data on tapes is much slower than that from disks. So generally are used for long-term storage and backup.
- Therefore the regularly used data is kept on the disk.
- Tapes are also used for transporting large amounts of data.
- Tapes are sometimes called Streamers or streaming tapes.

Types Of Magnetic Tapes

- Following are the types of magnetic tapes:-

1. **Helical Scan Cartridge**- The term helical scan refers to 8mm tapes. It has data capacity from 2.5GB to 5GB.
2. **DAT(Digital Audio Tape)**- It is slightly larger than a credit card and contains a magnetic tape that holds from 2 to 24GB of data. It can support data transfer rate of about 2MBPS(Million Bytes Per Second). The most common format of DAT is DDS(Digital Data storage).

Digital Data Storage (DDS)

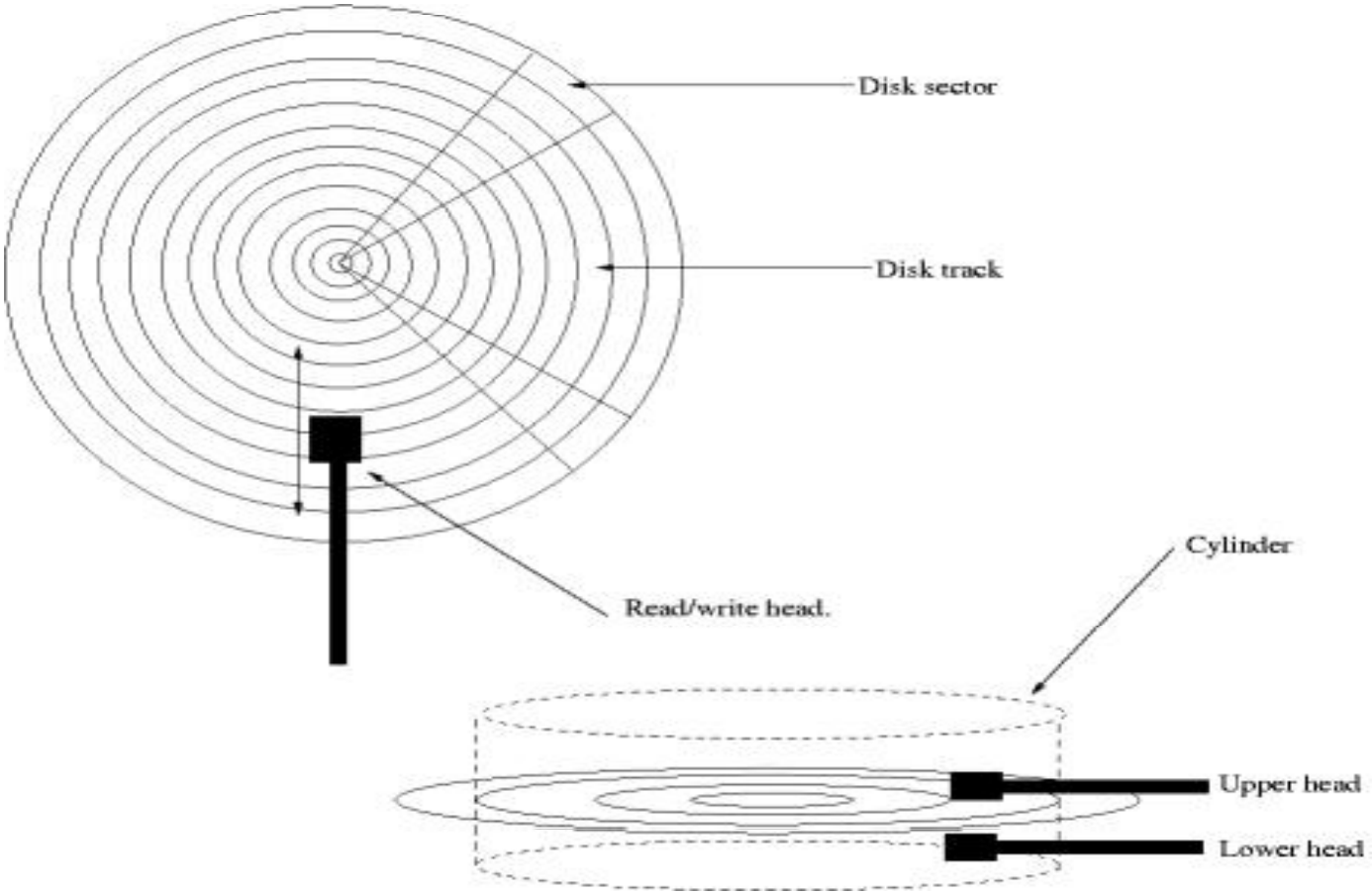
WINCHESTER DISK

- IBM's Winchester disk was a removable cartridge, but the heads and platters were built in a sealed unit and were not separable. (Hard Disk).

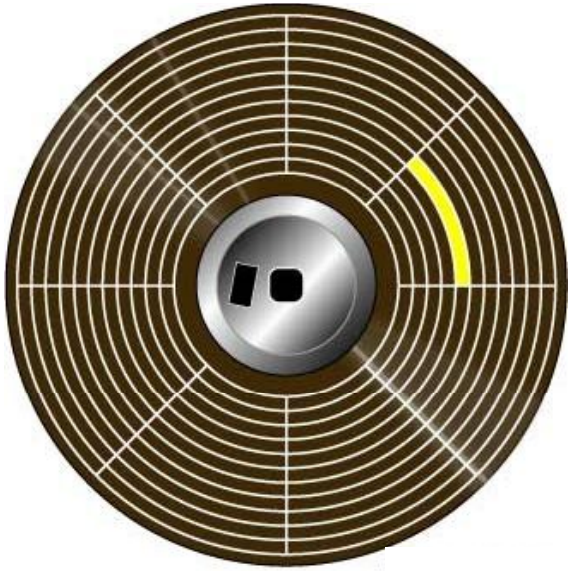
HARD DISK

- The term hard is used to distinguish it from soft, or floppy disk.
- Hard disk hold more data and faster than floppy.
- A single hard disk consists of several platters.
- Each platter requires read/write heads. All heads are attached to a single access arm so that these cannot move independently.
- Each platter has same number of tracks.

TRACKS AND SECTORS

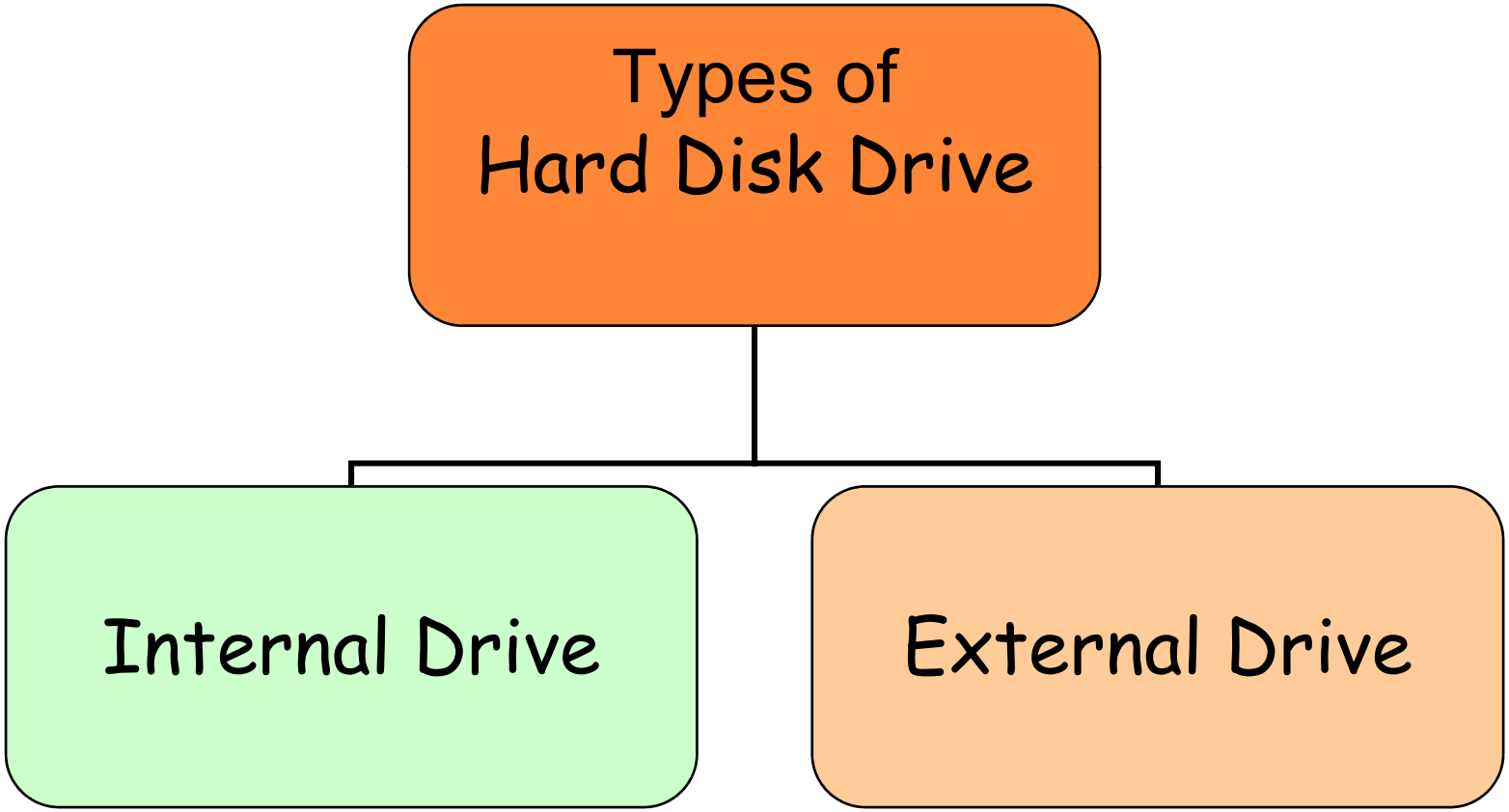


HARD DISK (ANATOMY)



User can see how the disk is divided into tracks (brown) and sectors (yellow).

Types of Hard Disk Drive



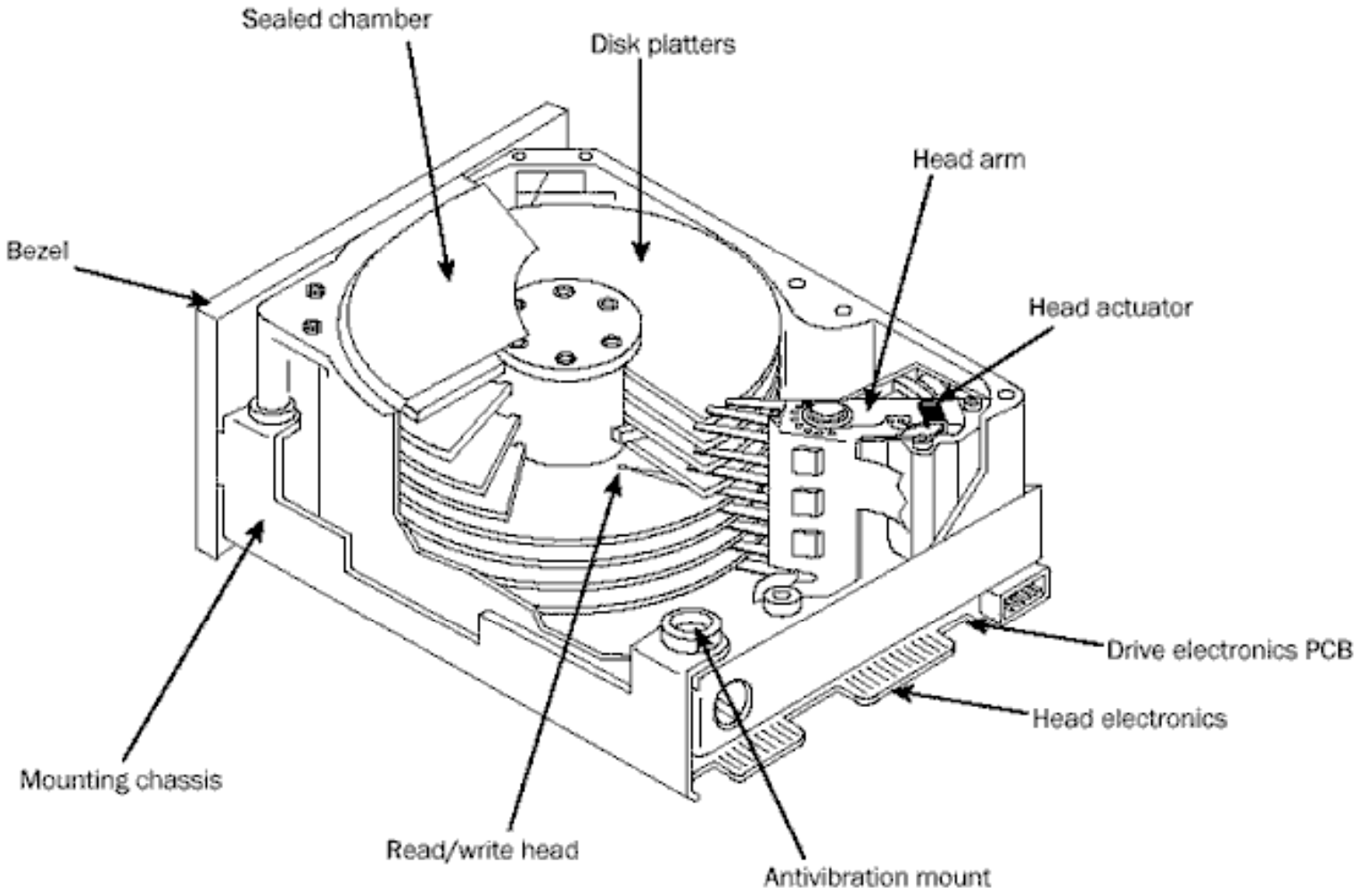
Internal Hard Disk Drive

The internal hard disk drives are used for the storage of the data in the computer case. There are not portable and usually are inside the case.

External Hard Disk Drive

The external hard disk drives are portable can be connected to other computer systems as well. There is a hard casing over the hard disk.

Hard Disk Drive Components



OPTICAL DISK

- They are the storage medium for which data is read and to which it is written by laser.
- They store up to 6 GB(6 billion bytes) than magnetic media, like floppies and hard disk.

OPTICAL DISK

•Three basic types of optical disks are:-

1) **CD-ROM**- It is abbreviation of "Compact Disk Read-Only Memory" store large amount of permanent data up to 1GB and can be read any number of times, but cannot be modified. These can be either internal or external.

2) **WORM**- This term stands for "Write-Once Read-Many". With WORM disk drive, we can write data on to a WORM disk, but only once. After that it behaves like a CD-ROM.

3) **ERASABLE** – These are optical disk which can be erased and loaded with new data , just like magnetic disks. Often referred as EO(Erasable Optical) disks.

These three technologies are not compatible with each other, each require a different type of disk drive and disk

1st Generation Optical Disk

Initially, optical discs were used to store music and computer software. The laser disc format stored analog video signals.

- Compact Disc (CD)
- Laser disc
- Magneto-optical disc
- Mini disc
- DVD

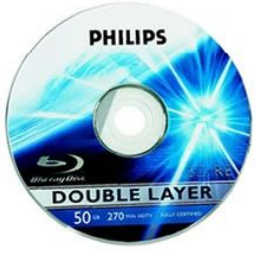
2nd Generation Optical Disk

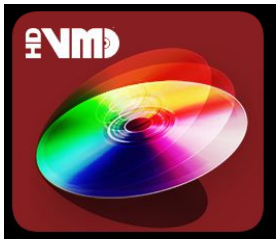
Second-generation optical discs were for storing great amounts of data, including broadcast-quality digital video.

- Hi-MD
- DVD and derivatives
  - DVD-Audio
  - DualDisc
  - Digital Video Express (DIVX)
- Super Audio CD
- Video CD
- Super Video CD
- Enhanced Versatile Disc
- GD-ROM
- DataPlay
- Phase-change Dual
- Universal Media Disc
- Ultra Density Optical

3rd Generation Optical Disk

Third-generation optical discs are in development, meant for distributing high-definition video and support greater data storage capacities, accomplished with short-wavelength visible-light lasers and greater numerical apertures.





Currently shipping:

- Blu-ray Disc
- HD VMD Disc
- CBHD Disc

In development:

- Forward Versatile Disc
- Digital Multilayer Disk / Fluorescent Multilayer Disc

Abandoned:

- HD DVD

Next Generation Optical Disk

The following formats go beyond the current third-generation discs and have the potential to hold more than one terabyte (1TB) of data:

- Holographic Versatile Disc
- LS-R (Layer-Selection-Type Recordable Optical Disk)
- Protein-coated disc

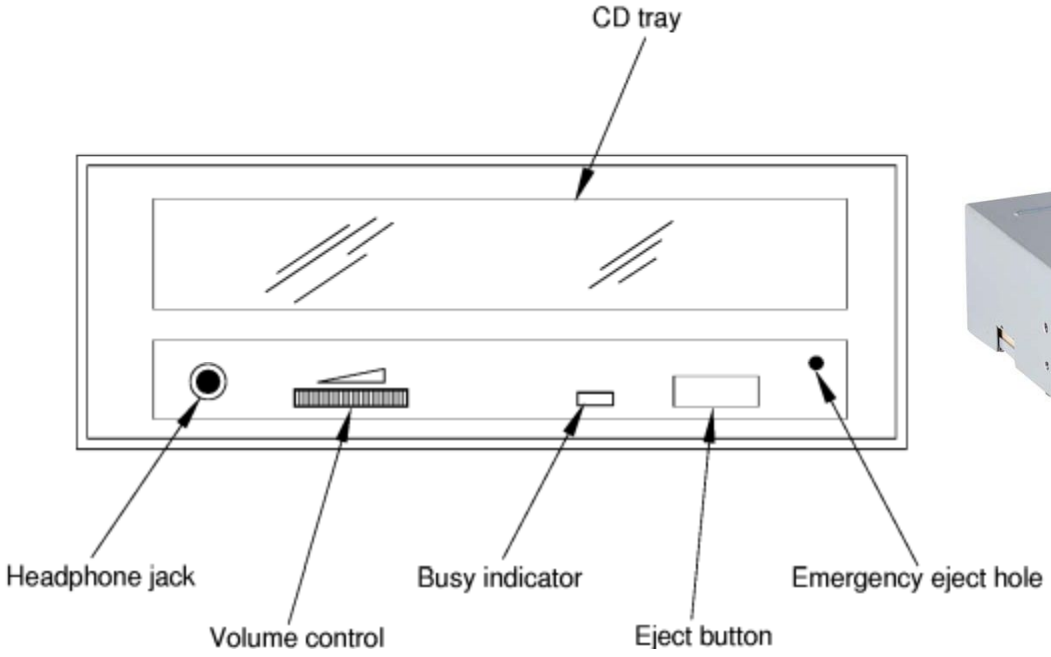
HVD
Holographic Versatile Disc

CD-ROM

- CD-ROM stands for Compact Disc Read-Only-Memory.
- It was introduced in 1984.
- CD-ROM is a type of optical disc that uses laser technology to store and to read data to and from the disc.
- A large amount of data can be stored on a single disk.
- Once the information is stored on the CD-ROM, it becomes permanent and cannot be changed (altered). The information can only be read for processing.
- The CD-ROM is removable and can be used to transfer data from one computer to another like a floppy disk.
- A typical CD-ROM has storage capacity from 650 MD to 1GB.

CD-ROM Drive

- The CD-ROM drive is used with computer to read the information from the CD-ROM.
- Today, CD-ROM drives have transfer rates (or speeds) ranging from 48X to 75X or more.



CD-Writer

- A CD-writer or recorder is used to write data on CD-R disks.
- Usually, a CD-writer can read information from CD as well as write information on CD.
- Today, most of the PCs have CD writer.
- The speed of these drives is up to 48X or more.
- These drives are more expensive than ordinary CD-ROM.

CD-R

- CD-R stands for Compact Disc Recordable which is a blank disk that is used to store information.
- It was introduced in 1988.
- The user can also write data on an optical disc.
- The process of writing data on the optical disc is called burning.
- A locally developed CD-R can be used in any CD-ROM drive.
- It must be noted that once data is written on the CD-R. It cannot be changed. However, a user can store data on other part of the disk until it is full. Each part of a CD-R can be written only one time and can be read as many times.
- The CD-writer is used to write data on CD-R.
- The main disadvantage of CD-R is that information can be written only once. These cannot be overwritten and erased.

CD-RW

- CD-RW stands for compact Disc Rewritable.
- It was introduced in 1996.
- The CD-RW is a new generation of optical disk.
- It is erasable disc.
- The user can write and over-write data on the CD-RW disc many times.
- The CD-RW acts like a floppy and hard disk that allow users to write and re-write data.
- However, the reliability of the disc tends to decrease, each time you rewrite data.

Magneto Optical Disc

- A magneto-optical drive is a kind of optical disc drive capable of writing and rewriting data upon a magneto-optical disc.
- Both 130 mm (5.25 in) and 90 mm (3.5 in) form factors exist.
- The technology was introduced at the end of the 1980s.

Close up of Magneto-optical Disk surface

Magneto Optical Disc

2.6 GB Mangneto-Optical Disc

DVD

DVD also known as Digital Versatile Disc or Digital Video Disc is a popular optical disc storage media format. DVD-ROM has data that can only be read and not written, DVD-R and DVD+R can record data only once and then function as a DVD-ROM. DVD-RW, DVD+RW and DVD-RAM can both record and erase data multiple times. The wavelength used by standard DVD lasers is 650 nm and thus the light has a red color.

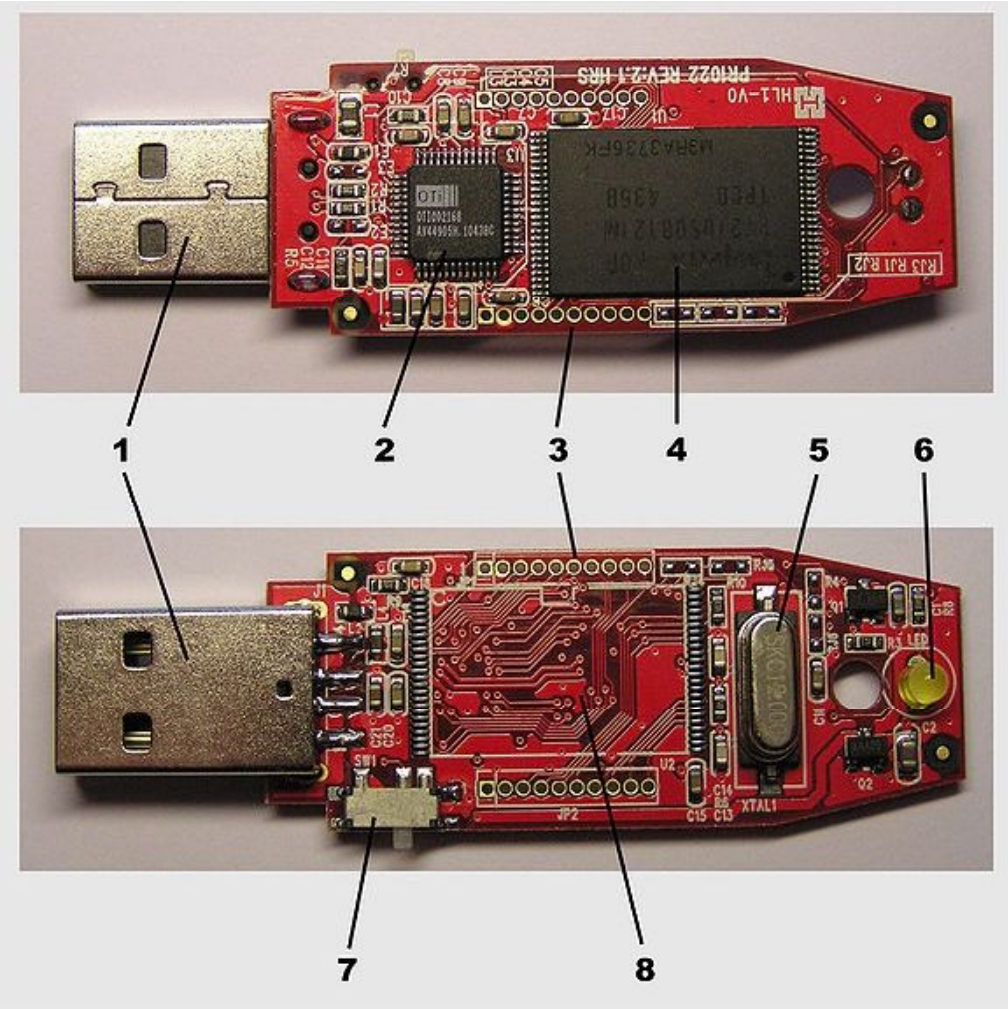
As next generation high-definition optical formats also use a disc identical in some aspects yet more advanced than a DVD, such as Blu-ray Disc, the original DVD is occasionally given the retronym SD DVD (for *standard definition).*

USB FLASH DRIVE

A USB flash drive consists of a NAND-type flash memory data storage device integrated with a USB (Universal Serial Bus) interface. USB flash drives are typically removable and rewritable, much smaller than a floppy disk (1 to 4 inches or 2.5 to 10 cm) and weigh less than 2 ounces (56 g). Storage capacities typically range from 64 MB to 64 GB with steady improvements in size and price per gigabyte. They have a more compact shape, operate faster, hold much more data, have a more durable design and operate more reliably due to their lack of moving parts. These types of drives use the USB mass storage standard, supported natively by modern operating systems such as Windows, Mac OS X, Linux and other Unix-like systems.

A flash drive consists of a small printed circuit board protected inside a plastic, metal or rubberised case, robust enough for carrying with no additional protection.and most flash drives use a standard type-A USB connection allowing plugging into a port on a personal computer.

Inside USB Drive



1 USB connector

2 USB mass storage controller device

3 Test points

4 Flash memory chip

5 Crystal oscillator

6 LED

7 Write-protect switch

8 Space for second flash memory chip