Computer Fundamentals and Digital Principles

Books of Study:

- Introduction to Computers (Ed. 6) - Peter Nortons
- Computer Fundaments (Ed 4) – P K Sinha & Priti Sinha
- Digital Logic & Computer Design (Ed. 4) - M Morris Mano

References Text:

- Digital Computer Fundaments (Ed. 6) – Thomas C Bartee
- Digital Fundaments (Ed. 9) – Thomas L Floyd
- Digital Principles & Applications (Ed. 6) – Malvino & Leach

FUNDAMENTALS OF COMPUTER

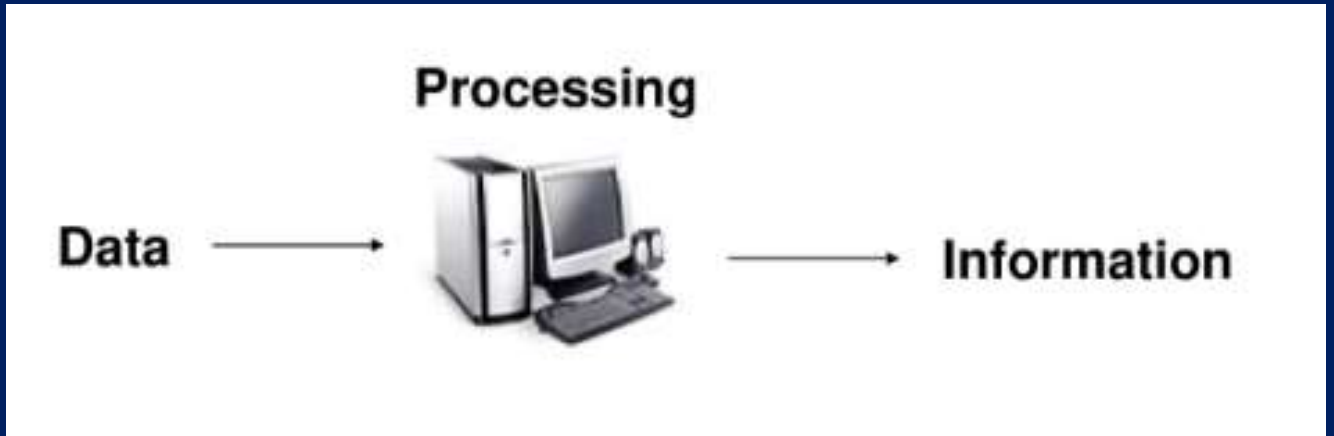
Module 1
Objectives

- Introduction:
- Functional units of a computer system
- Different types of computers
- Computer Software and Hardware
- Types of software - System software and Application programme.
- Characteristic of computers.
- Input Devices – Keyboard, Mouse, Optical input devices
- Output devices – Monitors and Printers.

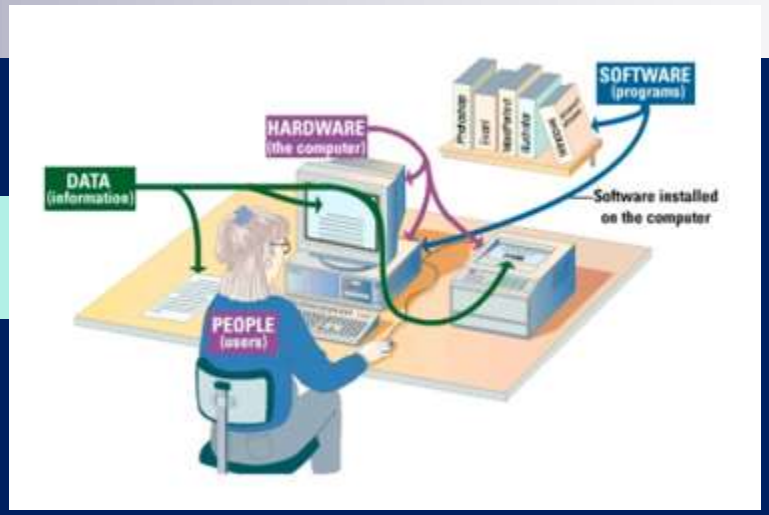
A desktop machine

What is a Computer?

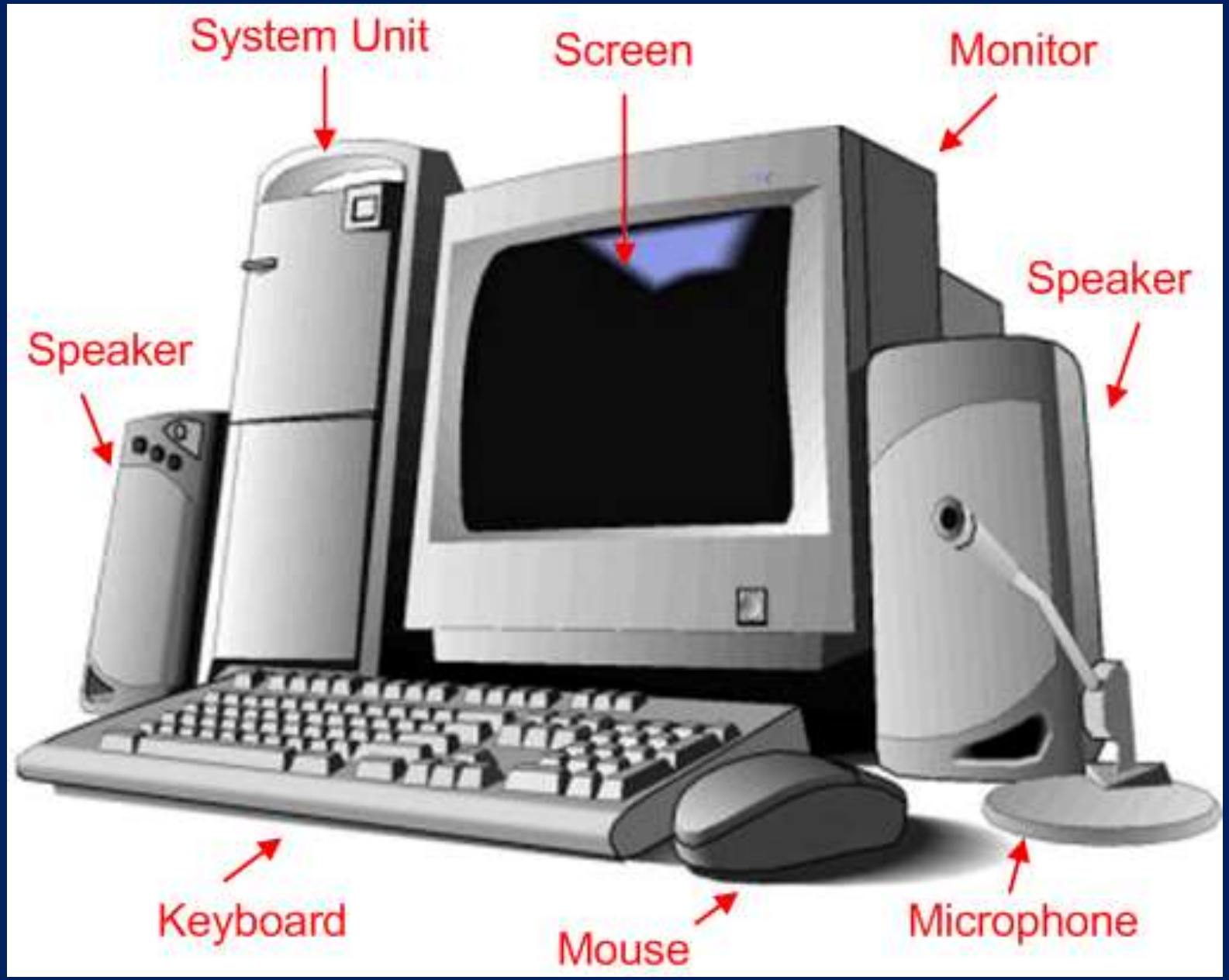
- An electronic machine that follows a set of instructions to process data and transform them into information.
- A data processor



Parts of a Computer :



- **DATA** : Collection of independent and unorganized facts.
  - **Information:** Processed and organized data presented in a meaningful form.
  - **Data Processing:** includes capturing input data, manipulating the data & managing output results.
- **Hardware**: physical parts of the computer
- **Software:** Instructions to the computer
- User


System Unit
Screen
Monitor
Speaker
Speaker
Keyboard
Mouse
Microphone

- Hardware
- They fall into one of four categories:
- - Processor (brain of computer) : microprocessor, CPU
- - Memory – RAM & ROM
- - Input and Output devices
- - Storage – Storage devices such as hard disk, floppy disk, CD-ROM

Functionalities of a Computer

1. It accepts and gather data. (INPUT)
2. It processes data to become information. (PROCESSING)
3. It stores data and information. (STORE)
4. It presents information. (OUTPUT)

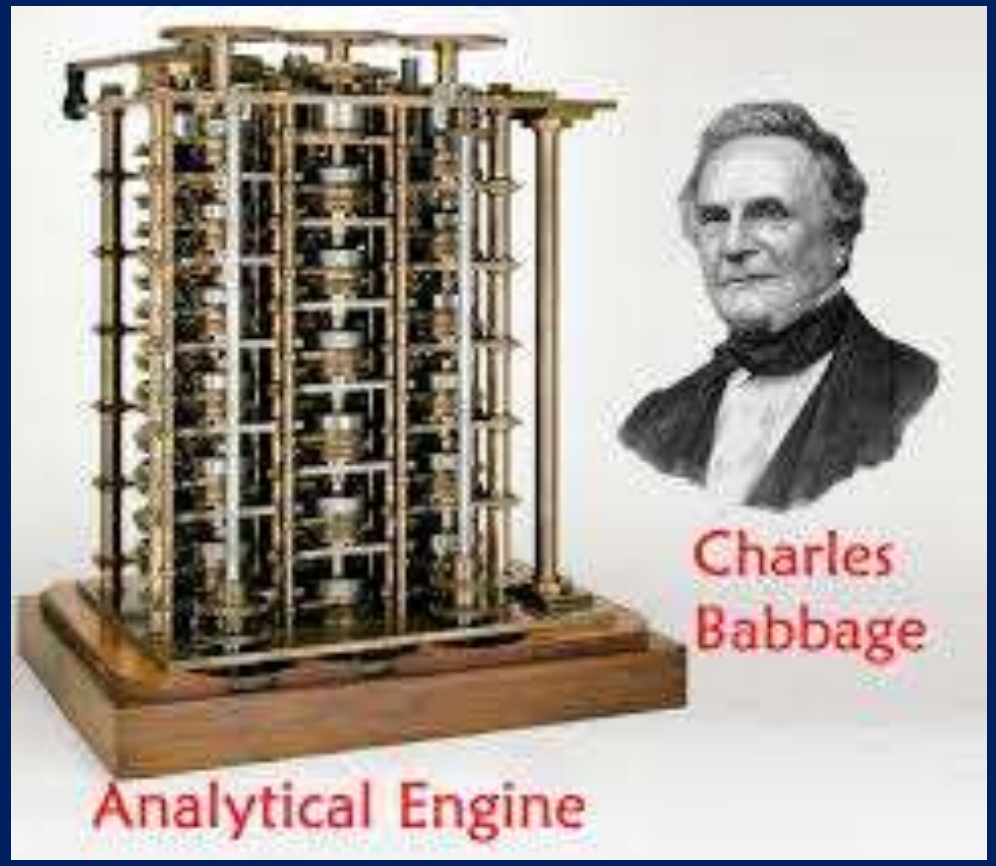
EVOLUTION OF COMPUTERS

- Blaise Pascal (1642) – 1st mechanical adding machine

- Baron Gottfried Wilhelm Von Leibniz (1671) – 1st calculator (for multiplication)
- Keyboard machines - US
- Herman Hollerith – punched cards concept

EVOLUTION OF COMPUTERS

- Charles Babbage - Difference Engine (reliable table)- Analytical Engine(basic arithmetic) – established number of principles (digital computer)



father of modern digital computer

EVOLUTION OF COMPUTERS

- Well-known early computers
  - The Mark 1 Computer (1937-1944)
  - The Atanasoff-Berry Computer (1939-42)– Atanasoff-Berry Computer - ABC
  - The **ENIAC** (1943-46)- Electronic Numerical Integrator and Calculator (first all electronic computer)
  - The **EDVAC** (1946-52) - Electronic Discrete Variable Automatic Calculator - Stored Program Concept
  - The **EDSAC** (1947-49) - Electronic Delay Storage Automatic Calculator
  - The **UNIVAC** 1(1951)- UNIversal Automatic Computer.

Arrival of commercially available digital computers

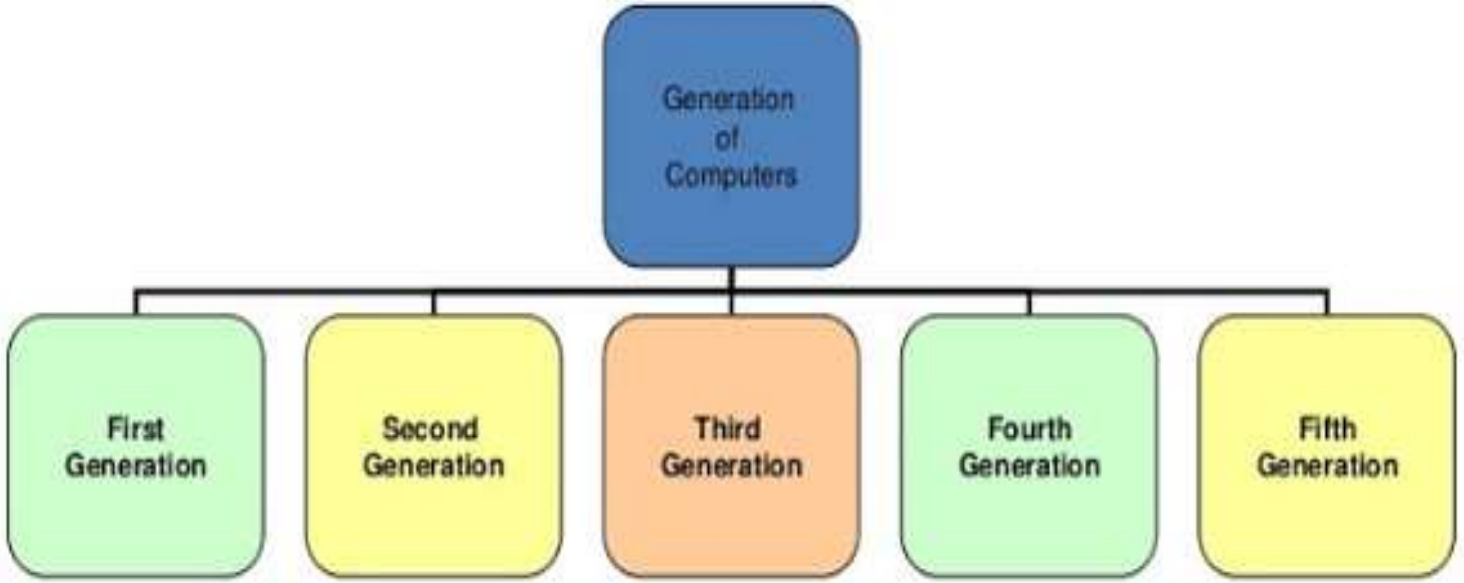
1951: UNIVAC – 1st Commercial Computer

1,905 operations per second

Cost: $750,000 + $185,000 for printer

GENERATIONS OF COMPUTER

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



Generation (Period)	Key hardware technologies	Key software technologies	Key characteristics	Some representative systems
First 	Vacuum Tubes	Machine & Assembly language. Stored program concept.	Huge Size, unreliable, costly, less user friendly	ENIAC, EDVAC, EDSAC, UNIVAC 1, IBM701
Second 	Transistors	High level programming languages (HLL) Batch Operating system (OS)	Faster, smaller, more reliable, costly	Honeywell 400, IBM 7030, UNIVAC LARC
Third 	ICs – SSI & MSI	Standardization of HLL	Faster, smaller, more reliable, cheaper	IBM 360/370
Fourth	ICs – VLSI microprocessors	OSs for PCs UNIX OS, C language	Small, affordable, reliable, more powerful	IBM PC, VAX 9000
Fifth	ICs – ULSI Internet	WWW	Portable computers, more powerful, cheaper, reliable, easier to use	IBM notebooks, Pentium PCs, PARAM 10000

Integrated Circuits

Complexity	Number of Gates
Small-scale integration(SSI)	<12
Medium-scale integration(MSI)	12 to 99
Large-scale integration(LSI)	100 to 9999
Very large-scale integration(VLSI)	10,000 to 99,999
Ultra large-scale integration(ULSI)	100,000 to 999,999
Giga-scale integration (GSI)	1,000,000 or more

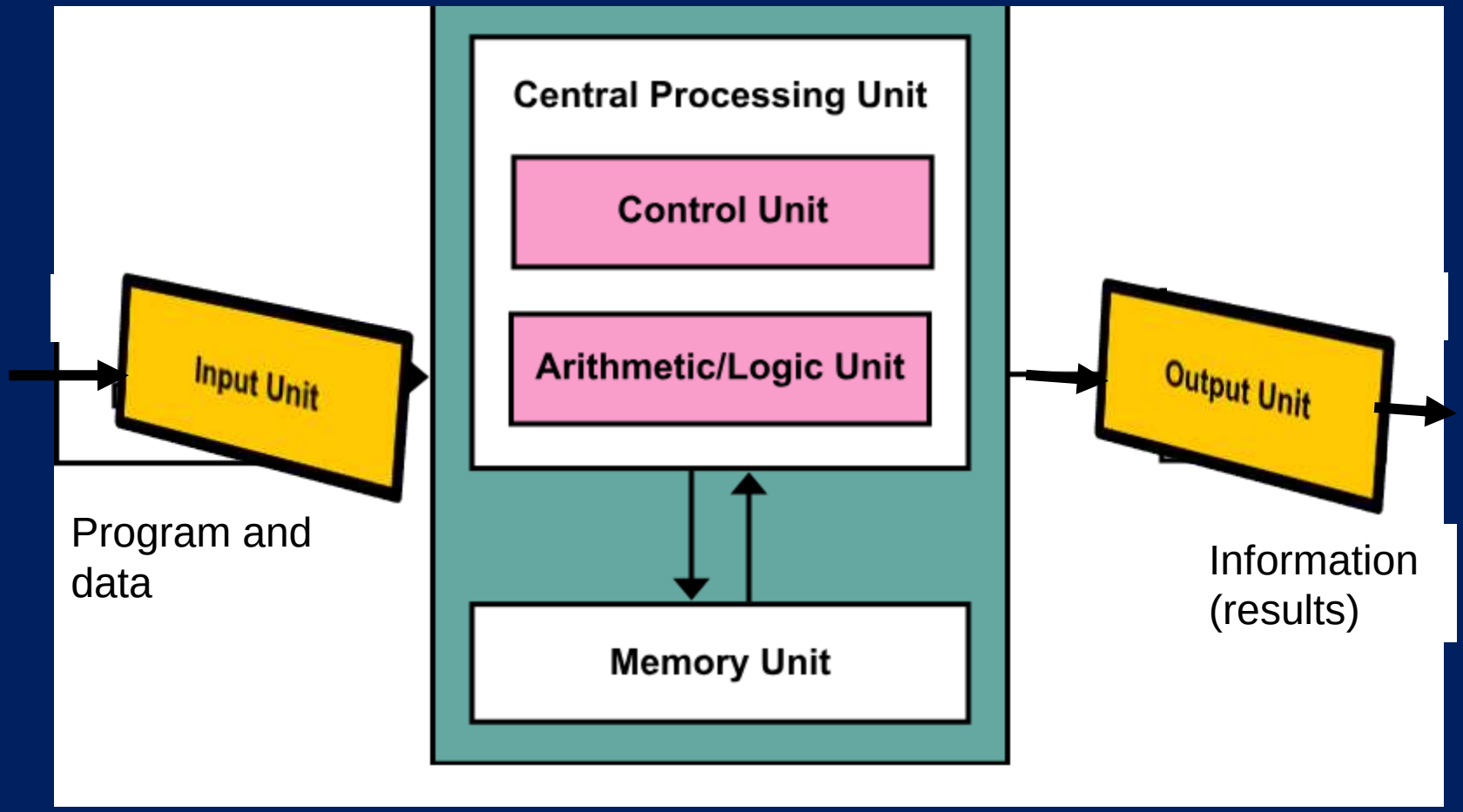
Microprocessor
an integrated circuit that contains all the functions of a central processing unit of a computer.

Basic Computer Organization

- Logical Structure of computer – based on the stored program concept – John Von Neumann

- Stored program concept - programs and data are stored in a separate storage unit called memories and are treated the same.

Functional Units of a Computer



Information Handled by a Computer

- Instructions/machine instructions
  - Govern the transfer of information within a computer as well as between the computer and its I/O devices
  - Specify the arithmetic and logic operations to be performed
  - List of instructions is called a Program
- Data
  - Used as operands by the instructions
  - Source program
- Encoded in binary code – 0 and 1

INPUT UNIT

- Functions:
  - It accepts (or reads) instructions & data from outside world
  - It converts these instructions & data in computer acceptable form
  - It supplies the converted instructions & data to computer system for further processing

OUTPUT UNIT

- Functions:
  - It accepts the results produced by a computer, which are in coded form
  - It converts these coded results to human readable form.
  - It supplies the converted results to outside world.

MEMORY UNIT

- A storage unit hold (stores):
  - Data & instructions received from input devices
  - Intermediate results of processing
  - Results for output, before they are released to an output device.
  - capable of storing information temporarily or permanently
- Types
  - Primary Memory (main memory)
  - Secondary Memory (auxiliary memory)

Primary Memory

- Primary memory is computer memory that is accessed directly by the CPU.
- RAM
  - The term memory or primary memory is typically used to mean RAM(Random Access Memory).
  - Hold pieces of program instructions & data, intermediate results of processing & recently produced results
  - Data is both written to & read from this memory (read/write memory)
  - Can hold information only while computer is on (Volatile memory).
  - Has limited storage capacity – very expensive
  - Made of semiconductor devices

Primary Memory

- ROM (Read-Only Memory)
  - Also a type of primary memory directly accessed by the CPU.
  - Unlike RAM, ROM permanently store its data even when the computer is shut off.
  - Non-volatile memory because it never loses its contents.
  - Holds instructions that the computer needs to operate.
  - Whenever the computer’s power is turned on, it checks ROM for directions that help it start up, & for information about its hardware devices.

Secondary Memory

- Used to take care of limitations of primary storage
- Secondary storage cannot be directly accessed by the CPU, non-volatile and is internal or external to the computer.
- Cheaper, retains information even when a computer switches off.
- Holds program instructions, data & information of jobs currently not working job.
- Eg. Magnetic disks

ARITHMETIC LOGIC UNIT(ALU)

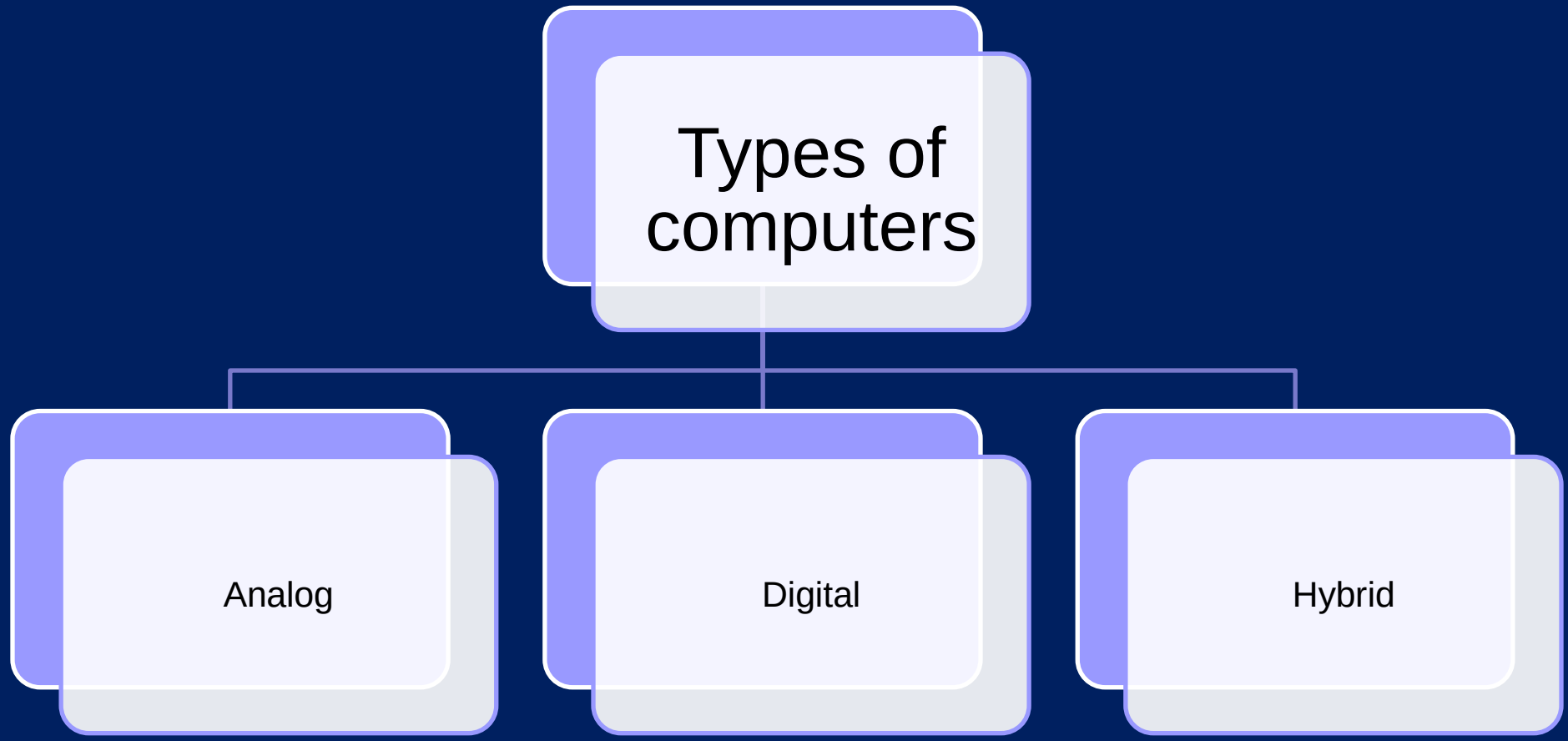
- Place where actual execution of instruction takes place.
- Calculations & comparisons are made in the ALU.
- Data & instructions stored in primary storage before processing are transferred as & when needed to the ALU where processing takes place.
- Intermediary results generated in ALU are temporarily transferred back to primary storage until needed later.
- Most ALUs designed to perform basic arithmetic operations & logic operations or comparisons (less than, equal to & greater than).

CONTROL UNIT (CU)

- It manages & coordinates the entire computer system.
- It obtains instructions from the program stored in main memory, interprets the instructions, & issues signals causing other units of the system to execute them.

CENTRAL PROCESSING UNIT

- Control Unit and arithmetic logic unit of a computer are together known as the Central Processing Unit (CPU)
- Brain of a computer system
- All major calculations & comparisons take place inside the CPU
- CPU is responsible for activating & controlling the operations of other units of the computer system.


Types of computers
Analog
Digital
Hybrid

Digital Computers

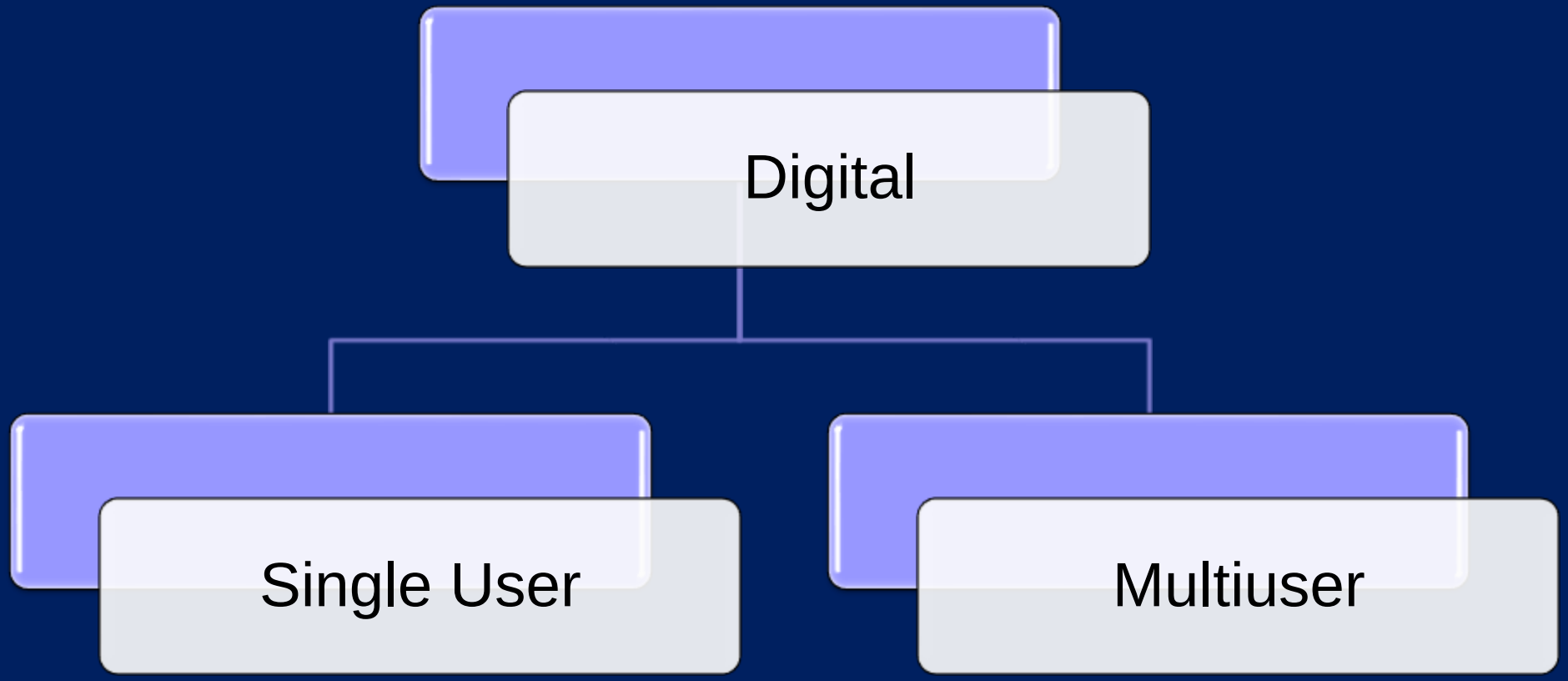
- They are mainly used for data processing and problem solving using programs.
- Digital computer operates on digital data such as numbers like 0 and 1.
- It processes data in digital form.
- They have very large memories to store huge quantity of data.

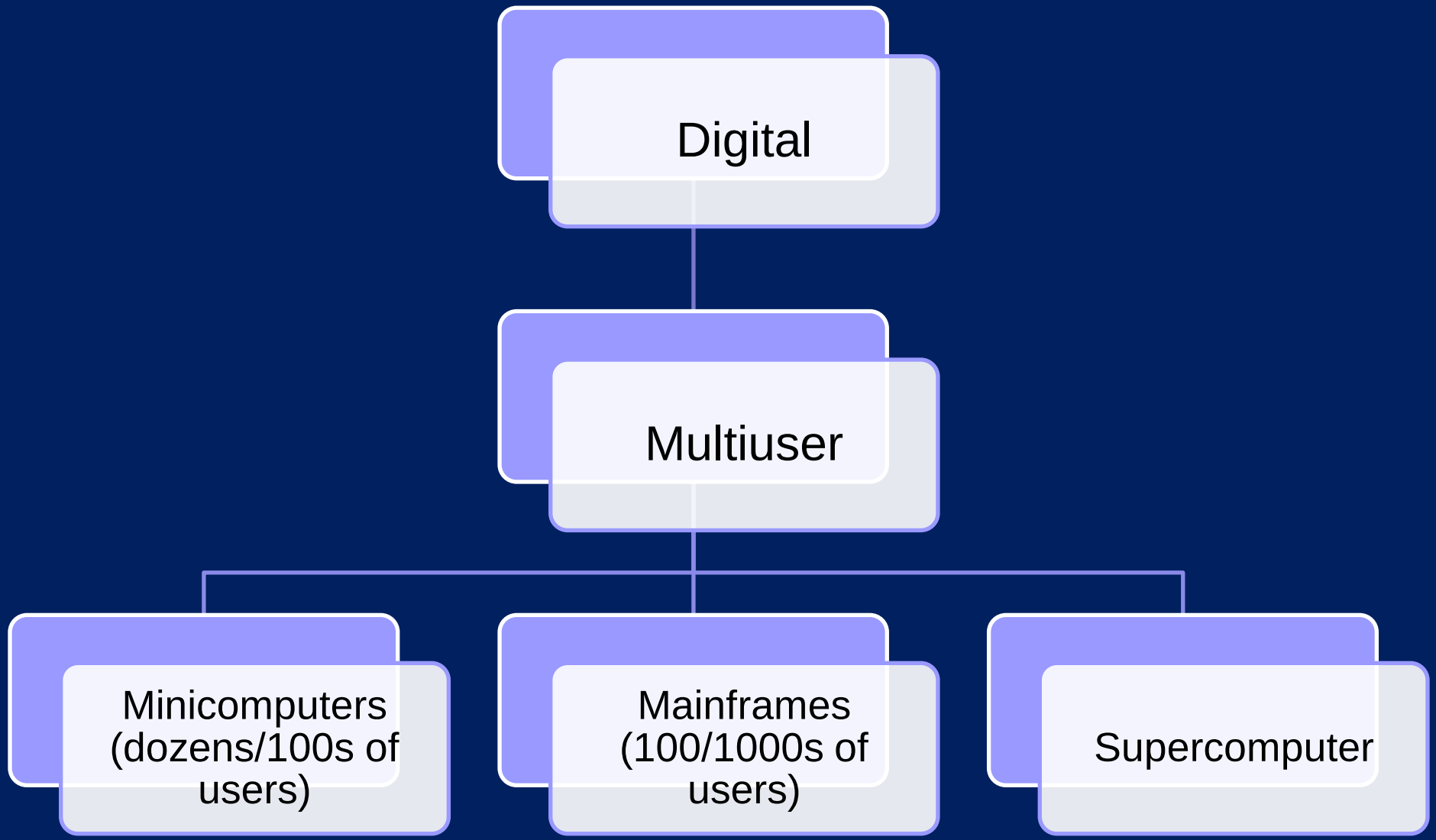
Analog Computer

- They are mainly used in industrial process controls and to measure physical quantities like pressure, temperature etc.
- They does not operate on binary digits.
- It works on continuous range of values like electrical signal inputs and the output is displayed continuously.
- Its memory capacity is less and has a faster processing speed than digital computer.
- They have accuracy of about 99%

Hybrid computers

- They are a combination of digital and analog computers.
- They uses the best features of digital and analog computers
- It helps the user to process both continuous and discrete form of data.
- They are mainly used to weather forecasting and industrial process control
- For eg. in hospital’s ICU, analog devices might measure patient’s blood pressure, temperature etc. which are in analog form and are converted into numbers and supplied to digital components in the system and send signals if any abnormal readings are detected. Hybrid computers are mainly used for specialized tasks.


Digital
Single User
Multiuser


Digital
Multiuser
Minicomputers (dozens/100s of users)
Mainframes (100/1000s of users)
Supercomputer

Super computer

- The most powerful computers in terms of performance and data processing are the Supercomputers.
- These are specialized and task specific computers used by large organizations.
- These computers are used for research and exploration purposes, like NASA uses supercomputers for launching space shuttles, controlling them and for space exploration purpose.
- They are very expensive and very large in size. It can be accommodated in large air-conditioned rooms; some super computers can span an entire building.

- Performance of a supercomputer is measured in floating-point operations per second (FLOPS) instead of million instructions per second (MIPS).

First super computer - A Cray-1 preserved at the Deutsches Museum

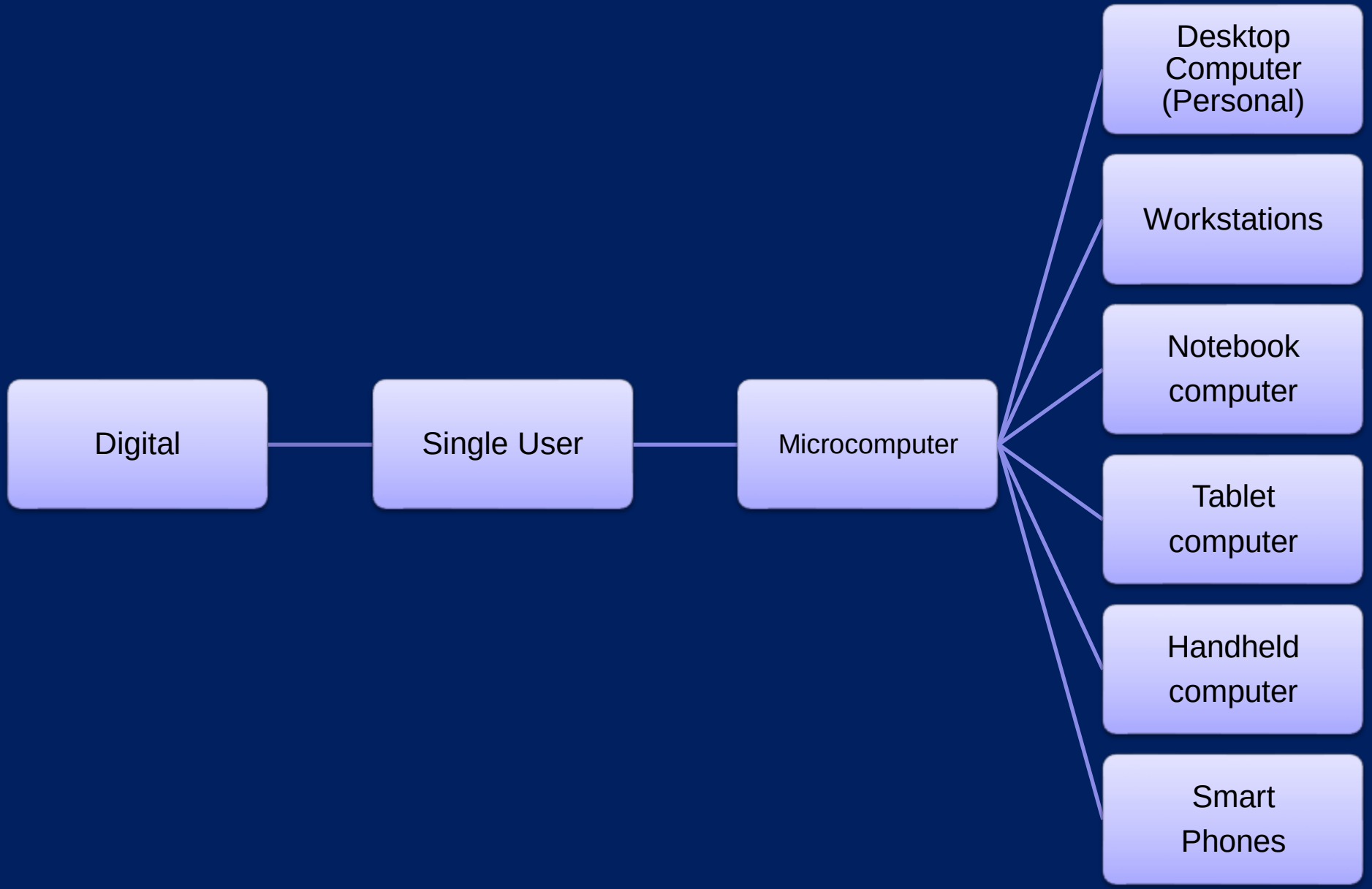
The IBM Blue Gene/P supercomputer "Intrepid" at Argonne National Laboratory

Mainframe computer

- They are not as powerful as supercomputers, but certainly they are quite expensive
- Many large firms & government organizations uses Mainframes to run their business operations.
- They can be accommodated in large air-conditioned rooms because of its size.
- Super-computers are the fastest computers with large data storage capacity, Mainframes can also process & store large amount of data.
- Banks educational institutions & insurance companies use mainframe computers to store data about their customers, students & insurance policy holders.

Minicomputer

- Minicomputers are used by small businesses & firms.
- Minicomputers are also called as “Midrange Computers”.
- These are small machines and can be accommodated on a disk with not as processing and data storage capabilities as super-computers & Mainframes.
- These computers are designed for multiple users.
- Individual departments of a large company or organizations use Mini-computers for specific purposes.
- For example, a production department can use Mini-computers for monitoring certain production process.


Digital
Single User
Microcomputer
Desktop Computer (Personal)
Workstations
Notebook computer
Tablet computer
Handheld computer
Smart Phones

Microcomputer

- Desktop computers, laptops, personal digital assistant (PDA), tablets & smartphones are all types of microcomputers.
- The micro-computers are widely used & the fastest growing computers.
- They are the cheapest among the other three types of computers.
- They are specially designed for general usage like entertainment, education and work purposes.
- Well known manufacturers of Micro-computer are Dell, Apple, Samsung, Sony, Toshiba etc.

Workstation – specialized computer, more power & features than desktop PC

A computer System

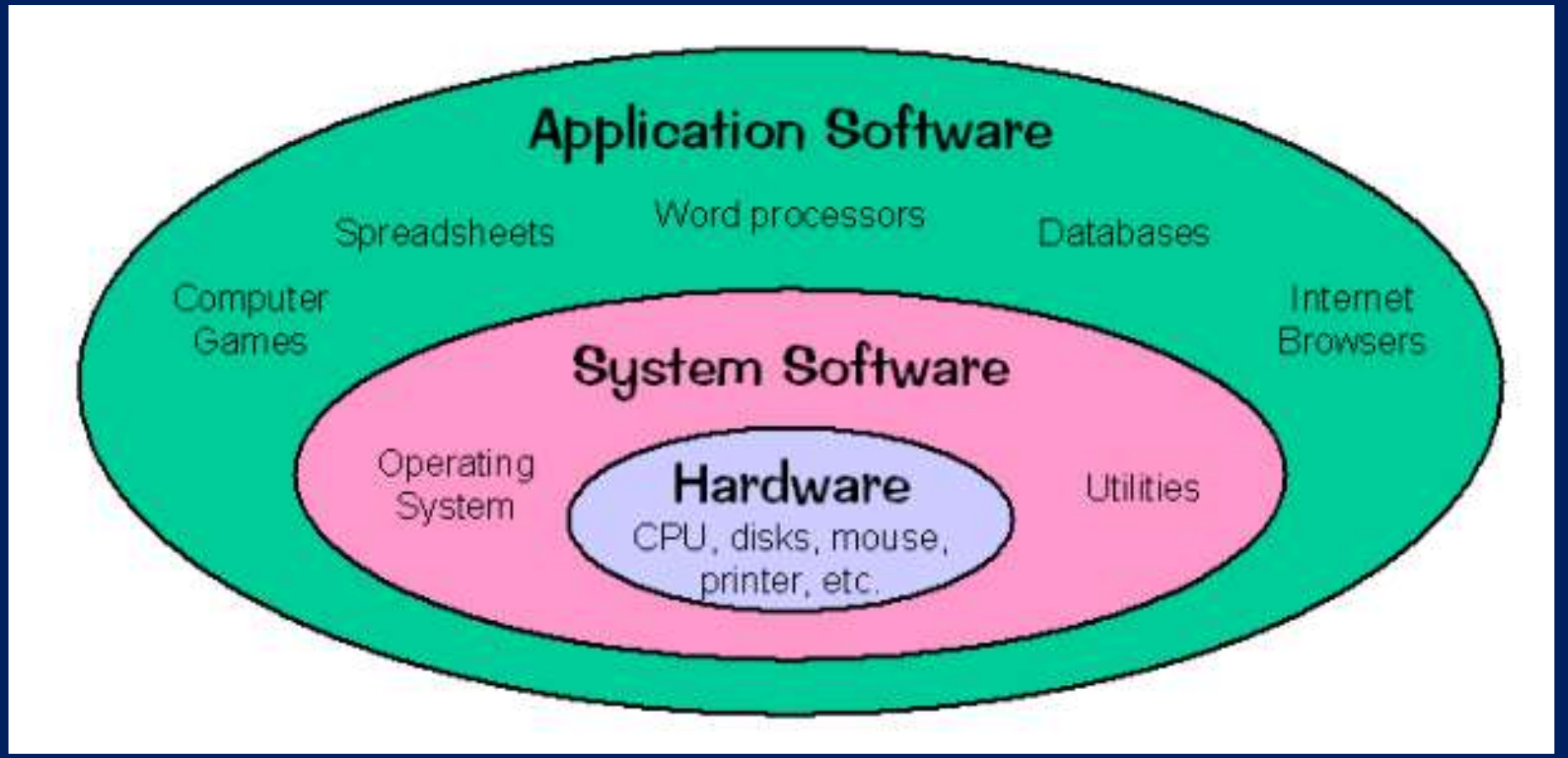
- Hardware
- Software
- Users

Basic hardware of a PC system

Includes the physical parts or components of a computer

- Central Processing Unit (CPU)
- Memory Unit
- Input Devices
- Output Devices
- Secondary Storage Devices

- Software is a set of programs (sequence of instructions) telling the computer how to process data.
- Types of Software
  - System Software
  - Application Software (programme)


Application Software
Spreadsheets
Word processors
Databases
Computer Games
Internet Browsers
System Software
Operating System
Hardware
CPU, disks, mouse, printer, etc.
Utilities

System Software

- It is any program that controls the computer's hardware or that can be used to maintain the computer in some way so that it runs more efficiently.
- There are 3 basic types of system software:
  - An operating system
  - A network operating system
  - A utility program

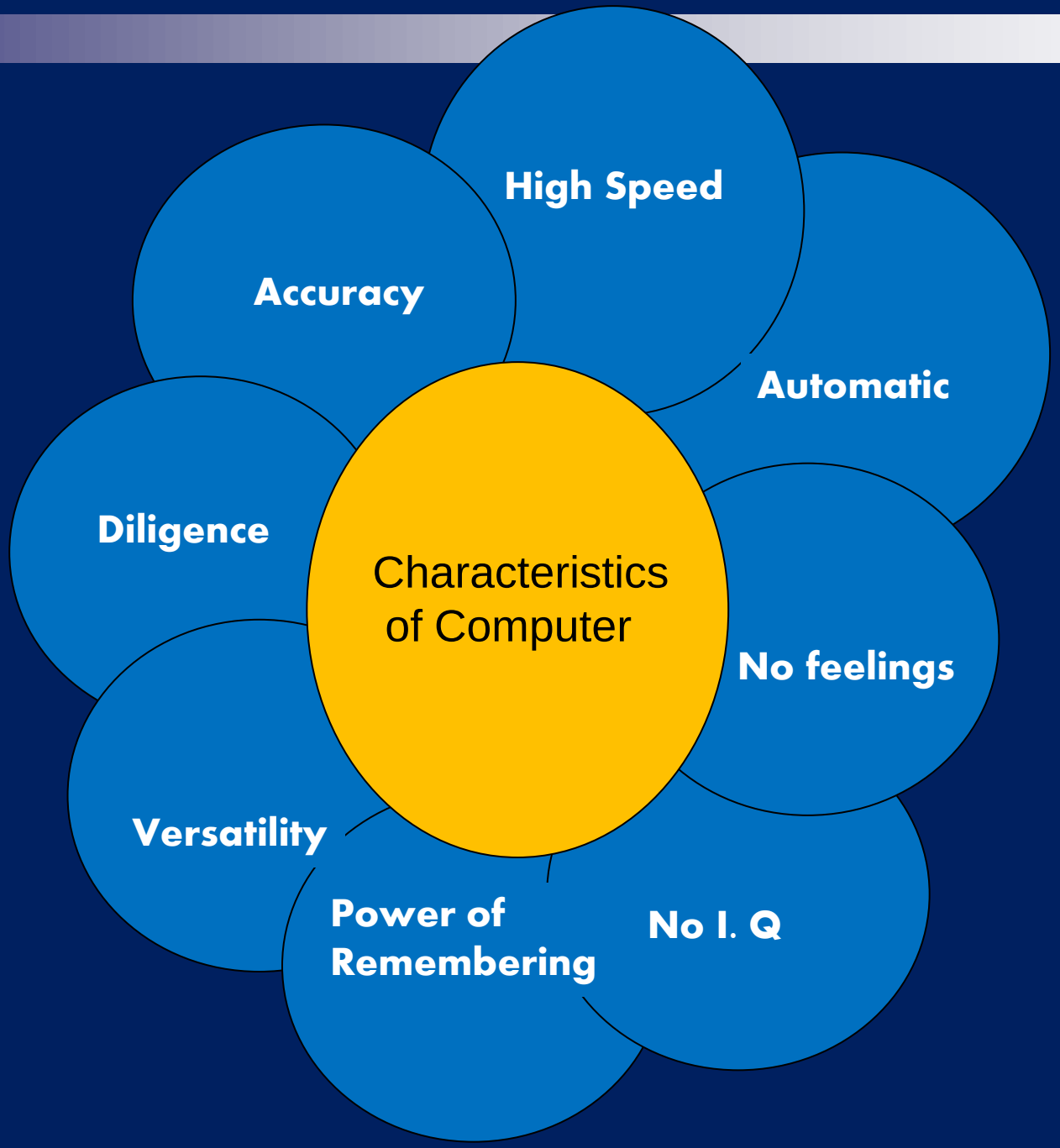
An **operating system** tells the computer how to use its own components. Ex: Windows, the Macintosh operating system & Linux.

A **network operating system** allows computers to communicate & share data across a network while controlling network operations & maintaining network security.

A **utility** is a program that makes the computer system easier to use or performs highly specialized functions. Ex: Disk Cleanup, Disk Partitioning, Antivirus Software, File Manager, Data Compression, Backup etc

Application Software

- Is a set of one or more programs designed to solve a specific task.
- Ex: payroll processing, examination results processing software, railway/ airline reservation s/w, computer games…etc.
- Commonly known application s/w
  - word processing s/w
  - Spreadsheet s/w
  - Database s/w
  - Graphics s/w

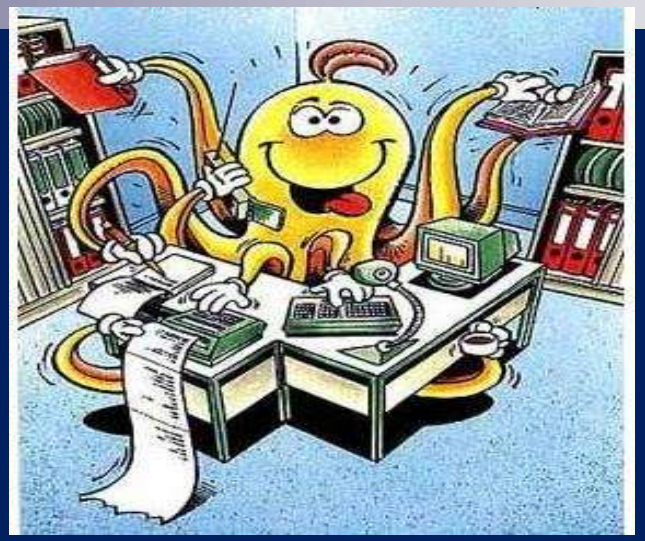

Characteristics of Computer
High Speed
Accuracy
Automatic
Diligence
No feelings
Versatility
Power of Remembering
No I. Q

- Automatic
  - Computer is an automatic machine.
  - Automation is the ability to perform a given task automatically.
  - Once the computer receives a program i.e., the program is stored in the computer memory, then the program and instruction can control the program execution without human interaction.

- High Speed
  - Computer is a very fast device.
  - It is capable of performing calculation of very large amount of data.
  - The computer has units of speed in microsecond (10^{-6}) , nanosecond (10^{-9}), and even the picosecond (10^{-12}).
  - It can perform millions of calculations in a few seconds as compared to man who will spend many months to perform the same task

- Accuracy
  - In addition to being very fast, computers are very accurate.
  - The calculations are 100% error free.
  - Computers perform all jobs with 100% accuracy provided that the input is correct.

- Diligence
  - Unlike human beings, a computer is free from monotony, tiredness, and lack of concentration.
  - It can work continuously without any error and boredom.
  - It can perform repeated tasks with the same speed and accuracy.

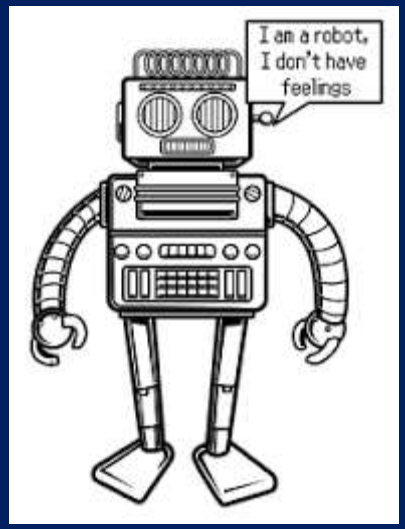


- Versatility
  - A computer is a very versatile machine.
  - A computer is very flexible in performing the jobs to be done.
  - This machine can be used to solve the problems related to various fields.
  - At one instance, it may be solving a complex scientific problem and the very next moment it may be playing a card game.

- Power of Remembering
  - Computer can store and recall any amount of information because of secondary storage device.
  - It can retain a piece of information as long as user desires and the user can recall

- No I. Q
  - A computer possess no intelligence of its own. Its IQ is zero .
  - It has to be told what to do and in what sequence

- No feelings
  - Computer does not have emotions, knowledge, experience, feeling.



Assignment

- From Syllabus – select any topic of your interest
- Topic submission -6th August 2018
- Date of assignment submission : 14th August 2018
- Viva
- Specified format

Input Devices

- Allows data and programs to be sent to the CPU.
  - Keyboard
  - Mouse
  - Joystick
  - Microphone
  - Webcam
  - Scanner
  - Monitor
  - Optical Input Devices

Keyboard

- Most commonly used input devices today. They allow data entry by pressing a set of keys neatly mounted on a keyboard connected to a computer system.
- Most popular keyboard used today is 101 keys QWERTY keyboard.

S.No	Keys & Description
1	**The Alphanumeric Keys** These keys include the letter keys (A-Z) and digit keys (0-9) which generally give the same layout as that of typewriters. Also TAB, CAPS LOCK, BACK SPACE & ENTER Keys.
2	**The Modifier Keys** SHIFT, ALT (Alternate) and CTRL (Control) keys. They modify the input of other.
3	**The Numeric Keypad** It is used to enter the numeric data or cursor movement. Generally, it consists of a set of 17 keys that are laid out in the same configuration used by most adding machines and calculators.
4	**Function Keys** The twelve function keys are present on the keyboard which are arranged in a row at the top of the keyboard (F1, F2, & so on). Each function key has a unique meaning and is used for some specific purpose.
5	**The Cursor-Movement Keys** Cursor or insertion point. It includes four directional arrow keys
	Special-Purpose Keys START key, SHORTCUT Key, Home, End, Insert, Delete, Page Up, Page Down, Escape(Esc), Space bar, Tab, Screen Lock and Print Screen.


Esc
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
F12
Print Screen Sys Rq
Scroll Lock
Pause Break
Backspace
Tab
Caps Lock
Enter
Shift
Ctrl
Alt
Insert
Home
Page Up
Delete
End
Page Down
Num Lock
ComputerHope.com

How the Computer Accepts Input from the keyboard?

- When a key is pressed on the keyboard, a tiny chip called the keyboard controller notes that a key has been pressed. The keyboard controller sends the scan code for the key to part of its memory, called the keyboard buffer. A buffer is a temporary storage area that holds data until it can be processed. The keyboard controller sends a signal (known as interrupt) to the computer's system software, notifying it that something has happened at the keyboard. When the system software receives the signal, it responds by reading the scan code from the keyboard buffer. The system, software passes the scan code to the CPU.

Mouse

- A mouse is an input device that you can move around on a flat surface(usually on a desk or keyboard tray) and control the pointer.
- The pointer is an on screen object usually an arrow.
- Used to select text, access menus, and interact with programs, files or data appear on the screen.

- Everything you do with a mouse is accomplished by
  - Clicking
  - Double clicking
  - Dragging
  - Right-clicking

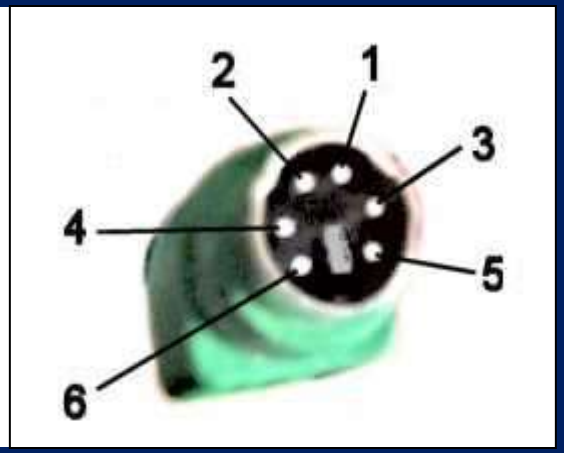
Two Types of Mouse

- **Mechanical** - a type of computer mouse that has a rubber or metal ball on its underside and it can roll in every direction.
- **Optical:** Non-mechanical This type uses a laser for detecting the mouse's movement.

How a Mouse Hooks Up to a PC

- Serial Mouse

- PS/2 Mouse



- USB/Cordless Mouse

Variants of the Mouse

- Trackballs – works like an upside-down mouse
- Trackpads (touchpad) – a stationary pointing device

Other Pointing Devices

- Trackball
- Track point
- Touch pad
- Touch Screen

- Joystick – input device for computer games

- Light Pens – light-sensitive penlike device

- Stylus – penlike device commonly used with tablet PCs and PDAs.

Optical Input Devices

- Bar Code Readers
- Image Scanners and Optical Character Recognition (OCR)

Bar Code Readers

- Common type of bar code reader - Flatbed model (used in supermarkets)
- Barcode readers convert a barcode (pattern of printed bars on products) to a code that computers can understand.
- The bar code reader emits a beam of light (a laser beam) – that is reflected by the bar code image.
- A light-sensitive detector identifies the bar code by recognizing special bars at both ends of the image.
- After the detector identifies the bar code, it converts it into numeric digits – code the computer can understand.

IMAGE SCANNERS AND OPTICAL CHARACTER RECOGNITION (OCR)

- The barcode reader is a special type of image scanner.
- Image scanner (also called scanners) convert any printed image into electronic form by shining light onto the image and sensing the intensity of the light's reflection at every point.
- Colour scanners use filters to separate the components of colour into the primary additive colours (red, green, and blue) at each point.
- Red, green, and blue are known as primary additive colours because they can be combined to create any other colour.
- Processes that describe colour in this manner are said to -use RGB colour.
- The image scanner is beneficial as a result of it interprets written pictures into an electronic format which will be kept in a very computer's memory.
- If you have scanned a text document, you might want to use optical character OCR) are to translate the image into text that you can edit

- Scanners come in a range of sizes from handheld models to flatbed scanners that sit on a desktop.
- Handheld scanners are more portable but typically require multiple passes to scan a single page because they are not as wide as letter-size paper.
- Flatbed scanners offer higher-quality reproduction than do handheld scanners and can scan a page in a single pass.

Output Devices

- Media used by the computer in displaying its responses to our requests and instructions.
- Monitor
- Printer

Monitor

- Two imp. h/w device determine the quality of the image,
  - 1. monitor 2. video controller

Types of Monitor

- Cathode Ray Tube (CRT)

- Flat Panel Display

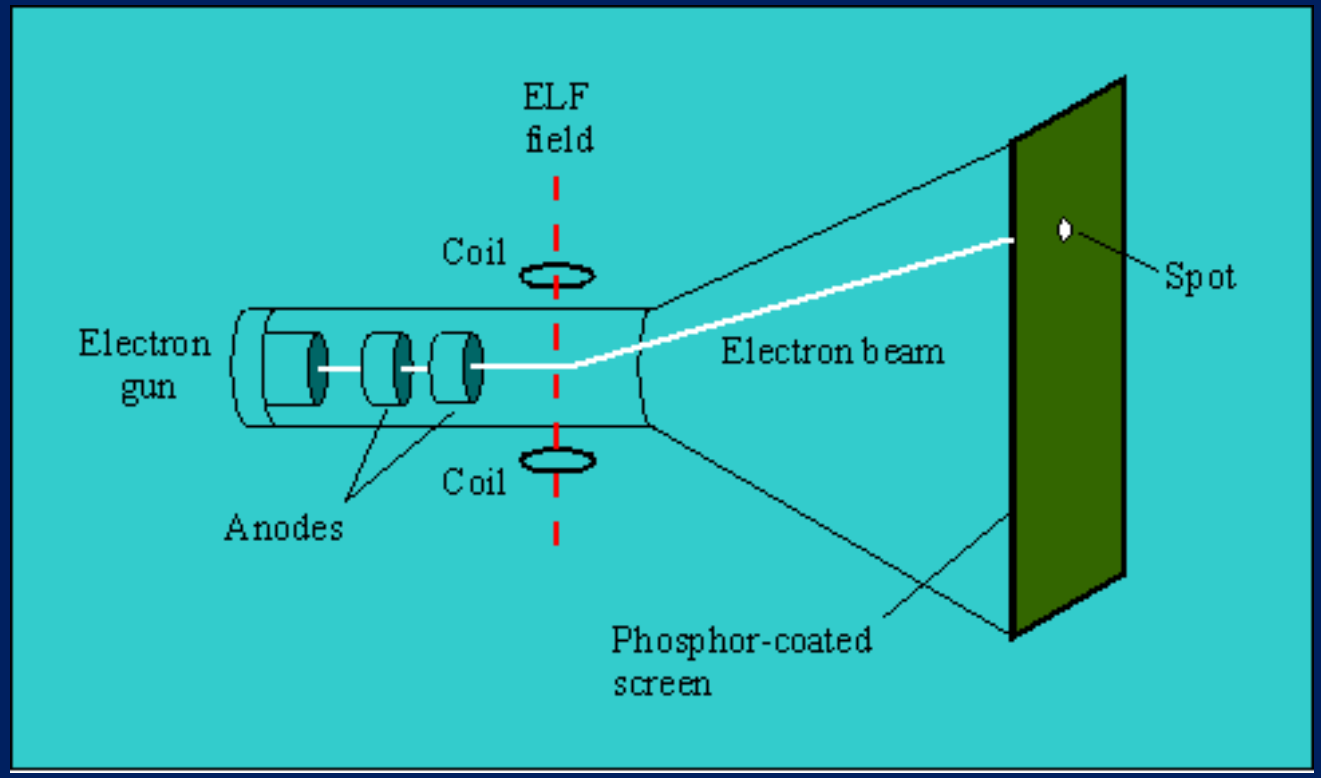
Monitor type based on colour

- Monochrome : display only one colour (such as green, amber or white) against a contrasting background which is usually black.
- Grayscale monitor: display varying intensities of gray(very light gray to black)
- colour monitor:- can display 16 colours to 16 million colours

CRT monitor

- CRT monitor contain an electron gun.
- Gun shoot beam of electrons through the magnetic coil, which aims the beam at the front of monitor.
- The back of monitor's screen is coated with phosphors, chemicals that glow when they are struck by the electron beam.
- The screen's phosphor coating is organized into a grid of dots.
- The smallest number of phosphor dots that the gun can focus on is called pixel.
- Each pixel has a unique address , which the computer uses to locate pixel and control its appearance .
- The gun focus at every pixel on the screen , starting at the top left corner and scanning to the right edge.
- A CRT monitor contain a shadow mask, which is made of metal, fitted to shape and size of the screen
- The holes in the shadow mask's are used to align the electron beam so that they strike precisely the correct phosphor dot.

- In a monochrome monitor, the beam’s intensity determine whether a pixel is on or off.
- In case of gray scale monitor, the beam intensity determines how brightly each pixel glows.
- A colour monitor work like a monochrome one, except that there are three electron gun instead of one.


ELF
field
Coil
Electron
gun
Electron beam
Spot
Coil
Anodes
Phosphor-coated
screen

Flat Panel Monitors

- Flat panel monitor used primarily on portable computers.
- There are Several type of flat panel monitors , most common is the liquid crystal display monitor
- The LCD monitor create images with special kind of liquid crystal that is normally transparent but opaque when charged with electricity.
- take less space and are lightweight.
- These monitors use much less power than CRTs. It does not emit harmful radiations. It is much expensive than CRT.
- Notebook computers, PDA and cellular phones use flat panel monitors.
- Dis adv:- images difficult to see in bright light(so users look for shady place)
- 2. limited viewing angle, the angle from which the display's image can be viewed clearly .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- There are two types of technologies used in flat panel display screens.
- 1. passive matrix LCD
- 2. active matrix LCD

Passive matrix LCD

- Passive matrix LCD relies on transistors for each row and column of pixels, thus create a grid that defines the location of each pixel.
- The colour displayed by a pixel is determined by the electricity coming from the end of the row and the top of column.
- Passive matrix monitor are inexpensive to manufacture.
- Dis : They do not refresh the pixels very quickly.
- Animated graphics can appear blurry on a passive monitor.

Active matrix LCD

- In this technology assign a transistor to each pixel and each pixel turn off or on individually.
- This enhancement allows the pixels to be refreshed rapidly, so blurry graphics is not a problem.
- Active matrix displays use thin film transistor technology, which employs many transistors per pixel.
- Today most notebook computers use these technology.

Important monitor specifications:

- Size –
  - It affects how well you can see images. With a larger monitor, you can make the objects on the screen appear bigger. Monitors are measured diagonally, in inches, across the front of the screen.
- Resolution –
  - The term resolution refers to the sharpness or clarity of an image. It is determined by the number of pixels on the screen. The more pixels a monitor can display, the higher its resolution & clearer its images appear.

Important monitor specifications:

- Refresh rate –
  - It is the number of times per second that the electron guns scan every pixel on the screen. If the screen is not refreshed often enough, it appears to flicker, & flicker is one of the main causes of eyestrain. It is measured in Hertz (Hz) or in cycles per second.
- Dot pitch –
  - it is the distance between the like-coloured phosphor dots of adjacent pixels. As a general rule, the smaller the dot pitch, the finer & more detailed images will appear on the monitor.

Printers

- Two types
- IMPACT PRINTERS uses pressure by physically striking the paper. Ex. Daisy wheel printers, line printers, dot matrix printers, drum printer & band printers.
- NON-IMPACT PRINTER does not apply pressure on the paper but instead produces character by using lasers, ink spray, photography or heat.

Dot matrix printer

Laser printer

Inkjet printer

Dot matrix printer

- Dot matrix printer are character printers, that form characters and all kind of images as patterns of dots.
- A dot matrix printer has a print head that moves horizontally (left to right and right to left) across a paper.
- Print head contain an array of pins that can be activated independent of each other to extend and strike against an inked ribbon to form patterns of dots on the page.
- To print a character , the printer activate the appropriate set of pins as the print head moves horizontally.

- Dot matrix printers are impact printers because they print by hamming the pins on the inked ribbon to leave ink impressions on a paper.
- - slow with printing speed ranging from 30 to 600 characters per date.
- - they are cheap in terms of both initial cost and cost of operation.
- They are used by organization for generating report where speed and quality of printing are not important.

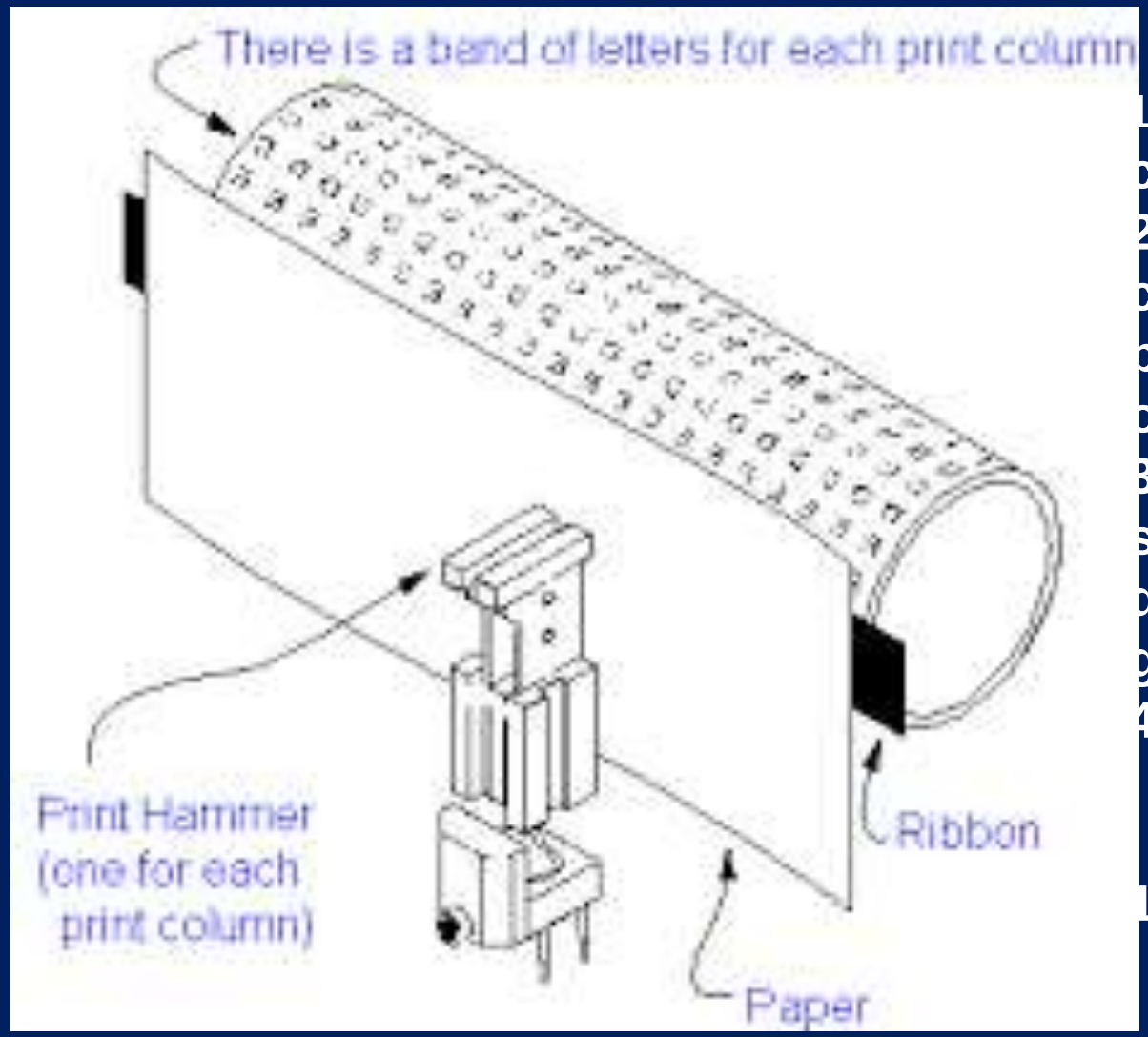
Inkjet printers

- Inkjet printers are character printers ,which form characters and all kind of images by spraying small drops of ink on to the paper.
- The print head consist of 64 tiny nozzles.
- It can be selectively heated up in a few microsecond by integrated circuit register.
- When the register heats up the ink near it vaporizes and is ejected through the nozzle and makes a dot on the paper placed in front of the head.
- To print a character the printer selectively heat the appropriate set of nozzles as the print head moves horizontally.
- Inkjet produce higher quality output than dot matrix.

- colour ink jet printers have four ink nozzles: cyan, magenta,yellow and black.
- Some time it referred as CMYK
- Ink jet produce higher quality o/p than dot matrix because they form characters by tiny ink dots.
- Ink jet is non impact printer because they print by spraying ink on the paper.

Drum printer

- Drum printer are line printer that print an entire line at a time.
- It consist of solid cylindrical drum with characters embossed on its surface in the form of circular band.
- Each band consist of all printing characters supported by printer in its character set.
- Total no. of band is equals to the maximum no. of characters that can be printed on a line.
- In addition to the drum, the printer has a set of hammers mounted in front of the drum .
- Paper is placed in between the inked ribbon and hammer.
- Drum rotate at high speed , character is printed at desired print position by activating appropriate hammer when character is embossed on the band at print position passed below it.

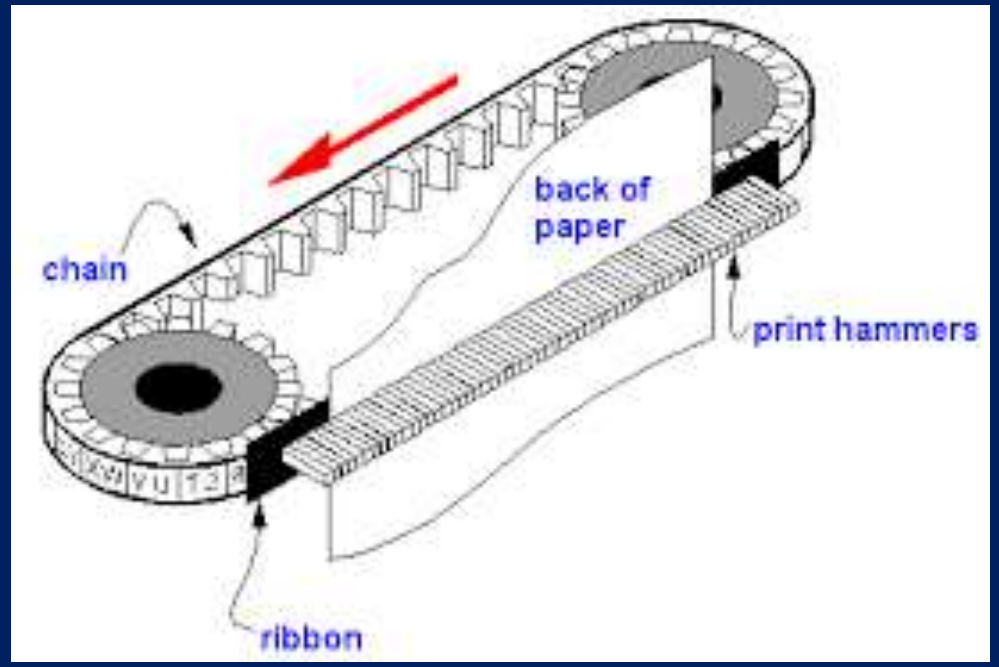


1. Expensive and cannot be changed often.
2. Print predefined set of characters only in predefined style embossed on the drum.
3. Not suitable to print any shape of characters , different size of print and graphics.
4. impact printer and noisy

1. Impact printer and Used to produce multiple copies by using carbon paper on it.

Chain/ band printer

- Chain printers are line printer that print a line at a time.
- It consist of metallic chain on which all characters set supported by the printer are embossed.
- To enhance printing speed , characters in the character set are embossed several times on the chain.
- For ex. 64 character set may have 4 set then 256 characters(64*4) characters embossed on it.
- The printer has a set of hammers mounted in front of the chain and the paper is placed in between the hammer and chain.
- Total no. of hammers is equal to total no of print positions.
- Chain rotate at high speed , the character is printed at desired position by activating appropriate hammer.



1. Unlike the drum of drum printer , the chain of chain printer can be changed easily.
2. So different fonts and different languages can be used .
3. Any pre defined set of characters are used.
4. so do not have the ability to print any shape of characters.

Laser printer

- Laser printer are more expensive than ink jet printers.
- Print quality is high and faster.
- Laser printer are page printers ,it print one page at a time.
- The main component of laser printers are ;laser beam source, a multi sided mirror, a photoconductive drum, and toner (tiny particles of oppositively charged ink)
- To print a page of o/p , the laser beam is focused on the electro statically charged drum by spinning multi sided mirror.
- The mirror focuses on the laser beam on the surface of drum in a manner to create a patterns of characters/ images to be printed on the pages.

- Since the drum is photoconductive , a difference in electric charges is created on those parts of the drum surface that are exposed to the laser beam.
- the toner, composed of oppositely charged ink particles , stick to the drum, in the places where the laser beam has charged the drum surface.
- The toner then fused permanently on the paper with heat and pressure to generate printed o/p.

- Laser printer produce high quality output because they form characters by very tiny ink particles.
- The most common laser printer have 600 dpi(dot per inch) and high end laser printer have 1200 dpi .
- so it give excellent graphics art gallery.
- Non impact printer and very quiet in operation.
- Faster in printing speed than other printers
- Low speed laser printer can print 4 to 12 pages per minute.

High-quality printers

- Used for special purposes
- Photo Printers
- Thermal-Wax Printers
- Dye-Sublimation Printers
- Plotters
  - It is like a printer because it produces images on paper, but it is used to print large-format images
  - Table plotters (or flatbed plotters) use two robotic arms, each of which holds a set of coloured ink pens, or pencils.
  - Roller plotter (also known as drum plotter) uses only one drawing arm but moves the paper instead of holding it flat & stationary.
  - Mechanical plotters have been displaced by thermal, electrostatic, & ink jet plotters – produce geometric drawing, full coloured