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FACULTY OF PHYSICAL & COMPUTING SCIENCES

CMP 101: Introduction to Computer Science

PART 2: Concept of the Computer System



CONTENTS

- ✓ What is a Computer?
- ✓ Characteristics of a Computer
- ✓ Components of a Computer
- ✓ Classifications of Computer



WHAT IS A COMPUTER ?

What is a Computer?

- ❖ A computer can be defined as a programmable device that can ***automatically perform logical and arithmetic operations*** based on the input given by the user and returns the desired result after processing.
- ❖ A computer can also be defined as an electronic device that ***accepts data, processes, and stores*** the data as per user instruction and gives the results quickly and accurately.
- ❖ A computer system is a combination of hardware and software that takes input, processes it, and gives output.

What is a Computer?

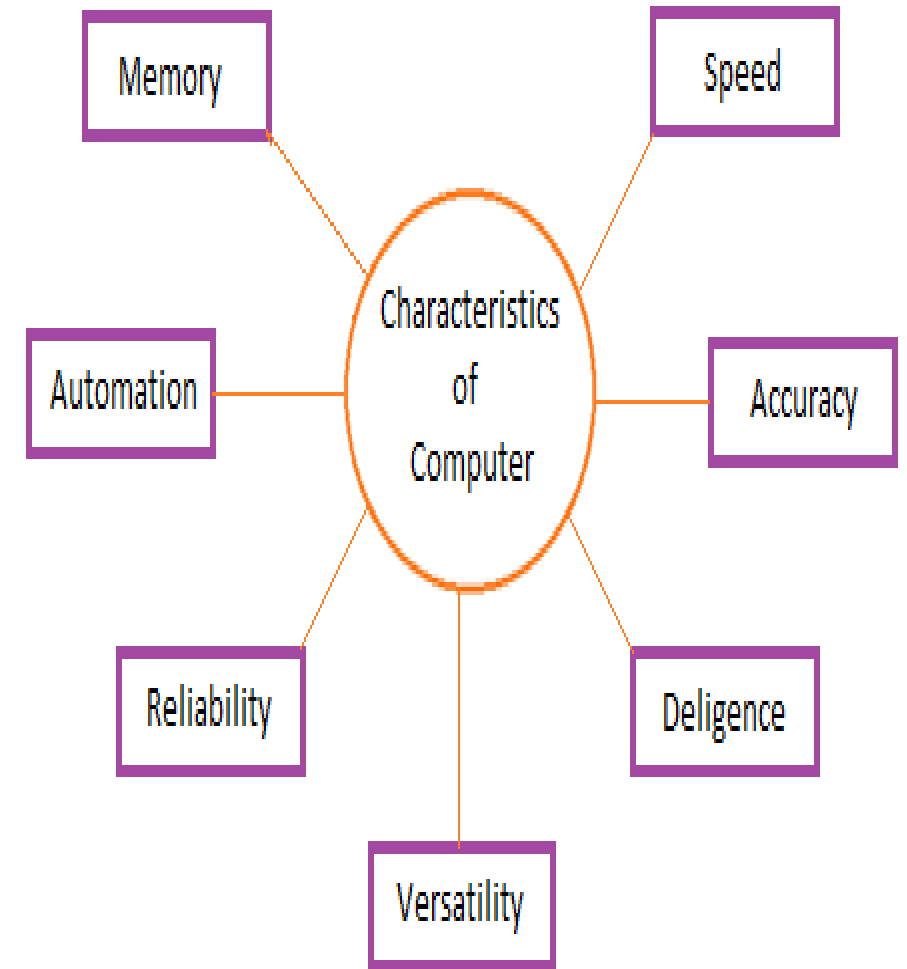
- ❖ NB: The main functions of a Computer System are: **Input, Processing, Output and Storage.**
- ❖ All these functions are performed via some components of the computer system such as:
 - ✓ **Input functions** are performed using the inputs devices
 - ✓ **Processing functions** are performed by the Central Processing Unit (CPU)
 - ✓ **Output functions** are performed using the output devices and
 - ✓ **Storage functions** are performed using the storage devices (Primary and Secondary Storage)

Characteristics of a Computer

❖ **Speed:** Computers can process millions (1,000,000) of instructions per second. The time taken by computers for their operations is **microseconds and nanoseconds**.

❖ **Accuracy:** Computers perform calculations and any other operation with 100% accuracy. Errors may occur due to data inconsistency or inaccuracy.

Diligence: A computer can perform millions of tasks or calculations with the same consistency and accuracy. It doesn't feel any fatigue or lack of concentration. Its memory also makes it superior to that of human beings.



Characteristics of a Computer

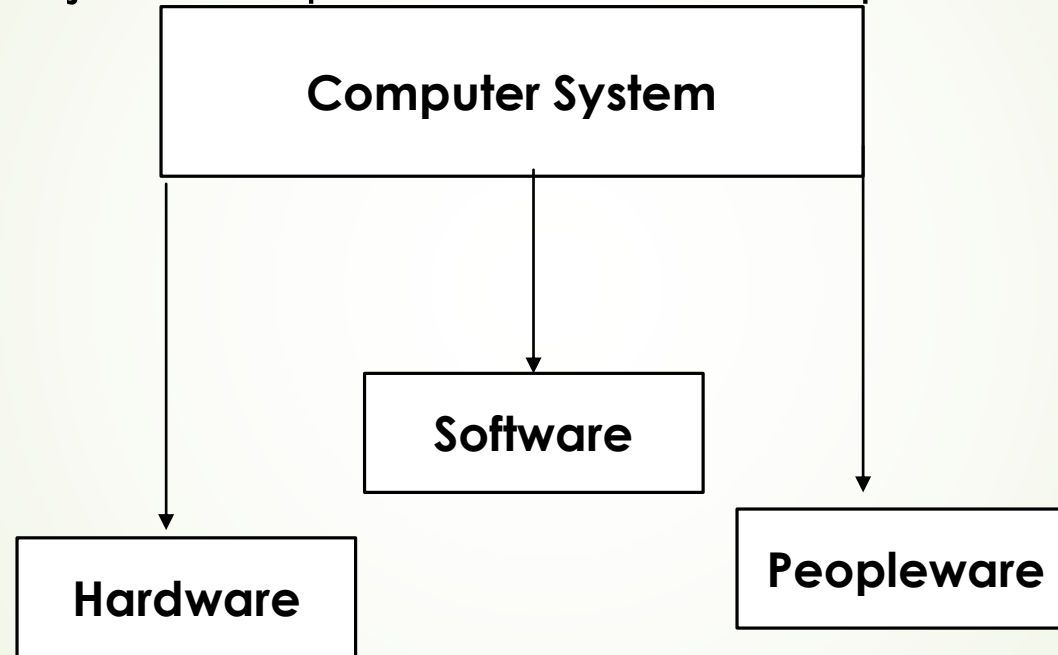
- ❖ **Versatility:** Versatility refers to the capability of a computer to perform different kinds of work with the same accuracy and efficiency.
- ❖ **Reliability:** A computer is reliable as it gives consistent results for similar set of data i.e., if we give the same set of input any number of times, we will get the same result.
- ❖ **Automation:** The computer performs all the tasks automatically i.e. it performs tasks without or with limited human/manual intervention.
- ❖ **Memory:** A computer has built-in memory called **primary memory** where it stores data. **Secondary storage** is removable devices such as CDs, pen drives, etc., which are also used to store data.



COMPONENTS OF A COMPUTER SYSTEM

Components of a Computer

- ❖ There are three major components of a computer system, namely:





HARDWARE COMPONENTS

Hardware Components

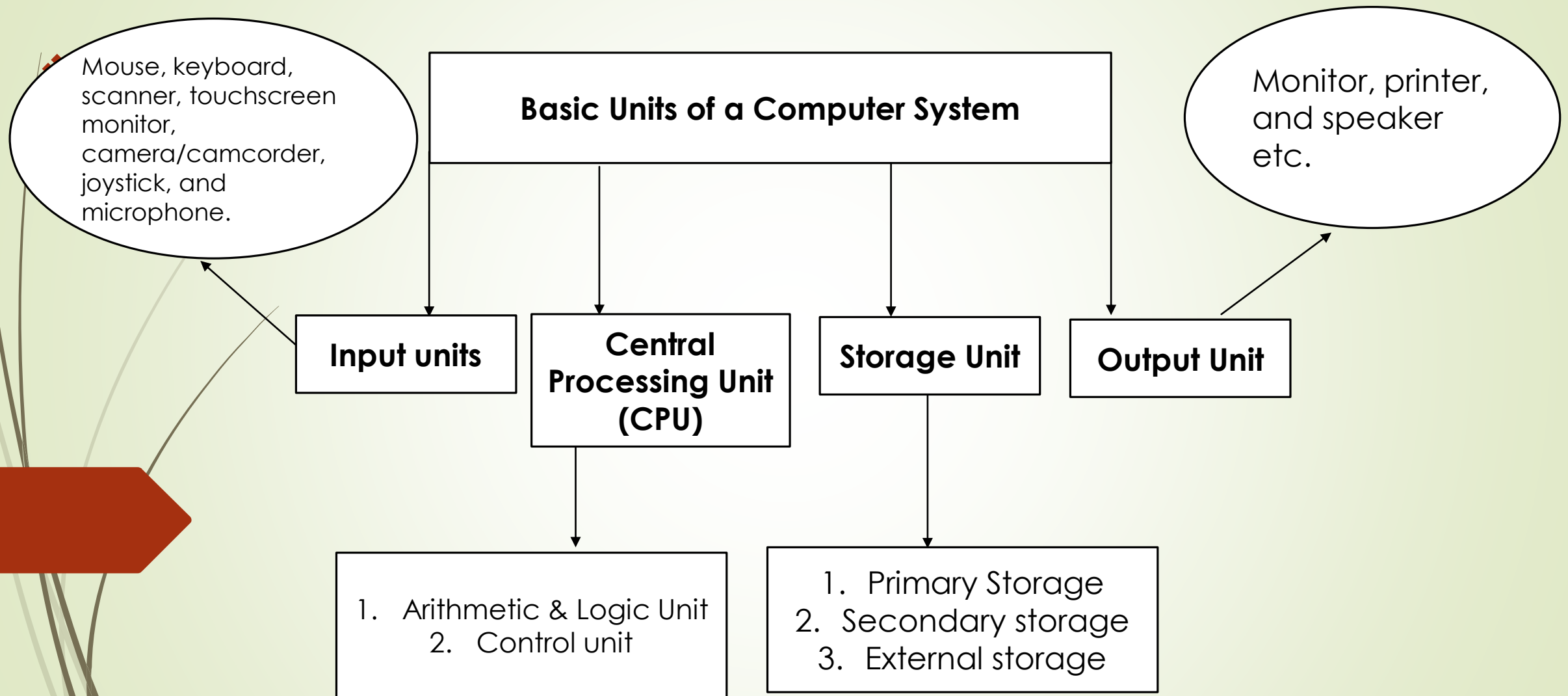
- ❖ These include the physical components that make up a computer system.
- ❖ The hardware components include all components that a user can see and touch while using the computer.
- ❖ A computer system consists of four basic units; namely the
 - ✓ Input unit,
 - ✓ Storage unit,
 - ✓ Central processing unit, and
 - ✓ output unit.
- ❖ The central processing unit is further divided into **Arithmetic logic unit and control unit**

Hardware Components (Cont...)

❖ These four units enable the computer to perform the following **five basic functions**:

- ✓ **Accepts** data or instructions as input
- ✓ **Stores** data and instructions
- ✓ **Processes** data based on per-user instructions
- ✓ **Controls** all operations inside a computer
- ✓ **Gives** results in the form of output to the user.

Basic Units of a Computer System



Central Processing Unit (CPU)

- ❖ This is the **processing center** of the computer. It is the center where all arithmetic and logical operations of the computer is performed. The CPU is divided into:
 - ✓ **The Arithmetic Logic (ALU) Unit** performs all calculations and comparisons based on the data and instructions provided.
 - ✓ It performs **arithmetic functions** such as addition, subtraction, multiplication, division and **logical operations** such as greater than, less than, greater than or equal to, equal to, etc.
- The Control Unit (CU)** controls all operations of the computer. It takes care of step by step processing of all operations inside the computer.
- ✓ Operations such as **input, processing, and output** are performed by the control unit.

Storage Unit

- ❖ Storage devices are used by the computer system to **save data and information for future use.**
- ❖ Some of the hardware components that make up the storage devices include:
 - ✓ **Primary memory/storage:** Random Access Memory (RAM), Read-Only Memory (ROM), cache and flash memory.
 - ✓ **Secondary (internal) storage:** Hard Disk Drive (HDD) and Solid State Drive (SSD)
 - ✓ **External storage:** CD/DVD, diskette, flash drive, external hard disk, blue ray disk, and a pen drive.



SOFTWARE COMPONENTS

Software Components

- ❖ Software components of a computer system have no physical presence but are a ***set of instructions and data stored in digital form*** within the computer memory.
- ❖ They are basically divided into two: ***system software and application software.***

System Software

- ❖ Are used to ***manage and control the hardware components*** of the computer.
- ❖ It allows for user interaction between the hardware and application software.
- ❖ There are four (4) major categories of system software:
 - ✓ The operating system
 - ✓ Device drivers
 - ✓ Utility software
 - ✓ *Language translators*

Operating System (OS)

- ❖ An Operating System (OS) can be defined as system software that manages computer hardware and software resources.
- ❖ It is a vital component of the computer system and it provides common services for computer programs.
- ❖ Application software is usually dependent on the operating system to function

Examples of the operating system include Unix, Linux, Mac Os, OS/2, Xenix, Windows NT, Windows XP, Windows 7, Windows 8.1, HP-UX, Android (for mobile devices), etc.



Functions of Operating System (OS)

- ❖ It helps in booting the computer system
- ❖ It monitors the system performance and activities
- ❖ It helps in managing various peripheral devices such as mouse, keyboard, printer, etc.
- ❖ It helps in resource allocation such as computer's memory and sharing of the central processing unit time by various applications or peripheral devices
- ❖ It provides a system of file management which includes the way the operating system manipulates, stores, retrieves and saves data.

Drivers & Utility Software

- ❖ **Drivers:** Device drivers are operating system specific. A driver that works in Windows 7 may not necessarily work in windows 8. **Examples of device drivers: printer drivers, video adapter drivers, network drivers, sound card drivers, etc.**
- ❖ **Utility software:** Utility software is routine software that is packaged with the operating system which helps in system maintenance. **Examples of utility software include Norton Antivirus, McAfee antivirus, Scandisk, disk defragmenter, backup and recovery manager, etc.**

Language Translators

➤ **Compiler**

- The programs written in any high-level programming language (C or Pascal) are converted into machine language using a compiler.

➤ **Interpreter**

- An interpreter analyses and executes the source code in line-by-line Manner, without looking at the entire program.

➤ **Assembler**

- Compared to all the types of programming languages, assembly Language is closest to the machine code. An assembler converts the assembly codes into machine codes, making the assembly program ready for execution.

Application Software

- ❖ Are used to accomplish specific tasks other than just running the computer system.
- ❖ There are different kinds of application software such as word processing software, spreadsheet application software, graphics, multimedia software, database software, etc.
- ❖ Application software may consist of a single program e.g. AVS Video editor,
Or **small collection of programs** that work closely together to accomplish a task e.g. Microsoft Office Word,
- ❖ Or **a larger collection of related** but independent programs and packages that have a common user interface or shared data format, such as Microsoft Office suite which consist of MS word, excel, PowerPoint etc.

Examples Application Software

- ❖ **Word Processing:** MS Word, WordPad, WordPerfect, word star, textmaker, Lotus word pro, Microsoft works, etc
- ❖ **Spreadsheet applications:** MS Excel, Lotus 1-2-3, Quattro Pro, PlanMaker, OpenOffice.org Calc, AppleWorks, Accel, etc.
- ❖ **Graphics Design applications:** 3D Studio Max, CorelDraw, Macromedia Dreamweaver & fireworks, paint, photoshop, illustrator, etc.
- ❖ **Multimedia software:** Windows media player, Real player, Total video player, Gamut, Winamp, etc.
- ❖ **Database applications:** MS Access, Oracle, MySQL, MS SQL Server, DB2, etc.

Peopleware

- ❖ The computer is designed to be used by people.
- ❖ The people who use the computer are referred to as peopleware component of the computer system.
- ❖ **Peopleware refers to the role** of people in the development and use of computer software and hardware.
- ❖ Anyone who designs, develops or uses computer systems plays an important role in the computing process.

They include **computer professionals** and users such as computer engineers, programmers, individual computer users, software engineers, IT specialists, network engineers, graphic designers, computer technicians, database administrators, desktop publishers, etc.



CLASSIFICATIONS OF COMPUTER SYSTEM

Classification of Computers

❖ In this section, we are going to look at classifications of computer system by:

- ✓ Classification by types
- ✓ Classification by size
- ✓ Classification by purpose

Classification by Types

❖ There are three major classification of computers by type, namely:

- ✓ Analog Computers
- ✓ Digital Computers
- ✓ Hybrid computers

Analog Computers

- ❖ An analog computer is a kind of computer that represents ***data as a variable across a continuous range of values.***
- ❖ The earliest computers were analog computers.
- ❖ Analog computers are used for measuring parameters that vary continuously in real-time, such as ***temperature, pressure, and voltage.***
- ❖ Other examples of analog computers are: ***Thermometers, weight scales, wall clock etc.***

Digital Computers

- ❖ A digital computer uses distinct values to represent the data internally.
- ❖ All information is represented using the **digits 0s and 1s**.
- ❖ The computers that we use in our homes and offices are digital computers.
- ❖ Digital computers can be built to take the solution of equations to almost unlimited precision, but quite slowly compared to analog computers.

Generally, complex equations are approximated using iterative numerical methods which take huge numbers of iterations.

- ❖ Examples are: **PC's, smart phones, tablets, calculators** etc.

Hybrid Computers

- ❖ Hybrid computers are computers that exhibit features of analog computers and digital computers.
- ❖ The digital component normally serves as the controller and provides logical operations, while the analog component normally serves as a solver of differential equations.
- ❖ With a three or four-digit, highly accurate numerical seed, the total digital computation time necessary to reach the desired precision is dramatically reduced, since many fewer iterations are required.
- ❖ E.g. **Fuel vending machine, ultra-sound machine** etc.

Classification by Size

- ❖ Computers are broadly classified into four based on their size, namely:
 - ✓ Microcomputers,
 - ✓ Mini-computers,
 - ✓ Mainframe computers, and
 - ✓ Supercomputers.

Micro-Computers

- ❖ Microcomputers are relatively small and low-cost.
- ❖ They consist of a CPU, an input unit, an output unit, a storage unit, and the software.
- ❖ Although microcomputers are stand-alone machines, they can be connected together to create a network of computers that can serve more than one user.

Microcomputers include **desktop computers, notebook computers or laptops, tablet computers, handheld computers, smartphones, and netbooks,**

Examples Micro-Computers

- ❖ **The Desktop Computer**
- ❖ **Notebook Computers or Laptops** look like a notebook. They are portable and have all the features of a desktop computer
- ❖ **Netbooks** are smaller notebooks optimized for low weight and low cost and are designed for accessing web-based applications
- ❖ **Tablet Computer** has features of the notebook computer but it can accept input from a stylus or a pen instead of the keyboard or mouse.
- ❖ **Handheld Computer or Personal Digital Assistant (PDA)** is a small computer that can be held on the top of the palm. It is small in size. Instead of the keyboard, PDA uses a pen or a stylus for input.
- ❖ **Smartphones** are cellular phones that function both as a phone and as a small PC. They may use a stylus or a pen or may have a small keyboard



Mini-Computers

- ❖ Minicomputers are digital computers, generally used in multi-user systems.
- ❖ They have high processing speed and high storage capacity than the microcomputers.
- ❖ Minicomputers can support up to **4 – 200 users simultaneously**.
- ❖ The users can access the minicomputer through their PCs or terminal.
- ❖ They are used for real-time applications in **industries, research centers, etc.**
- ❖ PDP 8, IBM (8000 series) are some of the widely used minicomputers

Mainframe Computers

- ❖ Mainframe computers are multi-user, multi-programming, and high-performance computers.
- ❖ They operate at a very high speed, have a very large storage capacity, and can handle the workload of many users.
- ❖ Mainframe computers are large and powerful systems generally used in centralized databases.

Mainframe computers are used in organizations like **banks or companies**, where many people require frequent access to the same data.

- ❖ Some examples of mainframes are CDC 6600 and IBM ES000 series.

Super Computers

- ❖ Supercomputers are the fastest and most expensive machines.
- ❖ They have high processing speed compared to other computers.
- ❖ The speed of a supercomputer is generally measured in **FLOPS (Floating Point Operations Per Second)**.
- ❖ Some of the faster supercomputers can perform **trillions of calculations per second**.
- ❖ Supercomputers are built by **interconnecting thousands of processors that can work in parallel**
- ❖ Supercomputers are used for highly calculation-intensive tasks, such as **weather forecasting, climate research (global warming), molecular research, biological research, nuclear research, and aircraft design**

Super Computers (Cont...)

- ❖ They are also used in major universities, military agencies, and scientific research laboratories.
- ❖ Some examples of supercomputers are IBM Roadrunner, IBM Blue Gene, and Intel ASCI red. PARAM is a series of supercomputers assembled in India by C-DAC (Center for Development of Advanced Computing), in Pune.

PARAM Padma is the latest machine in this series.

- ❖ The peak computing power of PARAM Padma is 1 TeraFLOP (TFLOP)

Classification by Purpose

- ❖ Based on degree of usage or versatility, computers fall into two groups:
 - ✓ General-purpose computers, and
 - ✓ Special-purpose computers

General – Purpose Computers

- ❖ General-purpose computers are designed to solve a large variety of problems.
- ❖ That is they can be given different programs to solve different types of problems.
- ❖ General-purpose computers can process business data as readily as they process complex mathematical formulas.
- ❖ General-purpose computers can store a large amount of data and the programs necessary to process them.

Because general-purpose computers are so versatile, most businesses today use them.

- ❖ Most **digital computers are general computers** and it is mainly such computers that are used in business and commercial data processing.

Special- Purpose Computers

- ❖ Special purpose computers are designed to solve specific problems; the computer program for solving the problem is built right into the computer.
- ❖ They have many features of general-purpose computers but are designed to handle **specific problems** and are not applied to other computerized activities
- ❖ They are designed to do specific kinds of jobs.
- ❖ A TV, a washing machine, an iPod etc, are forms of special-purpose computers, but they have only a small range of things that they can do, and are designed specifically to do them.
- ❖ Special purpose computers are often used as training simulators.
- ❖ A simulator is a computer-controlled device for training people under simulated, or artificially created, conditions

Class Activity

- ❖ What is a Computer?
- ❖ What are the four main functions of a Computer System?
- ❖ List and explain any five characteristics of a Computer
- ❖ State the three (3) components of a computer
- ❖ Differentiate between a general and special purpose computer

**THANK
YOU!**