Fundamentals of Computing

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Acknowledgement

The contents (figures, concepts, graphics, texts etc.) of the slides are gathered and utilized from the books mentioned and the corresponding PPTs available online:

Books:
1. **Let Us C,** Yashawant Kanetkar, BPB Publications.
2. **The C Programming Language,** B. W. Kernighan, D. Ritchie, Pearson Education India.

Web References:
1. **Problem Solving through Programming in C,** Anupam Basu, NPTEL Video Lectures. Link: https://nptel.ac.in/courses/106/105/106105171/
2. **Compile and Execute C Online (Link:** https://www.onlinegdb.com/)

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The Term Computing

- To compute is to calculate

- We encounter various problems in our day to day life. Some of them can be solved logically by following certain steps.

- We can solve some problems or can perform certain computing tasks through the help of computer programs.

- A **computer program** is a collection of instructions that can be executed by a computer to perform a specific task.

- To perform different tasks of computation we need to learn programming.

- A computer program is usually written by a computer programmer in a programming language.

A Computer System

- A computer is an electronic device, operating under the control of instructions (software) that is stored in its own memory unit, that can accept data (input), manipulate data (process), and produce information (output) from the processing.

- Generally, the term is used to describe a collection of devices that function together as a system.

- Computers can perform four general operations, which comprise the information processing cycle.

Input ➡ **Process** ➡ **Output**

⬍

Store Data

- Input
- Process
- Output
- Storage
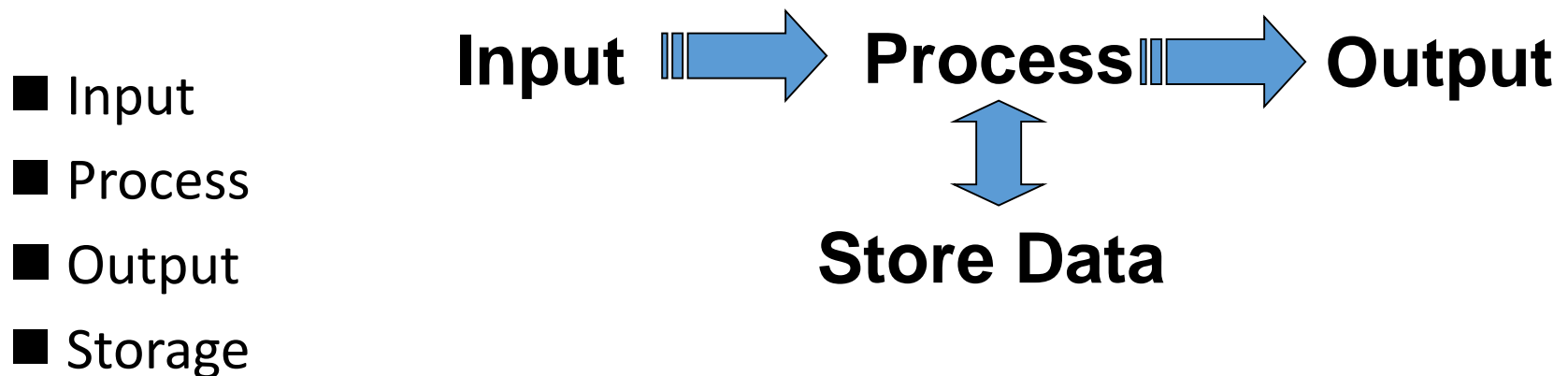
Why Is A Computer So Powerful?

- The ability to perform the information processing cycle with amazing speed.

- Reliability (low failure rate).

- Accuracy.

- Ability to store huge amounts of data and information.

- Ability to communicate with other computers.

How Does a Computer Know what to do?

- It must be given a detailed list of instructions, called a **compute program** or **software**, that tells it exactly what to do.

- Before processing a specific job, the computer program corresponding to that job must be stored in memory.

- Once the program is stored in memory the computer can start the operation by executing the program instructions one after the other.

Applications of Computer

Computers in Daily Life

- Accounts
- Games
- Educational
- On-line banking
- Smart ID cards
- Supermarkets
- Working from home
- Internet

History of Computers

COMPUTER
From the Latin word "computare"

to reckon – to sum up

Webster's Dictionary defines "computer" as any programmable electronic device that can store, retrieve, and process data
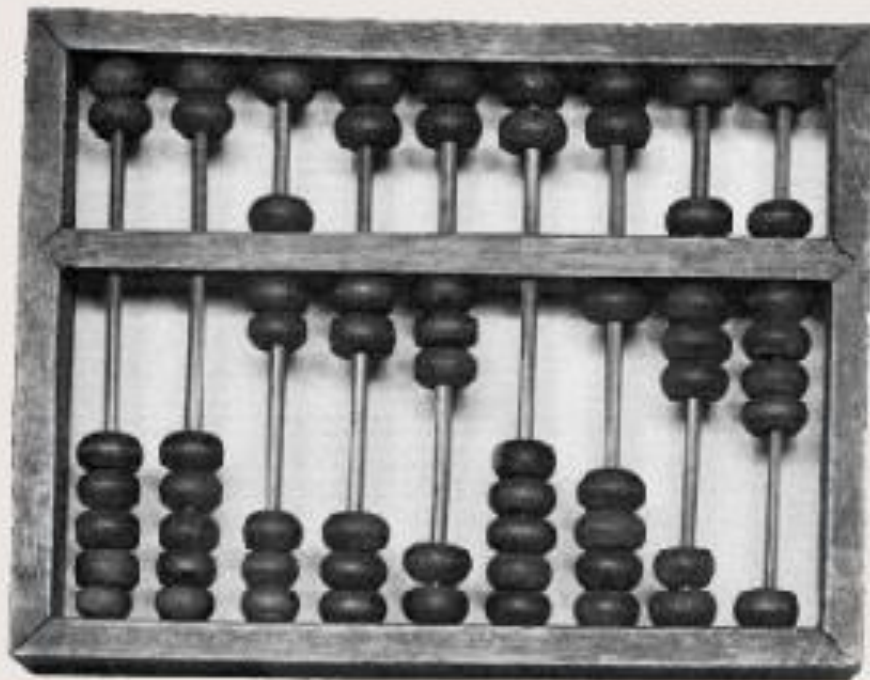
The Old Oxford English dictionary describes a computer as a **person** employed to make calculations.

* *Before the machines, people were hired to do calculations.*

Abacus 3000 BC

The Abacus, a simple counting aid, was most likely invented in Babylonia.

the slide rule 1622

- The **slide rule** is a mechanical precursor of the pocket calculator. It was invented in England by William Oughtred and was very commonly used until the 1970s when it was made obsolete for most purposes by electronic calculators.

1623 - 1833

•1623: **Wilhelm Schickard**, a professor at the University of Tubingen, Germany, builds the first mechanical calculator. It can work with six digits, and carries digits across columns
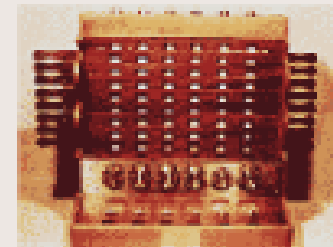
- 1640: **Blaise Pascal** invents the first commercial calculator, a hand powered adding machine

- 1673: **Gottfried Leibniz** builds a mechanical calculating machine that multiplies, divides, adds and subtracts

- 1780: American **Benjamin Franklin** discovers electricity

- 1801: a Frenchman, **Joseph-Marie Jacquard** builds a loom that weaves by reading punched holes stored on small sheets of hardwood.
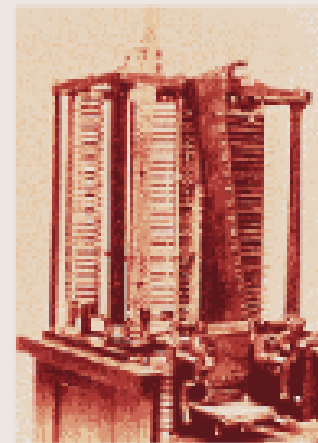

•1833: **Charles Babbage** designs the Analytical Machine that follows instructions from punched-cards. It is the first general purpose computer

First Generation Computers 1940-1956: Vacuum Tubes

The first computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms. They were very expensive to operate and in addition to using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions. First generation computers relied on machine language to perform operations, and they could only solve one problem at a time. Input was based on punched cards and paper tape, and output was displayed on printouts.
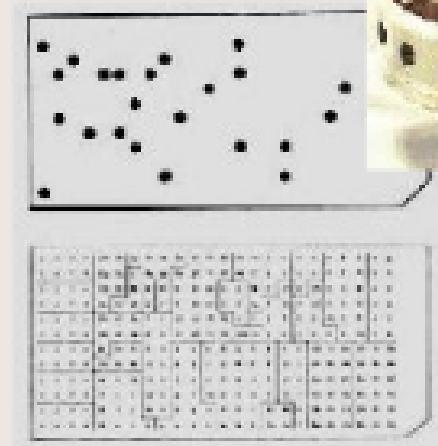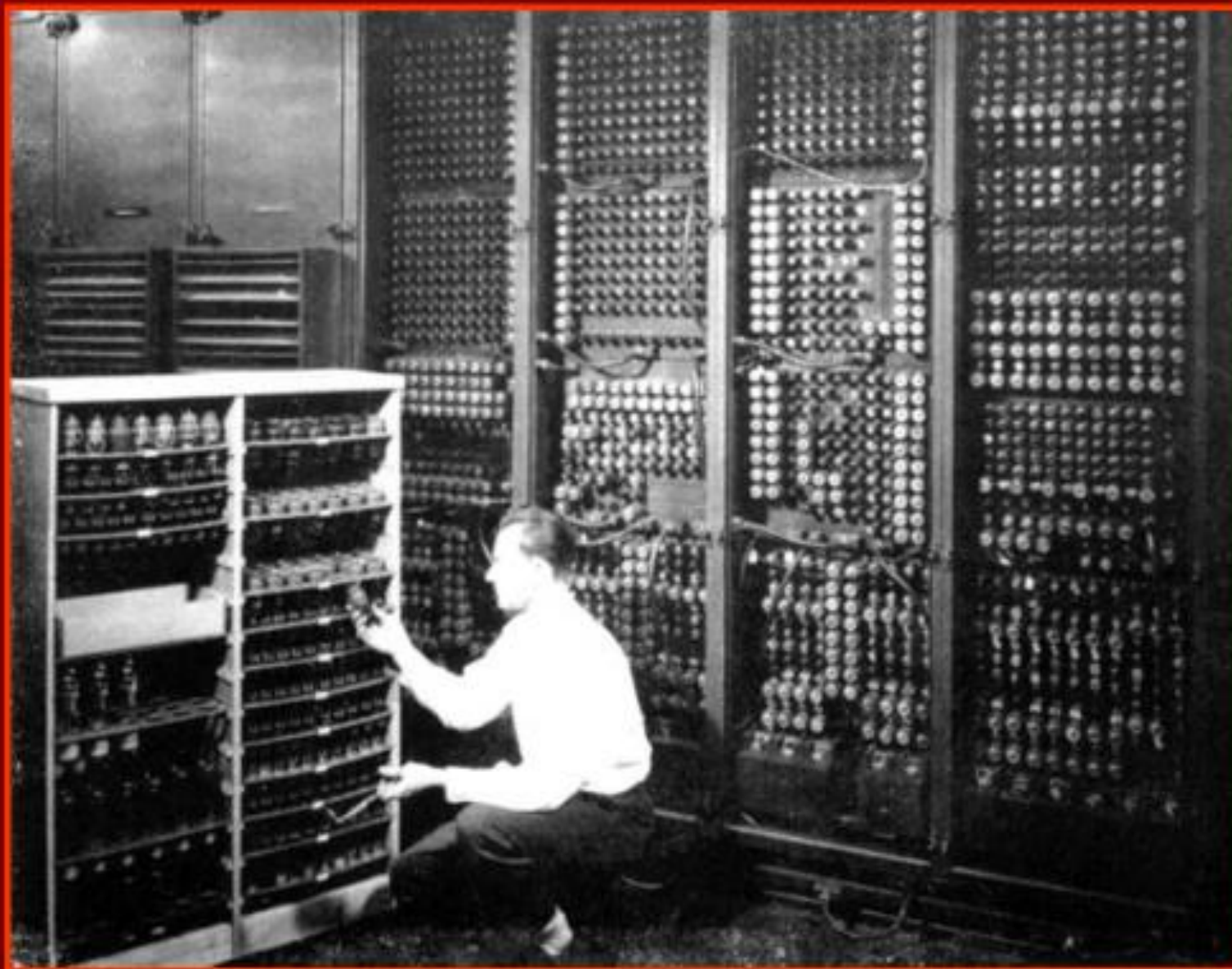
The ENIAC computer, University of Pennsylvania, 1945

ENIAC

Cost: about $486,000

Size: over 100 feet long, filling a 30 ft. x 50 ft. room.
Height: 10 feet. Depth: about 3 feet. Weight: about 30 tons.

# Second Generation Computers- 1956-1963: Transistors

Transistors replaced vacuum tubes and ushered in the second generation of computers. The transistor was invented in 1947 but did not see widespread use in computers until the late 50s. The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output.

In 1959 IBM shipped its first transistorized, or second generation, computers –
   The IBM 1401

Third Generation Computers – 1964-1971: Integrated Circuits

In 1961, the development of the integrated circuit by Robert Noyce of Fairchild Semiconductor, was the hallmark of the third generation of computers. Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers. Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time. Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors.
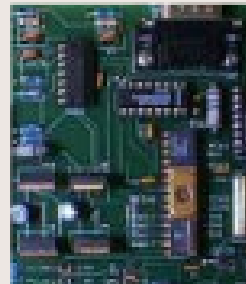
Fourth Generation computers – 1971-Present: Microprocessors

- The microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built onto a single silicon chip. What in the first generation filled an entire room could now fit in the palm of the hand. The Intel 4004 chip, developed in 1971, located all the components of the computer on a single chip.
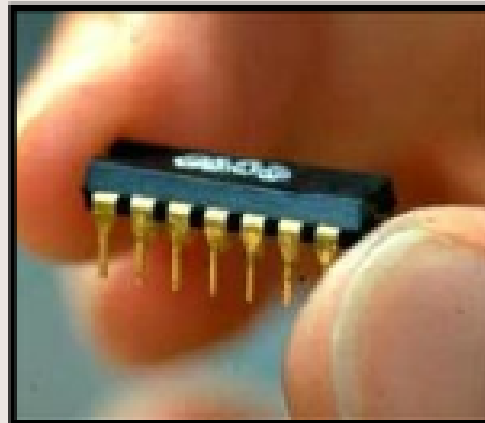
Osborne I – the first "laptop"

- 1981: Adam Osborne completed the first portable computer, which weighed 24 pounds and cost $1,795. The price made the machine especially attractive, as it included software worth about $1,500. The machine featured a 5-inch display, 64 kilobytes of memory, a modem, and two 5 1/4-inch floppy disk drives.

TODAY

CD / DVD

P D A

Flat Screens
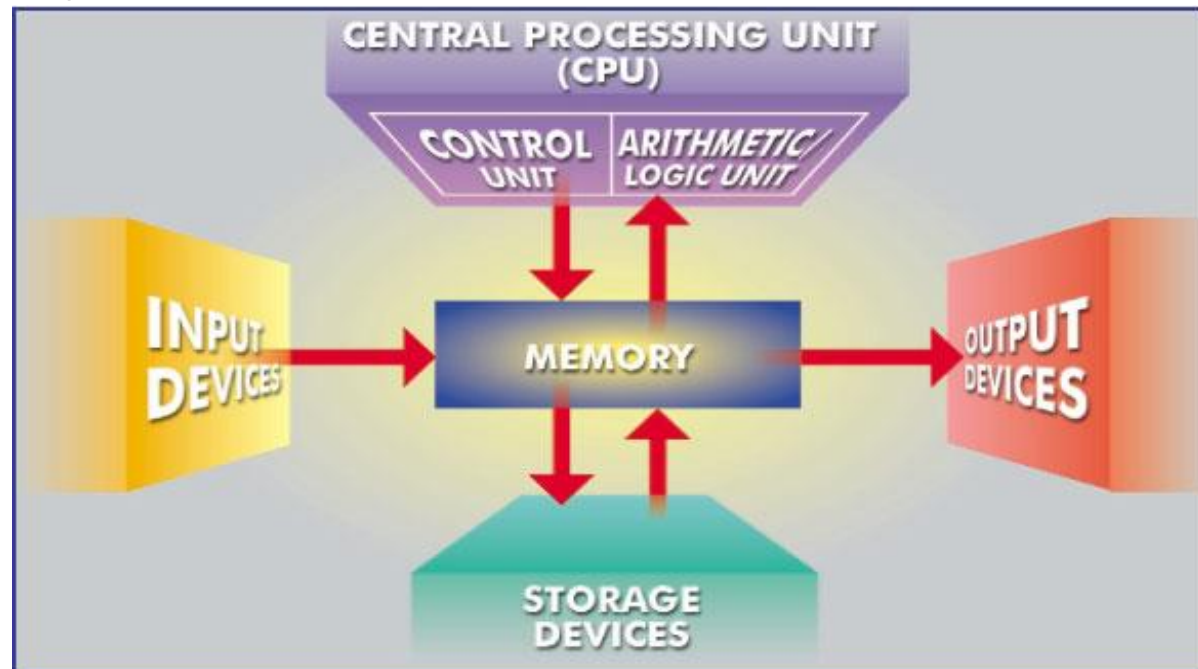

MP3 players
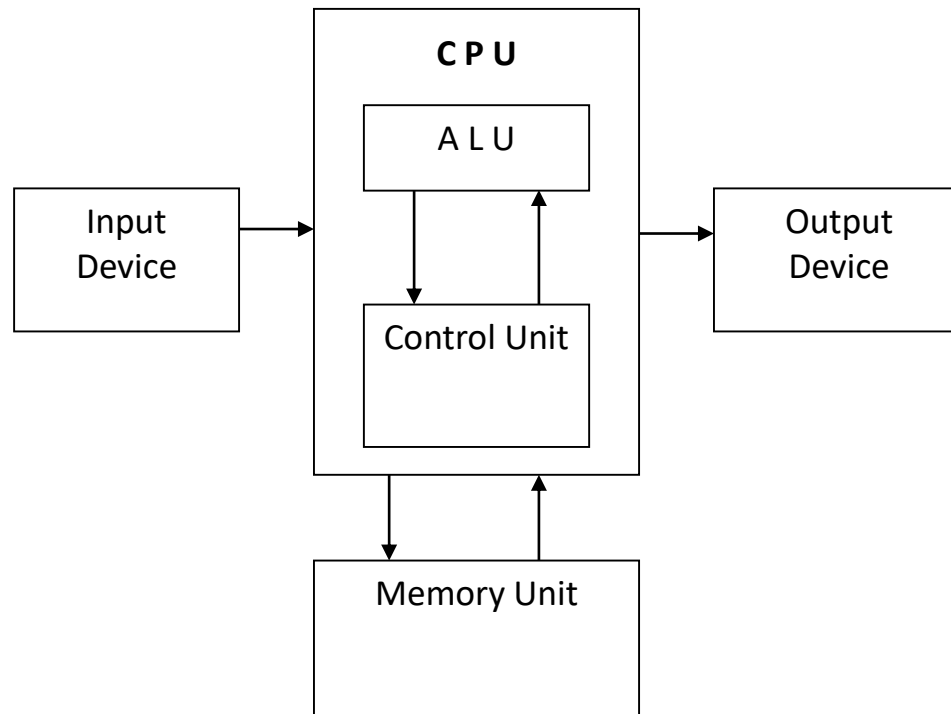

U S B connectivity

Electronic Tablets

scanner

Basic Anatomy of Computer

The Primary Components of A Computer

- Input devices.

- Central Processing Unit (containing the control unit and the arithmetic/logic unit).

- Memory.
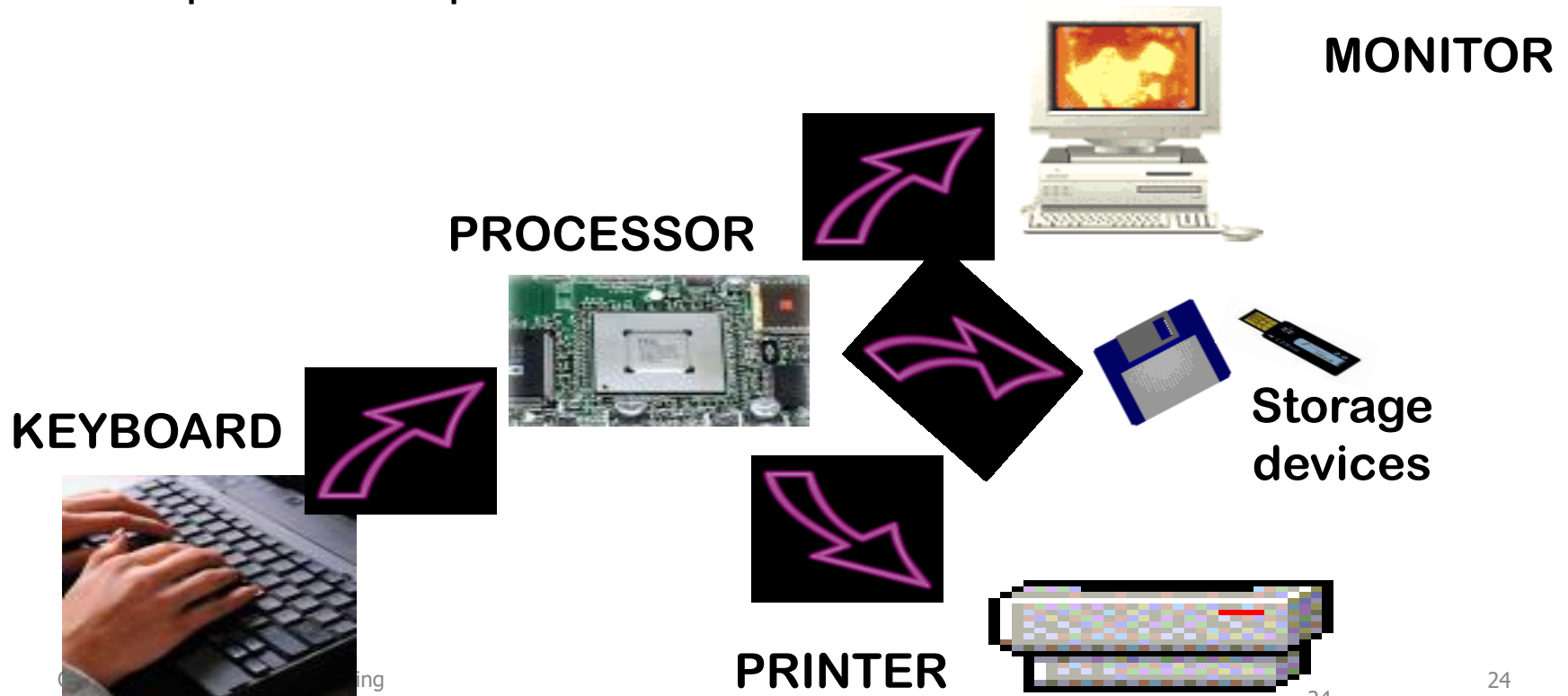
- Output devices.

- Storage devices.

Basic Block Diagram of Computer

Computer System

A computer system consists of three primary units:

1. Input units – accept data
2. Processor unit – processes data by performing comparisons and calculations
3. Output units – present the results

MONITOR

PROCESSOR

KEYBOARD

Storage devices

PRINTER

Computer System

Input Devices

- Data are facts, numbers and characters that are entered into the computer via keyboard.

- Other types of input devices are mouse, joystick, light pens, scanners, camera, etc.
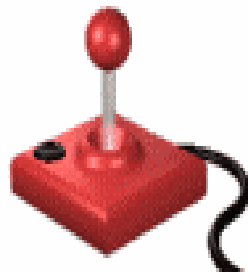
Computer System

Computer Input Devices

- Keyboard
- Mouse/Trackball
- Joystick
- Light pen
- Pointing Stick
- Touchpad

- Touch screen
- Bar code reader
- Scanner
- Microphone
- Graphics Tablet
- Digital Cameras

Computer System

Processor Unit

- Two main parts:
- **CPU** – where the actual processing takes place; and
- **Main memory** – where data are stored.
- The contents of main memory can be transferred to auxiliary storage devices such as hard disks, floppy diskettes, zip disks, compact disks, or USB flash disk.

Computer System

Central Processing Unit

- The microprocessor, the brains of the computer. Referred to a CPU or processor

- Housed on a tiny silicon chip

- Chip contains millions of switches and pathways that help your computer make important decisions.
    - CPU knows which switches to turn on and which to turn off because it receives its instructions from computer programs (software).

- CPU has two primary sections:
    - Arithmetic/logic unit
    - Control unit

Computer System

Arithmetic/logic unit (ALU):

- Performs arithmetic computations and logical operations; by combining these two operations the ALU can execute complex tasks.
  - Arithmetic operations include addition, subtractions, multiplication, and division.
  - Logical operations involve comparisons.

Control Unit: is the "boss" and coordinates all of the CPU's activities.

- Uses programming instructions, it controls the flow of information through the processor by controlling what happens inside the processor.
- Control units fetch and decode machine instructions. Control units may also control some external devices.

Computer System

Memory

Found on the motherboard

❑ Short term

Random Access Memory (RAM)

❑ Long term

Read Only Memory (ROM)

Computer System

Random Access Memory (RAM)

- "Temporary Memory" – Short Term
- Memory on the motherboard that is short term; where data, information, and program instructions are stored temporarily on a RAM chip or a set of RAM chips, known as the **main memory.**
- This memory is considered to be volatile.
- The computer can read from and write to RAM.
- When the computer is turned off or if there is loss of power, what ever is stored in RAM disappears.

Computer System

Read-Only Memory (ROM)

- Memory on the motherboard that is long term; where the specific instructions that are needed for the computer to operate are stored.
- This memory is nonvolatile and your computer can only read from a ROM chip.
- The instructions remain on the chip regardless if the power is turned on or off.
- Most common is the BIOS ROM; where the computer uses instructions contained on this chip to boot or start the system when you turn on your computer.
- "Permanent Memory" – Long Term

Computer System

Output Unit

- After the data has been processed, the results are output in the form of useful information.

- Output units such as monitors and printers make the result accessible for use by people.

Monitor: screen that display information such as text, numbers, and pictures-softcopy.

Printer: gives you information from the computer in printed form – hardcopy.
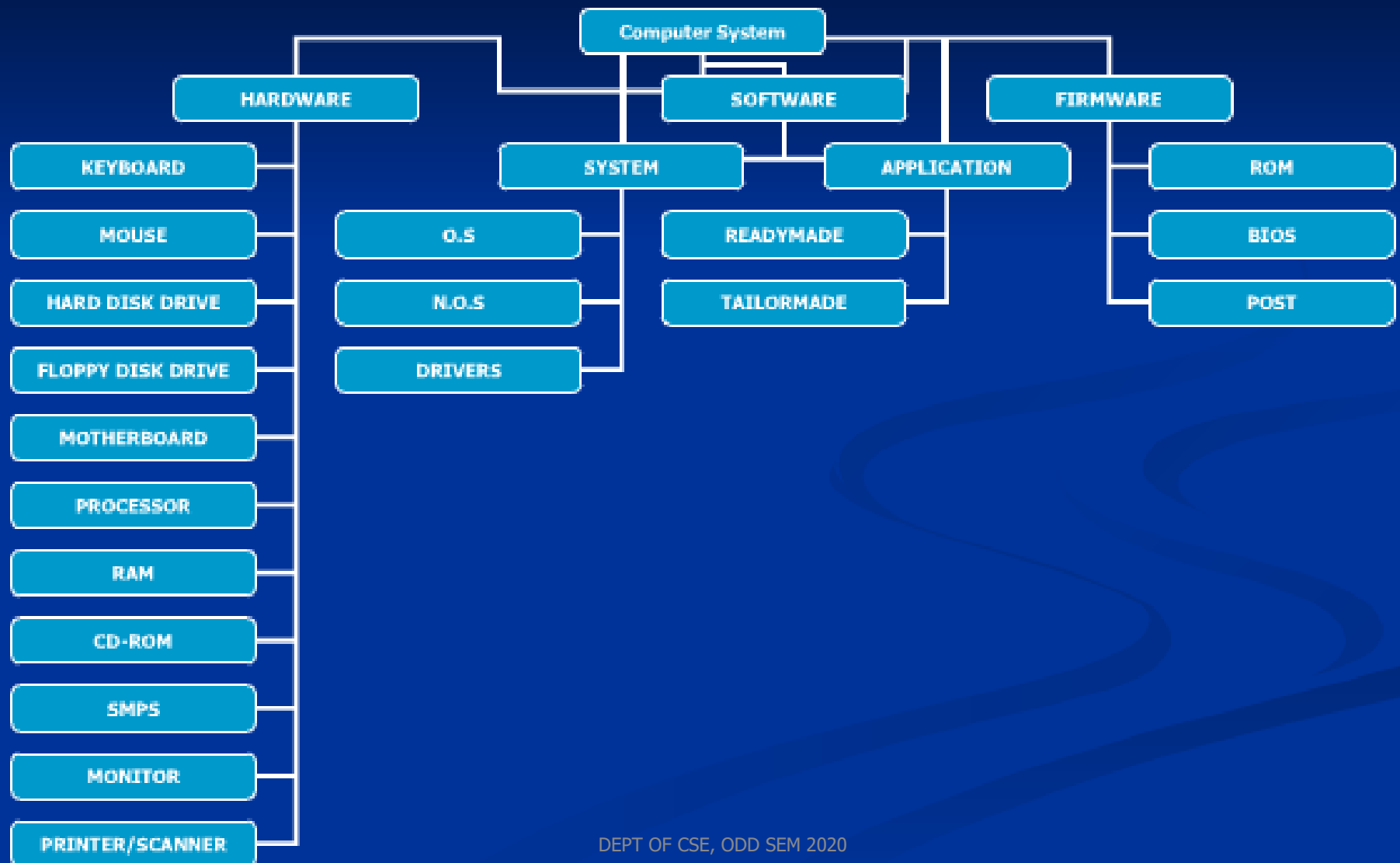
Speakers: allow you to hear voice, music, and other sounds from your computer.

Modem: allows you to use your computer to communicate with other computers.

The Parts of a Computer System

- A complete computer system includes four distinct parts:

  - **Hardware**

  - **Software**

  - **Firmware**

  - **User**

Computer System

Computer Software

- A computer system is referred to have software and hardware.

- Software refers to programs that make the machine do something. Many software packages exist for today's computers. They include word processing, database processing, spreadsheets, operating systems, and compilers etc.

- Software is usually classified as system software and application software.

- **Application Software**: are the combinations of programs, which are designed to perform a specific operation. This type of software performs all the specialized tasks that computers are used for: payroll, video editing, gif animator, computer aided design, airline reservations, email, chat.

- **Systems software**: controls the operations of a computer and the other types of software that it runs. Examples of systems software include the operating system, device drivers, programming languages, compilers, assemblers and translators