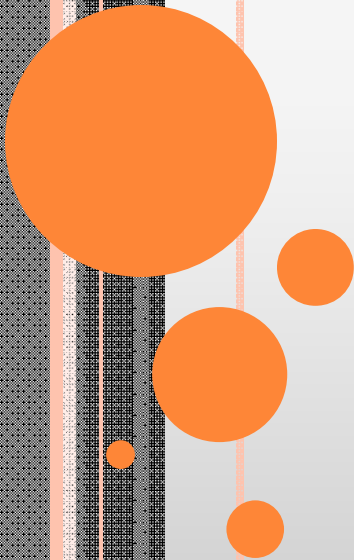


# **FUNDAMENTALS OF COMPUTERS & PROGRAMMING IN C**



# LECTURE-1

## Topics:

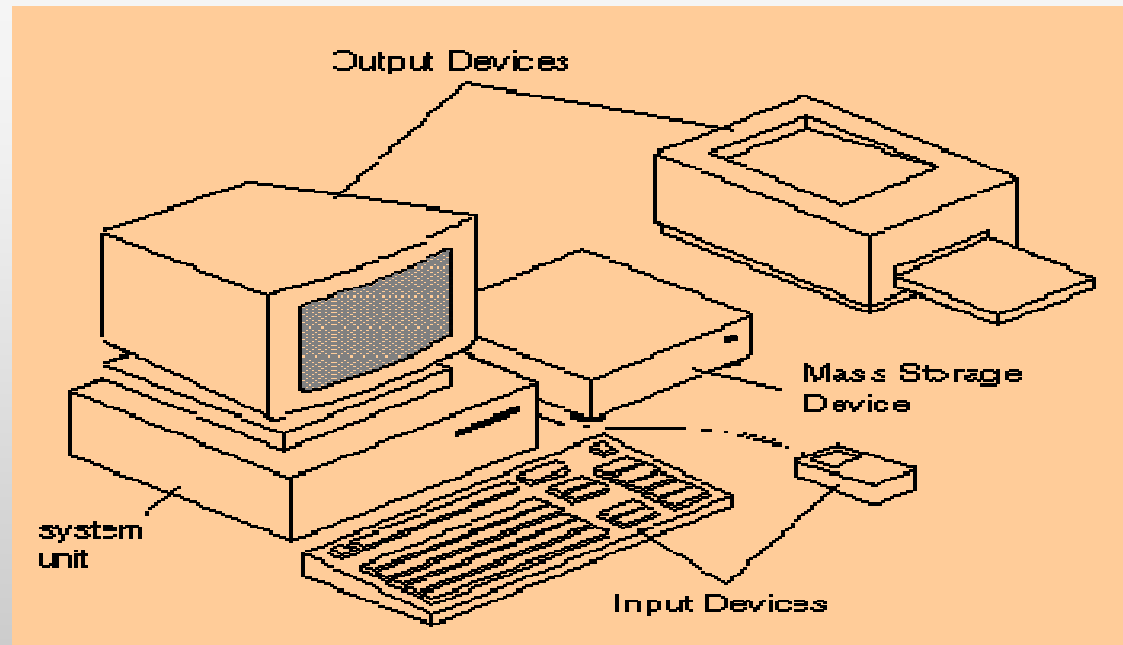
- Evaluation of computers
- Hardware organization of a computer

# Topic1:Evaluation of computers

## What is Computer ?

A programmable machine.

which responds to a specific set of instructions in a well-defined manner



# WHAT IS A COMPUTER?

A computer is an electronic device, operating under the control of instructions stored in its own memory unit,

- that can accept data (input),
- process data arithmetically and logically,
- produce results (output), and store the results for future use.

# COMPONENTS OF A COMPUTER

## Basic Components

- ❑ Input Devices
- ❑ System Unit
- ❑ Output Devices
- ❑ Storage Devices

## Other Components

- ❑ Peripheral Devices
- ❑ Communication Devices



# STRENGTHS OF COMPUTERS

- ❑ Speed.
- ❑ Storage
- ❑ Accuracy
- ❑ communication/Connectivity
- ❑ Processing

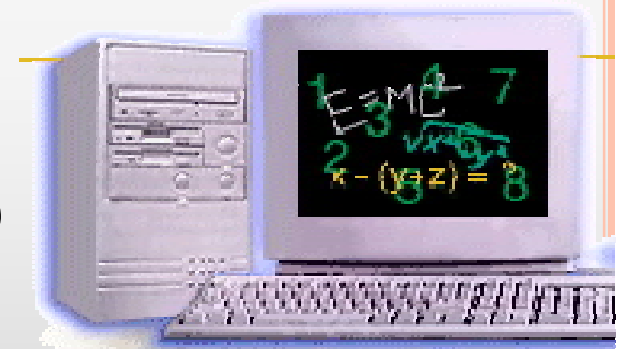


# GENERATIONS OF COMPUTERS

This term is also used in the different advancements of computer technology. With each new generation, the circuitry has gotten smaller and more advanced than the previous generation before it.

## 5 generations of computer

- I. First generation(1946-1959)
- II. Second generation(1959-1965)
- III. Third generation(1965-1971)
- IV. Fourth generation(1971-1980)
- V. Fifth generation(1980 onwards)



# FIRST GENERATION(1946-1959)

## VACUUM TUBES

The first computers used vacuum tubes for circuitry and magnetic drums for memory

### Main Features

- ❑ They were very expensive
- ❑ Non portable
- ❑ Huge size
- ❑ Supported machine language
- ❑ Very slow speed
- ❑ Consumed lot of electricity
- ❑ Generate lot of heat
- ❑ Slow I/O





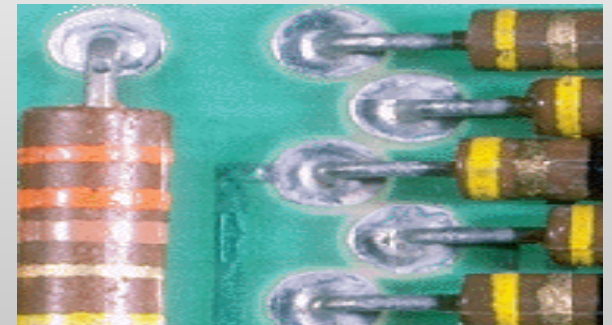
# SECOND GENERATION(1959-1965)

## TRANSISTORS

Transistors replaced vacuum tubes and ushered in the second generation of computers.

### Main Features

- ❑ Use of transistors
- ❑ Small size as compare to first generation
- ❑ Generate less heat as compare to first generation
- ❑ Faster than first generation
- ❑ Still very costly
- ❑ Support machine and assmebly languages



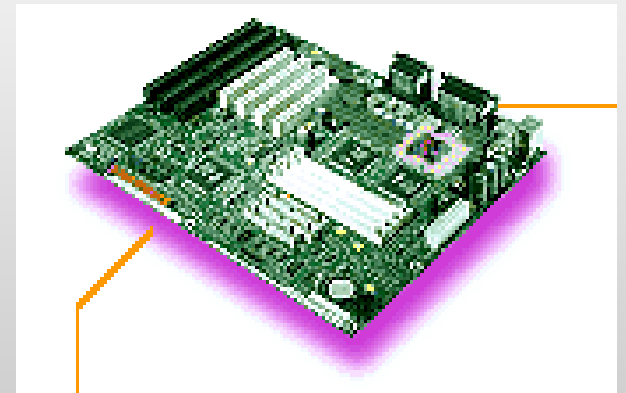
# THIRD GENERATION(1965-1971)

## INTEGRATED CIRCUITS

The development of the integrated circuit 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.

### Main Features

- ❑ IC used
- ❑ More reliable
- ❑ Still costly
- ❑ Faster
- ❑ Lesser maintenance
- ❑ Smaller size
- ❑ Support high level languages
- ❑ Consumed lesser electricity



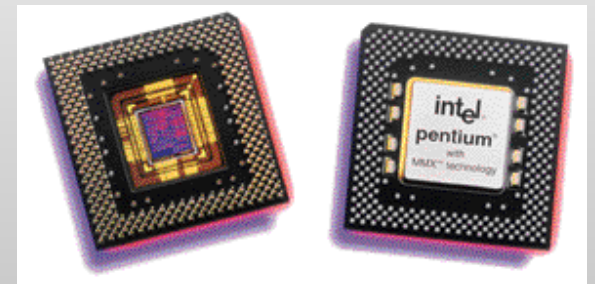
# FOURTH GENERATION(1971-1980)

## MICROPROCESSOR

The microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built onto a single silicon chip.

### Main Features

- ❑ VLSI technology
- ❑ Very cheap
- ❑ Portable and reliable
- ❑ Increased capabilities of I/O
- ❑ Concept of internet was introduced
- ❑ Pipeline processing



# FIFTH GENERATION(1980 ONWARDS)

## ARTIFICIAL INTELLIGENCE

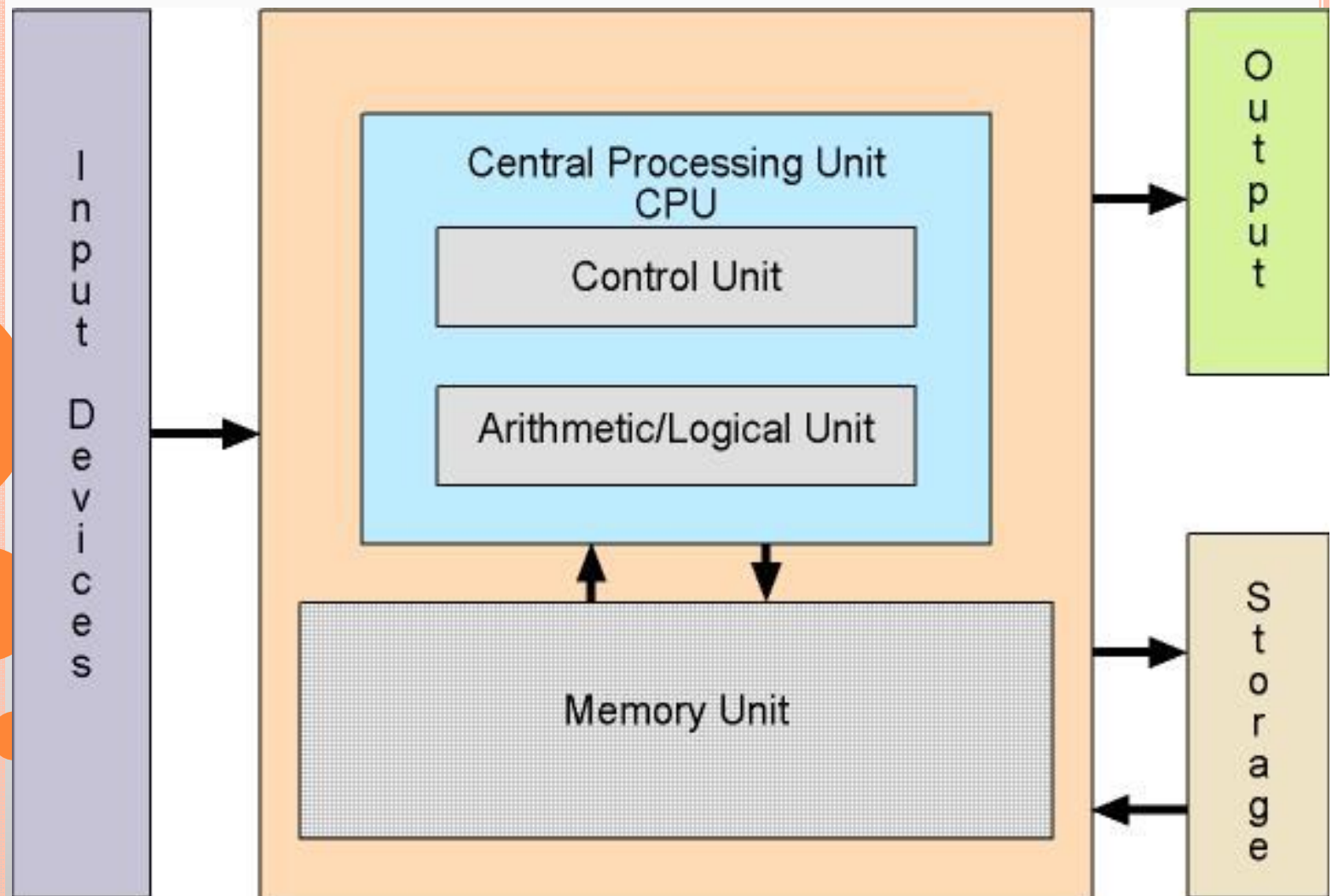
- ❑ Fifth generation computing devices, based on artificial intelligence, are still in development.
- ❑ though there are some applications, such as **voice recognition**, that are being used today. The use of **parallel processing and superconductors** is helping to make artificial intelligence a reality.
- ❑ The goal of fifth-generation computing is to develop devices that respond to **natural language** input and are capable of learning and self-organization.





# TOPIC 2: HARDWARE ORGANIZATION OF A COMPUTER

## Basic Computer Components



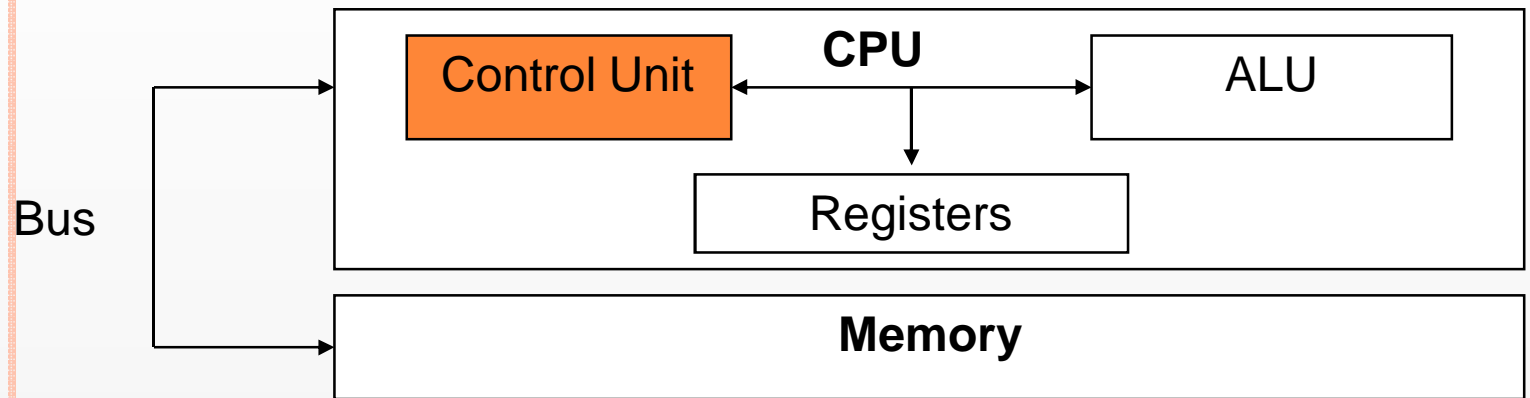
# THE CENTRAL PROCESSING UNIT

- ❑ It is the brain of a computer system
- ❑ The CPU:
  - ✓ receives input.
  - ✓ interprets instructions provided by programs.
  - ✓ directs other components of the system to act.
  - ✓ processes data.
  - ✓ controls output.





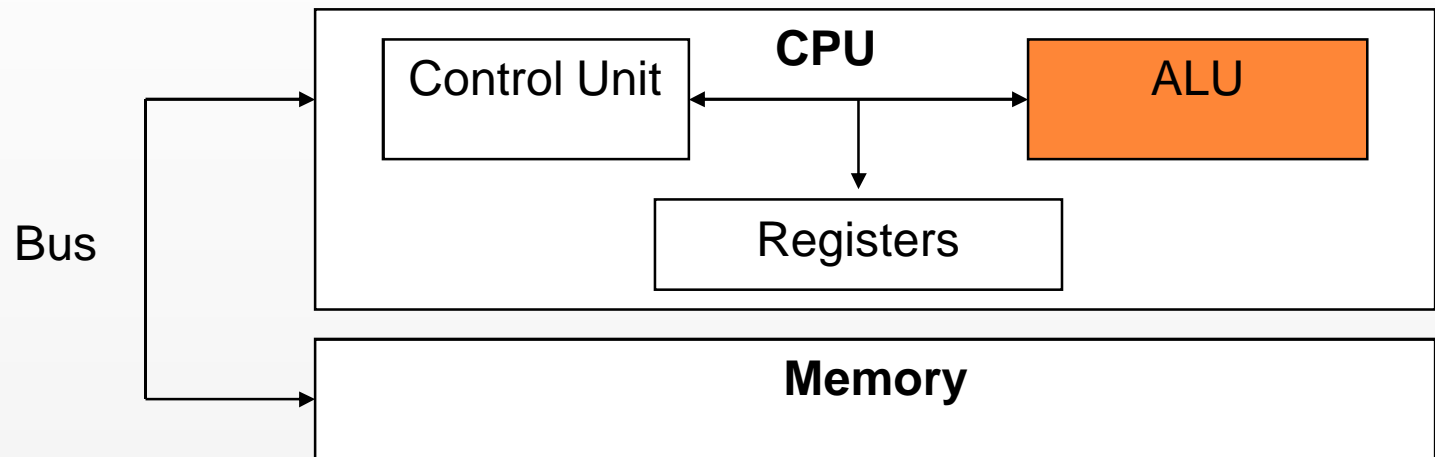
# THE CENTRAL PROCESSING UNIT



**Control Unit:** The control unit controls the computer by repeating 4 operations, called the machine cycle. The 4 operations are:

1. fetching program instructions from memory
2. decoding the instructions into commands that the computer can process
3. executing the commands
4. storing the results in memory

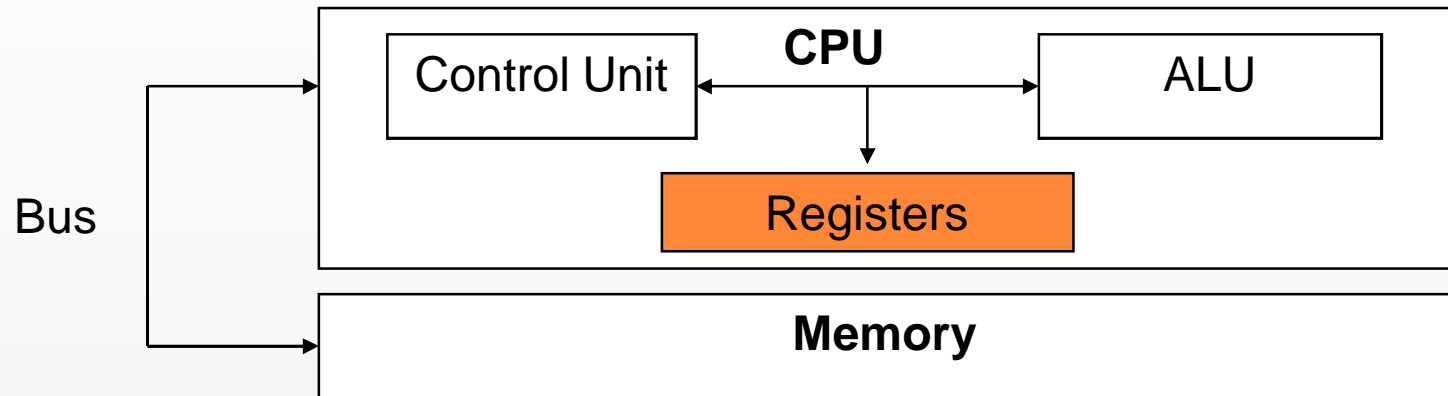
# THE CENTRAL PROCESSING UNIT



## Arithmetic and Logic Unit (ALU)

It performs calculations and comparisons of data.

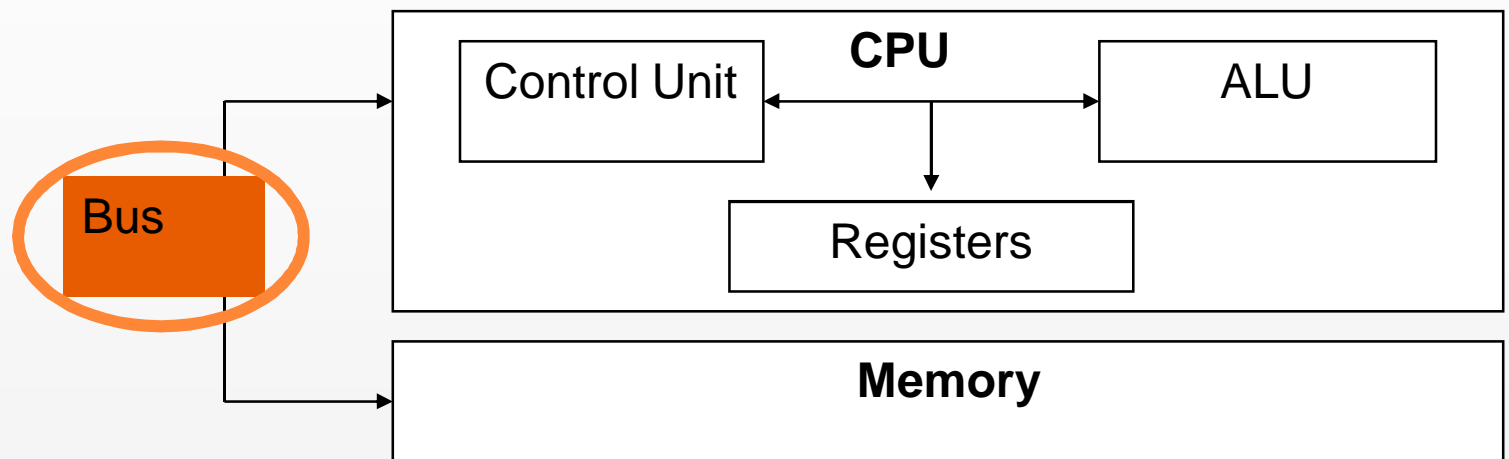
# THE CENTRAL PROCESSING UNIT



## Registers

They hold program instructions, data values, and memory locations as the computer executes a program.

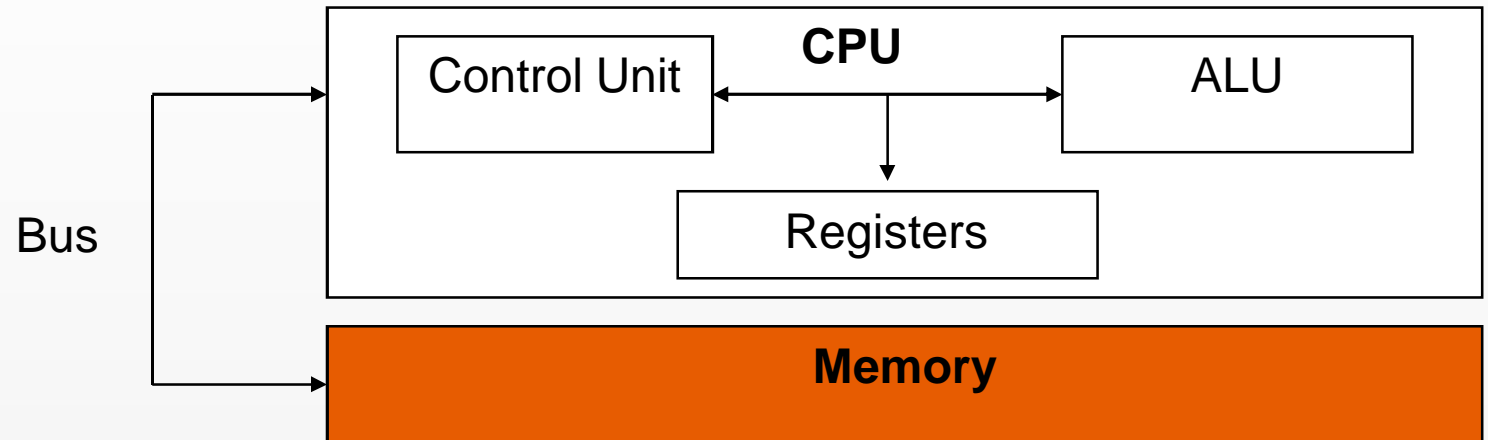
# THE CENTRAL PROCESSING UNIT



## Buses

They are electrical pathways that carry signal (bits) between a CPU's components and outside devices.

# THE CENTRAL PROCESSING UNIT



## Memory

- ✓ accepts and holds program instruction and data
- ✓ acts as the CPU's source for data and instructions and as a destination for operation results
- ✓ holds the final processed information until it can be sent to the desired output or storage devices, such as printer or disk drive

# LECTURE-2

## Topics:

- computers classification

• Introduction to Microprocessors



# 1. COMPUTERS CLASSIFICATION ACCORDING TO DATA REPRESENTATION TECHNIQUES

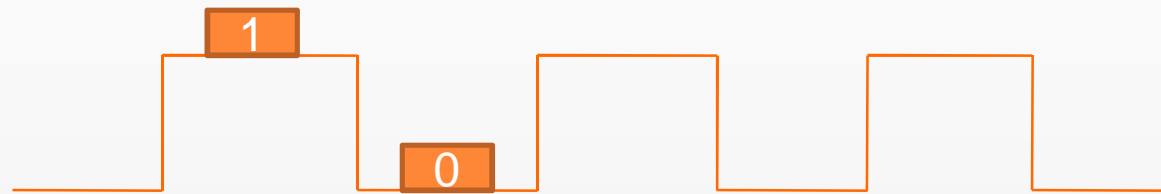
According to DRT ,computers can be classified into three types



computers		
Digital	Analog	Hybrid

# DIGITAL COMPUTERS

A computer that stores data in terms of digits (numbers) and proceeds in discrete steps from one state to the next.



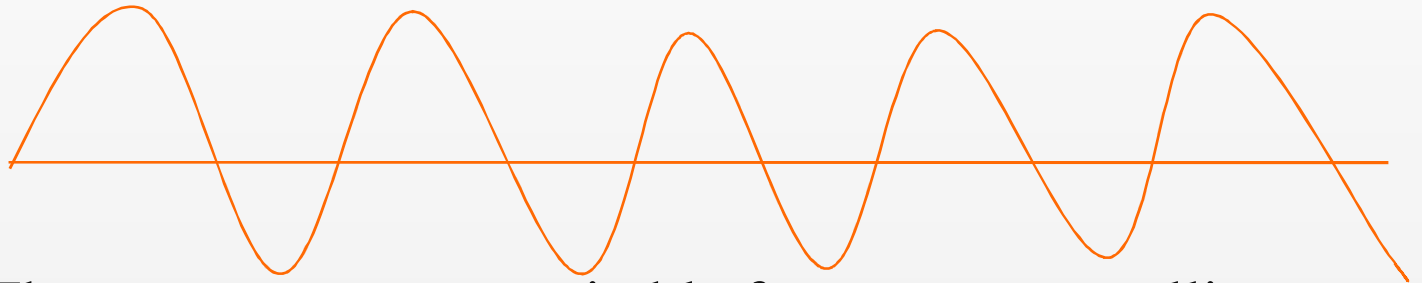
Digital computers have the capabilities of adding, subtracting, multiplying, dividing and comparing. These computers provide highly accurate results.

**For example:**

- I. Desk Calculators
- II. Electronic computers

# ANALOG COMPUTERS

A computer that represents data in terms of physical measures or quantities and proceeds along a continuum constituted by its components



These computers are suitable for use as controlling devices in factories ,military weaponry.

For example:

Speedometer

Voltmeters

Wall clock

Flight simulators

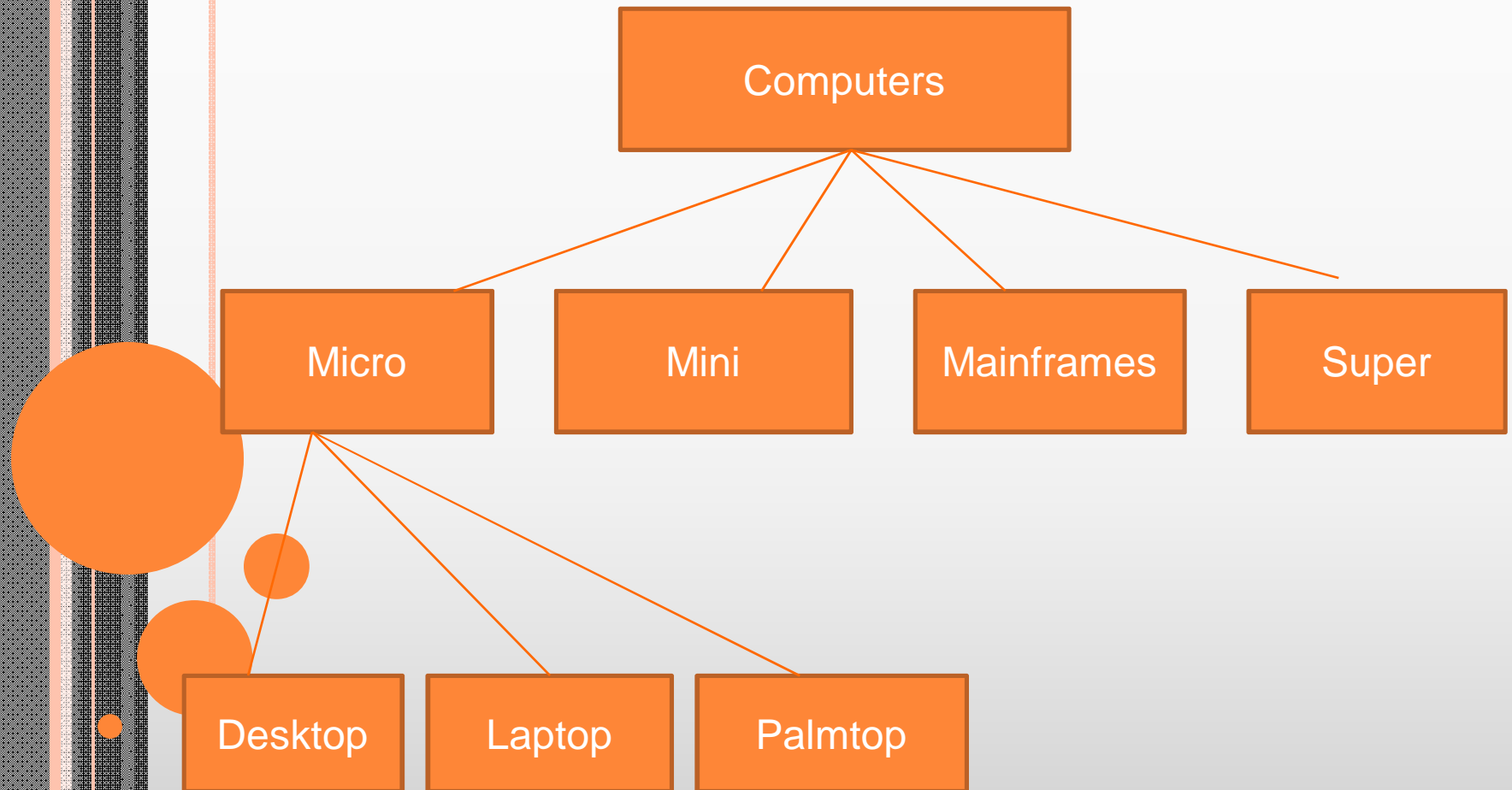
# HYBRID COMPUTERS

Hybrid computers are computers that comprise 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.

**For example:**

Intensive care unit (**I.C.U**)

## 2. COMPUTER CLASSIFICATION BY CAPACITY PERFORMANCE CRITERIA (BY SIZE, COST, SPEED & MEMORY)



# SUPER COMPUTERS

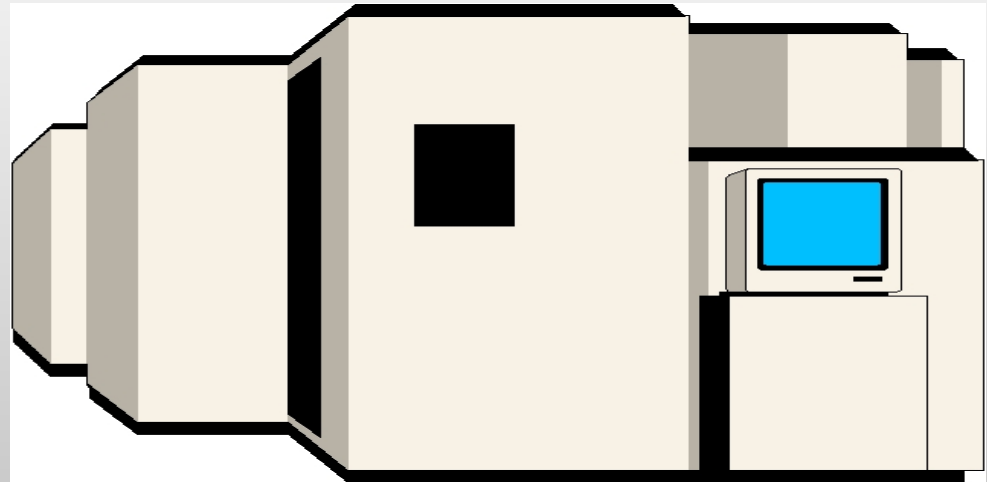
- The biggest in size
- the most expensive in price
- It can process trillions of instructions in seconds.
- This computer is not used as a PC in a home neither by a student in a college.
- Governments specially use this type of computer for their different calculations and heavy jobs.
- In most of the Hollywood's movies it is used for animation purposes.
- This kind of computer is also helpful for forecasting weather reports worldwide





# MAINFRAME COMPUTER

- This can also process millions of instructions per second and is capable of accessing billions of data.
- This computer is commonly used in **big hospitals, air line reservation companies**, and many other huge companies prefer mainframe because of its capability of retrieving data on a huge basis.
- This is normally too expensive
- This kind of computer can cost thousands of dollars



# MINI COMPUTERS

- Mini computers generally have greater size, main and secondary memories and powerful processor.
- It is capable of supporting from 4 to about 200 simultaneous users.
- It is commonly used as a server in the network environment.
- Mini computers are usually multi-user systems so they are used in interactive applications in industries, research organizations, colleges, and universities.

# MICRO COMPUTERS

- A micro computer is a small and low cost digital computer
- Which usually consists of a microprocessor, a storage unit, a power supply, appropriate peripherals.
- They are mainly used for managing personal data of a small company or an individual. that's why they are called (PC).



# INTRODUCTION TO MICROPROCESSOR

Microprocessor, the key component, the brain, of a computer

its various sub-systems

- ✓ Bus interface unit
- ✓ Data & instruction cache memory
- ✓ Instruction decoder
- ✓ Arithmetic-Logic unit
- ✓ Floating-point unit
- ✓ Control unit

# MICROPROCESSOR

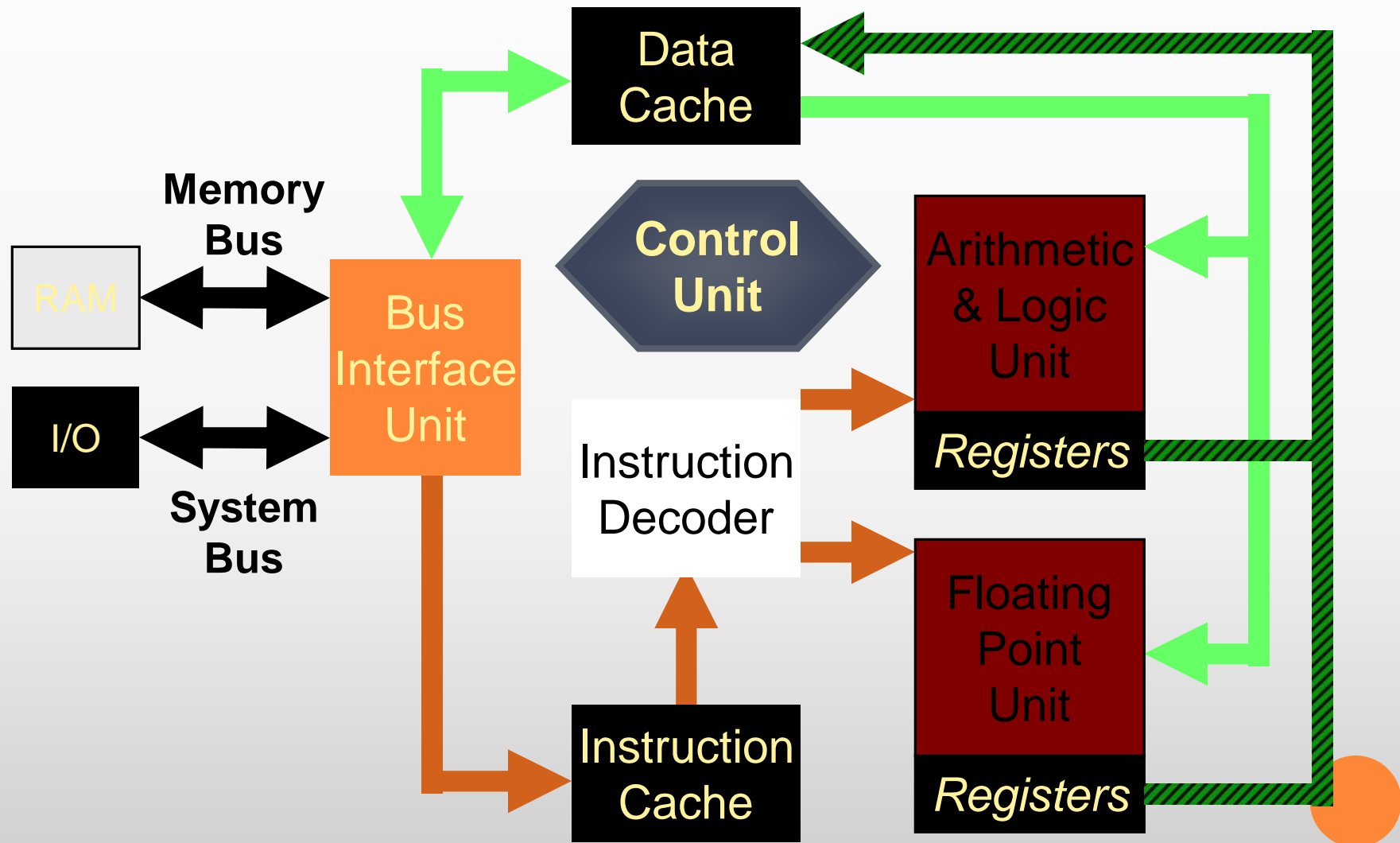
- ❑ The key element of all computers, providing the mathematical and decision making ability
- ❑ Current state-of-the-art uPs (Pentium, Athlon, SPARC, PowerPC) contain complex circuits consisting of tens of millions of transistors
- ❑ They operate at ultra-fast speeds – doing over a billion operations very second
- ❑ Made up from a semiconductor, Silicon

# INTEGRATED CIRCUITS

- Commonly known as an IC or a chip
- A tiny piece of Silicon that has several electronic parts on it
- Most of the size of an IC comes from the pins and packaging; the actual Silicon occupies a very small piece of the volume
- The smallest components on an IC are much smaller than the thickness of a human hair



# Microprocessor



# BUS INTERFACE UNIT

- ❑ Receives instructions & data from main memory
- ❑ Instructions are then sent to the instruction cache, data to the data cache
- ❑ Also receives the processed data and sends it to the main memory

## Instruction Decoder

- ❑ This unit receives the programming instructions and decodes them into a form that is understandable by the processing units, i.e. the ALU or FPU
- ❑ Then, it passes on the decoded instruction to the ALU or FPU

## Arithmetic & Logic Unit (ALU)

It performs whole-number math calculations (subtract, multiply, divide, etc) comparisons (is greater than, is smaller than, etc.) and logical operations (NOT, OR, AND, etc)

## Floating-Point Unit (FPU)

Also known as the “Numeric Unit”

It performs calculations that involve numbers represented in the scientific notation (also known as floating-point numbers).

Floating-point calculations are required for doing graphics, engineering and scientific work

# Registers

Both ALU & FPU have a very small amount of super-fast private memory placed right next to them for their exclusive use. These are called registers

The ALU & FPU store intermediate and final results from their calculations in these registers

Processed data goes back to the data cache and then to main memory from these registers

## Control Unit

The brain of the uP

Manages the whole uP

Tasks include fetching instructions & data, storing data, managing input/output devices

# INSTRUCTION SET

- ✓ The set of machine instructions that a uP recognizes and can execute – the only language uP knows
- ✓ An instruction set includes low-level, a single step-at-a-time instructions, such as add, subtract, multiply, and divide
- ✓ Each uP family has its unique instruction set
- Bigger instruction-sets mean more complex chips (higher costs, reduced efficiency), but shorter programs

# MICROPROCESSOR GENERATIONS

## **First generation: 1971-78**

Behind the power curve  
(16-bit, <50k transistors)

## **Second Generation: 1979-85**

Becoming “real” computers  
(32-bit , >50k transistors)

## **Third Generation: 1985-89**

Challenging the “establishment”  
(Reduced Instruction Set Computer/RISC,  
>100k transistors)

## **Fourth Generation: 1990-**

Architectural and performance leadership  
(64-bit, > 1M transistors,  
Intel/AMD translate into RISC internally)

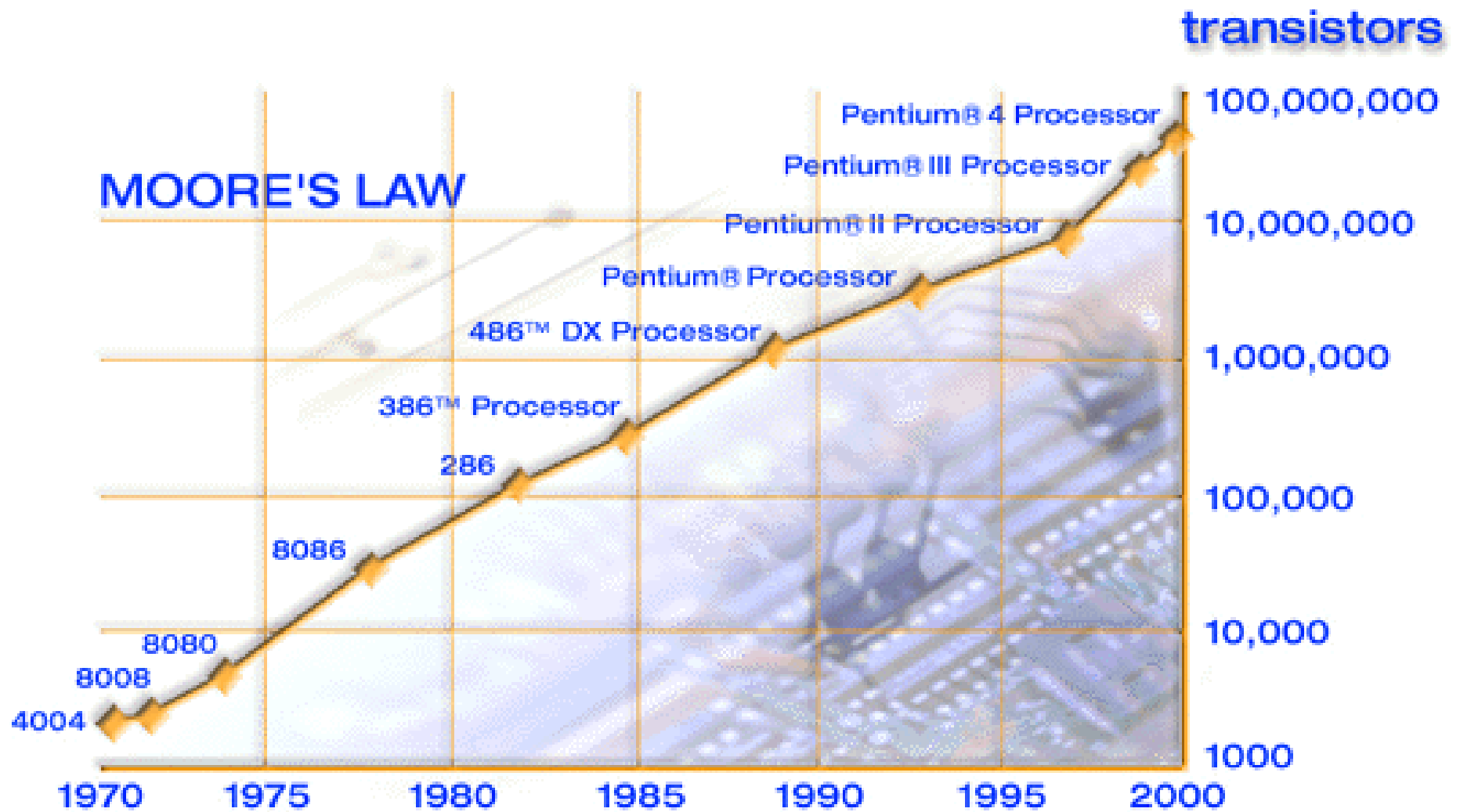


## MOORE'S LAW

**In 1965, one of the founders of Intel – Gordon Moore – predicted that the number of transistor on an IC (and therefore the capability of microprocessors) will double every year. Later he modified it to 18-months**

**His prediction still holds true in '02. In fact, the time required for doubling is contracting to the original prediction, and is closer to a year now**

# EVOLUTION OF INTEL MICROPROCESSORS



# LECTURE-3

## Topics:

- Input Devices: examples with explanation
- Output Devices : examples with explanation

# INPUT/OUTPUT DEVICES

## Input Devices

Any device used to input data into the computer  
(keyboard, mouse, scanner, etc)

Or

Hardware that allows the user to put data into  
the computer

## 2. INPUT DEVICES





# TYPES OF INPUT

## ○ Data

- raw facts that a computer receives and processes to produce information

## ○ Programs

- instructions that direct the computer operations

## ○ Commands

- key words that direct the computer to perform certain activities

## ○ User Responses

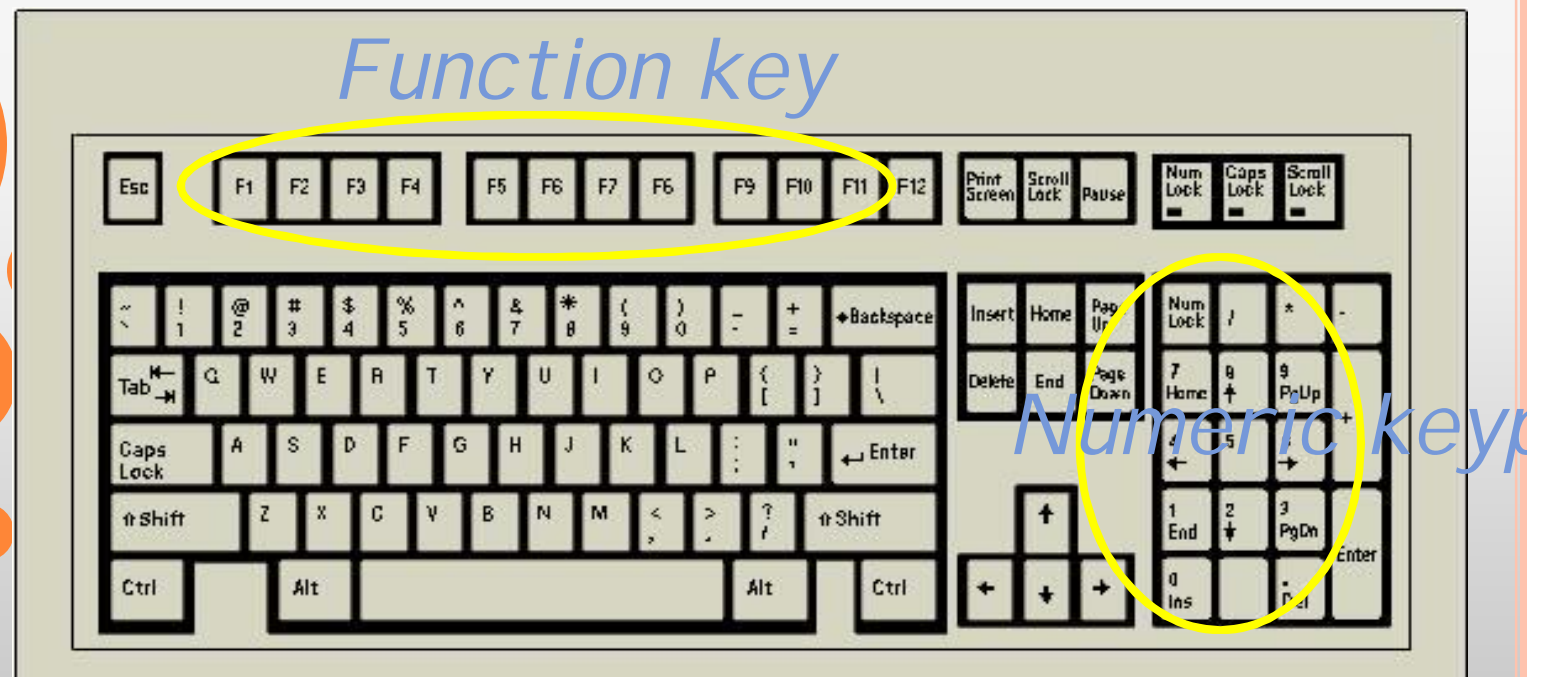
- data a user enters to respond to a question or message.





## A. KEYBOARDS

- ❑ The most commonly used input devices.
- ❑ Contains alphanumeric, cursors and function keys.

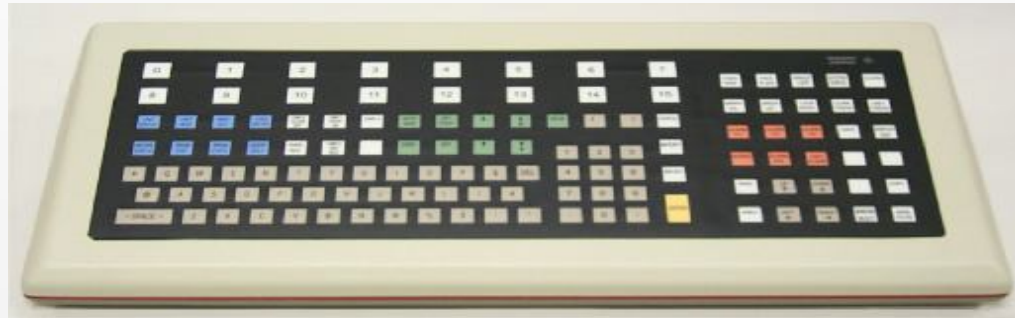


- **Function Keys**, labeled from F1 to F12, allow user to quickly access commands and functions, such as saving a document or calling up a **program's Help feature**.
- **Cursor-control Keys** govern the movement of the cursor on the screen. They include Up Arrow, Down Arrow, Left Arrow and Right Arrow key on the keyboard.
- **Special Purpose Keys** are used in conjunction with other keys to enter commands into a computer. Control (Ctrl), Alternate (Alt) and Shift keys are example of special purpose keys.
- **Toggle Keys** are keys that, when pressed, activates a certain mode or condition, and when pressed again, deactivates the condition. The Num Lock key, Cap Lock key and the Scroll Lock key are examples of toggle keys
- **Numeric Keypad**, located in the far right portion of the keyboard, is used for entering numbers quickly and for performing the same operations as a calculator.

# TYPES OF KEYBOARDS

## **Serial Keyboard**

A serial Keyboard is one, which communicate the data to the Central Processing Unit one bit at a time. This means that bit pattern that forms a particular character is sent on a single wire. So, bit-by-bit transmission is made.



## **Parallel Keyboard**

A Parallel Keyboard carries one Byte (8 bits) at a time to the Central Processing Unit. This means that the bit pattern that forms a character is sent on 8 different wires. Each wire carries one bit.



## B. POINTING DEVICES

- ❑ Many people use pointing devices instead of keyboards whenever possible.
- ❑ Pointing devices minimize the amount of typing (and the number of errors).

# MOUSE

- ❑ Palm-sized pointing devices
- ❑ a ball on the bottom senses its movement
- ❑ various actions can be preformed by moving the pointer and then pressing one of the buttons on top of the mouse.





# TYPES OF MOUSE

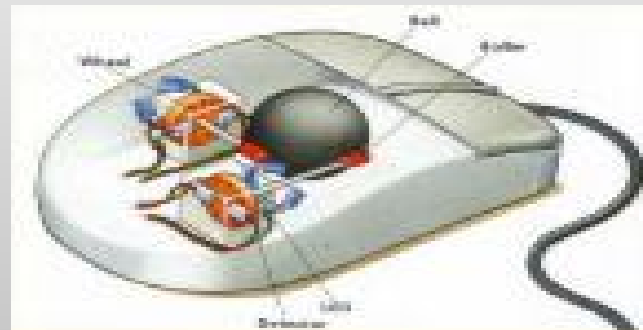
## Mechanical Mouse

A mouse that uses a rubber ball that makes contact with wheels inside the unit when it is rolled on a pad or desktop. Mechanical sensors within the mouse detect the direction the ball is rolling and move the screen pointer accordingly



## Optomechanical Mouse

Same as a mechanical mouse, but uses optical sensors to detect motion of the ball.





# TYPES OF MOUSE

## Optical Mouse

Uses a laser to detect the mouse's movement. You must move the mouse along a special mat with a grid so that the optical mechanism has a frame of reference. Optical mice have no mechanical moving parts. They respond more quickly and precisely than mechanical and optomechanical mice, but they are also more expensive.



## Cordless Mouse

aren't physically connected at all. Instead they rely on infrared or radio waves to communicate with the computer. Cordless mice are more expensive than both serial and bus mice, but they do eliminate the cord, which can sometimes get in the way.

# MOUSE INTERFACES



*Serial*



*PS2*



*USB*

## TRACKPOINT



## Touchpad



The mouse is not practical for people using a notebook computer in a small space. **Track Point** or **Touch pad** is therefore used instead to control the pointer.



# TOUCH-SENSITIVE SCREENS

- ❑ Touch screens are commonly used in grocery stores, fast-food restaurants, and information kiosks.
- ❑ Touch screens enable the user to select an option by pressing a specific part of the screen.



*A touch screen kit solution*

# JOYSTICKS

- Use the movement of a vertical stem to direct the pointer.
- Joysticks are used mostly for computer games, but they are also used occasionally for CAD/CAM systems and other applications.



## C. PEN INPUT DEVICES

Input data with hand written characters, select items by pressing the pen against the screen, and use gestures, which are special symbols, to issue commands.

### **Light Pen**

Used to select processing options or to draw on the screen





## D. SCANNING DEVICES

### Image Scanner

Electronically capture an entire image & convert it into digital form that can be processed by a computer



Image  
e

Scan

Edit

# OPTICAL MARK RECOGNITION

- ❑ Optical marks are the filled-in shape, usually ovals or rectangles, on scan sheets.
- ❑ The data collected on the scan sheets are translated into binary form by an **optical mark reader (OMR)**



Use lead pencil to mark on scan sheet Feed the scan sheets into the OMR

# OUTPUT DEVICES

**Output is data that has been processed into a useful form called information.**

- ☐ Report
- ☐ Computer Graphics
- ☐ Audio Output
- ☐ Video Output

# TYPES OF OUTPUT

- Most output can be divided into 2 categories: Soft copy & hard copy
  - Soft copy is what you see on the monitor. Soft copy is temporary.
  - Hard copy can be touched and carried. Hard copy is usually some form of paper output.



# MONITORS

- ❑ A visual output device of a computer.
- ❑ Monitor output is a most common form of soft copy.



CRT Monitor



Flat-panel Monitor



# RESOLUTION OF DISPLAY

- ❑ Images on the screen are created by configurations of dots called **pixels** (picture elements)
- ❑ The more the pixels, the better the **resolution** of the image
  - SVGA = pixel configuration of 800 by 600
  - XVGA = pixel configuration of 1024 by 768





## 2.PRINTER

A printer is a device that accepts text and graphic output from a computer and transfers the information to paper, usually to standard size sheets of paper.

Personal computer printers can be distinguished as

***impact* Printers**

***non-impact* Printers**

# PRINTERS

- ❑ Produce permanent output (hard copy)
- ❑ consists of 2 main types: impact & non-impact

Types	Impact Printers	Non-impact Printers
Mechanisms	Transfer an image by striking the paper and the ribbon.	Print without striking against a sheet of paper.
Advantages	Cheap consumables; Can print on multiple carbon copies	Fast; High printing quality; Quiet
Disadvantages	Noisy	Expensive consumable



# TYPES OF IMPACT PRINTERS

- ❑ **Line Printers**
- ❑ **Character Printers**

## CHARACTER PRINTERS

- ❑ Printer that stores individual characters when needed to print. The printer will print one character at a time instead of one line at a time. Today, these printers are rarely used because of speed issues and because only text is capable of being printed.

## A. LINE PRINTERS

- ✓ The line printer is a form of high speed impact printer in which one line of type is printed at a time.
- ✓ They are mostly associated with the early days of computing, but the technology is still in use.
- ✓ Print speeds of 600 to 1200 lines-per-minute (approximately 10 to 20 pages per minute) were common
- ✓ The disadvantages of line printers are that they cannot print graphics, the print quality is low, and they are very noisy.

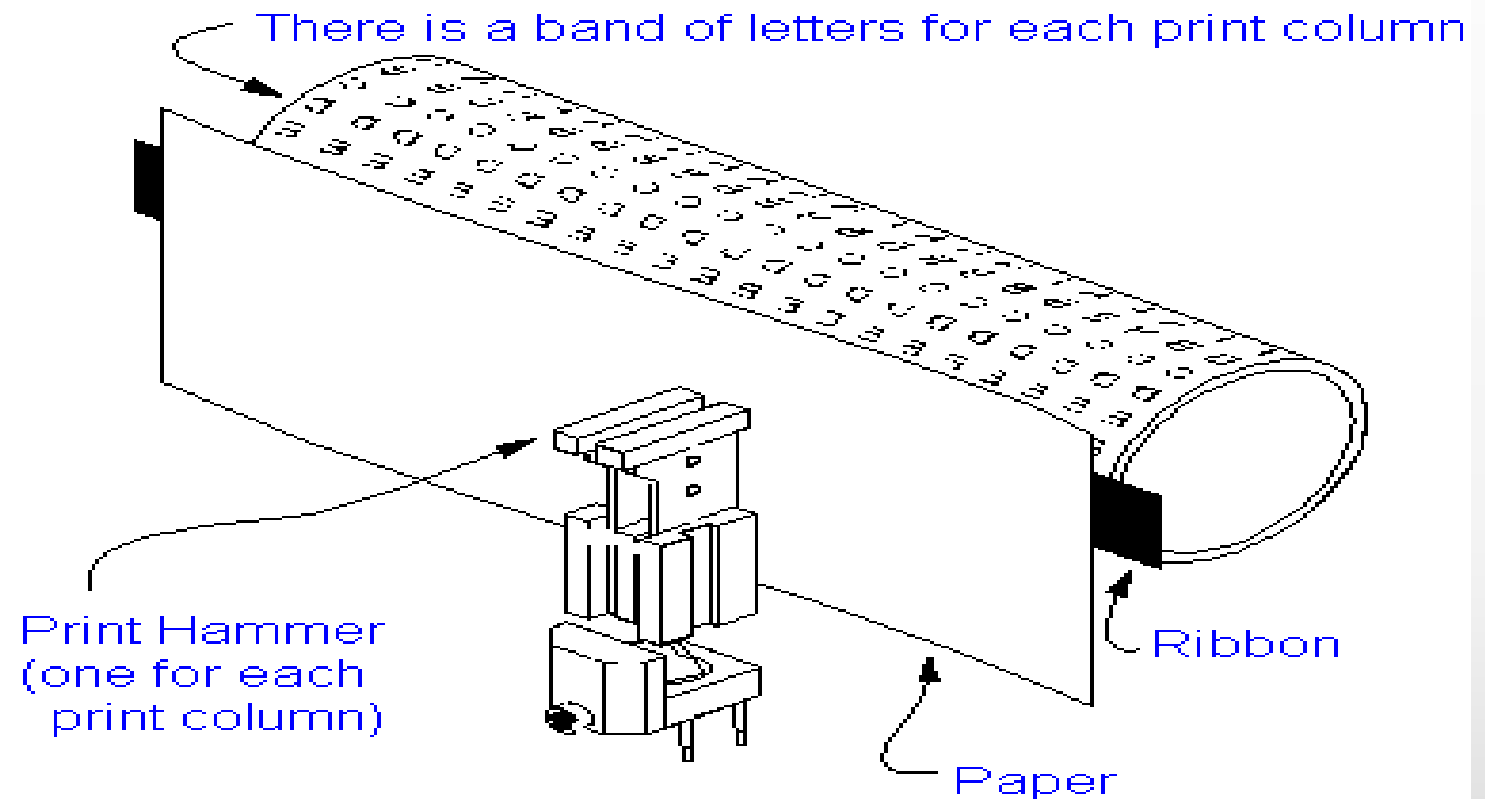
# TYPES OF LINE PRINTERS

- ❑ **Drum printers**
- ❑ **Chain (train) printers**
- ❑ **Bar printers**
- ❑ **Comb printers**



# DRUM PRINTER MECHANISM

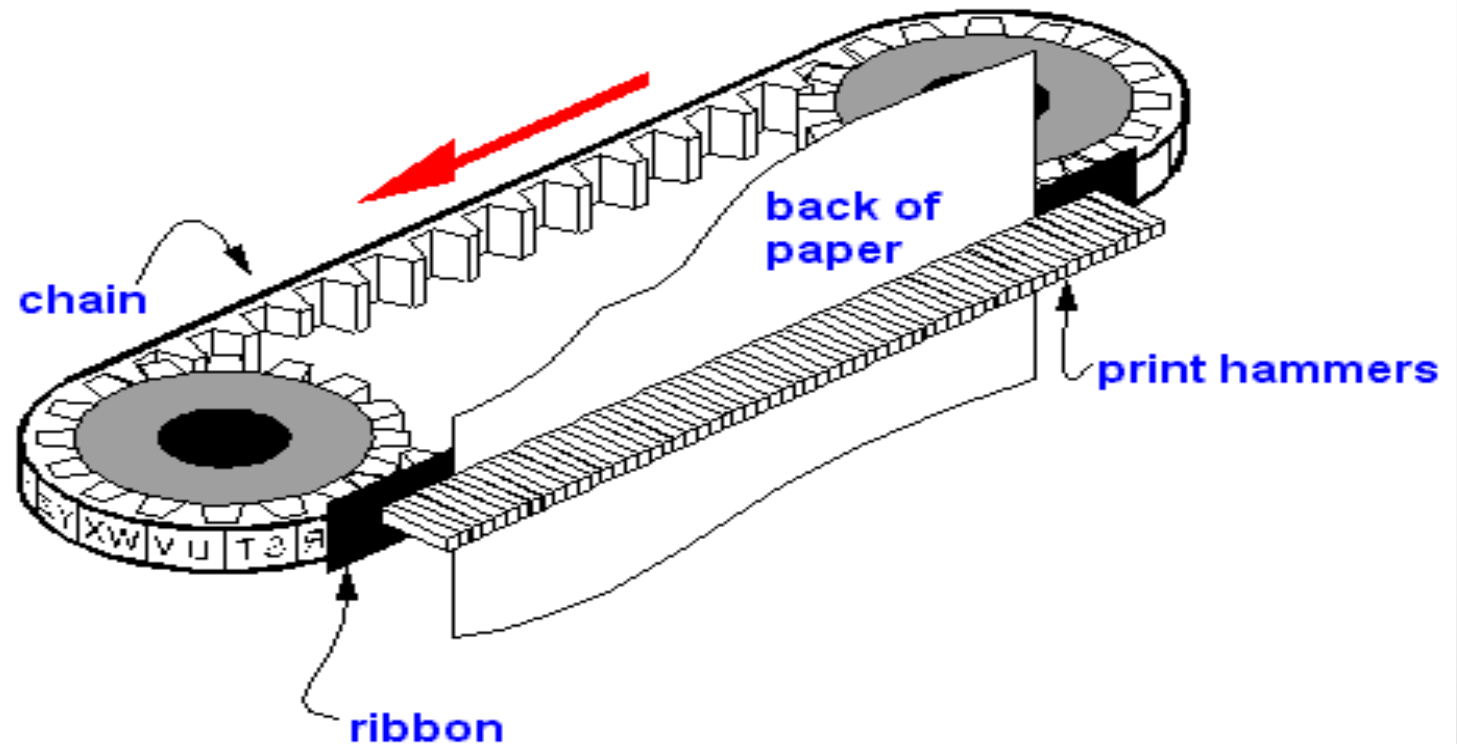
From Computer Desktop Encyclopedia  
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The hammer pushes the paper into the type slug when it rotated around to the proper position. Such printer technologies seem ridiculous compared to the quiet, high-speed workings of today's laser printers.

# CHAIN PRINTER MECHANISM

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When the required character in the chain has revolved to the selected print column, the hammer pushes the paper into the ribbon and against the type slug of the letter or digit.

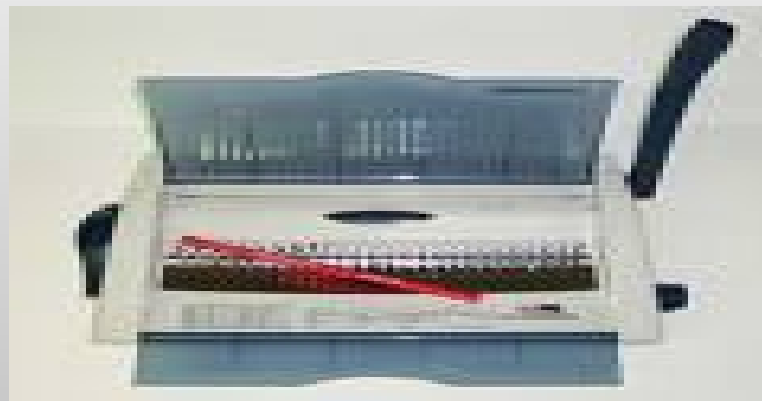
# BAR PRINTERS

- ❑ Bar printers were similar to chain printers but were slower and less expensive.
- ❑ Rather than a chain moving continuously in one direction, the characters were on fingers mounted on a bar that moved left-to-right and then right-to-left in front of the paper.
- ❑ An example was the IBM 1443



# COMB PRINTER

- **Comb printers**, also called line matrix printers, represent the fourth major design.
- These printers were a hybrid of dot matrix printing and line printing. In these printers, a comb of hammers printed a portion of a row of pixels at one time (for example, every eighth pixel).
- By shifting the comb back and forth slightly, the entire pixel row could be printed (continuing the example, in just eight cycles). The paper then advanced and the next pixel row was printed.



## B. CHARACTER PRINTERS

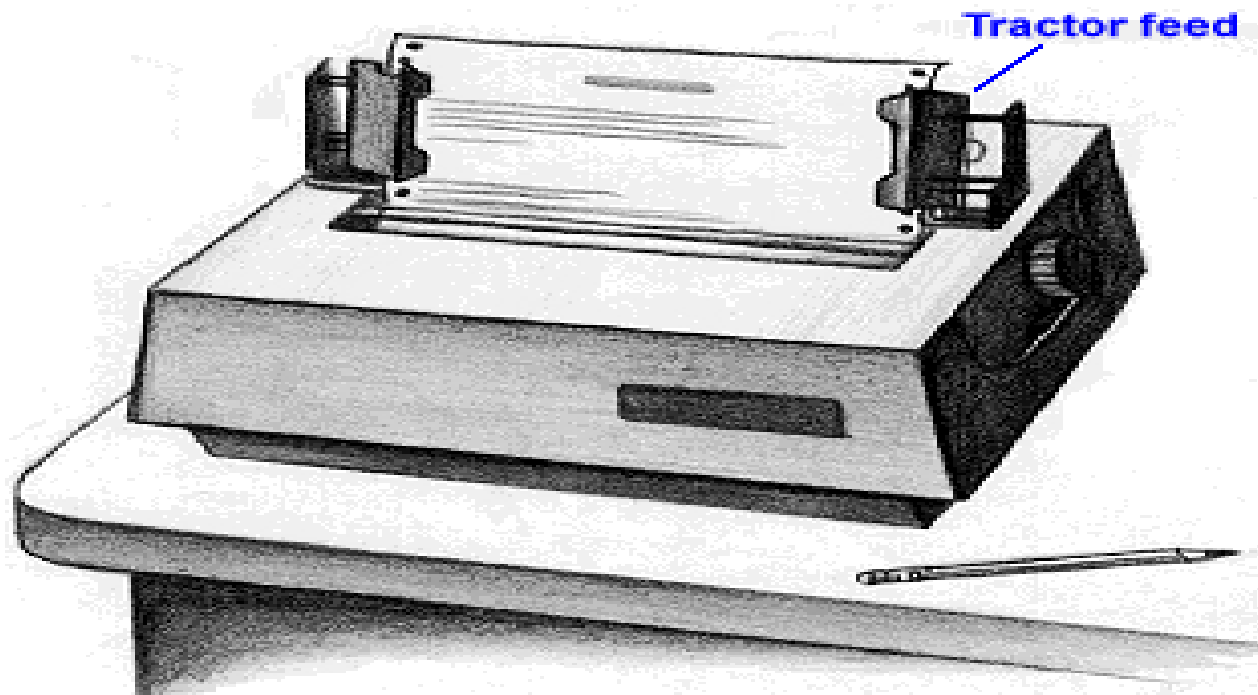
### Definition of: **character printer**

A printer that prints one character at a time. The typical character printer is the dot matrix printer.

Their printing speed lies in the range of 30 to 600 character per second .

# THE CHARACTER PRINTER

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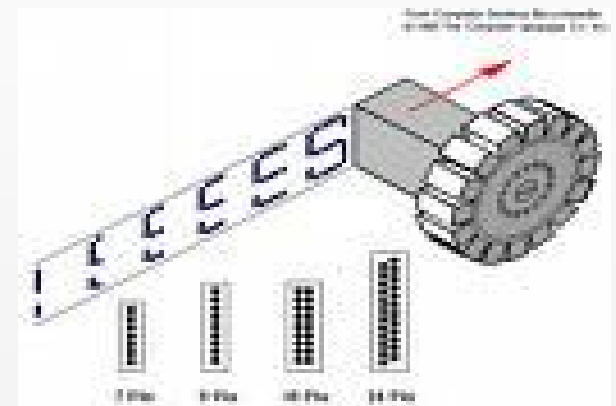




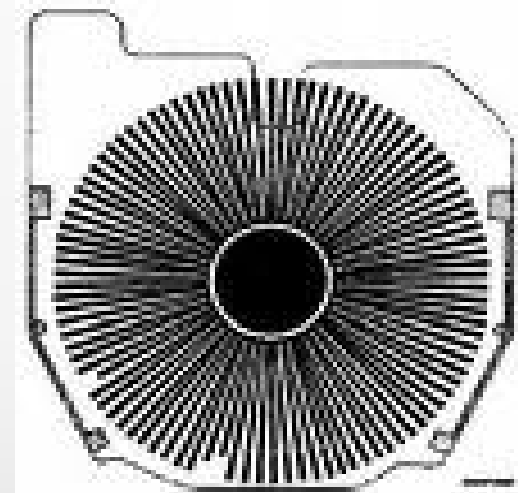
# TYPES OF CHARACTER PRINTER

- ❑ **Dot Matrix Printer**
- ❑ **Letter Quality Printer**

# DOT MATRIX PRINTERS



# LETTER QUALITY PRINTER



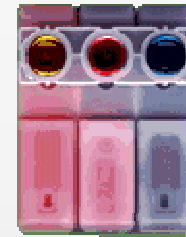
**A daisywheel printing element**

# Types of non-impact printer are:

- **Thermal Printer**
- **Laser Printer**
- **Ink Jet Printer**
- **Electromagnetic Printer**

# INK JET PRINTERS

Characters are formed as a result of electrically charged or heated ink being sprayed in fine jets onto the paper. Individual nozzles in the printing head produce high resolution (up to 400 dots per inch or 400 dpi) dot matrix characters



Colour cartridge showing inkjet nozzles

**Inkjet printers use colour cartridges which combine magenta, yellow and cyan inks to create colour tones. A black cartridge is also used for crisp monochrome output. This method of printing can generate up to 200 cps and allows for good quality, cheap colour printing.**

# THERMAL PRINTERS

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**



# LASER PRINTER

- Laser Printers use a laser beam and dry powdered ink to produce a fine dot matrix pattern. This method of printing can generate about 4 pages of A4 paper per minute.



The standard of print is very good and laser printers can also produce very good quality printed graphic images too

# OTHER OUTPUT DEVICES

## □ Plotter

- produce high-quality line drawings
- A continuous-curve plotter is used to draw maps from stored data.



## ❑ **LCD Projectors**

- project a computer image onto screen

## ❑ **Voice Output Devices**

- generate spoken words from text

## ❑ **Computer Output microfilm (COM)**

- records output as microscopic images on roll film.

## ❑ **Facsimile (FAX) Machine**

- transmit & receives document over telephone line.

## ❑ **Multifunctional Devices (MFD)**

- can print, copy and fax



# LECTURE-4

## **DATA STORAGE**

# Data Storage

The storage unit of a computer system is ranked according to the following criteria:

- **Access Time** – time required to retrieve data.
- **Storage Capacity** – amount of data that can be stored in storage unit.
- **Cost/bit of storage** – the goal is to minimize the cost

# Storage Devices

- The device which stores the data in a computer.
- Also known as memory.
- It is of two types –
  - Primary memory/storage device
  - Secondary memory/storage device



# Primary Storage

- Also known as memory.
- It is of two types –
  - Primary memory/storage
  - Secondary memory/storage

# Storage Types

Why storage is required by computer?

Computer storage can be classified into following types:

- **Primary Storage**

- >> RAM (Random Access Memory)

- >> ROM (Read only Memory)

- **Secondary Storage**

- >> Floppy Disk

- >> Hard Disk

- >> CD (Compact Disk)

- >> DVD (Digital Versatile Disk)

# Primary Storage

## 1. Random Access Memory (RAM)

- Basic to all computers.
- In the form of integrated circuits that allow the stored data to be accessed in any order i.e. at random and without the physical movement of the storage medium or a physical reading head.
- Made up of several small parts known as *cells*.
- Each cell can store a fixed no. of bits.
- Each cell has a unique no. assigned to it which is known as *address of cell*.

# Primary Storage

- Also known as Read/Write memory.
- Volatile in nature.
- Usually it is known as memory of computer.



# Types of RAM

There are two basic types of RAM:

1. **Dynamic RAM (DRAM)** - The term *dynamic* indicates that the memory must be constantly *refreshed* or it will lose its contents.
2. **Static RAM (SRAM)** –
  - Faster and more reliable than DRAM.
  - The term *static* is derived from the fact that it doesn't need to be refreshed like dynamic RAM.
  - It can give access times as low as 10 nanoseconds.
  - Much more expensive than DRAM.
  - Due to its high cost, SRAM is often used only as a memory cache.
  - **Cache memory** - a special high-speed storage mechanism. It can be either a reserved section of main memory or an independent high-speed storage device.

# Other Types of RAM

Other than the above basic types of RAM, there are few more **newer versions** –

1. **FPM DRAM:** Fast Page Mode DRAM, maximum data transfer rate is 176 mbps.
2. **EDO DRAM:** Extended data-out DRAM, maximum data transfer rate is 264 mbps.
3. **SDRAM:** Synchronous Dynamic RAM, maximum data transfer rate is 528 mbps.
4. **DDR SDRAM:** Double Data Rate SDRAM, maximum data transfer rate is 1064 mbps.



# Primary Storage

## **2. Read Only Memory(ROM) :**

- Computer memory on which data has been prerecorded.
- Information is permanently stored i.e. data stored in ROM cannot be modified, hence known as ROM.
- Non volatile in nature.
- Stores critical programs such as the program that boots the computer.
- Used extensively in calculators and peripheral devices such as laser printers, whose fonts are often stored in ROMs.

### **Types of ROM:**

#### **1. Programmable Read-Only Memory (PROM) –**

- One-time programmable ROM (OTP), can be programmed through a special device called a PROM programmer.
- PROM can only be programmed once.

# Primary Storage

## **2. Erasable programmable Read-Only Memory (EPROM):**

- Can be erased by exposure to strong ultraviolet light, then rewritten.
- Repeated exposure to UV light will eventually wear out an EPROM.

## **3. Electrically erasable programmable Read-Only Memory (EEPROM)**

- Based on a similar semiconductor structure to EPROM, but allows its entire contents to be electrically erased, then rewritten electrically, so that they need not be removed from the computer.
- Used in camera, MP3 player, etc.
- Writing or flashing an EEPROM is much slower.

# Primary Storage

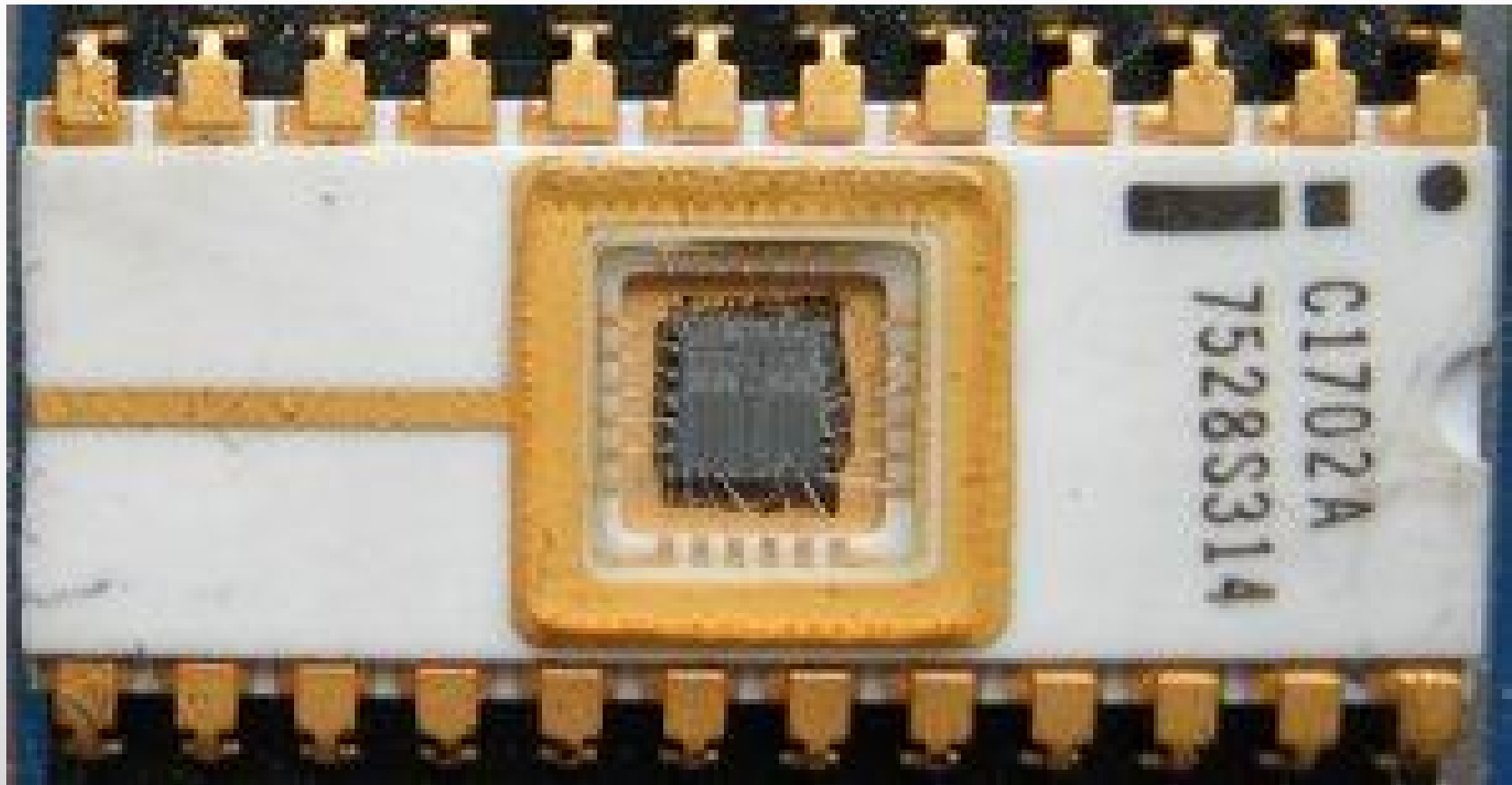
## 4. Electrically Alterable Read-Only Memory (EAROM):

- A type of EEPROM that can be modified one bit at a time.
- Writing is a very slow process and again requires higher voltage.
- intended for applications that require infrequent and only partial rewriting.

## 5. Flash memory (or simply flash)

- A modern type of EEPROM invented in 1984.
- Flash memory can be erased and rewritten faster than ordinary EEPROM.
- Modern *NAND* flash makes efficient use of silicon chip area.
- Is sometimes called flash ROM or flash EEPROM when used as a replacement for older ROM types.

# ROM



## Difference between RAM and ROM

### RAM

1. RAM stands for **Random Access Memory**
2. It is **volatile** in nature. Its contents are erased when power is turned off.
3. We can **read** as well as **write** through this memory

### ROM

1. ROM stands for **Read only Memory**
2. It is **non-volatile** in nature. Its contents are non erased when power is turned off.
3. We can **only read** this memory and cannot write through it

# Secondary Storage



# Secondary Storage

The storage capacity of primary storage is not sufficient to store large volume of data, hence, additional memory is used, known as secondary memory/storage.

Two methods of accessing data –

## **1. Sequential Access:**

Data can be retrieved in same sequence in which it is stored.

## **2. Direct Access:**

Data can be accessed directly eg. Computerised Airline ticket booking system

# Types of Secondary Storage

## 1. Magnetic Tape:

- Data is sequentially access and retrieved .
- Made up of plastic ribbon, half inch wide, one side coated with an iron oxide material.
- Ribbon is stored in reels of 50 to 2400 feet or a small cartridge.
- Unlimited storage
- High data density
- Low cost
- Rapid transfer rate
- Ease of handling
- Portable

### **BUT**

- No direct access
- Environmental problems

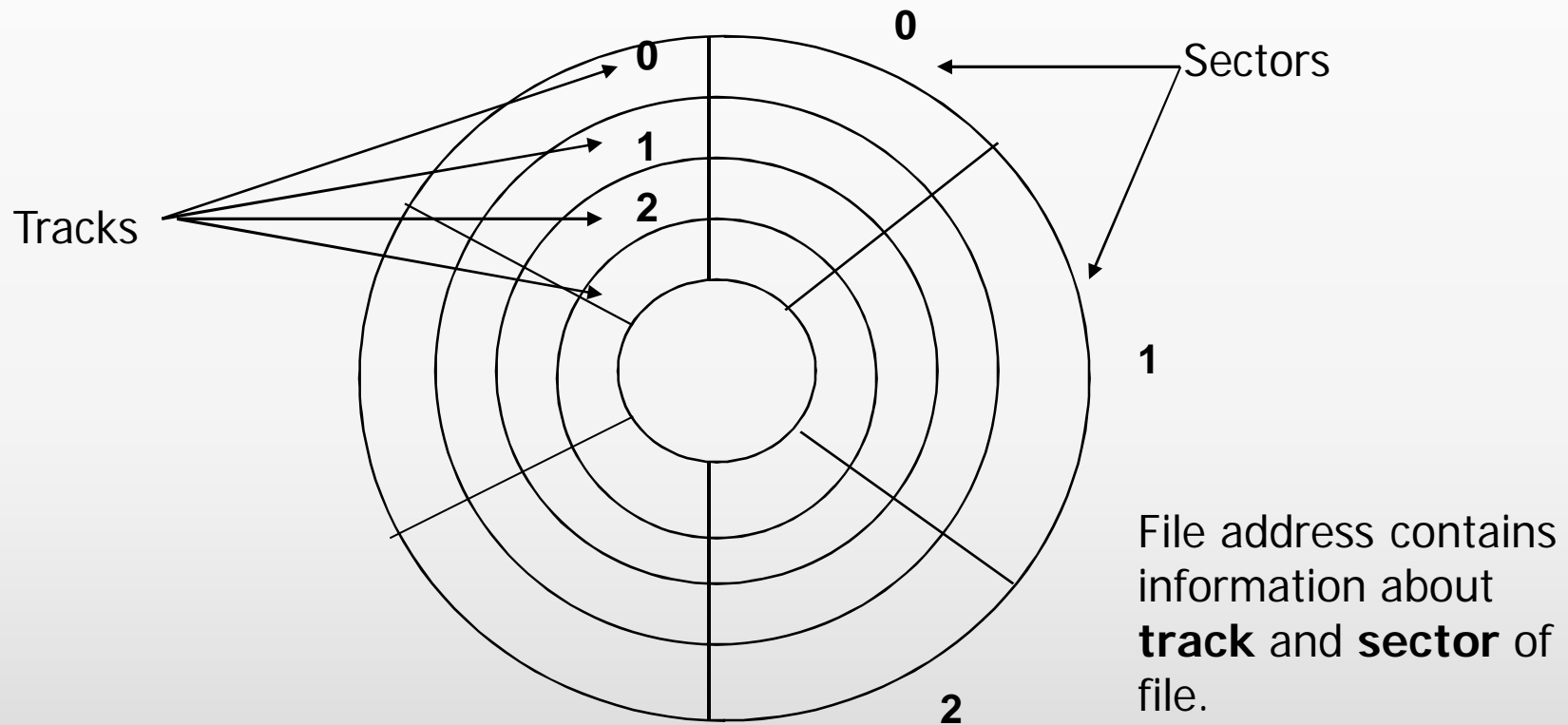
# Types of Secondary Storage

## 1. Magnetic Disk:

- Contains a thin metal plate, coated on both sides with a magnetic material.
- A disk pack consists of a no. of disks, mounted about half inch apart from each other on a central shaft which rotates at the speed of 2400 or more rpm.
- Information is stored on both sides.
- Each disk consists of a no. of invisible concentric circles called **Tracks**.
- A set of corresponding tracks in all the surfaces is called a **cylinder**.
- Each track is subdivided into **sectors**.
- Information is recorded on track and can be read using read/write heads.

# Storage Types

## 1. Floppy Disk



- Surface of floppy disk is coated with magnetic material.
- Data is stored on the surface of disk by magnetizing the surface.
- That's why FD is called magnetic storage device.

# Floppy Disk

• **Formatting** a floppy disk means creating tracks and sectors on the disk surface.

- Data is stored in files in floppy disk.
- Storage capacity is 1.44 MB.
- Each file has a size and location where it is stored in the floppy disk.
- In order to locate a particular file, **FAT (File Allocation Table)** is maintained:

**FAT** contains:

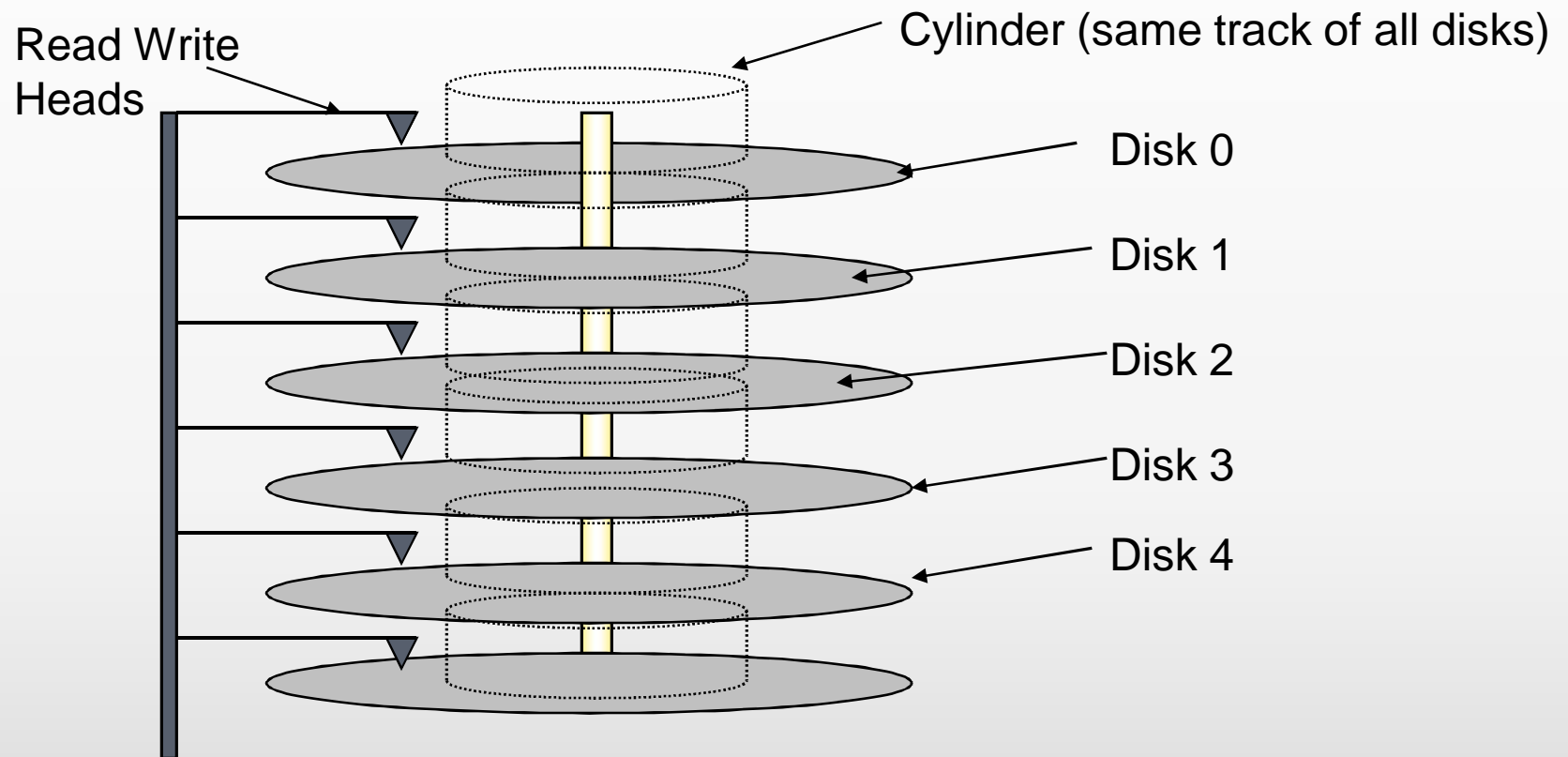
1. Name of file
2. Size of file
3. Location on disk (Starting Track and Sector)
4. Date created
5. Attributes such as Read Only, Hidden, etc.

# Structure of a Floppy Disk





# Hard Disk



File address contains information about **disk**, **cylinder** and **sector** of file.

HD is also a magnetic storage device.

Storage capacity of HD ranges from GBs to TBs.

# OPTICAL DISK

- An optical disc is an electronic data storage medium that can be written to and read using a low-powered laser beam.
- An optical disc holds much more data.
- Consist of rotating disk coated with a highly reflective material.
- A laser beam is focussed on the surface of disk.
- There is one spiral track on the disk surface.
- When the laser beam is turned on, it creates a small hole on the surface of the disk along its track while writing the data, known as **pit**.
- The surface of the disk is plane in the absence of data, known as **crater**.
- Storage capacity is higher.

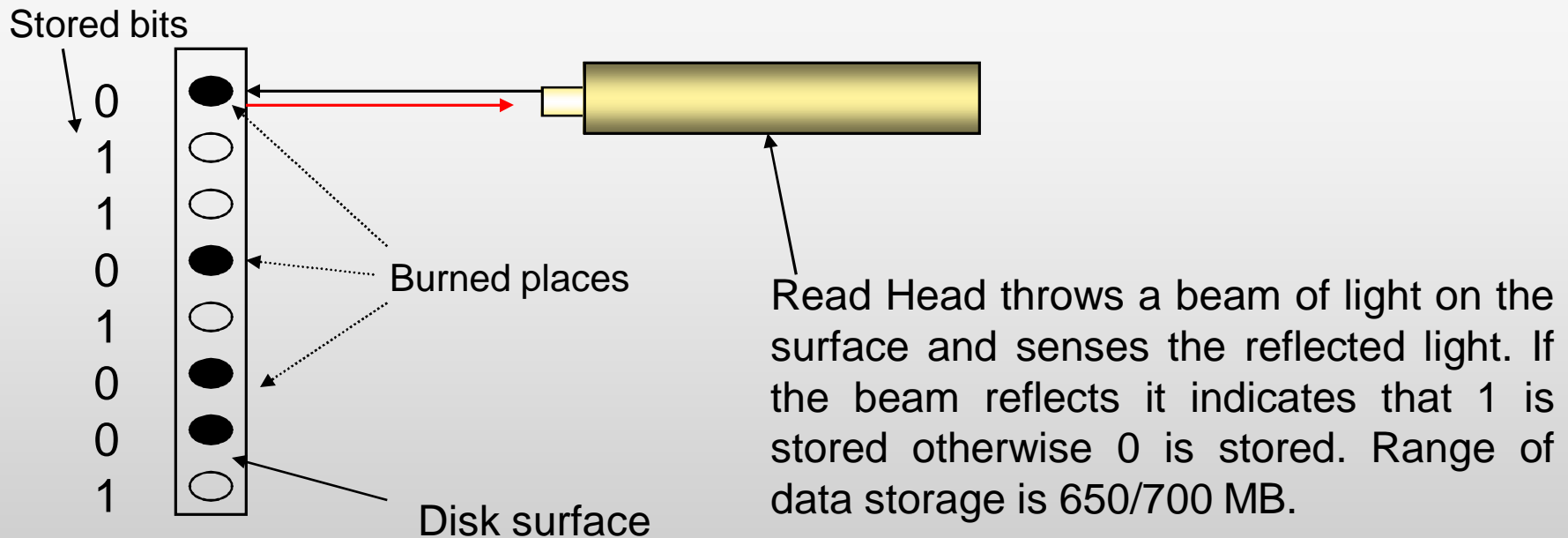
# Optical Disk

## 1. Compact Disk:

CD is an **optical storage device**.

In order to store the information, on the surface of CD, the surface is burned accordingly. That's why writing a CD is also called burning a CD.

Once written, the content of CD can't be changed.



# DIGITAL VERSATILE DISK

**DVD ("Digital Versatile Disc" or "Digital Video Disc"):**

- A popular optical disc storage media format that can be used for data storage.
- Including movies with high video and sound quality.
- DVDs resemble CDs.
- A DVD reader or writer can usually read CDs, but DVDs are encoded in a different format of much greater density, allowing a data storage capacity 8 times greater.
- Range of storage capacity is from 2.8 Gigabytes to 4.7 Gigabytes.

# OTHER TYPES OF STORAGE DEVICES

- ❑ PC Cards (PCMCIA)
- ❑ Compact Flash Memory Card
- ❑ Memory Stick
- ❑ Smart Card



# DATA REPRESENTATION



# Data Representation

**Data:** raw facts, inserted into the computer to be processed. eg typing the alphabets through keyboard – G, O, D

**Information:** processed data or output given by computer. eg the word GOD displayed on monitor.

## Types of Representation of Data

1. **Internal Representation:** values used by computer to store and process data.
2. **External Representation:** Computer translates data into the form of human understandable language of numbers, characters, figures and sound etc.

# Data Representation

For Example:

**G**  
**0110**

**O**  
**1110**

**D**  
**0011**

# Data Representation

**Bit:** A bit refers to one binary digit. Either 0 or 1.

**Byte:** Set of 8 bits is called byte. i.e. 1Byte = 8 Bits

**Word:** It is a collection of 2 bytes or 4 bytes depending on the word size of computer, whether it is 16 bit computer or 32 bit computer

**1024 bytes = 1Kilo Bytes**

**1024 KB = 1 Mega Bytes**

**1024 MB = 1 Giga Bytes**

# LECTURE-5

## **Input/output ports and connectors**

# THE COMPONENTS OF THE SYSTEM UNIT

## THE SYSTEM UNIT

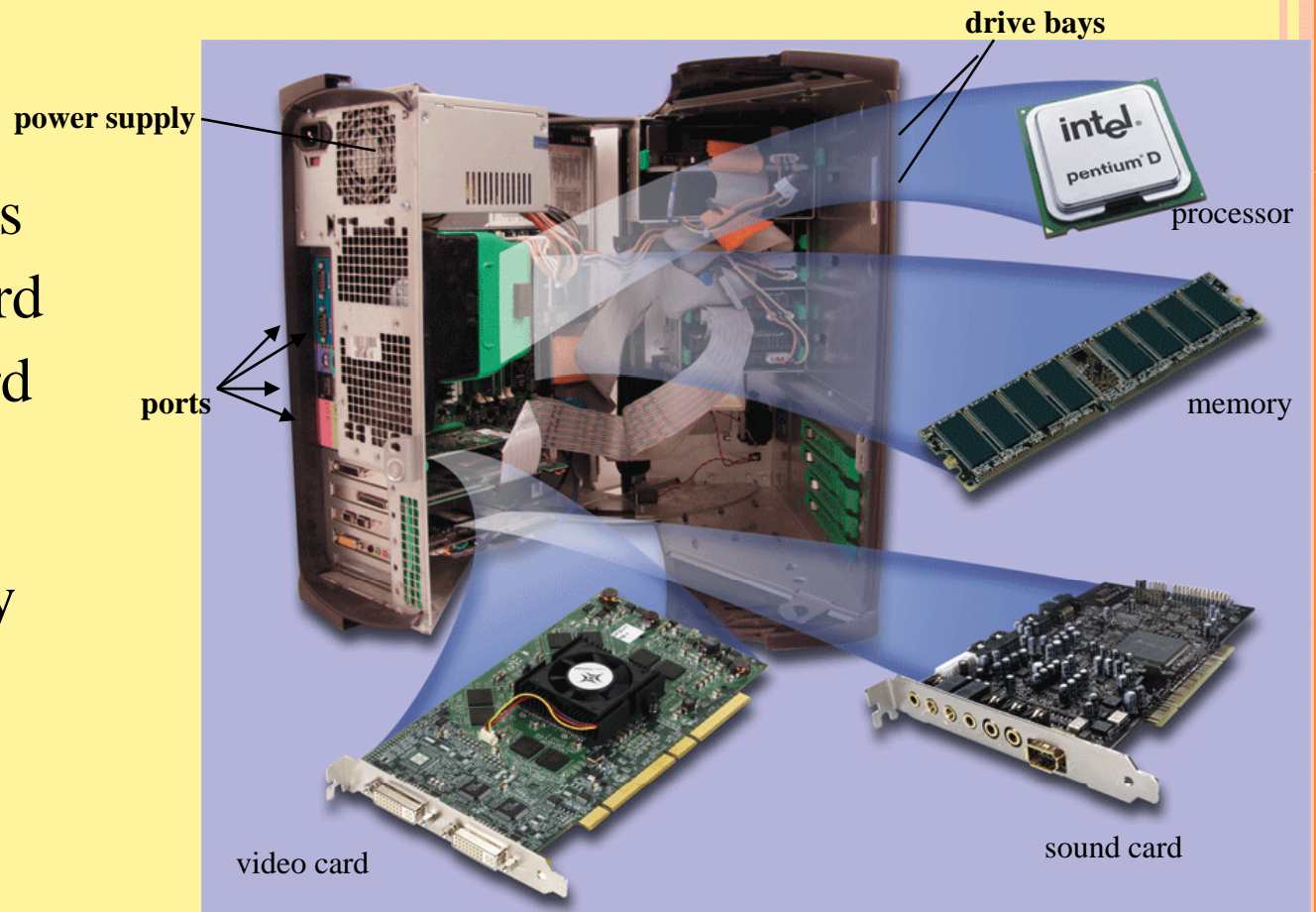
- **What is the system unit?**
  - Case that contains electronic components of the computer used to process data



# THE SYSTEM UNIT

## ❑ What are common components inside the system unit?

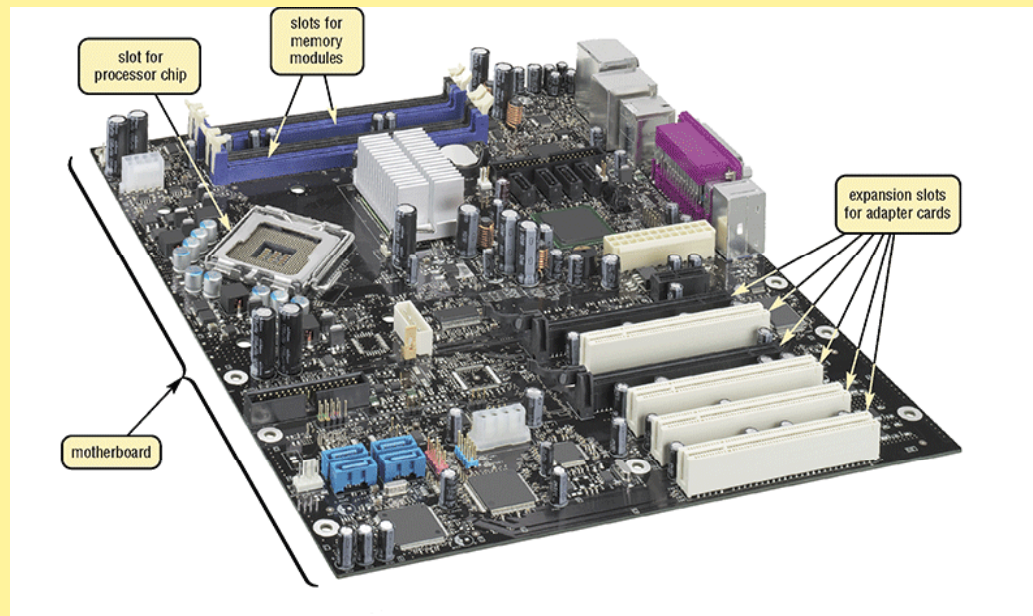
- ❑ Processor
- ❑ Memory
- ❑ Adapter cards
  - ❑ Sound card
  - ❑ Video card
- ❑ Ports
- ❑ Drive bays
- ❑ Power supply



# THE SYSTEM UNIT

## ❑ What is the motherboard?

- Main circuit board in system unit
- Contains adapter cards, processor chips, and memory modules





# THE SYSTEM UNIT

## ❑ What is a chip?

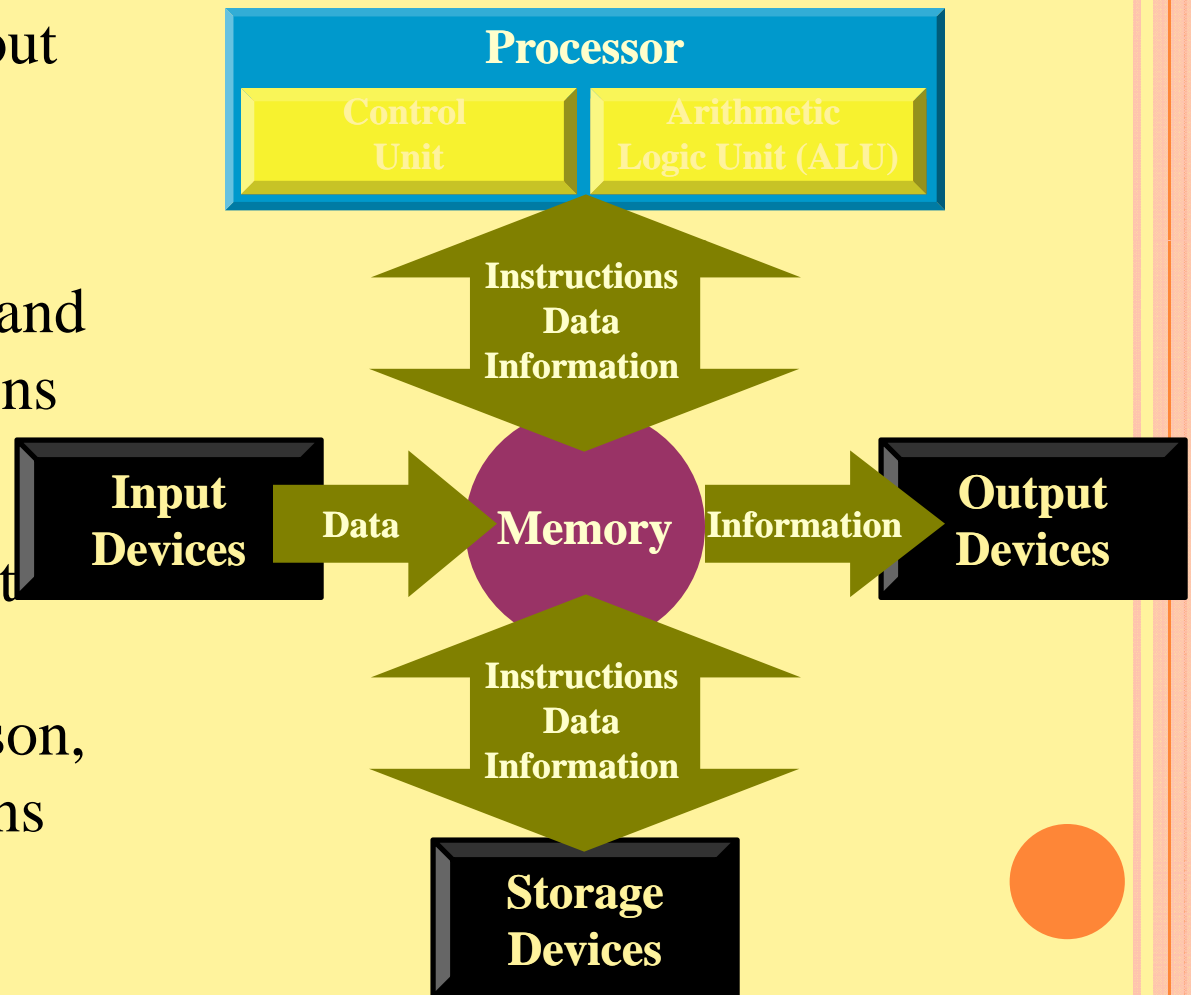
- Small piece of semi-conducting material on which integrated circuits are etched
- Integrated circuits contain many microscopic pathways capable of carrying electrical current
- Chips are packaged so they can be attached to a circuit board



# THE SYSTEM UNIT

## ❑ What is the central processing unit (CPU)?

- Interprets and carries out basic instructions that operate a computer
  - Control unit directs and coordinates operations in computer
  - Arithmetic logic unit (ALU) performs arithmetic, comparison, and logical operations
  - Also called the processor



# PROCESSOR

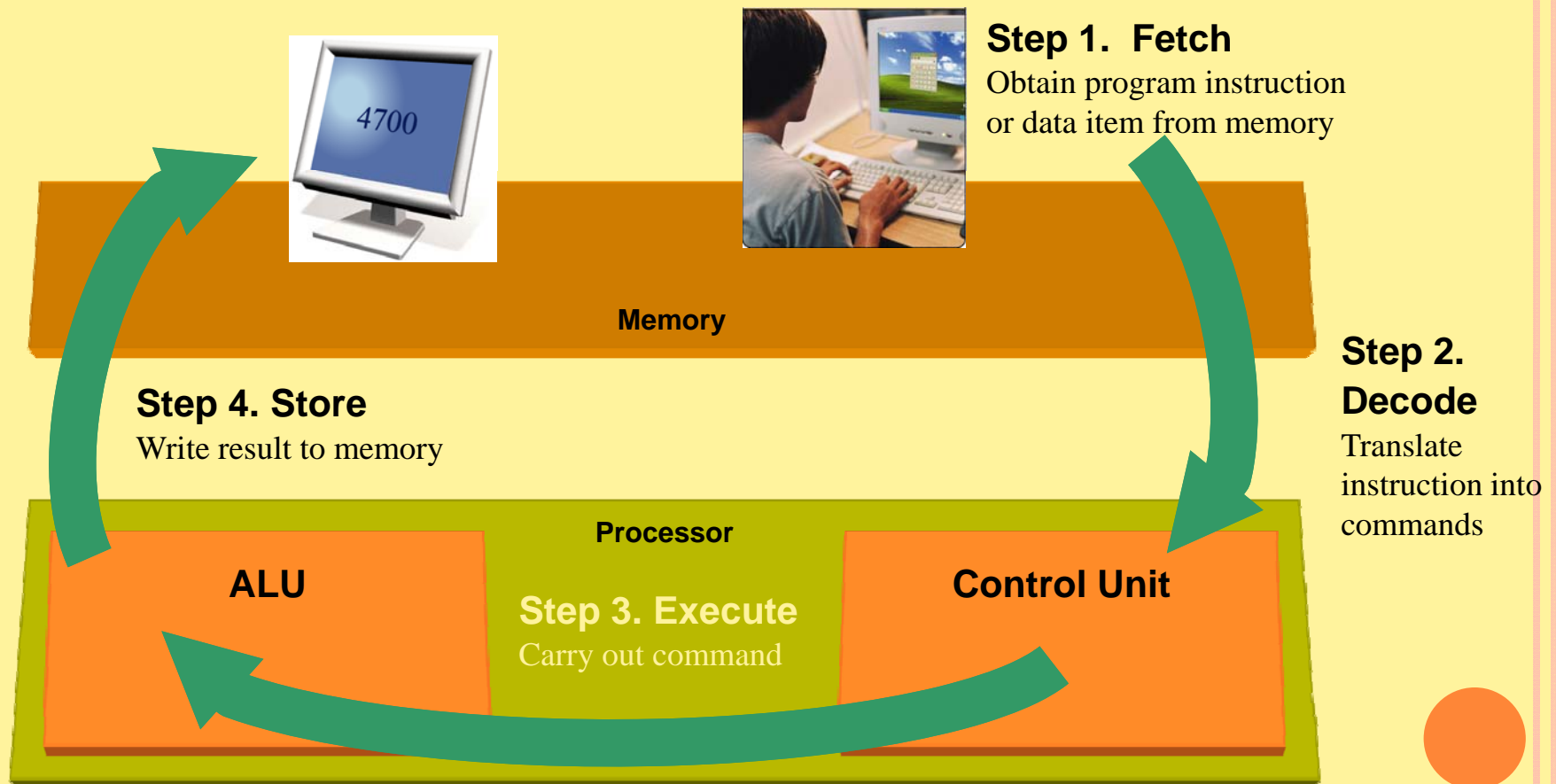
## What are **multi-core processors**?

- A dual-core processor is a single chip that contains two separate processors
- A quad-core processor is a single chip that contains four separate processors
- A multi-core processor is a chip with two or more separate processors
- Each processor on a multi-core chip generally runs at a slower clock speed, but increase overall performance





# WHAT IS A MACHINE CYCLE?

- Four operations of the CPU comprise a machine cycle



# DATA REPRESENTATION

- **Most computers are digital**

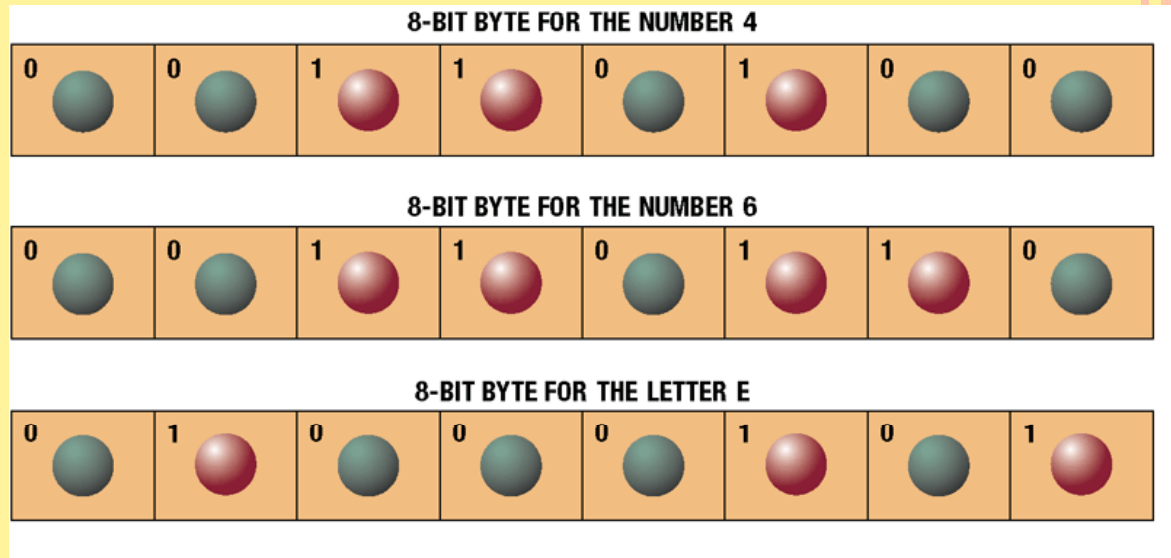
BINARY DIGIT (BIT)	ELECTRONIC CHARGE	ELECTRONIC STATE
1		ON
0		OFF

- Recognize only two discrete states: on or off
- Use a **binary system** to recognize two states
- Use Number system with two unique digits: 0 and 1, called **bits** (short for binary digits)



# WHAT IS A BYTE?

- Eight bits grouped together as a unit
- Provides enough different combinations of 0s and 1s to represent 256 individual characters
  - Numbers
  - Uppercase and lowercase letters
  - Punctuation marks



- ❑ **What are two popular coding systems to represent data?**

## **DATA REPRESENTATION**

- **ASCII—American Standard Code for Information Interchange**
- **EBCDIC—Extended Binary Coded Decimal Interchange Code**

ASCII	Symbol	EBCDIC
00110000	0	11110000
00110001	1	11110001
00110010	2	11110010
00110011	3	11110011





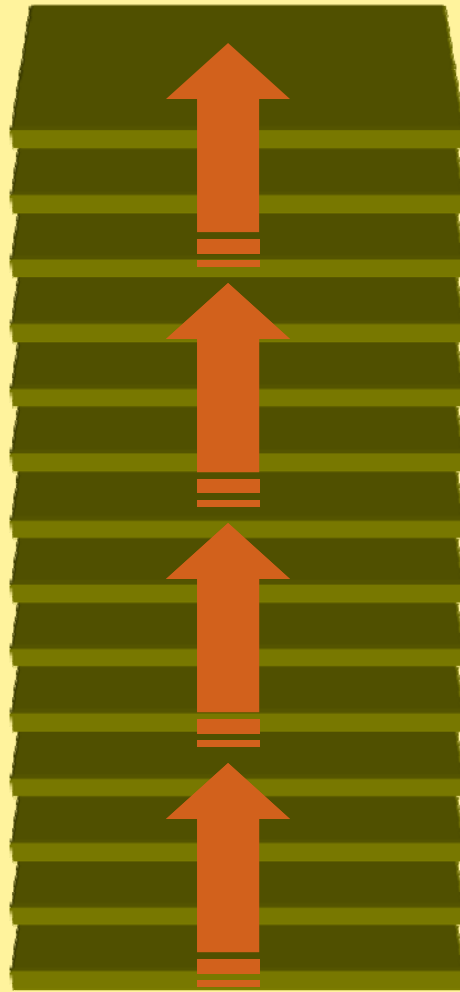
# MEMORY

## ○ What is **memory**?

- Electronic components that store instructions, data, and results
- Consists of one or more chips on motherboard or other circuit board.
- Each byte stored in unique location called an address, similar to seats in a concert hall



# WHAT IS RANDOM ACCESS MEMORY (RAM)?



**Memory chips that can be read from and written to by processor**

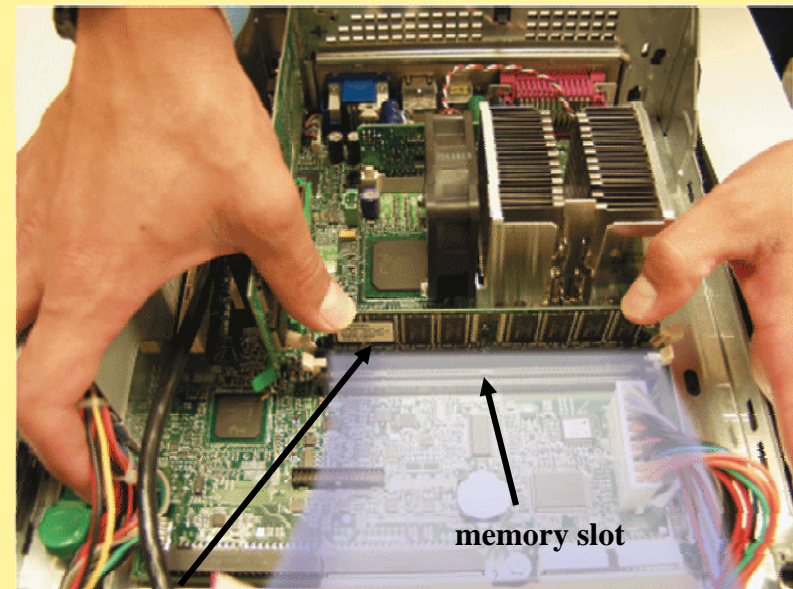
**Also called main memory or primary storage**

**Most RAM is volatile, it is lost when computer's power is turned off**

**The more RAM a computer has, the faster it responds**

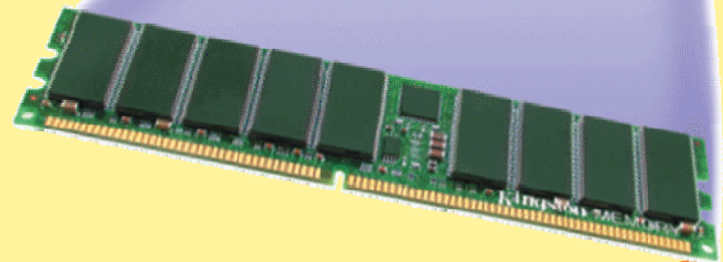
# MEMORY

- ❑ **Where does memory reside?**
  - Resides on small circuit board called memory module
  - Memory slots on motherboard hold memory modules



memory chip

memory slot



## ❑ What is access time?

- Amount of time it takes processor to read data from memory
- Measured in nanoseconds (ns), one billionth of a second
- It takes 1/10 of a second to blink your eye; a computer can perform up to 10 million operations in same amount of time

Term	Speed
Millisecond	One-thousandth of a second
Microsecond	One-millionth of a second
Nanosecond	One-billionth of a second
Picosecond	One-trillionth of a second



# EXPANSION SLOTS AND ADAPTER CARDS

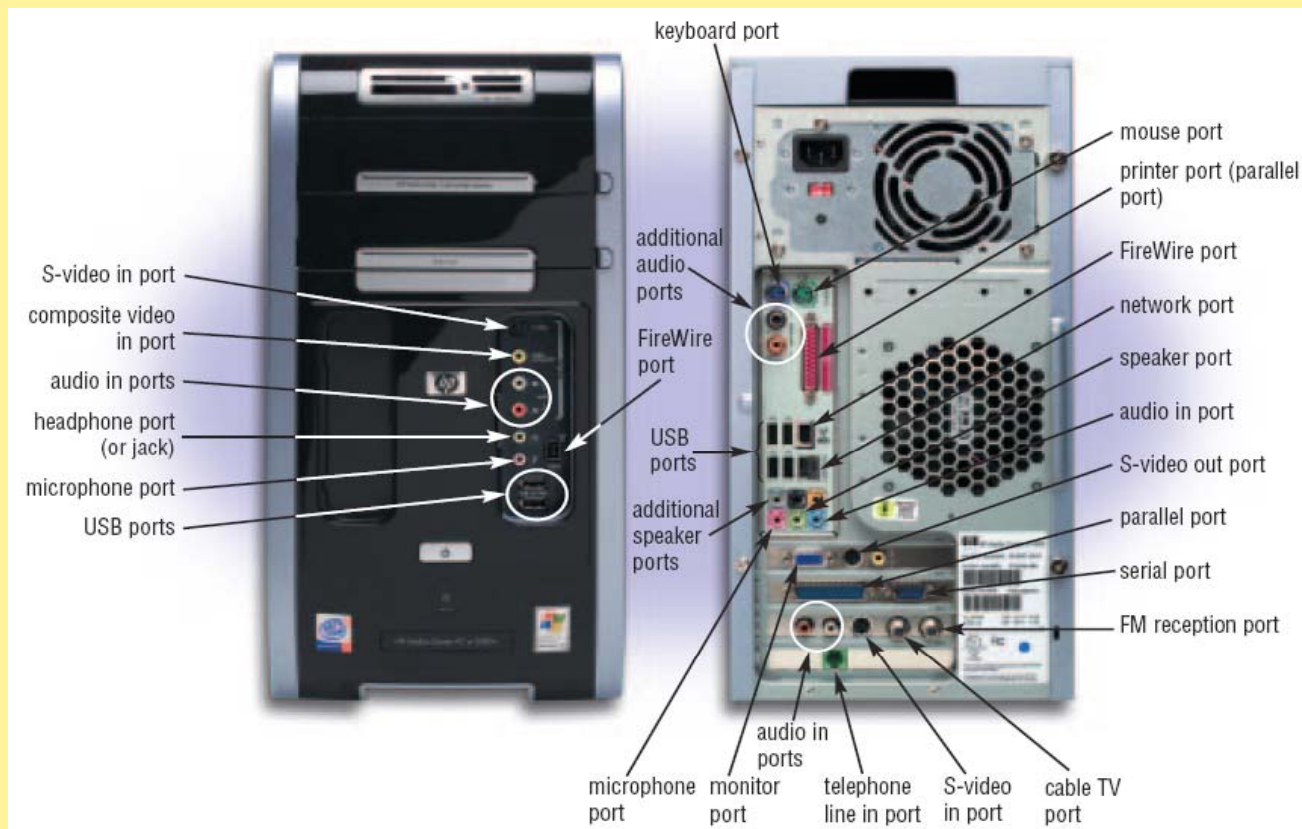
- ❑ **What are PC cards, flash memory cards, and USB Flash Drives?**
  - A PC card adds memory, storage, sound, fax/modem, communications, and other capabilities to notebook computers
  - A flash memory card allows users to transfer data from mobile devices to desktop computers
  - A USB flash drive is a flash memory storage device that plugs into a USB port on a computer



# PORTS AND CONNECTORS

## ❑ What are ports and connectors?

- Port connects external devices to system unit
- Connector joins cable to peripheral





# PORTS AND CONNECTORS

## ❑ What is a serial port?

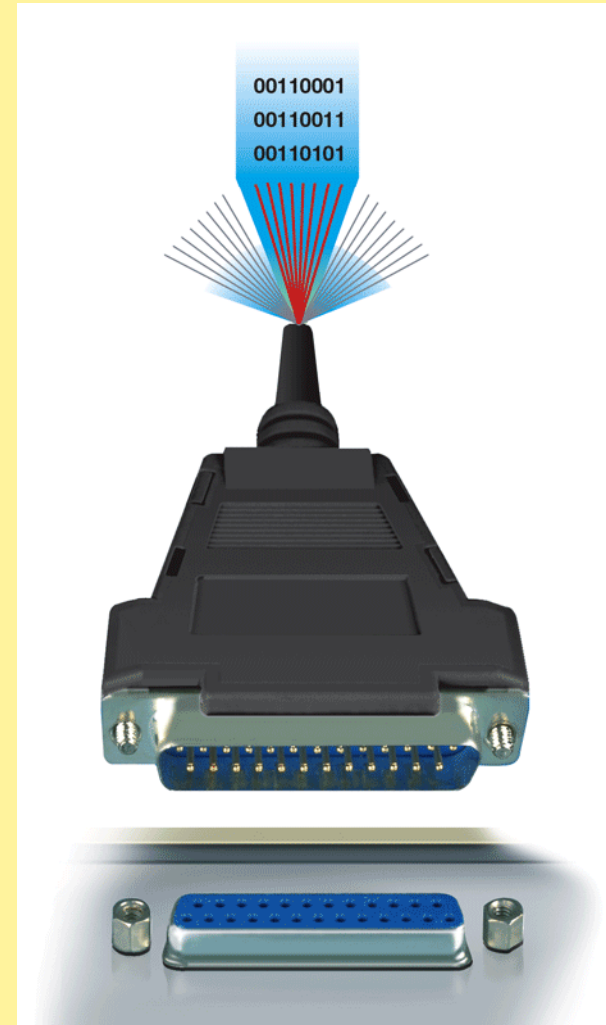
- Transmits one bit of data at a time
- Connects slow-speed devices, such as a mouse, keyboard, or modem





# PORTS AND CONNECTORS

- ❑ **What is a parallel port?**
- Connects devices that can transfer more than one bit at a time, such as a printer



# PORTS AND CONNECTORS

## ❑ What are USB ports?

**USB (universal serial bus) port can connect up to 127 different peripherals together with a single connector type**

PCs typically have six to eight USB ports on front or back of the system unit

Single USB port can be used to attach multiple peripherals using a **USB hub**

The latest version of USB is called USB 2.0



# PORTS AND CONNECTORS

## ❑ **What are FireWire ports?**

- Connects multiple types of devices that require faster data transmission speeds
- Allows you to connect up to 63 devices together



# PORTS AND CONNECTORS

## ❑ What are special-purpose ports?

- Allow users to attach specialized peripherals or transmit data to wireless devices
  - MIDI (Musical Instrument Digital Interface) port
    - Serial port
    - Electronic Keyboard
  - SCSI (small computer system interface) port
    - Disk Drives, Printers
  - IrDA (Infrared Data Association) port
    - Smart phone, PDA, keyboard
  - Bluetooth port
    - Uses radio-waves
    - Cell Phones

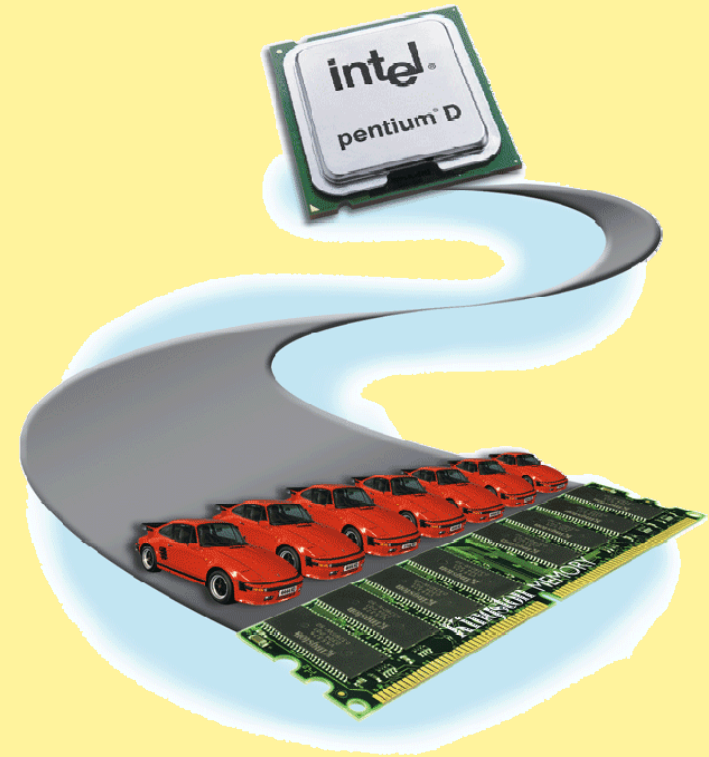


# PORTS AND CONNECTORS

## □ What is a bus?

➤ Channel that allows devices inside and attached to the computer to communicate with each other

- **Bus width (size) determines number of bits transmitted at one time**
- **64-bit common type**
- **2 Types:**
  - 1. System bus connects processor and main memory**
  - 2. Expansion bus allows processor to communicate with peripherals.**



# PORTS AND CONNECTORS

## ❑ What is a bay?

- Open area inside system unit used to install additional equipment
- Drive bays typically hold disk drives



# POWER SUPPLY

## □ What is a power supply?

**Converts  
AC Power  
(115 to 120 volts)  
into  
DC Power  
(5 to 12 volts)**

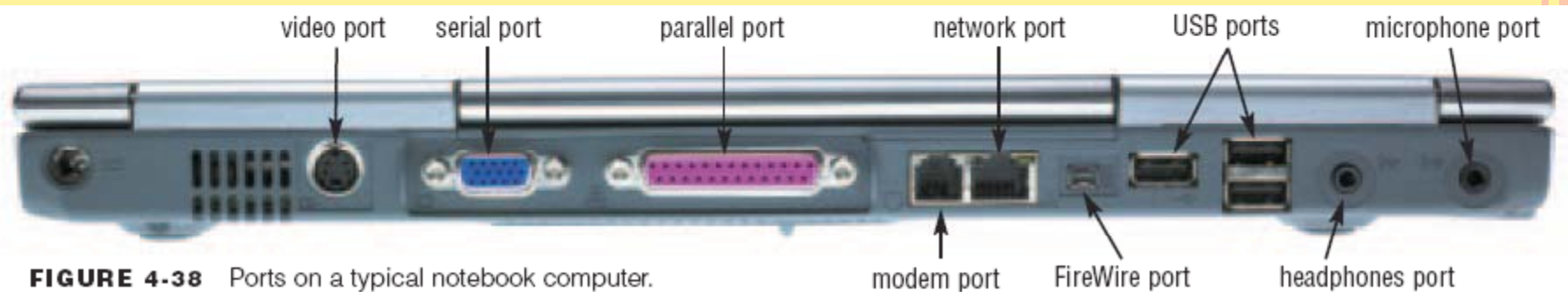
**Fan keeps  
system unit  
components  
cool**

**External peripherals  
might use an AC  
adapter, which is an  
external power supply**





# WHAT PORTS ARE ON A NOTEBOOK COMPUTER?



**FIGURE 4-38** Ports on a typical notebook computer.



# WHAT PORTS AND SLOTS ARE ON A TABLET PC?

