UNIT:- 1

Input/ Output Devices and Storage Devices

Processor, Memory and Input/ Output:

- Instruction Execution
- CPU Organization
- Parallel Instruction Execution
- Microprocessor chip(8088) & Buses
- Example of typical Microprocessor
- Memory : Main Memory, Secondary Memory, Types & Organization
- Input/output Types of I/O devices, Controllers.
- ISA bus, PCI bus, Universal Serial Bus (USB), Architecture of PC
- with multiple type of buses
- I/O chips

❖ What is instruction :

A Program, as we all know, is, a set of instructions that specify the operations, operands,andthesequencebywhichprocessinghastooccur.

Computer instructions are a set of machine language instructions that a particular processor understands and executes. A computer performs tasks on the basis of the instruction provided.

❖ Instruction Execution / Instruction Cycle:

The instruction cycle (also known as the fetch–decode–execute cycle, or simply the fetch-execute cycle) is the cycle that the central processing unit (CPU) follows from boot- up until the computer has shut down in order to process instructions. It is composed of three main stages: the fetch stage, the decode stage, and the executestage.

In simpler CPU, the instruction cycle is executed sequentially, each instruction being processed before the next one is started. In most modern CPU, the instruction cycles are instead executed concurrently,

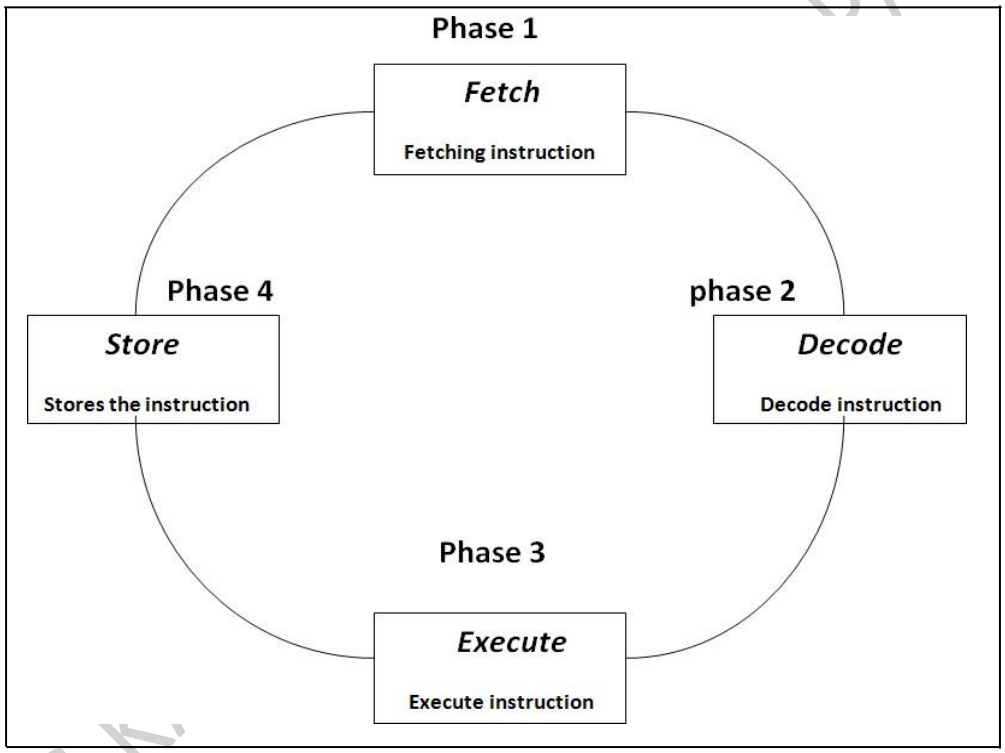
➢ **Registers Involved In Each Instruction Cycle:**

- **Memory address registers(MAR)** : It is connected to the address lines of the system bus. It specifies the address in memory for a read or write operation.
- **Memory Buffer Register(MBR)** : It is connected to the data lines of the system bus. It contains the value to be stored in memory or the last value read from the memory.
- **Program Counter(PC)** : Holds the address of the next instruction to be fetched.
- **Instruction Register(IR)** : Holds the last instruction fetched.

❖ Instruction Execution Process :

- In a basic computer, each instruction cycle consists of the following phases:

1. Fetch instruction from memory.
2. Decode the instruction.
3. Execute the instruction.
4. Store the instruction.



The four-phase of the machine cycle is usually grouped into two categories:

A) Instruction cycle :
1. Fetch stage
2. Decode stage

B) Execution cycle :
3. Execution stage
4. Store Stage

1) Fetch Stage :

The next instruction is fetched from the memory address that is currently stored in the program counter and stored into the instruction register. At the end of the fetch operation, the PC points to the next instruction that will be read at the next cycle.

2) Decode Stage :

During this stage, the encoded instruction presented in the instruction register is interpreted by the decoder.

- **Read the effective address** : In the case of a memory instruction (direct or indirect), the execution phase will be during the next clock pulse. If the instruction has an indirect address, the effective address is read from main memory, and any required data is fetched from main memory to be processed and then placed into data registers (clock pulse: T3). If the instruction is direct, nothing is done during this clock pulse. If this is an I/O Instruction or a register instruction, the operation is performed during the clock pulse.

3) Execute Stage :

The control unit of the CPU passes the decoded information as a sequence of control signals to the relevant function units of the CPU to perform the actions required by the instruction, such as reading values from registers, passing them to the ALU to perform mathematical or logic functions on them, and writing the result back to a register. If the ALU is involved, it sends a condition signal back to the CU. The result generated by the operation is stored in the main memory or sent to an output device. Based on the feedback from the ALU, the PC may be updated to a different address from which the next instruction will befetched.

4) Store Stage :

In this phase the result computed in the execution phase is either sent to the memory or to an output device of the computer system. This PC of the CPU is also updated in this phase to point to the next instruction that is to be executed.

❖ CPU Organization:

❖ What is CPU:

A central processing unit (CPU), also called a central processor, main processor or just processor, is the electronic circuitry within a computer that executes instructions that make up a computer program.The CPU performs basic arithmetic, logic, controlling, and input/output (I/O) operations specified by the instructions in the program. The computer industry used the term "central processing unit" as early as 1955.

❖ CPU Organization/Architecture:

The central processing unit (CPU) performs operations on data. In most architectures it has three parts: an arithmetic logic unit (ALU), a control unit and a set of registers, fast storage locations. The arithmetic logic unit (ALU) performs logic, shift, and arithmetic operations on data.

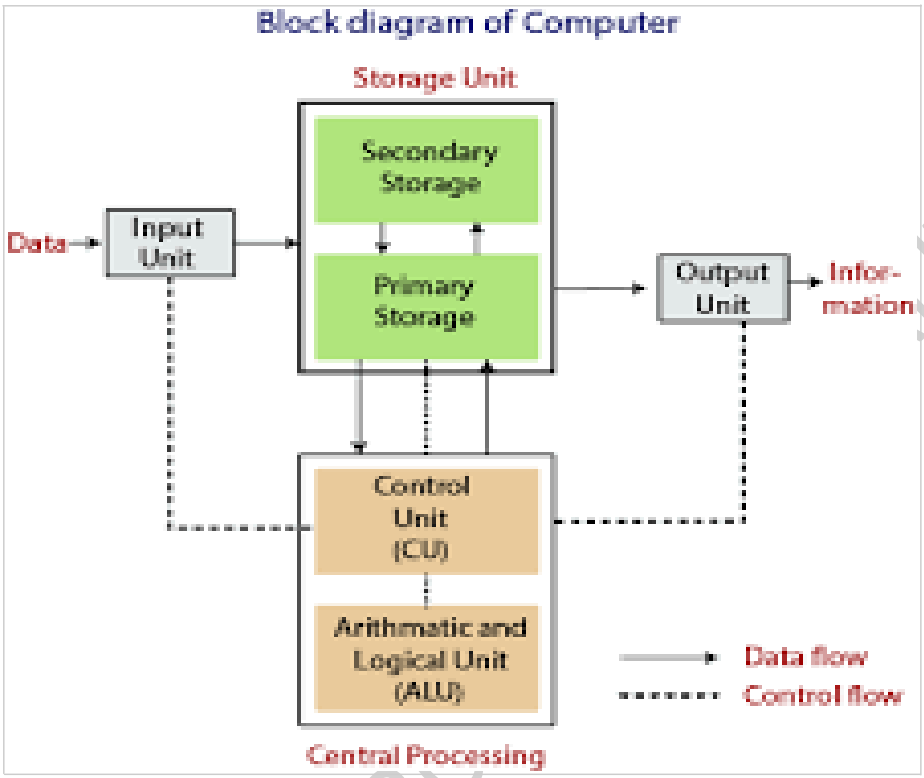
Block Diagram :

A Block diagram of a computer displays a structural representation of a computer system. The block diagram gives you a quick overview of the working process of a computer from inputting the data to retrieving the desired results.

✔ A computer system is a combination of three components:

1) Input Unit
2) CPU (central Processing Unit)
3) Output Unit

The following diagram represents a block diagram of the computer system:



1) Input Unit :

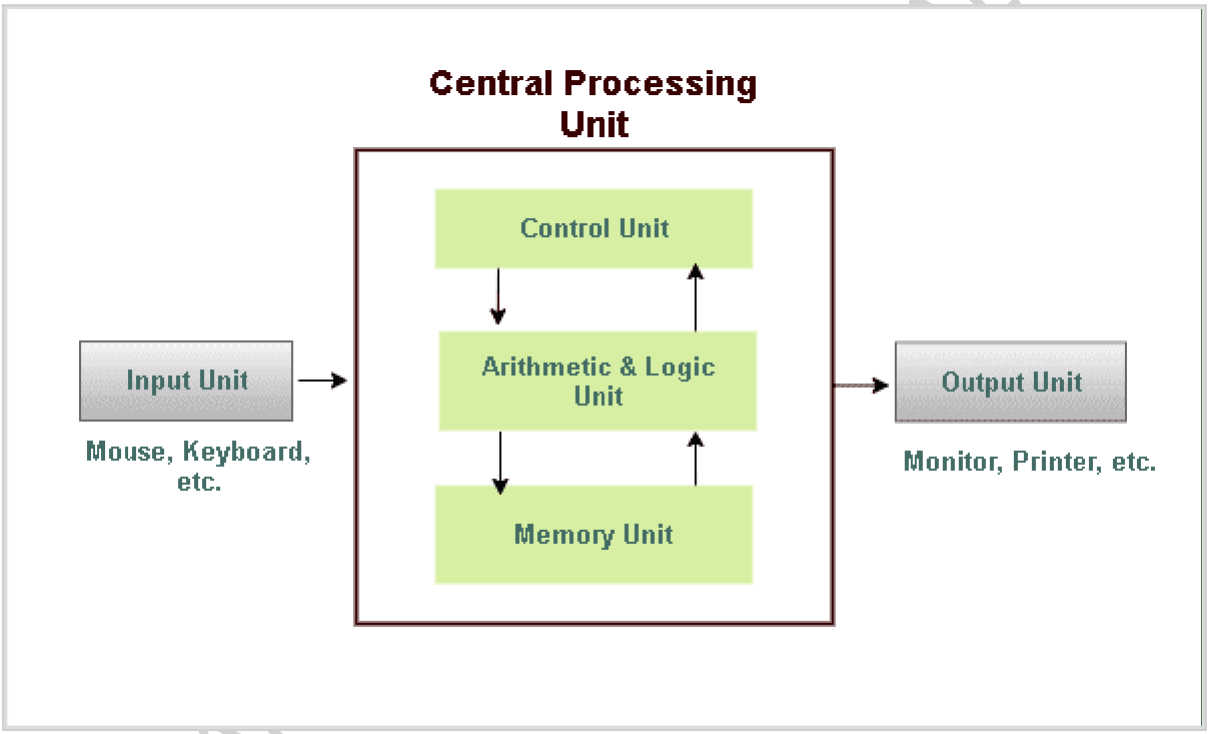
The Input Unit consists of input devices such as a mouse, keyboard, scanner, joystick, etc. These devices are used to input information or instruction into the computer system. Like other electronic machines, a computer takes inputs as raw data (binary data) and performs necessary processing giving out processed data. Therefore, the input unit is the medium of communication that takes data from us to the computer in an organized manner for processing.

The Input Unit performs the following major functions:

- The input unit converts the inputted data or instructions into binary form for further processing.
- Input Unit transmits the data to the main memory of the computer.

2) CPU :

CPU or Central Processing Unit is known as the brain of the computer system. It is an electronic hardware device that processes all the operations (ex., arithmetic and logical operations) of the computer. In other words, all the major calculations, operations or comparisons are performed inside the CPU. It is also responsible for handling the operations of several other units.



In the above diagram, the Control Unit (CU) and Arithmetic Logic Unit (ALU) are jointly called the Central Processing Unit (CPU).

- Let's discuss all the parts displayed in the above diagram one by one:

A) Control Unit :

As the name suggests, the control unit of a CPU controls all the activities and operations of the computer. It is also responsible for controlling input/output, memory, and other devices connected to the CPU.

The control unit acts like the supervisor which determines the sequence in which computer programs and instructions are executed. It retrieves instructions from memory, decodes the instructions, interprets the instructions and understands the sequence of tasks to be performed accordingly. It further transmits the instructions to the other parts of the computer system to execute them. In short, the control unit determines the sequence of operations to execute the given instructions.

B) Arithmetic & Logic Unit :

The data inputted through input devices is stored in the primary storage unit. The Arithmetic Logic Unit (ALU) performs arithmetic and logical operations.

The arithmetic unit controls simple operations such as addition, subtraction, multiplication and division.

On the other side, the logical unit controls the logical operations such as AND, OR, Equal, greater than, and less than , etc. Apart from it, the logic unit also responsible for performing several other operations such as comparing, selecting, matching, and merging data.

The information or data is transmitted to ALU from the storage unit only when it is required. After completing the operations, the result is either returned to the storage unit for further processing or getting stored

C) Memory Unit :

Memory Unit is an essential part of the computer system which is used to store data and instructions before and after processing. The memory unit transmits the information to other units of the computer system when required.

There are two types of memoryunits:

1 Primary Memory :

The use of primary memory is not possible to store data permanently for future access. Therefore, there are some other options to store the data permanently for future use, which is known as Main Memory or Temporary Memory. Random Access Memory (RAM) is an example of primary memory.

2 Secondary Memory :

The use of primary memory is not possible to store data permanently for future access. Therefore, there are some other options to store the data permanently for future use, which is known as secondary memory or permanent storage. The data stored in the secondary memory is safe even when there is a power failure or no power supply.

3) Output Unit :

The output unit consists of devices that are used to display the results or output of processing. The output data is first stored in the memory and then displayed in human-readable form through output devices. Some of the widely used output devices are Monitor, Printer, and Projector.

The Output Unit performs the following major functions:

- The output unit accepts the data or information in binary form from the main memory of the computersystem.
- The output unit converts the binary data into a human-readable form for better understanding.

❖ Chips

❖ What is Chips?

Computer chip, also called chip, integrated circuit or small wafer of semiconductor material embedded with integrated circuitry. Chips comprise the processing and memory units of the modern digital computer Chip making is extremely precise and is usually done in a “clean room,” since even microscopic contamination could render a chip defective.

❖ Types of Chips :

The types of chips produced by semiconductor companies can be categorized in two ways. Usually, chips are categorized in terms of their functionality. However, they are sometimesdividedintotypesaccording to the integrated circuits (ICs) used.

When looked at according to functionality, the four main categories of semiconductors are :

1) Memory chips
2) Microprocessors chips
3) Standard chips

When organized by types of integrated circuitry, the three types of chips are :

1) Digital
2) Analog
3) Mixed

1) Microprocessorschips:

Microprocessors are silicon chips that contain a computer's central processing unit (CPU)—the device that executes commands entered into the computer. Microprocessor chip is electronic equipment consisting of a small crystal of a silicon semiconductor fabricated to carry out a numberofelectronic functions in an integrated circuit.

❖ Types of Microprocessor Chips :

Microprocessors are classified into five types :

A) CISC - Complex Instruction SetMicroprocessors
B) RISC-Reduced Instruction Set Microprocessor
C) ASIC- Application Specific Integrated Circuit
D) Super Scalar Processors
E) DSP's - Digital Signal Microprocessors

A) Complex Instruction Set Microprocessors :

The short term of Complex Instruction Set Microprocessors is CISM and they classify a microprocessor in which orders can be performed together along with other low-level activities. These types of processors perform

different tasks like downloading, uploading, recalling data into the memory card and recalling data from the memory card.

B) Reduced Instruction Set Microprocessor :

The short term of Reduced Instruction Set Microprocessor is RISC. These types of processors are made according to the function in which the microprocessor can carry out small things in specific commands. In this way, these processors complete more commands at a faster rate.

C) Application Specific Integrated Circuit :

The short term of Application Specific Integrated Circuit processor is an ASIC. These processors are used for particular purposes that include automotive emissions control or personal digital assistants computer.

D) Super scalar Microprocessors:

Super scalar processor facsimiles the hardware on the processor to perform various tasks at a time. These processors can be used for ALUs or multipliers.

E) Digital Signal Microprocessors:

Digital signal processors are also called as DSP's, these processors are used to encode and decode the videos or to convert the D/A (digital to analog) &A/D (analog to digital). They need a microprocessor that is excellent in mathematical calculations.

- There are many companies like Intel, Motorola, DEC (Digital Equipment Corporation), TI (Texas Instruments) associated with many microprocessors such as 8085 microprocessors, ASIC, CISM, RISC, DSP's and 8086 microprocessors like Intel

❖ Examples of Microprocessor:

- Intel 4004 – The FirstMicroprocessor
- Intel8085
- Intel8086 and Intel 8088
- Intel Pentium 4
- Intel all Core processor
- AMD Athlon

2) Memory Chips:

A memory chip is an integrated circuit made out of millions of capacitors and transistors that can store data or can be used to process code.

Memory chips can hold memory either temporarily through random access memory (RAM), or permanently through read only memory (ROM).

Read only memory contains permanently stored data that a processor can read but cannot modify. Memory chips comes in different sizes and shapes. Some can be connected directly while some need special drives. Memory chips are essential components in computer and electronic devices in which memory storage plays a key role.

➢ Types/Example of Memory Chips :

There are following types of memory available in computer :

A) RAM

1. DRAM – Dynamic RAM
2. SRAM – Static RAM

B) ROM

1. PROM – Programmable ROM
2. EPROM – Erasable Programmable ROM

A) RAM:

RAM stands for Random Access Memory and is a type of chip used in primary storage memory.

Primary storage (RAM)is called 'primary' because it is the main memory that is accessible to the CPU. It is used to store data that is currently being used.

RAM is a short term memory; when the computer loses power the temporary storage will be lost.

❖ DRAM :

A DRAM chip has numerous small capacitors that contain each memory bit. DRAM chips do not hold change and need to be refreshed in order to keep the contents on the chips from being lost. DRAM chips are commonly referred to as volatile memory chips because they lose their memory when power is lost.

❖ **SRAM :**

SRAM chips are static random access memory chips. SRAM chipsare non-volatile memory chips and do not require refreshing or power to keep memory intact. SRAM chips are most common in portable battery powered devices like laptops, cameras, cell phones and video game consoles.

B) ROM :

ROM (Read Only Memory) refers to a read only memory chip that cannot be written on or erased by the computer user without special equipment. While using ROM contents are not lost when power to the computer is no longer available.

❖ PROM :

PROM chips are programmable read-only memory chips that differ from other programmable read-only memory chips because they can only be written to once. PROM chips cannot be erased with UV light or electronically.

❖ EPROM :

EPROM chips are erasable programmable read-only memory. These types of memory chips can be erased when they are exposed to ultraviolet light. When erased, the ERPOM chips can then be reprogrammedtocontainanewsetofdata orreusedtohousea different program.

❖ Buses

❖ What is Buses:

In computer architecture, a bus is a communication system that transfers data between components inside a computer, or between computers. This expression covers all related hardware components (wire, optical fiber, etc.) and software, including communication protocols.

❖ Internal buses

The internal bus, also known as internal data bus, memory bus, system bus or front-side bus, connects all the internal components of a computer, such as CPU and memory, to the motherboard. Internal data buses are also referred to as local buses, because they are intended to connect to local devices. This bus is typically rather quick and is independent of the rest of the computer operations.

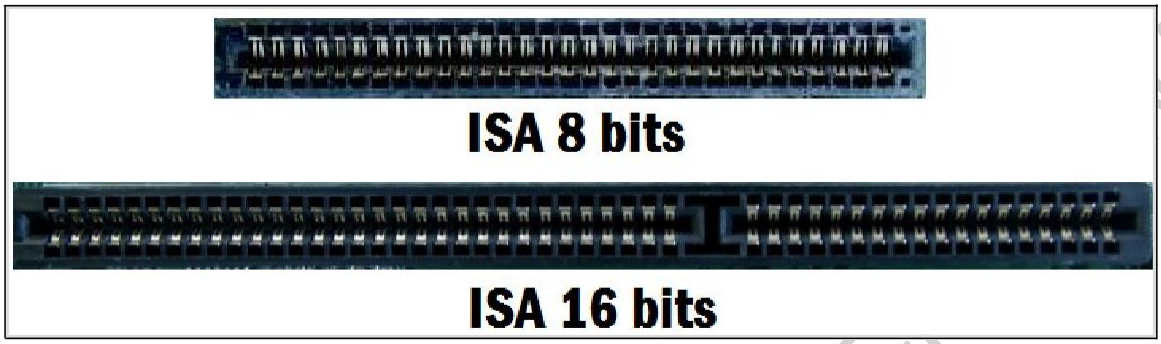
External buses

The external bus, or expansion bus, is made up of the electronic pathways that connect the different external devices, such as printer etc., to the computer.

1. ISA Bus

➢ Defination :

An Industry Standard Architecture bus (ISA bus) is a computer bus that allows additional expansion cards to be connected to a computer's motherboard.



❖ History :

It is a standard bus architecture for IBM compatibles. Introduced in 1981, the ISA bus was designed to support the Intel 8088 microprocessor for IBM's first-generation PC.

The original 8-bit version of PCI uses a 62 pin connection and supports clock speeds of 8 and 33 MHz. 16-bit PCI uses 98 pins and supports the same clock speeds.

The original 8-bit version of ISA was introduced in 1981 but the technology did not become widely used until 1984, when the 16-bit version was released.

For several years, motherboards provided a mix of both 8-bit and 16-bit ISA slots. As PCI became popular, motherboards included only 16-bit ISA.

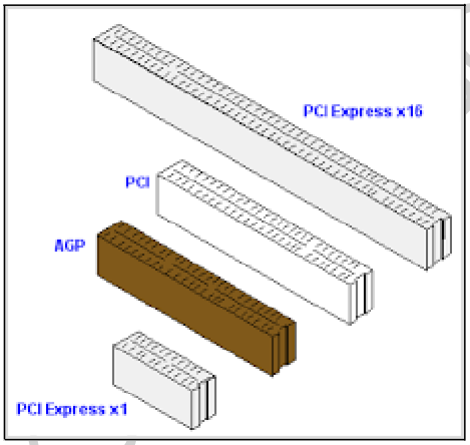
❖ **Use :**

ISA is a type of bus used in PCs for adding expansion cards. For example, an ISA slot may be used to add a video card, a network card, or an extra serial port.
Pronounced "eye-suh," ISA accepted cards for sound, display, harddrives and other devices.

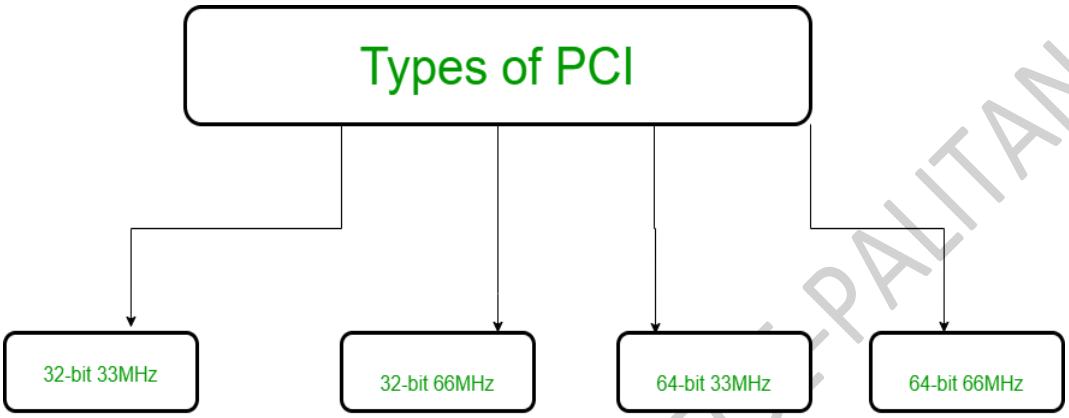
2. PCI Bus :-

➢ Definition :

Peripheral Component Interconnect (PCI) is a local computer bus for attaching hardware devices in a computer and is part of the PCI Local Bus standard.
A Peripheral Component Interconnect Bus (PCI bus) connects the CPU and expansion boards such as modem cards, network cards and sound cards. These expansion boards are normally plugged into expansion slots on the motherboard.



❖ **Types Of PCI :**



- PCI 32 bits have a transport speed of 33 MHz and work at 132 MBps.
- PCI 64 bits have a transport speed of 33 MHz and work at 264 MBps.
- PCI 64 bits have a transport speed of 66 MHz and work at 512 MBps.
- PCI 64 bits have a transport speed of 66 MHz and work at 1 GBps.

➢ Use :

PCI bus is a hardware bus used for adding internal components to a desktop computer. For example, a PCI card can be inserted into a PCI slot on a motherboard, providing additional I/O ports on the back of a computer.

➢ History :

The PCI architecture, also known as "conventional PCI," was designed by Intel and introduced in 1992.

Many desktop PC from the early 1990s to the mid 2000s had room for two to five PCI cards. Each card required an open slot on the motherboard and a removable panel on the back of the system unit. Both PCI and PCI-X were superseded by PCI Express, which was introduced in 2004.

3. USB Bus :

- **Defination :**

A Universal Serial Bus (USB) is a common interface that enables communication between devices and a host controller such as a personal computer (PC) or smartphone.
It connects peripheral devices such as digital cameras, mice, keyboards, printers, scanners, media devices, external hard drives and flash drives.

- **Use :**

USB was designed to standardize the connection of peripherals like pointing devices, keyboards, digital still and video cameras.

But soon devices such as printers, portable media players, disk drives and network adaptors to personal computers used USB to communicate and to supply electric power.

USB may also be used to send power to certain devices, such as powering smartphones and tablets and charging their batteries.

- **Advantages :**

1) The USB interface is self-configuring. This means that the user need not adjust settings on the device and interface for speed or data format, or configure interrupts, input/output addresses, or direct memory access channels.

2) USB connectors are standardized at the host, so any peripheral can use any available receptacle. USB takes full advantage of the additional processing power that can be economically put into peripheral devices so that they can manage themselves.

3) The USB interface is hot pluggable or plug and play, meaning devices can be exchanged without rebooting the host computer. Small devices can be powered directly from the USB interface thus removing extra power supply cables.

4) The USB interface defines protocols for improving reliability over previous interfaces and recovery from common errors.

5) Installation of a device relying on the USB standard minimal operator action is required.

❖ **Disadvantages :**

1) USB cables are limited in length.

2) Some very high speed peripheral devices require sustained speeds not available in the USB standard.

3) For a product developer, use of USB requires implementation of a complex protocol and implies an intelligent controller in the peripheral device.

4) Use of the USB logos on the product require annual fees and membership in the organization.