Introduction:

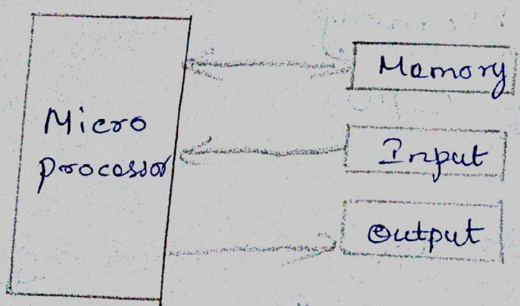
A microprocessor is a multipurpose, programmabl[e] clock-driven, register-based electronic device that reads binary Instructions from a storage device called Memory, accepts binary data as I/[P] and processes data according to those instructions and provides results as output.

A programmable machine can be represented with 4 components:

i) Microprocessor ii) Memory iii) I/P iv) O/P

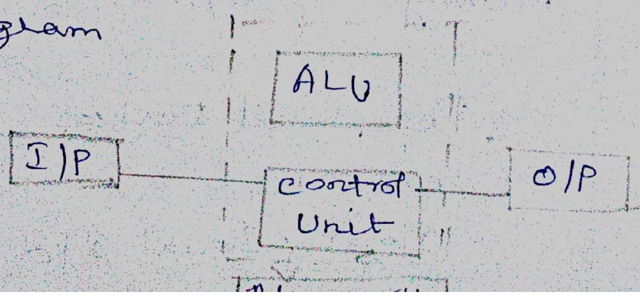
These 4 components works together or interact with each other to perform a given task thus they comprise a System. The physical component of this System. are called hardware. A Set of instructions written for the Microprocessor to perfo[rm] task is called a program and a group of progra[ms] is called Software.

A programmable Machine



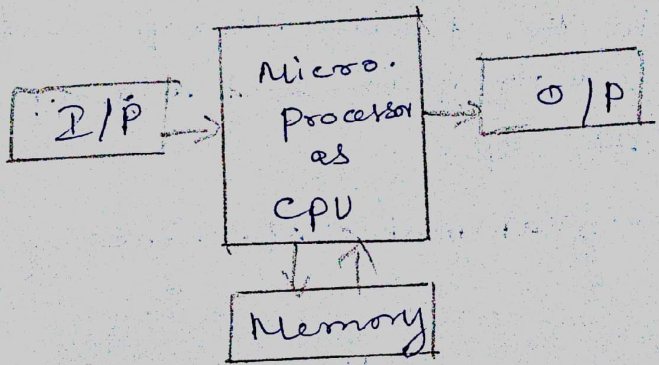
Microprocessor as a CPU (MPU)

The MP as a primary Component of a computer. The computer is represented in block diagram



The block diagram shows the 4 components: memory, I/P, O/P and CPU, which consist of the ALU and control unit. The CPU which contains various registers to store data, the ALU to perform arithmetic and logical operations, instruction decoders, counters, and control lines. The CPU reads instructions from the memory and performs tasks specified. It communicates with I/p and O/p devices either to accept or to send data. These devices are also know as peripherals. The timing of the communication process is controlled by the group of circuits called the control unit.

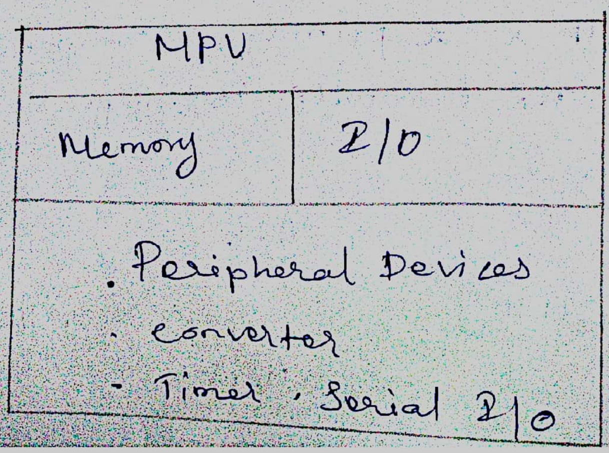
The process of CPU build on a single chip is called microprocessor.



Mp as CPU

Microcontroller

A microcontroller essentially an entire computer on a single chip.



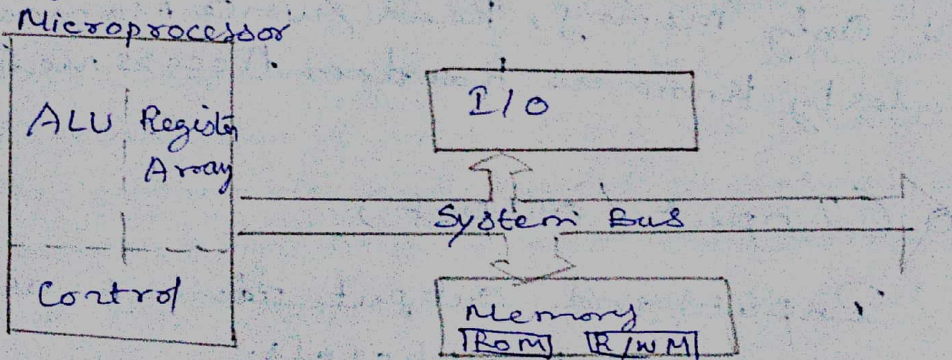
MPU → implies a complete processing unit with the necessary control signals.

Microcomputer:

A computer with a microprocessor as its CPU is known as a microcomputer.

Organization of a Microprocessor-Based System

The MP is a clock-driven semiconductor device consisting of electronic logic circuits manufactured by using either Large-Scale integration (LSI) or Very large Scale integration (VLSI) technique. The MP is capable of performing various computing functions and making decisions to change the sequence of program execution. It can be divided into 3 segments, they are ALU, register array and control unit.



ALU: The ALU performs such arithmetic operations as addition and subtraction, logic operations as AND, OR, and exclusive OR.

Register Array:

Microprocessor consist of various registers identified by letters such as B, C, D, H, and L. These are used to store data temporarily during the program execution and user can access through instructions.

Control Unit:

It provides the necessary timing and control signals to all the operations in the microcomputer. It controls the data flow between MP and memory and peripheral

System Bus

The system bus is a communication path between the microprocessor and peripherals. It is nothing but a group of wires to carry bits.

Memory:

Memory stores binary information as instructions and, data, and provides that infor to the microprocessor whenever necessary. The memory block has 2 sections. (ROM) Read Only memory, Read/write Memory (R/ Popularly know as Random Access memory.

I/O (Input / output)

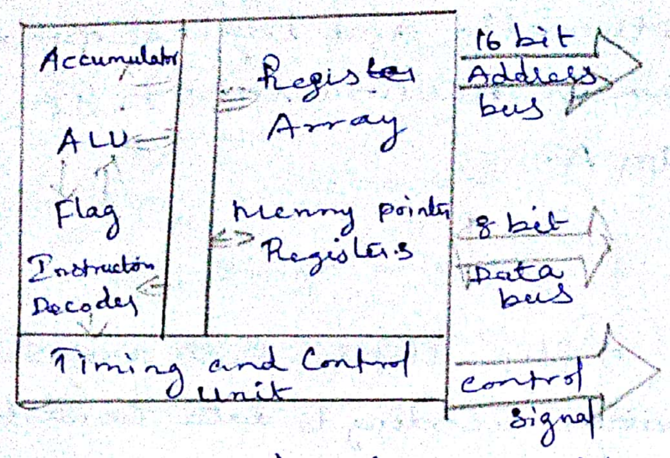
Input and output devices are also known as peripherals.

Input Device: Keyboard, Mouse

output Device: Monitor, Printer.

The 8085 ...

The Hardware model of a microprocessor as a part of the MP-based System. It has 3 Components ALU, Register, control array.



8085 Hardware Model

Hardware model has 2 Major Segment. One Segment include Accumulator, ALU, flag register, Instruction Decoder. The 2 Segment has 8 bit and 16 bit registers. Both Segments are connected with various internal Connections called an internal bus. The arithmetic and logical operations are Permomed in ALU. Results are Stored in Acc. and flip-flops, called flags are Set or reset to reflect the results.

There are 3 buses (i) 16 bit Address bus to Send out memory address. (2) 8 bit data bus: to transfer data, and (3) the control bus for time Signals.

Registers

It has 6 general-purpose registers to Store 8-bit data. Identified as B, C, D, E, H and L. They can be combined as register pairs — BC, DE, ~~HL~~ HL — to perform Some

16-bit operations.

Accumulator

It is a 8 bit register that is part of the ALU. this register is used to store 8-bit data and to perform arithmetic and logical operation. The result is stored in Accumulator. It identified as register A.

Flags

The ALU includes 5 flip-flops, which are set or reset after an operation according to data conditions of the result in the accumulator and other registers. They are called Z, cy, S, P, AC flags. The most commonly used flags are zero (Z), carry (cy), and Sign.

* Z - zero flag is set to 1 when the result is zero; otherwise it is reset.

* cy - carry; If an arithmetic operation results in a carry, the cy flag is set; otherwise it is reset.

* S - Sign: The sign flag is set if bit D_7 of the result = 1; otherwise it is reset.

* P - Parity: If the results has an even no. of 1s the flag is set; for an odd no. of 1s, the flag is reset.

* Ac - Auxiliary carry: In an arithmetic operation when a carry is generated by digit D_3 and passed to digit D_4, the Ac flag is

Program Counter (PC) And Stack pointer (SP)

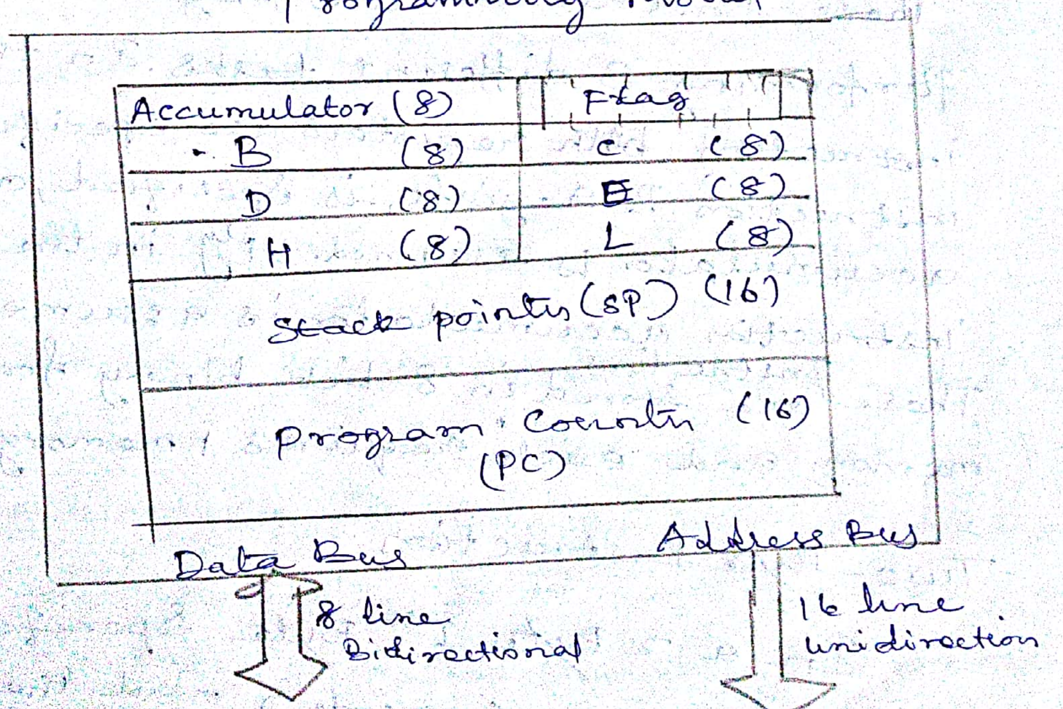
PC: The PC register is to sequence the execution of the instructions. The function of the program Counter is to point to the memory address from which the next byte is to be fetched. when a byte being fetched the program counter is incremented by one to point to the next memory locations.

The stack pointer: It is 16 bit register used as a memory pointer. It points to a memory location in R/W memory called Stack.

~~Instruction Format~~

~~Instruction is a Command to the μp to perform a~~

Programming Model.



D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
S	Z		AC		P		CY

Flag register.

Instruction format

An Instruction is a command to the MP to Perform a given task on Specified data. Each Instruction has 2 part: operation code (opcode), operand (data).

The Instruction set is classified into 3 groups according to word size or byte size

1) 1-byte instructions
2) 2-byte instructions
3) 3-byte instructions

One-Byte Instructions

Example

* MOV C, A
* ADD B
* CMA

A 1 byte Instruction inclu the Opcode and operand the Same byte.

These Instruction are 1-byte Instructions Performing 3 different tasks. In the 1st instruction both registers are Specified, In 2 instruction B register is Specified, and the accumulator is assumed. IIrly in the third instruction accumulator is assumed implicit. These Instructions are stored in 8-bit binary format in memory and each requires 1 memory location.

Two-Byte Instruction

In a 2 Byte Ist Byte Specifies the Operation code (opcode) and the Second byte Specifies the Operand. For examp

opcode	operand	Hex code
MVI	A, 32H	3E → 1st byte 32H → 2nd byt
	B, F2 H	06 → 1st byt

These Instruction require 2 memory locations each to store the binary codes.

3-BYTE Instructions

In 3-byte Instruction 1st byte specifies the Opcode, and the following 2 bytes specify the 16-bit address.

Ex:

LDA 2050 → 3A → 1st byte
50 → 2nd byte
20 → 3rd byte

JMP 2085 → C3 → 1st byte
85 → 2nd byte
20 → 3rd byte

These Instruction require 3 memory locations each to store the binary code.

MP Architecture and Its Operations.

The MP is a programmable digital device, designed with registers, flip-flops, and timing elements. It has a set instructions designed internally, to manipulate data and communicate with peripherals. This process of manipulation, communication is determined by the logic design of the MP, called the architecture.

Microprocessor can be classified in 3 general categories:

* MP-initiated operations * Internal operations * peripheral operations.

Initiated Operations

The MP performs primarily 4 operation

* Memory Read: Read data from Memory
* Memory write: writes data into memory.
* I/O Read: Accepts Data from I/p de
* I/O write: Sends Data to o/p Device

These operations are part of the communication between MPU and peripherals Devices. To communicate with peripherals, the MPU Need to perform the following steps.

S1: Identify the pheripheral or the Memory location.

S2: Transfer binary information

S3: Provide timing or synchronization Sig

The 8085 performs these functions usi 3 set of communication lines called bus address bus, Data Bus, and control bus. These buses are shown as one group call system bus.

Address Bus:

It is a group of 16 lines identif as A_0 to A_{15}. The Address bus is unidir -al. bits flow in one direction from MPU peripheral devices. The Address bus perfo the 1st functions (S1).

location is identified by a binary number, called an address, & the address bus is used to carry a 16-bit address. This is similar to the postal address of a house.

Data Bus

It is a group of 8 bus lines used for data flow. These lines are bidirectional - Data flow in both directions between the MPU and memory and peripheral Devices. This Bus used for perform the 2nd function (S2).

Control Bus

The Control Bus is comprised of various single lines that carry synchronization single. control Bus perform the 3rd function (S3).

Internal Data operations

The internal architecture of the 8085 MP determines how and what operations can be performed with the data. These operations are:

1. Store 8 bit data
2. perform arithmetic and logical operation
3. Test for conditions.
4. Sequence the execution of instruction
5. Store data temporarily during execution in the defined memory location called Stack.

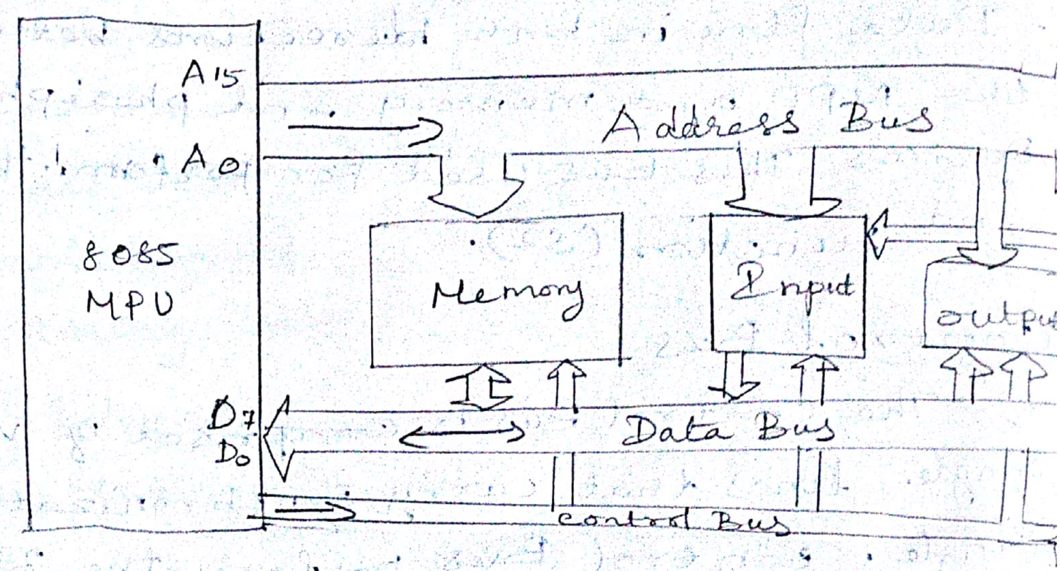
Ex: Load 2050

Mov B, A

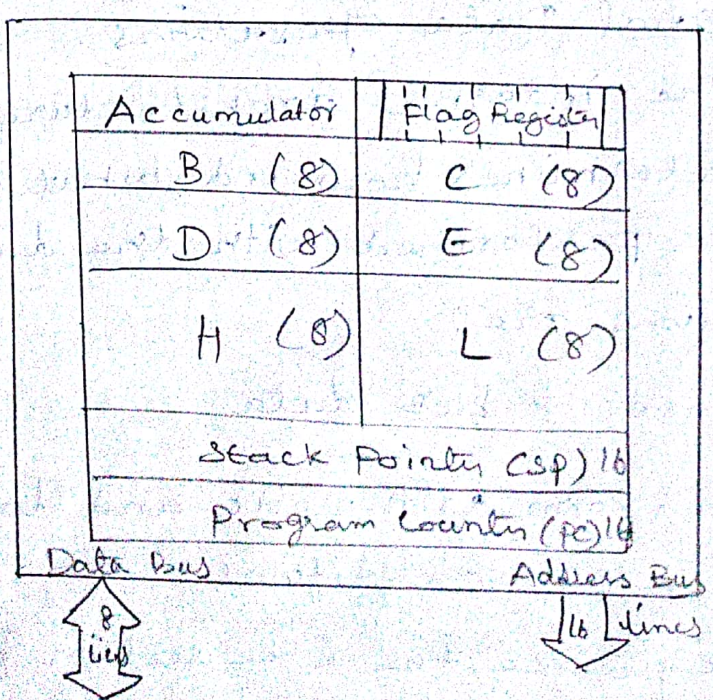
Load 2051

Add B

HLT



8085 Bus Structure



8085 programmable Register

Peripheral or Externally Initiated operations

External devices can initiate the following operations: ~~Reset~~ Reset, Interrup, Ready, Hold.

Reset: When this pin is activated all the Internal operations are suspended and program counter is cleard. Now the program execution begin at the zero memory location.

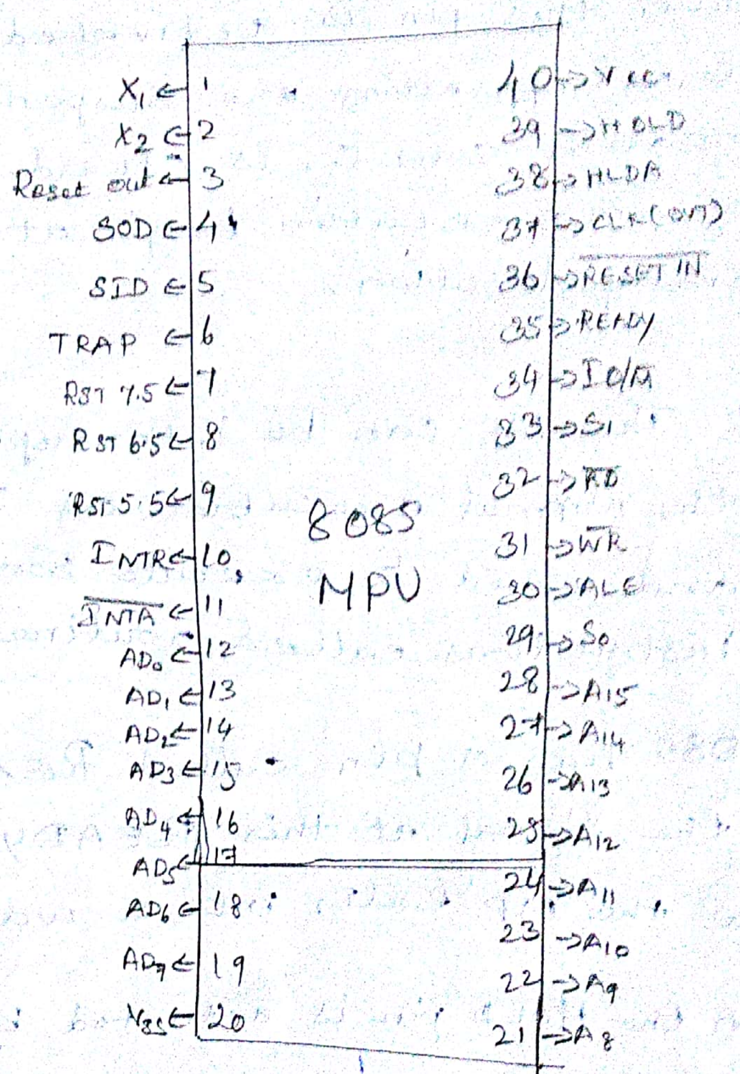
Interrupt: The MP can be interrupted from the normal execution of Instructions and asked to execute some other instructions called routine.

Ready: 8085 has a pin called READY. If the signal at this READY pin is low the MP enter into a wait state.

Hold: When the HOLD pin is activated by an external signal, the MP relinquishes control of buses and allows the external peripheral to use them. This pin is used in DMA.

The 8085 MPU

The term microprocessing unit (MPU) is similar to the term central processing unit used in traditional computers.



This device has 40 pins requires a +5V single power supply. In this logic pinout diagram All the signals can be classified into six groups (1) address bus, (2) data bus (3) Control bus, (4) Power Supply and frequency signals (5) externally initiated signals and (6) Serial (I/O) ports.

Address Bus

8085 has 16 lines (pins) that are used as the address bus. these lines are split into 2 segments $A_{15}-A_8$ and AD_7-AD_0. The eight signal lines, $A_{15}-A_8$ unidirectional and used for the most significant bits, called the high-order address of a 16-bit

Multiplexed Address/Data Bus

The Signal lines $AD_7 - AD_0$ are bidirectional they Serve a dual purpose. theys are used as the low order address bus as well as the data bus. This is also Known as multiplexing the bus.

Control and Status Signals

This group of Signals include 2 Control Signals ($\overline{RD}$ and $\overline{WR}$), 3 status Signals ($IO/\overline{M}$, S_1, and S_0) to identify the nature of the operation, and one Special signal (ALE to indicate the begining of the operations

The Signals are

* ~~AL~~ ALE (Address latch Enable) This is a +ve going pulse generated every time the 8085 begins an operation. it indicate the bit $AD_7 - AD_0$ are Address bits. it Separate Set of 8 address lines $A_7 - A_0$

* $\overline{RD}$ – Read : This is a Read Control Signal (active low). This signal indicate that the Selected I/O or memory device is to be read and data are available on the data bus.

* $\overline{WR}$ – write : This is write control signal (active low) This signal indicates that the data on the data bus are to be written into a Selected memory or I/O location.

* $IO/\overline{M}$: This is a Status Signal differentiate between I/O and memory operations. when it is high it indicates an I/O operation. when it is low it indicates a memory operation. This signal is combined with ($\overline{RD}$) and ($\overline{WR}$) to generate I/O and memory control signal.

S_1 and S_0 : These Status Signals, similar to $IO/\overline{M}$ can identify various Operations, but they rarely used in Small Systems.

Power Supply and Clock frequency

* V_{cc} : +5 V power Supply
* V_{ss} : Ground Reference.
* X_1, X_2: A crystal (or RC, LC Network) is connected at these pins.
* CLK (OUT) – Clock out: This Signal can be used as the System clock for other devices.

Externally Initiated Signals, Including Interrupts

* INTR → Interrupt request
  This is used for Interrupt. Similar to INT
* $\overline{INTA}$ → Interrupt Acknowledge: (OUTPUT)
  This is used to acknowledge an Inte
* RST 7.5 (InputS)
  RST 6.5
  RST 5.5
  } Restart Interrupts

These are vectored interrupts that transfer the program control to Specific memory locations. They have highest priorities than Among those 3 the priority Order is 7.5, 6

* TRAP (INPUT): Non maskable interrupts and has highest priority.
* HOLD (INPUT): This indicates the peripher (DMA).
* HLDA (output): Hold Acknowledge: It acknow the Hold Signal.
* Ready (Input): This Signal is used to dela the MP Read or write cycles until a Slow responding Peripheral is ready to Send or

$\times$ RESET IN : when the Signal on this pin goes low. the program counter is set to zero, the buses are tri-Stated and the MPU is reset.

$\times$ RESET OUT: This signal indicates the the MPU is being reset. The Signal can be used to reset other devices.

Serial I/O PORTS

The 8085 has 2 signals to implement the Serial transmission: SID (Serial Input Data) and SOD (Serial OUTPut Data). In Serial transmission, data bits are sent over a Single line One bit at a time Such as the transmission over telephone lines.