8085 MICROPROCESSOR

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Basic Concepts of Microprocessors

- Differences between:
  - Microcomputer – a computer with a microprocessor as its CPU. Includes memory, I/O etc.
  - Microprocessor – silicon chip which includes ALU, register circuits & control circuits
  - Microcontroller – silicon chip which includes microprocessor, memory & I/O in a single package.

8085 MICROPROCESSOR

- PROCESSOR
- MICRO

PROCESSOR

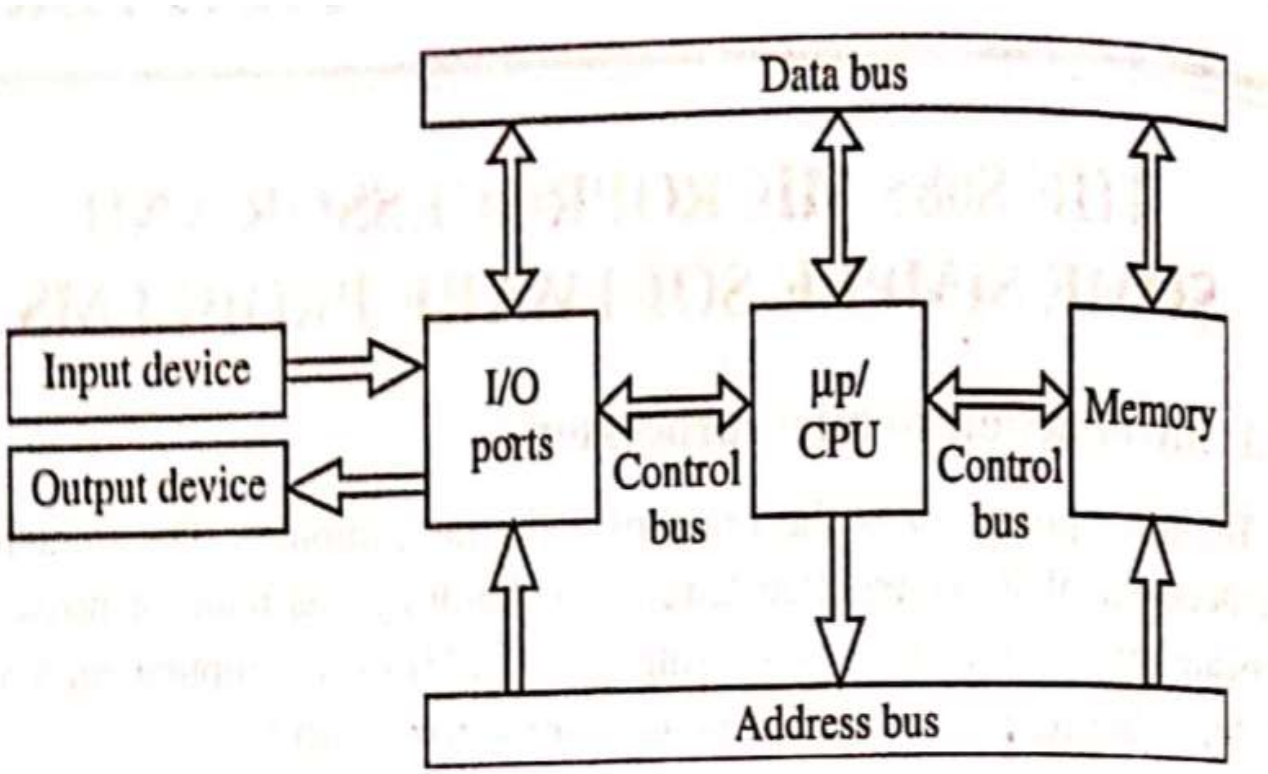
Device that processes whatever- numbers, specifically binary numbers, 0’s and 1’s

WHY MICRO?

Device that processes whatever- numbers, specifically binary numbers, 0's and 1's

BASIC COMPONENTS OF MICROPROCESSOR BASED SYSTEM

- MEMORY
- SYSTEM BUS
- CPU
- I/O PORT



MEMORY

READ ONLY MEMORY (ROM)

RANDOM ACESS MEMORY (RAM) OR READ/WRITE (R/W) MEMORY

System Bus –wires connecting memory & I/O to microprocessor

Address Bus→

- Unidirectional
- Identifying peripheral or memory location

Data Bus→

- Bidirectional
- Transferring data

Control Bus→

- Synchronization signals
- Timing signals
- Control signal

CPU/ MICROPROCESSOR

- **Control unit:** control microprocessor operations.
- **ALU:** performs data processing function.
- **Registers:** provide storage internal to CPU.
- **Interrupts**
- **Internal data bus**

I/O PORT

Various components required for data entry and data output
These are called PERIPHERALS

SWITCHES, KEYBOARDS, A/D CONVERTERS, MOUSE, ETC

CPU/ MICROPROCESSOR……MORE

- **Control unit:** control microprocessor operations.
- **ALU:** performs data processing function.
- **Registers:** provide storage internal to CPU.
- **Interrupts**
- **Internal data bus**

CPU/ MICROPROCESSOR.....MORE

- Zero Flag
  - Is set if result obtained after an operation is 0
  - Is set following an increment or decrement operation of that register

```
  10110011
+ 01001101
----------
1 00000000
```

- Carry Flag
  - Is set if there is a carry or borrow from arithmetic operation

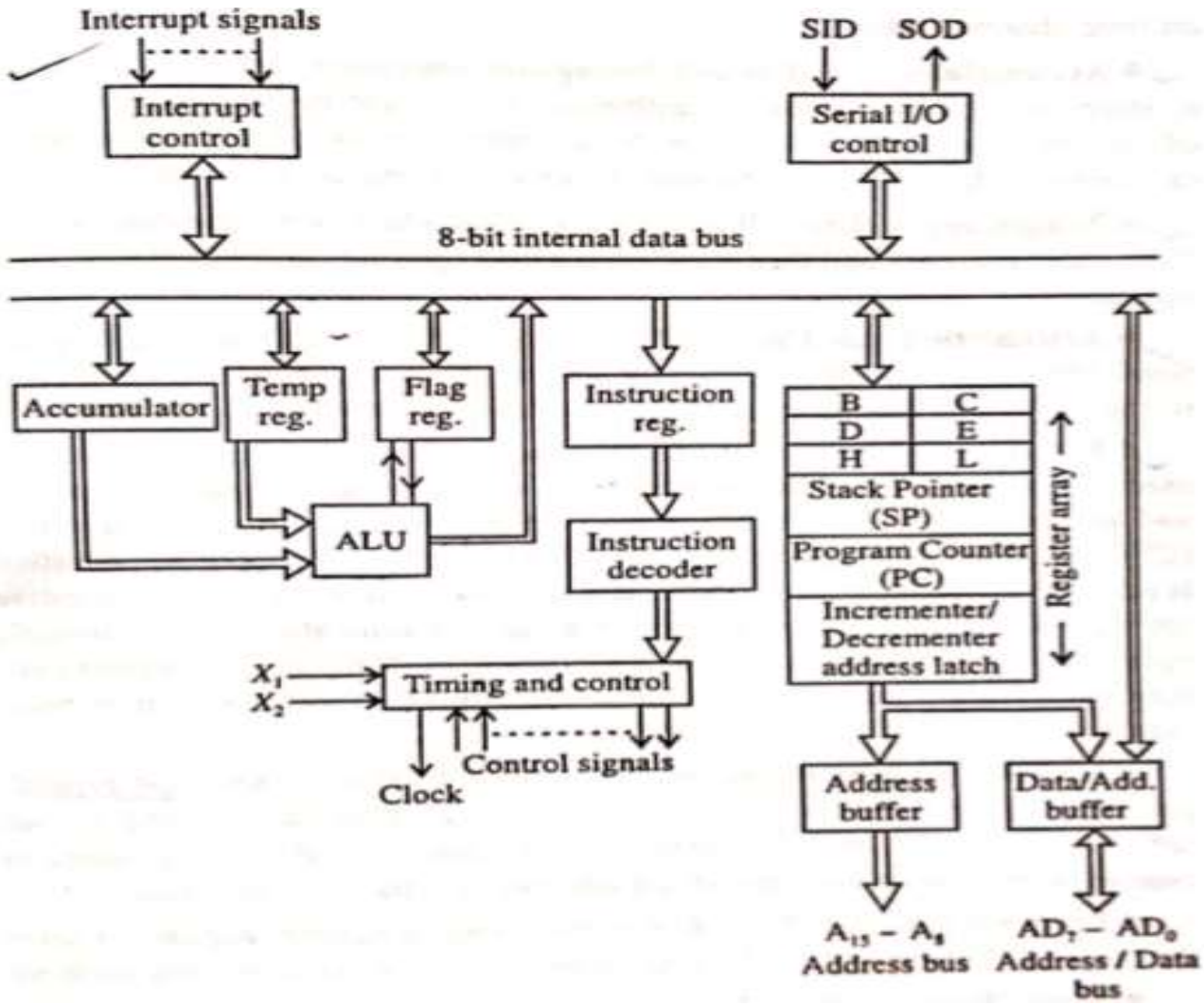
```
    1011 0101
+   0110 1100
-------------
Carry 1  0010 0001
```

```
    1011 0101
-   1100 1100
-------------
Borrow 1  1110 1001
```

CPU/ MICROPROCESSOR.....MORE

- Auxillary Carry Flag
  - Is set if there is a carry out of bit 3
- Parity Flag
  - Is set if parity is even
  - Is cleared if parity is odd

INTEL 8085


Interrupt signals
Interrupt control
SID
SOD
Serial I/O control
8-bit internal data bus
Accumulator
Temp reg.
Flag reg.
ALU
Instruction reg.
Instruction decoder
B
C
D
E
H
L
Stack Pointer (SP)
Program Counter (PC)
Incrementer/ Decrementer address latch
Register array
X_1
X_2
Timing and control
Clock
Control signals
Address buffer
Data/Add. buffer
$A_{15} - A_8$
Address bus
$AD_7 - AD_0$
Address / Data bus

INTEL 8085 BUS STRUCTURE

- ✓ It is a 8-bit microprocessor
- ✓ Data bus has 8 lines
- ✓ It has 16-bit wide address bus
- ✓ It is capable of address 2^16=65536=64k memory locations
- ✓ The 8 MSBs of the address are transmitted by data/address bus A_{15}-A_8 and 8 LSBs are transmitted by AD_7-AD_0

INTEL 8085

ACCUMULATOR (A)

- ✓ It is a 8-bit register associated with ALU
- ✓ It stores one of the operands of arithmetic and logical operations.
- ✓ The result is also stored in it.
- ✓ It can receive or send data to memory and other registers directly from it

INTEL 8085 TEMPORARY REGISTER

- ✓ It is a 8-bit register
- ✓ It can store the data coming from other register and then these data act as operand of arithmetic or logical operation.

INTEL 8085

ARITHMATIC LOGIC UNIT (ALU)

- ✓ It performs arithmetic or logical operations.
- ✓ The contents of accumulator and temporary register are the inputs of ALU.
- ✓ The results of ALU is the stored back in the Accumulator.

INTEL 8085 FLAGS

- Zero Flag
  - Is set if result obtained after an operation is 0
  - Is set following an increment or decrement operation of that register

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+ 01001101
----------
1 00000000
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- Carry Flag
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Carry 1 0010 0001
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```

INTEL 8085 Flags

- Auxillary Carry Flag
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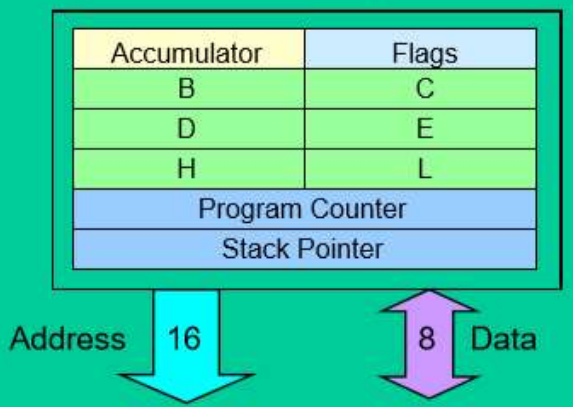
INTEL 8085 General Purpose Registers

- Registers
  - General Purpose Registers
    - B, C, D, E, H & L (8 bit registers)
    - Can be used singly
    - Or can be used as 16 bit register pairs
      - BC, DE, HL
    - H & L can be used as a data pointer (holds memory address)
  - Special Purpose Registers
    - Accumulator (8 bit register)
      - Store 8 bit data
      - Store the result of an operation
      - Store 8 bit data during I/O transfer



INTEL 8085 PROGRAM CONTROLLER (PC)

- The Program Counter (PC)
  - This is a register that is used to control the sequencing of the execution of instructions.
  - This register always holds the address of the next instruction.
  - Since it holds an address, it must be 16 bits wide.

INTEL 8085 STACK POINTER (SP)

- The Stack pointer
  - The stack pointer is also a 16-bit register that is used to point into memory.
  - The memory this register points to is a special area called the stack.
  - The stack is an area of memory used to hold data that will be retreived soon.
  - The stack is usually accessed in a Last In First Out (LIFO) fashion.

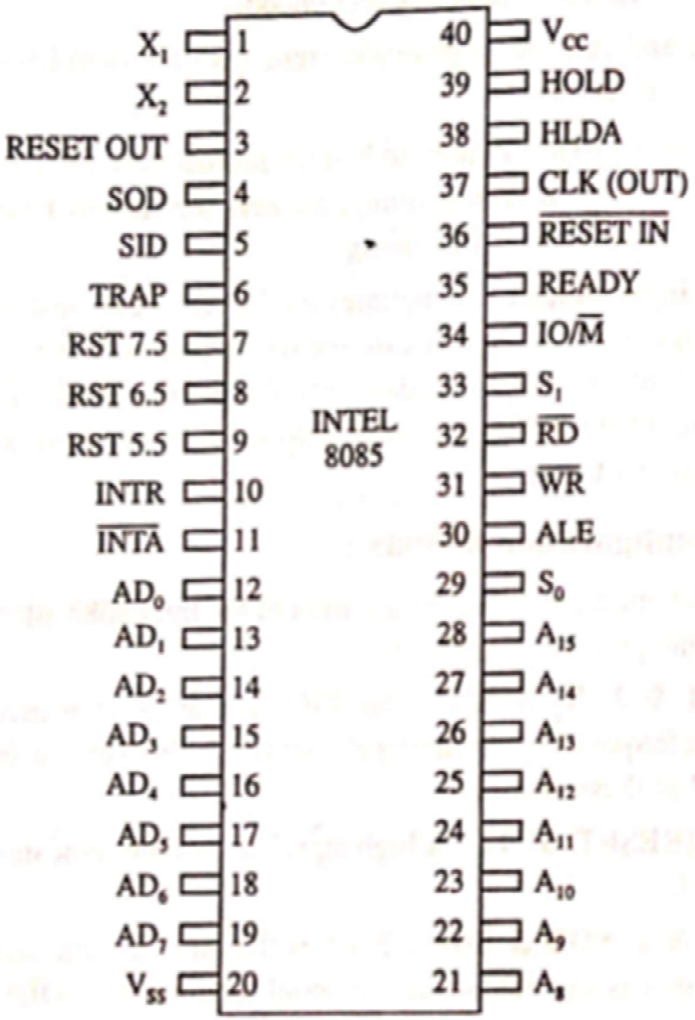
INTEL 8085 Instruction Register & Decoder

- Instruction is stored in IR after fetched by processor
- Decoder decodes instruction in IR

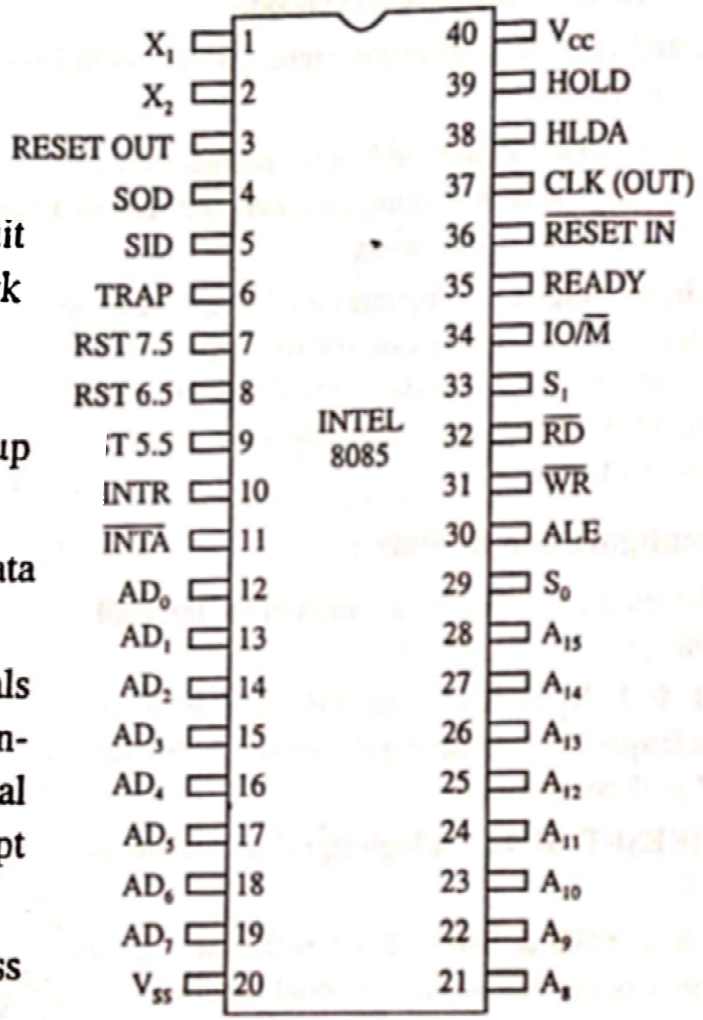
INTEL 8085 Internal Clock generator

- 3.125 MHz internally
- 6.25 MHz externally

INTEL 8085
PIN CONFIGURATION



INTEL 8085



- **Pins 1 & 2 (X_1 & X_2) :** The 8085 has an on-chip oscillator circuit excepting the frequency determining elements. For this a crystal or RC network is connected at these two pins.

- **Pin 3 (RESET OUT) :** A high signal at this pin indicates that the µp is being reset.

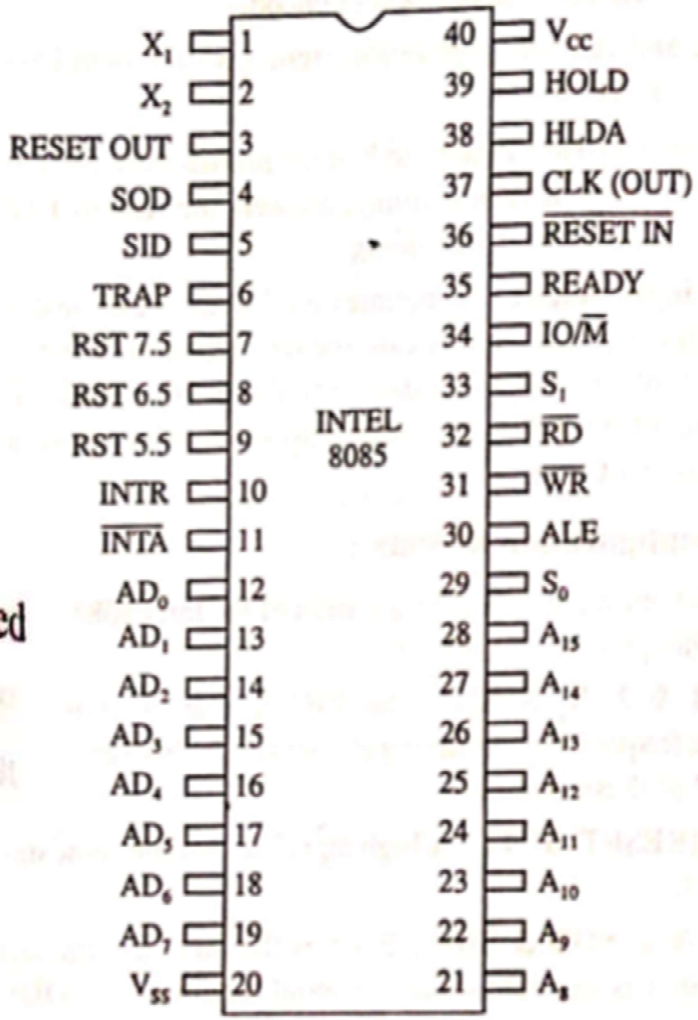
- **Pin 4 & 5 (SOD & SID) :** Pin 5 is the input pin for serial input data (SID) and pin 4 is the output pin for serial output data (SOD).

- **Pins 6 to 11 :** Pins 6 to 10 are input pins for five interrupt signals designated TRAP, RST 7.5, RST 6.5, RST 5.5 and INTR. TRAP is a non-maskable interrupt, RST stands for restart interrupt. INTR is used for general purpose interrupt. Pin 11 is the output pin with a signal called the interrupt acknowledgement $\overline{INTA}$.

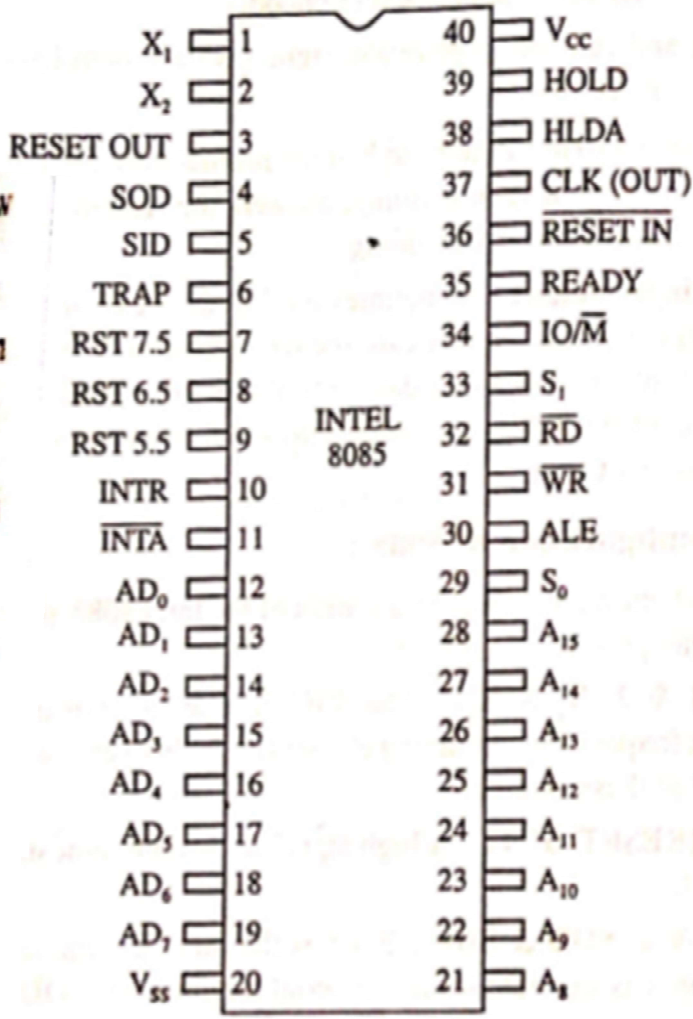
- **Pins 12 to 19 :** The signal lines $AD_7 - AD_0$ are used as lower order address bus as well as the data bus.

INTEL 8085

- **Pins 20(V_{ss}) :** *It is the system ground.*
- **Pins 21 to 28 :** *The signal lines $A_{15} - A_8$ are used as higher order address bus.*
- **Pins 29, 33 and 34 (S_0, S_1 and $IO/\overline{M}$) :** *They carry status signals which can identify various operations.*
- **Pin 30 (ALE) :** It stands for address latch enable and is primarily used to latch low-order address from the multiplexed bus.



INTEL 8085



- **Pins 31 & 32 ($\overline{WR}$ & $\overline{RD}$) :** They carry two control signals. A low $\overline{WR}$ means a write operation and a low $\overline{RD}$ means a read operation.
- **Pin 35 (READY) :** Here a signal is used to delay the 8085 operation until a slow peripheral device is ready.
- **Pin 36 ($\overline{RESET\ IN}$) :** When the signal on this pin goes low the program counter & the μp is reset.
- **Pin 37 [CLK (OUT)] :** It is a clock output and can be used for other devices.
- **Pins 38 & 39 (HLDA & HOLD) :** HOLD signal indicates that another device is requesting for the use of the address and data buses. HLDA signal acknowledges the HOLD request.
- **Pin 40 (V_{cc}) :** +5 V power supply.

INTEL 8085

PROGRAMING LANGUAGES

INTEL 8085

INSTRUCTION SET