Republic of Iraq
Ministry of Higher
Education & Scientific
Research Department of
Medical Instrumentation
Techniques Engineering

Microprocessor & Microcomputer

Class: 3rd

Lecturer: Sarah Kadhim Hwaidi

Pin Description of 8085 Microprocessor

The 8085 microprocessor is a 40-pin integrated circuit (IC), and its pins are organized into seven distinct groups, each serving a specific function. These groups are:

1. Power Supply and Clock Signals
2. Data Bus
3. Address Bus
4. Serial Input/Output Ports
5. Control and Status
6. Signals Interrupts and Externally Generated Signals
7. Direct Memory Access (DMA)

Each group of pins plays a crucial role in the operation of the 8085 microprocessor. Below, we'll explore the purpose of every pin and how it contributes to the overall functioning of the 8085 microprocessor.

Pin diagram of 8085 Microprocessor

1. **Power Supply and Clock Signals**

In the 8085 microprocessor, four pins are dedicated to the power supply and clock signals. These pins are:

- VCC (Pin 40): This pin is where you provide the external power supply, which is +5V. It powers the microprocessor.

- VSS (Pin 20): This is the ground pin, which connects the microprocessor to the circuit's ground.

- X1 and X2 (Pins 1 and 2): These two pins are used to connect a crystal or an LC network, which helps generate the clock signal needed to keep the processor running at the correct speed.

- CLK (OUT) (Pin 37): This pin provides the clock signal for the rest of the system, ensuring that each operation in the microprocessor takes the right amount of time to complete.

2. Address Bus – 8 Pins

The address bus in the 8085 microprocessor has 16 lines, which means it can send 16 bits of address information at once. However, only 8 of these lines are dedicated directly to the address bus, while the other 8 are shared (or multiplexed) with the data bus.

The pins for the separate address lines are from pin 21 to pin 28 on the microprocessor, and these are labeled A8 to A15. These pins carry the most significant bits (MSBs) of the memory or I/O address, telling the system where to find the data or instructions in memory. Since the address bus only sends information from the processor to memory, it works in one direction (unidirectional).

3. Data Bus

8 Pins (Multiplexed with Address Bus)

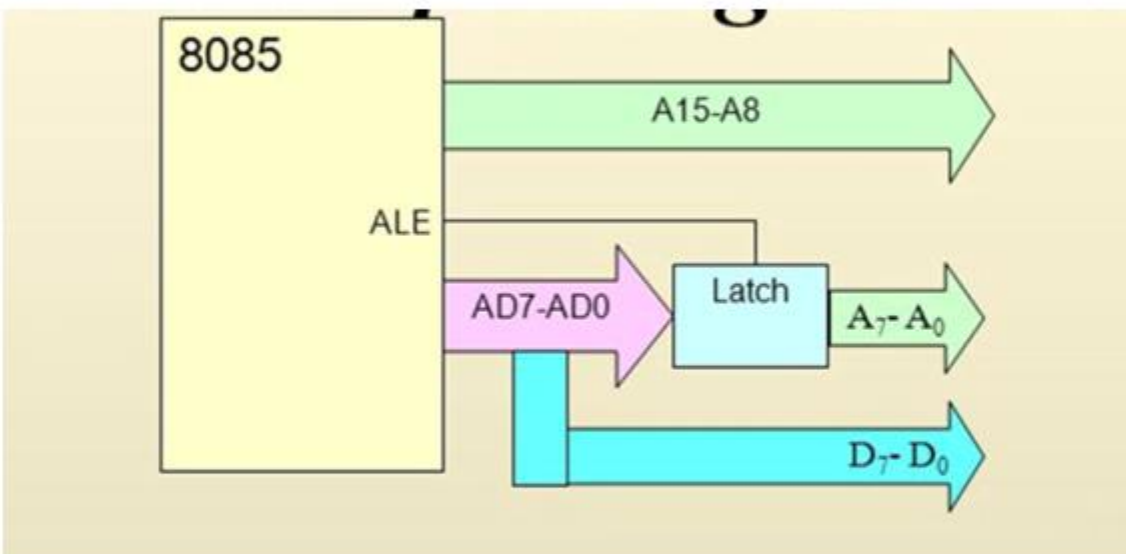
The 8085 microprocessor has an 8-bit data bus, which means it can send and receive 8 bits of data at a time. To save space and reduce the number of lines (wires) needed, these 8 data lines are shared (or multiplexed) with 8 lines of the address bus.

This means that the same set of pins is used first to carry the address and then to transfer the data, one after the other, helping the microprocessor communicate more efficiently with memory and other devices.

Pins for the Multiplexed Address and Data Bus

The multiplexed address and data lines are found on pin numbers 12 to 19. These pins handle both address and data at different times. The address lines are labeled A and the data lines are labeled D. For these pins, the lower 8 bits of the address and data are combined and represented as AD0 to AD7.

First, the address bus sends the address of the memory location where the processor needs to either read or write data. Then, the data bus carries the actual data or instruction from that memory location to the microprocessor.



4.Serial I/O Ports – 2 Pins

The 8085 microprocessor has two pins for serial input and output:

SID (Pin 5) : This stands for Serial Input Data. It's used to receive data from input devices, sending the data bit by bit directly to the microprocessor.

SOD (Pin 4) : This stands for Serial Output Data. Once the microprocessor processes the data, this pin sends the results bit by bit to output devices.

These pins allow data to be transferred in a serial form, one bit at a time.

5.Control and Status Signals – 6 Pins

Six pins in the 8085 microprocessor are used for control and status signals. One important pin is:

- **ALE (Pin 30)**: This stands for Address Latch Enable. The lower 8 bits of the address bus are shared with the data bus. The ALE pin helps the microprocessor know when an address is present on these shared lines. When an address is being sent, ALE is enabled (active). When no address is on the bus, ALE is disabled.
- **RD (Pin 32)**: This pin stands for Read. When it's active, it tells the microprocessor that it can now read data from memory or an input/output (I/O) device onto the data bus.

- **WR (Pin 31)**: This pin stands for Write. When it's active, it tells the microprocessor to write the data from the data bus into a memory location or I/O device.

- **IO/M (Pin 34)**: This pin helps the microprocessor decide whether the operation is for I/O or memory. If the pin is high (1), it's an I/O operation. If it's low (0), it's a memory operation.

- **S0 and S1 (Pins 29 and 33)**: These pins represent status signals. They tell the microprocessor what type of operation is currently happening. The combination of S0 and S1 shows whether the microprocessor is reading, writing, or idle. A status table is often used to show these conditions clearly.

IO/M	S_1	S_2	DATA BUS STATUS
0	0	0	Halt
0	0	1	Memory Write
0	1	0	Memory Read
1	0	1	IO Write
1	1	0	IO Read
0	1	1	Opcode fetch
1	1	1	Interrupt acknowledge

Table showing data bus status in 8085 microprocessor

6.Interrupts and Externally Generated Signals

Interrupts are signals that temporarily pause the current operation of the CPU. When an interrupt occurs, the CPU immediately stops what it's doing and switches to a special program called an Interrupt Service Routine (ISR) to handle the new task.

In the 8085 microprocessor, there are 5 pins dedicated to interrupts, from pin 6 to pin 10. Each of these pins is used to manage different types of interrupts, ensuring the CPU can handle high-priority tasks as soon as they come in.

Interrupt Pins

- **INTR, RST5.5, RST6.5, RST7.5, and TRAP** (Pins 6 to 10): These are the five pins used for handling different interrupts. Each one is responsible for managing a specific type of interrupt signal that pauses the current task to handle a higher-priority job.
  Reset Signals
- **RESET IN** (Pin 36): This pin is used to reset the microprocessor, which sets the program counter back to zero. It restarts the CPU, clearing any ongoing tasks.

- **RESET OUT** (Pin 3): When the microprocessor is reset, this pin sends a reset signal to all the other devices connected to it, so they also restart along with the microprocessor.

- **Interrupt Acknowledge (INTA)**
  INTA (Pin 11): This pin is used to send a signal that acknowledges an interrupt. When the microprocessor

receives an interrupt, it uses this pin to confirm that it's ready to handle the interrupt.

7. Direct Memory Access (DMA)

Normally, the microprocessor (CPU) controls the transfer of data between memory and input/output (I/O) devices. But when large amounts of data need to be transferred, this can slow down the CPU. To solve this, Direct Memory Access (DMA) allows the data to be transferred directly between the I/O devices and memory without involving the CPU.

During this process, the CPU is temporarily disabled, and its buses are put into a tri-state (disconnected) mode. An external control circuit then manages the data transfer instead.

DMA uses two pins in the 8085 microprocessor to handle this process.

- HOLD Signal (Pin 39)

The HOLD signal is used to notify the processor that another device needs to use the data and address bus. When this signal is active, the CPU finishes its current task and then releases control of the bus, allowing the other device to use it. Once the HOLD signal is turned off, the CPU can take control of the bus again and continue its operations.

- HLDA (HOLD Acknowledge)

  The HLDA signal tells us that the CPU has received the HOLD request and is about to release the data and address bus on the next clock cycle. Once the HOLD request is removed, HLDA goes low, meaning the CPU has taken back control of the bus.

- READY Signal (Pin 35)

  The READY signal is found on pin 35 and helps keep everything in sync between the CPU, memory, and peripheral devices. Since the microprocessor operates much faster than these devices, this pin is used to ensure that both the CPU and the devices are ready to start the next operation. When everything is ready, the READY pin is activated, allowing the next task to begin.

When the READY pin is turned off (disabled), the microprocessor enters a WAIT state. This means that the CPU cannot continue with its operations because it's waiting for the device to be ready to send or receive data. If the READY signal is low, the CPU must wait until it goes high again before it can proceed.

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Introduction

Microprocessor: The processing units in the computer are the masterminds because it is responsible for processing data externally, the working principle of the central processing unit is that it receives data from the input devices, processes it, and then Sending it to several kinds of memory used in the computer for storage and then sends it to the output units to display results.

- The microprocessor is an integrated circuit (semiconductor) produced using the VLSI (Very Large Scale Integration) technique.

- It consists of the Arithmetic and Logic Unit, registers, and control circuit on a single chip to perform a function or useful task. We can connect memory and other add-ons like a keyboard, logic circuit, etc. to the microprocessor. The microprocessor then commands these devices to act according to the program or code written in it.

- The memories, input device, output device and interfacing devices are called peripherals. The popular input devices are keyboards and floppy disks; the output devices are printers, LED/LCD displays, monitors, etc.

Advantages of Microprocessor based system

1. The speed of processing is high.
2. Systems now contain intelligence.
3. Since the devices are programmable, there is flexibility to alter the system by changing the software alone.

Application of microprocessor

1. **Instrumentation**: It has very wide applications in the field of instrumentation in systems such as control panels of press printing machines, security systems, etc. It is also included in smart medical devices such as electronic cardiograms (ECGs).

2. **Entertainment**: Microprocessors are also used in various gaming consoles, DVD players, etc.

3. **Communication**: A variety of communication devices, including televisions, satellite communication, digital phone sets, and others, employ microprocessors.

Features of 8085

1. It is an 8-bit microprocessor (each character is represented by 8 bits or a byte).

2. It is manufactured with N-MOS (n-type Metal Oxide Semiconductor)

technology implemented with 6200 transistors.

3. It works on, +5 volts supply

4. It has an execution speed of 3, 5, and 6 MHz

5. It has an 8-bit Data bus

6. It has 16-bit address lines - A0-A15 (to point to the memory locations) and

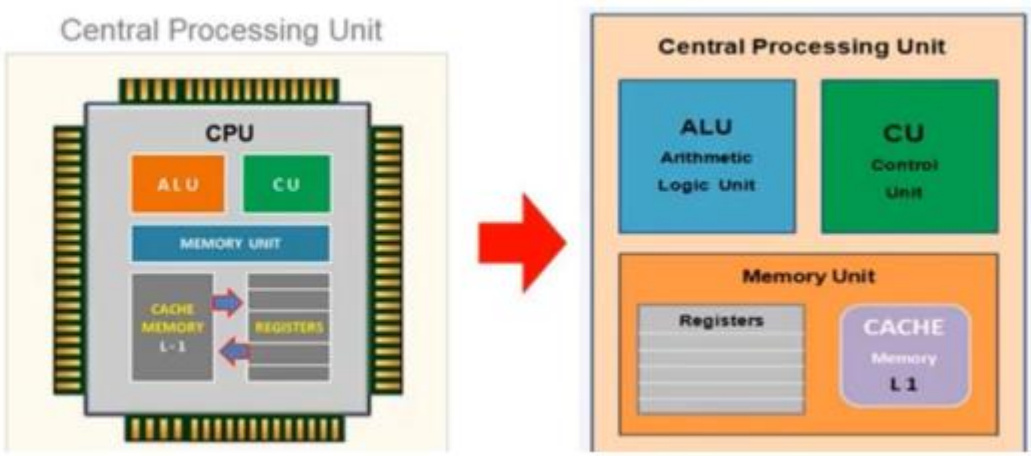
hence can point up to 2^16 = 65535 bytes (64KB) memory locations.

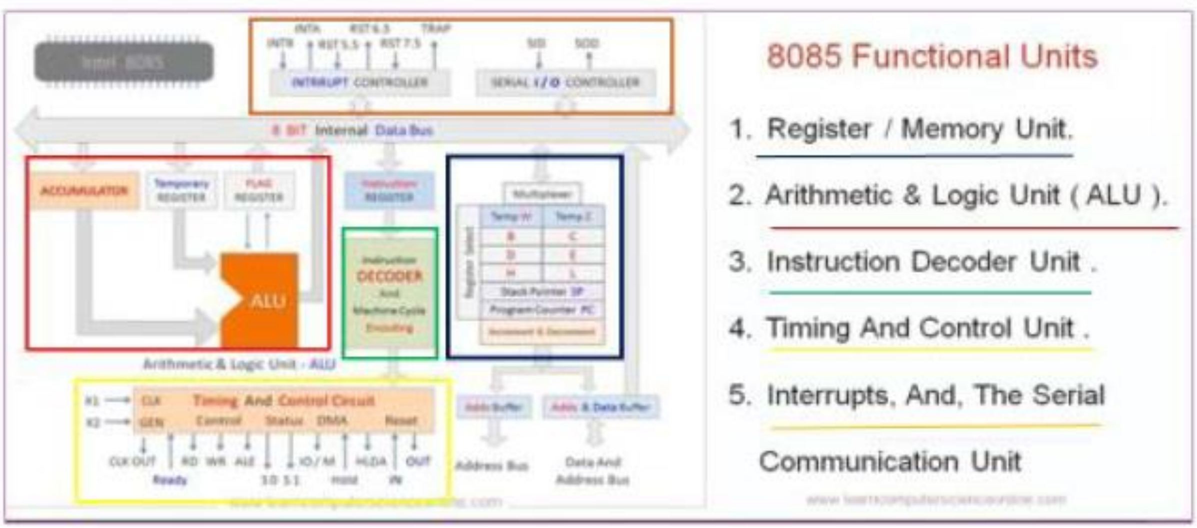
7. It consists of 74 instruction sets.

8. It performs arithmetic and logical operations.

9. It is enclosed with 40 pins.

8085 architecture





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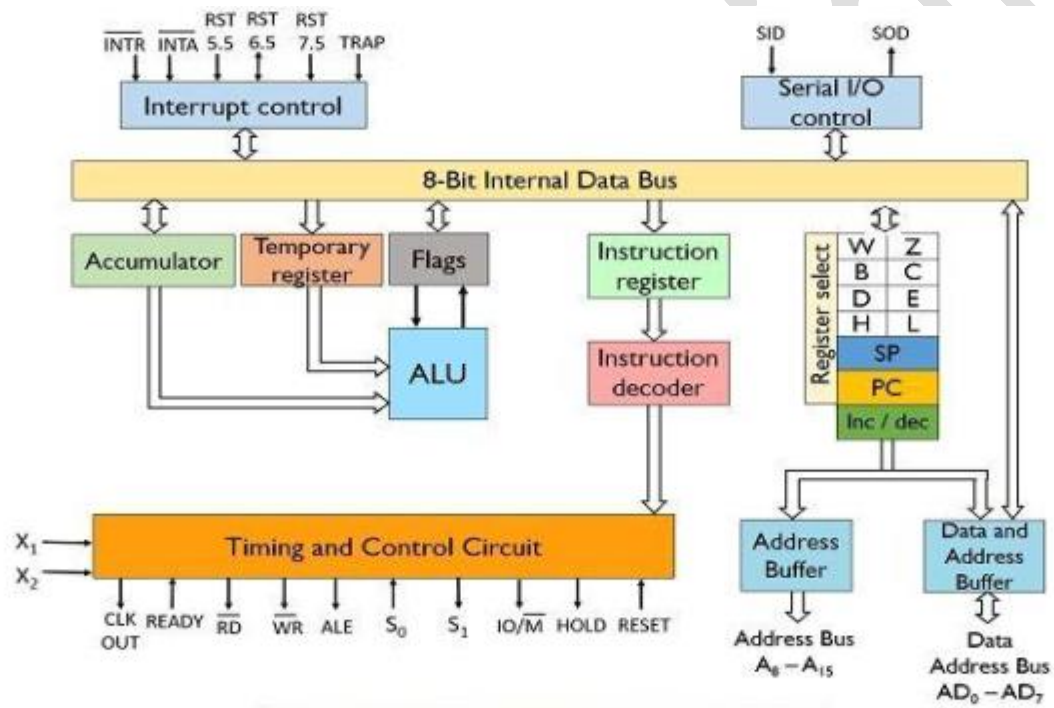
8085 architecture

In general, the microprocessor system contains from two basic parts are hardware and software. The hardware of 8085 μp included three parts are registers group, ALU and control unit:

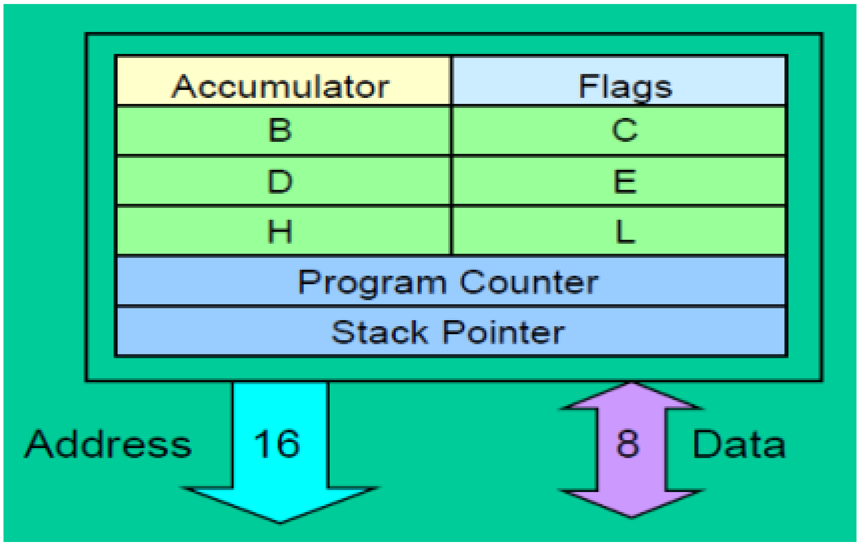


Architecture of 8085 Microprocessor

Electronics Desk

1. **Group of Registers**: there are two types of registers in 8085 microprocessor

as shown below:



a) General Purpose Register: GPRs are six (8-bit) registers used to store data temporarily during the execution of programs, these registers are (B, C, D, E, H, and L).

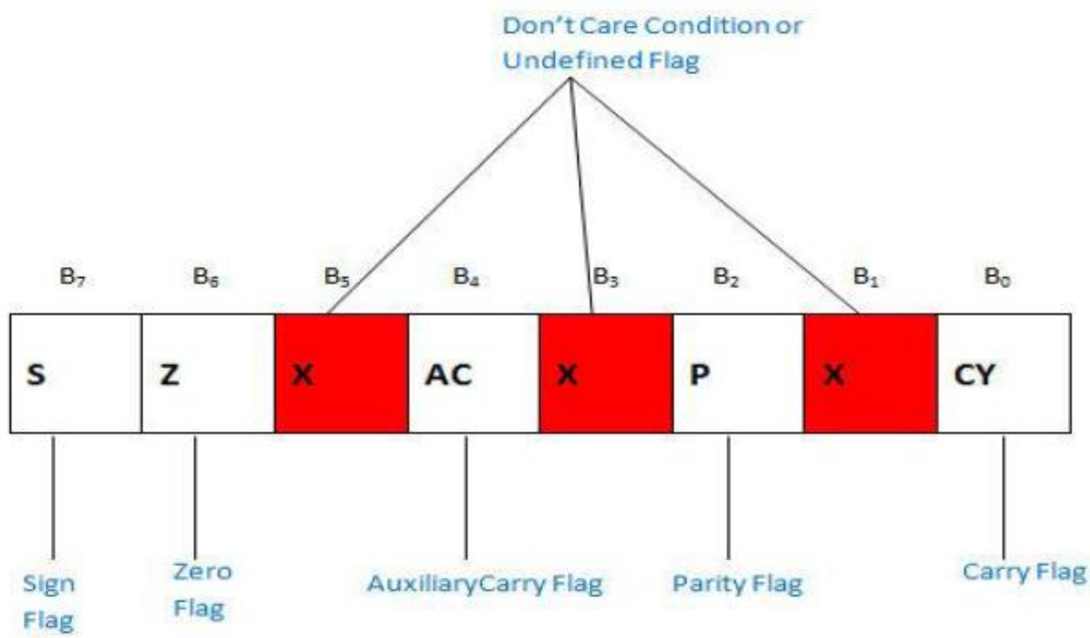
- 8-bit B and 8-bit C registers can be used as one 16-bit BC register pair. When used as a pair the C register contains low-order byte.
- 8-bit D and 8-bit E registers can be used as one 16-bit DE register pair. When used as a pair the E register contains a low-order byte.

b) Special Purpose Register: SPRs are used to achieve special task as shown

below:

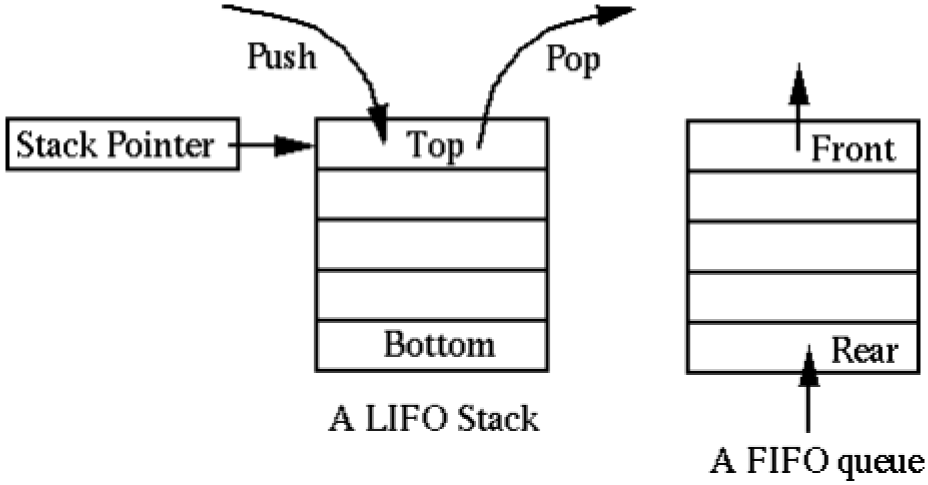
- **Accumulator(A):** Accumulator is an 8-bit register used as part of the Arithmetic/Logic unit (ALU) to perform arithmetic and logic operations and the results of these operations are stored in the accumulator.

- **Flag Register (F):** A flag register is an 8-bit register used to indicate the status of five flags after executing the arithmetic or logic operation. It consists of 5 flip flops which change their status according to the result stored in an accumulator. The distribution of flags on the flag register is shown in the figure below:



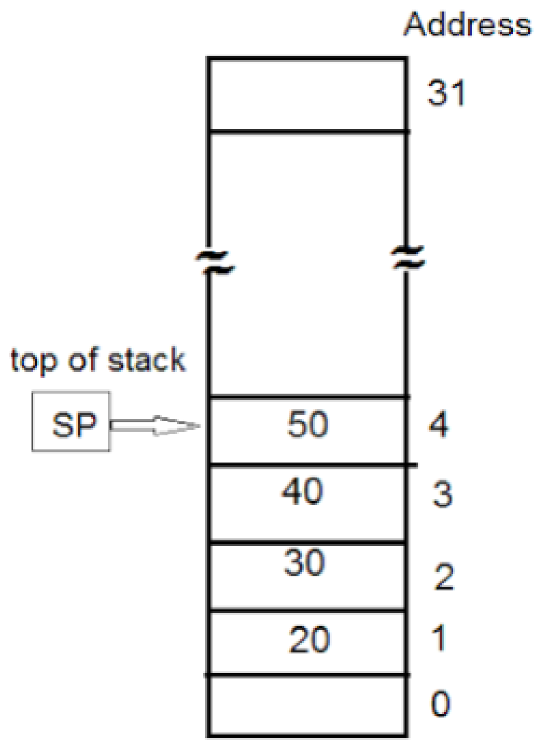
- **CY:** carry flag where is one if found carry from MSB and zero if no carry from MSB of the arithmetic or logic operation.
- **P:** parity flag where is one if the parity of result of arithmetic and logic operation is even and zero if parity of arithmetic and logic operation is odd.
- **AC:** auxiliary carry flag where is one if carry found from fourth bit F3 and zero if no carry from F3 of the arithmetic or logic operation.
- **Z:** zero flag where is one if the result of arithmetic and logic operation is zero and zero if any result found.
- **S:** sign flag where is one if the seventh bit (F7) of arithmetic and logic operation is one and zero if the seventh bit (F7) of arithmetic and logic operation is zero.

- **Stack Pointer (SP):** The stack pointer is a 16-bit register used to point to memory locations called stacks. Generally, a stack is a reserved portion of memory where information can be stored or taken back together.



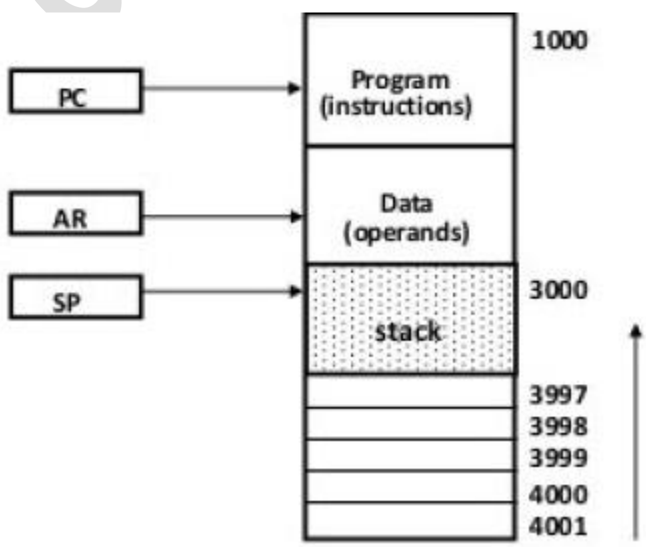
Example :

- Four elements stored in the stack.
- The data element 50 is top of the stack, therefore the content Of SP is now 4.
- The stack pointer is a 5-bit register because 2^5=32.
- Initially it is clear to 0 and stack is said to be empty.
- When a data element is pushed on the stack, SP is incremented.



- **<u>Program counter (PC):</u>** PC is 16-bit register used to stores the

  memory address of the next instruction to be executed, on the other hand, used to sequence the execution of instructions.



- **Instruction Register/Decoder**: it identifies the instructions, it takes
  the information from instruction register and decodes the instruction to be performed.

- **Temporary Register**: It is also called as operand register (8 bit).It provides operands to ALU. ALU can store immediate result in temporary register. It is not accessible by user.

- **Increment/decrement register**: This 16-bit register is used to increment or decrement the content of program counter and stack pointer register by 1.

2. **Arithmetic/Logic Unit (ALU):** this unit is part of microprocessor contain from digital circuits which used to execute the arithmetic and logic operation of data that stored in general purpose register or directly data. The result of most arithmetic and logic operation are saved in accumulator.

3. **Control Unit:** this part of microprocessor is responsible of provides the necessary timing and control signals which organize flow of data between the microprocessor and memory or peripherals devices.

4. **Interrupt control**: it controls the interrupts during a process. When a microprocessor is executing a main program and whenever an interrupt occurs, the microprocessor shifts the control from the main program to process the incoming request. After the request is completed, the control goes back to the main program.

5. **Serial Input/output control**: It controls the serial data communication by using these two instructions: SID (Serial input data) and SOD (Serial output data).

6. **Address buffer and address-data buffer**: The content stored in the stack pointer and program counter is loaded into the address buffer and address-data buffer to communicate with the CPU. The memory and I/O chips

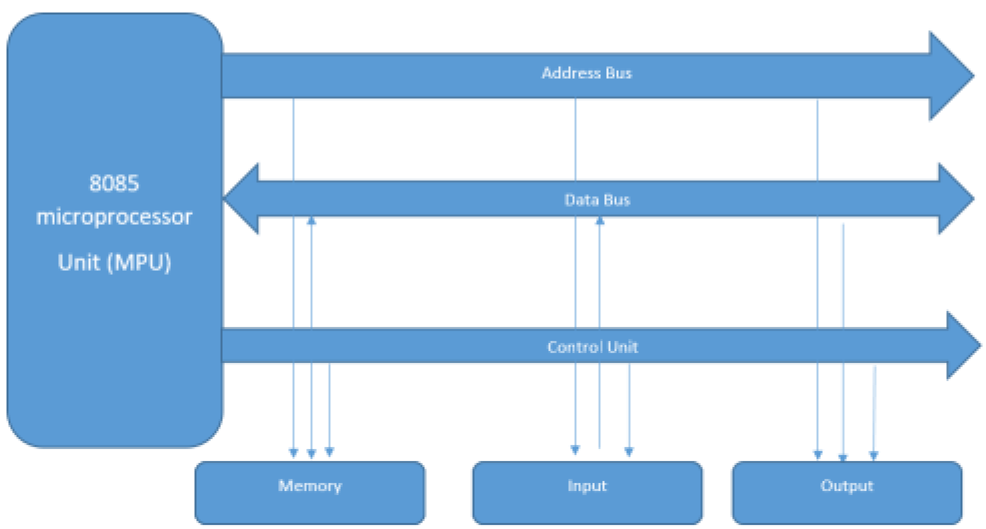
are connected to these buses; the CPU can exchange the desired data with the memory and I/O chips.

7. Bus Organization: A bus organization is a group of conducting wires which carries information, all the peripherals are connected to microprocessor through the bus. A system bus is nothing just a group of wires to carry bits.

The MPU (Micro Processing Unit) performs primarily four operations:

- Memory Read: Read data (or instructions) from memory.
- Memory Write: Write data (or instructions) into memory.
- I/O Read: Accepts data from I/P devices.
- I/O Write: Sends data to O/P devices.

The diagram to represent the bus organization of 8085 microprocessor is given below :-



Types of Bus in the microprocessor are :

1. Address bus .
2. Data bus .
3. Control bus .

Address Bus: The address bus carries information about the location of data in the memory. The addresses bus is unidirectional because of data flow in one direction, from the microprocessor to memory or from the microprocessor to input/out devices. Length of Address bus of 8085 microprocessor is 16 bit (That is, four hexadecimal digits), ranging from 0000H to FFFF H. The microprocessor 8085 can transfer maximum 16-bit address which means it

can address 65,536 different memory location i.e 64KB memory. Address Bus is used to perform the first function, identifying a peripheral or a memory location.

2. **Data Bus**: The data bus allows data to travel between the microprocessor (CPU) and memory (RAM). The data bus is bidirectional because of data flow in both directions, from the microprocessor to memory or input/output devices and from memory or input/output devices to microprocessors. Length of Data bus of 8085 microprocessor is 8 bit (that is, two hexadecimal Digits), ranging from 00H to FF H. the data bus is used to perform the second function, transferring binary information.

3. **Control Bus**: The control bus carries the control signals to control all the associated peripherals.