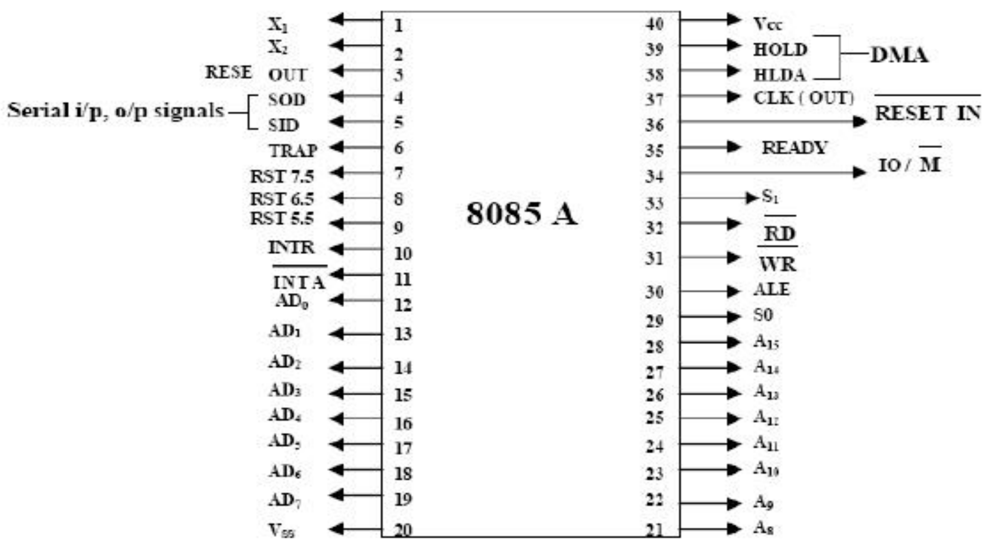
The 8085 microprocessor

· General definitions
· Overview of 8085 microprocessor

The main features of 8085 µp are:
· It is a 8 bit microprocessor.
· It is manufactured with N-MOS technology.
· It has 16-
bit address bus and hence can address up to 2^{16} = 65536 bytes (64KB) memory locations through A_0-A_{15}.
· The first 8 lines of address bus and 8 lines of data bus are multiplexed $AD_0 - AD_7$.
· Data bus is a group of 8 lines $D_0 - D_7$.
· It supports external interrupt request.
· A 16 bit program counter (PC)
· A 16 bit stack pointer (SP)
· Six 8-bit general purpose register arranged in pairs: BC, DE, HL.
· It requires a signal +5V power supply and operates at 3.2 MHZ single p
hase clock.
· It is enclosed with 40 pins DIP (Dual in line package).

Pin Diagram of the 8085 microprocessor



Pin Diagram of 8085

Memory

- Program, data and stack memories occupy the same memory space. The total addressable memory size is 64 KB.
- **Program memory** - program can be located anywhere in memory. Jump, branch and call instructions use 16-bit addresses, i.e. they can be used to jump/branch anywhere within 64 KB. All jump/branch instructions use absolute addressing.
- **Data memory** - the processor always uses 16-bit addresses so that data can be placed anywhere.
- **Stack memory** is limited only by the size of memory. Stack grows downward.
- First 64 bytes in a zero memory page should be reserved for vectors used by RST instructions.

Registers

- **Accumulator** or A register is an 8-bit register used for arithmetic, logic, I/O and load/store operations.
- **Flag Register** has five 1-bit flags.
- **Sign** - set if the most significant bit of the result is set.
- **Zero** - set if the result is zero.
- **Auxiliary carry** - set if there was a carry out from bit 3 to bit 4 of the result.
- **Parity** - set if the parity (the number of set bits in the result) is even.
- **Carry** - set if there was a carry during addition, or borrow during subtraction/comparison/rotation.

INDIVIDUAL	B, C, D, E, H, L
COMBININATON	B & C, D & E, H & L

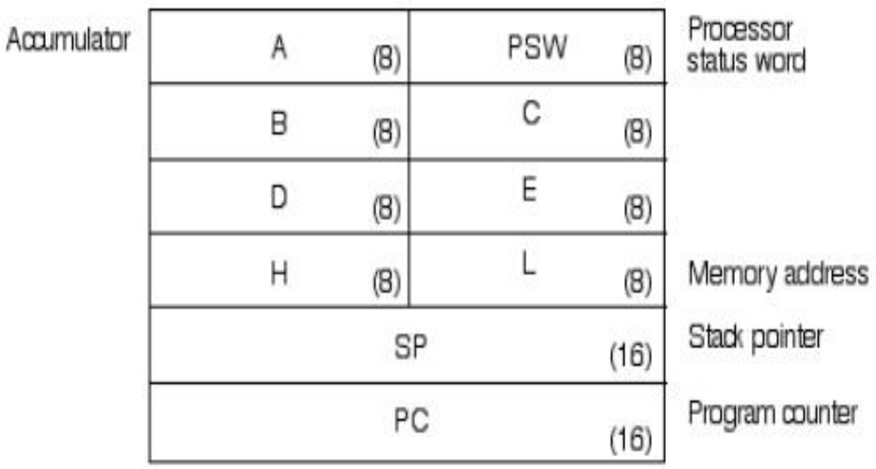
General purpose registers

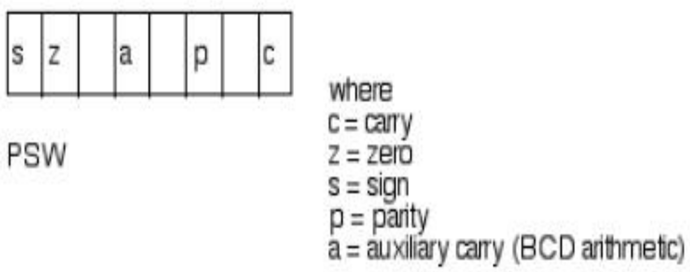
D_7	D_6	D_5	D_4	D_3	D_2	D_1	D_0
S	Z		AC		P		CY

Flag register

General Registers

- 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. Some instructions may use BC register as a data pointer.
- 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 low-order byte. Some instructions may use DE register as a data pointer.
- 8-bit H and 8-bit L registers can be used as one 16-bit HL register pair. When used as a pair the L register contains low-order byte. HL register usually contains a data pointer used to reference memory addresses.
- **Stack pointer** is a 16 bit register. This register is always decremented/incremented by 2 during push and pop.
- **Program counter** is a 16-bit register.





Instruction Types

1. Data transfer or movement

a. MOV

2. Arithmetic

3. Logical

4. Branching (Transfer of control)

5. Processor Control

8085 Addressing mode

Addressing modes are the manner of specifying effective address. 8085 Addressi ng mode
can be classified into:

Direct addressing mode: the instruction consist of three byte, byte for the opcode of
the instruction followed by two bytes represent the address of the operand

Low order bits of the address are in byte 2
High order bits of the address are in byte 3
Ex: **LDA 2000h**

This instruction load the Accumulator is loaded with the 8-bit content of memory location [2000h]

2 - Register addressing mode

The instruction specifies the register or register pair in which the data is located

Ex: **MOV A,B**

Here the content of B register is copied to the Accumulator

3 - Register indirect addressing mode

The instruction specifies a register pair which contains the memory address wher e the
data is located.

Ex. **MOV M , A**

Here the **HL** register pair is used as a pointer to memory location. The content of Accumulator is copied to that location

4- Immediate addressing mode:

The instruction contains the data itself. This is either an 8 bit quantity or 16 bit (t he LSB
first and the MSB is the second)

Ex: **MVI A , 28h**
LXI H , 2000h

First instruction loads the Accumulator with the 8-bit immediate data 28h
Second instruction loads the **HL** register pair with 16-bit immediate data 2000h

1. General Architecture of a Microcomputer System

The hardware of a microcomputer system can be divided into four functional sectio ns:
the *Input unit*,*MicroprocessingUnit*, *Memory Unit*, and *Output Unit*. See Fig. 1

•**M**icro**P**rocessor**U**nit (**MPU**) is the heart of a microcomputer. A microprocessor is a general purpose processing unit built into a single integrated circuit (IC).
The Microprocessor is the part of the microcomputer that executes instructions of the program and processes data. It is responsible for performing all arithmetic operations and making the logical decisions initiated by the computer's program.
In addition to arithmetic and logic functions, the MPU controls overall system operation.

•Input and Output units are the means by which the MPU communicates with the outside world.

○ Input unit: keyboard, mouse, scanner, etc.

○ Output unit: monitor, printer, etc.

•Memory unit:

○ Primary: is normally smaller in size and is used for temporary storage of active information. Typically ROM, RAM.

○ Secondary: is normally larger in size and used for long-term storage of information. Like Hard disk, Floppy, CD, etc.

2. Types of Microprocessors

Microprocessors generally is categorized in terms of the maximum number of bin ary bits in the data they process – that I, their word length. Over time, five standard data widths have evolved for microprocessors: 4-bit, 8-bit, 16-bit, 32-bit, 64-bit. There are so many manufacturers of Microprocessors, but only two compa nies have been produces popular microprocessors: *Intel* and *Motorola*. Table 1 lists some of types that belong to these companies (families) of microprocessors.

Table 1: Some Types of Microprocessors:

Type	Data bus width	Memory size
Intel family:		
8085	8	64K
8086	16	1M
80286	16	16M
80386EX , 80386DX	16 , 32	64M , 4G
80486DX4	32	4G + 16K cache
Pentium	64	4G + 16K cache
PentiumIII , Pentium4	64	
	64G+32K L1 cache +256 L2 cache	
Motorola family:		
6800	8	64K
68060	64	4G + 16K cache

Note that the 8086 has data bus width of 16-bit, and it is able to address 1Megabyte of memory.

It is important to note that 80286, 80386,80486, and Pentium-Pentium4 microprocessors are upward compatible with the 8086 Architecture. This mean that 8086/8088 code will run on the 80286, 80386, 80486, and Pentium Processors, but the reverse in not true if any of the new instructions are in use.

Beside to the general-purpose microprocessors, these families involve another type called special-purpose microprocessors that used in embedded control applications. This type of embedded microprocessors is called microcontroller. The 8080, 8051, 8048, 80186, 80C186XL are some examples of microcontroller.

3. Number Systems

For Microprocessors, information such as instruction, data and addresses are described with numbers. The types of numbers are not normally the decimal numbers we are
familiar with; instead, binary and hexadecimal numbers are used. Table 2 shows Binary
and Hexadecimal representations for some decimal numbers.

Table 1: Binary, and Hexadecimal representation of some numbers:

Decimal	Binary	Hexadecimal
0	0	0
1	1	1
2	10	2
3	11	3
4	100	4
5	101	5
6	110	6
7	111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

Example 1: Evaluate the decimal equivalent of binary number 101.01_2

Solution:

$101.01_2 = 1(2^2) + 0(2^1) + 1(2^0) + 0(2^{-1}) + 1(2^{-2})$

$= 1(4) + 0(2) + 1(1) + 0(0.5) + 1(0.25)$

$= 4 + 0 + 1 + 0 + 0.25$

$= 5.25$

Example2: Evaluate the binary representation of decimal number 8.875

Solution:

Integer			
8	/2=	0	(LSB)
4	/2=	0	
2	/2=	0	
1	/2=	1	(MSB)
0	/2=	0	
0	/2=	0	

Fraction			
0.875	x2=	1	(MSB)
0.75	x2=	1	
0.5	x2=	1	(LSB)
0	x2=	0	
0	x2=	0	
0	x2=	0	

1000 **.111**

1000.111

Generally, Binary numbers are expressed in fixed length either:

8-bit called Byte

16-bit called Word

32-bit called Double Word

Example3: Evaluate the 16-bit binary representation of decimal number10210, then
evaluate its hexadecimal representation

Solution:

10710 = 011010112 = 6BH