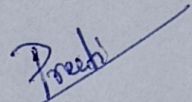


SUBJECT- DE&MP

BRANCH- ELECTRICAL

SEMESTER- 5TH SEM

PREPARED BY- PREETINANDA MISRA


Lect.(Electrical)

introduction

MICROPROCESSOR

It can be defined as that a semi-conductor device consisting of an electronic ckt manufactured by VLSI technology.

It is a combination of two words i.e. (Micro + processor). Micro means very small and processor means to perform or execute.

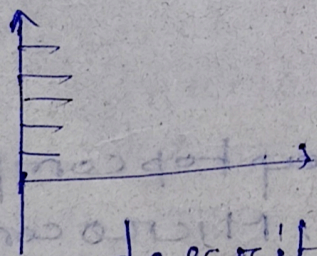
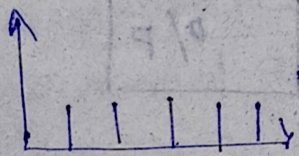
It is the one of the most important component of the digital computer.

It is the brain of the digital computer.

Computer

Digital computer

It processes the digital data (no.s)

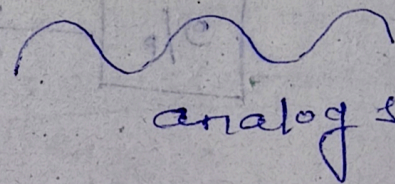


describer digital signal

uses discrete signal for its operation

Analog computer

It processes the analog data (signal)



analog signal

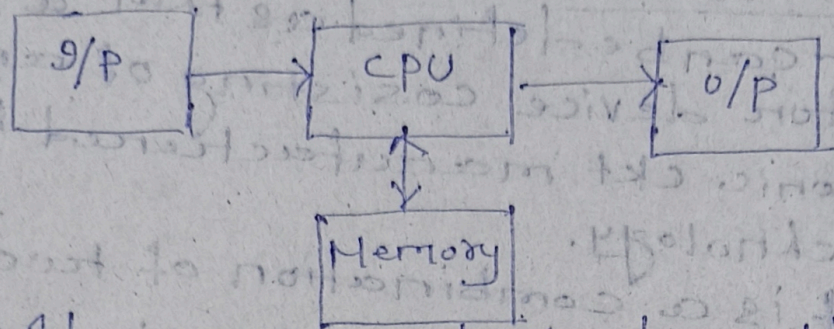
[It use data in continuously form, not discrete]

Now days computers are digital computer

Analog computers are based for some specific scientific & engineering purposes

Eg - Astrolabe (stars & planet)
- Speedometer
- Operational Amplifiers (OpAmp)

Schematic diagram of digital computer



CPU - It executes the instruction.

Memory - It is a storage device.

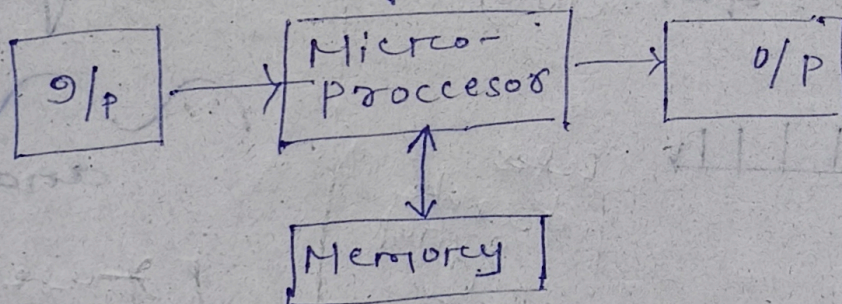
I/P - It gives the I/P to CPU.

O/P - It takes the O/P from CPU.

The CPU will be built on a single IC is called Microprocessor.

A digital computer in which one microprocessor has been provided to act as a CPU is known as Microcomputer.

Schematic diagram of Microcomputer



Ex - Desktop computer, Laptop computer, palm computer, mobile, Microcomputer act as a CPU.
CPU of large powerful computer contains more than one microprocessor.

Ex - server, mainframe computer, supercomputer, high power computer.

This are operated in parallel to each other i.e. it uses parallel processing and hence this are called Multiprocessor system.

GENERATION OF COMPUTER

1st Generation - (1940-55)

- first generation computers were marked by use of vacuum tubes.
- electrostatic tubes or mercury delay lines were used for storage.
- programs were written in machine level language.
- ENIAC, EDVAC, UNIVAC were some popular computers.
- These computers suffers from the drawbacks like large size, low speed, heavy heat generation, higher rate of failures, Air conditioning, high power consumption.

2nd generation (1956-63)

- second generation computers were marked by use of transistors in place of vacuum tube.
- magnetic disk, magnetic core were used for storage.
- programs were written in high level language like FORTRAN, COBOL, ALGOL etc.
- IBM-1400, IBM-7000, CDC-1604, etc were some popular computers.
- use of transistor reduces the size and cost. It also requires less power and less heat is generated, Reliability is also high.

3rd generation (1964-71)

- Third generation computers were made by use of integrated circuit (IC).
- An IC is a chip containing a no. of registers, transistors and capacitors.
- semiconductor memory is used.
- In addition to higher version of FORTRAN & COBOL new languages like BASIC, PASCAL, PLI were used.
- size becomes still smaller and speed becomes faster, so also less expensive.

Ex - IBN-360, ICL-1900,

Honeywell-6000

4th generation (1972-1991)

- These computers were marked by use of LST and VLSI techniques & also microprocessor.
- Other developments in the field of IC technology, LST & VLSI technology came into being. Development of microprocessor also took place.
- Floppy disks, optical disks are used in these computers.
- High level languages like C, C++, Java were used.
- These are charact by smaller size, lower cost, faster speed & higher reliability, user friendly software were also used in these computers.

- 5th generation (1990 onwards)
- The 5th generation computers are ~~under development~~ ^{ULSI} now in trend. They are
 - these computers are characterised by extensive use of parallel processing, Robotics, and presence of Artificial Intelligence.
 - capability & power wise it will be very much effective.
 - It will have special features for MLP and image processing.

GENERATION OF MICROPROCESSOR

1st evaluation (1971) 73

- The first microprocessor is INTEL 4004
- It is a 4 bit p-mos microprocessor.
- Memory addressable capacity - 1K V
- clock frequency = 750 KHz
- No. of pin - 16

clock frequency

It is defined as the no. of instructions that a processor can execute in 1 sec.

- Examples of 4 bit microprocessor are Rockwell International's PPS-4, Toshiba's T3472.

Applications of 4 bit up. are

It is used in industrial control Application, calculator, video game, instrumentation.

2nd evaluation (1974-78)

- The first 8 bit is Intel 8008. The 2nd evaluation of 8008 is Intel 4040.
- It is evaluated in the year 1972. It is a 8 bit p-mos microprocessor.
- which is not compatible to TTL.

→ In the year 1973, a 8 bit μP is evaluate i.e Intel 8080, which is a H-MOS microprocessor & it is compatible with TTL.

→ Drawback
It needs three power supply.

→ In the year 1975, a 8 bit μP is evaluate i.e Intel 8085, which is a H-MOS microprocessor & it is compatible to TTL.

→ The main Advantages of this μP is
It needs only one power supply
i.e. +5V d.c.

→ Examples of Intel 8085 μP are

~~Z80~~ ZILON'S → Z80, Z800

National 8085 → 8085

MOTOROLA → MC6800, MC6809

Rockwell → TPS-8

Applications

It is used in Industrial control application, calculator etc.

→ Memory addressable capacity - 64

→ clock frequency → 1 MHz - 6 MHz

→ No. of pin → 40

3rd evaluation (1979-80)

→ In 1978 a 16 bit μP is evaluate

i.e Intel 8086, which is uses a H-MOS technology.

→ Ex - Intel 8088, Intel 80286
Intel 80186
Intel 80188

ZILONG $\rightarrow$ Z8000

MOTOROLA $\rightarrow$ MC68000

$\rightarrow$ Intel 80186, Intel 80188 are

Integrated Microprocessor.

Besides CPU, it contains some additional components i.e. programmable interrupt controller (PIC) or peripheral interrupt controller.

$\rightarrow$ No independent high speed DMA i.e. direct memory accesses is used.

$\rightarrow$ Three programmable timer or counter, clock generator, programmable memory, peripheral chip select logic, programmable weight state generator, local bus controller.

$\rightarrow$ Intel 80288, besides CPU, it contains

integrated memory management unit, 4 level of memory protection.

$\Rightarrow$ It supports virtual memory & operate

$\rightarrow$ They use VLSI technology.

$\rightarrow$ Direct memory capacity $\rightarrow$ 1MB-16MB

$\rightarrow$ clock frequency $\rightarrow$ 6-12.5 MHz

$\rightarrow$ No. of pin - 68

uses - Complex industrial control application, general purpose, portable computer

4th Evaluation (1981-95)

→ After 1980, introduction of 32 bit μ P.

→ The 1st 32 bit μ P is iAPX-432.

→ But this is not popular due to

it is virtually disconnected

→ Hence, in the year 1985, the

Intel introduce very more powerful microprocessor i.e.

Intel-80386

→ It is widely used in desktop computer

→ memory addressable capacity -

→ clock frequency → 20 MHz - some G

→ No. of pin - 132 to above.

⇒ ~~other~~ examples are

Pentium pro

Pentium 2

Pentium 3

Pentium 4

for server

quad core processor

ELBRON etc

5th evaluation (1995-till date)

→ The introduction of 64 bit μ P i.e.

ITANIUM, HP1200, HP8200,

HP8500, PA8000 series etc

→ clock frequency → 733 MHz - 1.5 GHz

→ memory addressable capacity - more than 64 kb.

PIPE LINING

When a CPU contains more than one functional unit and each functional unit performs a part of task independently, is known as pipelining.

MULTI PROCESSOR SYSTEM

When a CPU contains more than one functional unit, this is called multi processor system.

MULTI PROGRAMING

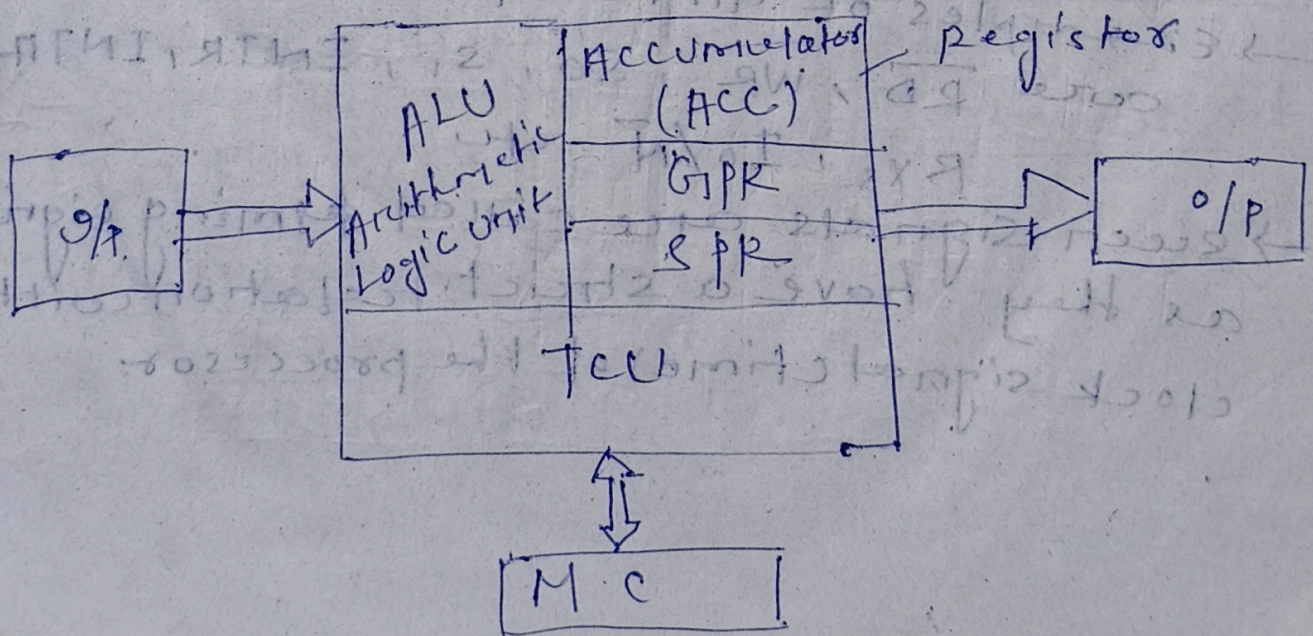
When a computer conduct more than one program simultaneously with a fraction of second.

MULTIUSER SYSTEM

In this system more than one user work on the different terminal of the computer simultaneously is called multiuser system.

ex - the computer 20 milli second to first user then to second & then to back).

(2) - ARCHITECTURE / BLOCK DIAGRAM



ALU (Arithmetic Logic Unit)

- It performs Arithmetic & Logical operation.
- Arithmetic operations are addition, subtraction, multiplication & division.
- The logical operations are complement of a no., compare two numbers, rotate bits from left to right, shift the bit from left to right, increment, decrement etc.
- ALU of simple 8085 microprocessor such as intel 8085 up and operate others doesn't have multiplication & operate others i.e. addition, subtraction & division.

TU (Timing and Control Unit)

- It is the brain of the computer.
- It controls all the operations of the CPU.
- It also controls I/O devices, O/P devices, all other devices connected to the CPU.
- It generates signal which are required for all the operations to be performed by the CPU & other I/O/O/P devices.
- Examples of different control devices are $\overline{RD}$, $\overline{WR}$, S_0 , S_1 , $INTR$, $INTA$, R_{Xs} , $I_0/\overline{M}$ etc.
- Such signals are called timing signal as they have a strict relation with clock signal (time) of the processor.

Register

It includes

- Accumulator
- General purpose register
- Special purpose register

Accumulator

- It contains one or more operations of the instruction to be executed and also store the final result.

After the execution of an arithmetic & logic instruction

$$C = a + b$$

↓
Operator Operant

(operation)

Ex

$$2 + 3 = 5$$

Accumulator ← 2 ✓ Final result

↓ Add

GPR ← 3 B

GPR (General purpose register)

- These are used to store the data and store the intermediate result while executing program.

→ Ex - B, C, D, E, H, L

pairs →

BC, DE, HL

$$(a + b) * (c + d)$$

↓
[accumulator] [acc]

↓
[E] ←

SPR (Special purpose Register)

→ SPR are used by the μp itself.

→ They are not accessible to user.

Ex - program counter, stack pointer, instruction register, ^{16 bit} ~~stack~~ register, data pointer, index register, timer mode register, timer selector.

BUSES

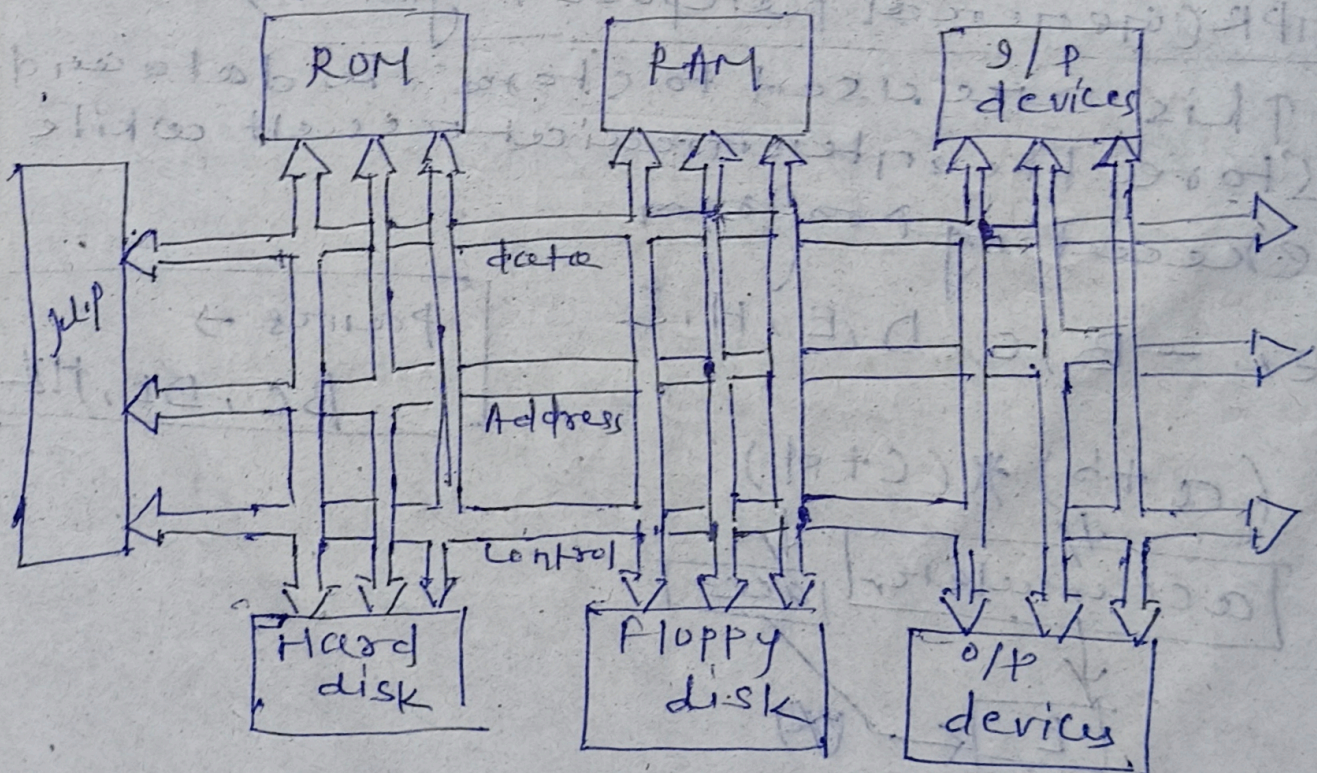
→ Various μp & μp memory devices are connected to the μp by a group of lines called buses.

→ It is 3 types

(1) Address Bus (unidirectional)

(2) Data Bus (bidirectional)

(3) Control Bus (bidirectional)



(1) Address BUS

- It carries addresses of memory locations or I/O devices that the CPU wants to access.
- when an address is sent by the CPU, I/O devices connected to the CPU through address bus, receives this address only that device response which will chip enable signal from CPU.
- The Address bus is unidirectional. In short it is called A-Bus.

(2) DATA BUS

- The data Bus is used to transform the data between the CPU, memory & I/O devices.
- It is bidirectional.
- In short, it is called D-Bus.

(3) Control BUS

- It is used to carry the access or control signal between CPU, memory & I/O devices.
- It is bidirectional.
- In short, it is called C-Bus.

Ex. $\overline{RD}$, $\overline{WR}$, $\overline{M}$ etc

→ The width of data bus is same as the word length of the CPU

Example - an 8-bit microprocessor has 8-bit data bus, a 16-bit μp has 16-bit data bus

→ The width of address bus is decided by the designed memory addressing capacity of the μ pu.

Example - Intel 8085, an 8-bit μ pu, has 16-bit ~~μ pu~~ address bus which gives $2^{16} = 64\text{K}$ bytes.

Memory addressing capacity,

Similarly, Intel 8086, a 16-bit microprocessor has 20-bit address bus which gives $2^{20} = 1\text{M}$ bytes memory addressing capacity.

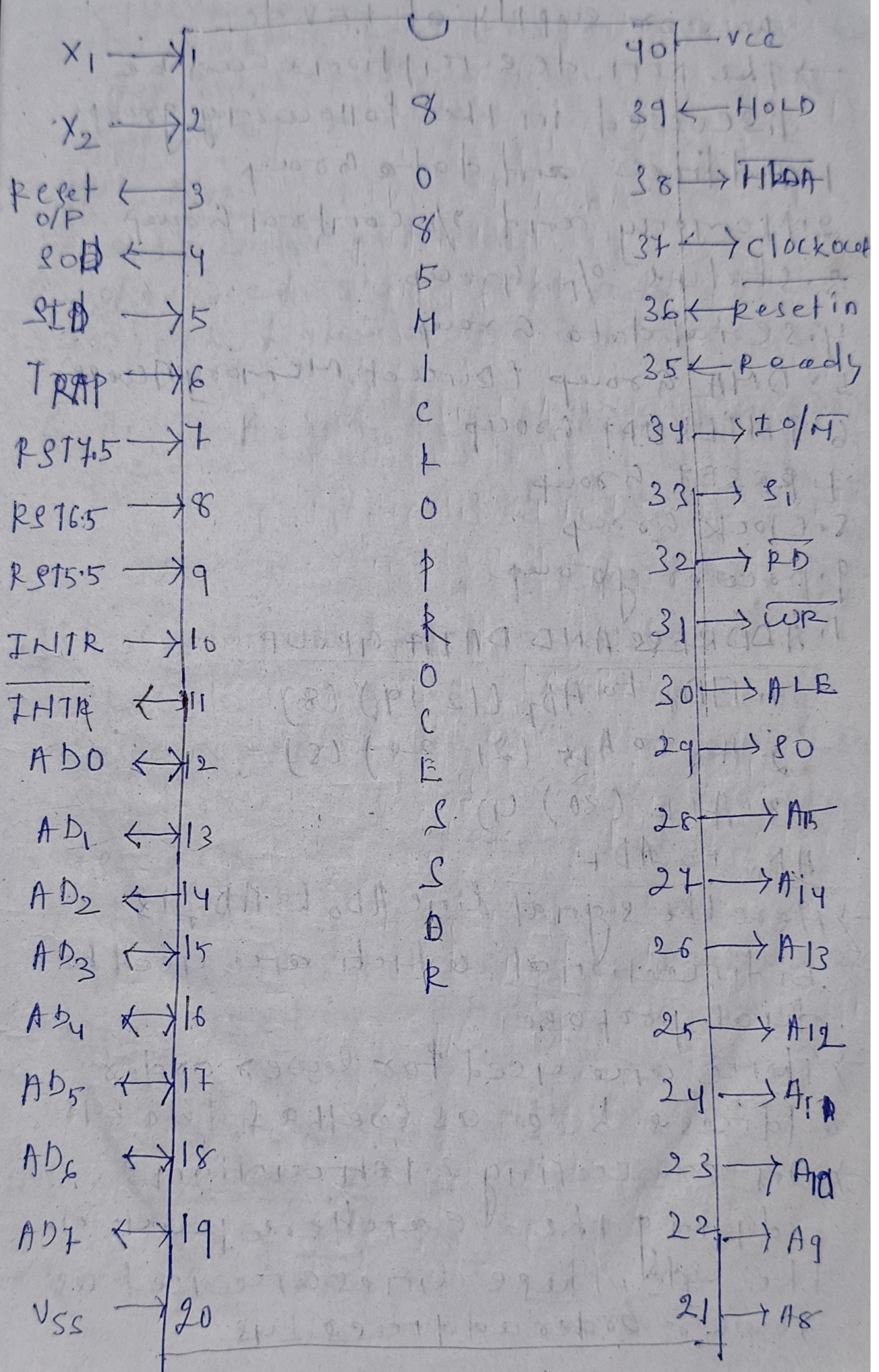
A group of 8-bits is called a byte.

MICROPROCESSOR ADDRESSING CAPACITY

NUMBER OF ADDRESS LINES	MEMORY ADDRESSING CAPACITY
4	→ 16 bytes
8	→ 256 bytes
16	→ 64 Kbytes
20	→ 1M bytes
24	→ 16M bytes
32	→ 4G bytes
64	→ 2^{24} terabytes

where 1 tera = 2^{40}

STRUCTURE OF INTEL 8085 PIN



→ Intel 8085 μ p has 40 pins V_{CC} as

power supply at +5V dc.

→ The pin descriptions can be discussed in the following groups.

1. Address and data group
2. Memory and I/O control group
3. Status I/O group
4. Serial data group
5. DMA group (Direct Memory Access)
6. INTERRUPT group
7. RESET group
8. Clock group
9. power group.

1. ADDRESS AND DATA GROUP

1. AD_0 to AD_7 (12-19) (8)

2. A_8 to A_{15} (21-28) (8)

3. ALE (30) (1)

AD_0 to AD_7

→ Here the signal line AD_0 to AD_7 is bidirectional which are used to dual purpose.

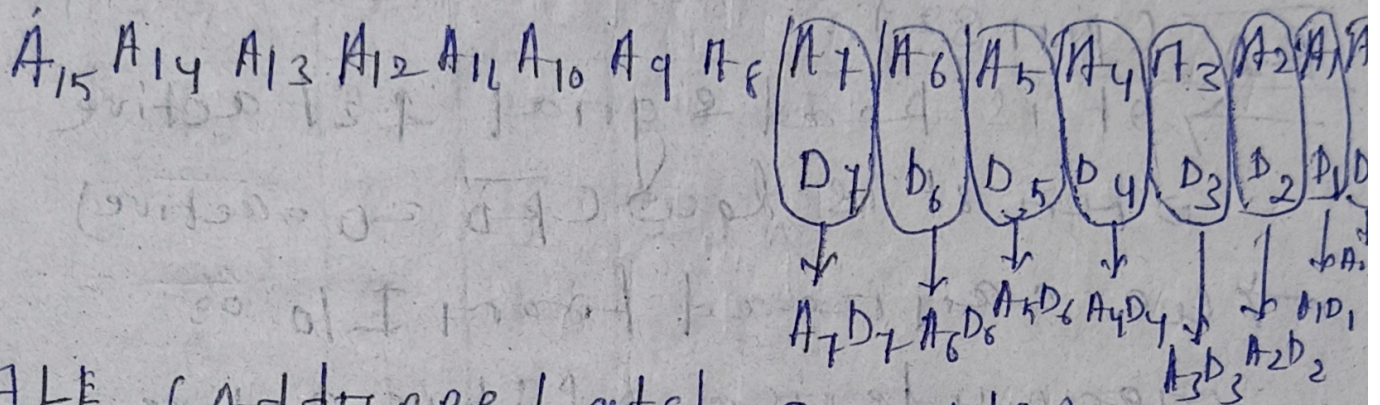
→ They are used for lower order address bus as well as data bus.

→ In executing instructions during the earliest part of the cycle, these lines are used as lower order address bus.

buses.
→ However the lower order addresses can be separated from the signal by using a latch.

A₈ to A₁₅

- It is unidirectional
- It is used only for the address bus.
- It is the higher order address bus.



ALE (Address Latch Enable)

- This pin is used to demultiplexing separate the A₁₅ to A₈ from A₇ to A₀. The process of separation of address is called as address latching.
- This is highly essential because the data address are multiplexed.
- It is used to latch the lower order address (during first clock of the machine cycle) with the data.

MEMORY AND IO CONTROL GROUP

Here 3 pins are used
IO/ $\overline{M}$, RD, WR

I/O/M (Pin-34)

→ It indicate the operation of Microprocessor either with I/O or I/P devices or with memory.

→ If $\overline{IO/\overline{M}} = 1$ or high, it indicates I/P, O/P operation & if $\overline{IO/\overline{M}} = 0$ or low, it indicates Memory operation.

$\overline{RD}$ (Pin-32)

→ It is Read signal & it active when it is low ($\overline{RD} = 0$ = active)

→ we can read from I/O or memory device if it is active.

$\overline{WR}$ (Pin-31)

→ It is write signal & it active when it is low ($\overline{WR} = 0$ = active)

→ we can write to I/O operation device if it is active.

* STATUS GROUP

→ It include 2 pins $\overline{S_0}$ & $\overline{S_1}$, (29) (33)

→ By this pin we can know the different status of read & write operation

INTEL 8085 microprocessor

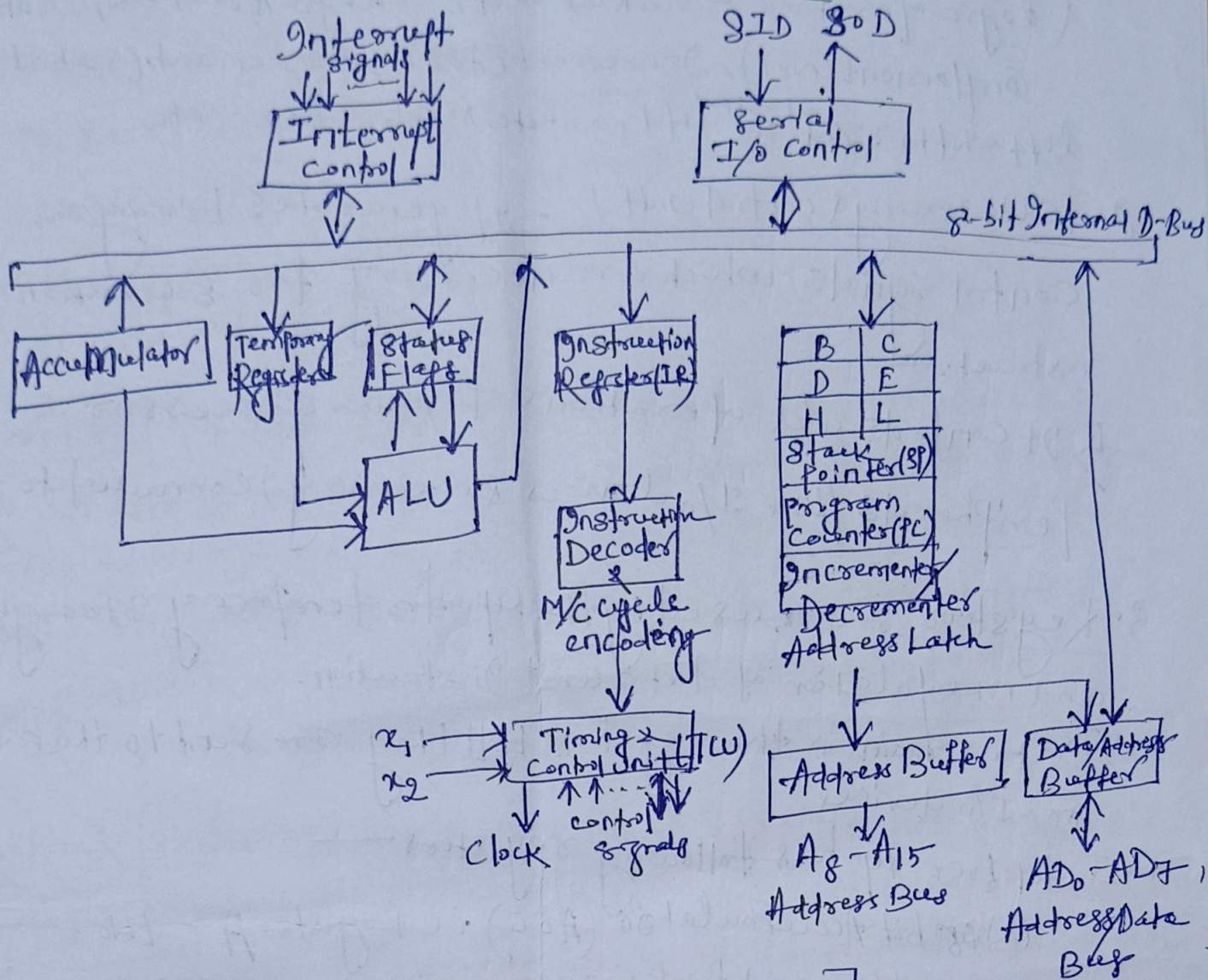


Fig [Block Diagram of Intel 8085]

- Intel 8085 is an 8-bit, NMOS MP.
- It is a 40 pin IC
- It uses a single $\pm 5V$ DC supply for its operation
- Its clock speed is about 3MHz.
- Its clock cycle is of 320 nsec.
- It has 80 Basic Instructions & 246 opcodes.
- It consists of 3 main sections
 - ALU
 - TCU
 - Set of Registers.

1. ALU (Arithmetic & Logic Unit) - performs following Arithmetic & Logic operations - such as $+$, $-$, Logic AND , OR , EXOR , Complement (NOT) , Increment (Add 1) , $\text{decrement (Subtract 1)}$, left shift , right shift , rotate left , rotate right , Clear etc

2. TCU (Timing & Control Unit) - It generates Timing & Control signals which are necessary for execution of instructions.

↳ It controls all operations of microprocessor & Peripherals (like I/O devices & memory) connected to it

3. Registers :- are used by the μp for temporary storage and manipulation of data and instruction.

↳ Data remain in the registers till they are sent to the memory & I/O devices.

↳ Intel 8085 μp has following registers -

(a) 8-bit Accumulator (ACC) i.e. Register A - 1 No.

(b) 8-bit general purpose registers (GPR) i.e. B, C, D, E, H & L - 6 No.

(c) 16-bit Stack Pointer (SP) - 1 No.

(d) 16-bit Program Counter (PC) - 1 No.

(e) Instruction register

(f) Temporary registers

(g) Set of five flip flops which serve as flags (i.e. status flags)

- Carry flag (CS)

- Parity flag (P)

- Auxiliary carry flag (AC)

- Zero flag (Z)

- Sign flag

3(a) Accumulator (Acc) (^{7th} Register A) → It is a 8-bit register
↳ It is used to hold one of the operands of an arithmetic/logic operation

↳ It serves as one input to the ALU
↳ It also stores the final result of Arithmetic/Logic operation
↳ Other operand may be stored either in memory or in one of GPR.

3(b) GPR - It has ~~8~~ 8-bit GPRs (i.e. B, C, D, E, H & L)
↳ To hold 16-bit data, a combination of two 8-bit registers can be employed, i.e. known as a "Register-pair".

↳ The valid register pairs are - B-C, D-E & H-L

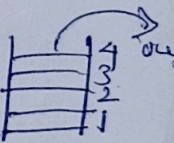
↳ The H-L pair is used to act as memory pointer
↳ For this purpose it holds 16-bit address of memory location

3(c) Stack Pointer (SP) - It is a 16-bit special function register

↳ Stack is a sequence of memory locations set aside by a programmer to store/retrieve the contents of Accumulator, Flags, Program Counter and GPRs during the execution of a program.

↳ Any portion of the memory can be used as stack.

↳ Stack works on LIFO (Last-in first-out) principle.



So, its operation is faster than normal store/retrieve of memory location.

↳ Sometimes, it saves the contents of ^{some registers} other registers, which are needed for subsequent steps of program & after completion of these operations, the contents are again brought back to that register.

↳ Stack Pointer (SP) - controls addressing of the stack which needs stack operations.
↳ ~~SP holds address of~~

3(d) Program Counter (PC) - It is a 16-bit 8PR.

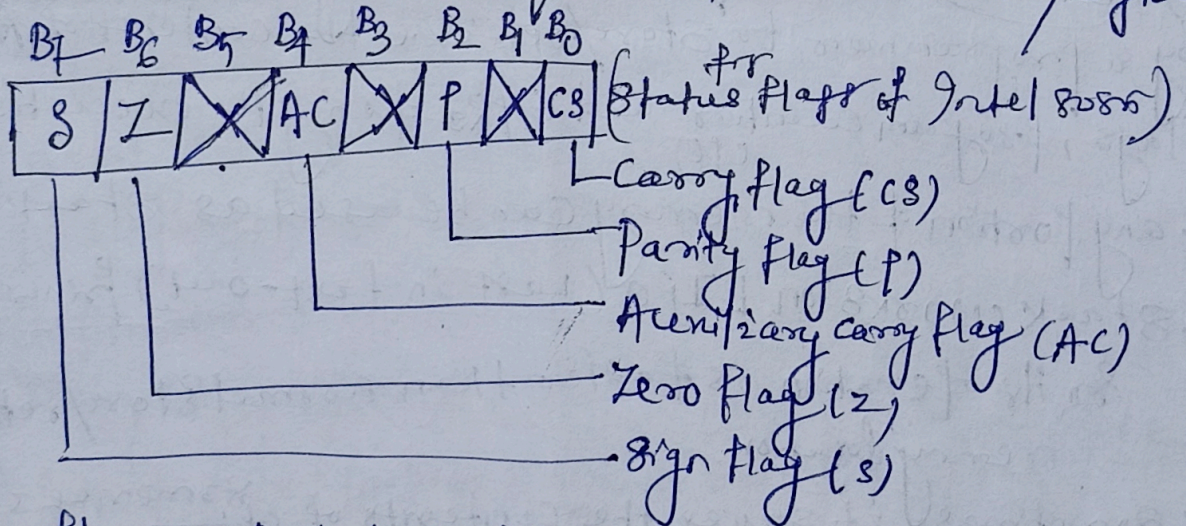
↳ It is used to hold memory address of next instruction to be executed.

↳ It keeps track of memory addresses of the instruction in a program while they are being executed.

3(e) Instruction Register - holds the opcode (Operation Code or Instruction code) of the instruction which is being decoded & executed.

3(f) Temporary Register - It is a 8-bit register associated with ALU. It holds data during an arithmetic/logic operation. It is used by μp itself & not accessible to programmer.

3(g) Flags - contains 5 flip-flops to set/reset ^(i.e.) ^(i.e. 0) according to conditions required for arithmetic/logic operation.



• Sign flag = Set to 1, if result of an Arithmetic/logical operation is negative. [Most Significant Bit (MSB) → Leftmost Value of 8-bit]

Sign flag = Set to 0, if result is positive. (MSB = 0)

• Zero flag (Z) = set to 1, if result of Arith/logic operation is 0 (Zero).

= set to 0, if result is not zero.

• Auxiliary carry flag (AC) - It holds carry out of B_3 to B_4 resulting from execution of an arithmetic operation. If carry generated, AC set to 1, otherwise set to 0.

• Parity flag (P) = set to 1, if the result of Arith/logical ops contains Even No. of 1s.
= set to 0, (reset), if result contains odd no. of 1s.

• Carry flag (CS) - set to 1, if carry is produced from ^{Execution} Arithmetic.
- set to 0, otherwise.

→ CS is set or reset in case of addition as well as subtraction.

→ In case of 2 8 bit no.'s addition - if sum is larger than 8 bits, a carry produced, CS set to 1.

→ In case of 2 8 bit no.'s subtraction - if borrow occurs, CS set to 1.

PSW (Program Status word) - is the combination of 5 status flag & 3 undefined bits.

Addition of Two 8-bit No's, sum = 8 bits

Q) Add 49H & 56H

DATA 2501 = 49H
2502 = 56H

Result 2503 = 9FH

1st No. in H-L pair

9000 21 LXI H, 2501

9001 01

9002 25

9003 7EH MOV A, M

1st No. in Accumulator

9004 23 INX H

Increment content of H-L pair

9005 86 ADD M

Add 1st & 2nd No.

9006 32 STA 2503

Store sum in 2503

9007 03

9008 25

9009 76 HLT

stop

8-bit Subtraction

Q) 49H - 32H

DATA 2501 = 49H
DATA 2502 = 32H
Result 2503 = 17H

9000 21 LXI H, 2501 — 2501

9001 01

9002 25

9003 7EH MOV A, M

9004 23 INX H — 2502

9005 96 SUB M

9006 23 INX H — 2503

9007 7FH MOV A, A

9008 76 HLT

4. Move the content of the memory location FC50 H to register C. The content of the memory location FC50 H is 08.

9000	21	LXI	H, FC50
9001	50		
9002	FC		
9003	4E	MOV	C, M
9004	76	HLT	

5. Place the content of memory location FC50 H in Register B and that of FC51 H in Register C. The content of FC50 & FC51 H are 11 H and 12 H respectively.

9000	21	LXI	H, FC50
9001	50		
9002	FC		
9003	46	MOV	B, M
9004	23	INX	H
9005	4E	MOV	C, M
9006	76	HLT	

(Increment H-L Pair by one)