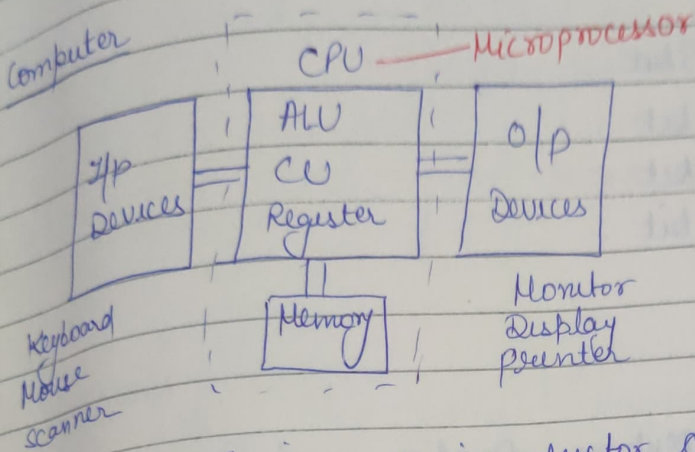
Microprocessor

Previous processors → mechanical, electrical, electronics - vacuum diodes

1947 - Transistor (William Shockley, John Bardeen, Walter Brattain)

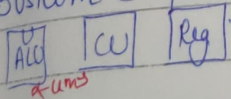
Microprocessor — VLSI >1K transistors.



Microprocessor It is a semiconductor component designed by using VLSI technology & includes ALU, CU & registers of a CPU in a single package.

Intel (DRAM) → 1st processor on single chip

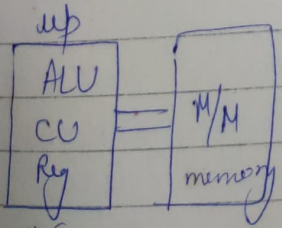
Busicom (Japan)



Distance b/w the components is cm, f = MHz, T = μsec

∴ The name microprocessor

Note for a μprocessor, memory is connected externally



1971 → Intel 4004 → 4bit Imp ← PSU

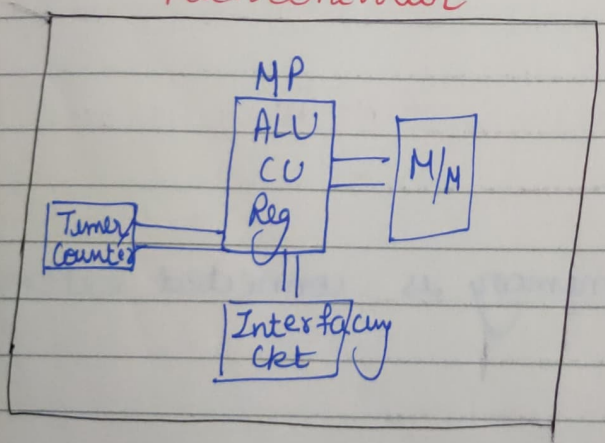
Gate, IES, PSU's → 8085 ✓ Imp
IES → 8086

Bit → Binary digit
→ 0/1
Nibble → 4bits
Bytes → 8bits
Wordlength → depends on type of processor
(How many bits a processor can process at a time)

1972 → Intel 8008 → 8bit
1974 → Intel 8080 → 8 bit
1977 → Intel 8085 → 8bit ✓
1978 → Intel 8086 → 16 bit ✓
Intel 8088
" 80186
⋮
" 386, 486, pentium, Dual core, i3, i7 (64 bit)
Nowadays
Now a days 64bit processor

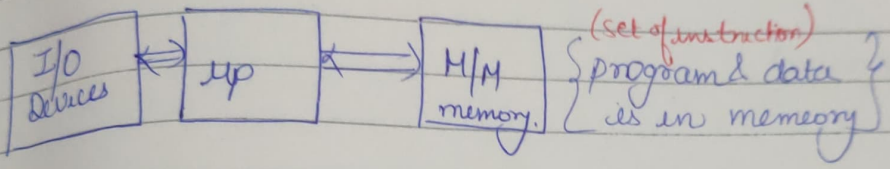
Wordlength
eg. 16bit processing - 2Bytes
32 " " → 4Bytes
64 " " → 8 Bytes.

Microcontroller



5 Machine cycles

µp	µC
1] contains ALU, CU & register	1] Contains ALU, CU & Reg.
2] No internal memory and timer/counters	2] Contains internal memory, Timer/Counters
3] No interfacing circuit	3] Contains interfacing circuit
4] Used for general purpose application	4] Used for special purpose of application
5] eg Intel 8085, Intel 8086 MC 280, Z 80, Pentium, i3, i7 (Zilog)	5] eg. Intel 8051, PIC → 8 bit / 16 bit TMS1000.



Opcode → Operation code (memory)

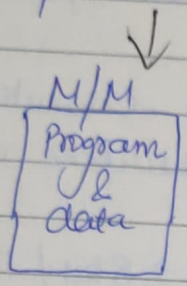
Basic operation of a Processor

1] Opcode fetch
2] Memory Read
3] Memory write
4] I/O read
5] I/O write

1] Opcode fetch (operation code) — Reading or accessing instruction (Opcode or from the memory into the µ processor.
2] Memory Read — Reading or accessing data from the memory
3] Memory write — Sending or Transferring data to memory
4] I/O Read — Reading or accessing data from i/p device or input port.
5] I/O write — Transferring data to o/p device or port.

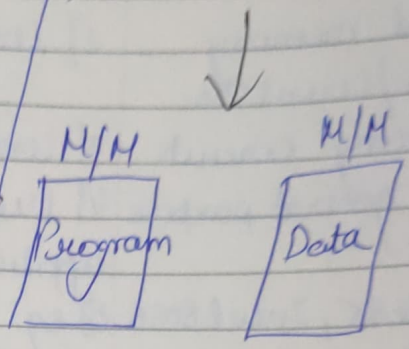
Depending upon how program or data is stored in the memory, there are two types of architecture

1] Von- Neumann Architecture (princeton architecture)



eg. Intel 8085
Intel 8086

2) Harvard architecture



eg: Microcontroller - Intel 8051 etc.

8085 (8 bit processor)

1] System Bus
2] Internal Architecture
3] Pin Description / Layout
4] Functional Description
5] Programming Model
6] Instruction format
7] Addressing Modes
8] Instruction set classification
9] Simple Programs
10] Interfacing

Number Systems

Decimal	Octal	Binary	Hexadecimal	Decimal
0	0	0	0	0
1	1	1	1	1
9	7	10 → (2)10	9	9
10	10 → (2)10		A	10
			B	11
			C	12
			D	13
			E	14
			F	15
			10H	16

H.D	Decimal
10H	16
11H	17
12H	18
13H	19
14H	20

Decimal

```
  9        9
 +8       +6
 17       15
```

Hexadecimal

```
  F       FF H
 +8       78 H
 17      177 H
```

Add ← | Subtract

Hexadecimal Addition

```
  1 1 1
  F F F F H
+ 6 5 4 3 H
1 6 5 4 2 H
```

```
  1 1 1
  D E D E H
+ 9 7 6 8 H
1 7 6 4 6 H
```

```
  1 1
  A B C D H
+ 1 2 3 4 H
  B E 0 1 H
```

Hexadecimal Subtraction

Decimal Subtraction

```
  84
- 59
  25
```

Manual

A-B

```
   10H
  7 8 4 H
-   5 9 H
    2 B H
```

Processor

= A + (-B)

84 + (-59)

```
   84 H
 + A7 H
cy 1 2 B
```

59 - 01011001

10100110 → 1's complement

+ 1

10100111 2's complement

A 7

8

2 complement

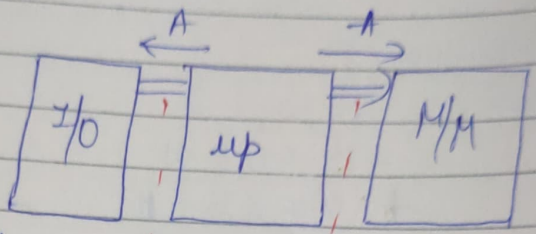
```
 F | 10H
-5 |  9
 A |  7
```

92H − 74H (Subtraction)

Manual	Processor	2's complement
8 10H 92H − 74H 1EH	92 + 8C 1 1E X	74 — 16 7 | 10H 8 | C

System Bus

Group of conductors or wires used for communication between up & memory & I/O devices



Bus (Purpose, Length, Direction)

1] Address Bus
2] Data Bus
3] Control Bus

Address Bus

⇒ It is use to transfer the address of either memory or I/O from the processor.
⇒ It defines the maximum memory that can be connected to a processor given by the relation

$$2^n = N$$

n → no. of address lines
N → No. of address or memory locations
⇒ It is of 16 bits in length for 8085
⇒ Address bus is unidirectional (up → M/M & up → I/O)

Data Bus (Bidirectional)