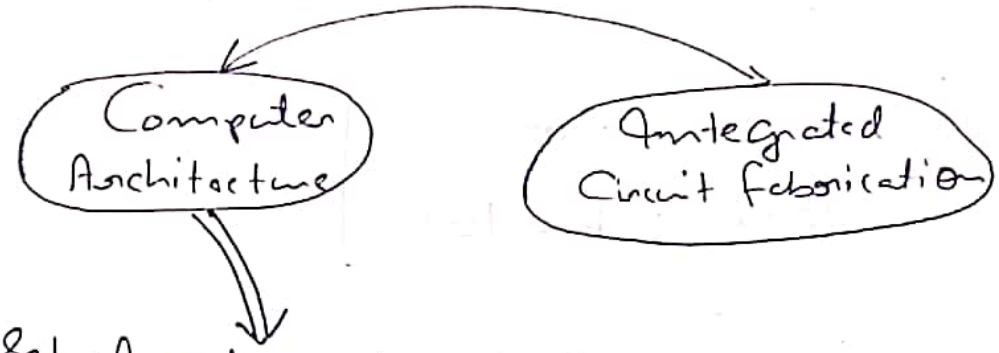
Microprocessors & Microcontrollers

★ Introduction



{ Set of rules and method that describe the functionality, organization, and implementation of Computer systems. }

First Commercial microprocessor (1971) ⟹ 4-bit 4004 (by Intel)

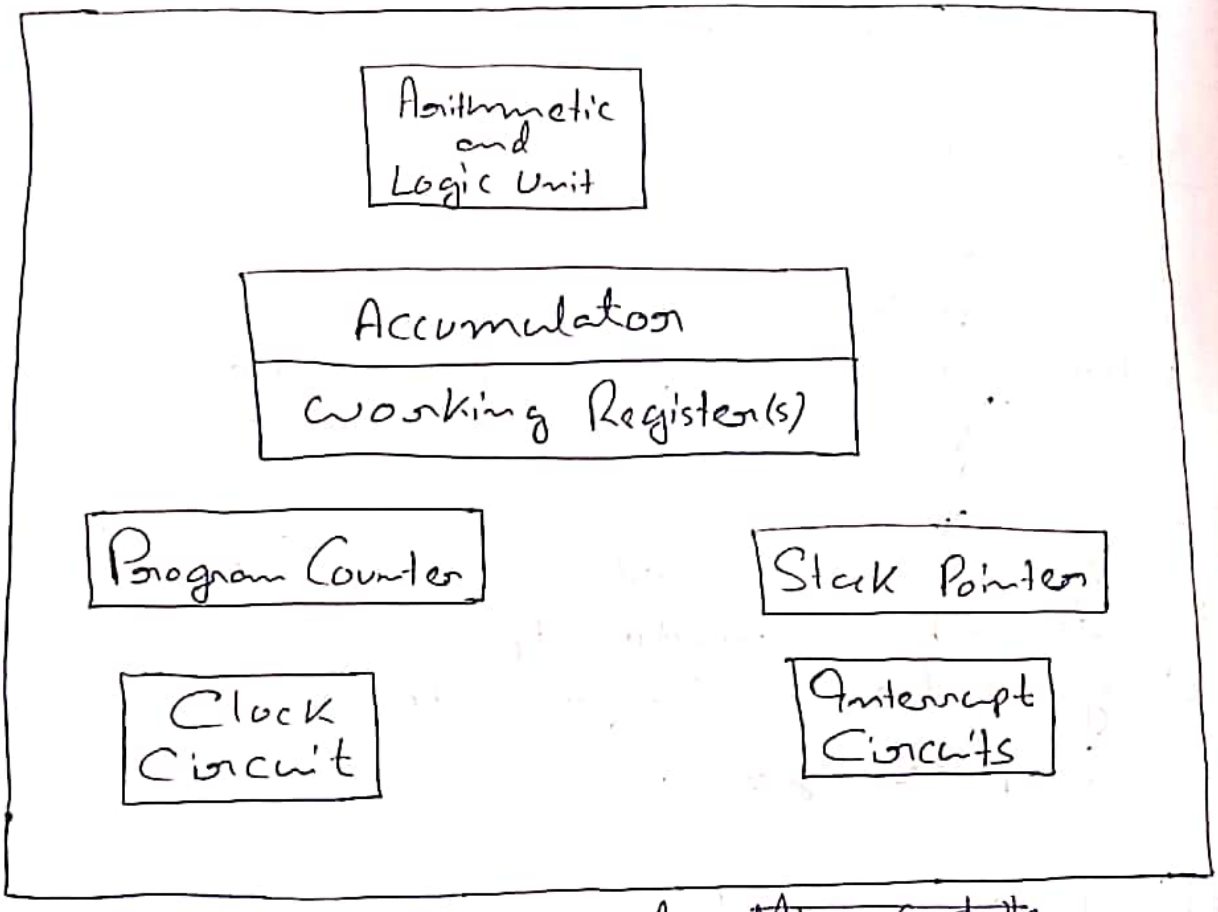
A by-Product of microprocessor development was the microcontroller.

★ Microprocessors and Microcontrollers

Microprocessors

⇒ It is a general-purpose digital computer Central processing unit (CPU)

↳ microprocessor is in no sense a complete digital computer.



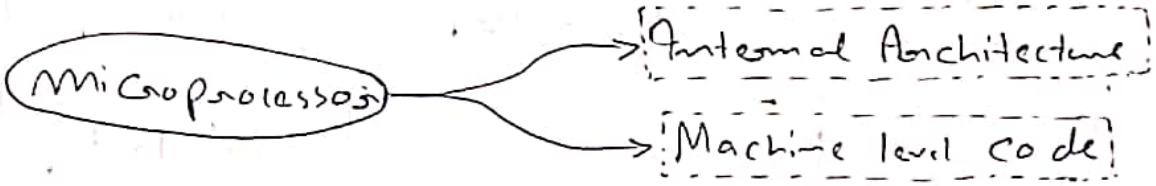
Block diagram of a ~~Microcontroller~~ Microprocessor

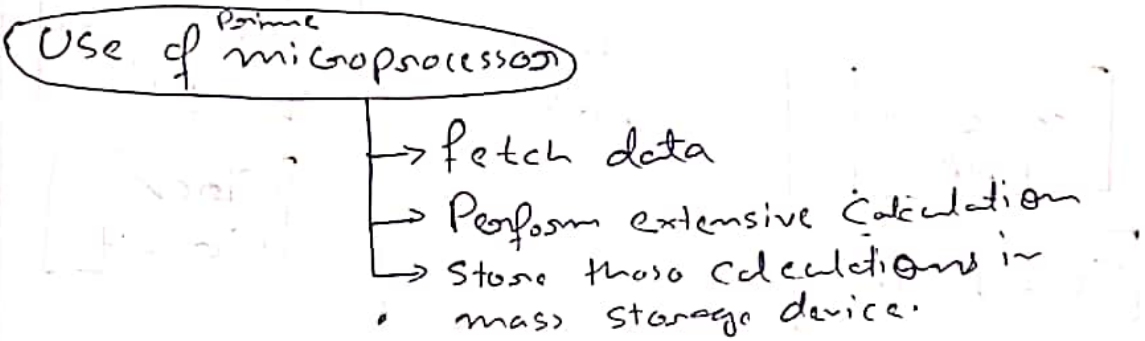
⇒ To make complete microcomputer one must add :-

- Memory → RAM, ROM
- Memory decoder
- Oscillator
- I/O devices {Serial & Parallel data port}
- Special-Purpose device → Interrupt handlers, counters.

⇒ From microcomputer to Computer:

- Mass storage device
- I/O Peripherals {Keyboard, CRT display}



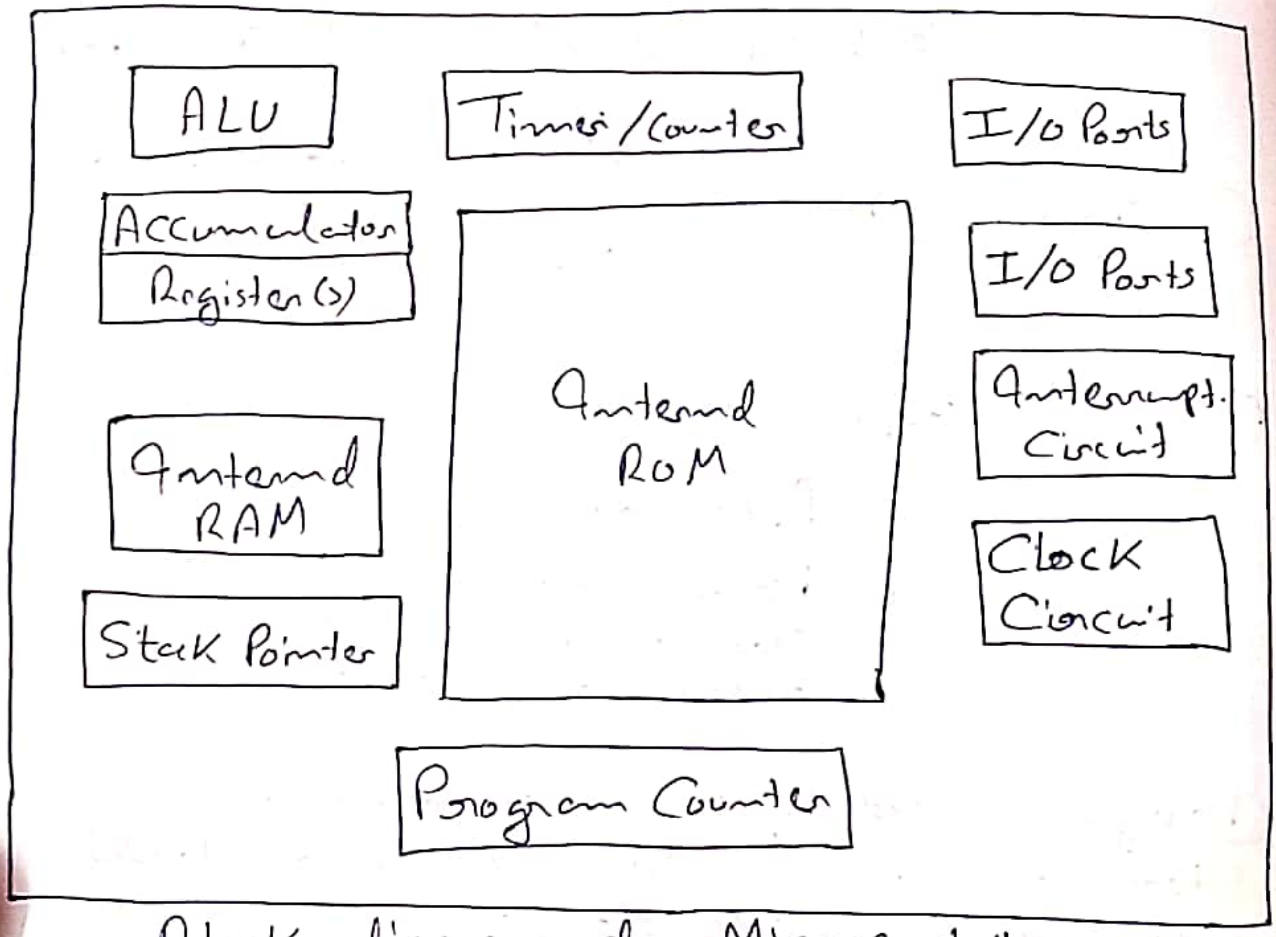


⇒ Program used by the microprocessor are stored in the mass storage device and loaded into RAM as the user directs.

⇒ A few microprocessor programs are stored in ROM.

- ROM based program are small fixed programs that operate peripherals and other fixed devices that are connected to the system.

Microcontrollers



Block diagram of a Microcontroller

⇒ Microcontroller are Complete micro Computer.

- → All the features fount in microprocessor
- → Plus Some additional features which makes is microComputer.

⇒ Microcontroller is a general-purpose device, but one which is mant to fetch data, Perform (limited) Calculations on that data

and Control its environment based on these Calculations.

⇒ Prime use → Control the operation of a machine using a fixed program Stored in ROM and that does not change over the lifetime of the system

Comparing Microprocessors and Microcontrollers

Microprocessors

- Have many operational Codes (opCodes) for moving data from external memory to CPU.
- One or two type of bit handling instructions.
- Summarize: It is connected with rapid movement of code and data from external addresses to the Chip.

Microcontrollers

- One or two Opcodes.
- Many bit handling instructions
- Summarize: It is connected with rapid movement of bits within the Chip.

★ The Z80 and 8051 → 8-bit Microprocessor / 8-bit Microcontroller

Pin Configuration

	Z80	8051
Total Pins	40	40
Address Pins	16 (fixed)	16
Data Pins	8 (fixed)	8
Interrupt Pins	2 (fixed)	2
I/O Pins	0	32

#Architecture	Z80	8051
8-bit register	20	34
16-bit register	4	2
Stack size	64K	128
Internal ROM	0	4K byte
Internal RAM	0	128 byte
External memory	64K	128K byte
Flags	6	4
Timers	0	2
Parallels port	0	4
Serial ports	0	1

#Instruction Set (types/variations)	Z80	8051
External moves	4/14	2/6
Block moves	2/4	0
Bit-manipulate	4/4	12/12
Jump on bit	0	3/3
Stack	3/15	2/2
Single byte	203	49
Multi-byte	490	82

#"Lean" instruction set in 8051 increases programme effort to write code.

↳ This disadvantage can be overcome when writing large programs by the use of high level language such as BASIC and C.

↳ The price paid for reducing Programmer time is the size of the program generated.

★ A Microcontroller Survey

↳ Microcontroller is a Commodity item.

↳ Expense is represented more by the Volume of the package and the number of pins it has than the amount of Silicon inside.

Four-Bit MicroControllers

⇒ The 4-bit micro controller is today the most Popular micro made

Typical Examples
- Hitachi : HMCS40
- National : COP420
- OKI : MSM6411
- TI ; TMS 1000
- Toshiba : TLCS47

Typical Application ⇒ Toys.

8 Bit MicroController

⇒ Transition from high Volumt to high performance.

⇒ In Some Cases, the microcontroller has no onboard ROM at all, or the ROM is an EPROM.

⇒ Application ranges from Simple application Control to high-Speed machine control.

↳ So the microcontroller vendors have established extensive "families" of Similar models"

↳ All features a common language, but differs in the amount of inter ROM, RAM and other cost Sensitive features.

⇒ The ROMless or EPROM versions can be used by the designer to Prototype the applicdion and then the designer can order the ROM version in large quantities from the factory.

⇒ Some families have members with fewer extend pins to shrink the package and the cost.

other have Specid features Such as A/D and D/A Converter on Chip.

Manufacturer: (Model)	Pins: I/O	Counters	RAM (bytes)	ROM (bytes)	Other Features
Intel: 8048	40:27	1	64	1K	External memory to 8K
Intel: 8051	40:32	2	128	4K	External memory to 128K; Serial Port Serial bit I/O
National: COP820	28:24	1	64	1K	Serial bit I/O
Motorola: 6805	28:20	1	64	1K	—
Motorola: 68HC11	52:40	2	256	8K	Serial Ports: A/D watch dog timer (WDT)
Rockwell: 6500/1	42:32	1	64	2K	—
Signetics: 87C552	68:48	3	256	8K	Serial Port A/D; WDT
TI: TMS7800	40:32	1	128	2K	External memory to 112K A/D; Serial Ports, WDT
TI: TMS370C050	68:55	2	256	4K	External memory to 64K
Zilog: Z8	40:32	2	128	2K	External memory to 124K; Serial Port
Zilog: Z8820	44:40	2	272	8K	External memory to 126K; Serial Port

#16 Bit Microcontrollers

Clock Speed

byte-wide data word

⇒ 16-bit microcontrollers have evolved to solve high-speed control problems of the type that might typically be confronted in the control of servomechanisms such as robot arms, or for digital signal processing (DSP) application.

Manufacturer Model	Pins I/O	Counter	RAM (bytes)	ROM (bytes)	Other features
Hitachi: H8/532	84/65	5	1K	32K	Serial port A/D Pulse width modulator
Intel: 8096	68/40	2	232	8K	Serial port A/D WDT PWM
National: HPC16164	68/52	4	512	16K	Serial port A/D, WDT PWM

⇒ PWM can be done using software in 8-bit unit. with the usual loss of time, for other tasks.

32 Bit Microcontroller

⇒ 32 bit design target robotics, highly intelligent instrumentation, avionics, image processing, telecommunications, automobiles and other embedded feature application program running under an operating System.

Intel 80960

Hardware features	Software features
132-Pin Ceramic Package	Efficient Procedure calls.
20 Megahertz Clock	Fault-handling Capability
32 bit bus	Trace events
Floating-Point unit	Global registers
512-byte instruction Cache	Efficient interrupt vectors
Interrupt Control	Versatile addressing

★ Development Systems for Microcontrollers

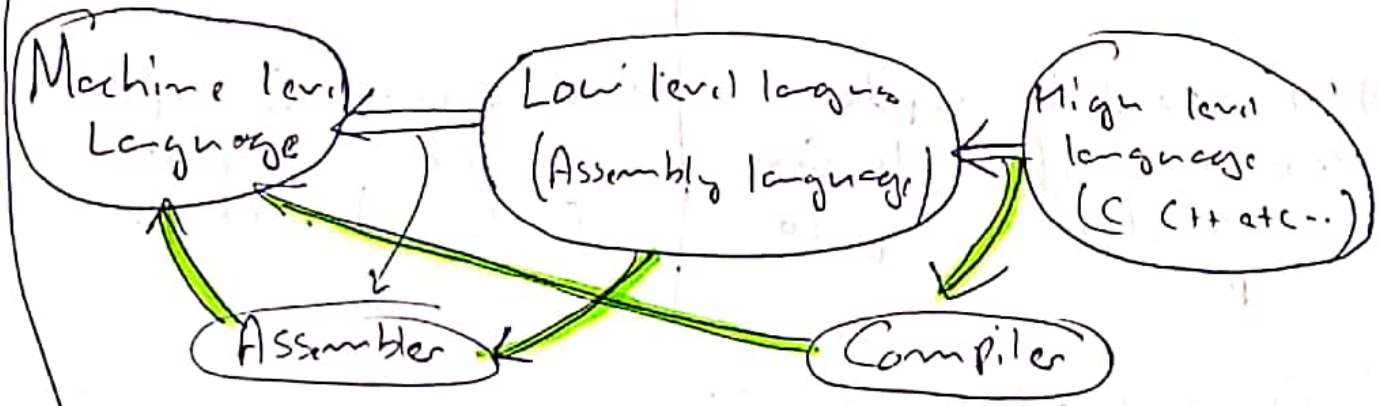
development System → Package of hardware & software which allow the microcontroller to be programed and Connected to your application.

① Device capable of programming EPROM.

② Software, along with a personal Computer to host it.

→ atleast : Machine language Assembler.

(which can be supplied by the microcontroller vendor or brought from indipendent Vendor.



→ More expensive software mainly Consisting of high-level language Compiler and debuggers is also available.

Questions

1)

Microprocessor	Micro Controller
1) Microprocessor Contains ALU, ~~Timing & Control Unit~~ · Stack pointer, Program Counter, Registers, Accumulator · Circuit Clock & Interrupt Circuit.	1) It contains all the components that is in microprocessor with Internal RAM, ROM, I/O Ports and timers.
2) It is intended for a general-purpose digital computer.	2) It is intended to be special-purpose digital Controller.
3) It is called computer on chip but it is not. It need additional components to be called a micro computer.	3) It is a micro computer in true sense.
4) It is used for rapide movement of data from external memory to chip.	4) It is used for rapide movement of bits within the chip.

2) Both have 40 pins.

3) 1) Toys
2) Digital Clock
3) 3D Printer
4) Mobile phone (may be)
5) Robots
6) Washing machine (digital)
7) Scanners
8) CFL
9) Mouse
10) Speaker

(4) Shoaib

(6) (a) 32 bit
(b) 8 bit
(c) 4 bit
(d) 8 bit

(e) 32 bit
(f) 8 bit
(g) 32 bit
(h) 8 bit

(7) Instide of ROM, EPROM is used for ease of Prototyping.

→ So that user can buy extend ROM for large memory at low cost.

(8) 1) Increase clock speed

2) Byte width data word

(9) (1) Computer (with Serial Port)
(2) Assembler or Compiler of the Board
(3) Programmer (Device Capable of Programming EPROM)

(10) 64 bit Microcontroller.

→ ARM has announced 64-bit ARMV8 Platform.