Microprocessors Lap

Lecture: 1

2024- 2023

What is the Microprocessor?

Microprocessor is a multipurpose, programmable device that accepts digital data as input, processes it according to instructions stored in its memory, and provides results as output. `

Or

A microprocessor is a multipurpose, programmable, clock-driven, register-based electronic device that reads binary instructions from a storage device called memory accepts binary data as input and processes data according to instructions, and provides result as output.

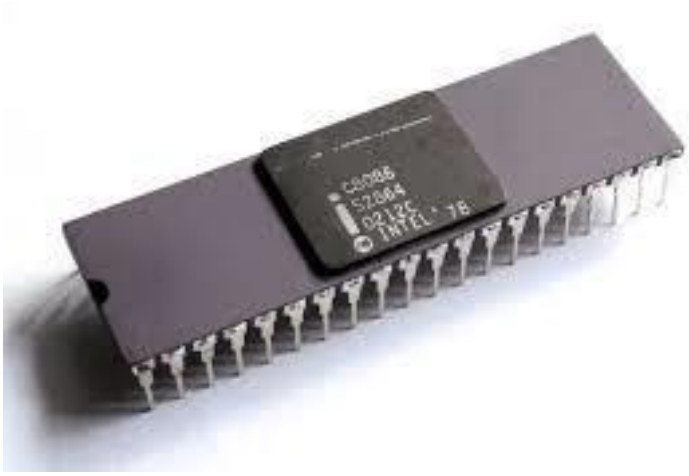
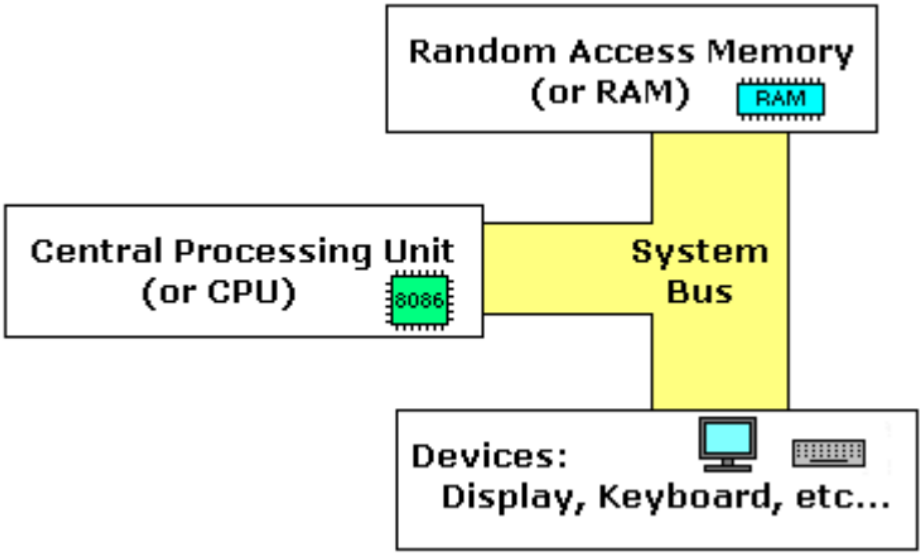


Figure 1: 8086 Microprocessor

What is an assembly language?

Assembly language is a low level programming language. You need to get some knowledge about computer structure in order to understand anything. The simple computer model:

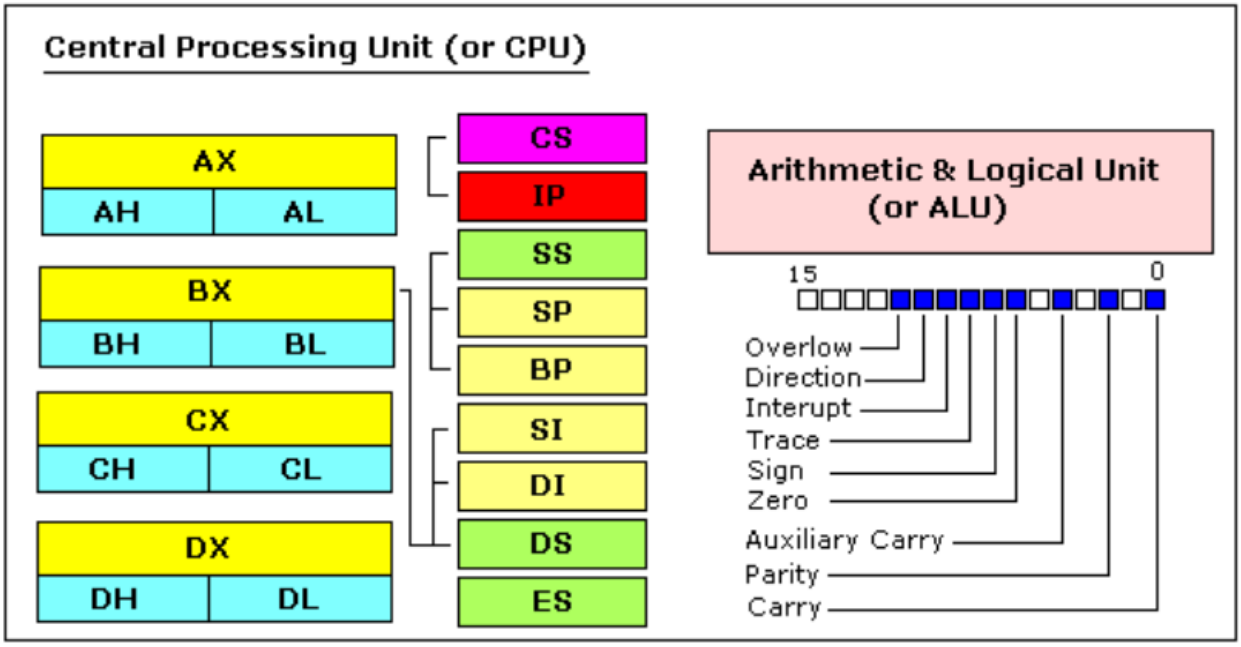


The **system bus** (shown in yellow) connects the various components of a computer.

The **CPU** is the heart of the computer, most of computations occur inside the **CPU**.

RAM is a place to where the programs are loaded in order to be executed.

Inside the CPU



GENERAL PURPOSE REGISTERS

8086 CPU has 8 general purpose registers, each register has its own name:

- **AX** - the accumulator register (divided into **AH / AL**).
- **BX** - the base address register (divided into **BH / BL**).
- **CX** - the count register (divided into **CH / CL**).
- **DX** - the data register (divided into **DH / DL**).
- **SI** - source index register.
- **DI** - destination index register.

- **BP** - base pointer.
- **SP** - stack pointer.

Despite the name of a register, it's the programmer who determines the usage for each general purpose register. The main purpose of a register is to keep a number (variable). The size of the above registers is 16 bit, it's something like: **0011000000111001b** (in binary form), or **12345** in decimal (human) form. 4 general purpose registers (AX, BX, CX, DX) are made of two separate 8 bit registers, for example if AX=**0011000000111001b**, then AH=**00110000b** and AL=**00111001b**. Therefore, when you modify any of the 8 bit registers 16 bit register is also updated, and vice-versa. The same is for other 3 registers, "H" is for high and "L" is for low part. Because registers are located inside the CPU, they are much faster than memory. Accessing a memory location requires the use of a system bus, so it takes much longer. Accessing data in a register usually takes no time. Therefore, you should try to keep variables in the registers. Register sets are very small and most registers have special purposes which limit their use as variables, but they are still an excellent place to store temporary data of calculations.

SEGMENT REGISTERS

- **CS** - points at the segment containing the current program.
- **DS** - generally points at segment where variables are defined.
- **ES** - extra segment register, it's up to a coder to define its usage.
- **SS** - points at the segment containing the stack.

Although it is possible to store any data in the segment registers, this is never a good idea. The segment registers have a very special purpose - pointing at accessible blocks of memory.

Segment registers work together with general purpose register to access any memory value. For example if we would like to access memory at the physical address **12345h** (hexadecimal), we should set the **DS = 1230h** and **SI = 0045h**. This is good, since this way we can access much more memory than with a single register that is limited to 16 bit values.

CPU makes a calculation of physical address by multiplying the segment register by 10h and adding general purpose register to it (1230h * 10h + 45h = 12345h):

```
 12300
+ 0045
-------
 12345
```

The address formed with 2 registers is called an **effective address**. By default **BX, SI** and **DI** registers work with **DS** segment register; **BP** and **SP** work with **SS** segment register. Other general purpose registers cannot form an effective address! Also, although **BX** can form an effective address, **BH** and **BL** cannot!

SPECIAL PURPOSE REGISTERS

- **IP** - the instruction pointer.
- **Flags Register** - determines the current state of the processor.

IP register always works together with **CS** segment register and it points to currently executing instruction.

Flags Register is modified automatically by CPU after mathematical operations, this allows to determine the type of the result, and to determine conditions to transfer control to other parts of the program. Generally you cannot access these registers directly.

Objective:-

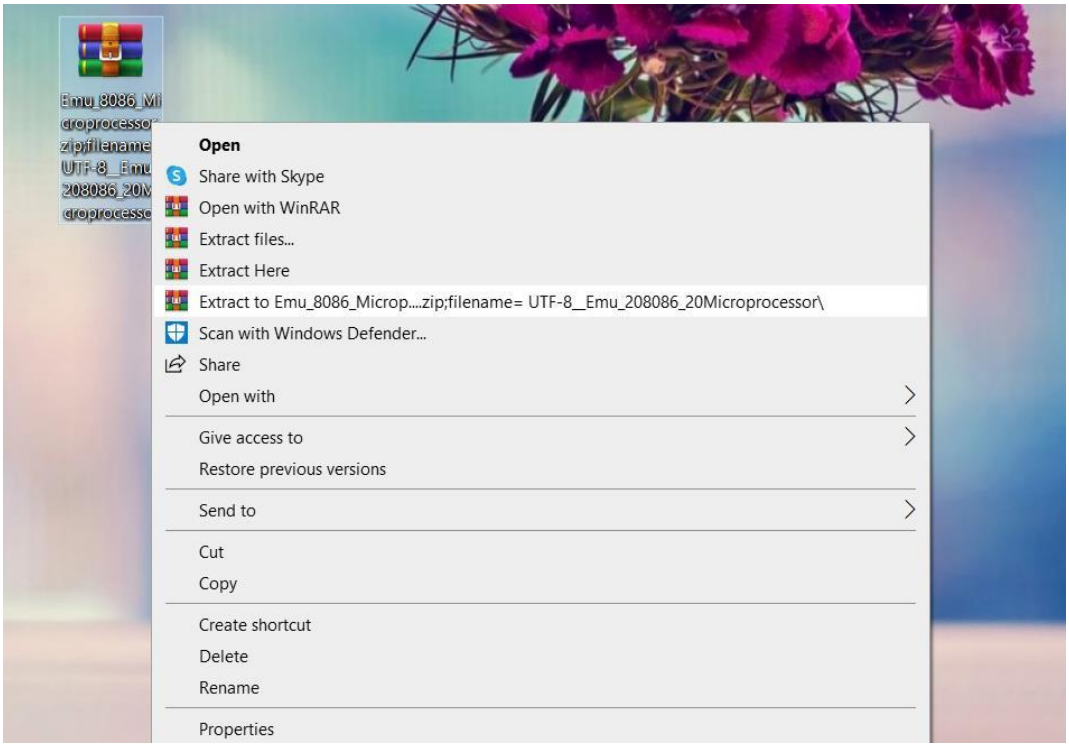
To Learn how to download and install the 8086 emulator program.

Equipments:-

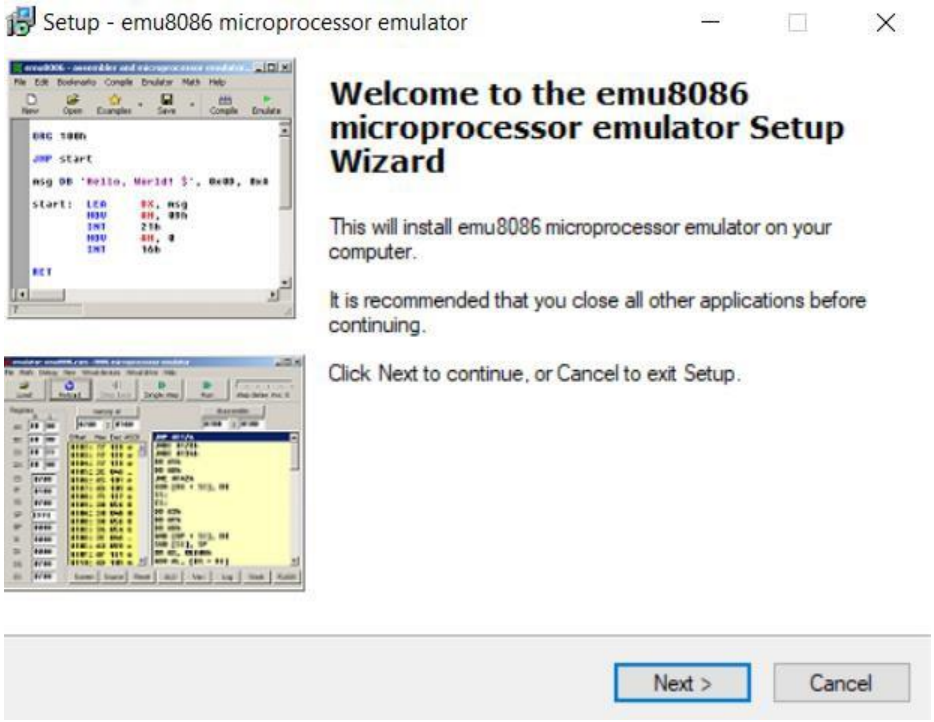
- PC

Procedure:-

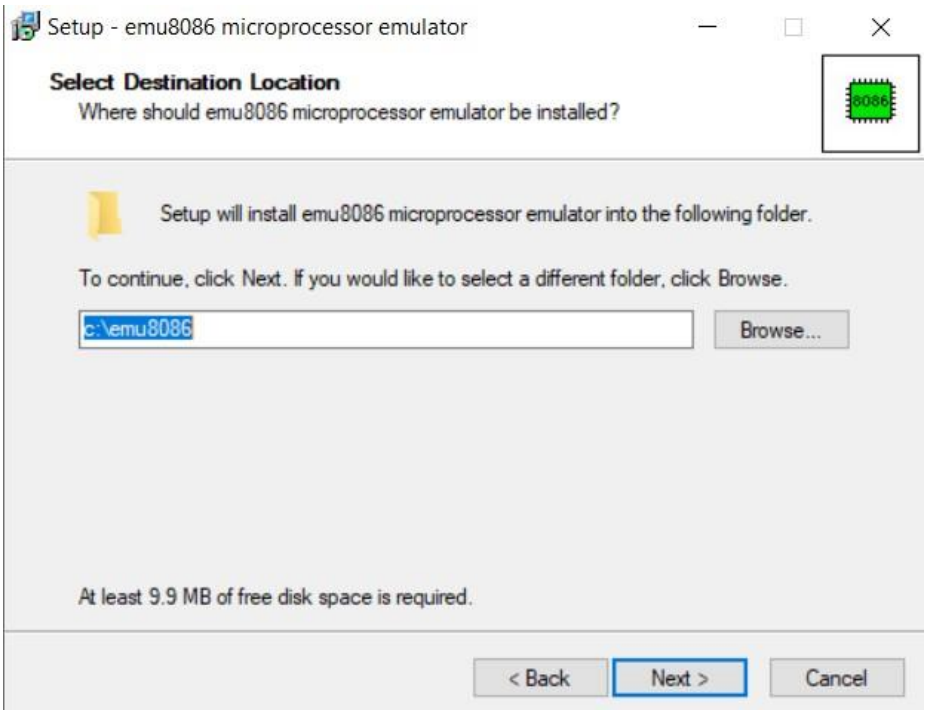
1. Download 8086 emulator program using any browser.
2. Extract the exe. File into :



1. Open the file → then Emu8086 → then Setup.



2. tap Next → then Next
3. Select the destination location by tab the browse button (prefer to be in C:Drive)



4. Tab Next → then Next → then Install.