Microprocessor Background:

Microprocessor is a center processing unit on a single integrated circuit, containing millions of very small component including transistor, register and diodes, which works together.

A Microprocessor is a brain of computer system. A microprocessor is also known as a central processing unit (CPU) it is an important part of a computer architecture without which you will not be able to perform anything on your computer. It is a programmable device that takes in input performs some arithmetic and logical operations over it and produces the desired output. In simple words, a Microprocessor is a digital device on a chip that can fetch instructions from memory, decode and execute them and give results.

The microprocessor is a multipurpose, clock-driven, register-based, digital integrated circuit that accepts binary data as input, processes it according to instructions stored in its memory, and provides results (also in binary form) as output. Microprocessors contain both combinational logic and sequential digital logic, and operate on numbers and symbols represented in the binary number system.

History

Fair child semiconductors (founded in 1957) invented the first Integrated Circuit in 1959 that marked the microprocessor history. In 1968, Gordan Moore, Robert Noyce and Andrew Grove resigned from the Fair child semiconductors and started their own company: Integrated Electronics (Intel). In 1971, the first microprocessor Intel 4004 was invented.

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Name	Word Length	Memory/Addressing Capacity	Number of Pins
4004	4-bits	540 bytes	16
8008	8-bits	16 Kb	18
8080	8-bits	64 Kb	40
8085	8-bits	64 Kb	40
8086	16-bits	1 Mb	40

Family /Size of Microprocessor

Name	Year of Invention	Clock Speed	Number Of Transistors	Inst. Per Second
INTEL 4004/4040	1971 by Ted Hoff and Stanley Mazor	740 kHz	2300	50,000
8008	1972	500 kHz	3500	60,000
8080	1974	2Mhz	6000	10 time faster
8085	1976 (16-bit address bus)	3 MHz	6500	769230
8086	1978 (multiply and divide instruction, 16-bit data bus and 20-bit address bus)	4.77 MHz, 8 MHz, 10 MHz	29000	2.5 Million
8088	1979 (cheaper version of 8086 and 8-bit external bus)			2.5 Million
80186/80188	1982 (80188 cheaper version of 80186, and additional components like interrupt controller, clock generator, local bus controller, counters)	6 MHz		
80286	1982 (data bus 16bit and address bus 24 bit)	8 MHz	134000	4 Million
INTEL 80386	1986 (other versions 80386DX, 80386SX, 80386SL , and data bus 32-bit address bus 32 bit)	16 MHz – 33 MHz	275000	
INTEL 80486	1986 (other versions 80486SX,80486DX, 80486DX2, 80486DX4)	16 MHz – 100 MHz	1.2 Million transistors	8 KB of cache memory
80586-PENTIUM-I,II,III,IV	1993	66 MHz		Cache memory 8 bit for instructions 8 bit for data
INTEL core 2	2006 (other versions core2 duo, core2 quad, core2 extreme)	1.2 GHz to 3 GHz	291 Million transistors	64 KB of L1 cache per core 4 MB of L2 cache
i3, i5, i7	2007, 2009, 2010	2.2GHz – 3.3GHz, 2.4GHz – 3.6GHz, 2.93GHz – 3.33GHz		

First-generation –

From 1971 to 1972 the era of the first generation came which brought microprocessors like INTEL 4004 Rockwell international PPS-4 INTEL 8008 etc.

Second generation –

The second generation marked the development of 8-bit microprocessors from 1973 to 1978. Processors like INTEL 8085 Motorola 6800 and 6801 etc came into existence.

Third generation –

The third generation brought forward the 16-bit processors like INTEL 8086/8088/80186/80286 Motorola 68000 68010 etc. From 1979 to 1980 this generation used the HMOS technology.

Fourth generation –

The fourth-generation came into existence from 1981 to 1995. The 32-bit processors using HMOS fabrication came into existence. INTEL 80386 and Motorola 68020 are some of the popular processors of this generation.

Fifth-generation –

From 1995 till now we are in the fifth generation. 64-bit processors like PENTIUM, Celeron, dual, quad, and octa-core processors came into existence.

A microprocessor can be classified into three categories

- RISC Processor
- CISC Processor
- Special Processors

RISC Processor

RISC stands for Reduced Instruction Set Computer. It is designed to reduce the execution time by simplifying the instruction set of the computer. Using RISC processors, each instruction requires only one clock cycle to execute results in uniform execution time. This reduces the efficiency, as there are more lines of code; hence, more RAM is needed to store the instructions. The compiler also has to work more to convert high-level language instructions into machine code.

Some of the RISC processors are –

- Power PC: 601, 604, 615, 620
- DEC Alpha: 210642, 211066, 21068, 21164
- MIPS: TS (R10000) RISC Processor
- PA-RISC: HP 7100LC

CISC Processor

CISC stands for Complex Instruction Set Computer. It is designed to minimize the number of instructions per program, ignoring the number of cycles per instruction. The emphasis is on building complex instructions directly into the hardware.

The compiler has to do very little work to translate a high-level language into assembly level language/machine code because the length of the code is relatively short, so very little RAM is required to store the instructions.

Some of the CISC Processors are –

- IBM 370/168
- VAX 11/780
- Intel 80486

Special Processors

These are the processors, which are designed for some special purposes. Few of the special processors are briefly discussed

Coprocessor

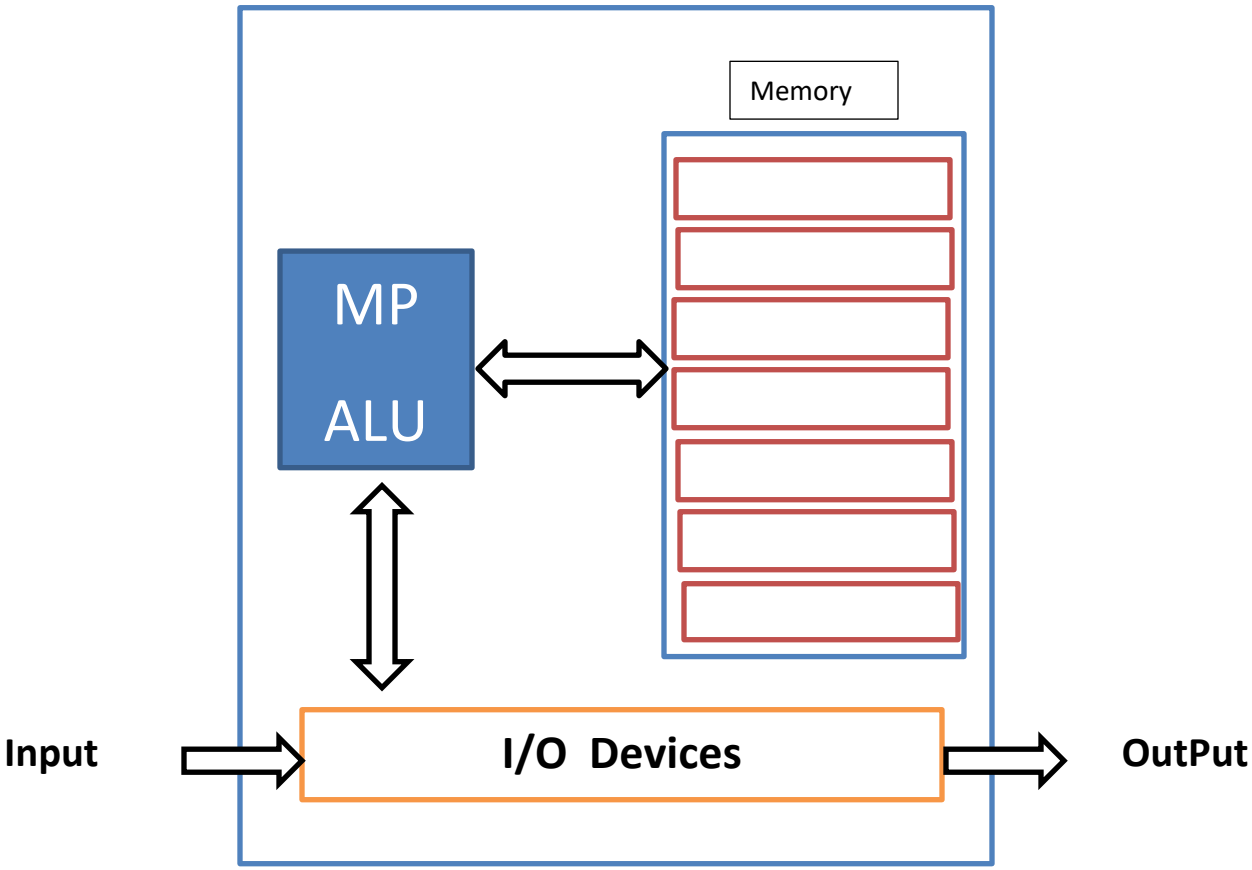
A coprocessor is a specially designed microprocessor, which can handle its particular function many times faster than the ordinary microprocessor.

For example – Math Coprocessor.

Some Intel math-coprocessors are –

- 8087-used with 8086
- 80287-used with 80286
- 80387-used with 80386

Block Diagram of Micro Computer System



Instruction cycle

Fetch: gets an instruction from memory

Decode: decides what the instruction means.

Execute: performs the instruction.

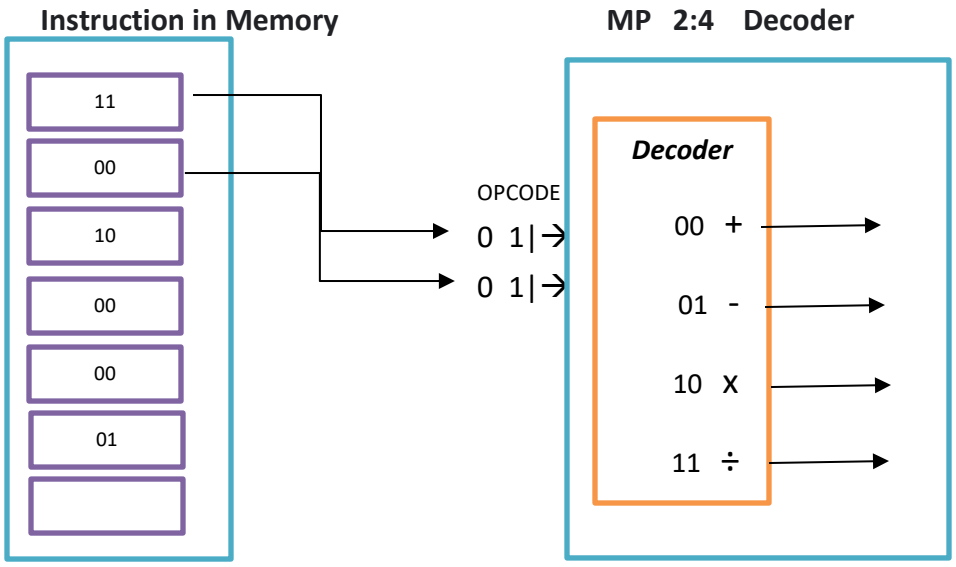
These are steps repeat and repeat that is called instruction cycle.

OPCODE(Operation Code)

In computing, an opcode (abbreviated from operation code, also known as instruction machine code, instruction code is the portion of a machine language instruction that specifies the operation to be performed.

An opcode is a single instruction that can be executed by the CPU. In machine language, it is a binary or hexadecimal value such as 'B6' loaded into the instruction register. In assembly language, mnemonic form an opcode is a command such as MOV or ADD or JMP.

Supose opcode for ***00 Add***, ***01 Sub***, ***10 Mul*** and ***11 Div*** there are four 4 operation of 4 opcode.



Numbering System

There are three basic types of numbering system.

1) ***Decimal system :*** we use Decimal system In the real world it is consist of 0-9 digits here is total 10 digits therefore base is 10 so that is called **Decimal** system. Decimal digits list are (0,1,2,3,4,5,6,7,8,9)

2) ***Binary system:*** This is use in computer system, it is consist of 0-1 digits here is total 2 ***digits*** therefor base is 2 so that is called **Binary** system. Binary digits list are (0 ,1)

3) ***Hexadecimal System:*** This is use also in computer system, it is consist of 0-15 digits here is total 16 digits therefor base is 16 so that is called **Hexadecimal** system. Decimal digits list are (0,1,2,3,4,5,6,7,8,9 ,A,B,C,D,E,F)

Decimal	Binary 8 4 2 1	Hexadecimal
0	0 0 0 0	0
1	0 0 0 1	1
2	0 0 1 0	2
3	0 0 1 1	3
4	0 1 0 0	4
5	0 1 0 1	5
6	0 1 1 0	6
7	0 1 1 1	7
8	1 0 0 0	8
9	1 0 0 1	9
10	1 0 1 0	A
11	1 0 1 1	B
12	1 1 0 0	C
13	1 1 0 1	D
14	1 1 1 0	E
15	1 1 1 1	F

Convert Hexadecimal into Binary

1) 23 → 0010 0011

2) 769 → 0111 0110 1001

00→ 0000 0000 Mean 8 bits/1 byte value. FF → 1111 1111 Mean 8 bits/1 byte value.	0000→0000 0000 0000 0000 16 bits/byte FFFF→1111 1111 1111 1111 16 bits/words

1C→0001 1100 83→1000 0011	2B3C→0010 1011 0011 1100 6AD7→0110 1010 1101 0111

Size of Computer Data

4 bits →1 nibble 8 bits → 1 byte 1024 bytes →1KB	1024KB →1MB 1024MB →1GB 1024GB → 1TB

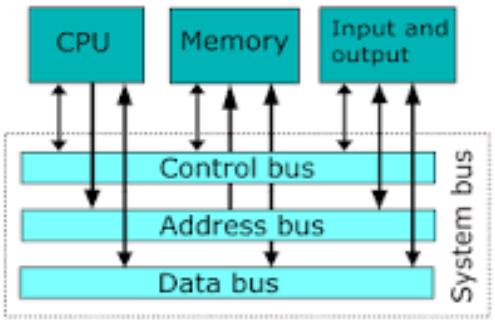
$2^1 = 2$	$2^2 = 4$	$2^3 = 8$	$2^4 = 16$	$2^5 = 32$
$2^6 = 64$	$2^7 = 128$	$2^8 = 256$	$2^9 = 512$	$2^{10} = 1K$
$2^{20} = 1M$	$2^{30} = 1G$	$2^{40} = 1T$		

$2^{14} = 2^4 \times 2^{10}$ $= 16 \times 1K$ $= 16K$	$2^{19} = 2^9 \times 2^{10}$ $= 512 \times 1K$ $= 512K$	$2^{24} = 2^4 \times 2^{20}$ $= 16 \times 1M$ $= 16M$

Bus System

The computer buses are electrical wires that connect the various hardware components in a computer system. The computer buses carries the data, control signal and memory address. There are three types of buses in computer system.

1) ***Control Bus***: The control bus carries the control, timing and coordination signals to manage the various functions across the system.
2) ***Address Bus:*** The address bus is used to specify memory locations for the data being transferred.
3) ***Data Bus:*** The data bus, which is a bidirectional path, carries the actual data between the processor, the memory and the peripherals



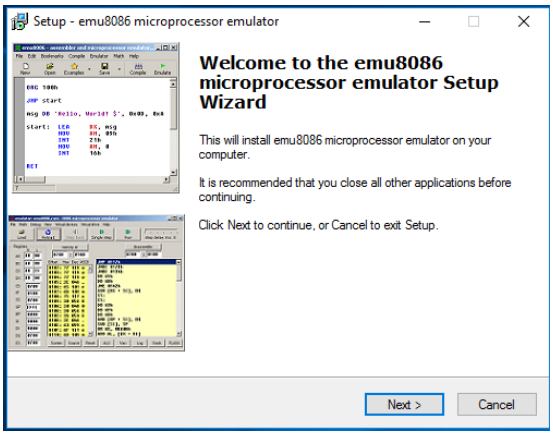
The EMU8086

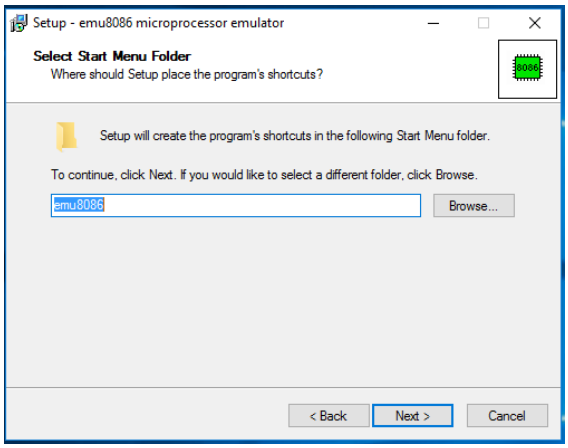
The 8086 Microprocessor Emulator, also known as EMU8086, is an emulator of the program 8086 microprocessor. It is developed with a built-in 8086 assembler. This application is able to run programs on both PC desktops and laptops. This tool is primarily designed to copy or emulate hardware. These include the memory of a program, CPU, RAM, input and output devices, and even the display screen.

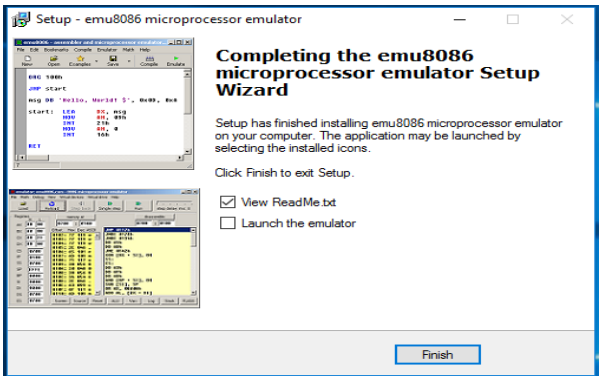
There are instructions to follow when using this emulator. It can be executed into one of the two ways: backward or forward. There are also examples of assembly source code included. With this, it allows the programming of assembly language, reverse engineering, hardware architecture, and creating miniature operating system (OS).

Installation and setup steps of EMU8086

1) First, you open any browser and then write www.sirmasood.com at URL bar.
2) Here you will see download software then you click download software.
3) Then click download EMU8086 Microprocessor emulator software.
4) After download, this software you go download folder and double click on this emu8086v408 RAR Zip file.
5) Extract this file.
6) After extract files then you will see emu8086v408 folder and open this folder.
7) Here you will see setup file then double click at this file and start installation and you click next , next and finish.







Exercise

Theory Questions.

1. Background of Microprocessor?
2. Define Bus System.
3. Write block diagram of Computer System.
4. Convert the hexadecimal number into Binary number there are following.
   1) 45C 2) ABC 3) 290 4) 3D4F
5. Write of size of computer data.
6. Define EMU8086.

Practical Questions.

1. Write steps of EMU8086 emulator software installation or setup process.

Objective and MCQs:

1. What is the default extension of Assembly language source code file?
   a) .c
   b) .jpp
   c) .asm
   d) .java

2. The **Intel** ____ is a 4-bit central processing unit (CPU).
   a) 8086
   b) 80286
   c) 8080
   d) 4004

3. The first Microprocessor released by _____.
   a) Intel
   b) IBM
   c) Apple Corporation.
   d) Microsoft
4. A _____ is a brain of computer system.
   a) Internal Memory.
   b) Hard disk.
   c) Microprocessor.
   d) Keyboard and mouse.

5. The Intel 8086 is a _____ bits central processing unit (CPU)
   a) 16
   b) 8
   c) 32
   d) 4

6. The _____, which is a bidirectional path.
   a) Address bus
   b) Control bus
   c) Data bus
   d) Mini bus

7. The 2^3 = ___.
   a) 6
   b) 4
   c) 8
   d) 2

8. The 2^{30}= _____
   a) 1K
   b) 1M.
   c) 1G.
   d) 1T.

9. The 83_{16} Convert into binary _____.
   a) 0000 11.
   b) 1000 11.
   c) 1000 0011.
   d) 11100010.

10. The $6AD7_{16}$ Convert into binary _____.
    a) 0110101011010111.
    b) 0000111100001111.
    c) 11010101100111101.
    d) 11111000100011010.