Introduction

Microprocessors and Assembly Language

Course Teacher:

Md. Obaidur Rahman, Ph.D.
Professor
Department of Computer Science and Engineering (CSE)
Dhaka University of Engineering & Technology (DUET), Gazipur.

Course ID: CSE - 4503
Course Title: Microprocessors and Assembly Language
Department of Computer Science and Engineering (CSE),
Islamic University of Technology (IUT), Gazipur.

Topics to be Covered in this Course !!

- Microprocessor and Assembly Language:
- Microprocessors and Microcomputers
- Evaluation of Microprocessors Applications
- Intel 8086 Microprocessor: internal architecture, register structure, programming model, addressing modes, instruction set
- Assembly language programming
- Coprocessors.
- An overview of Intel 80186, 80286, 80386, 80486 and Pentium microprocessors
- RISC and CISC processors.

Recommended Texts

- *Microprocessor, architecture, programming & application with the 8085*, **Author:** Gaonkar
- *Microprocessors and Interfacing: Programming and Hardware*, **Author:** Douglas V. Hall
- *Assembly Language Programming and Organization of the IBM PC*, **Author:** Ytha Yu, Charles Marut

- **Additionally** !! Lecture materials will be provided.

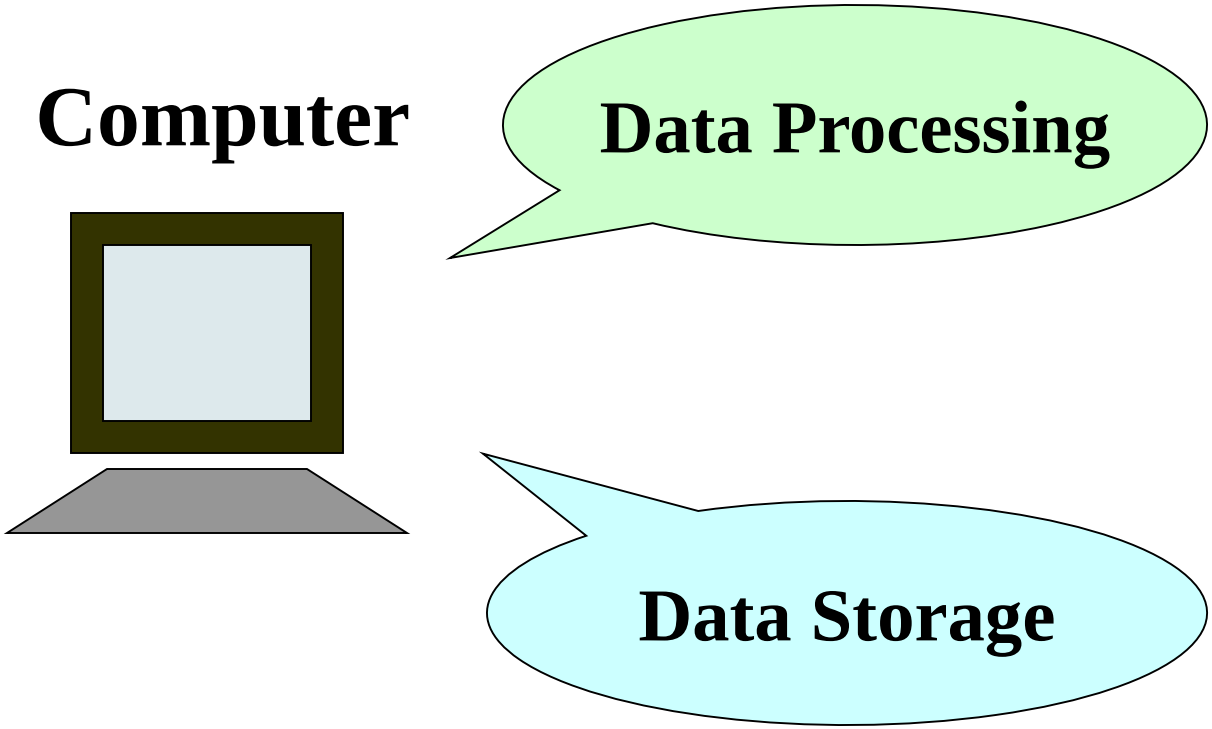
Does Earlier Knowledge Require ??

- You should have the knowledge about –
  - *Number Systems*.
  - Basics of "*Digital Logic Design*" course.
  - Basics of "*Computer Organization and Architecture*" course.
  - "*Basic Programming*".

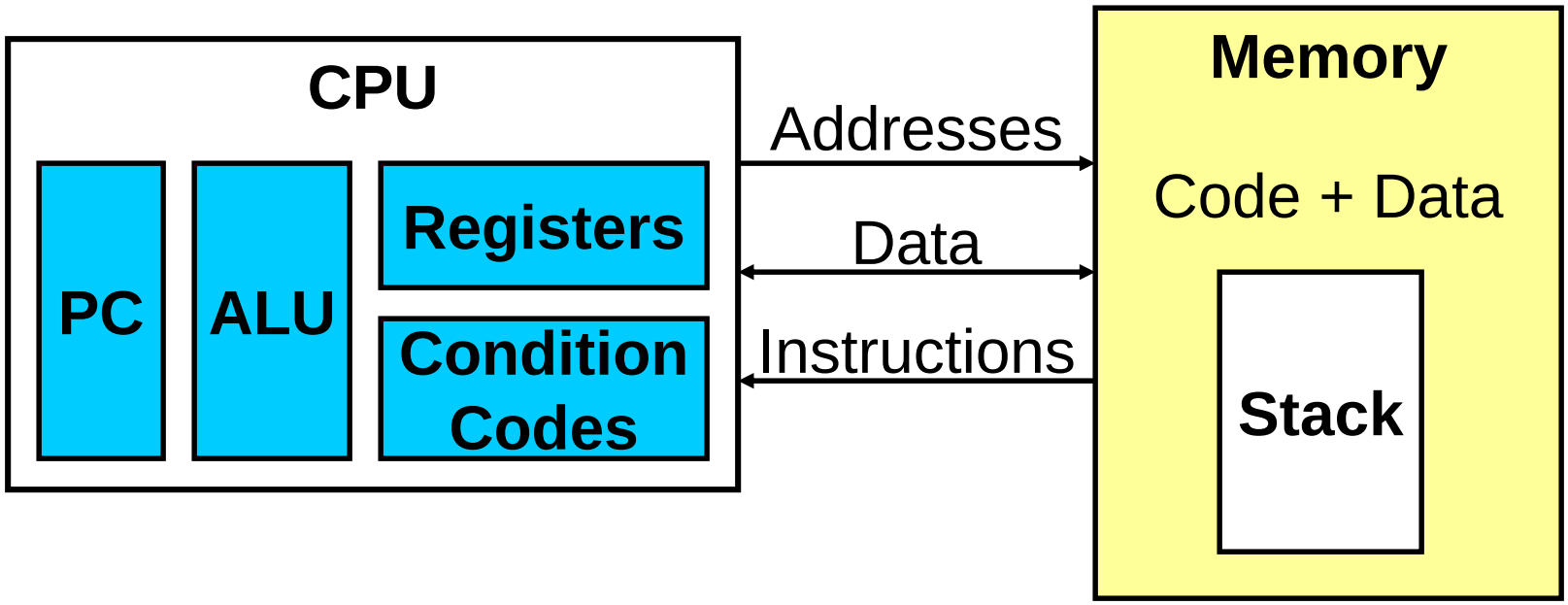
Lecture References:

- **Book:**
  - *Microprocessors and Interfacing: Programming and Hardware,* **Author:** Douglas V. Hall (Chapter-2)
- **Lecture Materials:**
  - *ECP2036: Microprocessor and Interfacing.*
- **Web Materials:**
  - Wikipedia, the free encyclopedia
  - http://www.cpu-world.com/Arch/8085.html
  - http://www.ehow.com/way_5230222_8085-microprocessor-tutorial.html

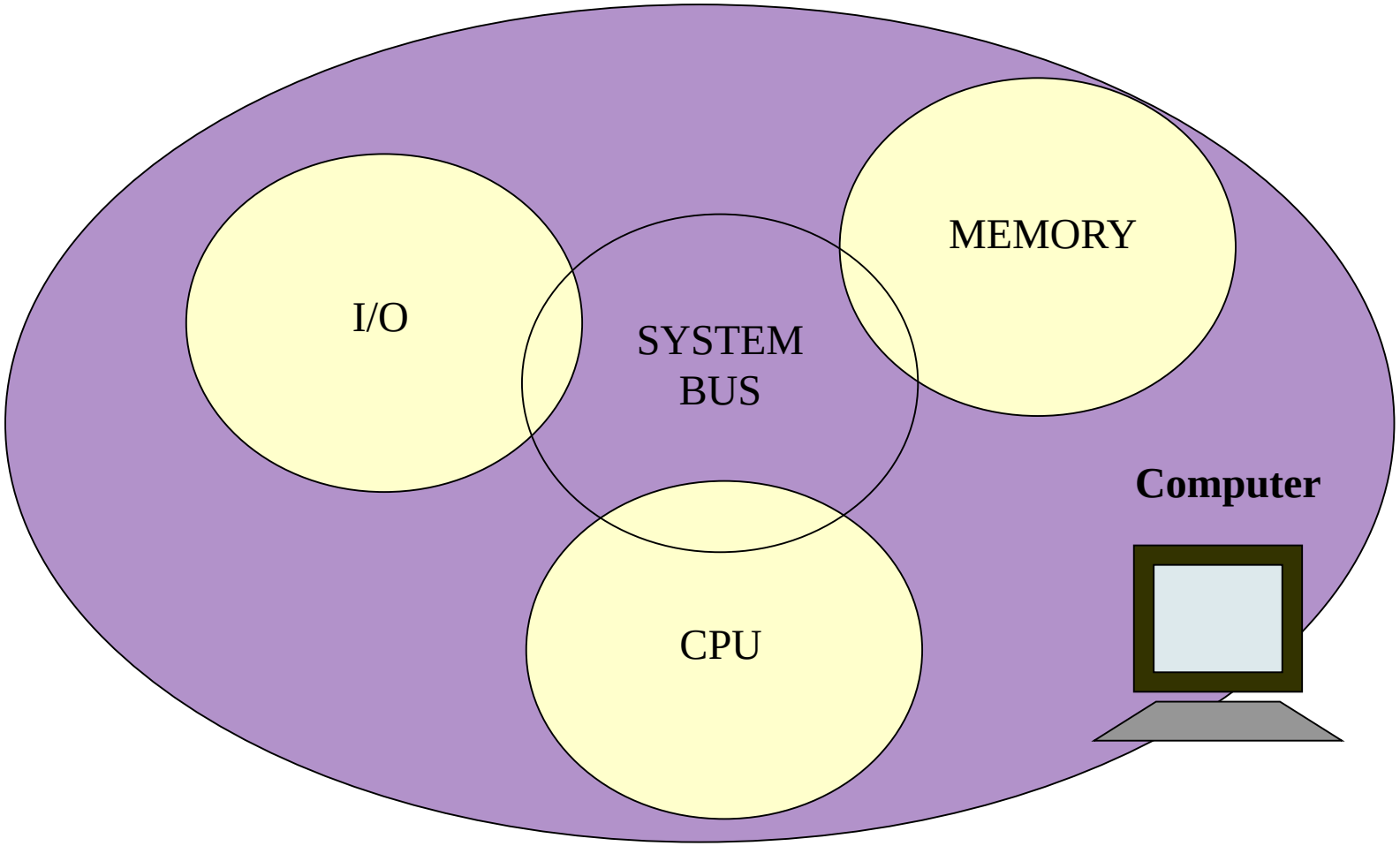
Concept of Computer



Major Components of Computer

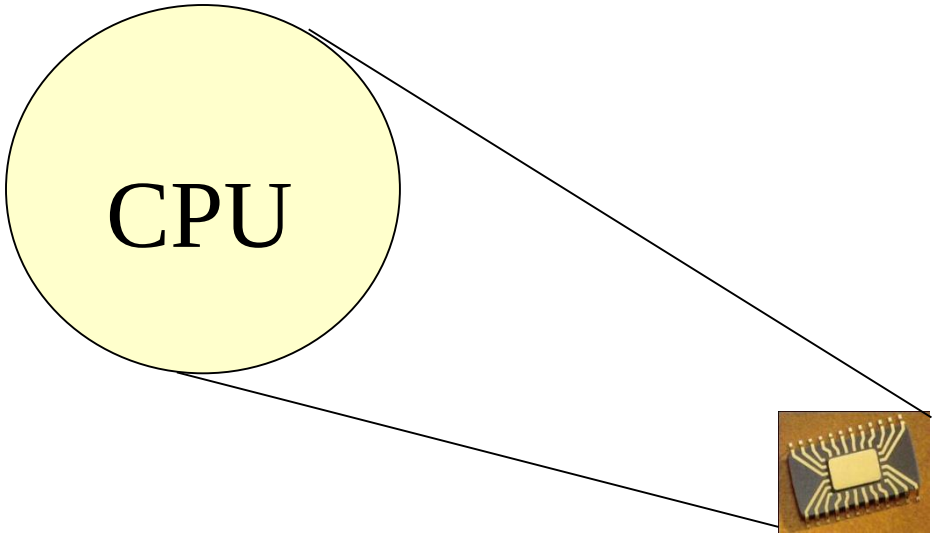


Major Components of Computer

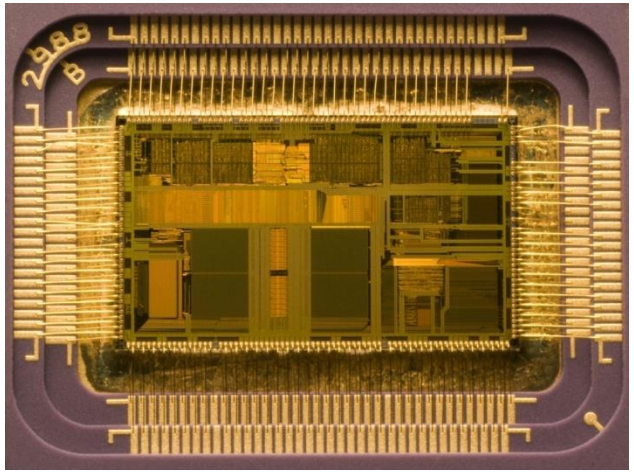


Concept about Microprocessor

- A **microprocessor** incorporates most or all of the functions of a central processing unit (CPU) on a single **integrated circuit** (IC).



Die of an Intel **80486DX2** microprocessor (actual size: 12×6.75 mm) in its packaging

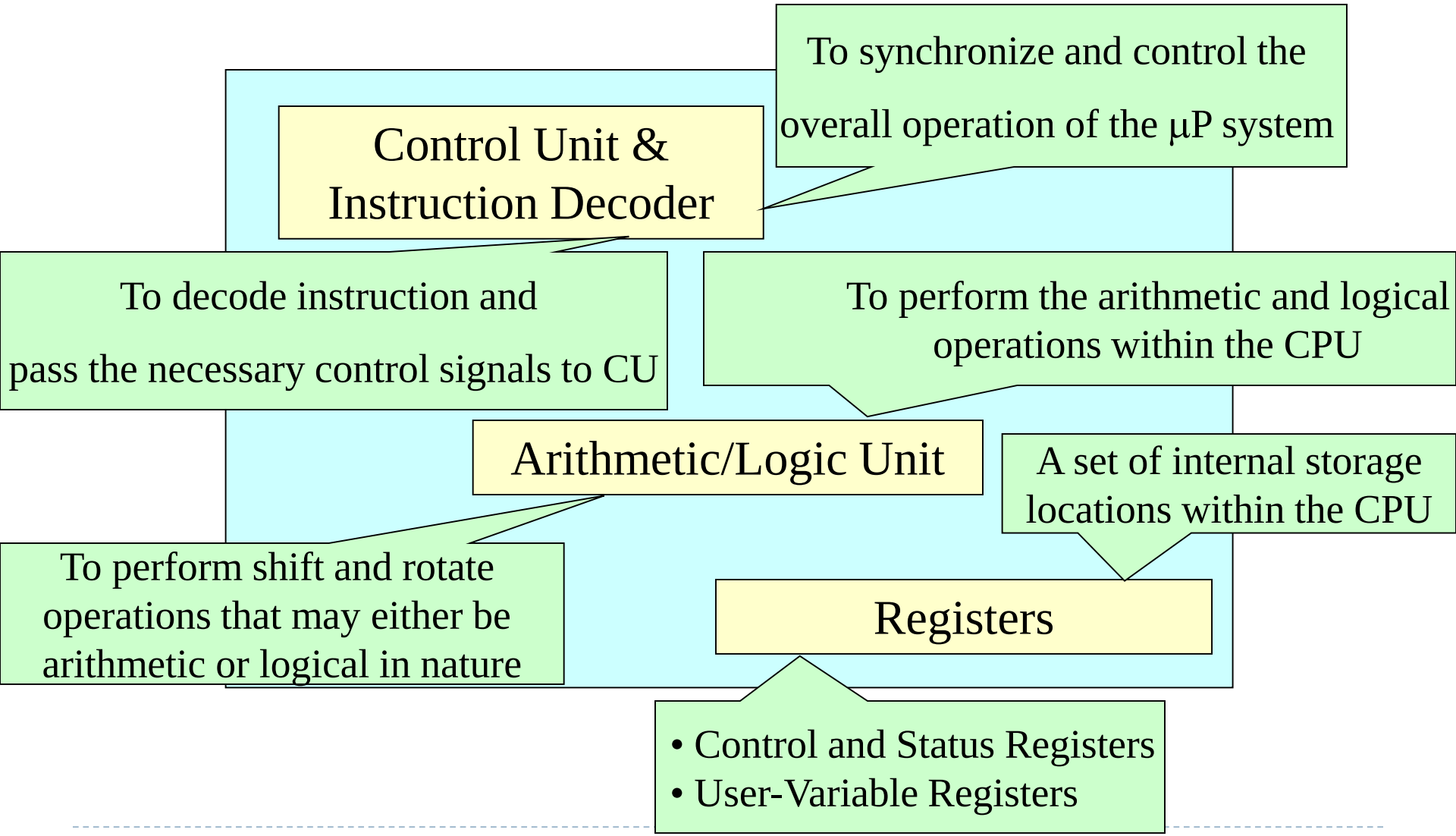


Central Processing Unit

- A **central processing unit** (**CPU**), or sometimes just called **Microprocessor (μP)**, is a description of a class of logic machines that can execute **computer programs**.

- This broad definition can easily be applied to many early computers that existed long before the term "CPU" ever came into widespread usage. However, the term itself and its initialism have been in use in the computer industry at least since the early 1960s.
- The form, design and implementation of CPUs have changed dramatically since the earliest examples, but their fundamental operation has remained much the same.

Central Processing Unit/Microprocessor (μP)



So .. What is Microprocessor?

- A microprocessor (abbreviated as µP or uP) is a Silicon Chip that contains an electronic central processing unit (CPU). In the world uP or CPU used interchangeably, which is made from miniaturized transistors and other circuit elements on a single semiconductor integrated circuit (IC).
- The integration of the whole CPU onto a single **VLSI Chip** therefore greatly reduced the cost of processing capacity.
- **Architectures of Microprocessors:**
  - 8-bit designs
  - 16-bit designs
  - 32-bit designs
  - 64-bit designs
  - Multi-core designs
  - RISC (Reduced Instruction Set Computer)
  - CISC (Complex Instruction Set Computer)
  - Special-purpose designs: Microcontrollers, Digital Signal Processors (DSP) and Graphics Processing Units (GPU).

List of Microprocessors

1971 - Intel 4004, 1st single chip CPU, 4-bit processor, 45 instructions

1972 - Intel 4040, enhanced 4004, 60 instructions

1972 - Intel 8008, 8-bit μP

1972 - Texas Instrument TMS 1000, 1st single μC, 4-bit

1974 - Intel 8080, successor to the 8008, used in Altair 8800

1975 - Motorola 6800, used MOS technology

1976 - Intel 8085, updated 8080, +5V power supply

1976 - Zilog Z80, improved 8080

1976 - TI TMS 9900, 1st 16-bit μP

1978 - Zilog Z8000, Motorola 68000, 16-bit μP

1978 - Intel 8086, 16-bit, IBM's choice...

History of Intel Era

- 1978: 8086 (16 bit architecture)
- 1980: 8087
  - Floating point coprocessor is added
- 1982: 80286
  - Increases address space to 24 bits
- 1985: 80386:
  - 32 bits Address Space,
  - Virtual Memory & new addressing modes
  - Protected mode (OS support)
- 1989-95: 80486/Pentium/Pro
  - Added a few instructions of base MMX

History of Intel Era

- 1997: Pentium II
  - 57 new “MMX” instructions are added,
- 1999: Pentium III:
  - Out of Order, added another 70 Streaming SIMD Ext (SSE)
- 2001: Pentium 4
  - Net burst, another 144 instructions (SSE2)
- 2003: PI4 HT, Trace Cache
- 2005: Centrino, low power
- 2007: Core architecture, Duo
- 2008: Atom, Quad core with HT….
- 2009 --- till now: Multi core (Large chip multiprocessor)

Assembly Language

- **Assembly language:**
  - Assembly language is used for most programming because it is extremely difficult to program a microprocessor in its native, that is hexadecimal machine language.
- **Assembler:**
  - An assembler is a program that converts software written in symbolic machine language (the source programme) into hexadecimal machine language (object programme).
  - The primary reason to use assembler is because development and modification are always difficult in machine language.

Example of 8085 Assembly Language

Address	Mnemonics	Machine (Hex) Code	
202A	MVI A, 32H	3E	
		32	;Copies 21 into accumulator
202C	MVI B, 48H	06	
		48	; Copies 2A into B register
202E	ADD B	80	;Adds B reg. content with Acc and stores the result in Acc.
202F	STA [41 FF]	D3	
		01	;Stores the Acc (the sum) into the memory location 41 FF.
2032	HLT	76	; Stops the program

Another Example of 8085 Assembly Language

Address	**Instruction**		
2020	MVI	B, 24	; Copies 24 into accumulator
2022	INR	B	; Increment B reg content by 1
2023	MOV	A, B	; Copies B register into Acc.
2024	SUB	B	; Subtracts B reg content from Acc and stores the result in Acc.
2025	STA	[5F FF]	; Stores the Acc content into the memory location 5F FF.
2028	HLT		; Stops the program

Solve It !!

```
MVI   A, 24H        // load Reg  ACC with 24H
MVI   B , 56H       // load Reg B with 56H
ADD   B             // ACC= ACC+B
OUT 01H             // Display ACC contents on port 01H
HLT                 // End the program
```

OUTPUT ??

Example of 8086 Assembly Language

- Machine Language vs Assembly Language
  - Machine language or object code is the only code a computer can execute but it is nearly impossible for a human to work with
  - E4 27 88 C3 E4 27 00 D8 E6 30 F4 the object code for adding two numbers input from the keyboard
- When programming a microprocessor, programmers often use assembly language
  - This involves 3-5 letter abbreviations for the instruction codes (mnemonics) rather than the binary or hex object codes

Address	Hex Object Code				Mnemonics		Comment
					Op-Code	Operand	
0100	E4	27			IN	AL,27H	Input first number from port 27H and store in AL
0102	88	C3			MOV	BL,AL	Save a copy of register AL in register BL
0104	E4	27			IN	AL,27H	Input second number to AL
0106	00	D8			ADD	AL,BL	Add contents of BL to AL and store the sum in AL
0107	E6	30			OUT	30H,AL	Output AL to port 30H
0109	F4				HLT		Halt the computer

Thank You !!

Good Luck with the course ☺