Introduction to Microprocessor

Microprocessor and Microcontroller

Session Objectives

- To explain the definition of Microprocessor
- To understand the components of 8086 trainer kit
- To understand the execution procedure

Session Outcomes

- At the end of the session, students will be able to
  - Understand basics of microprocessor.
  - Understand the components of 8086 trainer kit
  - Understand the execution procedure

Definition of Microprocessor

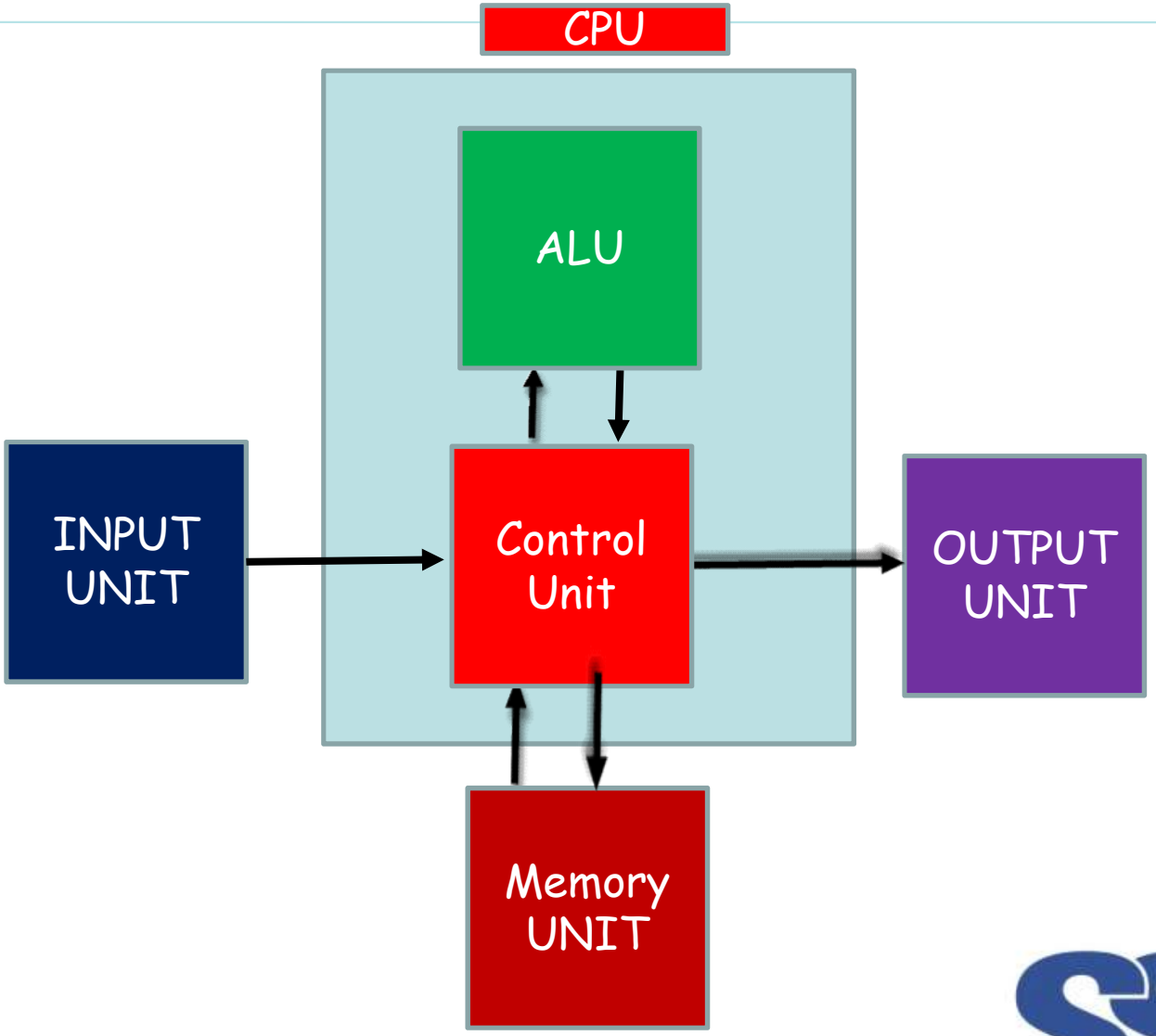
- Microprocessor (μP) is the Central Processing Unit of Microcomputer
- It can be implemented on single semiconductor chip.
- The word comes from the combination micro and processor.
- Processor means a device that processes whatever(binary numbers, 0's and 1's)
- To process means to manipulate. It describes all manipulation.

Classification of Microprocessor

- Microprocessor can be classified based on
  - The number of bits handled by the processor
    8 bit, 16 bit, 32 bit, etc. processors
  - Depending on the Instruction set of the processor
    - Reduced Instruction Set Computer (RISC)
    - Complex Instruction Set Computer (CISC)
  - Applictions
    - General purpose,
    - special purpose such image processing, floating point calculations

    And more …

Block Diagram of Micro Computer



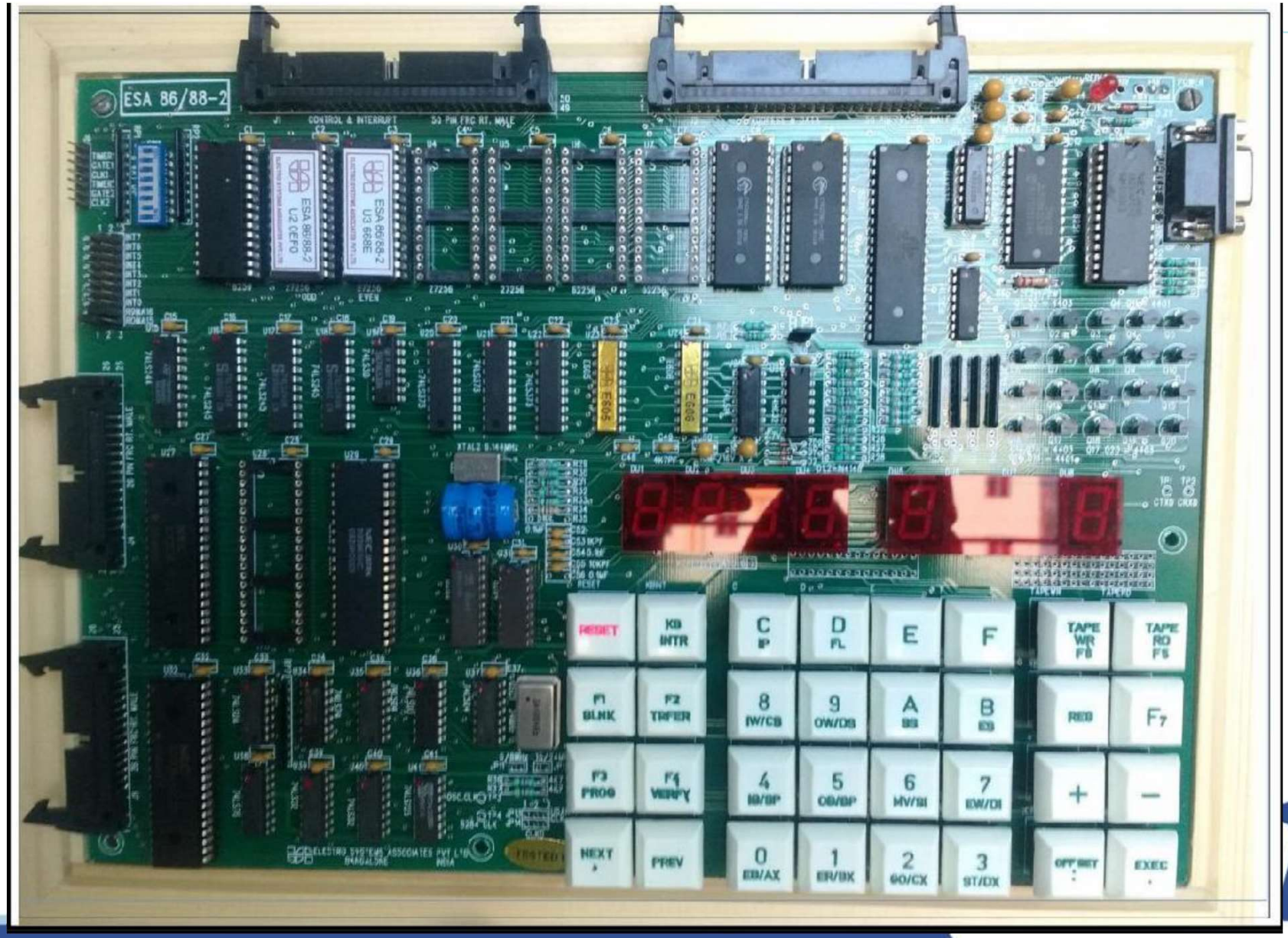
Evolution of Intel Microprocessor

8086	1979
286	1982
386	1985
486	1989
Pentium	1993
Pentium Pro	1995
Pentium MMX	1997
Pentium II	1997
Pentium II (Celeron)	1998
Pentium II (Zeon)	1998
Pentium III	1999
Pentium IV	2000
Petium IV Zeon	2001
Duo Core	2006

Example of other Processors

- Widely used processors
  - Mimic/68K
    - Introduced by Motorola
  - MIPS
    - RISC Machine
    - Developed by MIPS Technologies
  - ARM
    - Advanced RISC Machine
    - Acorn RISC Machine from Acorn Computers in 1990
    - ARM was established and ARM was renamed as Advanced RISC Machines.
  - PowerPC
    - Performance Optimization With Enhanced RISC – Performance Computing, sometimes abbreviated as PPC
    - Apple-IBM-Motorola alliance known as AIM
  - Atmel AVR

8086 trainer kit



Features of the ESA -86/88 Microprocessor Trainer

- 8086 CPU operating at 8 MHz MAX mode.
- Provision for on-board 8087 (NDP) coprocessor.
- Provision for 256 KB of EPROM & 128 KB of RAM onboard
- Battery backup facility for RAM.
- 48 programmable I/O lines using two 8255‟s
- Timer1 & Timer2 signals are brought out to header pins
- Priority Interrupt Controller (PIC) for eight input using 8259A
- In standalone mode using on board keypad or with PC compatible system through its RS-232 interface
- Display is 8 seven segment LED

Features of the ESA -86/88 Microprocessor Trainer

- Designed & engineered to integrate user‟s application specific interface conveniently at a minimum cost.
- Powerful & user-friendly keyboard / serial monitor, support in development of application programs.
- Software support for development of programs on Computer, the RS-232C interface cable connecting to computer from the kit facilitates transfer of files between the trainer kit & computer for development & debugging purposes.
- High quality reliable PCB with solder mask on both sides & clear legend prints with maximum details provided for the user.

SPECIFICATIONS:

- CPU: Intel 8086 operating at 8 MHz in MAX mode.
- MEMORY: Total 1MB of memory is in the Kit provided.
- EPROM: 4 JEDEC compatible sockets for EPROM
- RAM: 4 JEDEC compatible sockets for RAM
- PARALLEL I/O: 48 I/O lines using two 8255
- SERIAL I/O: One RS-232C compatible interface Using UART 8251A
- TIMER: Three 16 bit counter / timers 8253ACounter 1 is used for serial I/O Baud rate generation.

EXECUTION PROCEDURE FOR 8086

- Check if DIP switches board is in serial or keyboard mode (Serial mode = 1 on, Board mode = 4 On)
- Press Reset Press „EB"(Examine Byte) Enter Starting Memory location (Ex: 2000)
- Press next button, Enter OP-Code value
- Then press next button
- Enter 2nd memory location and op code . . . Enter up to nth values

EXECUTION PROCEDURE FOR 8086

- Execution:
- Press Exec. Button Press Go enter starting memory location
- Press Exec.
- Press EB give input memory location and input values
- Press Exec.
- Press Go Give starting memory location Press Exec.
- Press Go Now observe the results in memory location

Addition program with opcode

```
0000                          CODE    SEGMENT
                                      ASSUME CS:CODE, DS:CODE
0000  B1 00                           MOV CL, 00H
0002  BB 3000                        MOV BX, 3000H
0005  8B 07                          MOV AX, [BX]
0007  03 47 02                       ADD AX, [BX]+02H
000A  73 02                          JNC SKIP
000C  FE C1                          INC CL
000E  89 47 04                SKIP:   MOV [BX]+04H, AX
0011  88 4F 06                       MOV [BX]+06H, CL
0014  F4                              HLT
0015                          CODE    ENDS
                                      END
```

Subtraction program with opcode

```
0000                            CODE    SEGMENT
                                        ASSUME CS:CODE, DS:CODE
0000  B1 00                             MOV CL, 00H
0002  BB 3000                           MOV BX, 3000H
0005  8B 07                             MOV AX, [BX]
0007  2B 47 02                          SUB AX, [BX]+02H
000A  73 04                             JNC SKIP
000C  F7 D8                             NEG AX
000E  FE C1                             INC CL
0010  89 47 04                  SKIP:   MOV [BX]+04H, AX
0013  88 4F 06                          MOV [BX]+06H, CL
0016  F4                                HLT
0017                            CODE    ENDS
                                        END
```

Multiplication program with opcode

```
0000                            CODE    SEGMENT
                                        ASSUME CS:CODE, DS:CODE
0000  BE 3000                           MOV SI, 3000H
0003  8B 04                            MOV AX, [SI]
0005  8B 4C 02                         MOV cX, [SI]+02H
0008  F7 E1                            MUL cx
000A  89 44 04                         MOV [SI]+04H, AX
000D  89 54 06                         MOV [SI]+06H, DX
0010  F4                               HLT
0011                            CODE    ENDS
                                        END
```

Division program with opcode

```
0000                            CODE    SEGMENT
                                        ASSUME CS:CODE, DS:CODE
0000  BE 3000                           MOV SI, 3000H
0003  8B 04                            MOV AX, [SI]
0005  BA 0000                          MOV DX, 0000H
0008  8B 4C 02                         MOV cX, [SI]+02H
000B  F7 F1                            DIV CX
000D  89 44 04                         MOV [SI]+04H, AX
0010  89 54 06                         MOV [SI]+06H, DX
0013  F4                               HLT
0014                            CODE    ENDS
                                        END
```

Logical operations

- CS cannot be the destination operand
- Only one of the operands can be a segment register

Segment	Offset	Special purpose
CS	IP	Instruction address
SS	SP OR BP	Stack address
DS	BX, DI,SI	Data address
ES	DI for string	String destination address

Logical operations

- Result = AX. NUM1 + NUM2’ ⊕ BX + CX

```
DATA  SEGMENT
        AX1 DB 1111H
        BX1 DB 2222H
        CX1 DB 3333H
        DX1 DB 4444H
        NUM1 DB 0AAA
        NUM2 DB 0CCCH
        RESULT DB 0000H
DATA ENDS
```

Logical operations

- Result = {AX. NUM1 + (NUM2' ⊕ BX) }+ CX

```
CODE SEGMENT

        ORG 2000H
        MOV AX, DATA
        MOV DS, AX
        LEA SI, AX1
        MOV AX, [SI]

        LEA SI, BX1
        MOV BX, [SI]
```

Logical operations

- Result = {AX. NUM1 + (NUM2’ ⊕ BX) }+ CX

```
LEA SI, CX1
MOV CX, [SI]

LEA SI, NUM1
LEA DI, NUM2

NOT WORD PTR[DI]
XOR BX, [DI]
```

Logical operations

- Result = {AX. NUM1 + (NUM2' $\oplus$ BX) }+ CX

```
AND AX, [SI]
OR AX,BX
OR AX,CX


LEA SI, RESULT1
MOV [SI], AX

INT 3
```

Summary

- The basic operations of microprocessor.
- The components of 8086 microprocessor trainer kit
- The execution procedure of trainer kit

References

- Walter A Triebel and Avatar Singh, The 8088 and 8086 Microprocessors – Programming, Interfacing, Software, Hardware and Applications, Pearson, Fourth Edition, 2002.

Thank you