

Unit 5

Introduction to 8086 Microprocessor

Introduction

- A **microprocessor** is a computer processor that incorporates the functions of a central processing unit on a single [integrated circuit](#) (IC), or at most a few integrated circuits.
- Microprocessors contain both [combinational logic](#) and [sequential digital logic](#).
- Microprocessors operate on numbers and symbols represented in the [binary number system](#).
- A microprocessor executes a collection of machine instructions that tell the processor what to do
- Microprocessor is multipurpose, programmable logic device that reads the binary instruction from storage device like memory, accepts the binary data as input and processes data according to those instructions, and provides the results as output.
- Microprocessors have been developed by various companies like Intel, AMD, Motorola, IBM, Sun etc.
- Initially Microprocessors were of 8 bit then we had 16 bit, 32 bit, and the latest is 64 bit microprocessors.

Introduction

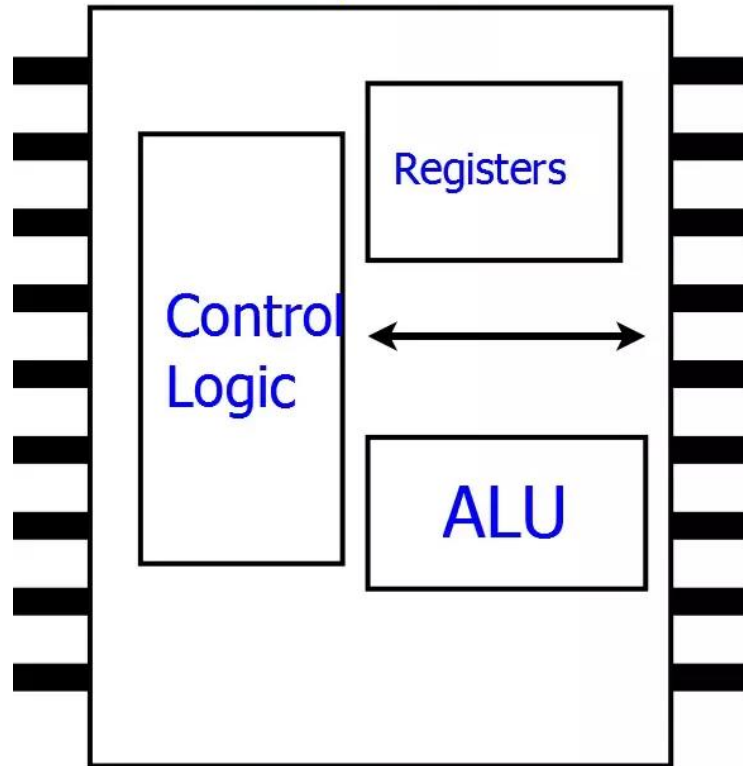
- Example of 8 bit microprocessors: Intel 8085, Motorola 6809, Zilog Z80 etc.
- Example of 16 bit microprocessors: Intel 8086, Intel 80286, Motorola 68000, Zilog 8000 etc.
- Example of 32 bit microprocessors: Intel 486, Pentium, Pentium pro, Celeron, Pentium II, Pentium III etc.
- Example of 64 bit microprocessors: Intel Pentium 4EE, Itanium, SUN Ultrasparc, DEC Alpha 21264 etc.

Overview of Microprocessor and Microcomputer

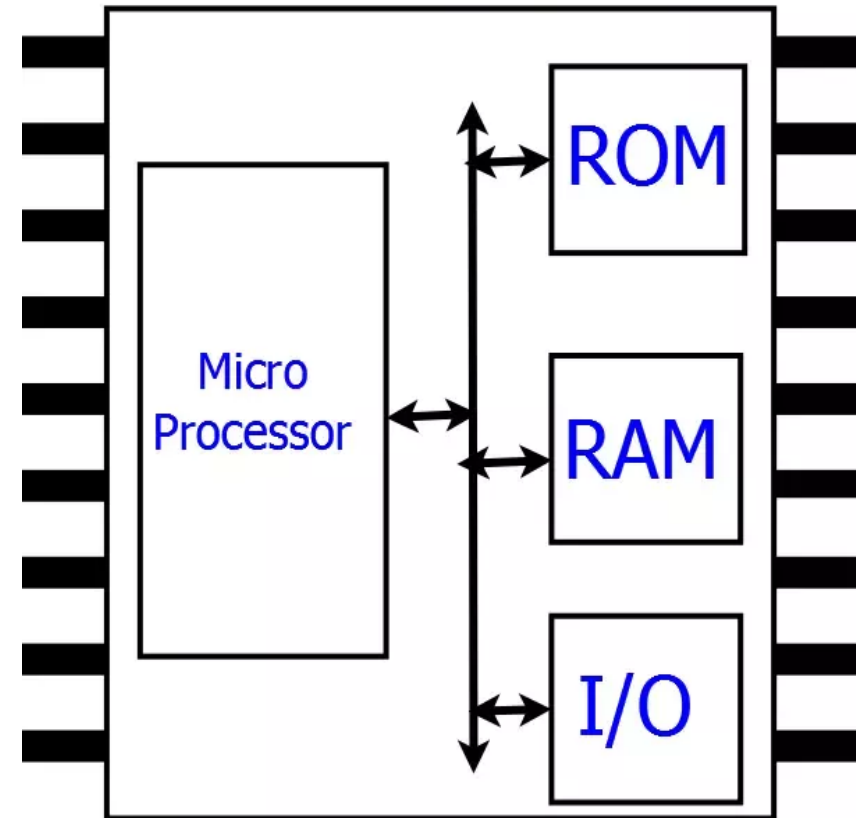
- Microprocessor: Microprocessor is a simple central processing unit (CPU) on a single chip (remember the word 'Single Chip'). It includes Arithmetic logic unit (ALU), control unit (CU), registers, instruction decoders, bus control circuit etc. but everything should be on a single chip.
- Microcomputer: it is a digital system consisting of microprocessor, memory and I/O devices connected using system bus. The system bus includes data, address and control buses.

Overview of Microprocessor and Microcomputer

Microprocessor



Microcontroller



Features of 8086 Microprocessor

- 8086 Microprocessor is an enhanced version of 8085 Microprocessor that was designed by Intel in 1976.
- It supports two modes of operation, i.e. Maximum mode and Minimum mode (Two hardware modes: Maximum and Minimum mode).

Maximum mode is suitable for system having multiple processors and Minimum mode is suitable for system having a single processor.

- 40 pin DIP(Dual Inline Package).
- 16 bit ALU.
- 16 bit data bus.
- 20 bit address bus, total addressable memory 1 MB.

Features of 8086 Microprocessor

- Two internal hardware units:
 - **BIU (Bus interface unit)**
 - **EU (Execution Unit)**
- 6 byte pre fetch queue.
- Four 16 bit **general purpose registers** (AX, BX, CX, DX) also accessible as eight 8 bit registers (AH, AL, BH, BL, CH, CL, DH and DL).
- Two 16 bit **index registers** (SI and DI)
- Two 16 bit **stack pointers** (SP and BP)
- Four 16 **bit segment registers** (CS, DS, ES, SS)
- 16 bit instruction Pointer register (IP)

Features of 8086 Microprocessor

- 16 bit **flag registers** : six conditional flags (OF, SF, ZF, PF, AF, CF) and three control flags (DF, IF and TF).
- **Memory divided into odd and even banks** and accessible simultaneously to read 16 bit word in one cycle.

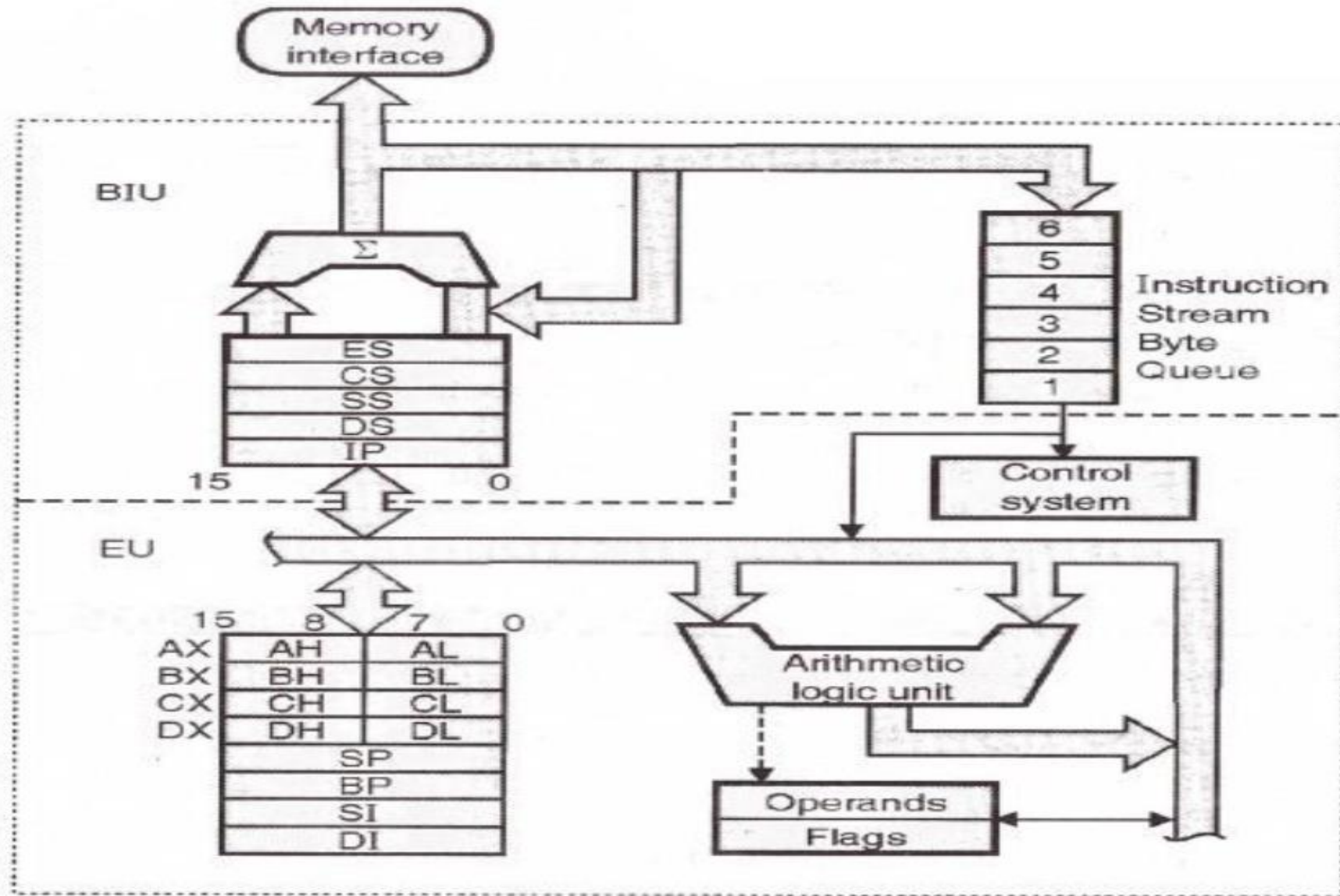
The 8086 Architecture

- 8086 has two blocks BIU and EU.
- The BIU performs all bus operations such as instruction fetching, reading and writing operands from memory and calculating the addresses of the memory operands.
- The instruction bytes are transferred to the instruction queue.
- EU executes instructions from the instruction queue.
- Both units operate independently to give the 8086 an overlapping instruction fetch and execution mechanism which is called as Pipelining.
- This results in efficient use of the system bus and system performance.

The 8086 Architecture

- BIU contains Instruction queue, Segment registers, Instruction pointer, Address adder.
- EU contains Control circuitry, Instruction decoder, ALU, Pointer and Index register, Flag register.

The 8086 Architecture



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8086 internal architecture

BUS INTERFACE UNIT (BIU)

- It provides a full 16 bit bidirectional data bus and 20 bit address bus.
- The bus interface unit is responsible for performing all external bus operations.
- Specifically it has the following functions:

Instruction fetch, Instruction queuing, Operand fetch and storage, Address relocation and Bus control.

The BIU uses a mechanism known as an instruction stream queue to implement a pipeline architecture.

- Functional Components of BIU:
- **Prefetch Queue, Segment Registers and Instruction Pointer**

Prefetch Queue (instruction Queue)

Prefetch Queue (instruction Queue):

- To increase the execution speed, BIU fetches as many as six instruction bytes ahead to time from memory.
- The pre fetched instruction bytes are held for the EU in a first in first out group of registers called a instruction queue.
- When the EU is ready for its next instruction, it simply reads the instruction from this instruction queue. This is much faster than sending out an address to the system memory and to send back the next instruction byte.
- Fetching the next instruction while the current instruction executes is called pipelining.

EXECUTION UNIT (EU)

- Execution unit gives instructions to BIU stating from where to fetch the data and then decode and execute those instructions.
- Its function is to control operations on data using the instruction decoder & ALU.
- EU has no direct connection with system buses, it performs operations over data through BIU.
- It contains 16 bit ALU, general purpose registers, pointer registers, index registers, flag registers and temporary operand registers.
- It gets instruction from Prefetch queue, decodes it and requests the BIU for data read or write operation if necessary and performs the steps to complete the execution of the instruction.