

Microprocessors and Microcontrollers

PC-EI 402

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Introduction

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 - * General block diagram of microprocessor based system
 - * General definition
 - * History of microprocessor

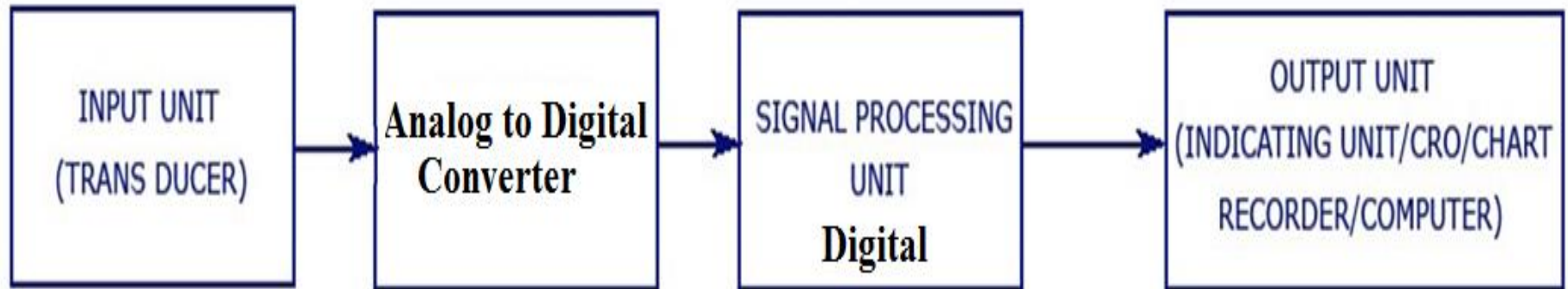
General Block Diagram of Instrumentation System

ANALOG INSTRUMENTATION SYSTEM



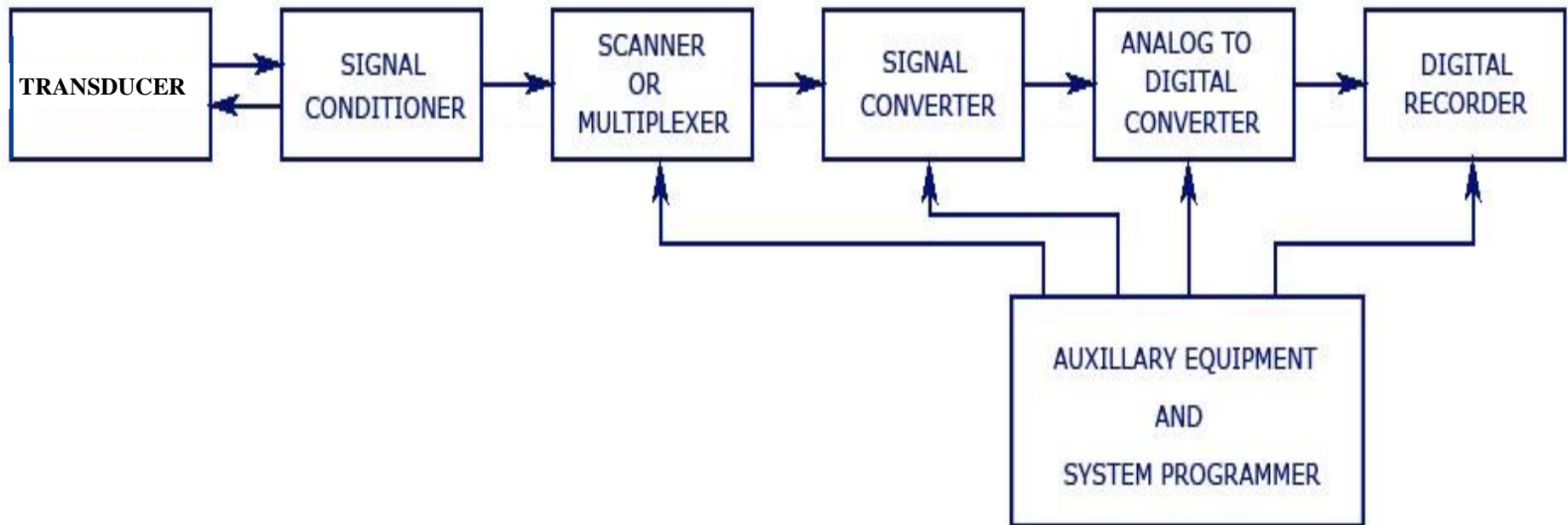
General Block Diagram of Instrumentation System

Digital INSTRUMENTATION SYSTEM

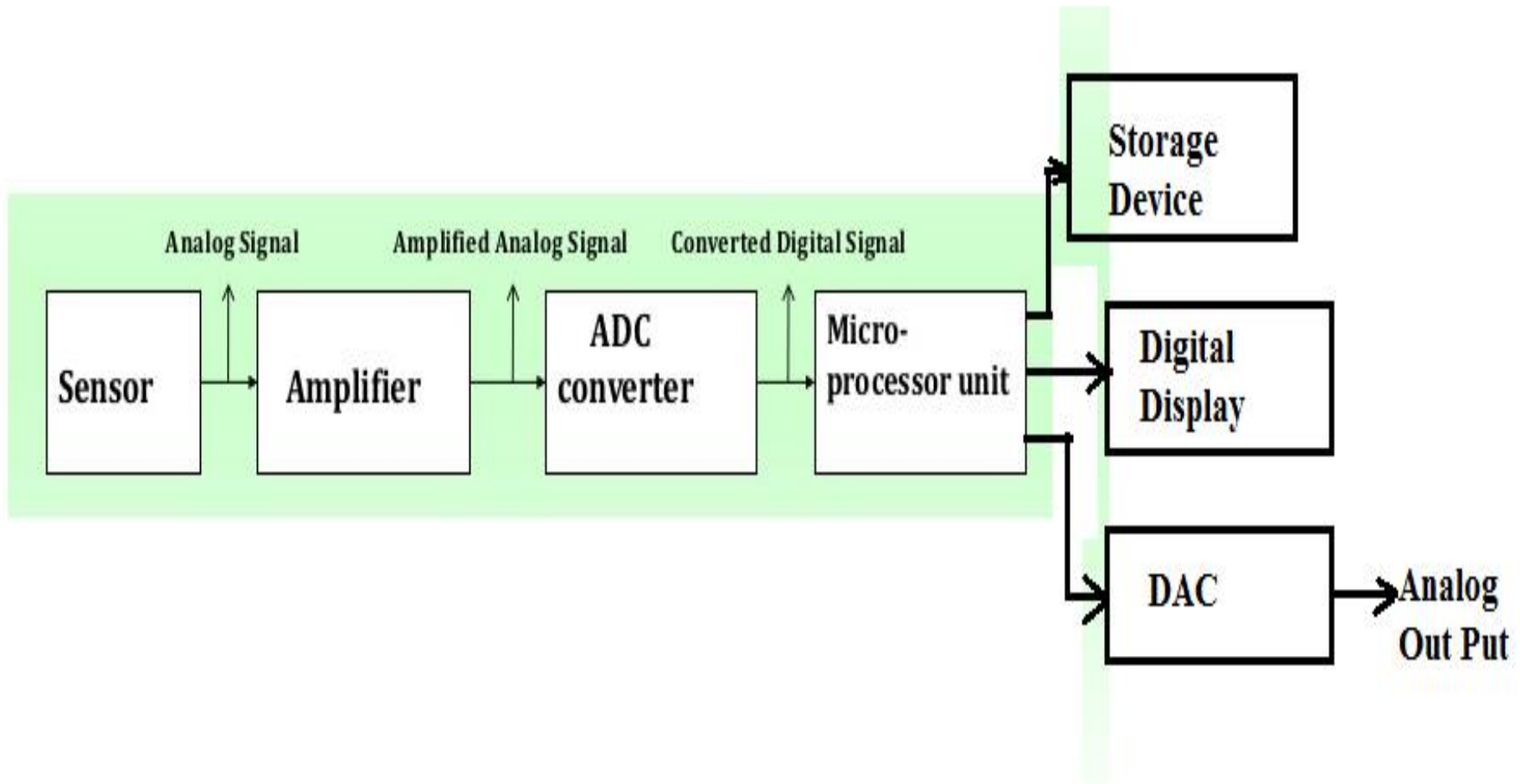


General Block Diagram of Instrumentation System

DIGITAL INSTRUMENTATION SYSTEM

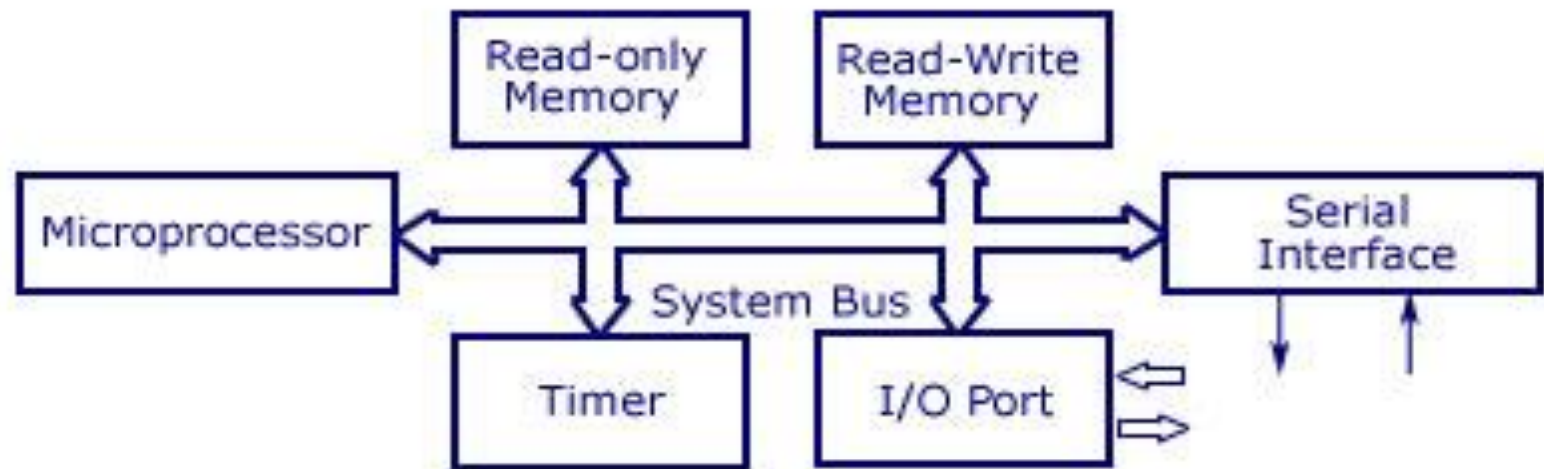


Microprocessor Based Systems

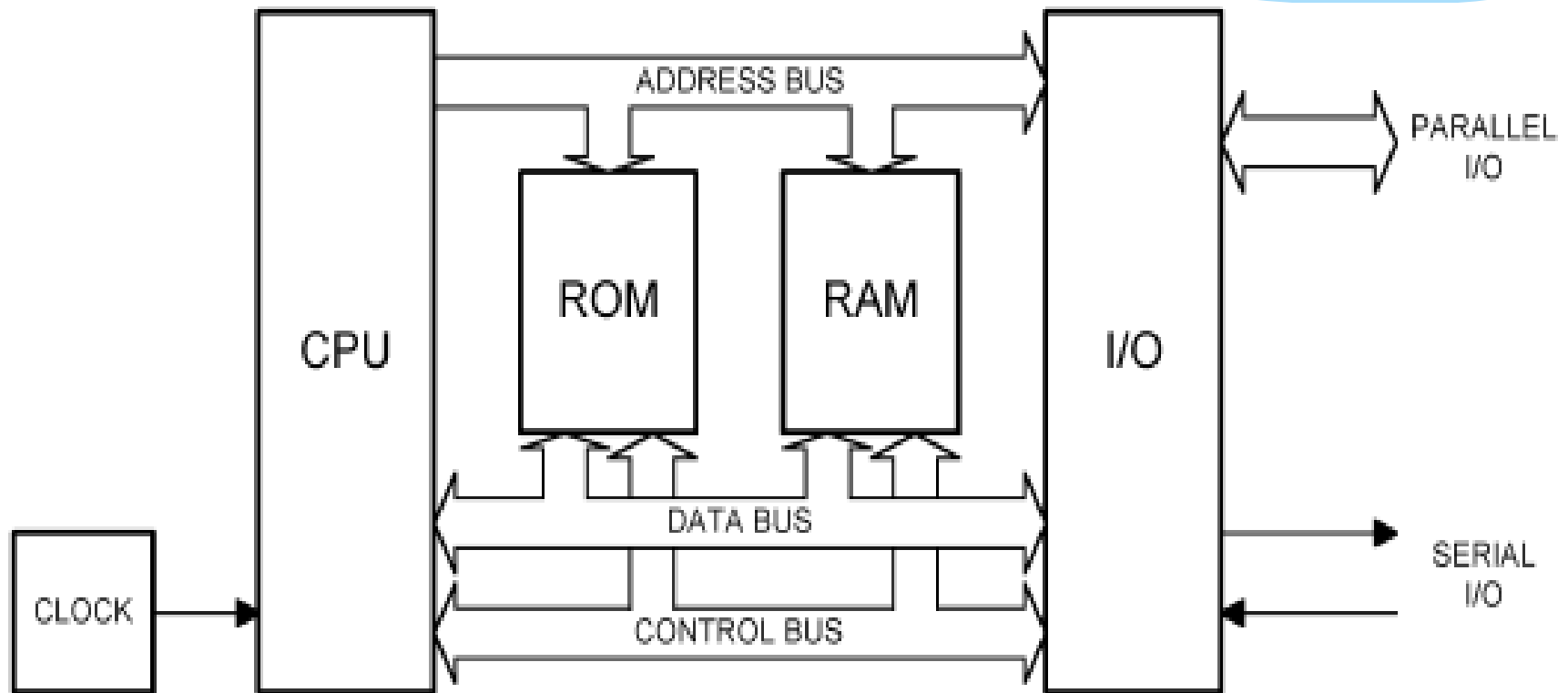


Microprocessor Based Systems

Schematic Arrangement of a Microprocessor Based System



Microprocessor Based Systems



General Definitions

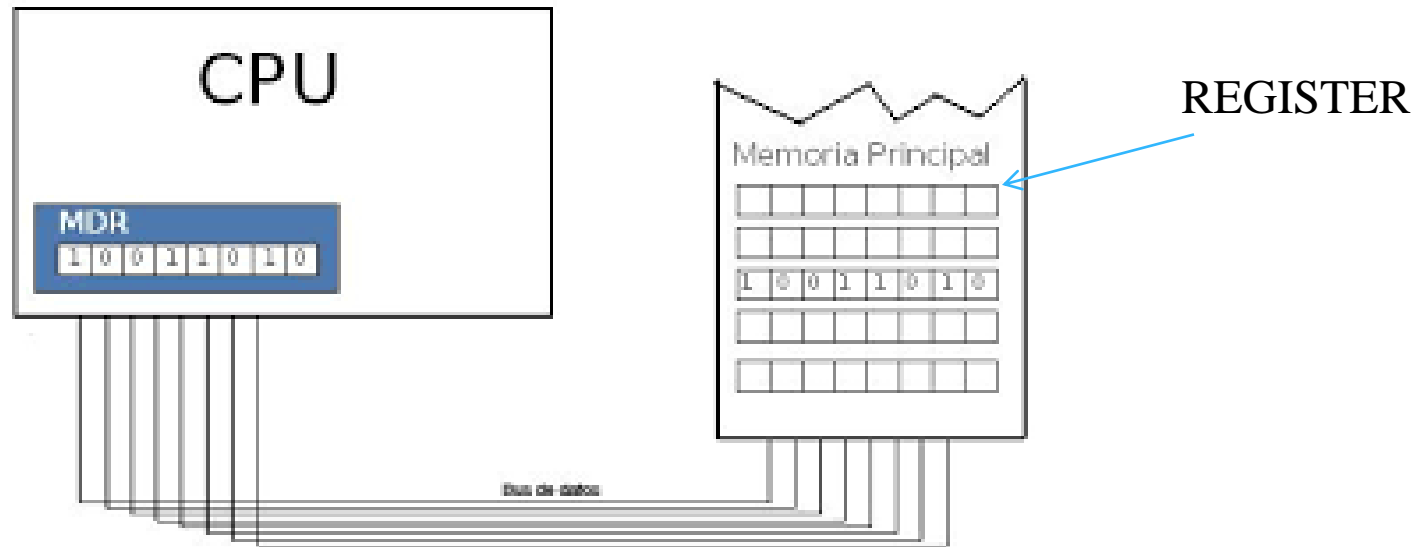
Bit size

The bit size of a microprocessor refers to the number of bits that can be processed simultaneously by the basic arithmetic circuits.(also called **word length** of processor)

General Definitions

Memory Word

- * The number of bits that can be stored in a register or memory elements is called memory word.



General Definitions

Bus

- * A bus is group of wires/lines that carry similar information.



General Definitions

Firmware

- * Software written for a microprocessor application without provision for changes is called firmware. These are stored in ROM of computer.

General Definitions

High level language

- * A computer programming language in which programs are written without knowledge of the processor in which program will be executed.

E.g. FORTRAN, PASCAL, JAVA, etc.

General Definitions

Assembly language:

- * A programming language written using mnemonics or the instruction set of a particular microprocessor is called assembly language.
- * E.g. MOV A,B
- * ADD B

General Definitions

Machine language

- * Machine language refers to binary code programs that are specific to the processor and can be directly executed by the processor.

General Definitions

Assembler

- * A computer application (software) program that converts the assembly language program into machine language.



```
mov ax, 5  
inc bx  
add ax, bx
```

Assembler-programm



Assembler

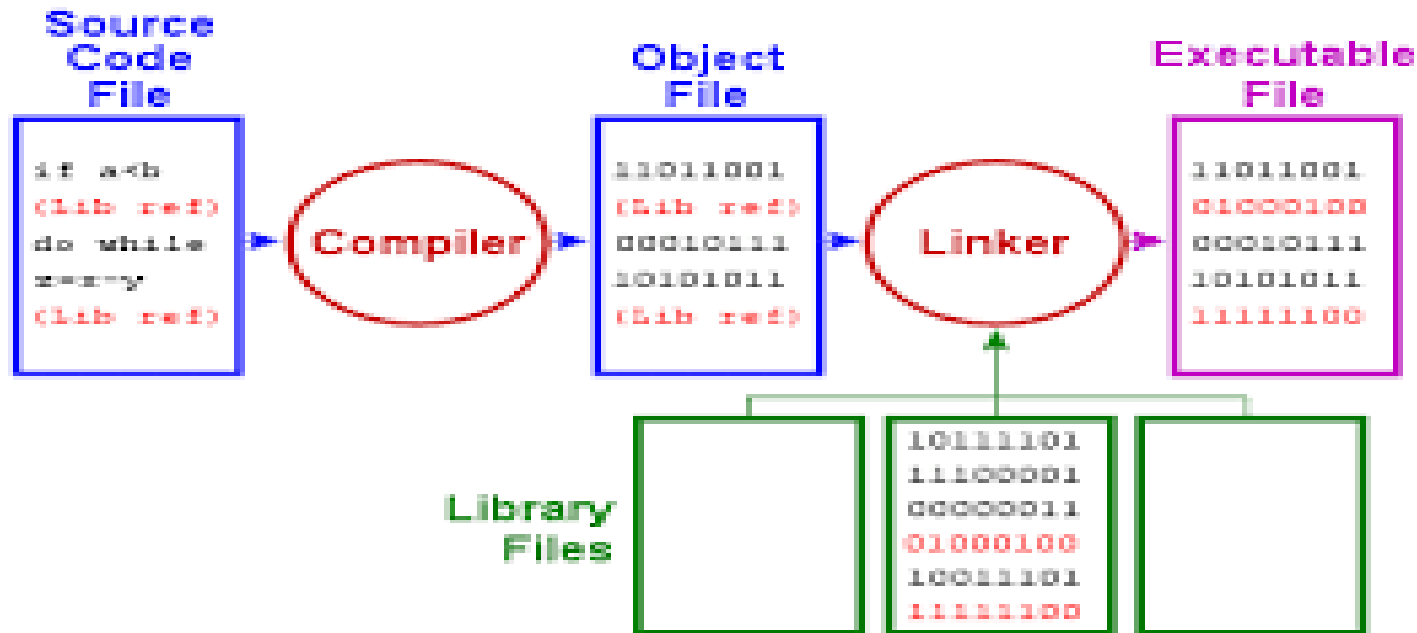
```
0010 0011  
1001 0110  
1001 0010  
... ..
```

Maschinen-sprache

General Definitions

Compiler

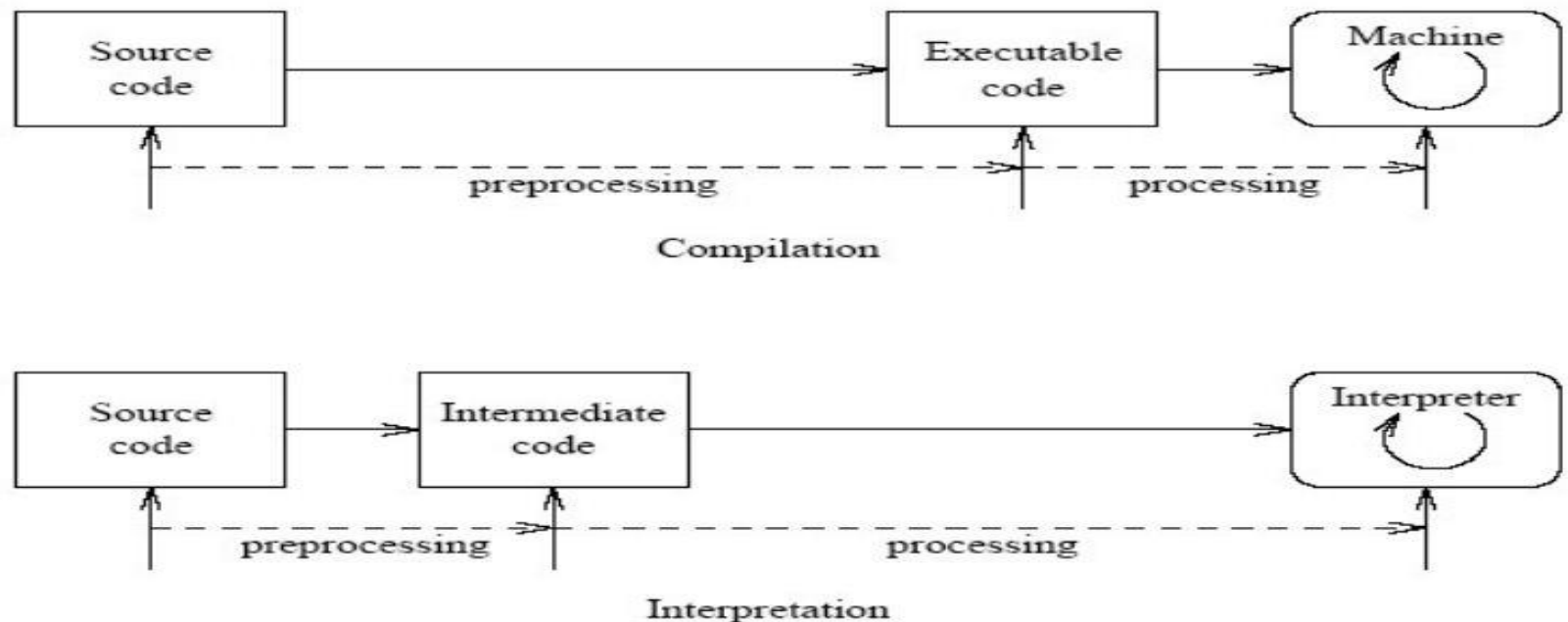
- * A compiler program that converts the high-level language program into machine-level language program.



General Definitions

Interpreter

- * A computer program that reads the high-level or assembly-level program one line at a time and converts into machine-level program.



Difference between compiler and interpreter

Sr No	Compiler	Interpreter
1	Compiler Takes Entire program as input	Interpreter Takes Single instruction as input .
2	Intermediate Object Code is Generated	No Intermediate Object Code is Generated
3	Conditional Control Statements are Executes faster	Conditional Control Statements are Executes slower
4	Memory Requirement : More (Since Object Code is Generated)	Memory Requirement is Less
5	Program need not be compiled every time	Every time higher level program is converted into lower level program
6	Errors are displayed after entire program is checked	Errors are displayed for every instruction interpreted (if any)
7	Example : C Compiler	Example : BASIC

General Definitions

Algorithm

- * A sequence of operation that defines how to solve a problem using a computer or microprocessor.

General Definitions

BIOS

- * Basic Input/Output System is a set of programs that handles the input and output functions and interacts with the hardware directly. A new hardware installed must be provided with the corresponding BIOS routine.

General Definitions

- * MIPS

- * Million instructions per second is a measure of the speed at which the instructions are executed in a processor.

General Definitions

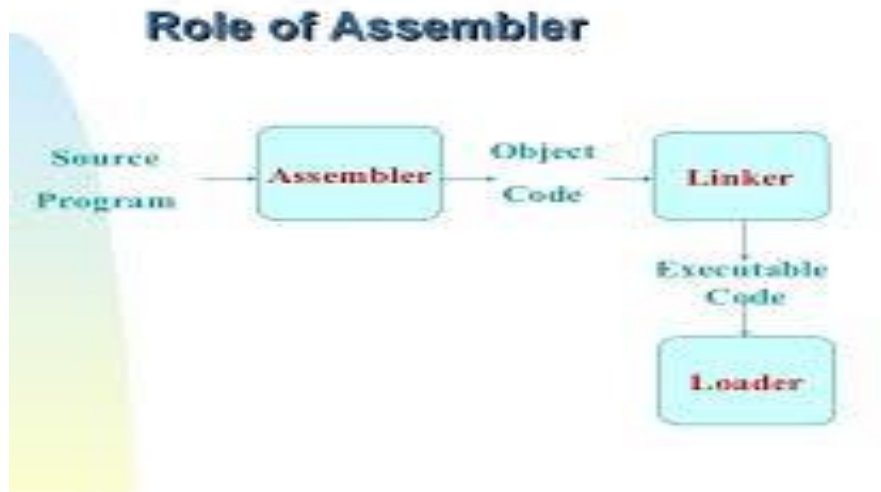
Operating System

- * The program that controls the entire computer and its resources and enables users to access the computer and its resources is called operating system.

General Definitions

Loader

- * The loader (or linker) is a program that takes the object file generated by the assembler and generates a file in binary code called com file or exe file.



General Definitions

Debugger

- * The debugger is a program that allows the user to test and debug the object file. The user can employ this program to perform the following functions:
 - * Make change in the object code.
 - * Examine and modify the content of memory.
 - * Set break points, execute a segment of the program and
 - * Display register content after the execution.

General Definitions

Cross Assembler

- * A cross-assembler is a program that can be used to translate 8085 mnemonics by a computer that has a microprocessor other than 8085.

General Definitions

Microprocessor:

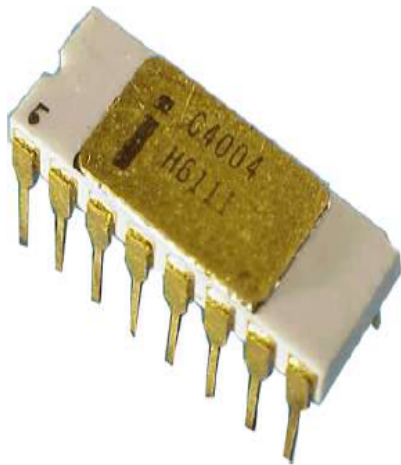
- * Integrated circuit that contains the entire central processing unit of a computer on a single chip.
- * Microprocessor is a device that integrates the functions of the CPU in a computer onto the IC or semiconductor chip.
- * Microprocessor is a clock driven semiconductor device consisting of electronic logic circuits manufactured by using either LSI or VLSI technology.



Evaluation of Microprocessor

4-BIT MICROPROCESSORS

INTEL 4004



- Introduced in 1971.
- It was the first microprocessor by Intel.
- It was a 4-bit μ P.
- Its clock speed was 740KHz.
- It had 2,300 transistors.
- It could execute around 60,000 instructions per second.

INTEL 4040

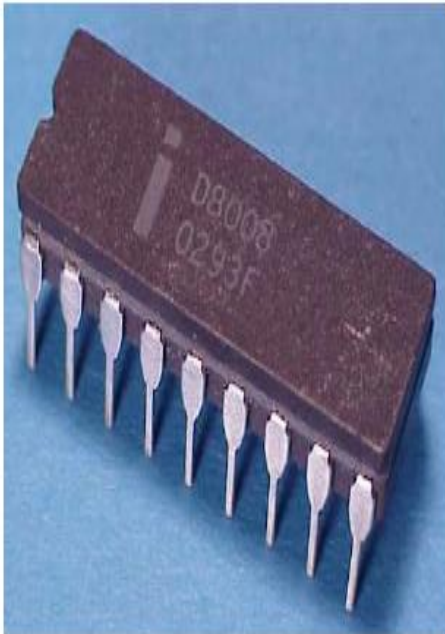


- Introduced in 1974.
- It was also 4-bit μ P.

Evaluation of Microprocessor

8-BIT MICROPROCESSORS

INTEL 8008



- Introduced in 1972.
- It was first 8-bit μ P.
- Its clock speed was 500 KHz.
- Could execute 50,000 instructions per second.

INTEL 8080



- Introduced in 1974.
- It was also 8-bit μ P.
- Its clock speed was 2 MHz.
- It had 6,000 transistors.
- Was 10 times faster than 8008.
- Could execute 5,00,000 instructions per second.

Evaluation of Microprocessor

8-BIT MICROPROCESSORS

INTEL 8085

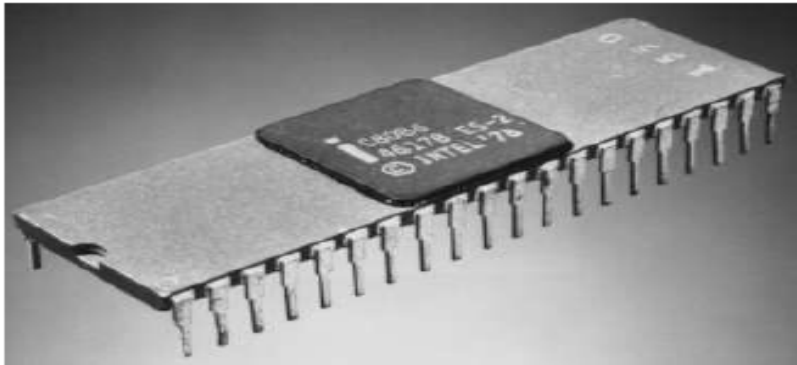


- Introduced in 1976.
- It was also 8-bit μ P.
- Its clock speed was 3 MHz.
- Its data bus is 8-bit and address bus is 16-bit.
- It had 6,500 transistors.
- Could execute 7,69,230 instructions per second.
- It could access 64 KB of memory.
- It had 246 instructions.
- Over 100 million copies were sold.

Evaluation of Microprocessor

16-BIT MICROPROCESSORS

INTEL 8086

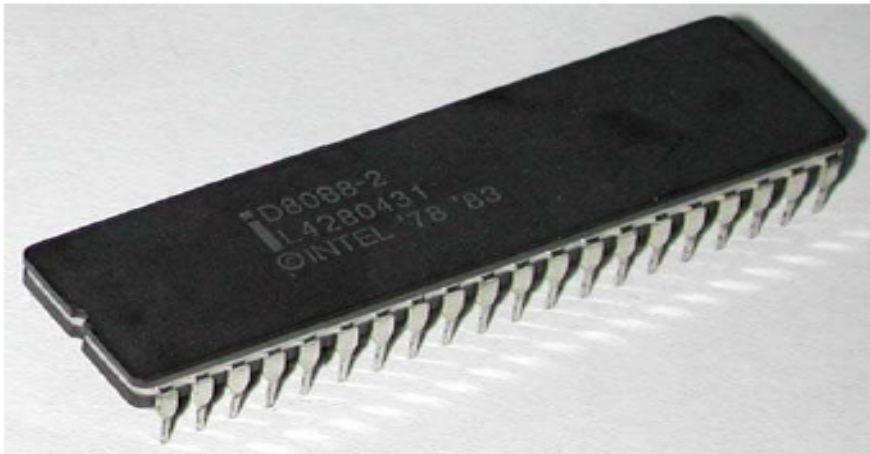


- Introduced in 1978.
- It was first 16-bit μ P.
- Its clock speed is 4.77 MHz, 8 MHz and 10 MHz, depending on the version.
- Its data bus is 16-bit and address bus is 20-bit.
- It had 29,000 transistors.
- Could execute 2.5 million instructions per second.
- It could access 1 MB of memory.
- It had 22,000 instructions.
- It had ***Multiply*** and ***Divide*** instructions.

Evaluation of Microprocessor

16-BIT MICROPROCESSORS

INTEL 8088



- Introduced in 1979.
- It was also 16-bit μ P.
- It was created as a cheaper version of Intel's 8086.
- It was a 16-bit processor with an 8-bit external bus.
- Could execute 2.5 million instructions per second.
- This chip became the most popular in the computer industry when IBM used it for its first PC.

Evaluation of Microprocessor

16-BIT MICROPROCESSORS

INTEL 80186 & 80188



- Introduced in 1982.
- They were 16-bit μ Ps.
- Clock speed was 6 MHz.
- 80188 was a cheaper version of 80186 with an 8-bit external data bus.
- They had additional components like:
 - Interrupt Controller
 - Clock Generator
 - Local Bus Controller
 - Counters

INTEL 80286



- Introduced in 1982.
- It was 16-bit μ P.
- Its clock speed was 8 MHz.
- Its data bus is 16-bit and address bus is 24-bit.
- It could address 16 MB of memory.
- It had 1,34,000 transistors.
- It could execute 4 million instructions per second.

Evaluation of Microprocessor

32-BIT MICROPROCESSORS

INTEL 80386



- Introduced in 1986.
- It was first 32-bit μ P.
- Its data bus is 32-bit and address bus is 32-bit.
- It could address 4 GB of memory.
- It had 2,75,000 transistors.
- Its clock speed varied from 16 MHz to 33 MHz depending upon the various versions.
- Different versions:
 - 80386 DX
 - 80386 SX
 - 80386 SL
- Intel 80386 became the best selling microprocessor in history.

INTEL 80486



- Introduced in 1989.
- It was also 32-bit μ P.
- It had 1.2 million transistors.
- Its clock speed varied from 16 MHz to 100 MHz depending upon the various versions.
- It had five different versions:
 - 80486 DX
 - 80486 SX
 - 80486 DX2
 - 80486 SL
 - 80486 DX4
- 8 KB of cache memory was introduced.

Evaluation of Microprocessor

32-BIT MICROPROCESSORS

INTEL PENTIUM



- Introduced in 1993.
- It was also 32-bit μ P.
- It was originally named 80586.
- Its clock speed was 66 MHz.
- Its data bus is 32-bit and address bus is 32-bit.
- It could address 4 GB of memory.
- Could execute 110 million instructions per second.
- Cache memory:
 - 8 KB for instructions.
 - 8 KB for data.

INTEL PENTIUM PRO



- Introduced in 1995.
- It was also 32-bit μ P.
- It had L2 cache of 256 KB.
- It had 21 million transistors.
- It was primarily used in server systems.
- Cache memory:
 - 8 KB for instructions.
 - 8 KB for data.
- It had L2 cache of 256 KB.

Evaluation of Microprocessor

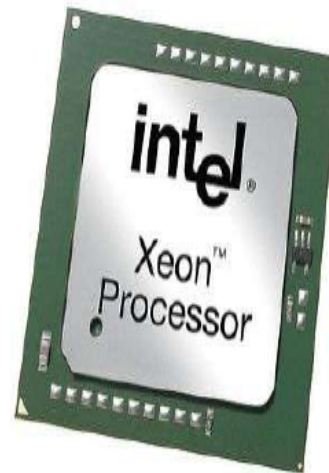
32-BIT MICROPROCESSORS

INTEL PENTIUM II



- Introduced in 1997.
- It was also 32-bit μ P.
- Its clock speed was 233 MHz to 500 MHz.
- Could execute 333 million instructions per second.
- MMX technology was supported.
- L2 cache & processor were on one circuit.

INTEL PENTIUM II XEON



- Introduced in 1998.
- It was also 32-bit μ P.
- It was designed for servers.
- Its clock speed was 400 MHz to 450 MHz.
- L1 cache of 32 KB & L2 cache of 512 KB, 1MB or 2 MB.
- It could work with 4 Xeons in same system.

Evaluation of Microprocessor

32-BIT MICROPROCESSORS

INTEL PENTIUM III



- Introduced in 1999.
- It was also 32-bit μ P.
- Its clock speed varied from 500 MHz to 1.4 GHz.
- It had 9.5 million transistors.

INTEL PENTIUM IV



- Introduced in 2000.
- It was also 32-bit μ P.
- Its clock speed was from 1.3 GHz to 3.8 GHz.
- L1 cache was of 32 KB & L2 cache of 256 KB.
- It had 42 million transistors.
- All internal connections were made from aluminium to copper.

Evaluation of Microprocessor

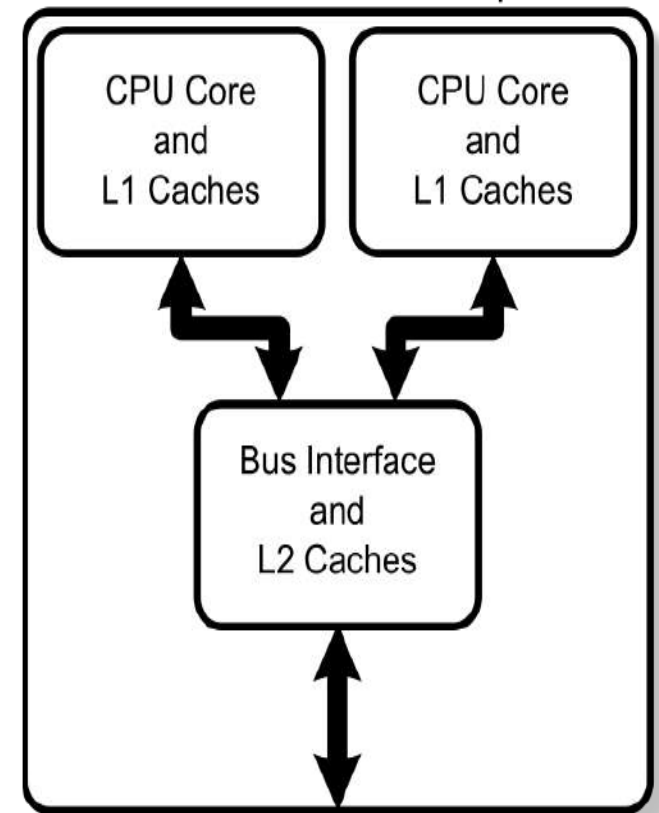
32-BIT MICROPROCESSORS

INTEL DUAL CORE



- Introduced in 2006.
- It is 32-bit or 64-bit μ P.
- It has two cores.
- Both the cores have their own internal bus and L1 cache, but share the external bus and L2 cache (Next Slide).
- It supported SMT technology.
- SMT: Simultaneously Multi-Threading
- E.g.: Adobe Photoshop supported SMT.

Dual CPU Core Chip



Evaluation of Microprocessor

64-BIT MICROPROCESSORS

INTEL CORE 2



- Introduced in 2006.
- It is a 64-bit μ P.
- Its clock speed is from 1.2 GHz to 3 GHz.
- It has 291 million transistors.
- It has 64 KB of L1 cache per core and 4 MB of L2 cache.
- It is launched in three different versions:
 - Intel Core 2 Duo
 - Intel Core 2 Quad
 - Intel Core 2 Extreme

INTEL CORE i7



- Introduced in 2008.
- It is a 64-bit μ P.
- It has 4 physical cores.
- Its clock speed is from 2.66 GHz to 3.33 GHz.
- It has 781 million transistors.
- It has 64 KB of L1 cache per core, 256 KB of L2 cache and 8 MB of L3 cache.

Evaluation of Microprocessor

64-BIT MICROPROCESSORS

INTEL CORE I5



- Introduced in 2009.
- It is a 64-bit μ P.
- It has 4 physical cores.
- Its clock speed is from 2.40 GHz to 3.60 GHz.
- It has 781 million transistors.
- It has 64 KB of L1 cache per core, 256 KB of L2 cache and 8 MB of L3 cache.

INTEL CORE I3



- Introduced in 2010.
- It is a 64-bit μ P.
- It has 2 physical cores.
- Its clock speed is from 2.93 GHz to 3.33 GHz.
- It has 781 million transistors.
- It has 64 KB of L1 cache per core, 512 KB of L2 cache and 4 MB of L3 cache.

Evolution of Intel Microprocessors

4-bit	8-bit	16-bit	32-bit	64-bit
4004	8008	8086	80386	Dual Core
4040	8080	8088	80486	Core 2
	8085	80186	Pentium/80586	Core i7
		80188	PII	Core i5
		80286	PIII	Core i3
			PIV	
			Dual Core	

Thank you