

Microprocessor and Computer Architecture



Dr. Trần Thị Anh Xuân

Department of Instrumentation and Industrial
Informatics

BM. Kỹ Thuật Đo & THCN – Viện Điện

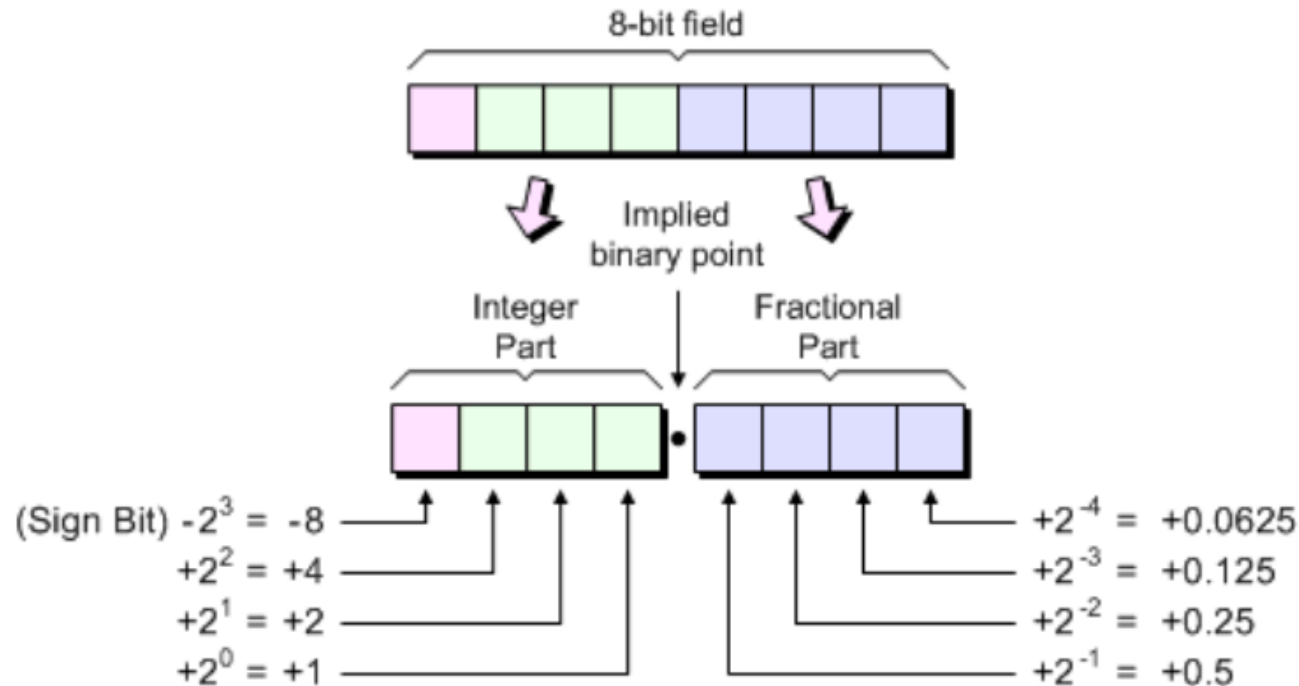
Documents

- MCS-51 Microcontroller Family Users Manual – Intel 1994



1.7.Fixed and Floating Point Number System

- Fixed Point Number System



8-bit signed binary 4.4 fixed-point representation



1.7.Fixed and Floating Point Number System

- Floating Point Number

- Floating-point numbers

$$x = \pm s \times b^e \quad \text{or} \quad \pm \text{significand} \times \text{base}^{\text{exponent}}$$

- The binary floating point numbers will always be of the general form:
 - $(\text{sign}) 1.\text{mmmmmm} \times 2^{\text{exponent}}$



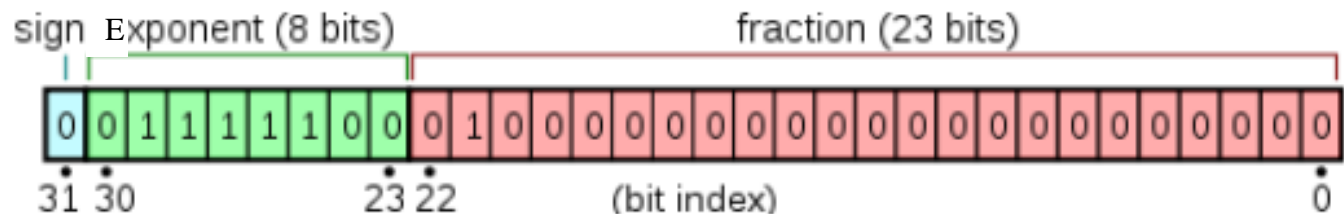
1.7.Fixed and Floating Point Number System

- Floating Point Number

- The ANSI/IEEE standard floating-point number representation formats

	Sign	Biased exponent	Significand $s = 1.f$ (the 1 is hidden)
	\pm	$e + \text{bias}$	f
32-bit:		8 bits, bias= 127	23+1 bits, single-precision or short format
64-bit:		11 bits, bias=1023	52+1 bits, double-precision or long format

- Example:

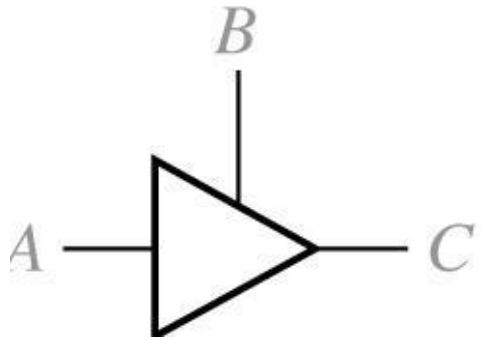


$$\text{value} = (-1)^{\text{sign}} \left(1 + \sum_{i=1}^{23} b_{23-i} 2^{-i} \right) \times 2^{(E - 127)}$$



1.8. Tri-state Buffer

- Tri-State Buffer, example:

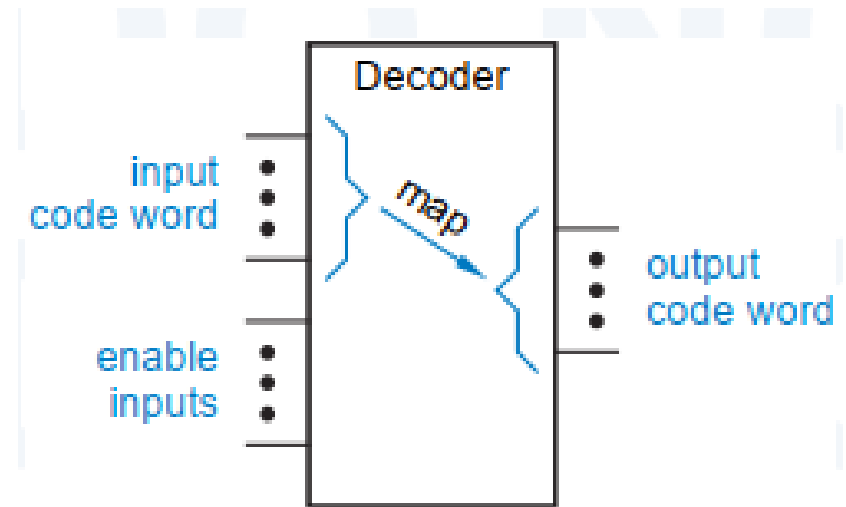


$$B = \begin{cases} 1, & C=A \\ 0, & \text{High-impedance} \end{cases}$$



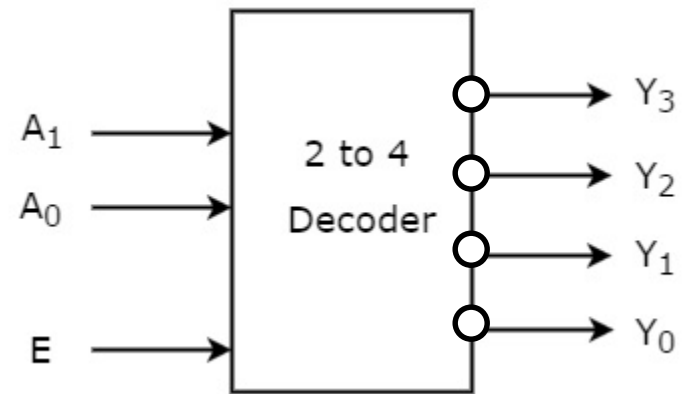
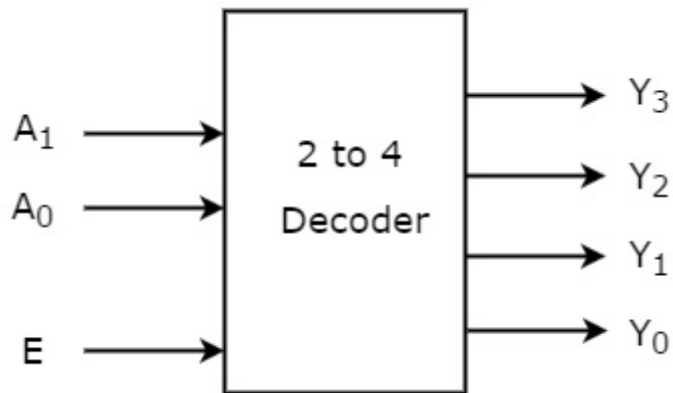
1.9. Decoders

- Decoder is a combinational circuit that has:
 - ‘n’ input lines
 - And maximum of 2^n output lines
 - One of these outputs will be active based on the combination of inputs present



1.9. Decoders

- Example 1: 2-to-4 Decoder



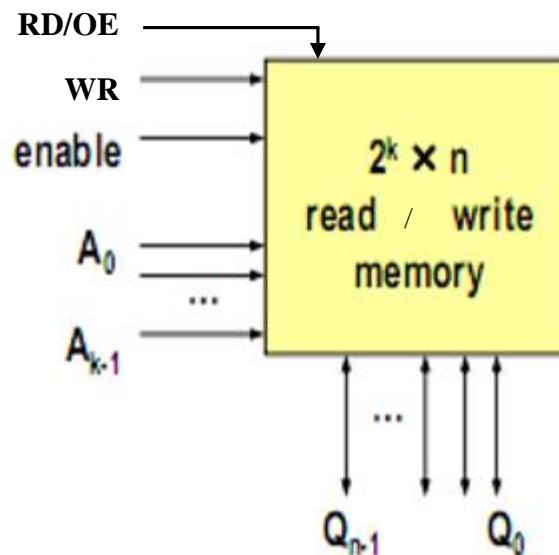
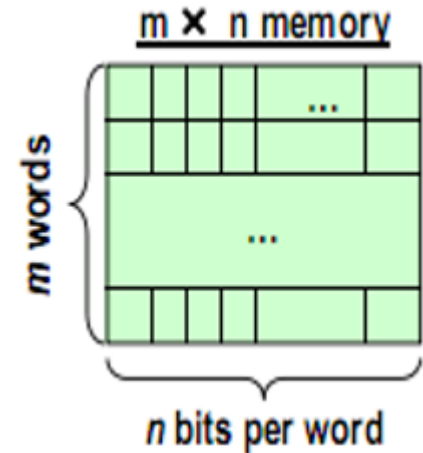
1.10. Register

- A collection of two or more D Flip-Flops with a common clock input is called a register
- Registers are often used to store a collection of data bits:
 - Can be the related bits, such as a byte of data in a computer
 - Can be the unrelated bits, such as bits of data or control information



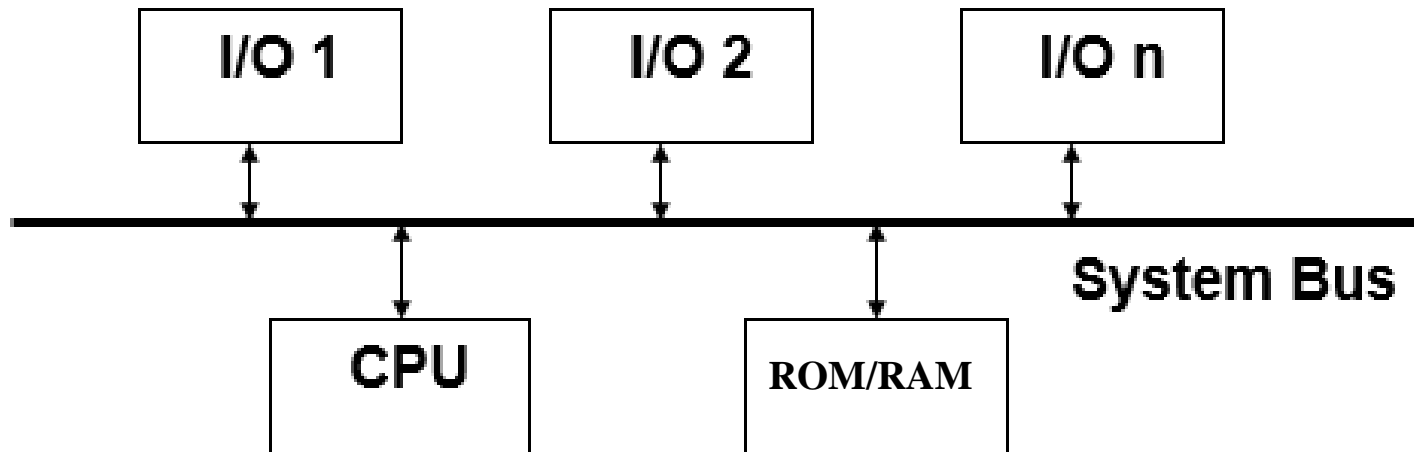
1.11. Memory

- Store large number of bits \rightarrow memory array:
 - Capacity: $m \times n$ (bits): m words of n bits each
- Memory access (Read/Write)
- Memory Architecture



1.12. The microprocessor based system

- Structure Diagram:



1.12. The microprocessor based system

- Including:
 - CPU (Central Processing Unit)
 - RAM/ROM
 - Peripheral I/O devices (interface circuit)
- } Connect together by System Bus



1.13.1. The microprocessor

- The Microprocessor (CPU):
 - is the master, which controls all the activities of the system
- Functions:
 - Calculate and data process control
 - Work done both internal and external to the processor



1.13.1. The microprocessor

- The Microprocessor types base on:
 - The word size
 - Instruction set structure
 - Functions
 - And more...



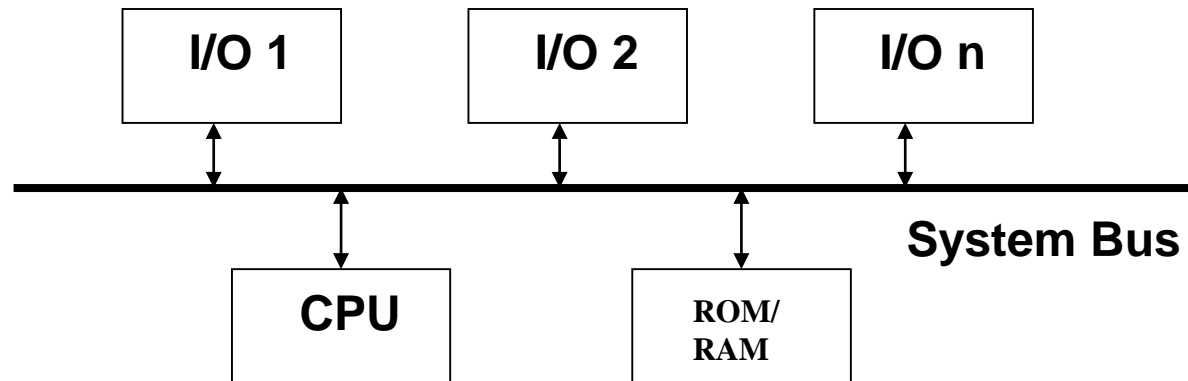
1.13.2. I/O Interfacing

- Functions:
 - is utilized to move information between internal storage and external Input/Output devices

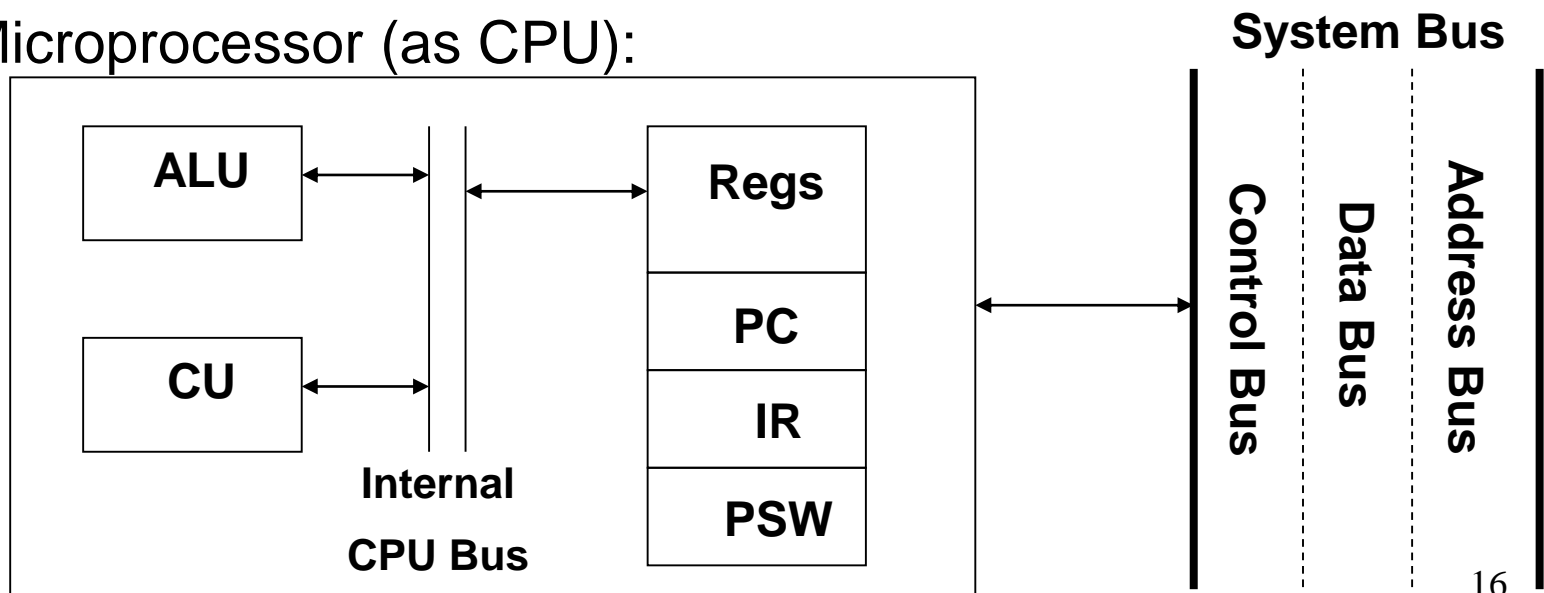


1.14. Internal structure of the Microprocessor (CPU)

- The Microprocessor based System:



- The Microprocessor (as CPU):



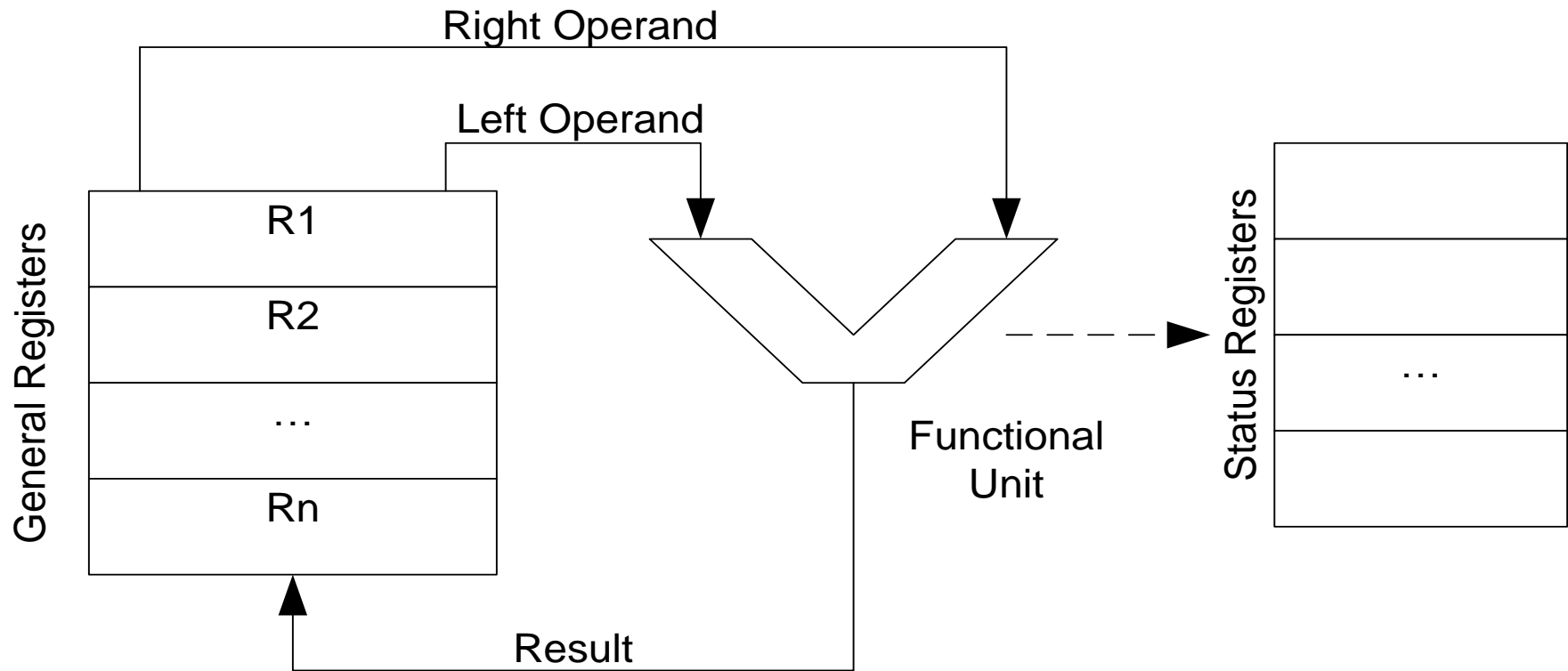
1.14. Internal structure of the Microprocessor (CPU)

- CPU includes 3 main components:
 - ALU (Arithmetic Logic Unit): do all computations
 - Register (PC, MAR, IR, MBR, SP,...): stores variables
 - CU (Control Unit)
- These components transfer data together by Internal Data Bus



1.14.1. ALU (Arithmetic Logic Unit)

- ALU Architecture:



1.14.2. Register

- Two types:
 - General purpose
 - Special purpose
- 1st type: General purpose registers
 - Used for storing temporary data/results
 - Example: Register A (Accumulator)



1.14.2. Register

- 2nd type: Special Register
 - PC (Program Counter)
 - For storing memory address of next executed instruction
 - IR (Instruction Register)
 - Contains whole content of current instruction
 - Still more...

