Ministry of Higher Education and Scientific Research
العلمي البحث و العالي التعليم وزارة

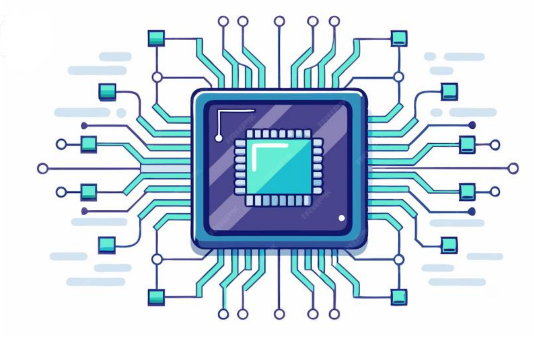
BADJI MOKHTAR-ANNABA UNIVERSITY
UNIVERSITE BADJI MOKHTAR-ANNABA

جامعة باجي مختار-عنابة

Faculty of technology
Electronics departement

Microcontrollers and Microprocessors course

Microcontrollers and Microprocessors
Course 1: Reminder

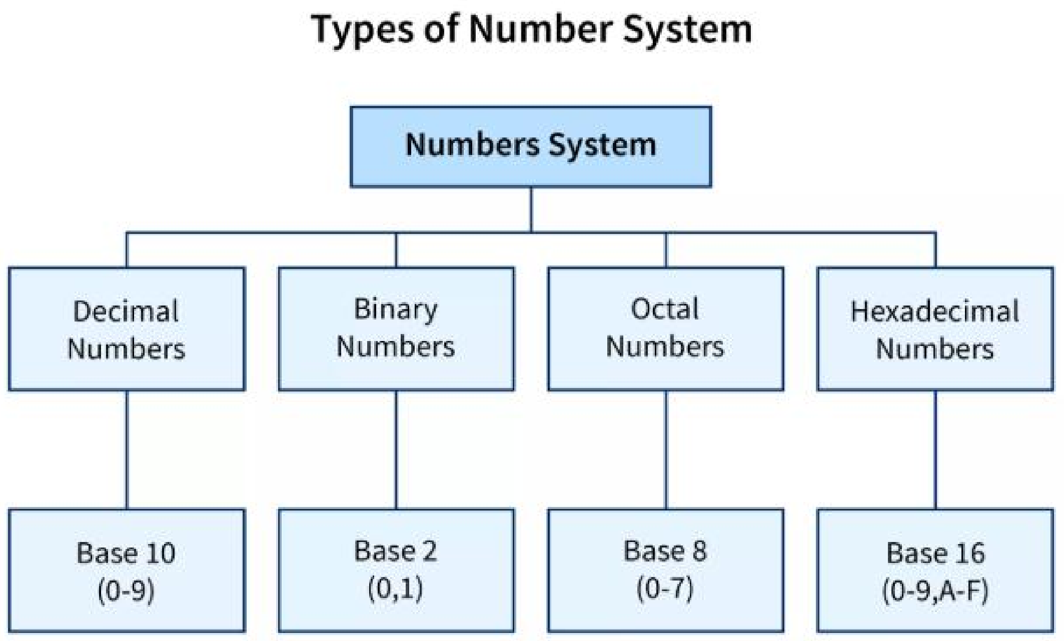


Teaching by
Dr. MERABTI Nardjes

L3 AUTO
Promotion : 2025/2026

Course Reminder: Basics Before Microprocessors & Microcontrollers

Numbers system



Why numbers system are matter in Microprocessors & Microcontrollers

- **Binary:** Everything inside the processor is binary—it's the language of the machine, Data is stored and manipulated in binary
- **Hexadecimal:** Used to simplify long binary numbers , Memory and registers) addresses are often shown in hexadecimal
- **Octal:** Useful for grouping binary bits (especially in older systems or low-level programming).
- **Decimal:** Used for input/output and user-facing data.

❖ Decimal (Base 10)

This is the number system we use every day: 0 to 9

- **Example:**

25, 100, 2025

Microprocessors convert decimal numbers into binary to process them

❖ Binary (Base 2)

Used inside the microprocessor

Only two digits: 0 and 1

Everything—numbers, instructions, data—is stored and processed in binary

- **Example:**

1010 (binary) = 10 (decimal)

❖ Octal (Base 8)

Octal uses 8 digits: 0 to 7

It’s a shortcut for binary, just like hexadecimal

Each octal digit represents 3 binary bits

- **Example:**
- Binary: 11001000
- Group into 3 bits: 011 001 000
- Octal: 310
- Decimal: 200

❖ Hexadecimal (Base 16)

Used to simplify binary

Digits: 0–9 and A–F (A=10, B=11, ..., F=15)

Easier to read and write than long binary strings

- **Example:**

FF (hex) = 255 (decimal) = 11111111 (binary)

If you want to store the number 200:

Decimal: 200, **Binary:** 11001000, **Hexadecimal:** C8

❖ BCD = Binary Coded Decimal.

It means each decimal digit (0–9) is written in binary using 4 bits.

BCD is mainly used in microprocessors/microcontrollers for display purposes (digital watches, calculators, etc.), because it is easier to handle each digit directly.

- **Example:** Decimal 59

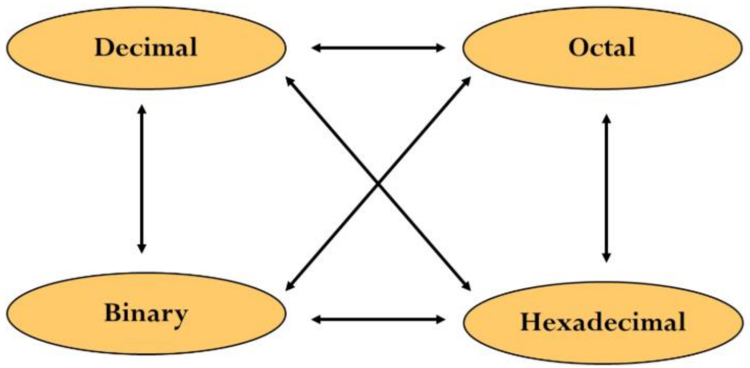
"5" → 0101 in binary

"9" → 1001 in binary

So in BCD: 59 = 0101 1001

Decimal Base-10	Binary Base-2	Octal Base-8	Hexa Decimal Base-16
0	0	0	0
1	1	1	1
2	10	2	2
3	11	3	3
4	100	4	4
5	101	5	5
6	110	6	6
7	111	7	7
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F
16	10000	20	10

Decimal	Binay (BCD) 8 4 2 1
0	0 0 0 0
1	0 0 0 1
2	0 0 1 0
3	0 0 1 1
4	0 1 0 0
5	0 1 0 1
6	0 1 1 0
7	0 1 1 1
8	1 0 0 0
9	1 0 0 1

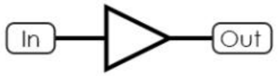


Digital Logic : A logic gate is a small digital circuit that performs a basic operation on binary inputs (0 or 1) and gives a binary output. Microprocessors and microcontrollers are made of millions of these gates.

Logic gates allow microprocessors and microcontrollers to:

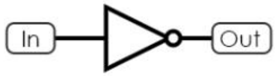
- ✓ Calculate, decide, store, and communicate
- ✓ Transform simple signals into complex actions
- ✓ Form the foundation of all digital intelligence

BUF (Buffer)



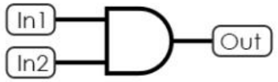
In	Out
0	0
1	1

NOT (Inverter)



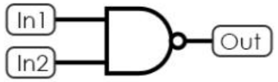
In	Out
0	1
1	0

AND



In1	In2	Out
0	0	0
0	1	0
1	0	0
1	1	1

NAND (NOT AND)



In1	In2	Out
0	0	1
0	1	1
1	0	1
1	1	0

OR

In1	In2	Out
0	0	0
0	1	1
1	0	1
1	1	1

NOR (NOT OR)

In1	In2	Out
0	0	1
0	1	0
1	0	0
1	1	0

XOR (Exclusive Or)

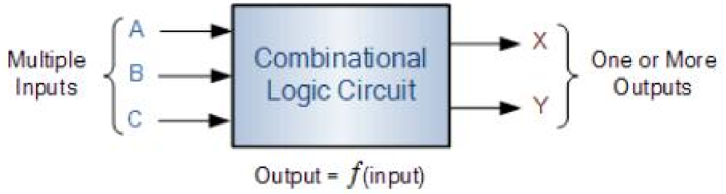
In1	In2	Out
0	0	0
0	1	1
1	0	1
1	1	0

XNOR (NOT XOR)

In1	In2	Out
0	0	1
0	1	0
1	0	0
1	1	1

❖ Combinational Logic

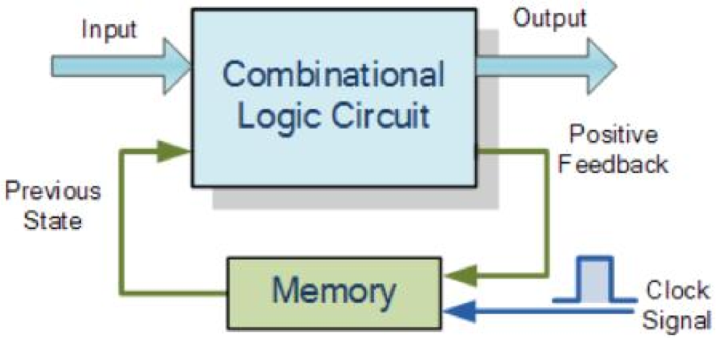
Combinational logic is a type of digital circuit where the output depends only on the current inputs:



- ✓ No memory
- ✓ Output changes immediately when inputs change
- ✓ Used for simple operations like calculations and selections

Exemple: Multiplexers, Decoders

❖ Sequential Logic



Sequential logic is a type of digital circuit where the output depends on current inputs and past states (memory), Often works with a clock signal and used for systems that change over time

Exemple: Counters, Registers

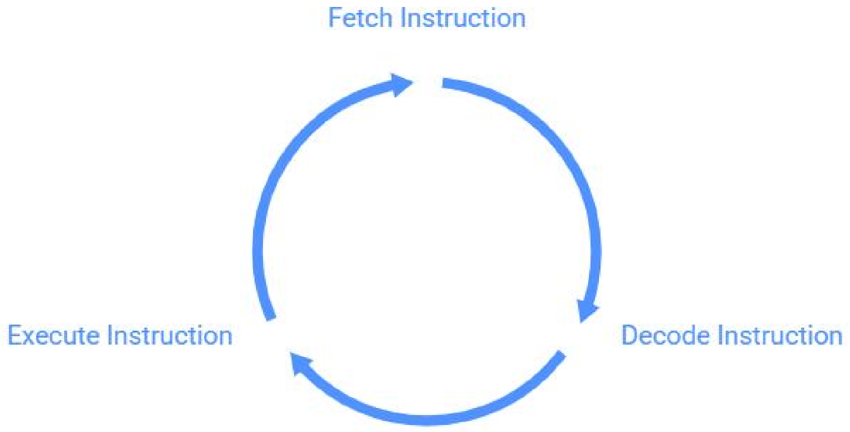
Why Sequential Logic matters for MP & MC ?

Microprocessors and microcontrollers are sequential machines,

They use clock, registers, counters to:

Fetch instructions decode them, execute in order and finaly store results,

These are the memory + timing building blocks that make processors work step by step.



Data Units – Basic Concepts

Computers work with data in the form of bits (0s and 1s). Larger units are built from bits.

1. Bit (b) → The smallest unit of data, value is either 0 (low/off) or 1 (high/on).

- **Example:** Light switch (ON = 1, OFF = 0).

2. Nibble → A group of 4 bits.

1	0	1	0

Range: 0000 (0 in decimal) to 1111 (15 in decimal).

Used often in hexadecimal representation.

- **Example:**

1010 (binary) = 10 (Decimal) = A (Hex).

3. Byte (B) ⟶ A group of 8 bits = 2 nibbles.

0	1	0	0	0	0	0	1

Most common unit in computers, Bytes are the dominant unit of measurement for calculating quantities of data or storage capacities. abbreviated with “B”. Unlike the bit, which can only represent one of two states, the byte can represent 256 (2^8) states (0–255).

- **Example:**

01000001 = 65 (Decimal)= Letter “A”.

4. Word ⟶ A group of 16, 32, or 64 bits, depending on the processor.

The word size determines how much data the processor can handle at once.

- **Example:**

32-bit CPU → Word = 32 bits.

64-bit CPU → Word = 64 bits.

5. Storage Units → Since bytes are small, bigger multiples are used:

→ 1 Kilobyte (KB) = 1024 Bytes

→ 1 Megabyte (MB) = 1024 KB

→ 1 Gigabyte (GB) = 1024 MB

→ 1 Terabyte (TB) = 1024 GB

- **Example:**

1 text page ≈ 2 KB

1 photo ≈ 3 MB

1 movie ≈ 2 GB