LOGIC GATES

Logic gates are the fundamental building blocks of digital electronics and computers.

They process binary information (0 and 1) and make decisions based on logical conditions.

- Each gate is a small digital circuit made using transistors
- Many gates combined → form complex circuits (CPU, memory, calculators)

What is the Main Purpose of Logic Gates?

Perform logical operations and help computers make decisions

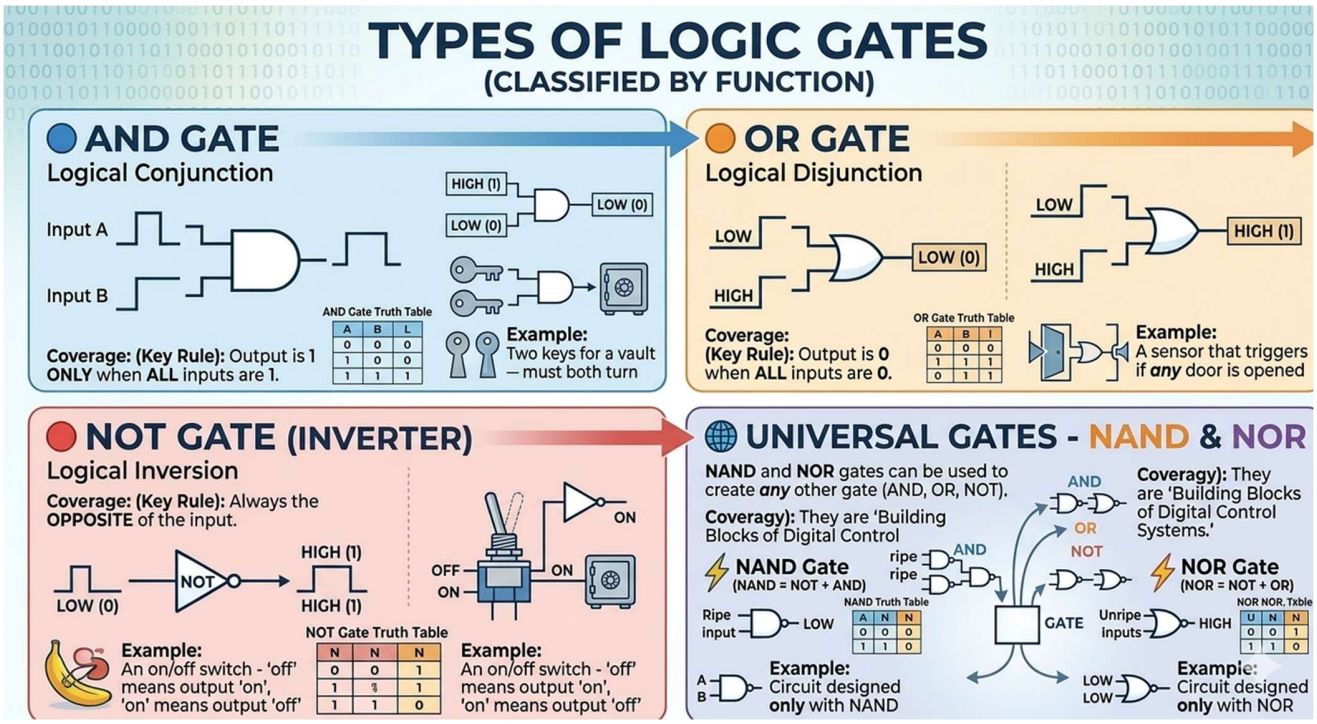
In simple terms:

- They take input (0 or 1)
- Apply a rule (logic)
- Give an output (0 or 1)

Importance of Logic Gates

Decision Making	Calculations	Control Systems	Build Computers
Used in conditional operations (IF-ELSE)	Used in adders and arithmetic circuits	Alarms, traffic lights, automation	CPU, memory, all digital devices

Types of Basic Logic Gates



AND Gate

The AND gate implements logical conjunction. It behaves so that a HIGH output (1) results ONLY if BOTH inputs are HIGH (1). If neither or only one input is HIGH, the output is LOW (0). The AND gate effectively finds the minimum between two binary digits.

Key Rule: Output is 1 ONLY when ALL inputs are 1.

AND Gate Truth Table

Input A	Input B	Output (A AND B)
0	0	0
0	1	0
1	0	0
1	1	1

OR Gate

Of all basic logic gates, the OR gate is most likely to produce a HIGH (1) output. An OR gate produces a HIGH output if ANY of the inputs is HIGH. The output from an OR gate is LOW (0) ONLY if ALL the inputs are LOW.

Key Rule: Output is 0 ONLY when ALL inputs are 0.

OR Gate Truth Table

Input A	Input B	Output (A OR B)
0	0	0
0	1	1
1	0	1
1	1	1

NOT Gate (Inverter)

The NOT gate is also known as an inverter — it simply changes the input to its opposite. The NOT gate accepts ONLY ONE input and the output is always the opposite of the input. A LOW-voltage input (0) is converted to HIGH-voltage output (1) and vice versa.

Key Rule: Output is always the OPPOSITE of the input.

NOT Gate Truth Table

Input A	Output (NOT A)
0	1
1	0

Universal Gates – NAND & NOR

NAND and NOR gates possess a special property — they are UNIVERSAL.

A universal gate is a logic gate that can be used to create any other logic gate (AND, OR, NOT).

That means:

- **Using only NAND gates, we can build AND, OR, NOT**
- **Using only NOR gates, we can also build AND, OR, NOT**

So, they are called UNIVERSAL GATES

- Digital control systems have been designed using ONLY NAND or ONLY NOR gates

NAND Gate

NAND = NOT + AND

Output is LOW (0) only when ALL inputs are HIGH (1). Output is HIGH in all other cases.

A	B	NAND
0	0	1
0	1	1
1	0	1
1	1	0

NOR Gate

NOR = NOT + OR

NOR is an OR gate with the output inverted. Output is HIGH (1) only when ALL inputs are LOW (0).

A	B	NOR
0	0	1
0	1	0
1	0	0
1	1	0

Real-Life Examples

AND Gate

Machine works only if TWO switches are both ON

OR Gate

Alarm rings if ANY ONE sensor is active

NOT Gate

Reverses a signal — ON becomes OFF

Key Points to Remember

- ✓ Logic gates work on binary system (0 and 1)
- ✓ They are basic digital circuits

- ✓ Used to process data and make decisions
- ✓ Combination of gates forms complex systems like CPUs
- ✓ NAND and NOR are Universal Gates

Quick Revision Questions

Very Short Answer Questions

1. What is a logic gate?
2. What is the main purpose of logic gates?
3. Are logic gates circuits?
4. Which gate is called an inverter?

Short Answer Questions

1. Explain AND gate with truth table.
2. Differentiate between OR and NOR gate.
3. What is XOR gate? Give an example.