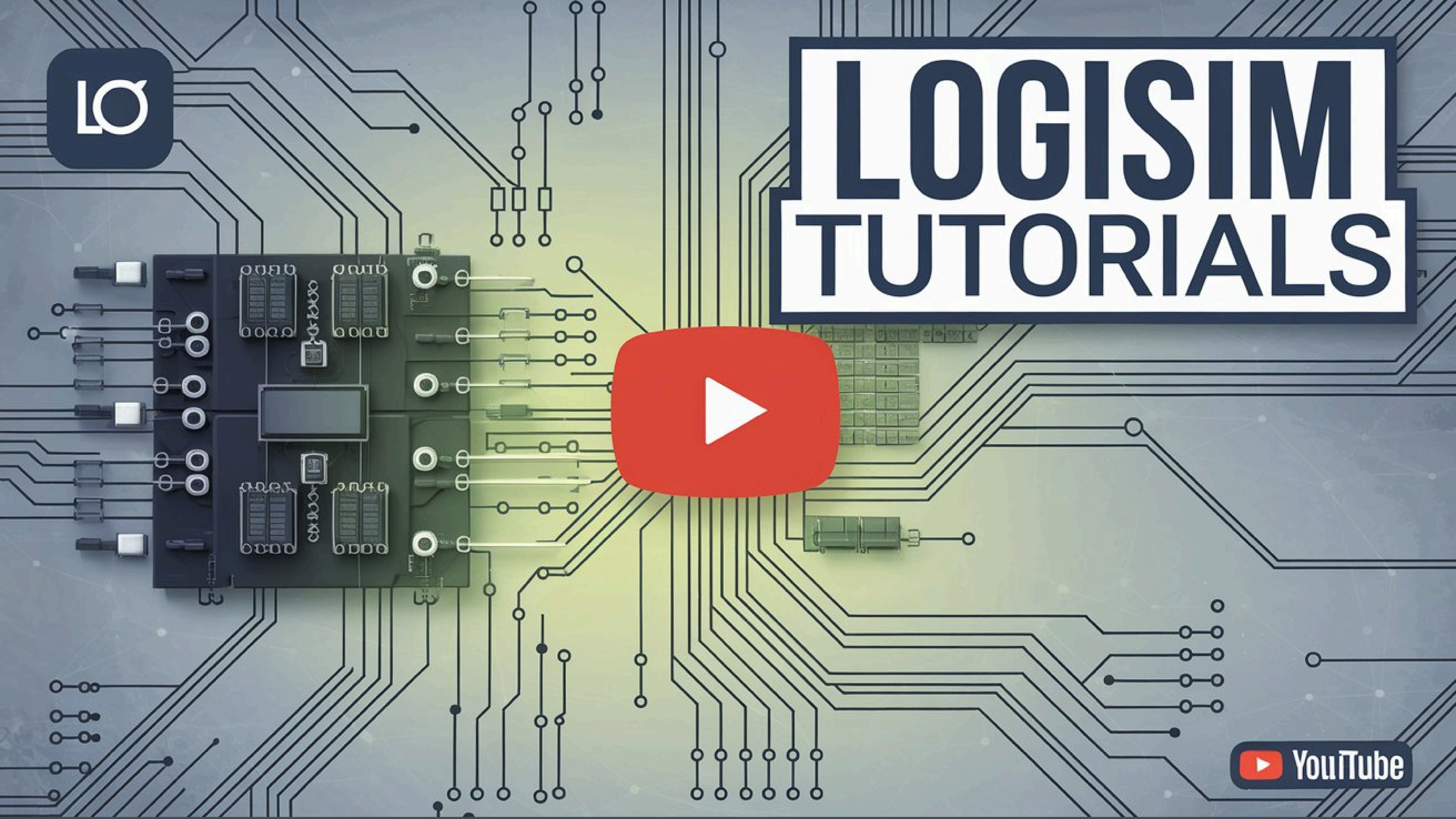
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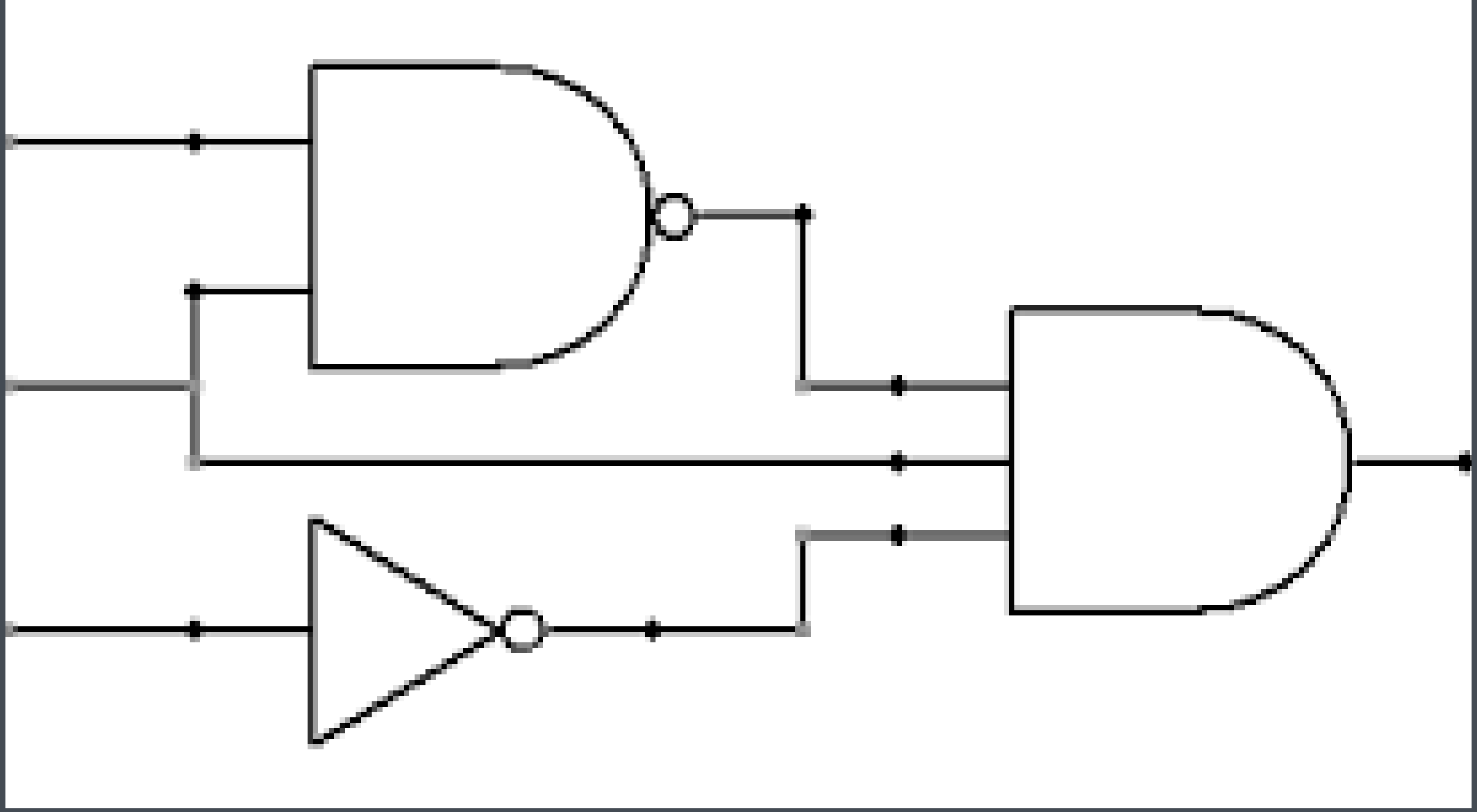
What Are Combinational Circuits?



First things first—what exactly are combinational circuits? Simply put, these are circuits whose output depends only on the current inputs. There’s no memory or feedback involved. If the inputs change, the output changes instantly—there’s no state information carried forward. This makes them fast and essential for tasks like decision-making, data routing, and arithmetic operations.
Some common examples include:

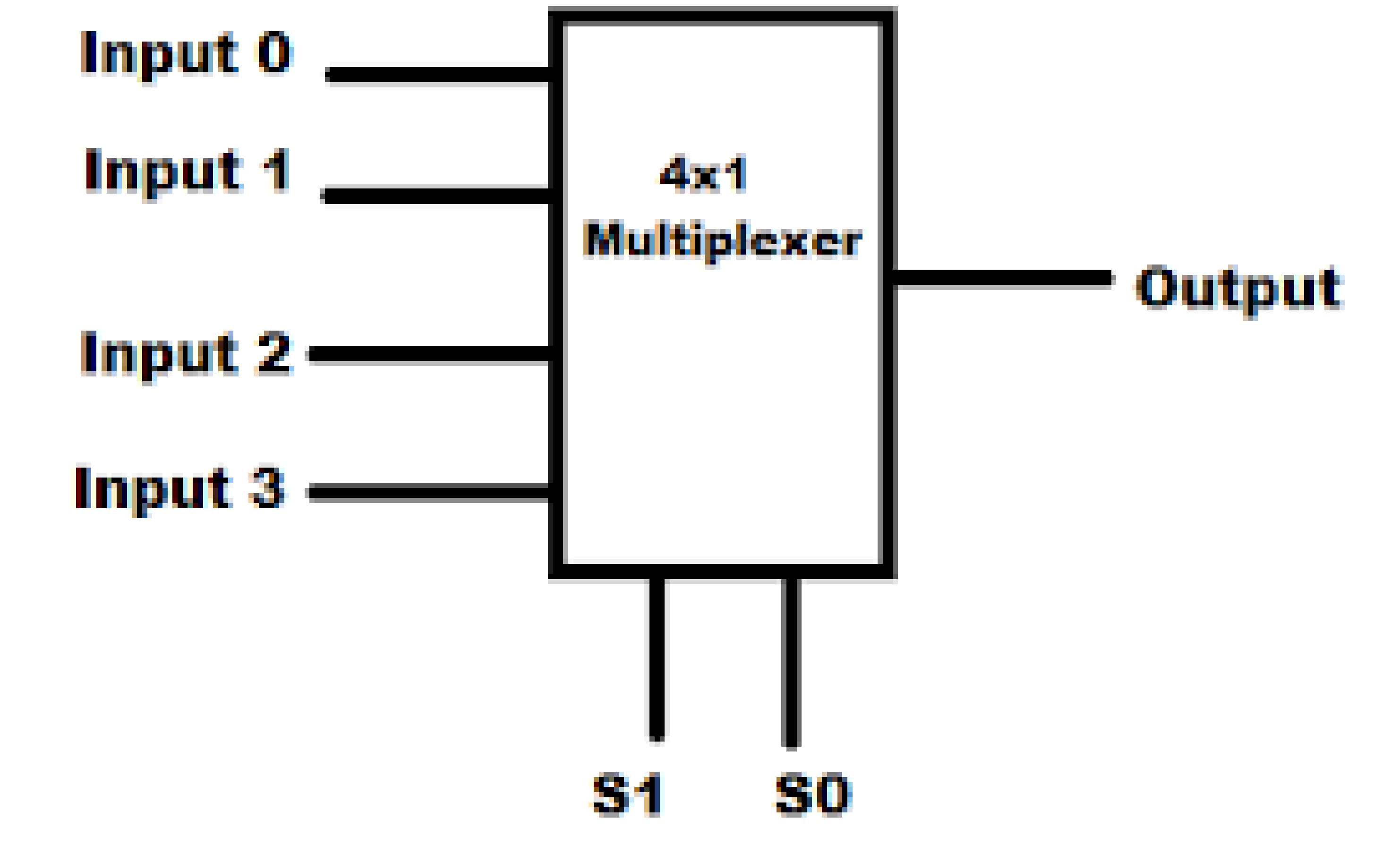
- Multiplexers
- Demultiplexers
- Encoders
- Decoders

Multiplexers

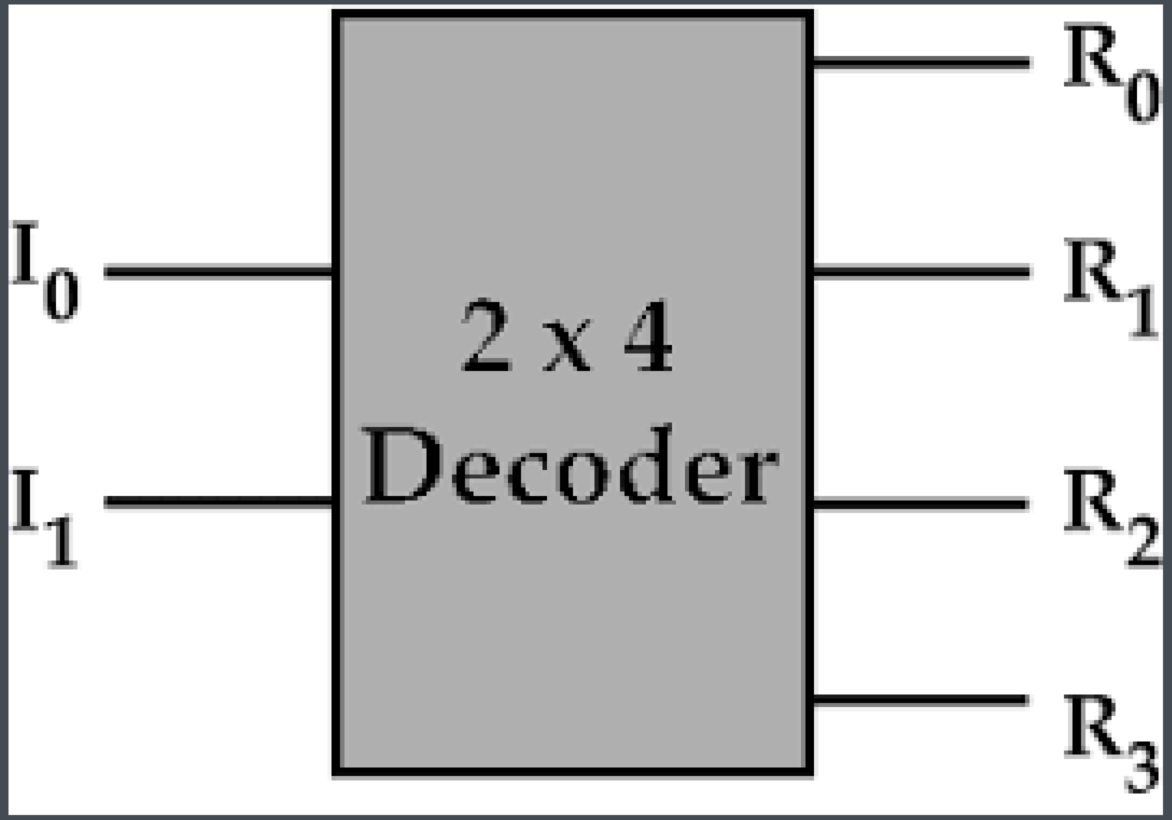
A Multiplexer (or MUX) is a combinational circuit that selects one of several input signals and forwards the selected input to a single output.

It acts like a data selector; based on the select lines, one of the inputs is routed to the output.

Multiplexers are widely used in digital circuits for applications like data routing, communication, and even arithmetic logic units.



S0	S1	Y
0	0	I0
0	1	I1
1	0	I2
1	1	I3



A0	A1	D3	D2	D1	D0
0	0	0	0	0	1
0	1	0	0	1	0
1	0	0	1	0	0
1	1	1	0	0	0

Decoders

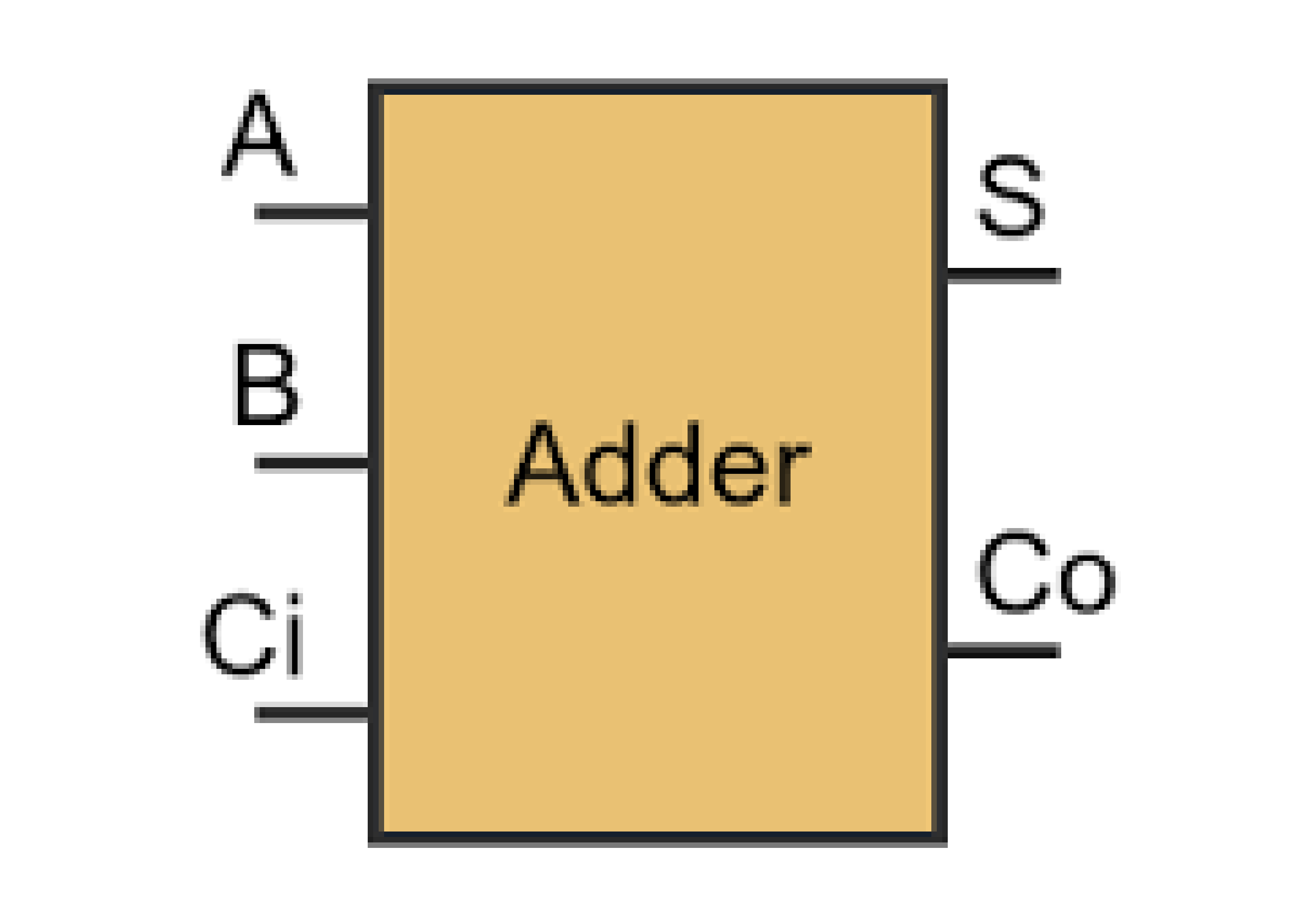
A decoder is a digital circuit that translates binary input into a specific output. With n inputs, it produces 2^n outputs, activating one output for each input combination. Decoders are used in various applications such as memory address selection, seven-segment displays, and CPU instruction decoding. They convert binary data into a single active output, simplifying the control of digital systems.

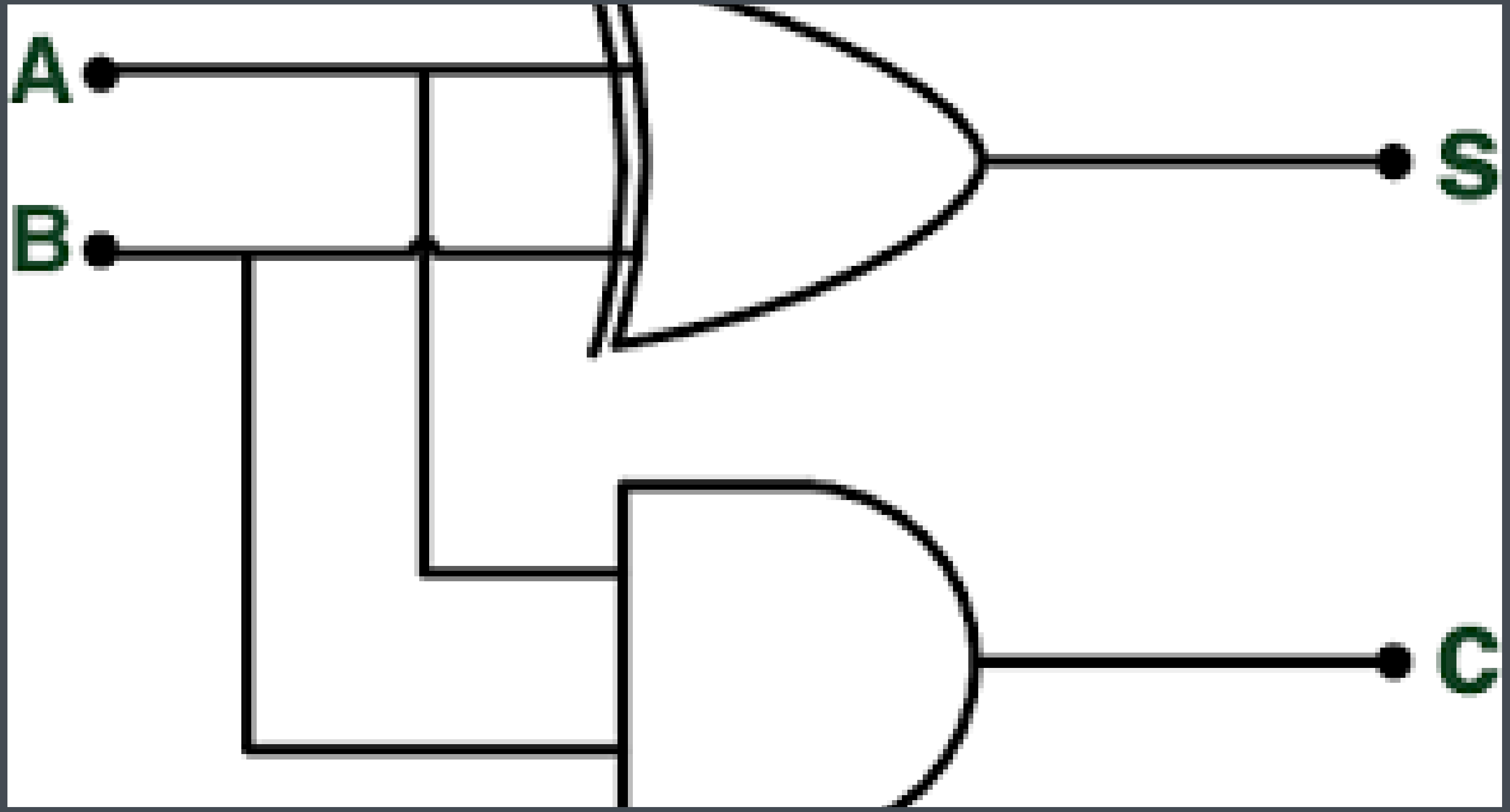
Adders

Adders are fundamental elements in arithmetic logic units (ALUs) responsible for performing basic arithmetic operations such as addition. In this presentation, we focus on two primary types of adders:

1. Half-Adder:
    - Function: Adds two single-bit binary numbers.
    - Outputs: Provides a Sum and a Carry.
2. Full-Adder:
    - Function: Adds three single-bit binary numbers, including two significant bits and an input Carry.
    - Outputs: Provides a Sum and a Carry-out.

These adders are essential for constructing more complex arithmetic circuits and are key to performing addition operations in digital systems.





A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Half Adder

A Half-Adder is a fundamental digital circuit used to add two single-bit binary numbers. It has two inputs: A and B, which represent the binary digits to be added. The Half-Adder produces two outputs:

Sum: The result of the addition without considering any carry from a previous bit.

Carry: Indicates whether there is a carry-out from the addition, which is useful when adding more than one bit.

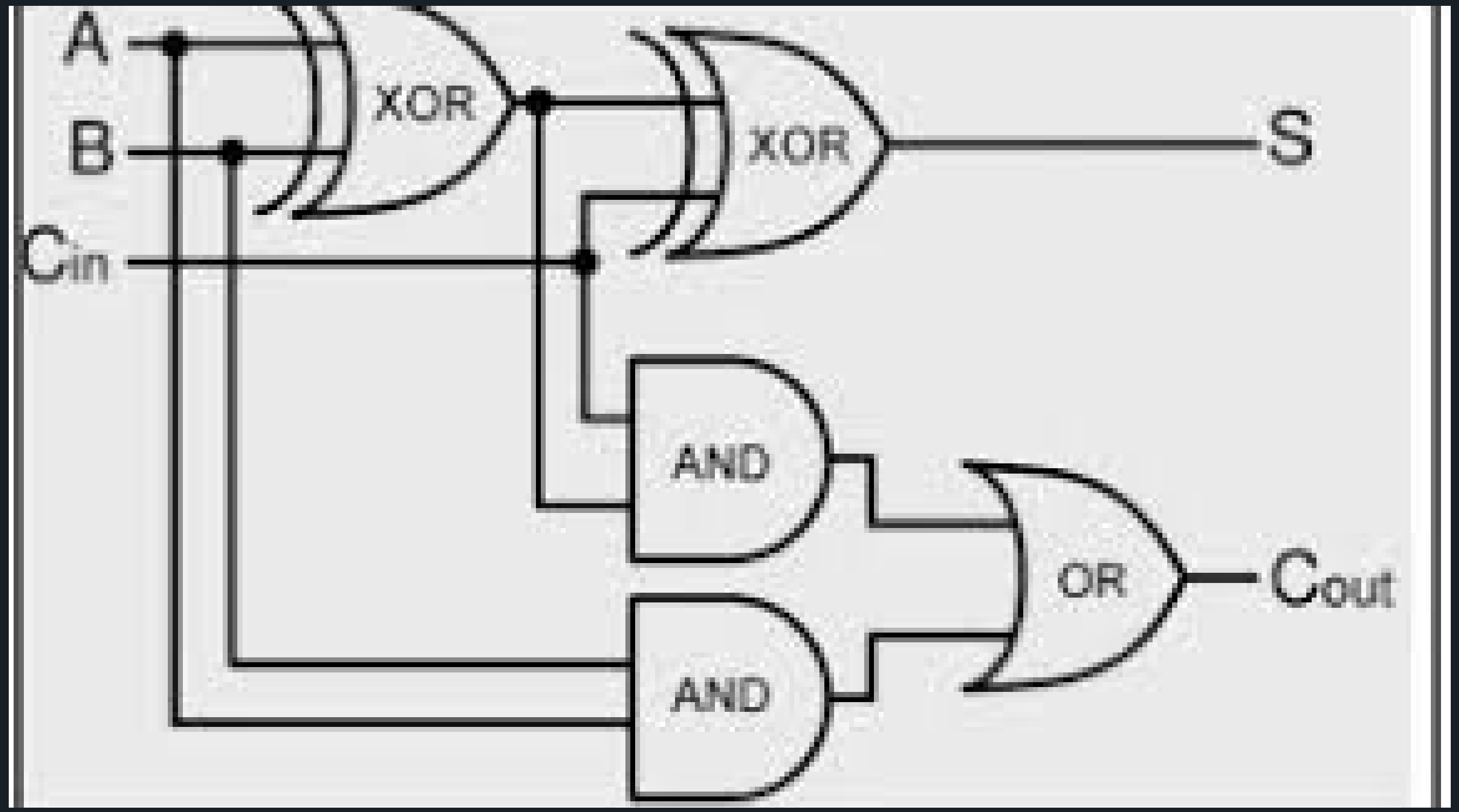
The Half-Adder is simple and does not handle carry-in values from previous additions, making it suitable for basic arithmetic operations where no previous carry is involved. It is an essential building block for more complex adders like the Full-Adder.

Full Adder

A Full-Adder is a digital circuit that adds three single-bit binary numbers: two significant bits and an input carry. It has three inputs: A, B (the two binary digits to be added), and Cin (the carry-in from a previous addition). The Full-Adder produces two outputs:

Sum: The result of the addition, combining A, B, and Cin.
Carry-out: Indicates if there is a carry-out from the current addition, which can be used as the carry-in for the next stage in multi-bit additions.

The Full-Adder is crucial for performing multi-bit binary addition, as it can handle carry inputs and outputs, making it a key component in more complex arithmetic operations.



A	B	Cin	S	Cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Thank You