LOGIC GATES

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WHAT IS

GATE

A device that performs a basic operation on electrical signals

CIRCUITS

Gates combined to perform more complicated tasks

How do we describe the behavior of gates and circuits?

Boolean expressions

Uses Boolean algebra, a mathematical notation for expressing two-valued logic

Logic diagrams

A graphical representation of a circuit; each gate has its own symbol

Truth tables

A table showing all possible input value and the associated output values

Gates

Six types of gates

- NOT
- AND
- OR
- XOR
- NAND
- NOR

Typically, logic diagrams are black and white with gates distinguished only by their shape

We use color for emphasis (and fun)

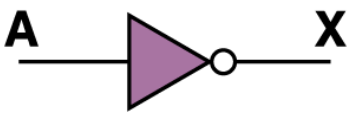
NOT Gate

A NOT gate accepts one input signal (0 or 1) and returns the opposite signal as output

Boolean Expression

$X = A'$

Logic Diagram Symbol



Truth Table

A	X
0	1
1	0

Figure 1 **Various representations of a NOT gate**

AND Gate

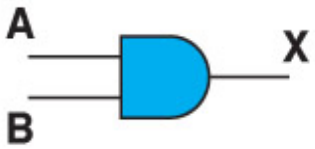
An AND gate accepts two input signals

If both are 1, the output is 1; otherwise, the output is 0

Boolean Expression

$$X = A \cdot B$$

Logic Diagram Symbol



Truth Table

A	B	X
0	0	0
0	1	0
1	0	0
1	1	1

Figure 2 **Various representations of an AND gate**

OR Gate

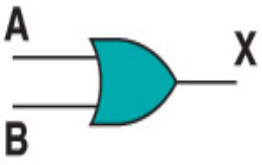
An OR gate accepts two input signals

If both are 0, the output is 0; otherwise, the output is 1

Boolean Expression

$$X = A + B$$

Logic Diagram Symbol



Truth Table

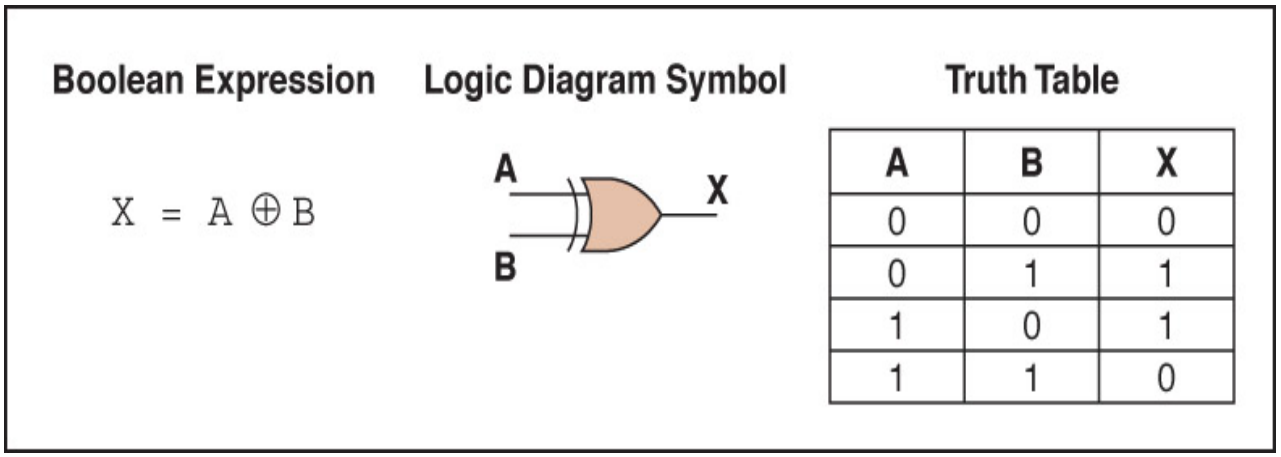
A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

Figure 3 Various representations of a OR gate

XOR Gate

An XOR gate accepts two input signals

If both are the same, the output is 0; otherwise, the output is 1



A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

Figure 4 **Various representations of an XOR gate**

XOR Gate

Note the difference between the XOR gate and the OR gate; they differ only in one input situation

When both input signals are 1, the OR gate produces 1 and the XOR produces 0

XOR is called the *exclusive OR*

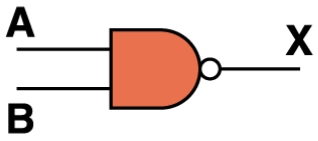
NAND Gate

The NAND gate accepts two input signals
If both are 1, the output is 0; otherwise, the output is 1

Boolean Expression

$X = (A \cdot B)'$

Logic Diagram Symbol



Truth Table

A	B	X
0	0	1
0	1	1
1	0	1
1	1	0

Figure 5 Various representations of a NAND gate

NOR Gate

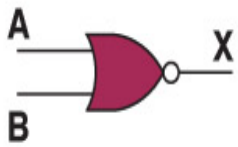
The NOR gate accepts two input signals

If both are 0, the output is 1; otherwise, the output is 0

Boolean Expression

$X = (A + B)'$

Logic Diagram Symbol



Truth Table

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

Figure 6 **Various representations of a NOR gate**

Review of Gate Processing

A NOT gate inverts its single input

An AND gate produces 1 if both input values are 1

An OR gate produces 0 if both input values are 0

An XOR gate produces 0 if input values are the same

A NAND gate produces 0 if both inputs are 1

A NOR gate produces a 1 if both inputs are 0

THANK YOU