Logic Gates

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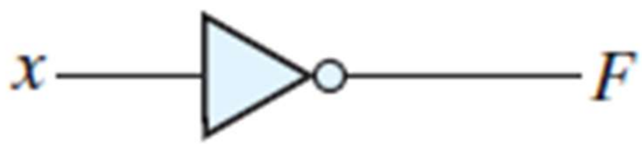
Logic Gates

- Logic gates are electronic circuits that operate on one or more input signals to produce an output signal.
- Electrical signals such as voltages or currents exist as analog signals having values over a given continuous range, say 0 to 5 V.
- In a digital system these voltages are interpreted to be either of two recognizable values, 0 or 1. For example, a particular digital system may define logic 0 as a signal equal to 0 V and logic 1 as a signal equal to 3 V.

Logic Gates (Inverter)

One input, One output

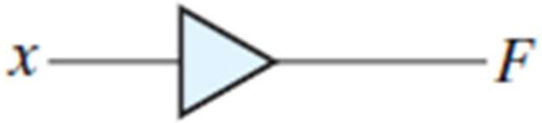


$$F = \overline{x}$$

x	F
0	1
1	0

Logic Gates (Buffer)

One input, One output

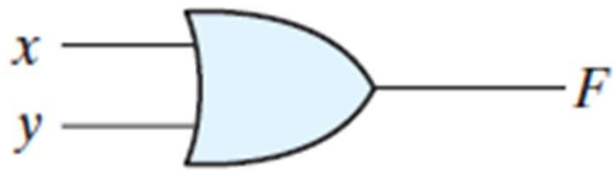


$$F = x$$

x	F
0	0
1	1

Logic Gates (OR)

Two or more inputs, One output



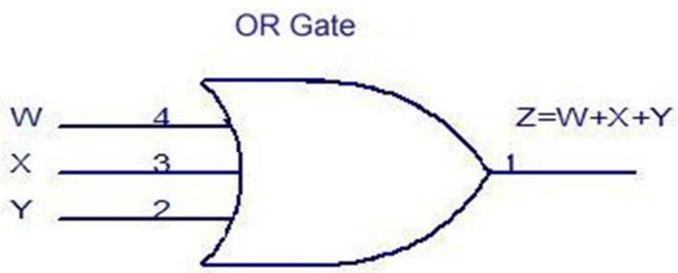
$$F = x + y$$

x	y	F
0	0	0
0	1	1
1	0	1
1	1	1

Logic Gates (OR)

Two or more inputs, One output

3 Input OR Gate

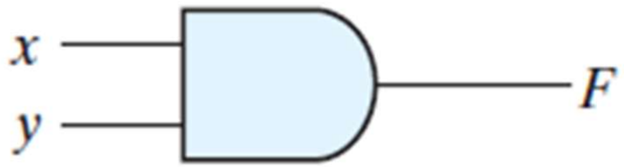


TRUTH TABLE

INPUTS			OUTPUT
W	X	Y	Z
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Logic Gates (AND)

Two or more inputs, One output



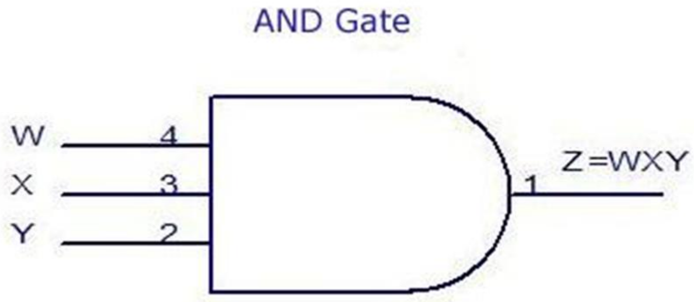
$$F = x \cdot y$$

x	y	F
0	0	0
0	1	0
1	0	0
1	1	1

Logic Gates (AND)

Two or more inputs, One output

3 Input AND Gate

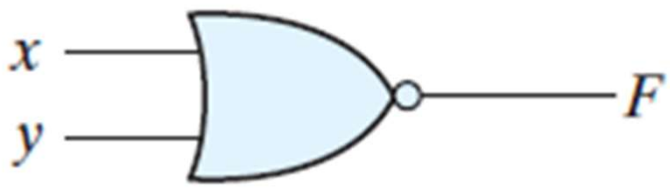


TRUTH TABLE

INPUTS			OUTPUT
W	X	Y	Z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

Logic Gates (NOR)

Two or more inputs, One output



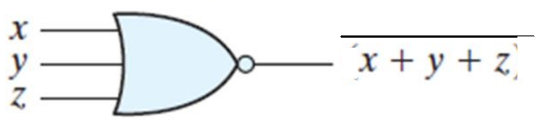
$$F = (\overline{x + y})'$$

x	y	F
0	0	1
0	1	0
1	0	0
1	1	0

Logic Gates (NOR)

Two or more inputs, One output

3 Input NOR Gate

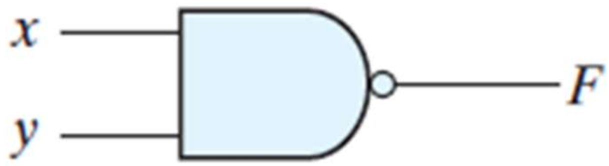


TRUTH TABLE

INPUTS			OUTPUT
x	y	z	f
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

Logic Gates (NAND)

Two or more inputs, One output

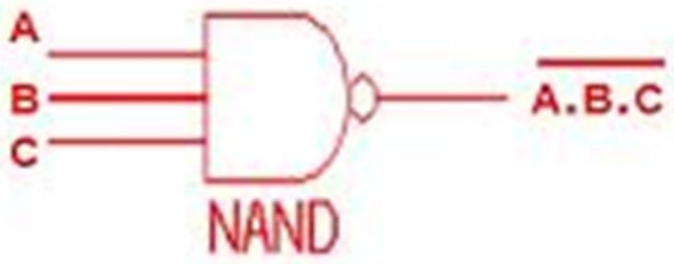


$$F = \overline{(xy)}$$

x	y	F
0	0	1
0	1	1
1	0	1
1	1	0

Logic Gates (NAND)

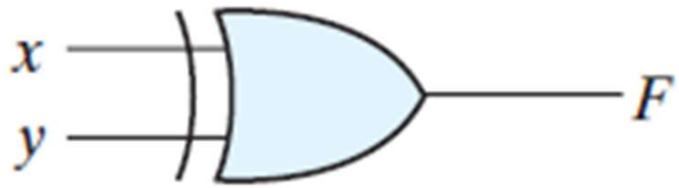
Two or more inputs, One output



3 input NAND gate				
A	B	C	A.B.C	$\overline{A.B.C}$
0	0	0	0	1
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	0	1
1	0	1	0	1
1	1	0	0	1
1	1	1	1	0

Logic Gates (XOR)

Two or more inputs, One output

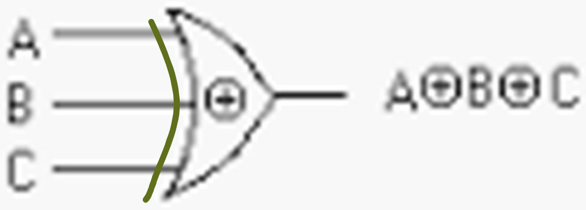


$$F = x\bar{y} + \bar{x}y$$
$$= x \oplus y$$

x	y	F
0	0	0
0	1	1
1	0	1
1	1	0

Logic Gates (XOR)

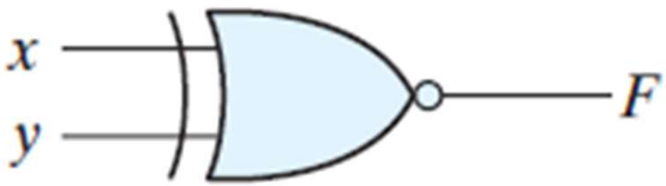
Two or more inputs, One output



Inputs			outputs
W	X	Y	Q = A⊕B⊕C
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

Logic Gates (XNOR)

Two or more inputs, One output

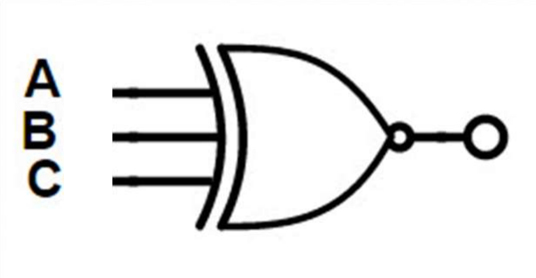


$$F = xy + \bar{x}\,\bar{y}$$
$$= \overline{(x \oplus y)}$$

x	y	F
0	0	1
0	1	0
1	0	0
1	1	1

Logic Gates (XNOR)

Two or more inputs, One output



A	B	C	Output
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

Three State gate

A three state gate is a circuit that has three states, logic 0, logic 1 and a high impedance state, where:

- The logic behaves like an open circuit, which means that the output appears to be disconnected.
- The circuit has no logic significance.
- The circuit connected to the output of the three-state gate is not affected by the inputs to the gate.

Three State gate

Three-state gates may be any logic gate, but the most commonly used is the buffer gate.