Logic Gate

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Logic Gate

A gate is an digital circuit which operates on one or more signals and produce single output.

Gates are digital circuits because the input and output signals are denoted by either 1(high voltage) or 0(low voltage).

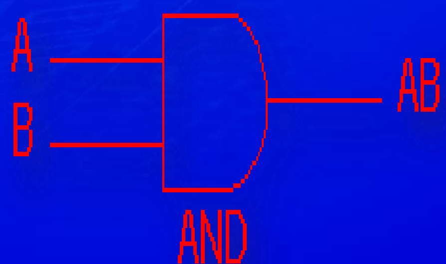
There are three basic gates and are:

1. AND gate
2. OR gate
3. NOT gate

AND gate

AND gate

- The AND gate is an electronic circuit that gives a high output (1) only if all its inputs are high.
- AND gate takes two or more input signals and produce only one output signal.

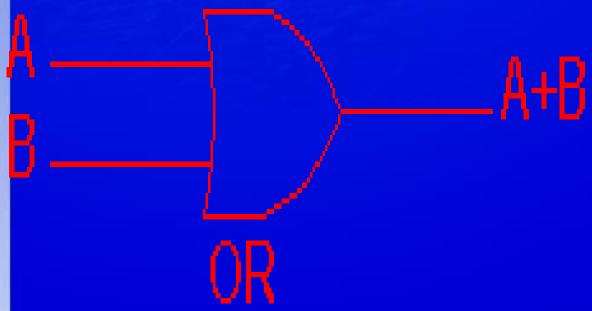


Input A	Input B	Output AB
0	0	0
0	1	0
1	0	0
1	1	1

OR gate

OR gate

- The OR gate is an electronic circuit that gives a high output (1) if one or more of its inputs are high.
- OR gate also takes two or more input signals and produce only one output signal.

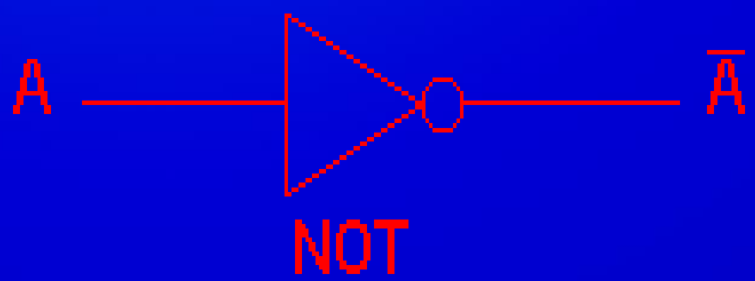


Input A	Input B	Output A+B
0	0	0
0	1	1
1	0	1
1	1	1

NOT gate

NOT gate

- The NOT gate is an electronic circuit that gives a high output (1) if its input is low .
- NOT gate takes only one input signal and produce only one output signal.
- The output of NOT gate is complement of its input.
- It is also called inverter.



Input A	Output $\bar{A}$
0	1
1	0

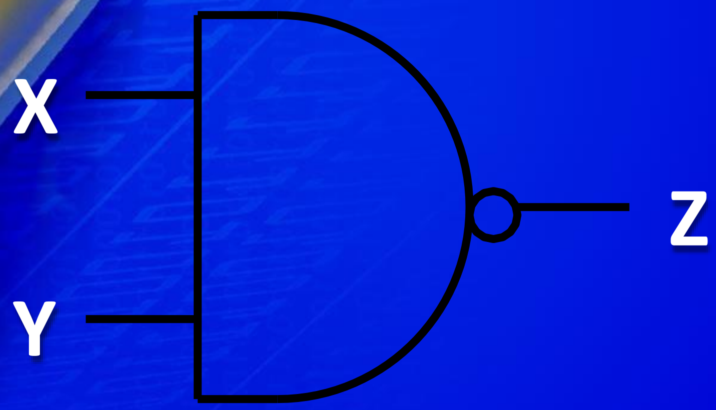
NAND, NOR XOR, XNOR GATES

NAND Gate

Known as a “universal” gate because ANY digital circuit can be implemented with NAND gates alone.

NAND Gate

NAND

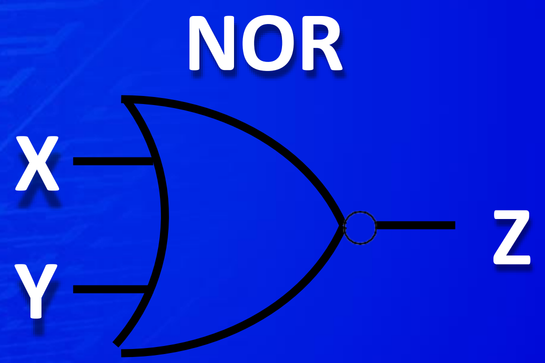


X	Y	Z
0	0	1
0	1	1
1	0	1
1	1	0

$$Z = \overline{X.Y}$$

NOR Gate

NOR Gate



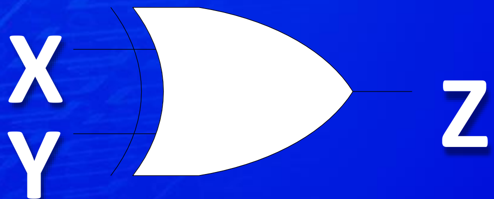
X	Y	Z
0	0	1
0	1	0
1	0	0
1	1	0

$$Z = \overline{X + Y}$$

Exclusive-OR Gate

Exclusive-OR Gate

XOR

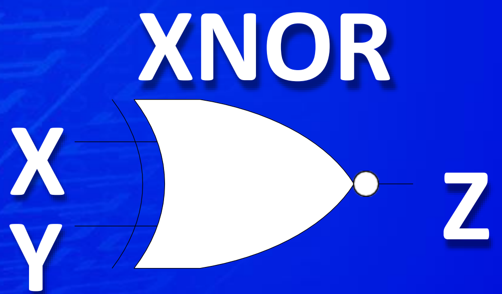


$Z = X \oplus Y$

X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	0

Exclusive-NOR Gate

Exclusive-NOR Gate



X	Y	Z
0	0	1
0	1	0
1	0	0
1	1	1

$$Z = \overline{X \oplus Y}$$

Basic Theorem of Boolean Algebra

Basic Theorem of Boolean Algebra

T1 : Properties of 0

(a) $0 + A = A$

(b) $0\,A = 0$

T2 : Properties of 1

(a) $1 + A = 1$

(b) $1\,A = A$

Basic Theorem of Boolean Algebra

T3 : Commutative Law

(a) A + B = B + A

(b) A B = B A

T4 : Associate Law

(a) (A + B) + C = A + (B + C)

(b) (A B) C = A (B C)

T5 : Distributive Law

(a) A (B + C) = A B + A C

(b) A + (B C) = (A + B) (A + C)

(c) A+A’B = A+B

Basic Theorem of Boolean Algebra

T6 : Indempotence (Identity) Law

(a) $A + A = A$

(b) $A\ A = A$

T7 : Absorption (Redundance) Law

(a) $A + A\ B = A$

(b) $A\ (A + B) = A$

Basic Theorem of Boolean Algebra

T8 : Complementary Law

(a) $X+X'=1$

(b) $X.X'=0$

T9 : Involution

(a) $x'' = x$

T10 : De Morgan's Theorem

(a) $(X+Y)'=X'.Y'$

(b) $(X.Y)'=X'+Y'$

De Morgan's Theorem

De Morgan's Theorem 1

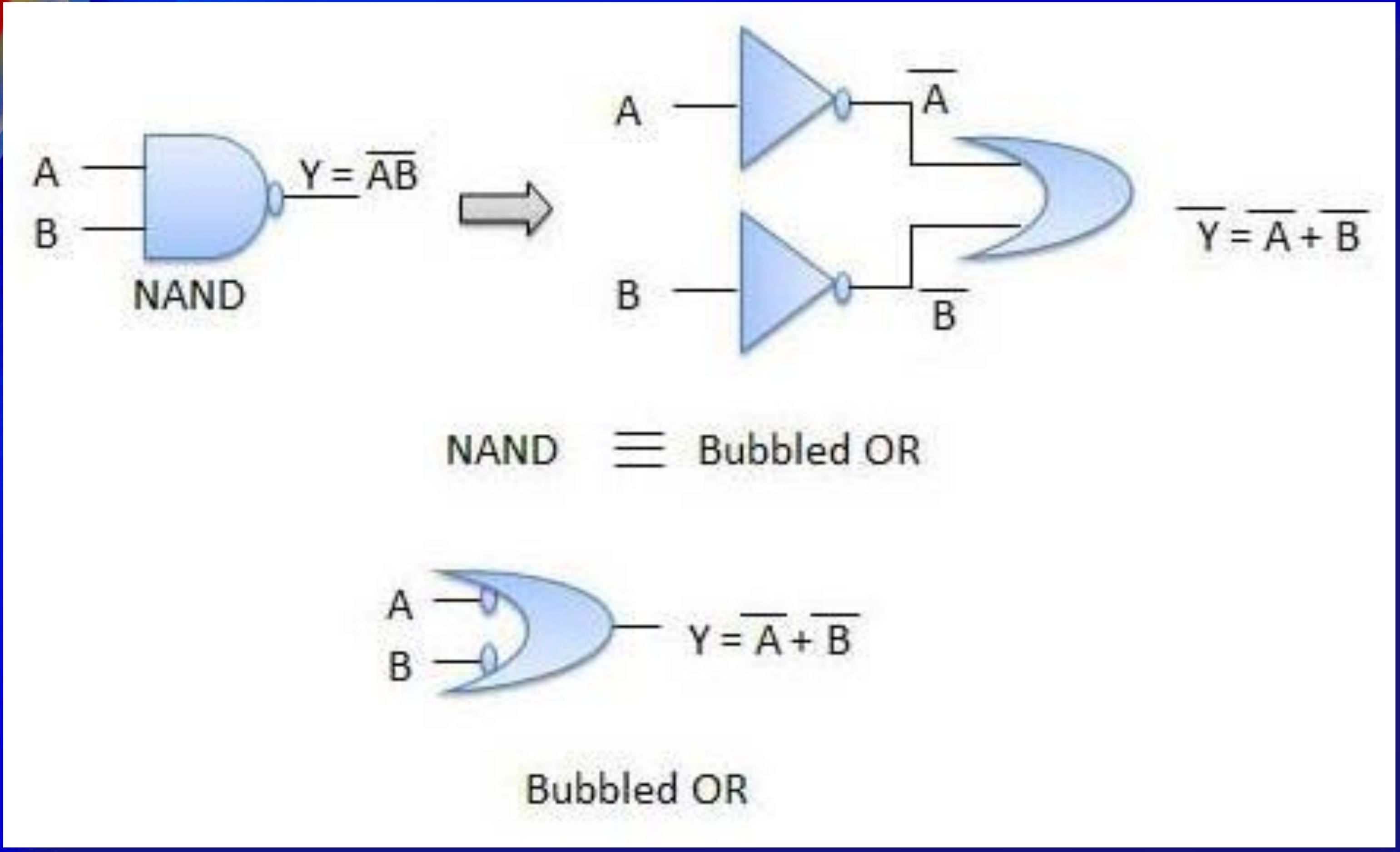
Theorem 1 $\overline{A . B} = \overline{A} + \overline{B}$

$$\overline{A.B} = \overline{A} + \overline{B}$$

NAND = Bubbled OR

De Morgan's Theorem 1

Theorem 1 $\overline{A \,.\, B} = \overline{A} + \overline{B}$



De Morgan's Theorem 1

Theorem 1 $\overline{A \cdot B} = \overline{A} + \overline{B}$

A	B	$\overline{AB}$	$\overline{A}$	$\overline{B}$	$\overline{A} + \overline{B}$
0	0	1	1	1	1
0	1	1	1	0	1
1	0	1	0	1	1
1	1	0	0	0	0

De Morgan's Theorem 2

Theorem 1 $\overline{A + B} = \overline{A} . \overline{B}$

De Morgan's Theorem 2

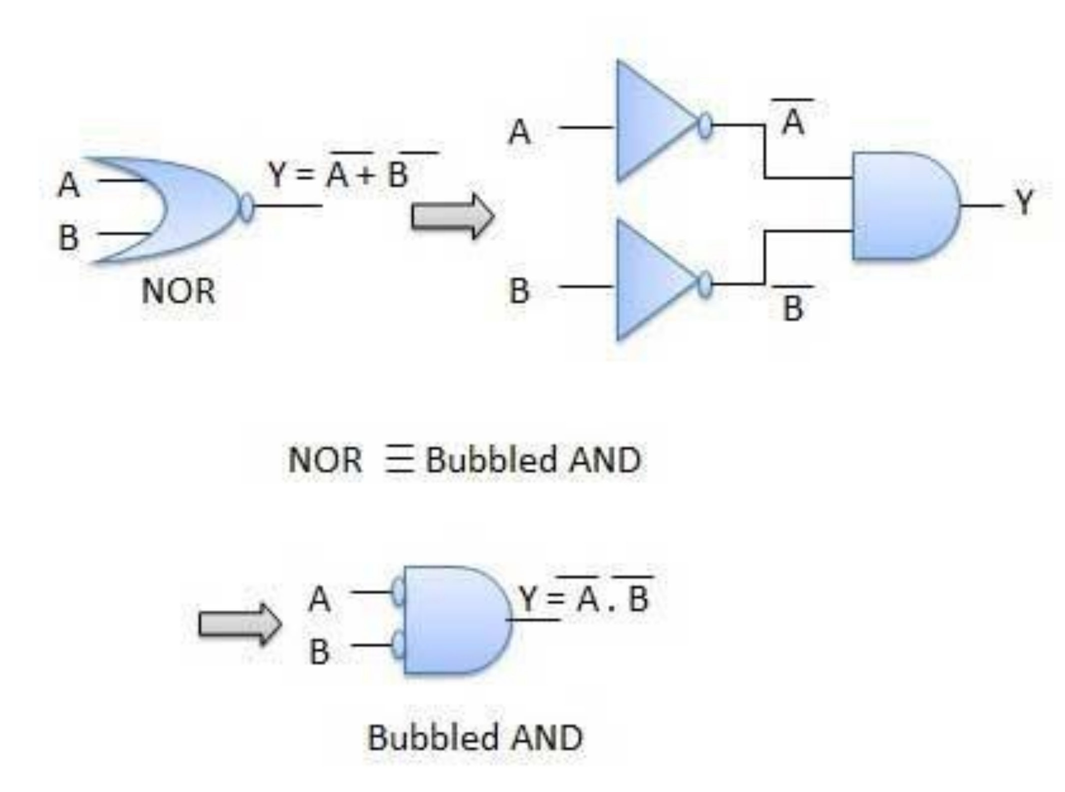
Theorem 2 $\overline{A + B} = \overline{A} \cdot \overline{B}$

$$\overline{A + B} = \overline{A}.\overline{B}$$

NOR = Bubbled AND

De Morgan's Theorem 2

Theorem 2 $\overline{A + B} = \overline{A} \cdot \overline{B}$



De Morgan's Theorem 2

Theorem 2 $\overline{A + B} = \overline{A} \cdot \overline{B}$

A	B	$\overline{A+B}$	$\overline{A}$	$\overline{B}$	$\overline{A} \cdot \overline{B}$
0	0	1	1	1	1
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	0