SUMMARY OF COMBINATIONAL LOGIC

I. Logic Variables

Logic variables take on only two states. The two states are represented by a 1 (logic one) or a 0 (logic zero), although TRUE and FALSE, ON and OFF, HIGH and LOW, are also names given to the two states. The states are exclusive. That is:

If $A \neq 0$, then $A = 1$
If $A \neq 1$, then $A = 0$

II. Three Basic Boolean Operations

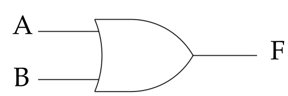
A. "OR"

Expression: $F = A + B$ **Read:** "*F* is equal to *A or B*"
Meaning: *F* is true (1) if either *A or B* is true.

Truth Table:

F	*A*	*B*
0	0	0
1	0	1
1	1	0
1	1	1

Logic Symbol:



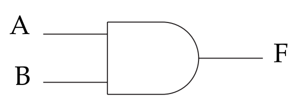
B. "AND"

Expression: $F = A \bullet B = AB$ **Read:** "*F* is equal to *A and B*"
Meaning: *F* is true (1) if *A and B* are true

Truth Table:

F	*A*	*B*
0	0	0
0	0	1
0	1	0
1	1	1

Logic Symbol:



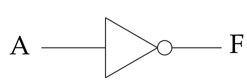
C. "NOT"

Expression: $F = \overline{A}$ **Read:** "*F* is equal to *not A*"
Meaning: *F* is true (1) if *A* is *not* true.

Truth Table:

F	*A*
1	0
0	1

Logic Symbol:



III. Derived Logic Operations

A. "NOR"

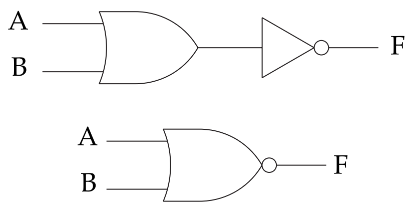
Expression: $F = \overline{A + B}$ **Read:** "*F* is equal to *A nor B*"

Meaning: Combined OR and NOT operations.
F is true (1) if the quantity $A + B$ is not true.

Truth Table:

F	*A*	*B*
1	0	0
0	0	1
0	1	0
0	1	1

Logic Symbol:



B. "NAND"

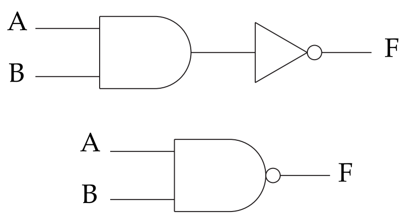
Expression: $F = \overline{AB}$

Meaning: Combined AND and NOT operations.
F is true (1) is the quantity AB is not true.

Truth Table:

F	*A*	*B*
1	0	0
1	0	1
1	1	0
0	1	1

Logic Symbol:



IV. Basic Theorems

With the basic logic operations it is possible to deduce a set of basic theorems.

$$
\begin{aligned}
1 + A &= 1 \\
0 + A &= A \\
A + A &= A \\
A + \overline{A} &= 1 \\
\overline{\overline{A}} &= A \\
A + B &= B + A \\
A + (B + C) &= (A + B) + C \\
A(B + C) &= AB + AC
\end{aligned}
$$

$$
\begin{aligned}
0\mathrm{A} &= 0 \\
1\mathrm{A} &= \mathrm{A} \\
\mathrm{AA} &= \mathrm{A} \\
A\,\overline{A} &= 0 \\
AB &= BA \\
A(BC) &= (AB)C \\
(A+B)(A+C) &= A + BC
\end{aligned}
$$

V. DeMorgan's Theorem's

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

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

Once expressions or logic symbol diagrams are written for a logic system, they can be manipulated (simplified) using the above rules.