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BOOLEAN ALGEBRA

Boolean Algebra developed by English Mathematician *George Boole* in between 1815 - 1864, is the mathematics we use to analyse digital gates and circuits.
We can use these "Laws of Boolean" to both reduce and simplify a complex Boolean expression in an attempt to reduce the number of logic gates required.

Laws of Boolean:

1(a) $A + A = A$	(b) $A \cdot A = A$
2(a) $A + 1 = 1$	(b) $A \cdot 0 = 0$
3(a) $A + A \cdot B = A$	(b) $A \cdot (A + B) = A$
4(a) $A + \bar{A} \cdot B = A + B$	(b) $A \cdot (\bar{A} + B) = A \cdot B$

De Morgan's Theorem: De Morgan, a logician gave two very important theorems which are used in Boolean algebra, which is stated as: The complement of a product of two variables is equal to the sum of the complemented variables.

1. $\overline{(A \cdot B)} = \overline{A} + \overline{B}$

2. $\overline{(A + B)} = \overline{A} \cdot \overline{B}$

Boolean Algebra Application:

- Boolean algebra can be applied to any system in which each variable has two states. It is used to perform the logical operations in digital computer.
- In digital computer True represent by '1' (high volt) and False represent by '0' (low volt)
- Logical operations are performed by logical operators. The fundamental logical operators are:
  1. AND (conjunction)
  2. OR (disjunction)
  3. NOT (negation/complement)

BOOLEAN ALGEBRA

AND operator:

It performs logical multiplication and denoted by (.) dot.

X	Y	X.Y
0	0	0
0	1	0
1	0	0
1	1	1

OR operator:

It performs logical addition and denoted by (+) plus.

X	Y	X+Y
0	0	0
0	1	1
1	0	1
1	1	1

NOT operator:

It performs logical negation and denoted by (-) bar. It operates on single variable.

X	$\overline{X}$ (means complement of x)
0	1
1	0

Representation of Boolean expression

Boolean expression can be represented by

1.Sum of Product(SOP) form (e.g. **AB+AC**)

or

2.Product of Sum (POS) form(e.g. **(A+B)(A+C)**)

Note: In above examples both are in SOP and POS respectively but they are not in Standard SOP & POS.