



Gear up for **COMPUTER SCIENCE** *Series*

Target 80/80



CLASS 5





BOOLEAN ALGEBRA

Target 80/80
16th May at 10 PM



CLASS 5



BOOLEAN ALGEBRA

Boolean Algebra is a branch of algebra in which the value of the variables are truth value T/F usually denoted by 1/0.

Warm Up Questions

Range of numbers that can be expressed in 8 bits

1. 1's Comp
2. 2's Comp

Warm Up Questions

Represent -97 in Signed Magnitude, 1's complement and 2's complement form

OPERATIONS

AND OPERATOR

$A.B$

AND		
x	y	xy
0	0	0
0	1	0
1	0	0
1	1	1



OPERATIONS

OR OPERATOR

$A+B$

<i>OR</i>		
<i>x</i>	<i>y</i>	<i>x+y</i>
<i>0</i>	<i>0</i>	<i>0</i>
<i>0</i>	<i>1</i>	<i>1</i>
<i>1</i>	<i>0</i>	<i>1</i>
<i>1</i>	<i>1</i>	<i>1</i>



OPERATIONS

NOT COMPLEMENT

\overline{A}

NOT

x

x'

0

1

1

0



THEOREMS ON BOOLEAN ALGEBRA



COMMUTATIVE LAW

$$A+B = B+A$$

A	B	A+B	B+A
0	0	0	0
0	1	1	1
1	0	1	1
1	1	1	1

$$A.B = B.A$$

A	B	A.B	B.A
0	0	0	0
0	1	0	0
1	0	0	0
1	1	1	1

ASSOCIATIVE LAW

$$(x \cdot y) \cdot z = x \cdot (y \cdot z)$$
$$(x + y) + z = x + (y + z)$$

A	B	C	A + B	(A + B) + C	B + C	A + (B + C)
0	0	0	0	0	0	0
0	0	1	0	1	1	1
0	1	0	1	1	1	1
0	1	1	1	1	1	1
1	0	0	1	1	0	1
1	0	1	1	1	1	1
1	1	0	1	1	1	1
1	1	1	1	1	1	1

DISTRIBUTIVE LAW

$$x \cdot (y + z) = (x \cdot y) + (x \cdot z)$$
$$x + (y \cdot z) = (x + y) \cdot (x + z)$$

RMS

$$(x+y) \cdot (x+z)$$
$$= x \cdot x + x \cdot z + x \cdot y + y \cdot z$$
$$= x + x \cdot z + x \cdot y + y \cdot z$$
$$= x(1+z) + x \cdot y + y \cdot z$$
$$= x \cdot 1 + x \cdot y + y \cdot z \quad \{1+z\}$$
$$= x + xy + yz$$
$$= x(1+y) + yz$$
$$= x + yz = LHS$$

COMPLEMENT LAW

- Complement

$$x \cdot x' = 0$$

$$x + x' = 1$$

ABSORPTION LAW

$$X \cdot (X + Y) = X$$

$$X + (X \cdot Y) = X$$

(ii) $X \cdot (X + Y) = X$

(i) LHS = $X + XY$
 $= X(1 + Y)$
 $= X \cdot 1 \quad \{1 + Y = 1\}$
 $= X = \text{RHS}$

(ii) LHS $X \cdot (X + Y)$
 $= X \cdot X + XY$
 $= X + (XY)$ $\{X \cdot X = X\}$
 $= X(1 + Y)$
 $= X \cdot 1 \quad \{1 + Y = 1\}$
 $= X = \text{RHS}$

IDEMPOTENT LAW

$$X+X = X$$

$$X.X = X$$

DE MORGAN'S LAW

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

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



SUMMARIZING...

Name	AND form	OR form
Identity law	$1A = A$	$0 + A = A$
Null law	$0A = 0$	$1 + A = 1$
Idempotent law	$AA = A$	$A + A = A$
Inverse law	$A\bar{A} = 0$	$A + \bar{A} = 1$
Commutative law	$AB = BA$	$A + B = B + A$
Associative law	$(AB)C = A(BC)$	$(A + B) + C = A + (B + C)$
Distributive law	$A + BC = (A + B)(A + C)$	$A(B + C) = AB + AC$
Absorption law	$A(A + B) = A$	$A + AB = A$
De Morgan's law	$\overline{AB} = \bar{A} + \bar{B}$	$\overline{A + B} = \bar{A}\bar{B}$

PRINCIPLE OF DUALITY

Principal of Duality.

It says that:-

- ① Changing each AND sign to OR sign
- ② Changing each OR sign to AND sign
- ③ Converting any 0 or 1 appearing in the expression.

eg:- $A + B.C = 1$ \rightarrow Dual
 $A.(B + C) = 0$

Example of Duality

- ① $x + 0 = x \Rightarrow x.1 = x$
- ② $x + 1 = 1 \Rightarrow x.0 = 0$
- ③ $x + \bar{x} = 1 \Rightarrow x.\bar{x} = 0$

CONSENSUS THEOREM

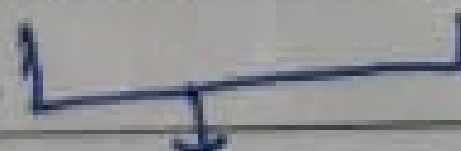
Consensus Theorem ✓

Conditions to apply consensus theorem

- 3 var must be present in expression
- Each var is repeated twice
- One var must present in complement form
- Take the complemented variable.



Theorem: ① $AB + \bar{A}C + BC = AB + \bar{A}C$



Ek var aur uska complement hai
to dono ki terms ka bacha hua combined
term hoga chahiye like BC to BC is
redundant

Eg

$$\overline{A}B + AC + BC + \textcircled{B'\overline{C}} + AB$$

$$\overline{A}B + AC + BC + \textcircled{AB}$$

$$\overline{A}B + AC + BC$$

②

Theorem:

$$(A+B)(\bar{A}+C)(B+C) = (A+B)(\bar{A}+C)$$

Eg $(A+B)(\bar{A}+C)(B+C)(\bar{A}+D)(B+D)$

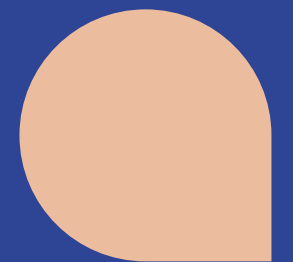
$$(A+B)(\bar{A}+C)(\bar{A}+D)(B+D)$$

$$(A'+B)(A'+C)(A'+D)$$

PRACTISE PROBLEMS

$$(X+Y) + X'Y' = ?$$

Solution

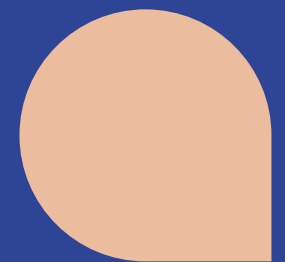


PRACTISE PROBLEMS

Reduce the following expression

$$X'Y' + X' + XY$$

Solution



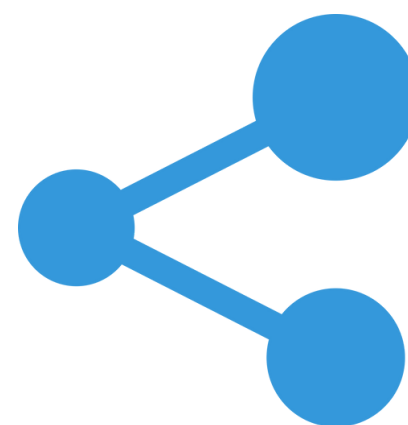
COMING UP NEXT

- Minterms Maxterms
- Logic Gates

**STAY TUNED
FOR FURTHER
TOPICS**



LIKE



SHARE



SUBSCRIBE