

# Tutorial 9

# Example 1

- Simplify each Boolean expression

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

# Explanation

- $A(A + \bar{A}) + B$

$$= AA + A\bar{A} + B$$

by the distributive law

$$= A + 0 + B$$

because  $AA = A$  and  $A\bar{A} = 0$

$$= A + B$$

because  $A + 0 = A$

## Example 2

Simplify each Boolean expression

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

# Explanation

- $(A+B)(\bar{A} + B)\bar{B}$   
=  $(A+B)(\bar{A}\bar{B} + B\bar{B})$  by the distributive law  
=  $(A+B)(\bar{A}\bar{B} + 0)$  because  $B\bar{B} = 0$   
=  $(A+B)(\bar{A}\bar{B})$  because  $\bar{A}\bar{B} + 0 = \bar{A}\bar{B}$   
=  $A\bar{A}\bar{B} + B\bar{A}\bar{B}$  by the distributive law  
=  $\bar{B}0 + \bar{A}0$  because  $A\bar{A} = 0$  and  $B\bar{B} = 0$   
=  $0$  because 0 ANDed with anything is 0

## Example 3

- Simplify each Boolean expression

$$(A + B)(A + C)$$

# Explanation

$(A + B)(A + C)$	
$= AA + AC + AB + BC$	Distributive law
$= A + AC + AB + BC$	$AA = A$
$= A(1 + C) + AB + BC$	$1 + C = 1$
$= A \cdot 1 + AB + BC$	Factoring (distributive law)
$= A(1 + B) + BC$	$1 + B = 1$
$= A \cdot 1 + BC$	$A \cdot 1 = A$
$= A + BC$	

## Example 4

- Simplify the following expression

$$\overline{A(\bar{B}\bar{C} + BC)}$$



# Explanation

- Simplification

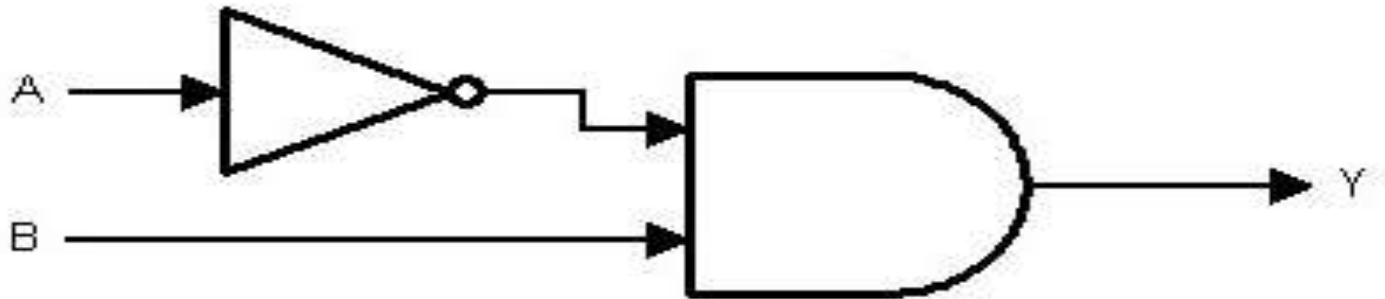
$$\begin{aligned}\overline{\mathbf{A}(\overline{\mathbf{B}}\overline{\mathbf{C}} + \mathbf{B}\mathbf{C})} &= \overline{\mathbf{A}} + \overline{(\overline{\mathbf{B}}\overline{\mathbf{C}} + \mathbf{B}\mathbf{C})} \\ &= \overline{\mathbf{A}} + (\overline{\overline{\mathbf{B}}\overline{\mathbf{C}}})(\overline{\mathbf{B}\mathbf{C}}) \\ &= \overline{\mathbf{A}} + (\mathbf{B} + \mathbf{C})(\overline{\mathbf{B}} + \overline{\mathbf{C}})\end{aligned}$$

# Summary of 2-input Logic Gates

Inputs		Truth Table Outputs For Each Gate					
A	B	AND	NAND	OR	NOR	EX-OR	EX-NOR
0	0	0	1	0	1	0	1
0	1	0	1	1	0	1	0
1	0	0	1	1	0	1	0
1	1	1	0	1	0	0	1

# Example 5

- Truth Table of output Y ?

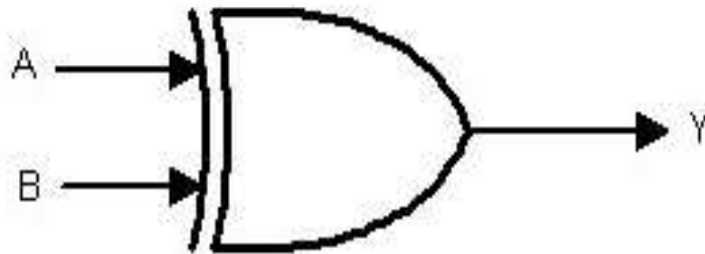


# Explanation

A	B	$\bar{A}$	Y
0	0	1	0
0	1	1	1
1	0	0	0
1	1	0	0

# Example 6

- Truth Table of output Y ?



# Explanation

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

# MCQ 1

- How many truth table entries are necessary for a four-input circuit?
  - a) 4
  - b) 8
  - c) 12
  - d) 16

## MCQ 2

- Which input values will cause an AND logic gate to produce a HIGH output?
  - a) At least one input is HIGH
  - b) At least one input is LOW
  - c) All inputs are HIGH
  - d) All inputs are LOW



## MCQ 3

- The basic logic gate whose output is the complement of the input is the \_\_\_\_\_
- 
- a) OR gate
  - b) AND gate
  - c) INVERTER gate
  - d) XOR gate

## MCQ 4

- The expression for Absorption law is given by

\_\_\_\_\_

- a)  $A + AB = A$
- b)  $A + AB = B$
- c)  $AB + AA' = A$
- d)  $A + B = B + A$

## MCQ 5

- Which of following are known as universal gates?
  - a) NAND & NOR
  - b) AND & OR
  - c) XOR & OR
  - d) EX-NOR & XOR

## MCQ 6

- **The output of OR gate is 1**
  - a) If both inputs are zero
  - b) If either or both inputs are 1
  - c) Only if both inputs are 1
  - d) If either input is zero

# MCQ 7

- Which of the following logical operations is represented by the + sign in Boolean algebra?
- **A.inversion**
- **B.AND**
- **C.OR**
- **D.complementation**