

DeMorgan's Theorem

ENT262/ENT263



Theorems



The complement of two or more ANDed variables is equivalent to the OR of the complements of the individual variables

Equation:

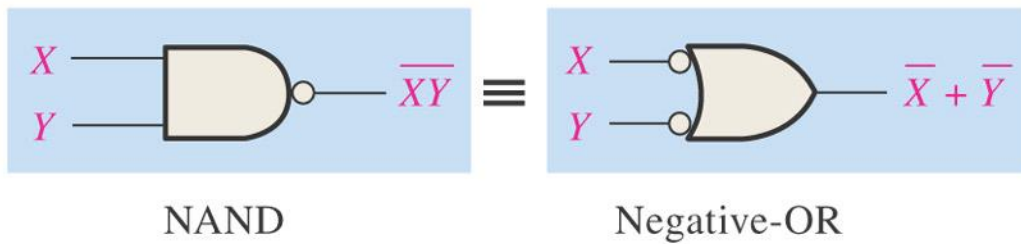
$$\overline{XY} = \overline{X} + \overline{Y}$$

The complement of two or more ORed variables is equivalent to the AND of the complements of the individual variables

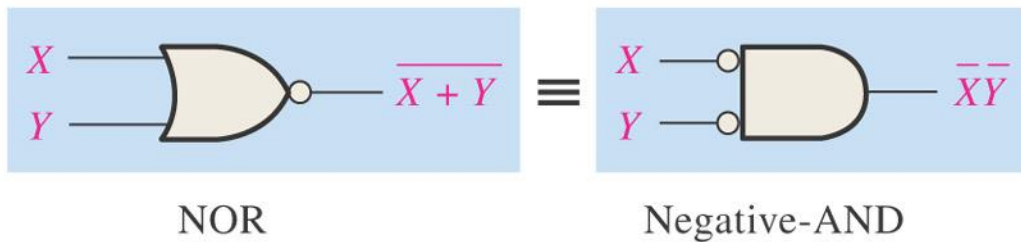
Equation:

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

Gate equivalencies and the corresponding truth tables that illustrate DeMorgan's theorems



Inputs		Output	
X	Y	\overline{XY}	$\overline{X + Y}$
0	0	1	1
0	1	1	1
1	0	1	1
1	1	0	0



Inputs		Output	
X	Y	$\overline{X + Y}$	\overline{XY}
0	0	1	1
0	1	0	0
1	0	0	0
1	1	0	0

Example:

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

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

$$\overline{XYZ}$$

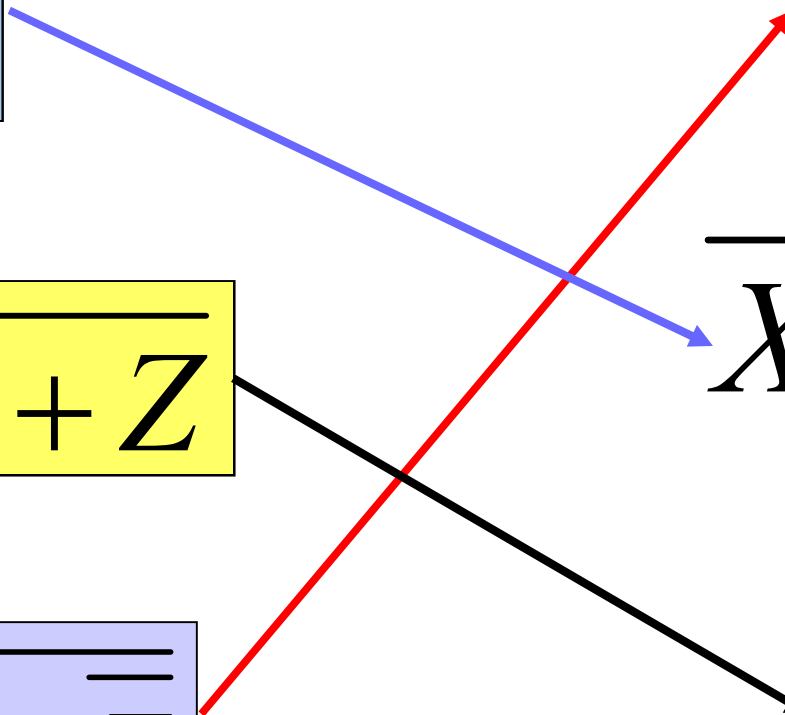
$$XYZ$$

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

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

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

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



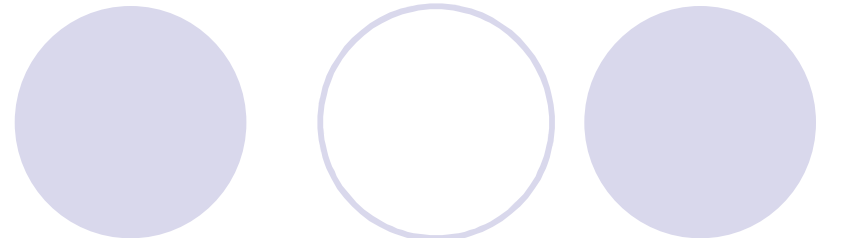
Example:

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

$$\overline{ABC + DEF}$$

$$\overline{\overline{AB} + \overline{CD} + EF}$$

$$\overline{\overline{ABC} + D + E}$$

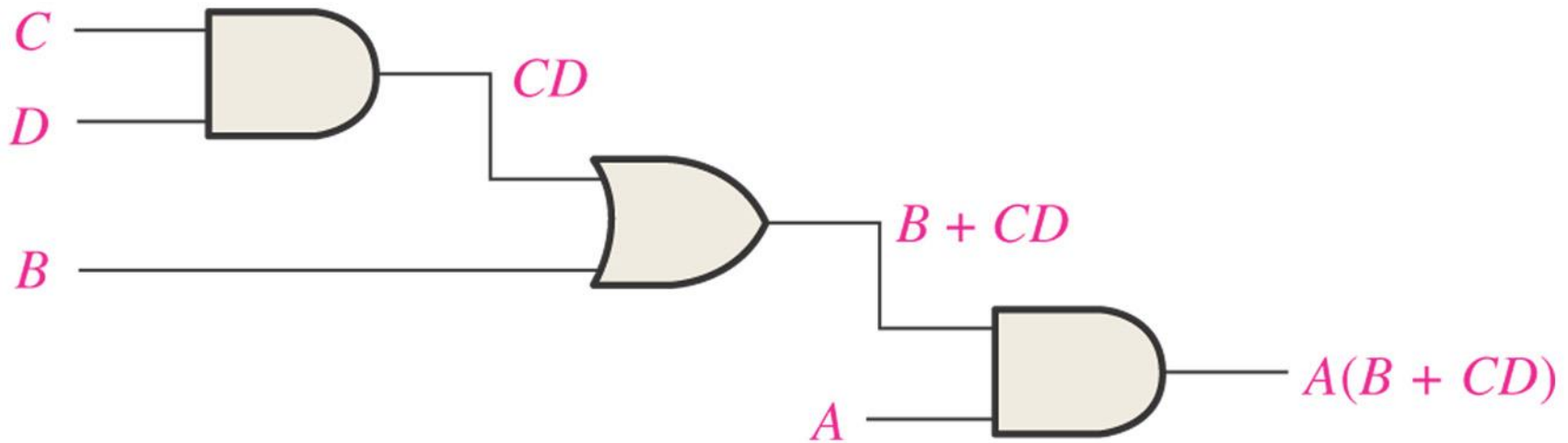

$$\overline{ABC} + \overline{D}$$

$$(\overline{A} + \overline{B} + \overline{C})(\overline{D} + \overline{E} + \overline{F})$$

$$(\overline{A} + B)(C + \overline{D})(\overline{E} + \overline{F})$$

$$ABC\overline{D}\overline{E}$$

Boolean Analysis of Logic Circuits



IF $A = 1$, $B = 1$, $C = 1$ and $D = 1$, so the Output is ???

Truth Table

Inputs				Output
A	B	C	D	$A(B + CD)$
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

Simplification using Boolean Algebra

Example: Draw your possible logic gate?
Simplify this expression using Boolean algebra?

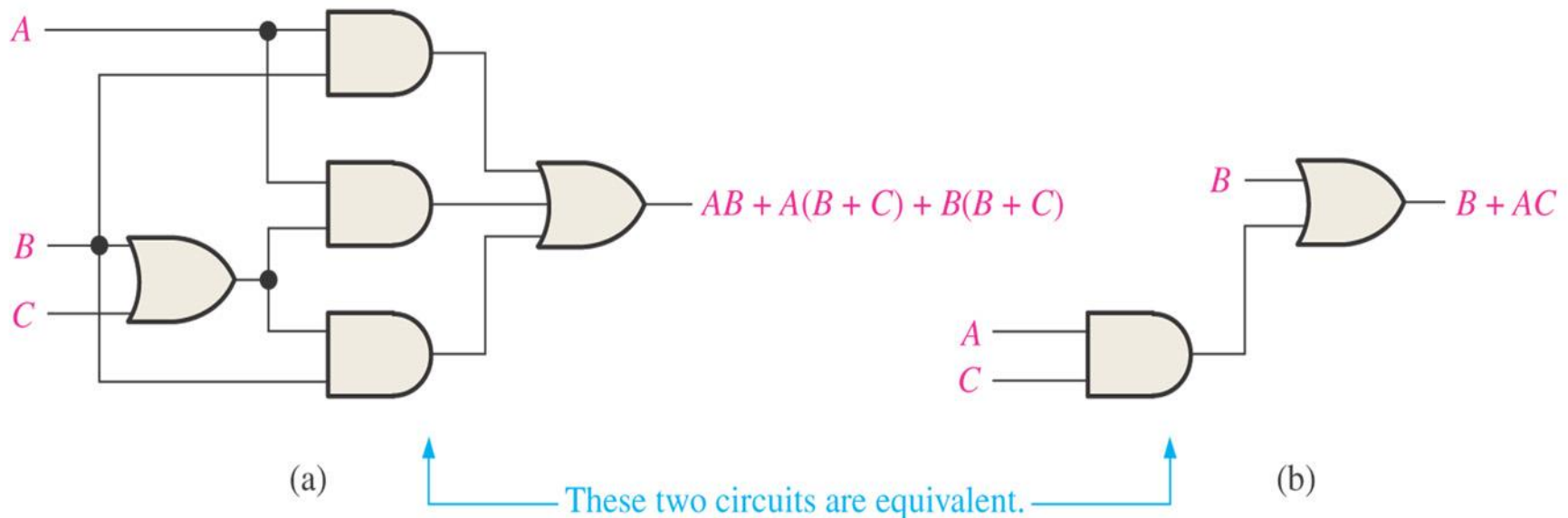
$$AB + A(B + C) + B(B + C)$$

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

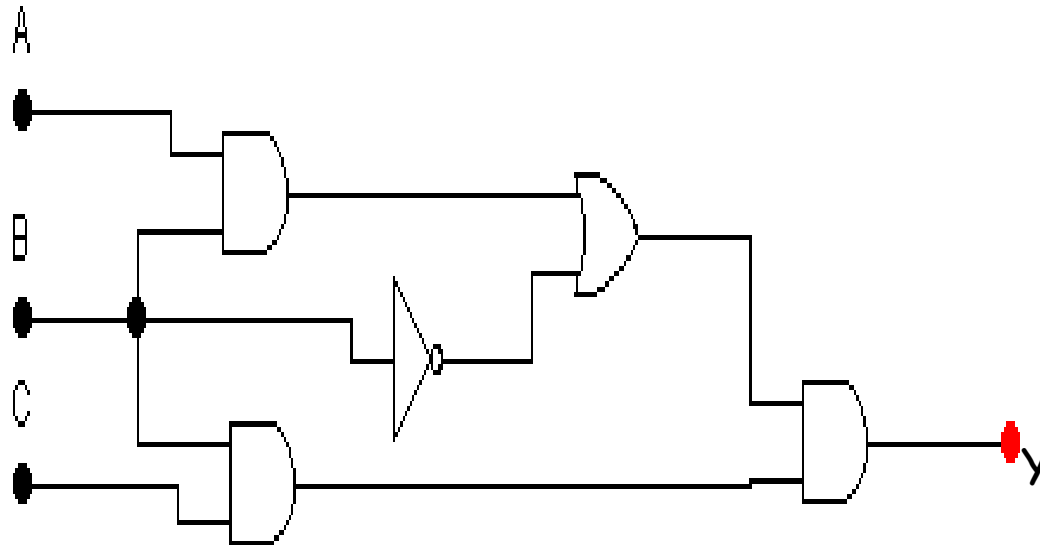
Try
This:

$$B + AC$$

$$A\bar{B}$$

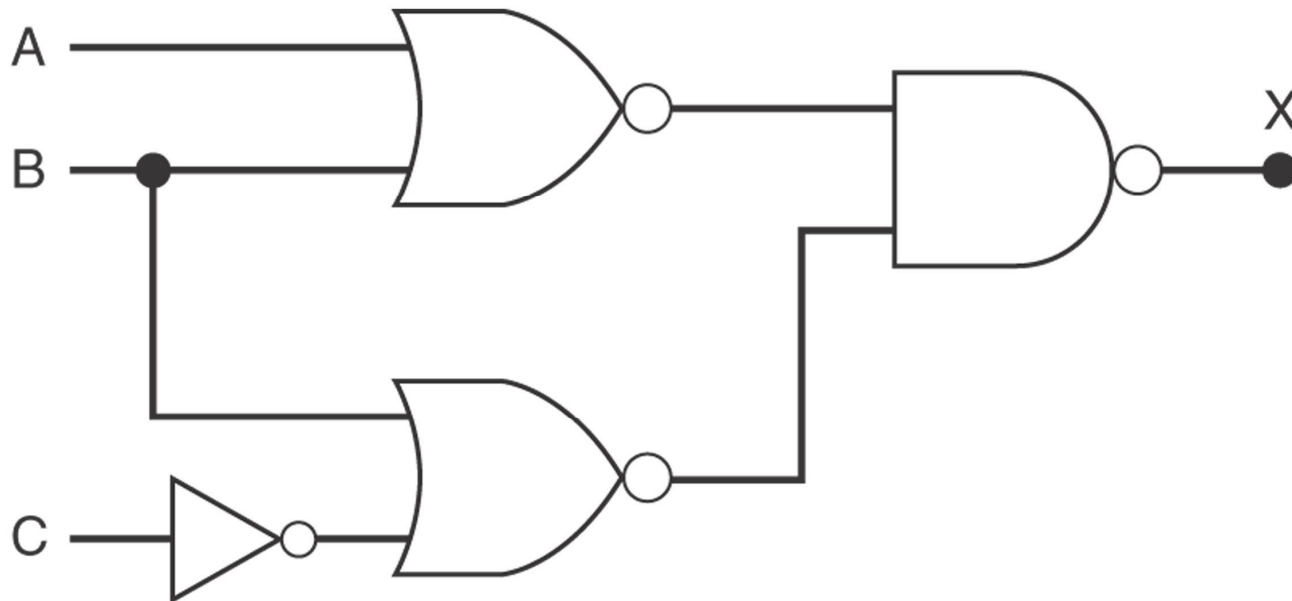


Exercise: Analyze the circuit below



1. $y = ???$
2. Simplify the Boolean expression found in 1

Exercise:



1. $X=???$

2. Simplify the Boolean expression found in 1

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



Thank You

*“Gagal Setelah Mencuba Seribu Kali
Lebih Baik Daripada Tidak Pernah
Mencuba. Keperitan dan Kepayahan
Adalah Jalan Menuju Kebenaran”*