

Lecture 3

Logic Gates

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جامعة
المنارة

□ البوابة المنطقية هي دائرة إلكترونية تستخدم لمعالجة البيانات الثنائية.

□ هناك العديد من البوابات المنطقية المستخدمة في الكمبيوتر الرقمي.

□ لكل دائرة منطقية رمز بياني مميز ويمكن أن تمثل عمليتها تعبيراً.

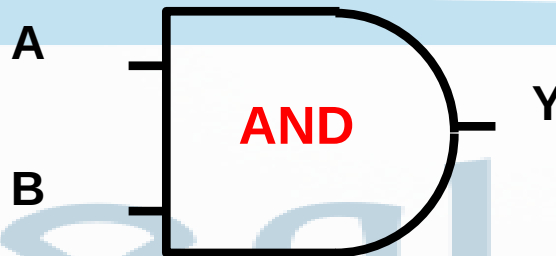
□ يكون لكل بوابة مدخل أو مدخلان يحملان بيان بالنظام الثنائي وتولد مخرجا ثنائيا واحدا يساوي ١ أو ٠.

- لكل بوابة منطقية يمكن تمثيل عملياتها بجدول الحقيقة.
- جدول الحقيقة: تمثل علاقة المدخلات والمخرجات من البتات الثنائية على شكل جدول يسمى بجدول الحقيقة.
- البوابات المنطقية المختلفة المتاحة في الكمبيوتر الرقمي هي:

AND Function

Text Description $\Rightarrow$ Output Y is TRUE if inputs A AND B are TRUE, else it is FALSE.

Logic Symbol $\Rightarrow$



Truth Table $\Rightarrow$

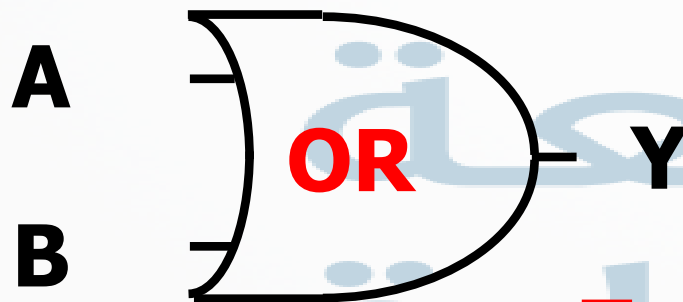
INPUTS		OUTPUT
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1
AND Gate Truth Table		

Boolean Expression $\Rightarrow$ $Y = A \times B = A \cdot B = AB$ **AND Symbol**

OR Function

- **Text Description** $\Rightarrow$ Output Y is TRUE if input A **OR** B is TRUE, else it is FALSE.

- **Logic Symbol**



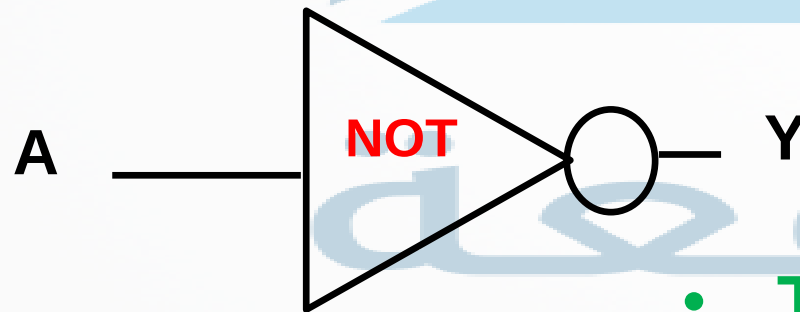
- **Truth Table** $\Rightarrow$

INPUTS		OUTPUT
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1
OR Gate Truth Table		

- **Boolean Expression** $\Rightarrow$ $Y = A + B$ **OR Symbol**

NOT Function (inverter)

- **Text Description** $\Rightarrow$ Output Y is TRUE if input A is FALSE, else it is FALSE. Y is the inverse of A.
- **Logic Symbol** $\Rightarrow$



- **Truth Table** $\Rightarrow$

INPUT	OUTPUT
A	Y
0	1
1	0
NOT Gate Truth Table	

- **Boolean Expression** $\Rightarrow$

$$Y = \overline{A}$$

NOT
Bar

Alternative Notation

$$Y = A'$$

$$Y = !A$$

NAND Function

- Text Description ⇒

Output Y is FALSE if inputs A AND B are TRUE, else it is TRUE.

- Logic Symbol ⇒

This is an AND Gate with an inverted output.

A bubble is an inverter



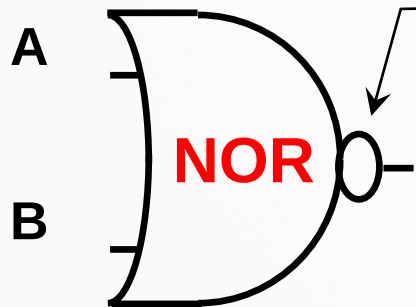
- Truth Table ⇒

INPUTS		OUTPUT
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0
NAND Gate Truth Table		

- Boolean Expression ⇒ $Y = A \times B = \overline{AB}$

NOR Function

- **Text Description** $\Rightarrow$ Output Y is FALSE if input A OR B is TRUE, else it is TRUE.
- **Logic Symbol** $\Rightarrow$



A bubble is an inverter.

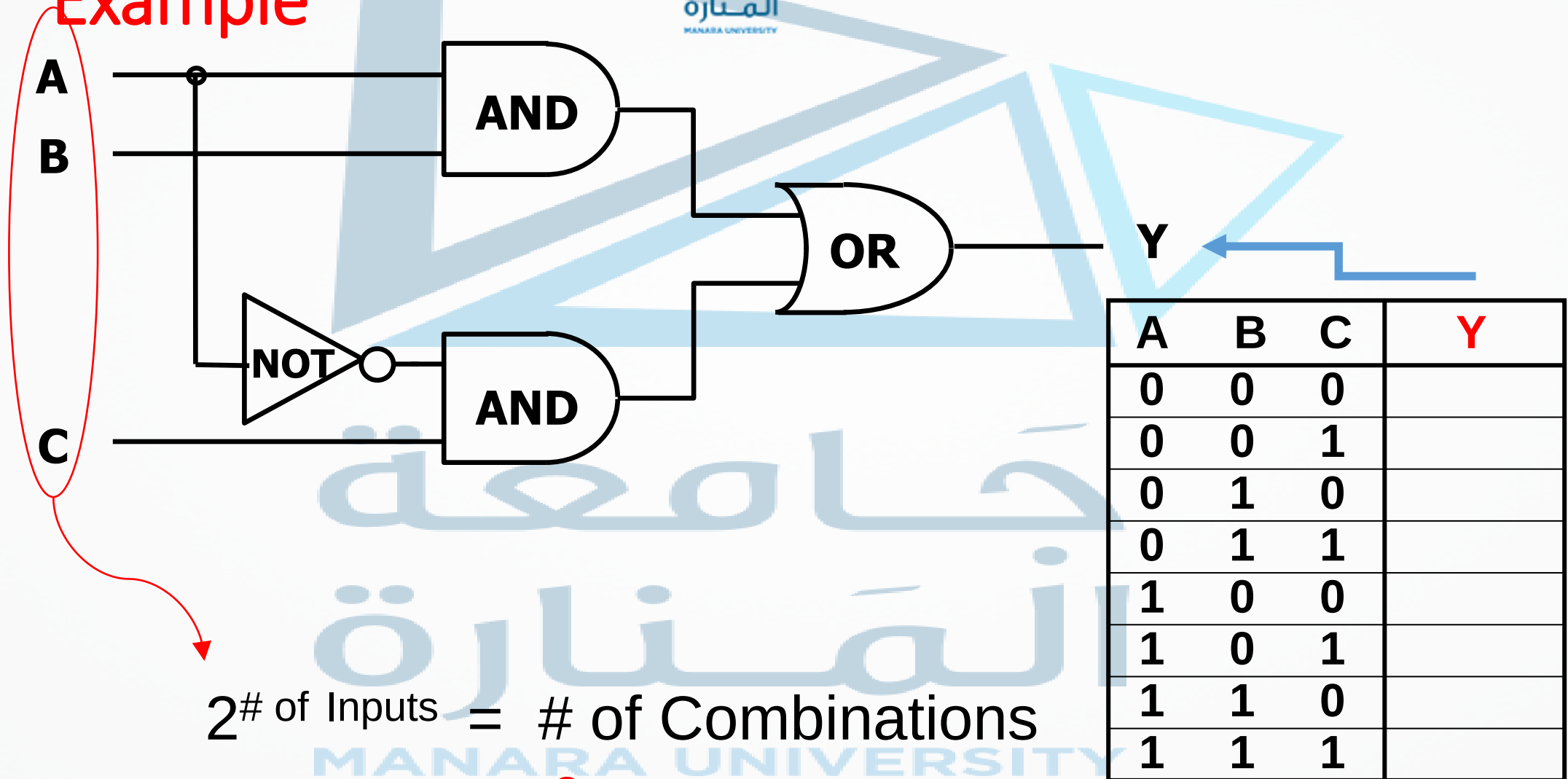
This is an OR Gate with its output inverted.

INPUTS		OUTPUT
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0
NOR Gate Truth Table		

- **Truth Table** $\Rightarrow$

• **Boolean Expression** $\Rightarrow$ $Y = \overline{A + B}$

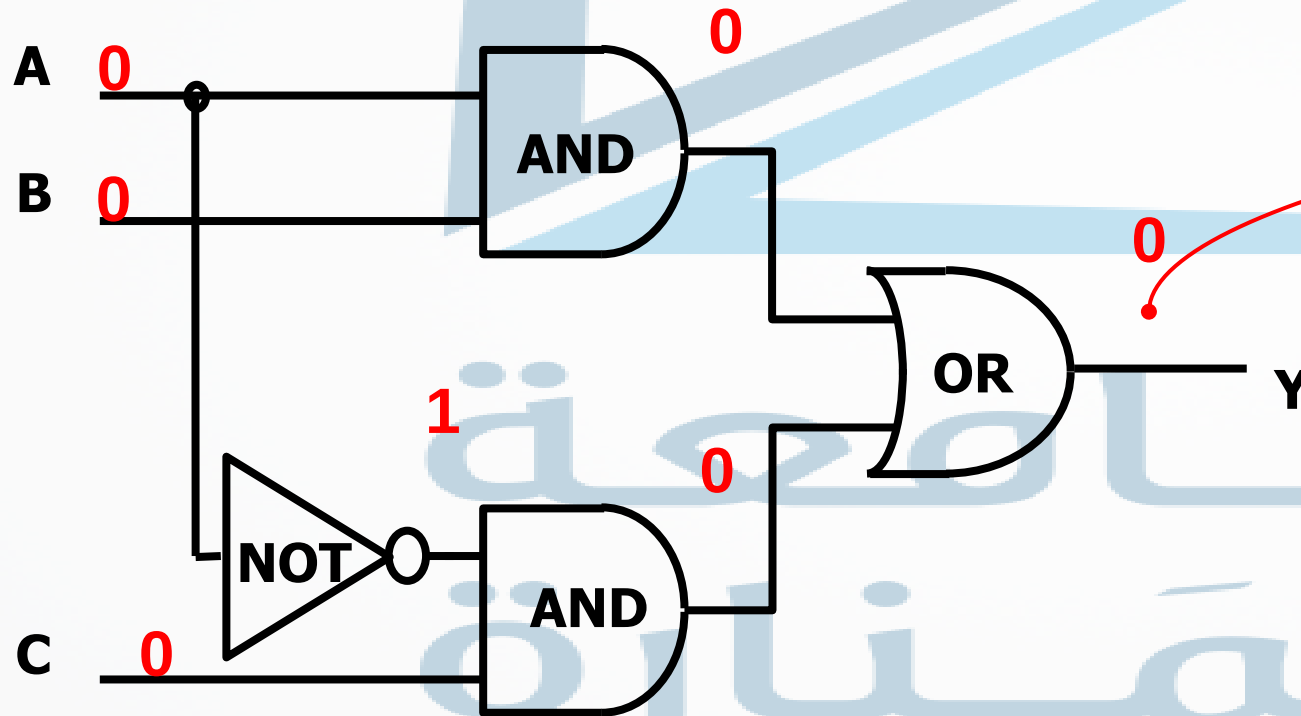
Circuit-to-Truth Table Example



$2^{\# \text{ of Inputs}} = \# \text{ of Combinations}$

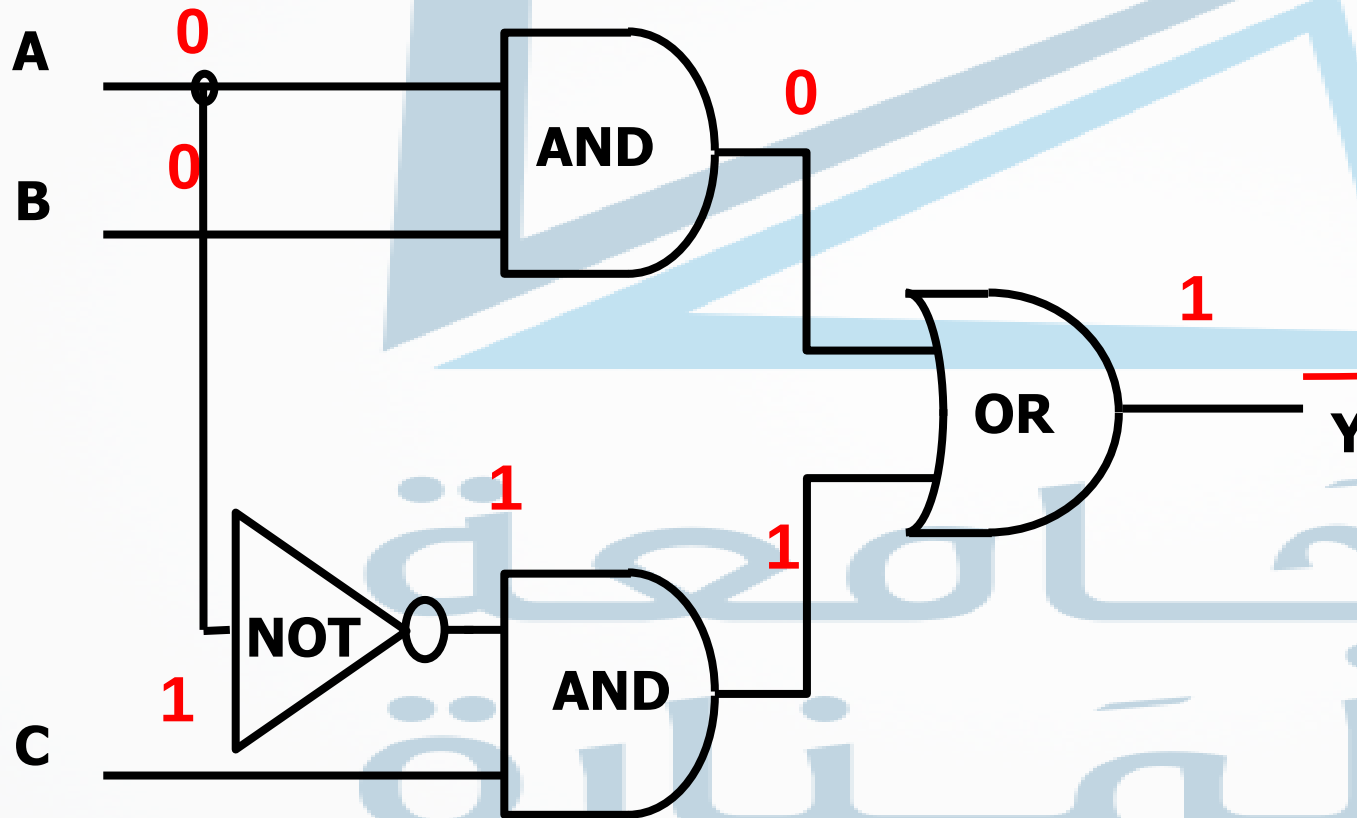
$$2^3 = 8$$

Circuit-to-Truth Table Example



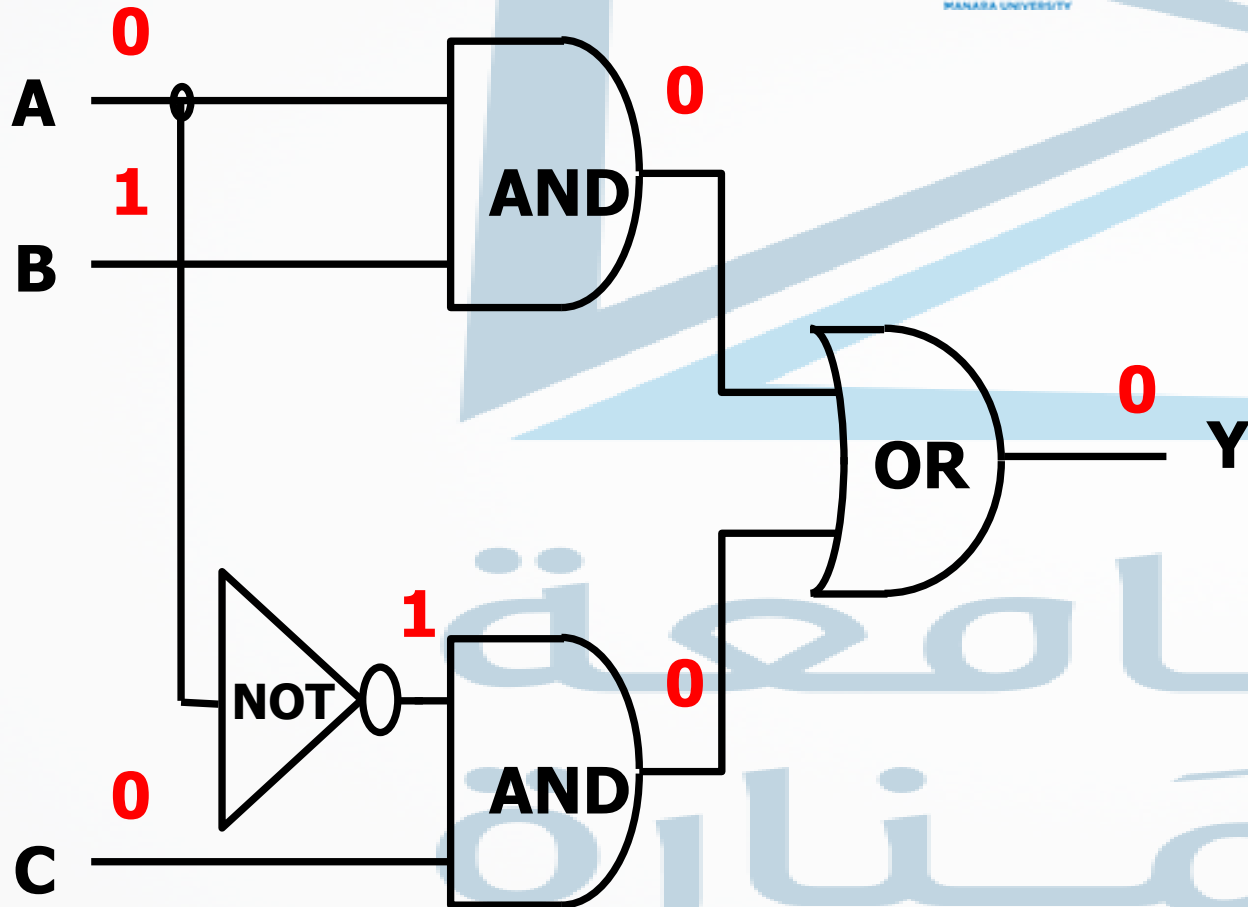
A	B	C	Y	
0	0	0		0
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Circuit-to-Truth Table Example



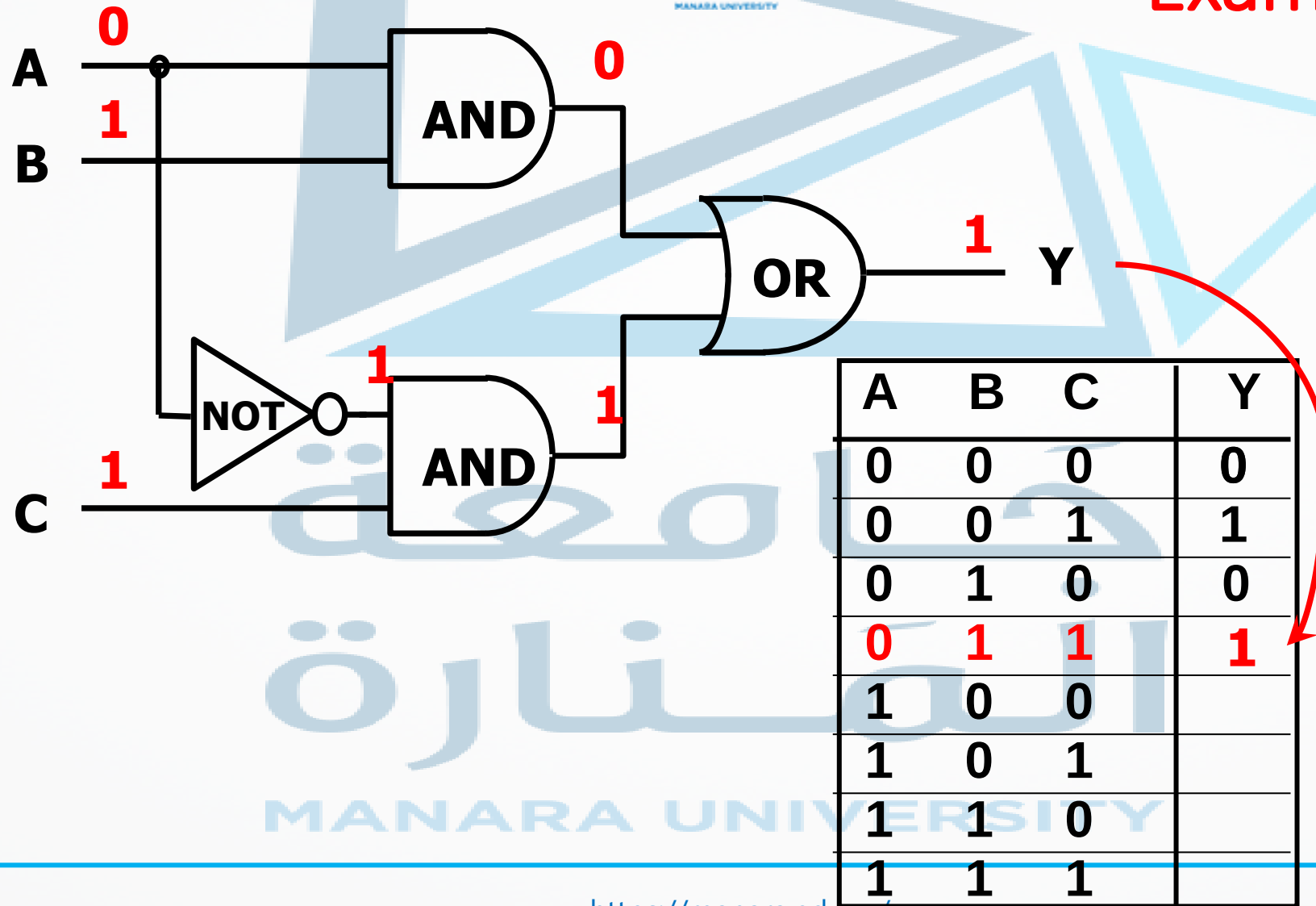
A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Circuit-to-Truth Table Example

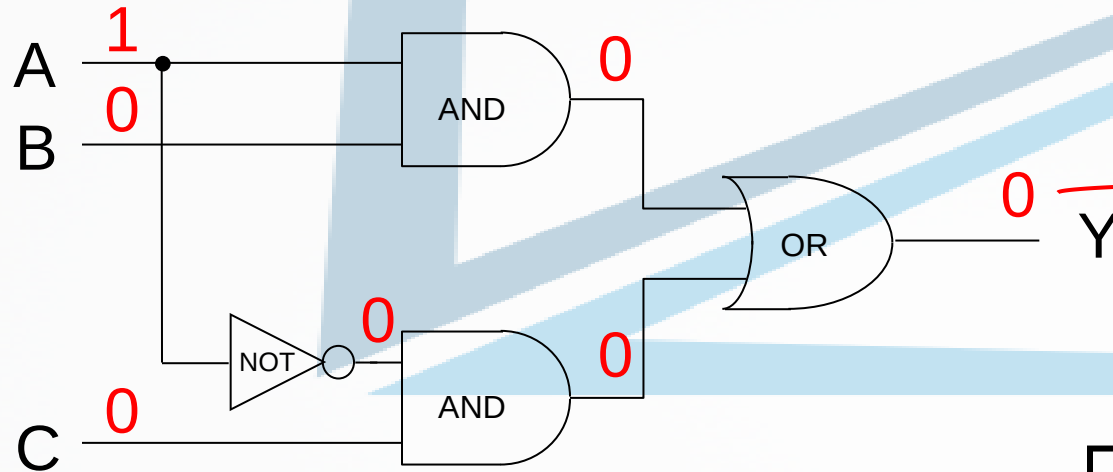


A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Circuit-to-Truth Table Example

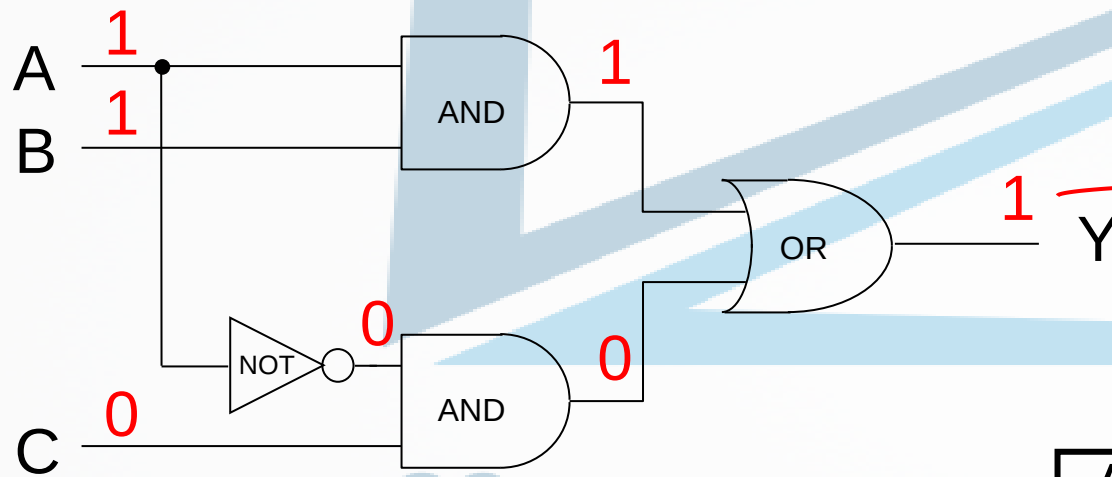


Circuit-to-Truth Table Example



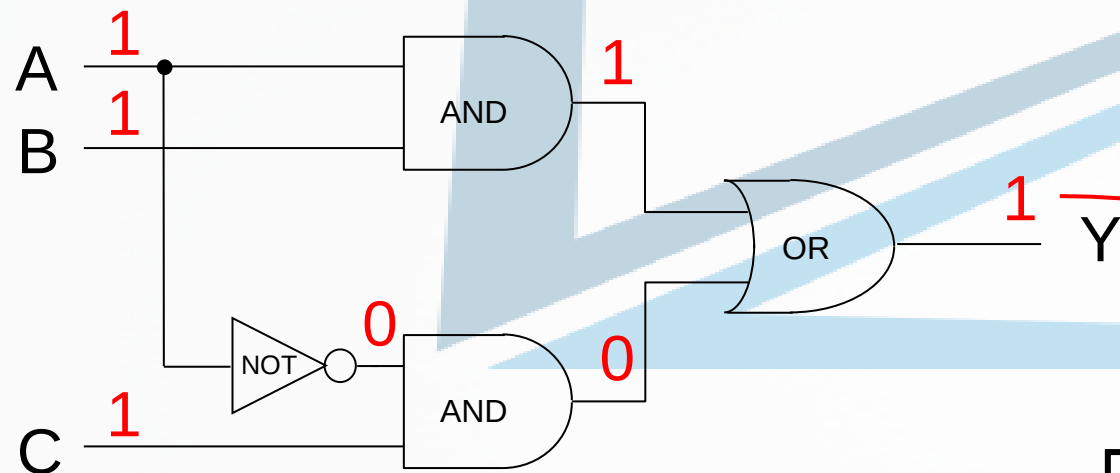
A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	
1	1	0	
1	1	1	

Circuit-to-Truth Table Example



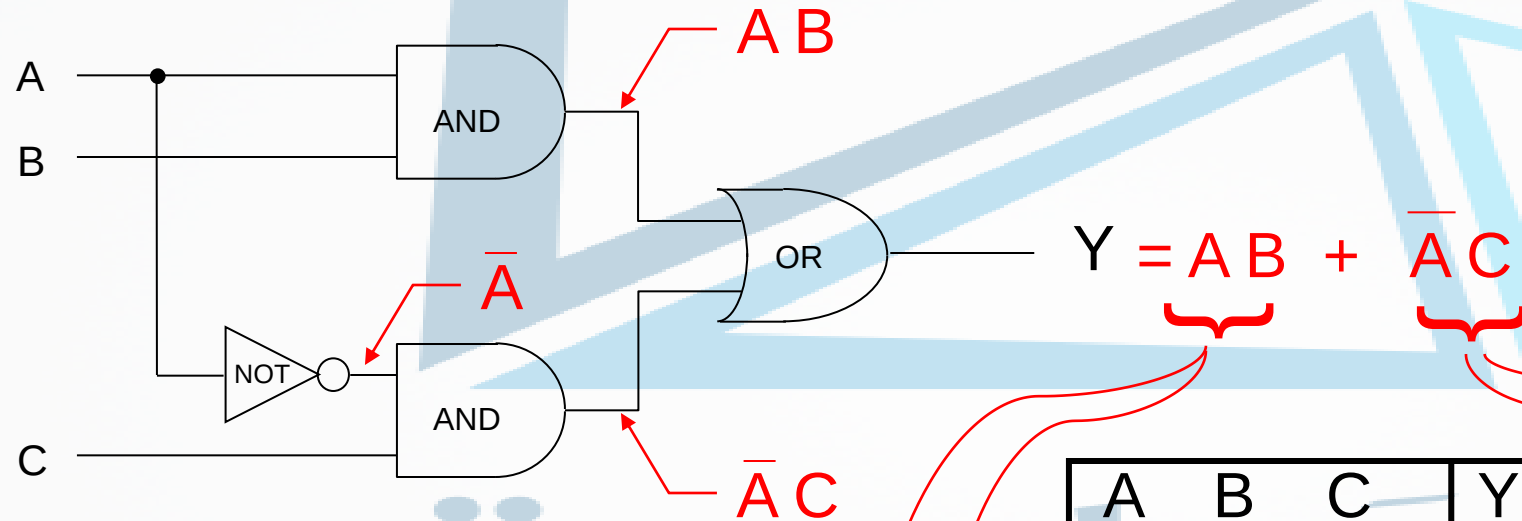
A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	

Circuit-to-Truth Table Example



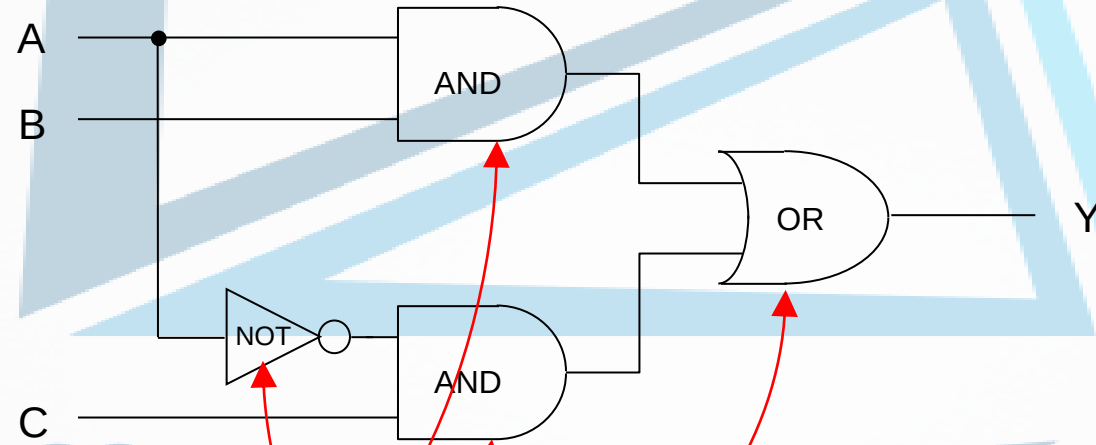
A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

Circuit-to-Boolean Equation



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

A - O - I Logic



AND Gates

OR Gates

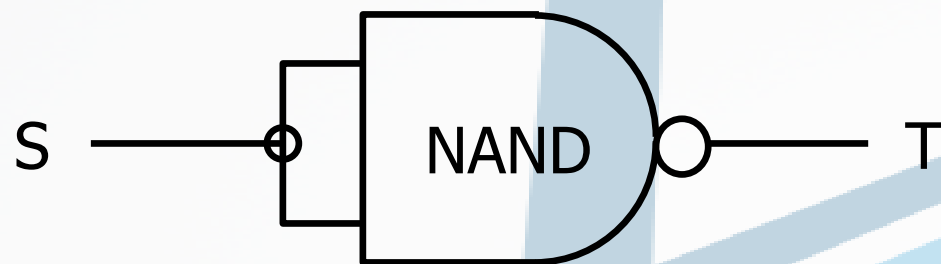
INVERTER Gates

Other Logic Arrangements:

NAND - NAND Logic

NOR - NOR Logic

NAND Gate – Special Application



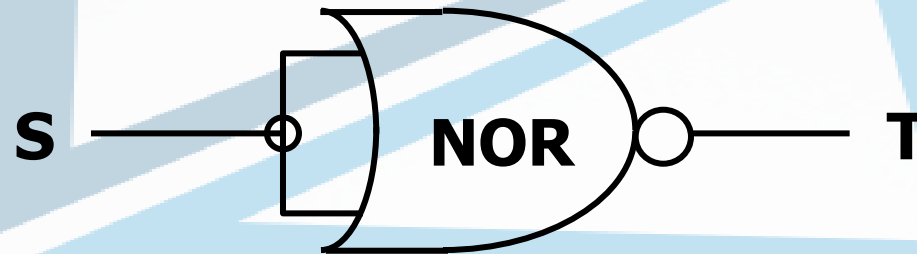
S	T
0	1
1	0



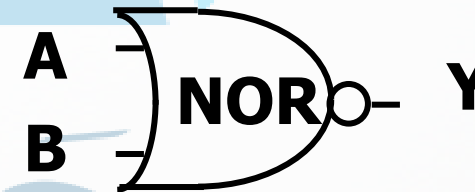
INPUTS		OUTPUT
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Equivalent To
An Inverter Gate

NOR Gate - Special Application



S	T
0	1
1	0



INPUTS		OUTPUT
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0

Equivalent To An Inverter Gate

NEXT LECTURE

Boolean algebra

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