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Class Group: COMP1D-X

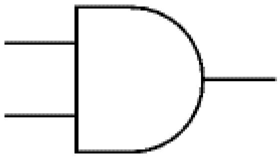
Download and install Logisim, available on Canvas

Lab 4 – Basic Logic Gates

1. AND GATE

When ANDing 2 bits, the output is 1 (i.e. on / high / true) only when both inputs are 1.

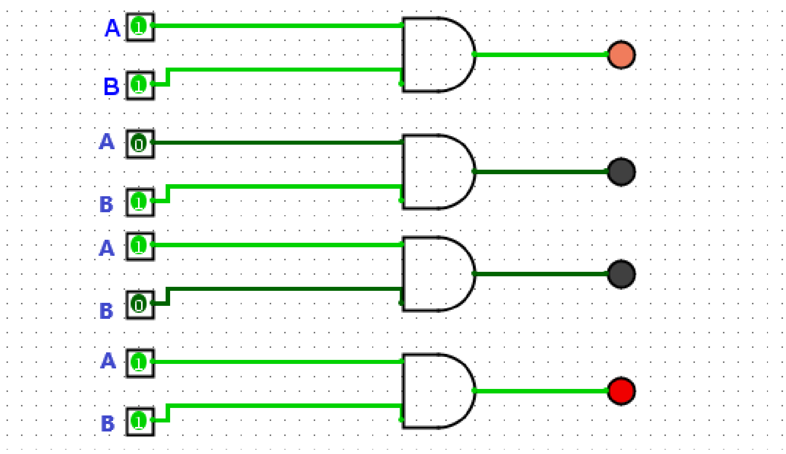
Symbol for AND = A.B



i) Complete the truth table for an AND gate:

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

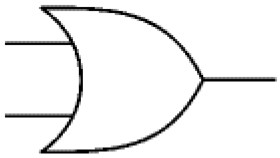
ii) Implement a simple AND gate using Logisim. Copy and paste the diagram below:



2. OR GATE

When using an OR gate, the output is 1 if either/both inputs are 1.

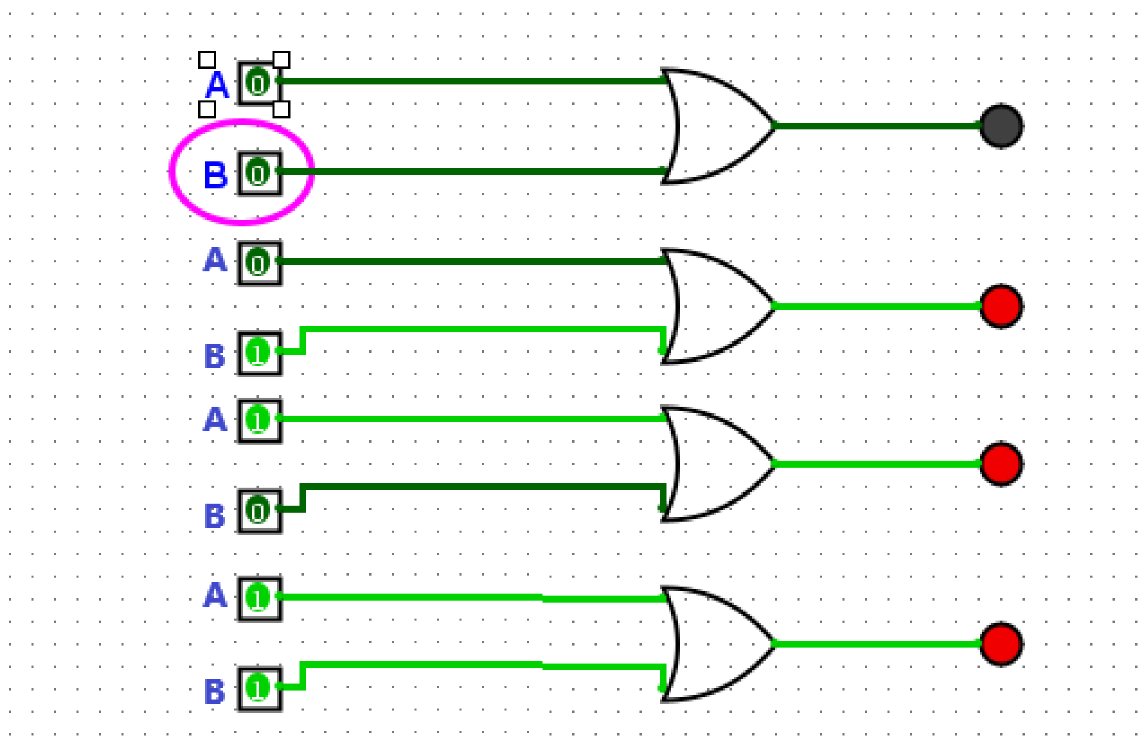
Symbol for OR = A+B



i) Complete the truth table for an OR gate

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

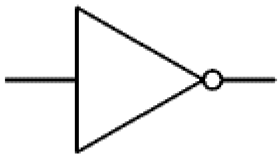
ii) Implement a simple OR gate using Logisim. Copy and paste the diagram below:



3. NOT GATE

A NOT gate gives the opposite value of the input, i.e. a 0 becomes a 1, and a 1 becomes a 0.

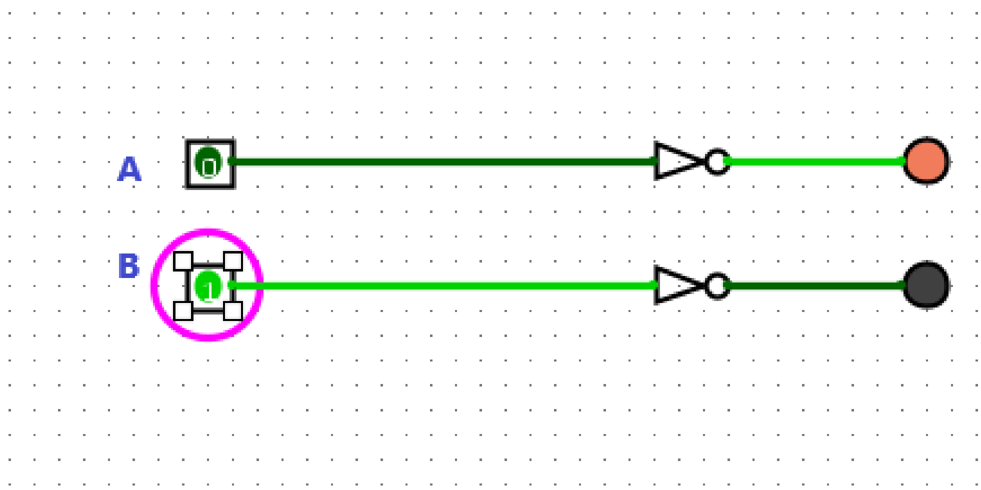
Symbol for NOT = $A = A'$



i) Complete the truth table for an NOT gate:

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

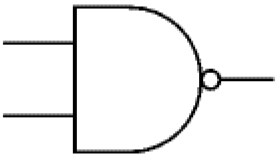
ii) Implement a simple NOT gate using Logisim. Copy and paste the diagram below:



4. NAND GATE

A NAND gate returns the opposite value to an AND gate. When NANDing 2 bits, the output is 0 only when both inputs are 1.

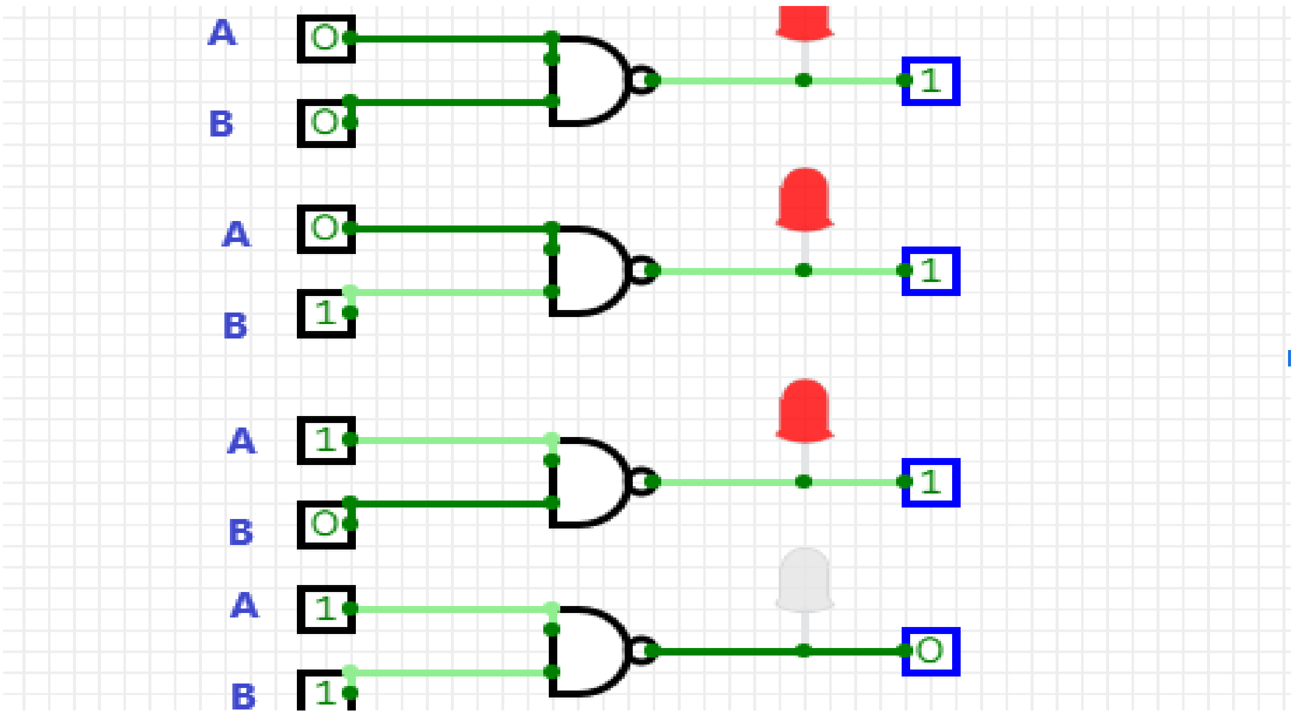
Symbol for NAND = $\overline{A.B}$



i) Complete the truth table for an NAND gate:

A	B	$\overline{A.B}$
0	0	1
0	1	1
1	0	1
1	1	0

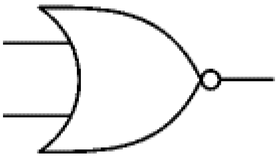
ii) Implement a simple NAND gate using Logisim. Copy and paste the diagram below:



5. NOR GATE

A NOR gate returns the opposite value to an OR gate. When using a NOR gate, the output is 0 if either/both inputs are 1.

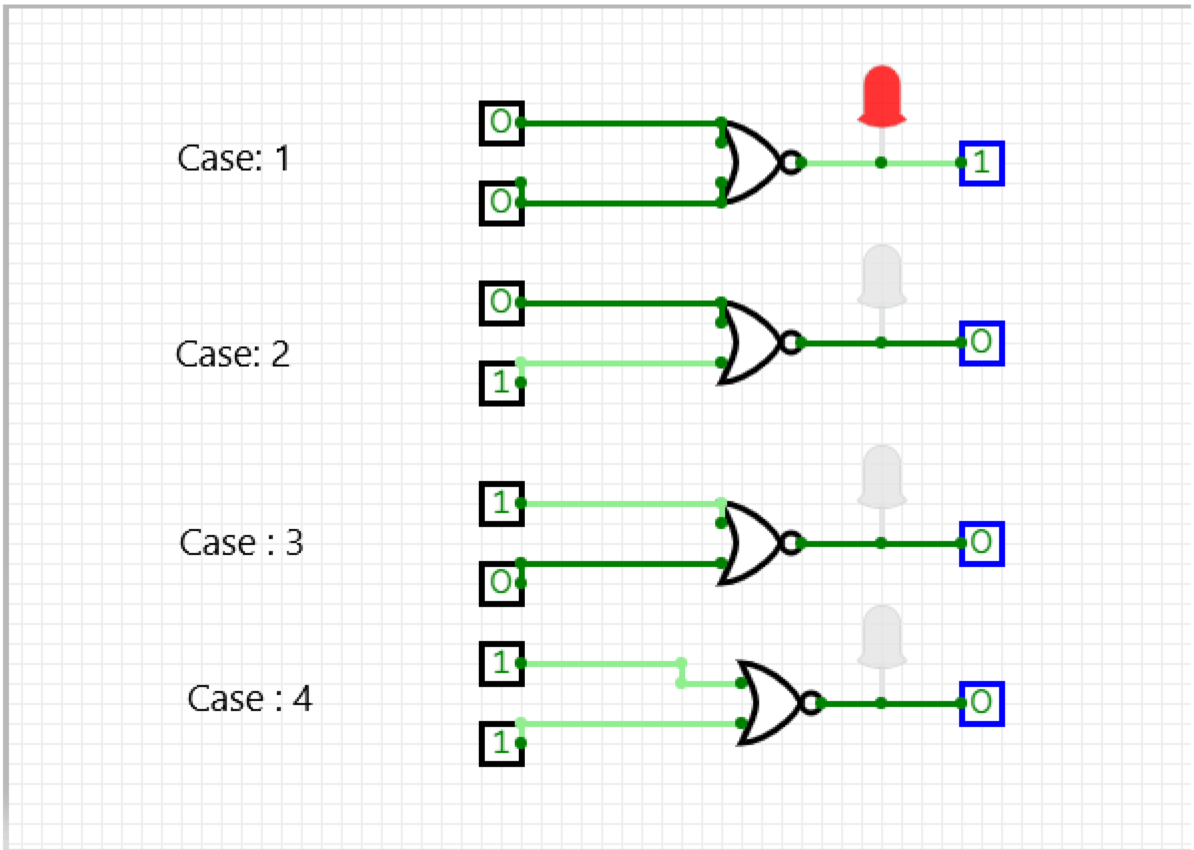
Symbol for NOR = $\overline{A + B}$



i) Complete the truth table for a NOR gate:

A	**B**	$\overline{A + B}$
0	0	1
0	1	0
1	0	0
1	1	0

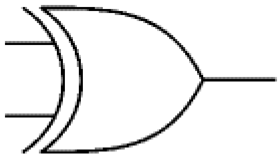
ii) Implement a simple NOR gate using Logisim. Copy and paste the diagram below:



6. EXOR GATE

EXOR means exclusive OR. The output is 1 only if either input is 1, excluding the case when both are 1.

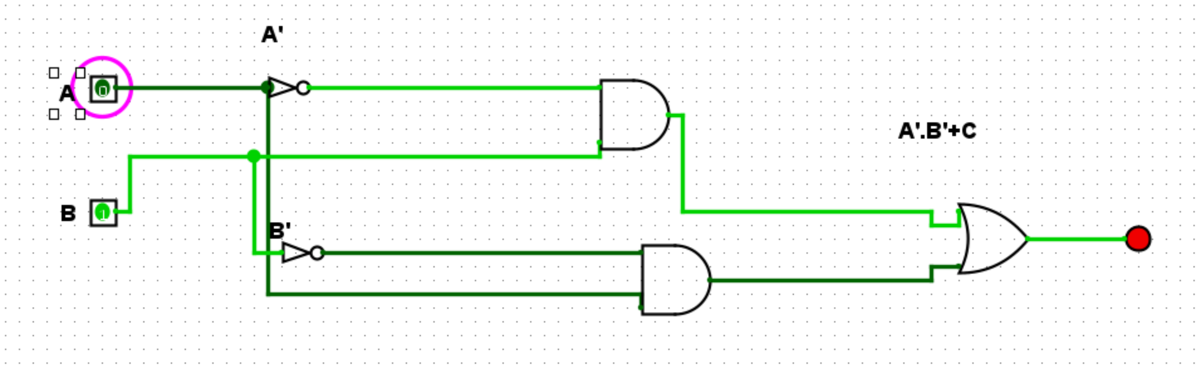
Symbol for EXOR = A'B + AB' = **A** $\oplus$ **B**



i) Complete the truth table for an EXOR gate:

A	B	A $\oplus$ B
0	0	0
0	1	1
1	0	1
1	1	0

ii) Implement a simple EXOR gate using Logisim. Copy and paste the diagram below:



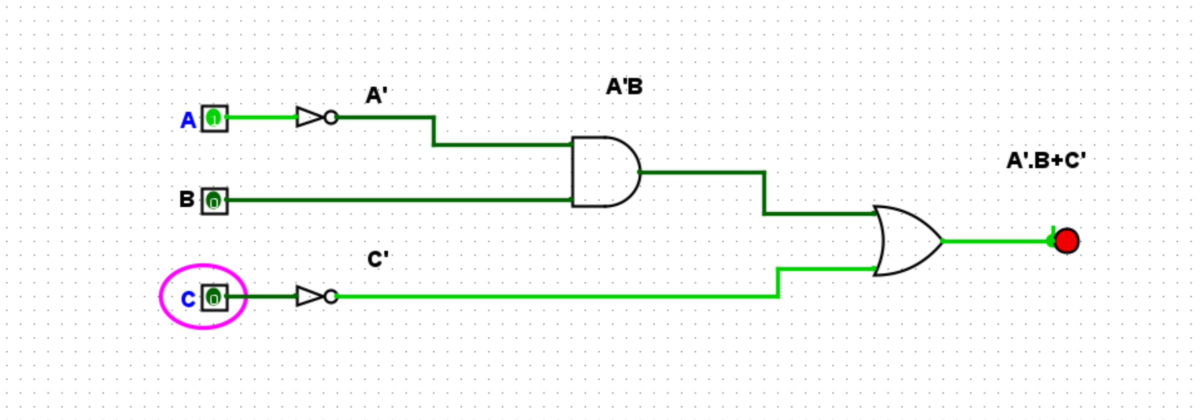
7. Implement Boolean expressions as circuits

Draw circuits for the Boolean expressions outlined below.

Complete the truth tables for these expressions and verify the truth tables using your circuits.

1. $\overline{A}.B + \overline{C}$
2. $\overline{A.B} + C$
3. $\overline{A}.\overline{B} + C$

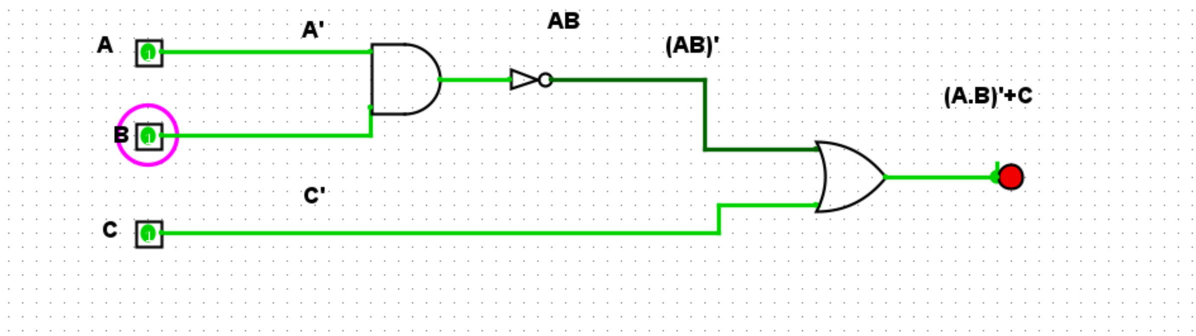
01. Boolean expressions : $\overline{A}.B + \overline{C}$



1. Truth Table :

A	B	C	A'	C'	$\overline{A}.B + \overline{C}$
0	0	0	1	1	1
0	0	1	1	0	0
0	1	0	1	1	1
0	1	1	1	0	1
1	0	0	0	1	1
1	0	1	0	0	0
1	1	0	0	1	1
1	1	1	0	0	0

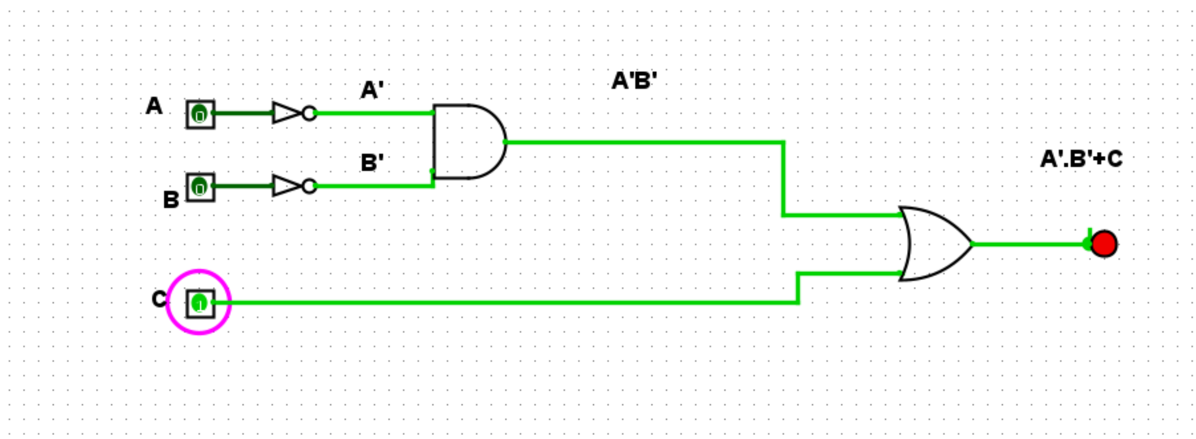
2. Boolean expressions : $\overline{A.B} + C$



2. Truth Table :

A	B	C	AB	(AB)’	$\overline{A.B} + C$
0	0	0	0	1	1
0	0	1	0	1	1
0	1	0	0	1	1
0	1	1	0	1	1
1	0	0	0	1	1
1	0	1	0	1	1
1	1	0	1	0	0
1	1	1	1	0	1

3 . Boolean expressions : $\overline{A}.\overline{B} + C$



3. Truth Table :

A	**B**	**C**	A'	**B'**	A'B'	$\overline{A}.\overline{B} + C$
0	**0**	**0**	**1**	**1**	**1**	**1**
0	**0**	**1**	**1**	**1**	**1**	**1**
0	**1**	**0**	**1**	**0**	**0**	**0**
0	**1**	**1**	**1**	**0**	**0**	**1**
1	**0**	**0**	**0**	**1**	**0**	**0**
1	**0**	**1**	**0**	**1**	**0**	**1**
1	**1**	**0**	**0**	**0**	**0**	**0**
1	**1**	**1**	**0**	**0**	**0**	**1**