
[Lab 3]. Digital logic circuits analysis and converting Boolean expressions to digital circuits

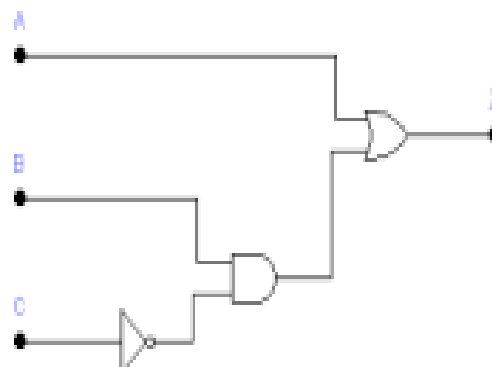
Objectives

- To learn how to directly convert a Boolean expression to circuit.
- To learn how to analyze a given digital logic circuit by finding the Boolean expression that represents the circuit
- To learn how to analyze a given digital logic circuit by finding the truth table that represents the circuit.

Example:

$$Z = A + B \cdot C'$$

The above function is implemented in the following digital logic Circuit



Now after drawing the circuit above using EWB we find that its truth table is as shown below (notice that logic 1 means connect the input to the Vcc line, and logic 0 means connecting the input to the ground)

A	B	C	Z
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Lab Tasks

Task 1: Converting Boolean expressions into circuits

Convert the following Boolean expression to a circuit, draw the circuit on EWB and simulate it to fill-in its truth table shown below.

$$X = Y + Z \cdot Y'$$

Draw the circuit in the space below



Now, fill-in the truth table of the circuit you drawn

Y	Z	X
0	0	
0	1	
1	0	
1	1	

Task 2: Converting Boolean expressions into circuits

Convert the following Boolean expression to a circuit, draw the circuit on EWB and simulate it to fill-in its truth table shown below.

$$D = (A \cdot B) + (C' \cdot A)$$

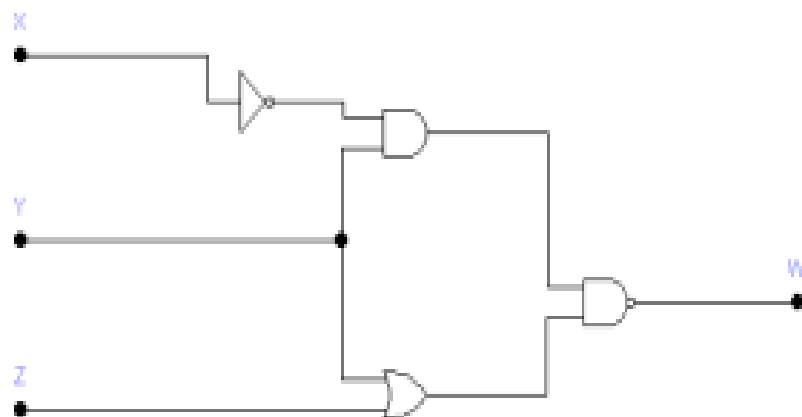


A	B	C	D
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

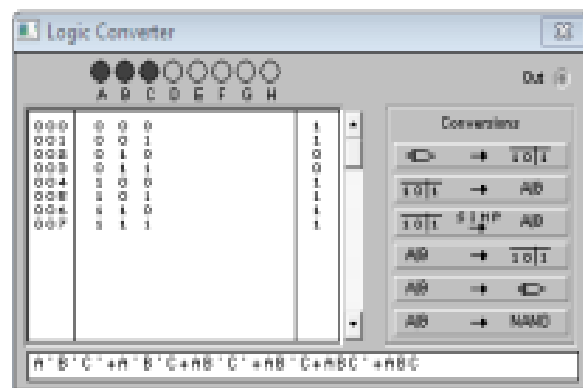
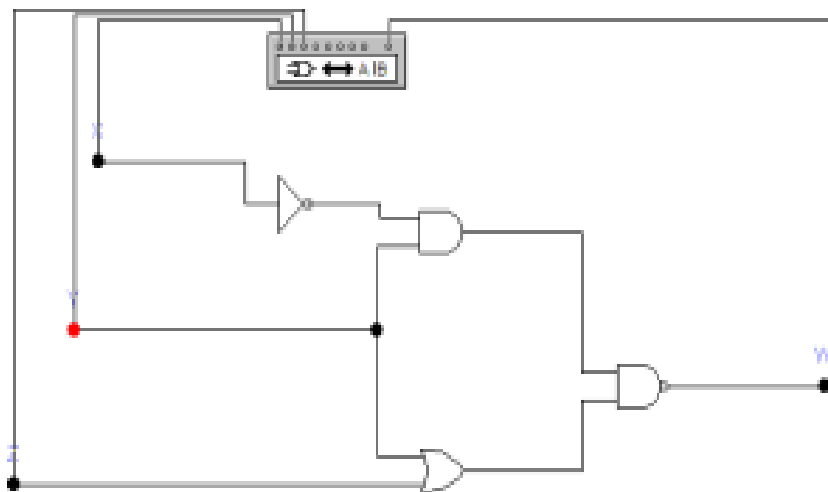
Task 3: Digital logic circuit analysis – Finding the Boolean expression of a given circuit

Find the Boolean expression of the following circuit, draw the circuit on EWB and simulate it to fill-in its truth table shown below.

W =



Note: the logic converter tool from EWB to fill-in the following table. For that, you need to connect the A, B and C inputs of the logic converter to X, Y and Z lines, respectively. Further, you need to connect the 'out' line of the logic converter to W. As shown in the following diagram

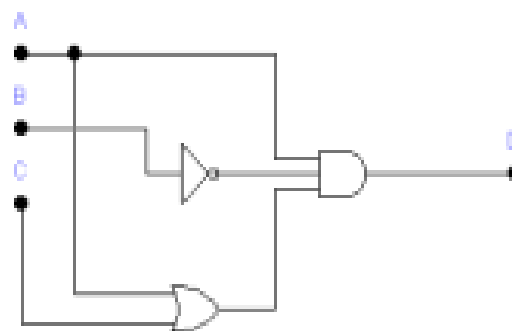


X	Y	Z	W
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Task 4: Digital logic circuit analysis – Finding the Boolean expression of a given circuit

Find the Boolean expression of the following circuit,

D –



Draw the circuit on EWB and simulate it to fill-in its truth table shown below (use logic converter please).

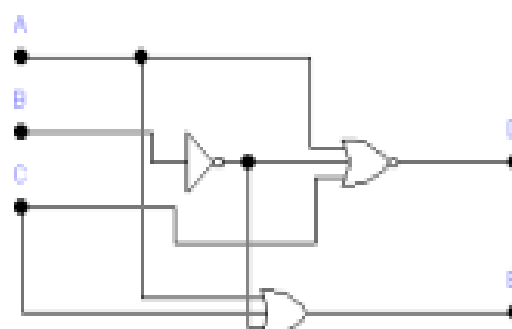
A	B	C	D
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Task 5: Logic circuits with multiple outputs

Find the Boolean expression of the outputs of the following circuit,

D =

E =



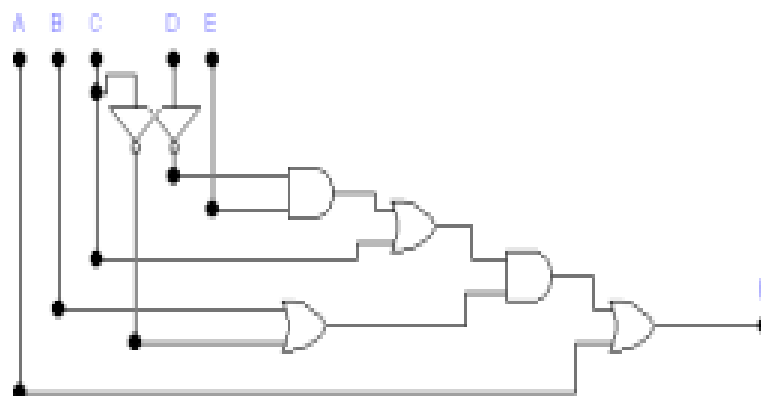
Draw the circuit on EWB and simulate it to fill-in its truth table shown below (use logic converter please).

Note: You need to use the logic converter two times, once for the output D, and another time for the second output E.

A	B	C	D	E
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Task 6*: Finding the Boolean expression of a given circuit using the logic converter

Draw the following circuit on EWB and then find its Boolean expression using the logic converter.



Task 7*: Converting Boolean expressions to circuits using the logic converter

Use the logic converter to realize the following circuit using suitable logic gates:

$$AB'C(BD + CDE) + AC'$$