

Boolean Algebra Theorems and Sum of Products

Lab L06

Introduction:

In this lab you will implement and test the following two sum-of-products (SOP) Boolean expressions:

$$Y = DB + CBA + DCA + DCB + CBA$$

$$Z = CA + DB + DC + DB$$

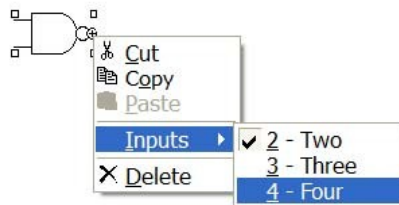
You will need to apply Boolean-algebra theorems to simplify SOP Boolean expressions. In addition, you will practice how NAND gates can be used to implement SOP Boolean expressions.

Design:

In Digital Works implement two digital circuits to realize the above Boolean functions: Y and Z. Your implementation should follow the following guidelines:

- ←• Use the interactive input device to provide the input signals from push buttons. You will need one push button for each input (here you have four inputs: A, B, C, and D).
- ←• Utilize two LEDs to show the state of the outputs (here you have two outputs: Y and Z).
- ←• Use only AND, OR, and NOT gates to realize function Y.
- ←• Use only NAND gates to realize function Z.

In your implementation you will need logic gates with more than 2 inputs. To do that in Digital Works, right-click on the gate → select Inputs → select the number of inputs you desire (as shown in the figure).



In your circuit to realize function Y you will need a 5-input OR gate. If Digital Works provides gates with maximum 4 inputs, you can utilize three OR gates (one with 3 inputs and the others with 2 inputs) to implement the 5-input OR gate (refer to the lecture slides for more explanation on how to do that).

Submitting Results

1. After implementing Y and Z following the above guidelines, change the states of the input push buttons to generate all possible input values for A, B, C, and D. For each input value, record the state of the output LEDs, which represent Y and Z, in the following truth table:

Inputs				Outputs	
A	B	C	D	Y	Z
0	0	0	0		
0	0	0	1		
0	0	1	0		
0	0	1	1		
0	1	0	0		
0	1	0	1		
0	1	1	0		
0	1	1	1		
1	0	0	0		
1	0	0	1		
1	0	1	0		
1	0	1	1		
1	1	0	0		
1	1	0	1		
1	1	1	0		
1	1	1	1		

2. All macros are to be submitted with your assignment. Please make sure that each macro includes your name, date and assignment number. Also that they are named correctly ie: LastnameF_L06x (Where Lastname is your last name, F is your first initial and x is a unique letter [a-z] that you used to distinguish each macro.