

Class: CECS 201, Section 7

Lab: 5

Title: Logic Simplification

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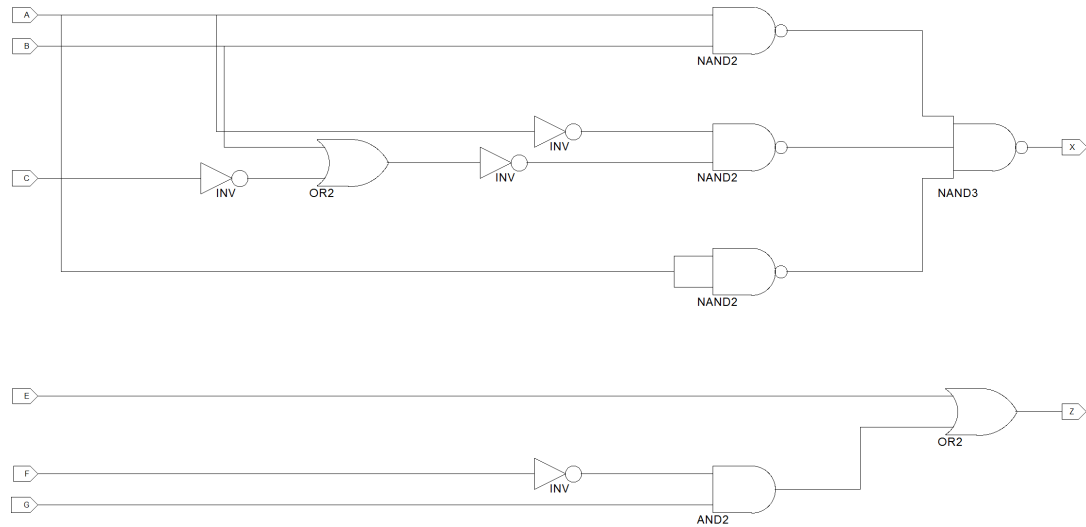
Due Date: 07:00:00 P.M., 16, March 2015

Instructor: Dan Cregg

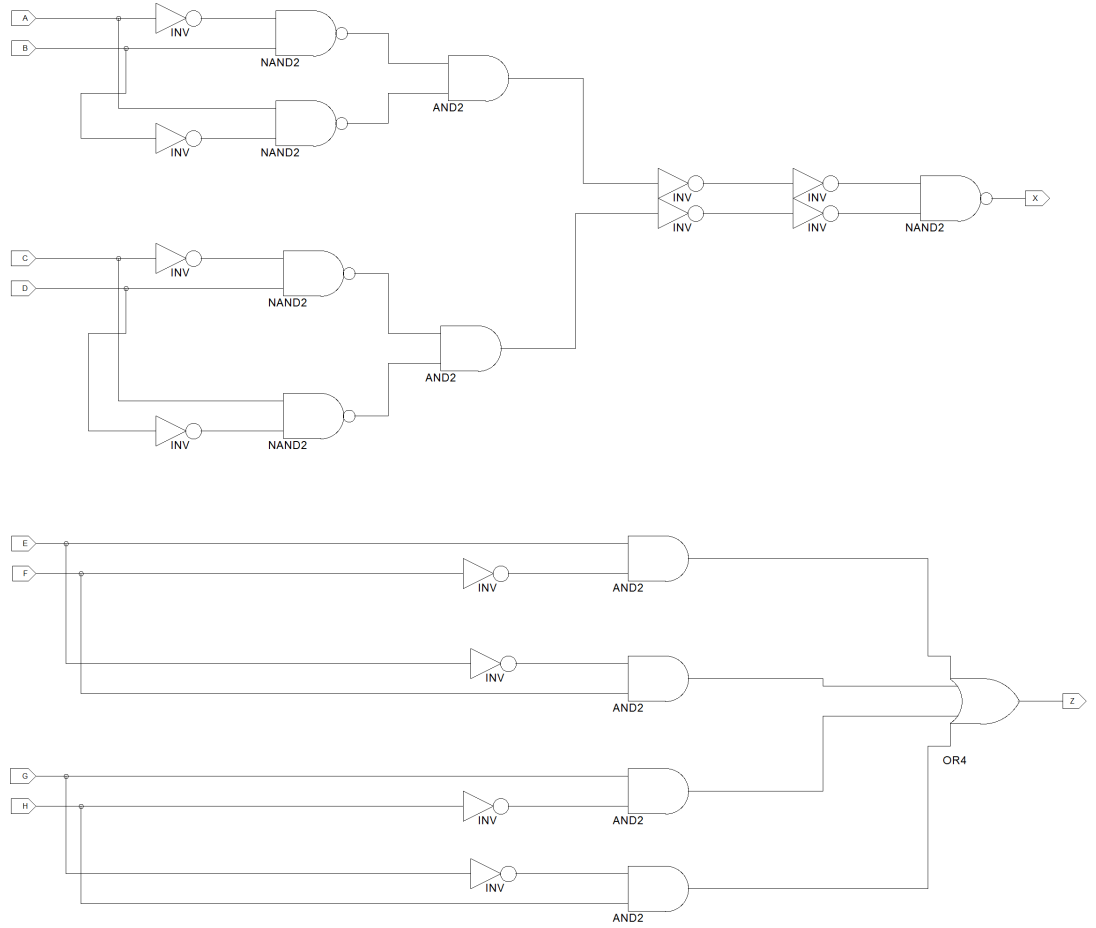
Introduction. This lab involves simplifying complex circuits using Boolean Algebra and Karnaugh Maps.

Project Description. We use Boolean Algebra and Karnaugh maps to simplify an equation. Then we draw two circuits on a schematic, one which represents the unsimplified equation, and the other that represents the simplified equation. Upon observing the program on the Digilent board, one should observe that for the same input, both circuits return the same output.

Schematic Part 1.



Schematic Part 2.



Part 1. We wish to reduce $X = ((AB)'(A'(B + C')')'(A)')'$ to sum of products. Thus

$$\begin{aligned}
 X &= ((AB)'(A'(B + C')')'(A)')' \\
 &= (AB)'' + (A'(B + C')')'' + (A)'' \\
 &= AB + A'(B + C')' + A \\
 &= AB + A'(B'C''') + A \\
 &= AB + A'B'C + A \\
 &= AB + A + A'B'C \\
 &= A(B + 1) + A'B'C \\
 &= A + A'B'C.
 \end{aligned}$$

We have the following truth table of the equation $X = A + A'B'C$:

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Using Karnaugh map, we have that

	00	01	11	10
0	0	1	0	0
1	1	1	1	1

so that $X = A + B'C$.

Part 2. We now wish to reduce the equation $X = (((A'B)'(B'A'))''((C'D)'(CD'))'')'$ to sum of products. Thus

$$\begin{aligned}
X &= (((A'B)'(B'A'))''((C'D)'(CD'))'')' \\
&= (((A'B)'(B'A'))((C'D)'(CD'))')' \\
&= (((A'' + B')(B'' + A'))((C'' + D')(C' + D'')))' \\
&= (((A + B')(B + A'))((C + D')(C' + D)))' \\
&= ((A + B')(B + A'))' + ((C + D')(C' + D))' \\
&= (A + B')' + (B + A')' + (C + D')' + (C' + D)' \\
&= A'B'' + B'A'' + C'D'' + C''D' \\
&= A'B + B'A + C'D + CD'.
\end{aligned}$$

We have the following truth table of the equation $X = A'B + B'A + C'D + CD'$:

A	B	C	D	$A'B + B'A$	$C'D + CD'$	X
0	0	0	0	0	0	0
0	0	0	1	0	1	1
0	0	1	0	0	1	1
0	0	1	1	0	0	0
0	1	0	0	1	0	1
0	1	0	1	1	1	1
0	1	1	0	1	1	1
0	1	1	1	1	0	1
1	0	0	0	1	0	1
1	0	0	1	1	1	1
1	0	1	0	1	1	1
1	0	1	1	1	0	1
1	1	0	0	0	0	0
1	1	0	1	0	1	1
1	1	1	0	0	1	1
1	1	1	1	0	0	0

Using Karnaugh map, we have that

	00	01	11	10
00	0	1	0	1
01	1	1	1	1
11	0	1	0	1
10	1	1	1	1

so that $X = A'B + AB' + C'D + CD'$.