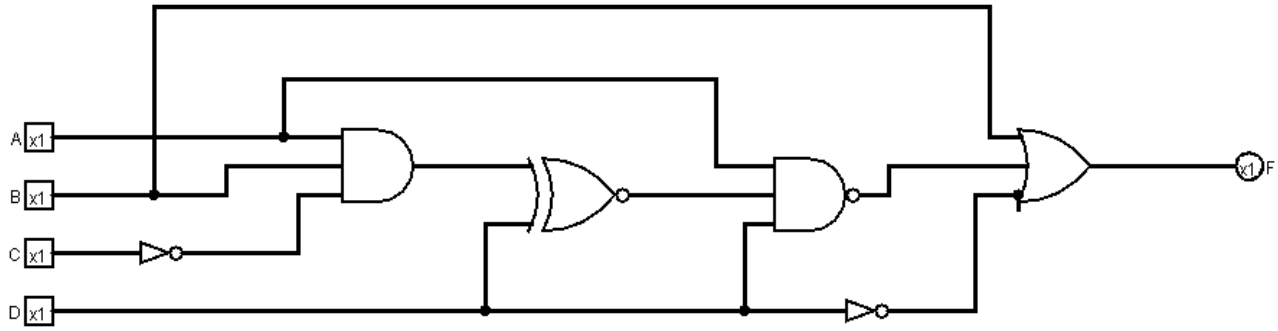
Homework 1

Total Points: 57

Written

1. (5 points) Use Boolean Algebra to prove that
   $(\bar{A}*B*\bar{C})+(\bar{A}*B*C)+(A*\bar{B}*C)+(A*B*\bar{C})+(A*B*C)=(A+B)*(B+C)$
2. (3 points) Prove that A XOR B = $A*\bar{B}+\bar{A}*B$
3. (3 points) Write the function that represents the following circuit. Do not simplify.



4. Given the following truth table

A	B	C	Output
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

   1. (3 points) Write a function in SOP form that behaves according to the truth table. Do not simplify.
   2. (3 points) Write a function in POS form that behaves according to the truth table. Do not simplify.
5. (3 points each) For each of the following problems assume that the variables are $x_0 - x_{N-1}$, with x_0 representing the least significant bit and x_{N-1} the most significant. For example if we had an equation of 3 variables, $m_1 = \bar{x}_2 * \bar{x}_1 * x_0$ and $m_6 = x_2 * x_1 * \bar{x}_0$. For each of the following problems write each function in **both** its most simplified SOP and POS form.
   1. $m_0 + m_1 + m_2$
   2. $M_0 * M_3 * M_4 * M_7$
   3. $m_4 + m_5 + m_7 + m_{12} + m_{13} + m_{15}$
   4. $m_0 + m_3 + m_4 + m_8 + D_2 + D_5 + D_7 + D_{10} + D_{13} + D_{15}$
   5. $m_1 + m_3 + m_7 + m_9 + m_{11} + m_{15} + m_{17} + m_{19} + m_{25} + m_{27} + D_4 + D_6 + D_{12} + D_{14} + D_{16} + D_{18} + D_{20} + D_{22} + D_{24} + D_{26} + D_{28} + D_{30}$

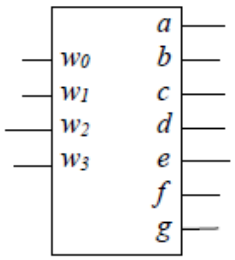
Logisim

For each of the following problems you have already been provided with a correctly named circuit to test your implementation. You should create your answer in the subcircuit that is already present. The name of a subcircuit is either part1, part2, or part3, depending on if you are working on question 1, 2, or 3. You may only use AND, OR, NOT, and XOR gates in your solution.

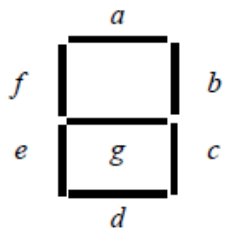
1. (5 points) File name: **fun.circ**. Create the **simplest** circuit in Logisim that implements the following function: $(x_1 * x_2 * \bar{x}_3) + (x_3 * x_4) + (x_1 * x_2 * \bar{x}_4)$
2. (5 points) File name: **grey.circ**. Grey scale is an alternative method for representing binary numbers. The following truth table shows the mapping from binary to grey scale. Create the **simplest** circuit in Logisim that implements the following truth table.

X2	X1	X0	Grey Code
0	0	0	000
0	0	1	001
0	1	0	011
0	1	1	010
1	0	0	110
1	0	1	111
1	1	0	101
1	1	1	100

3. (15 points) File name: **bcd.circ**. Given the following BCD-to-7-segment display, derive the minimal SOP function for the outputs, a, b, c, d, e, f, g of the 7-segment display, and then implement that function in Logisim.



Code converter



7-segment display

w_3	w_2	w_1	w_0	a	b	c	d	e	f	g
0	0	0	0	1	1	1	1	1	1	0
0	0	0	1	0	1	1	0	0	0	0
0	0	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	1	0	0	1
0	1	0	0	0	1	1	0	0	1	1
0	1	0	1	1	0	1	1	0	1	1
0	1	1	0	1	0	1	1	1	1	1
0	1	1	1	1	1	1	0	0	0	0
1	0	0	0	1	1	1	1	1	1	1
1	0	0	1	1	1	1	1	0	1	1