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ECE350 HW #2

1.

a)

T1	T2	T3	P	f(T1, T2, T3, P)
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

POS: f(T1, T2, T3, P) = (T1 + T2 + T3 + P)(T1 + T2 + T3 + P')(T1 + T2 + T3' + P)(T1 + T2' + T3 + P)(T1 + T2' + T3' + P)(T1' + T2 + T3 + P')(T1' + T2 + T3 + P)(T1' + T2 + T3' + P)(T1' + T2' + T3 + P)

b) Minimized:

Combining: (T1 + T2 + T3)(T1'+T2+T3)(T1+T2' + P)(T1' + T2 + T3)(T1+T2+P)(T1'+T2 +P)(T2' + T3 + P)
(T2' + T3 + P)

Combining: (T2 + T3)(T1 + P)(T2 + P)(T2' + T3 + P)
Distributive: (T2T1 + T2P + T3T1 + T3P)(T2T2' + T2T3 + T2P + T2'P + T3P + PP)
xx' =0 and xx = 1: (T2T1 +T2P + T3T1 + T3P)(T2T3+T2P + T2'P + T3P)
combining : (T2T1 +T2P + T3T1 + T3P)(T2T3 + P + T3P)
distributive : (T1T2T3 + T1T2P + T1T2T3P + T2PT3 + T2P + T2PT3 +T2T3TP + T3PT2T3 + T3P + T3P)
Absorption: (T1T2T3 + T2P + T3P)

→ **f(T1, T2, T3, P) = T2P + T3P + T1T2T3**

2.

a) SOP:

f = ΣM(1,3,5,6,7) = x1'x2'x3 + x1'x2x3 + x1x2'x3 + x1x2x3' + x1x2x3
Combining: x1'x3 + x2'x3 + x1x2 + x1x3 + x2x3
combining: x1x2 + x3

f = x1x2 + x3

b) POS:

f = ΠM(0,2,4) = (x1 + x2 + x3)(x1 + x2' + x3)(x1' + x2 + x3)

Combining: (x1+x3)(x2+x3)

f = (x1+x3)(x2+x3)

c) SOP cost: 6
POS cost: 9

SOP has lowest hardware complexity

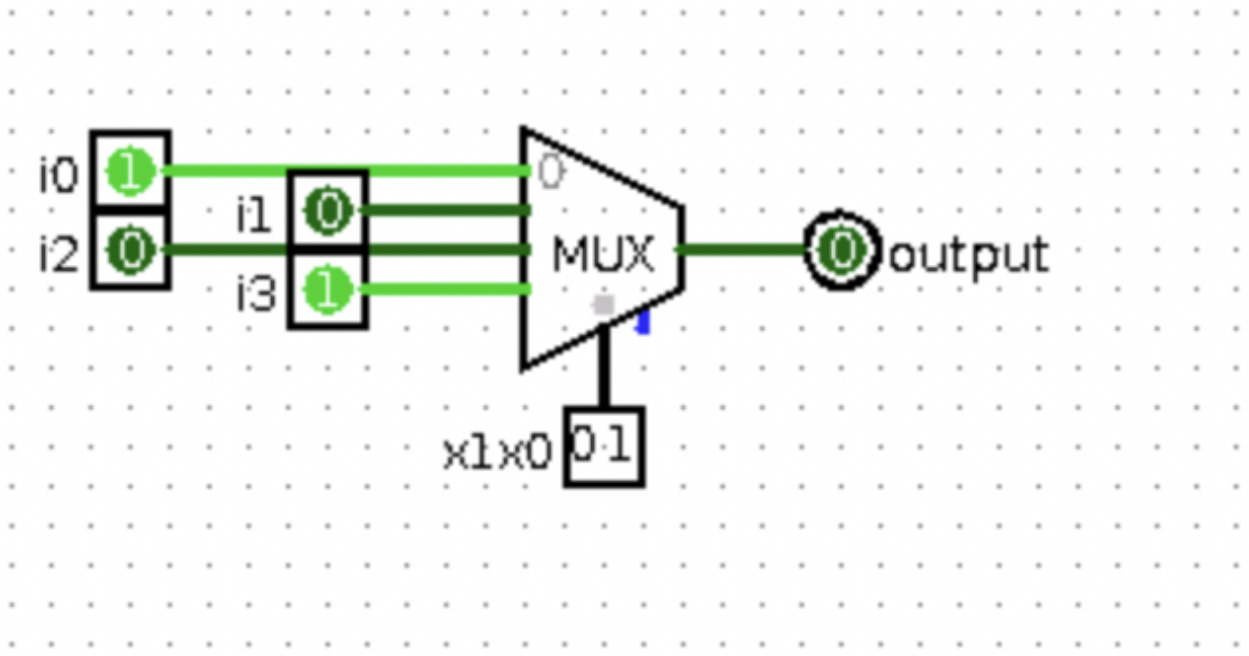
3. XNOR out of a 4-input mux:

x1	x0	f(x1,x0)
0	0	1
0	1	0
1	0	0
1	1	1

Select bits are x1x0

Input 0 to the mux is 1
Input 1 to the mux is 0
Input 2 to the mux is 0
Input 3 to the mux is 1

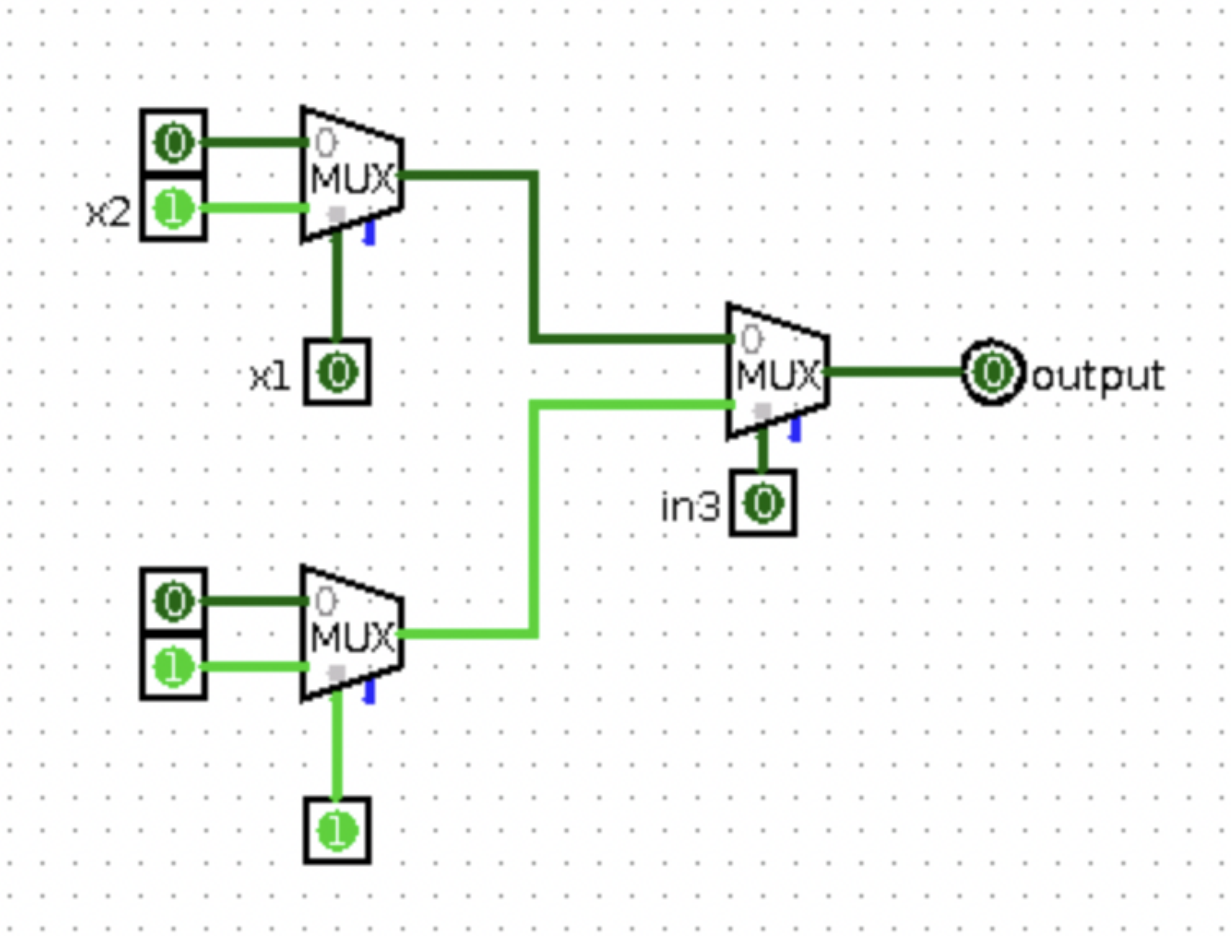
Shown in logism:



4.

a) In3 is x1. In2 is 0. In3 is x2. So, when x1 and x2 are both 1, the mux outputs 1. Otherwise, the output is 0. In4, In5, and In6 are all 1, so that the high bit for the third mux is always 1. In7 is x3, so when it is low, the output depends on x1x2. If it is high, the output is 1.

Shown in logisim:



b) In1 is x3. In2 is 0. In3 is x1. So, when x1 and x3 are both 1, the mux outputs 1. In 4 is 0. In5 is 1. In6 is x3. So mux outputs 0 if x3 is 0 and 1 if x3 is 1. In7 is x2. So, when x2 is 0, the output depends on x1x3. If x2 is 1, then the output depends on x3.

Shown in logisim: