CSEE W3827

Fundamentals of Computer Systems

Homework Assignment 2

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Due September 25, 2014 at 10:10 AM

Write your name **and UNI** on your solutions

Show your work for each problem; we are more interested in how you get the answer than whether you get the right answer.

1. (15 points) Show how to build a half adder using only two 4:1 muxes.

2. (15 points) Show how to build a full adder using only two 3:8 decoders and two OR4 gates (OR4 = 4 input OR).

3. (15 points) Show how to build a full adder using two 4:1 muxes and an inverter.

4. (10 points) Show how to build a 4-bit "multiplier by negative one". This multiplier takes a 4-bit input A (A_3, A_2, A_1, A_0) and produces a 5-bit output N (N_4, N_3, N_2, N_1, N_0) that has the negative of the twos complement value of A.

5. (45 points) For this problem, you will analyze the three functions, F, G, and H, implemented below.
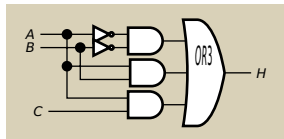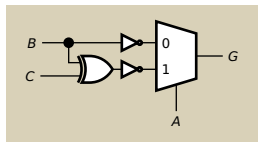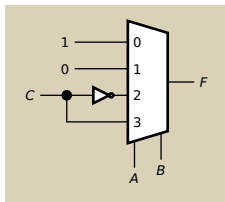
(a) (10 points) Do the three schematics above compute the same or different functions? (In other words, is F == G? G == H?) Provide support for your answer.

(b) (10 points) Given the component area and critical paths in the table below, complete the table for F, G, and H.

	Area	Critical Path
4:1 MUX	10	4
2:1 MUX	5	2
XOR2	4	3
OR3	3	1
AND3	3	1
OR2	2	1
AND2	2	1
INV	1	0.5
F		
G		
H		

(c) (10 points) Give a function J that computes the same function as F, but has a shorter critical path than F. Provide J's schematic, area, and critical path.

(d) (15 points) Does H have a glitch? If yes, provide the input transition that triggers it. If no, argue why not.