The UNIVERSITY *of* NORTH CAROLINA *at* CHAPEL HILL

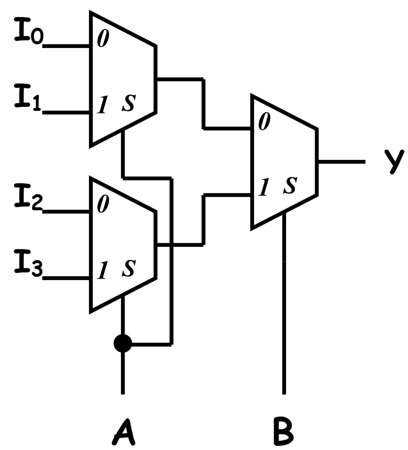
Comp 411 Computer Organization
Spring 2011

Problem Set #3
Issued Monday, 3/14/11; Due Monday, 3/21/11

Note: You may use additional sheets of paper, but please enter your answers in the space provided in this document.

Problem 1. Mux Madness (16 points)

Suppose you wanted to implement a Boolean function *Y* of two inputs *A* and *B* using multiplexers, as shown in the figure.



Give binary values for I_0, I_1, I_2, and I_3 that implement the following functions on the two inputs *A* and *B:*

a) Y = NOR(A,B)
b) Y = (A == B)
c) Y = (A >= B)
d) Y = XOR(A,B)

Function Y=	I_0	I_1	I_2	I_3
NOR(A, B)				
A == B				
A >= B				
XOR(A, B)				

Problem 2. "Go Forth and Multiply" (52 points)

a) [16 points] Complete the truth table below showing multiplication of two 2-bit unsigned integers A_1A_0 and B_1B_0, producing a 4-bit result $P_3P_2P_1P_0$. Please enter your answer directly in the table below.

$A_1A_0B_1B_0$	$P_3P_2P_1P_0$
0000	
0001	
0010	
0011	
0100	
0101	
0110	
0111	
1000	
1001	
1010	
1011	
1100	
1101	
1110	
1111	

b) [20 points] Suppose you wanted to compute the *fourth power* of a 2-bit number (i.e., A^4). Complete the truth table below in which the input column contains the 2-bit input ($A=A_1A_0$), and the output column is the 8-bit result.

A_1A_0	$P_7P_6P_5P_4P_3P_2P_1P_0$
00	
01	
10	
11	

c) [16 points] For each of the 8 output bits from part (b), give the sum-of-products Boolean equation (circuit not needed):

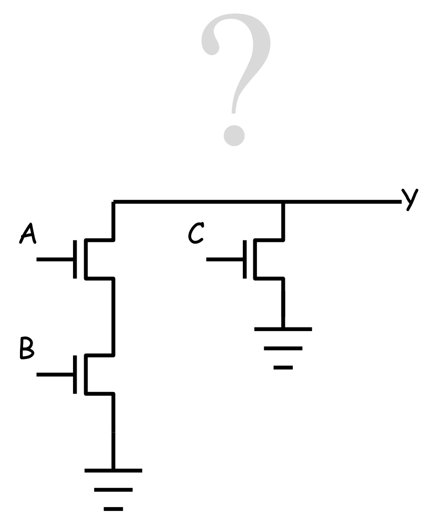
$P_0 =$
$P_1 =$
$P_2 =$
$P_3 =$
$P_4 =$
$P_5 =$
$P_6 =$
$P_7 =$

How many Boolean gates are needed for this implementation?

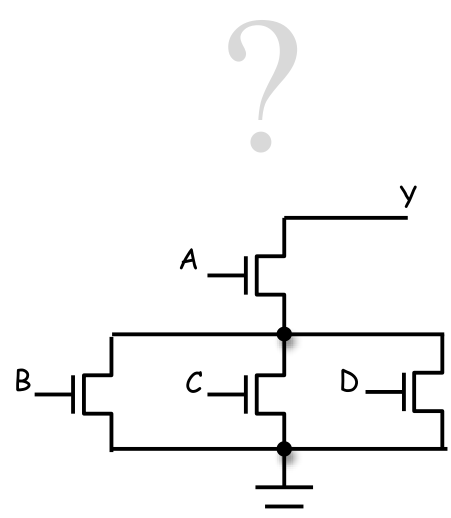
# of AND gates = ____, # of OR gates = ____, # of inverters = ____.

Problem 3. "Fishing for Complements" (32 points). Show the complementary set of p-channel or n-channel transistors that complete the following CMOS circuits:

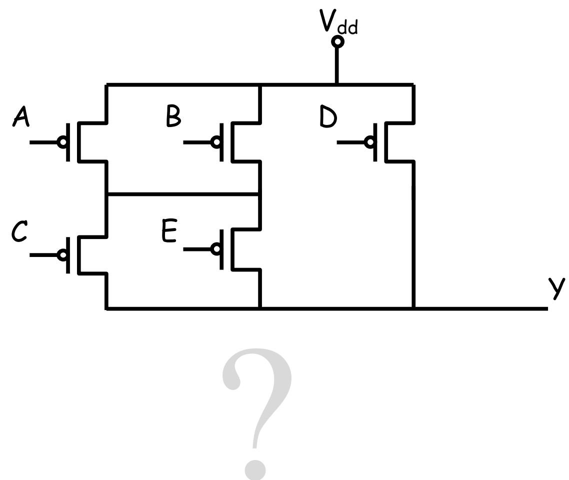
a)



b)



c)



d)