CS 362 Homework 3 NetID: _____

Name: _____

Boolean Algebra, DeMorgan's Law, K-Maps, Universal Gates, Rapid Prototyping

This assignment is to be submitted electronically via Gradescope. You must upload your answers as a PDF to Gradescope by Friday, 10/25/19 at 11:59pm.

1. Simplify the following Boolean Algebra equations using DeMorgan's Law plus other boolean properties. Show your work. Note the "single quote" means the previous value is complemented or previous group of values when the given after a closing parenthesis. (20 points)

1a. F(A,B,C,D) = $\overline{(A'B' + C'D'B')' + (ACD)'}$

1b. F(A) = $\overline{(A' + A)'}$

1c. F(x,y,z) = $\overline{(x' + y' + z')' \bullet (xyz' + yz)'}$

1d. F(x, y) = $\overline{(x + y)' \bullet (x' + y')}$

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2. Simplify the equations using Boolean Algebra properties. Show your work. (10 points)

2a. F (x,y) = $(\overline{x} + \overline{y})\bullet(\overline{x} + y)$

2b. F(A,B,C,D) = $[AB\bullet(C + \overline{BC}) + A\overline{B}]\bullet C\overline{D}$

3a. Convert the truth table to sum-of-minterms expression. Show your work. (10 points)

x	y	z	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

3b. Simplify the sum-of-minterms expression from 2a to sum-of-products form with fewest literals.

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4. Find the simplified expression using the given the K-Maps. Note: the values in m( ) values are expression are where the minterms have a value of 1. (30 points)

4a. F(A,B,C) = Σ m(0,2,3,6)

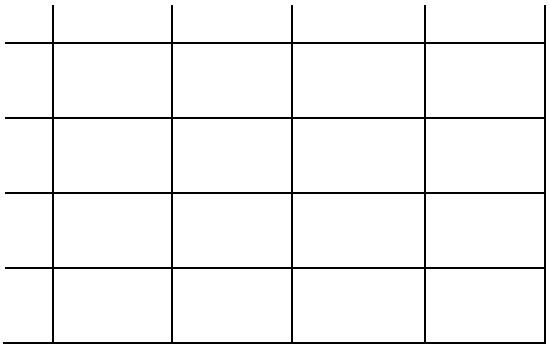
	B'C'	B'C	BC	BC'
A'	0	1	3	2
A	4	5	7	6

4b. F(A,B,C) = Σ m(0,1,2,4,5)

4c. F(A,B,C,D) = Σ m(0,2,8,9,10,13)

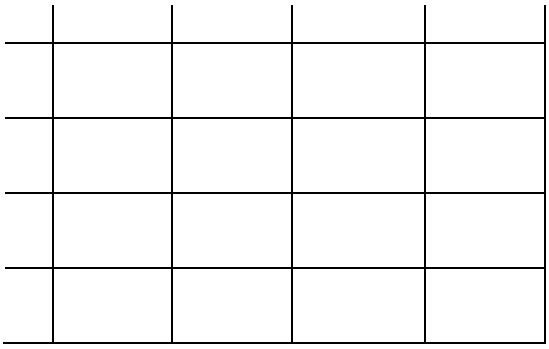
	C'D'	C'D	CD	CD'
A'B'	0	1	3	2
A'B	4	5	7	6
AB	12	13	15	14
AB'	8	9	11	10

4d. $F(A,B,C,D) = \Sigma\, m(1,3,8,9,10,11,12,14)$



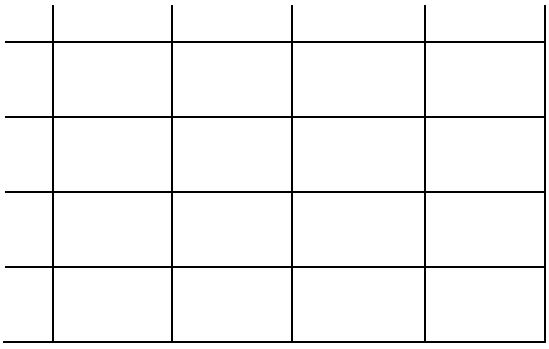
4e. $F(A,B,C,D) = \Sigma\, m(1,3,5,7,11) + \Sigma\, d(4,13,14)$

note: The m( ) values are where the minterms have a value of 1. The d( ) values are where the minterms are “don’t care” conditions.



4f. $F(A,B,C,D) = \Sigma\, m(1,4,8,9,11,13) + \Sigma\, d(10,12,14,15)$

note: The m( ) values are where the minterms have a value of 1. The d( ) values are where the minterms are “don’t care” conditions.



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5. NAND gates and NOR gates are two types of Universal Gates. Represent each equation as a circuit using only **a single type** of a Universal Gate. I.E. Each answer must contain only NAND gates or must contain only NOR gates. (10 points)

5a. $F(x,y,z) = xz + \overline{y}z + \overline{x}yz$

5b. $F(x,y,z) = \overline{(x + y) \bullet (y' + z) \bullet (x' + y + z)}$

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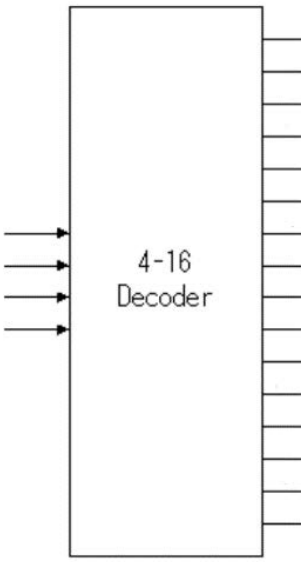
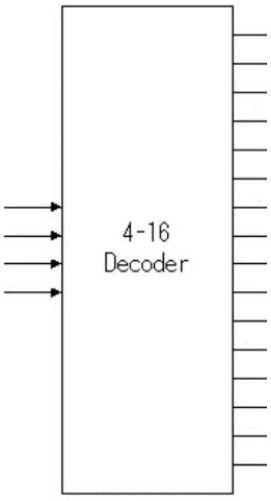
6. Implement the equations below using a 4-to-16 decoder and minimal other gates. Hint: only 1 other gate is needed per answer. (10 points)

6a. $F(A,B,C,D) = \Sigma\, m(0,2,8,9,10,13)$



6b. $F(A,B,C,D) = \Sigma\, m(1,3,8,9,10,11,12,14)$



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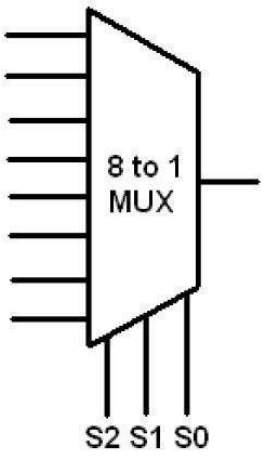
7. Implement the equations below using an 8-to-1 multiplexor and minimal other gates. Hint: at most only 1 other gate is needed per answer. (10 points)

7a. $F(A,B,C,D) = \Sigma\, m(0,3,6,7,8,10)$



7b. $F(A,B,C,D) = \Sigma\, m(3,4,6,9,11,12,14, 15)$