You must show **all** your work! Answers without supporting work will not be given credit. Write answers in spaces provided. Illegible work falls under the *Intended Purpose* policy.

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This assignment is worth 10.0/60.0 ($\approx 17\%$) of Problem Assignment points

Name:_____

1. Show the truth table for a two-bit binary adder–that is a circuit with
   - Four inputs, a_1, a_0, b_1, b_0.
     - a_1a_0 and b_1b_0 represent two 2-bit unsigned binary integers
   - Three outputs, c_{out}, s_1 and s_0.
     - c_{out} represents a carry signal from the sum of the two 2-bit integers and
     - s_1s_0 represents the 2-bit unsigned binary sum of the two 2-bit integers.
   - For credit, ensure you order your input $a_1a_0b_1b_0$ and
   - Your output $c_{out}s_1s_0$.
   - Notice there is no c_{in}. You're welcome! Why is this a *very good* thing from your point of view?

   (1.0 Points)

2. For each of the following two expressions, select all of the following definitions [i, ii, iii, iv] which apply. **(1.0 points)**
   i. Product term iii. Sum term
   ii. SoP expression iv. PoS expression

   (a) $ab'cd'$

   Answer:_____

   (b) $a' + b + c' + d$

   Answer:_____

3. Using properties 1 to 10, reduce the following expressions to a minimum SOP form. Show each step; the numbers of terms and literals in minimum form are shown in parentheses. **(1.0 points)**

   (a) $x'y'z + x'yz + xy'z' + xyz'$ (2 terms, 4 literals)

(b) $w'x'y'z + wx'y'z + wx'yz + wxyz$ (2 terms, 6 literals)

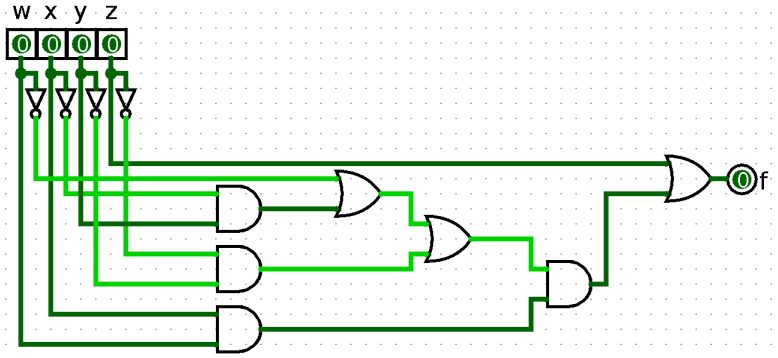
(c) $w'x'y'z' + w'x'yz' + w'x'yz + wxy'z' + wxyz' + wxyz$ (4 terms, 12 literals)

Cont.

4. Show a block diagram of a system using `AND`, `OR`, and `NOT` gates to implement the following functions. Your `AND` and `OR` gates have a fan-in of two (2). Assume that variables are available only uncomplemented (this means `NOT` gates are required when variables are complemented). **Do not manipulate the equation**. **(1.0 points)**

$$wxy'z' + vy(w + x)' + w'y$$

5. Translate the following circuit into an algebraic expression, then put it in sum of product form. Write your final answer as $f(w, x, y, z) = \ldots$ **(1.0 points)**



Answer:_____

Answer:_____

Cont.

6. Given the following function h, find the complement, h'. Only single variables may be complemented in the answer. **(1.0 points)**

$$h = ab'c + a'bc' + d(c' + a')(b' + a')$$

7. For each of the following functions:

$$f(a, b, c, d) = \Sigma m(1, 6, 9, 11, 15)$$
$$g(a, b, c, d) = \Sigma m(0, 6, 7, 8, 14)$$

   (a) Provide truth table for both f and g behavior.

   (b) Convert to an algebraic expression in sum of **minterms** form.

   (1.0 Points)

Cont.

8. Perform each of the following using only `P8a`, `P8b`, and `P14`.

   (a) Convert the following PoS algebraic expression into SoP form. **(1.0 points)**

   $(b' + d')(a' + b + c)(b + c' + d)$

Cont.

(b) Convert the following SoP algebraic expression into PoS form. **(1.0 points)**

$w'xy' + w'x'y + wx'z$

Cont.

9. Draw, label, and fill in a Karnaugh Map for the following functions.

   (a) Use the horizontal form of the 8-cell map we discussed in class:

   $$f(x, y, z) = x'y + xz + yz.$$

   You must circle and label the implicant(s) which correspond to each product term. **(0.5 points)**

   (b) For the sum of Minterms, $f(a, b, c, d) = \Sigma m(1, 4, 9, 13)$. You need not circle the Minterms on your map. **(0.5 points)**

The End.