CSE140 Fall 2012 Homework 1. Due Wed 10/10 before the class.

1. Bubble Pushing
1.1. Exercise 2.26 in textbook H2.

1.2. Exercise 2.27 in textbook H2.

2. Consensus Theorem
2.1. Prove the following using Boolean algebra
   \[ ab + b'cd + acd = ab + b'cd. \]
2.2. Prove the following using Boolean algebra
   \[ (a + b + c)(a' + d)(b + c + d) = (a + b + c)(a' + d). \]

3. Shannon’s Expansion
3.1. Prove problem 2.1. using Shannon’s expansion.
3.2. Prove problem 2.2. using Shannon’s expansion.

4. Boolean logic vs. Schematic Diagram
4.1. Implement the Boolean functions on the two sides of the equal sign in problem 2.1.
4.1.1. Draw the schematic diagrams.
4.1.2. Compare the numbers of literals, operators vs. the numbers of gates, nets, and pins in the schematic diagrams.
4.2. Implement the Boolean functions on the two sides of the equal sign in problem 2.2.
4.2.1. Draw the schematic diagrams.
4.2.2. Compare the numbers of literals, operators vs. the numbers of gates, nets, and pins in the schematic diagrams.
5. Combinational Problem Description

5.1. A Full Subtractor inputs three bits: bit \( x \), subtrahend \( y \), borrow-in bit \( b_{\text{in}} \), and outputs two bits: difference \( d \), borrow-out bit \( b_{\text{out}} \).

5.1.1. Describe the truth table.

5.1.2. Write the function in sum-of-products canonical form.

5.1.3. Write the function in product-of-sums canonical form.

5.2. A circuit has three inputs and one output. The inputs \((a_2, a_1, a_0)\) represent a number from 0 to 7. Output \( Y \) is true if the number is prime (0 and 1 are not prime, but 2, 3, 5 and so on are prime).

5.2.1. Describe the truth table.

5.2.2. Write the function in sum-of-products canonical form.

5.2.3. Write the function in product-of-sums canonical form.