SP22 CSCI 113 Assignment 1 20 pts due: 01/31 (M)

Practice for Logic Design

1. Draw a complete schematic diagram of the 4x1 multiplexor, using only three basic gates (2-input AND, 2-input OR, and negator).

2. Assume that signal X is 3 bits wide, i.e., (x_2, x_1, x_0).
   Write logic equations for F1~F4 based on the following functionalities.

   F1: X contains only one 0.
   F2: X contains an even number of 0's.
   F3: X, when interpreted as an unsigned binary number, is less than 4.
   F4: X, when interpreted as a signed (two's complement) number, is negative.

3. Consider the following two equivalent logic equations for E.

   $E = ((A \cdot B) + (A \cdot C) + (B \cdot C)) \cdot \overline{(A \cdot B \cdot C)}$

   $E = (A \cdot B \cdot \overline{C}) + (A \cdot \overline{B} \cdot C) + (\overline{A} \cdot B \cdot C)$

   Draw a schematic diagram for each equation with minimum number of 2-input gates.

   Answer which equation is more efficient in terms of the number of 2-input gates.
   Note that the negator is not counted for this.

4. Prove that the two equations for E (shown in #3) are equivalent by using DeMorgan's laws and other basic laws (if needed).

5. One logic function that is used for a variety of purposes is *exclusive_OR (XOR)*.
   Output of 2-input XOR function is true only if exactly one of the inputs is true.
   Prove that the following two logic equations for the 2-input XOR function are equivalent by using DeMorgan's laws and other basic laws (if needed).

   $XOR = (A \cdot \overline{B}) + (\overline{A} \cdot B)$

   $XOR = (A+B) \cdot \overline{(A \cdot B)}$

6. From #5, extend your practice to the 3-input XOR function by showing its truth table, logic equation and schematic diagram (using only 2-input basic gates).

- Submission: Please write answers on blank papers and submit a .pdf version.
  Please organize your answers in the order of #1,2,3,4,5 and6, and don't forget to write your name on the first page.