ECE 380: PRELAB #8: Code Converters for Mini-Calculator

One of the critical factors concerning engineers designing embedded systems is the design of efficient interfaces to provide information to users. One of the most simple and useful methods for displaying numerical information is the 7-segment LED display. Many embedded systems incorporating clocks or timers display hours, minutes, and/or seconds in this way. However, microprocessors normally represent numbers internally in a binary format and 7-segment displays are typically used to display decimal or hexadecimal digits externally, digital circuitry must be developed to translate from the internal to external representations. In this lab, we use code converters to drive LED display.

Prelab tasks:

Design A: Write VHDL code for a BCD-to-seven segment LED display converter with four inputs, h_3-h_0, representing a single decimal digit, and a seven-bit output suitable for driving a seven segment LED display on the Altera DE1 board. Refer to the textbook on the sample codes. Do not just simply copy the codes.

Please use negative logic for the seven segment LED display, i.e., use expression such as *when "0000" =>leds<="0000001"*, as the DE1 board uses such logic for the LEDs.

Design B: Using two 7-segment LEDs to display a 4-bit signed number in 2's complement representation. For example, 1000 will be displayed as -8. You can use the first LED to display the negative sign and the second LED to display the magnitude, 8. For a positive number between 0000 to 0111, you display nothing on the first LED and the magnitude on the second LED.

Signed binary	Display
1000	-8
1001	-7
1010	-6
1011	-5
1100	-4
1101	-3
1110	-2
1111	-1

Design C (Bonus 15 points): Use three set of two-LEDs in Design B to display two inputs, X, Y, and the result, S, for a 4-bit unified adder/subtractor (again for signed numbers). You will use six LEDs in total. You can use a structure VHDL to implement the 4-bit unified adder/subtractor. You will use a control signal to switch between the addition and subtraction operations. You will use a LED light to indicate the overflow.

The outcome is a mini-calculator. For example, addition between input 1000 and 0011 will be displayed by six LEDs that show "-", 8, nothing, 3, "-", and 5, respectively.

Prelab requirements:

At the beginning of your lab session, you need to present to the TA: **Design A and Design B in the forms of VHDL codes and Quartus II functional simulations.**

Pre-Lab (30%)	**Score**	**TA initial**
30% Designs		
Report (70%)		
10% Introduction		
10% Procedures		
20% Results		
30% Conclusions		

Lab Grade (100%)	
Bonus points	