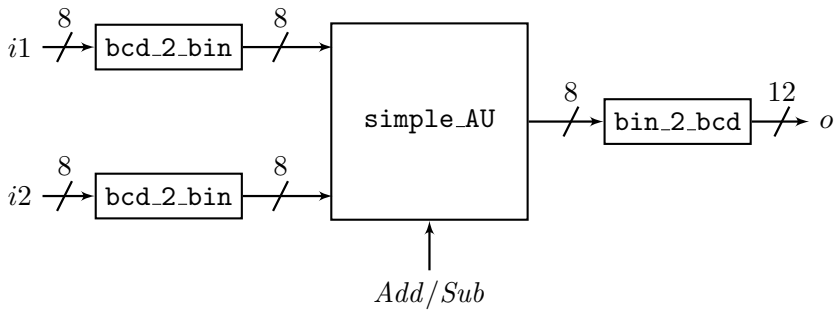
CDA 4253/EEL 4935 FPGA System Design

Assignment #3

1 Description

In this assignment, you will design and implement a combinational circuit on Basys3 FPGA boards that performs 8-bit binary unsigned addition/subtraction with BCD inputs and BCD outputs. This design takes two 8-bit BCD inputs, converts them to binary numbers, adds/subtracts them, and converts the result to BCD for outputs. The block diagram for this design is shown below. Assume all values are unsigned numbers.



A simple arithmetic unit design `AU`.

1. Name your design entity as `AU`.
2. Use switches `sw7` − `sw0` to represent a 2-digit decimal number for $i1$.
3. Use switches `sw15` − `sw8` to represent another 2-digit decimal number for $i2$.
4. Use `BTNU` to control Add/Sub. If `BTNU` is pressed, the design performs $i1 - i2$. Otherwise, it performs $i1 + i2$.
5. If $i1 < i2$, then operation $i1 - i2$ should produce 0.
6. The output is shown on the 7-segment displays in decimal format. The unused display should be turned off.
7. Use *processes* and appropriate *sequential* statements to model the block `simple_AU`.

Hints:

1. Use the testing circuit as shown Figure 3.7 in Pong Cu's book to implement your design on Basys3 FPGA boards by replacing the +1 block with your design `AU` in this assignment. The VHDL code for blocks `hex_to_sseg` and `disp_mux` can be found in Listing 3.14 and Listing 4.12, respectively, in Chu's book, and they can be accessed on Canvas for this assignment.
2. The VHDL code for the testing in Figure 3.7 is given in Listing 3.15.
3. Make necessary changes to these VHDL code examples for this assignment.

Designs that do not work correctly on Basys3 FPGA boards will get no more than 70/100 points.

2 Requirements

1. Create a folder `hw3-your-name` for this assignment, which holds design project files.
2. Create a README file to explain your work if necessary.
3. To submit, zip the entire folder `hw3-your-name`, and upload `hw3-your-name.zip` file to Canvas.

   Note: Make sure that your zipped file is in the ZIP format to avoid any potential issues in opening your files.

   Note: Make sure that you copy all necessary files into the projects.
4. *Make sure that you do NOT modify your work before the HW grading is finished in case that your original work needs to be examined.*