

# Laboratory Exercise 1

The purpose of this exercise is to learn how to connect simple input and output devices to an FPGA chip and implement a circuit that uses these devices. We will use the switches,  $SW_{15-0}$ , as inputs to the circuit. We will use light emitting diodes (LEDs) and 7-segment displays as output devices.

## Part I

Implement a circuit that connects inputs and outputs as follows:

1. Create a new project which will be used to implement the desired circuits on the Altera DE2 board.
2. Write a VHDL file that will connect switches  $SW_{15-0}$  to the LEDs labeled  $LEDR_{15-0}$ , respectively.
3. Include the VHDL file in your project and compile the project.
4. Assign the pins on the FPGA to connect to the switches and LEDs, as indicated in the User Manual for the DE2 board.
5. Recompile the project and download the compiled circuit into the FPGA chip.
6. Test the functionality of your design by toggling the switches and observing the LEDs.

## Part II

Add to your circuit the ability to add binary numbers as follows:

1. Use switches  $SW_{15-8}$  and  $SW_{7-0}$  to represent 8-bit unsigned binary numbers  $A$  and  $B$ , respectively. Augment your VHDL code to specify a circuit that generates  $C = A + B$  and displays the sum,  $C$ , on the LEDs labeled  $LEDG_{8-0}$ .
2. Compile the designed circuit and simulate its functional behavior.
3. Make additional pin assignments for  $LEDG_{8-0}$  and recompile the circuit.
4. Download the circuit into the FPGA chip.
5. Test your circuit by trying different values for numbers  $A$  and  $B$ .

Each team is to write a lab report to document your design. The report should be written in MSWORD. Include the necessary steps to complete the design and copy of your documented VHDL code.