SER 232 - Assignment 1

[10 Points]

Description

This assignment aims at becoming familiar with Logisim and how to use basic circuit schematic elements. The goal of this assignment is to create a small and simple circuit that will convert three 4-bit binary numbers to a hexadecimal value each.

Tasks

This assignment will have two circuits: A *main* circuit that will include 3 hex digit displays and inputs that allow the user to input a total of 12 bits. The second circuit is a so called *subcircuit*, which will be used in the *main* circuit and will connect the inputs to the hex displays. This *subcircuit* will route each bit from the inputs to the correct hex display using splitters.

In Logisim, create a new file, add a subcircuit called "Acumen", open it and do the following:

To control the first hex digit display:

- Add 4 inputs with a bit width of 1
- Add 1 output with a bit width of 4
- Add a splitter with 4 fan outs and a bit width of 4
- Connect the four 1-bit circuit inputs to the splitter fan out
- For each of the four inputs: Set the "Label" property to the number of the splitter fan out it is connected to (should be a number between 0 and 3)
- Connect the splitter output to the 4-bit output of the circuit
- Add the label "hex 1" to the output

To control the second hex digit display:

- Add 2 inputs one with a bit width of 1 and the other with a bit width of 3
- Add 1 output with a bit width of 4
- Add a splitter with 2 fan outs and a bit width of 4
- In order to make the splitter take in a group of 3 bits on one fan out and 1 bit on the second, we need to change the properties: Make sure the splitter has one fan out for bits 0, 1 and 2 (3-bit bus) and bit 3 on a separate fan out (1-bit wire).

- Connect the two inputs (1 bit input and 3 bit input) to the splitter fan out
- Connect the splitter output to the second 4-bit output of the circuit
- For each of the two inputs: Set the "Label" property to the number of the splitter fan out it is connected to (should be the two numbers *3* and *2,1,0*, make sure the label reflects the bit position correctly)
- Add the label "hex 2" to the output

To control the third hex digit display:

- Add 2 inputs with a bit width of 2
- Add 1 output with a bit width of 4
- Add a splitter with 2 fan outs and a bit width of 4
- Connect the two 2-bit circuit inputs to the splitter fan out
- Connect the splitter output to the third 4-bit output of the circuit
- For each of the two inputs: Set the "Label" property to the bit numbers of the splitter fan out it is connected to (should be the two numbers *3,2* and *1,0*, make sure the label reflects the bit position correctly)
- Add the label "hex 3" to the output

Lastly, open the "main" circuit and to the following:

- Add the "Acumen" subcircuit
- Add 3 "Hex Digit Display" (can be found in the "Input/Output" folder in Logisim)
- Connect each of the three outputs of the subcircuit to the left (black) input of each of the three Hex Digit Display
- Add the required inputs: 4 inputs with a bit width of 1 for the first hex display, 2 inputs - one with 3 bit width the other with 1 bit width - for the second hex display and 2 inputs with a bit width of 2 for the third hex display.
- Set the "Facing" property of all inputs to "North"
- Arrange all inputs that they are horizontally next to each other and the bit positions are in a descending order. You can group the inputs in three groups: One for each hex display.
- Change the label of each input to the corresponding label of the subcircuit input you will connect it to (hover over the subcircuit input/outputs to see its label).

- Connect the inputs to the subcircuit and make sure that you connect bit in position 0 to the input with the label 0, position 1 to input with label 1 and so on.

Use the simulation tool (select the *hand cursor* in the top task bar, left side, then click on any of the inputs to change its value) to input a binary number into the subcircuit. Check if the displayed hex digit on each of the three Hex Digit Display are correct. If not, double check your wiring and/or double check if the input order of the bits are correct.

If all 16 possible binary combinations (for each hex display) give you the correct hexadecimal digit, you are done and can submit this assignment (see "Deliverables" below).

Deliverables

Submit the following deliverables on Canvas in *Module 1* before the due date (see Canvas)

1. Submit your Logisim file with the following naming convention:

   lastname_a1.circ