Carleton University

Department of Systems and Computer Engineering

SYSC 2310 Fall 2017

Introduction to Digital Systems

Lab #1

Lab Report Due: At **6:00 am** on the day that is one week after your scheduled lab session.
(E.G. for lab session on Tues Sep 12: report due 6:00 am on Tues Sep 19.

LATE REPORTS will **NOT** be accepted.

Submit the report as a SINGLE PDF FILE. Place the report in a folder named Lab1 (along with your lab work as described below), zip the folder and submit it to the appropriate location in the cuLearn course website for your lab section.

Read this document completely and carefully before deciding what to do.

Please bring questions about the lab to class for discussion at the beginning of class.

In this lab you will:

- Use the basic features of Logisim.
- Design a logic circuit.
- Enter circuit designs into Logisim.
- Test circuits using Logisim's simulation capability.

"[Report]" indicates content that should be included in the lab report.

Step1: Read this entire document before going to Step 2.

Step 2: Copy the Lab1 zipped folder from the course website into a working area on your computer.

Step 3: UNZIP the folder. The folder contains several Logisim circuit files. **Warning**: If you do not unzip the folder the enclosed files may not work properly in Logisim!

Step 4: Do the getting started tutorial in the Logisim Guide to SYSC 2310 (posted on the course webpage). [Report] What gate does the tutorial implement? (**Hint**: You might consider doing the tutorial as pre-lab preparation on your own time before you come to the lab; there might not be enough time in the scheduled lab to complete both the tutorial and the lab.)

Step 5: a) Load the Lab1Start circuit into Logisim. This is a complete, working circuit. The main component in the circuit is the "Lab1TestHelper" component. The Lab1TestHelper library was added as part of the Lab1Start project when you loaded the circuit. (See the bottom of the Explorer Pane).

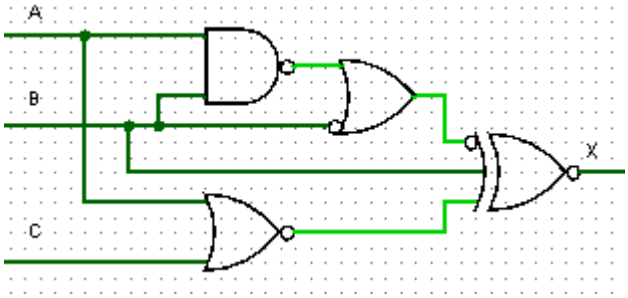
b) Select each of the components (one at a time) and notice how their Attributes are shown. Add the Label "Test Helper" in the Attributes of the helper component.

c) Use the buttons to explore the behaviour of the circuit. (**Hint**: you will have to use the Poke tool to get the buttons to change state.) [Report] In your own words, describe the behaviour of the Lab1Start circuit.

Save the file back to the unzipped folder under the name "Lab1StartDone" (use Save As).

Step 6: a) Save the file (again) back into the unzipped folder, but this time save the file under the name "Lab1Mystery" (use Save As).

b) Extend the circuit by adding the Mystery circuit shown below. Try to keep the components in approximately the same relative positions … it will make the TA's job easier when marking. Include the labels (use the Text tool) on the inputs (A,B,C) and output (X). Note that all of the gates have only the inputs that have been shown as connected. You can set the number of inputs in each gate's Attributes.



c) Connect A, B, and C to the TestHelper such that A is connected to Q2, B is connected to Q1 and C is connected to Q0. Connect an LED to X, and label the LED X (in the LED's Attributes).

d) Explore the behaviour of the added circuit using the Test Helper. Use the Logging facility of Logisim to record the input/output relationship implemented by the circuit. (For the Logging facility: See the "Logging…" entry in the Simulate menu. For help with the Logging facility, see Help → Tutorial, and then select the Logging entry in the left pane.) Use the Logging capability to log to a file, and save the log file in the unzipped folder under the name Lab1MysteryLog.

Save the circuit back to the unzipped folder under the same name (Lab1Mystery).

[Report] Use information from the log file to create a truth table for the Mystery circuit.

Step7: a) Design a circuit that uses only AND, OR and NOT gates to implement a circuit that is equivalent to the Mystery circuit. Extend the circuit in Logisim to include your equivalent circuit. Connect the Test Helper to your circuit and use the Logging facility to capture the input/output relationship implemented by your equivalent circuit.

Save the log file in the unzipped folder under the name "Equivalent.txt"

Save the circuit in the unzipped folder under the name "Lab1Solution".

b) BONUS: Extend the circuit further by adding a Confirmation sub-circuit that confirms that your circuit is equivalent to the Mystery circuit. Log the behaviour of the final solution to show that the behaviour associated with the circuit. Save the Log file in the unzipped folder under the name "Bonus.txt". [Report]: In your own words, describe how the Confirmation circuit works, and how that is reflected in the Bonus Log file. Save the circuit to the unzipped folder under the name "Lab1Bonus".

Step 8: The lab is done! If you could not complete the lab during the scheduled lab time … that's OK … finish up the lab on your own time.

Before you leave the lab (even if you could not complete the lab), show the TA what you have completed. [Attendance marks are associated with this.]

Step 9: Before the due date for your lab section (i.e. does not have to be done during the scheduled lab). Prepare your report and place the single pdf in the unzipped Lab1 folder containing your lab work. Name the report "Lab1Report". ZIP the folder (should retain the name "Lab1") and submit it to the appropriate place in your lab section's cuLearn page. **Note** that the system will automatically stop accepting submissions at the due date/time for your lab section.

A note about making pdf files: The lab has PDFCreator installed. PDFCreator is a free program that can also be downloaded for use at home from http://sourceforge.net/projects/pdfcreator/ . When installed, it appears as a printer. Printing a file to this "printer" will generate a pdf file as output. (Prof. Pearce uses PDFCreator to create all of the pdf files for this course.)

In this course, you might find it useful to build documents (like Reports) as a Word document and then print the complete document using a program like PDFCreator.

Lab 1 Grading Scheme:

Please be careful as you work … a significant portion of the marks are associated with following directions **exactly** as requested.

In-Lab Demonstration: lab complete: 5 marks lab incomplete: 4 marks did not attend: 0 marks

Report & lab work: 20 marks

Bonus: 5 marks