

CS 325 Lab 3 Introduction

Logisim Logic Simulator

Table of Contents

- 1. Goals for this week:
- 2. Starting Point Code
- 3. Learning Logisim
 - 3.1. Demo
 - 3.2. Advice on Using Logisim
- 4. Lab 3 Assignment
- 5. Handy References

1. Goals for this week:

1. Gain experience with the Logisim logic circuit simulator.
2. Run through the [Logisim tutorial](#) for building an XOR component.
3. Introduce Lab 3.

2. Starting Point Code

Start by creating a Lab3 subdirectory and copying over some files:

```
intro.circ  solution.circ
```

Follow the instructions in [logisiminstall.pdf](#) to install it on your own machine.

3. Learning Logisim

For this lab, we'll be using [Logisim](#) to create and test digital circuits using the logic gates (AND, OR, NOT, etc.) we've been talking about in class.

We'll start by demonstrating the basics of Logisim (adding gates, inputs, and outputs) to implement a simple circuit. Afterwards, you and your partner will run through the Logisim tutorial to create an XOR circuit.

3.1. Demo

First, open `intro.circ` with Logisim. You can do this by starting Logisim then going to the File→Open menu and navigating to the folder containing the `intro.circ` file.

Together, we're going to implement a 1-bit circuit that computes $(X \text{ AND } Y) \text{ OR } (\text{NOT } X)$, and then we'll add some tester circuitry around it. After we try this out together, you can open the `solution.circ` file to see my solution.

1. Follow these steps in the `intro.circ` file:
 - a. Create a new circuit by choosing Project→Add Circuit, and enter the name of the new circuit: "first circuit". You should now see 2 circuits in the subcircuits folder: "main", "first circuit". Double-click "first circuit" to select it for editing. The title bar should display "first circuit". (Details about creating subcircuits are in the "Subcircuits" part of the [Logisim User's Guide](#)).
 - a. Place an "AND Gate" from the "Gates" menu. Although the size of the gate won't matter for this example, you might find it easier to work with if you change its size to *Medium*.
 - b. Add input pins (green square boxes) to the two inputs on the "AND Gate" and label them as X and Y. Change the "Label Location" to "West" so the label shows up to the left of the input.
 - c. Add a "NOT Gate" and attach X as an input. (You don't need to change the size of this gate.)
 - d. Add an "OR Gate" (you may wish to change the size to Medium) and connect the output of X AND Y as one input and the output of NOT X as the other.
 - e. Add an output (green circle) to the output of the OR gate, label it as "result". Change the "Label Location" to "East" so the label shows up to the right of the output.
2. Let's test the circuit by adding a clock and a counter to run a simulation of all possible input values.
 - a. Add a "first circuit" to your "main" circuit.
 - a. Double-click the "main" subcircuit to select it for editing. The title bar should display "main".
 - b. Single-click "first circuit" in the subcircuits folder.
 - c. Place the "first circuit" icon on the main canvas.
 - b. Add a Memory→Counter.
 - a. Set its Data Bits to 2.
 - b. Connect a Wiring→Probe to the Q output. To make your circuit more readable, have the probe's Facing set to South.
 - c. Add a Wiring→Splitter.
 - a. Set its Fan Out and Bit Width In to 2. Connect the tail of the splitter (hertext: "Combined end of the splitter") to the Counter's "Q" output.

- b. If you hover your mouse over the input and outputs of the "first circuit" you added, you will see their labels. Connect one output of the splitter to "X" and the other output of the splitter to "Y". Add an output pin to the "result" output of your "first circuit" and label it appropriately.
- d. Add a Wiring→Clock.
 - a. Connect the Clock to the Counter at the bottom left input (hovertext: "Clock: value may update on trigger").
 - b. Add an input pin and connect it to the Counter at the bottom right input (hovertext: "Clear: when 1, resets to 0 asynchronously"). Changing this input to 1 will allow you to reset the Counter.
- e. Try poking at the Clock.

3.2. Advice on Using Logisim

- Save your changes frequently. Occasionally Logisim may freak out and you need to exit Logisim and restart it. If you have saved your changes as you go, you will not lose your work if this happens.

4. Lab 3 Assignment

Next, you and your partner should run through the [Logisim tutorial: Beginner's Guide](#) to build an XOR gate using only AND, OR, and NOT gates (plus inputs and outputs). Build your gate as a new component that you can then deploy in a main circuit.

After about 20 minutes working on the XOR, we'll introduce Lab3.

5. Handy References

- [Logisim beginner's guide](#)
- [Logisim User's guide](#)
- [Logisim video tutorials](#)
- [Logisim git repo](#)