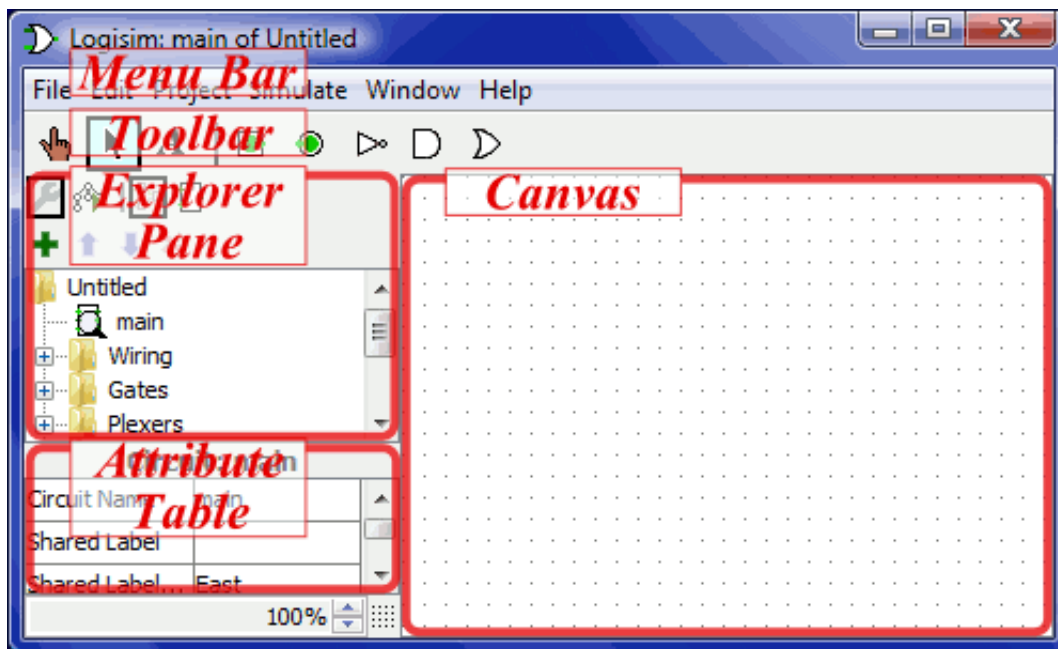


# 1 A Quick Introduction to Logisim

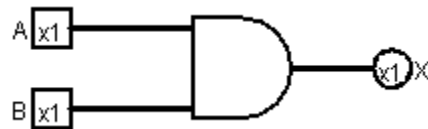
Logisim is an educational tool for designing and simulating digital logic circuits. With its simple toolbar interface and simulation of circuits as they are built, it is simple enough to facilitate learning the most basic concepts related to logic circuits. With the capacity to build larger circuits from smaller subcircuits, and to draw bundles of wires with a single mouse drag, Logisim can be used (and is used) to design and simulate entire CPUs for educational purposes.



The basic mode of operation is to select a gate, wire, or circuit from the toolbar or explorer pane, drop it on the canvas (virtual breadboard), link the circuit up with the desired wiring and then use the poke tool or simulator to examine the attributes of the circuit.

The attribute table allows you change the structure of the items that are on your bread board. For example, the default and gate has 5 inputs, you can change that from 2 to 32. The default toolbar has some basic functional tools and a few well used gates. The first three icons are the poke tool, the selection tool, and the font tool. The poke tool is for changing the value of an input pin from 0 to 1 or 1 to 0. The selection tool is for selecting an object or group of objects. The font tool is for inserting text. The five tools to the right are the input and output pins. Input pins are square and the output pins are round. The final three tools are the NOT, AND, and OR gates respectively.

When analyzing a logic circuit we wish to know the value of the output for each possible input. This takes the form of a truth table. For example, say we want to create a truth table for a simple AND gate. Although an AND gate can have more than two inputs, we will consider the case of just two. So to construct the circuit in Logisim we insert two input pins (square ones), an AND gate, and an output pin (circular one). We then select labels for the input and output pins as below.



Since there are two input pins there are  $2^2 = 4$  possible inputs.

$A$	$B$	$X$
0	0	
0	1	
1	0	
1	1	

In the Logisim canvas you will see the input pins have a 0 in them. Select the poke tool (hand) and click on the input pins to change their values, and observe the value of the output pin  $X$ . Going through all possible combinations gives us the following chart.

$A$	$B$	$X$
0	0	0
0	1	0
1	0	0
1	1	1

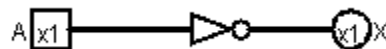
Similarly, the OR gate would be constructed as



with truth table,

$A$	$B$	$X$
0	0	0
0	1	1
1	0	1
1	1	1

The NOT gate would look like,

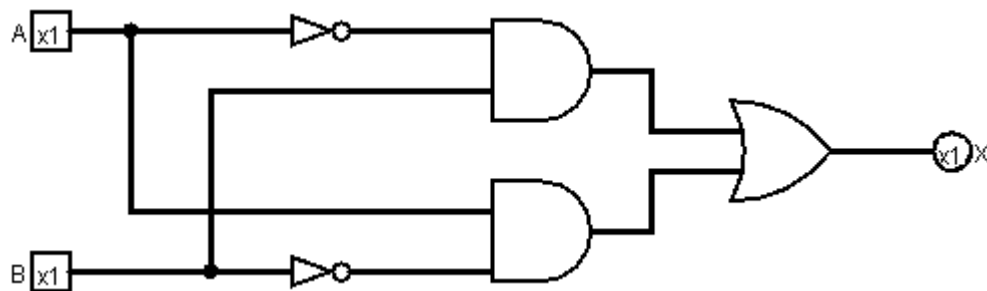


with truth table,

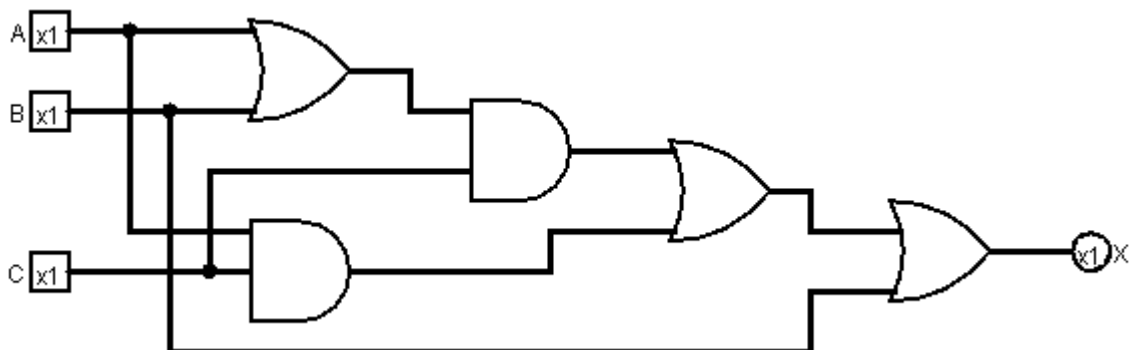
$A$	$X$
0	1
1	0

## 2 Exercises

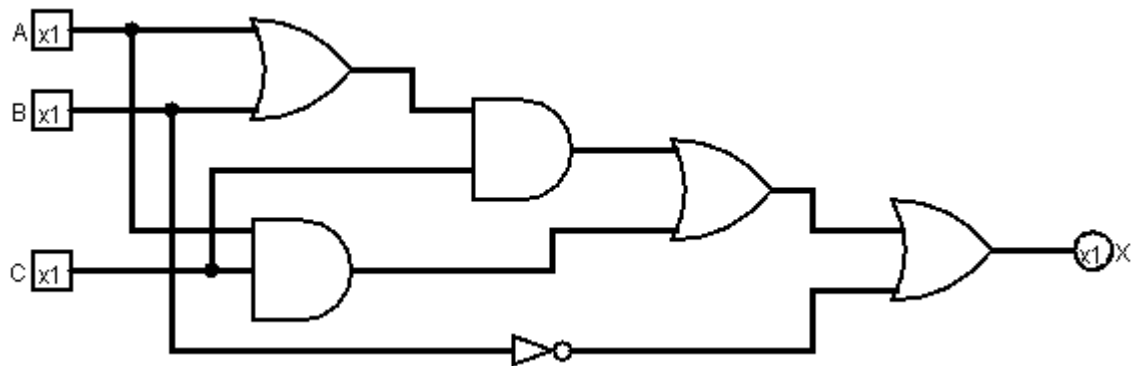
- Using Logisim, construct simple gate circuits, as we did above, for the following gates and then use the poke tool to help construct the truth table. Display the truth tables for each of the following gates.
  - NAND
  - XOR
  - NOR
  - XNOR
- Construct the following circuit in Logisim and use the poke tool to help construct the truth table. Display the truth table. Do you notice anything about the truth table to this logic circuit?



- Construct the following circuit in Logisim and use the poke tool to help construct the truth table. Display the truth table. Do you notice anything about the truth table to this logic circuit? Note that since there are three input pins there will be  $2^3 = 8$  possible inputs.



- Construct the following circuit in Logisim and use the poke tool to help construct the truth table. Display the truth table. Do you notice anything about the truth table to this logic circuit? Note that since there are three input pins there will be  $2^3 = 8$  possible inputs.



5. Construct the following circuit in Logisim and use the poke tool to help construct the truth table. Display the truth table. Do you notice anything about the truth table to this logic circuit? Note that since there are three input pins there will be  $2^4 = 16$  possible inputs.

