

ICT 1019Y Computer Architecture

Week 03 Practical: Half Adder and Full Adder

You will use Logisim to create and test circuits. Take a look at some of the examples for how to do different things in Logisim. Also, see the Beginners Guide, Slides and Library Documentation of the Logisim web page for more help.

<http://www.cburch.com/logisim/docs/2.7/en/html/guide/tutorial/index.html>

Task 1 : 1-bit Full Adder

Create a 1-bit full adder as a new circuit (Project→Add Circuit). Name this circuit **fulladder**. Your full adder should take 3 inputs (**X**, **Y**, **CarryIn**) and yield two outputs (**Sum**, **CarryOut**).

Start with the truth table for

$$X+Y+C_{in}=Sum, C_{out}$$

and then translate this into a circuit using basic gates only. (i.e. there is an adder circuit in logisim, you cannot use that to solve this problem, you have to build your own).

Once built, test out your circuit for all possible input values.

Task 2: 4-bit Full Adder

Add a new circuit **fulladder4** that takes **two** 4-bit input values, x and y, and 1-bit input value carry-in, and produces a 4-bit sum output value, and a 1-bit carry-out value. To build this circuit you should use four copies of your 1-bit adder to add each digit. The two 4-bit input values can be represented as a single input of size 4 and then you can use a splitter to get the value of each bit.

You do not need to worry about overflow, but you should add a probe to the carry out bit wire to see when it is 0 or 1.

Test out your 4-bit adder for different input values.

NOTE: The 4-bit adder you are building adds two 4-bit numbers, whether they are unsigned or 2's complement. The only difference has to do with overflow -- which you aren't dealing with in this question -- the addition is the same either way.