CS/COE 0447 Fall 2009
Lab 9: Combinatorial Logic Design
Due Date: November 12, 2009

To get started on this lab, attend recitation on 11/6. Each of you should submit your own solution, according to these instructions: http://www.cs.pitt.edu/~sab104/teaching/cs447/submission.html. You may collaborate with your partner, but each person must turn in their own copy of the lab, with the name of their partner. The lab is due on 11/12 at 11:59pm.

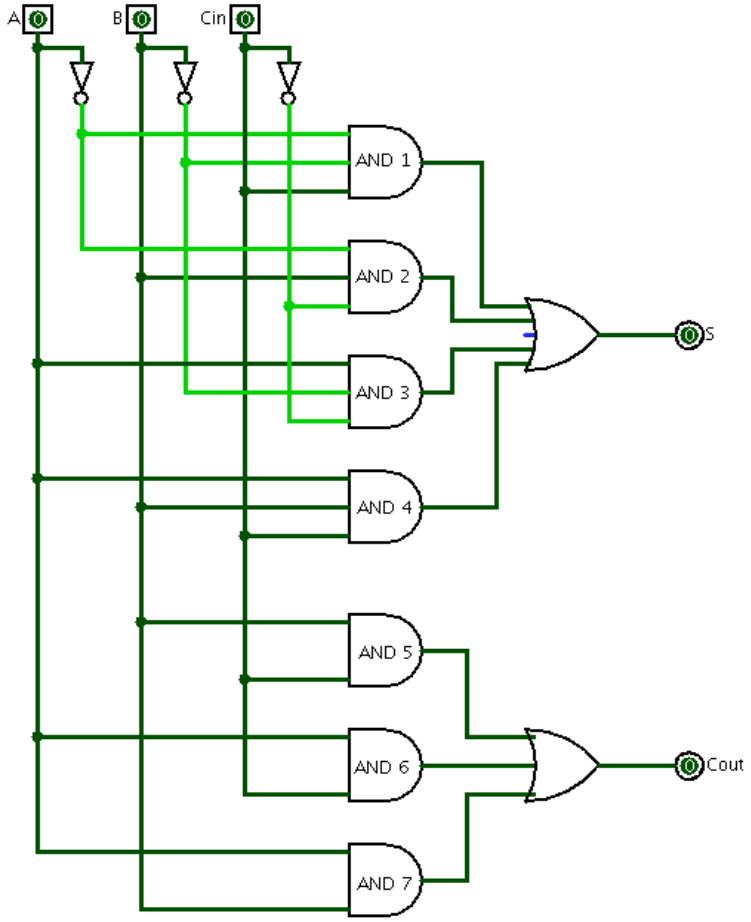
For this lab, we will use a tool for designing and simulating digital circuits. The tool is called *Logisim* and is available at http://ozark.hendrix.edu/~burch/logisim/.

1) Getting started with *Logisim*

Consider the following sum of products for a 1-bit adder:

$$S = \bar{A}\,\bar{B}\,C_{\text{in}} + \bar{A}\,B\,\bar{C}_{\text{in}} + A\,\bar{B}\,\bar{C}_{\text{in}} + A\,B\,C_{\text{in}}$$
$$C_{out} = BC_{\text{in}} + AC_{\text{in}} + AB$$

The following logic circuit implements the adder with AND, OR and NOT gates.



Implement the circuit in *Logisim*. Change the values of the inputs and fill the following table with the intermediate values at the output of each AND gate and at the outputs of the circuit. You can insert additional probes anywhere in a circuit to determine the value of the wire at that location. Turn in the table as well as the circuit file.

A	**B**	**C_{in}**	**S**	**C_{out}**	**AND1**	**AND2**	**AND3**	**AND4**	**AND5**	**AND6**	**AND7**
0	0	0									
0	0	1									
0	1	0									
0	1	1									
1	0	0									
1	0	1									
1	1	0									
1	1	1									

2) 7-Segment Display

A 7-segment display is a simple electronic device for displaying decimal numbers. It is composed of 7 segments that can be turned on or off individually and that can be combined to produce a representation of a decimal digit.

The following is *Logisim*'s 7-segment display. Each of the inputs (little dots at the top and bottom) controls one of the 7 segments and the additional decimal point.

Your task is to make a circuit that takes a 2-bit input (which represents a number between 0 and 3) and generates the 7 inputs of the display to show the number. Start by experimenting with the 7-segment display and determine which input drives which segment. Then create the truth table for each input of the display based on the segments that have to be on to represent each number and use it to determine the sum of products. Implement the circuit in *Logisim*.