Aneesh Panchal - 2K20/MC/21

Experiment V

AIM:

Design and study of Half and Full Adder

Theory:

Combinational Circuits:

Combinational circuit is a circuit in which we combine the different gates in the circuit.
Some of the characteristics of combinational circuits are following −

1. The output of combinational circuit at any instant of time, depends only on the levels present at input terminals.
2. The previous state of input doesn't have any effect on the present state of the circuit.
3. A combinational circuit can have an n number of inputs and m number of outputs.

Half Adder:

Half adder is a combinational logic circuit with two inputs and two outputs. The half adder circuit is designed to add two single bit binary number A and B. It is the basic building block for addition of two single bit numbers. This circuit has two outputs **Carry** and **Sum**.
Basic Binary Additions:
0 + 0 = 0
1 + 0 = 1
0 + 1 = 1
1 + 1 = 0 (1 Carry)

Inputs		Outputs	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Truth Table for Half Adder

The SOP(Sum of Products) form of the Sum and Carry are as follows:
Sum = A'B+AB'
Carry = AB

Full Adder:

Full adder is developed to overcome the drawback of Half Adder circuit. It can add two one-bit numbers A and B, and carry c.

The full adder is a three input and two output combinational circuit.

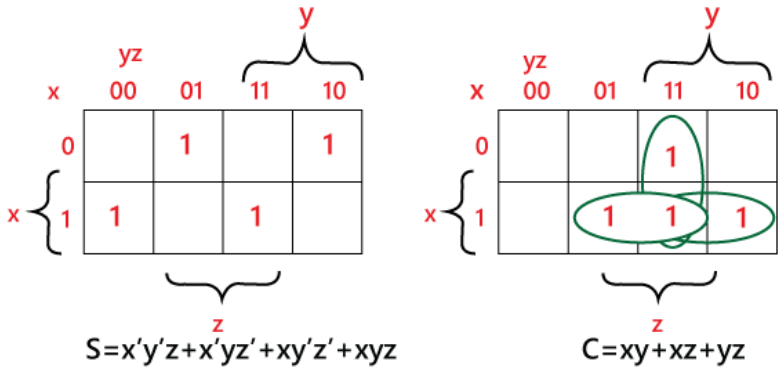
How to perform Operation:

A + B + C = (A + B) + C = A + (B + C)

Inputs			Outputs	
A	B	C_{in}	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

Logic Table for Full Adder

The SOP(Sum of Products) form can be obtained with the help of K(Karnaught)-map as:



Sum = x'y'z + x'yz + xy'z' + xyz

Carry = xy + xz + yz

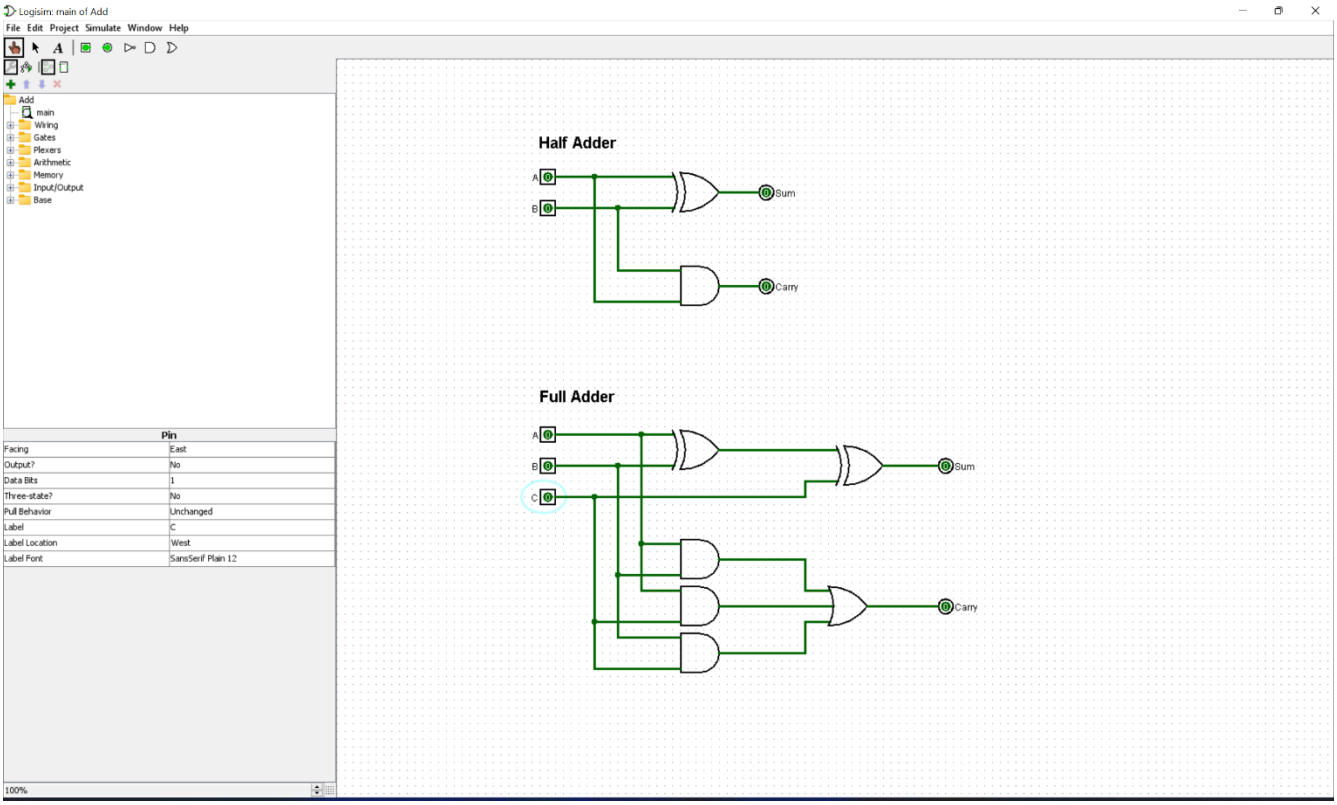
For the above Logic Table,

Sum = A'B'C + A'BC + AB'C' + ABC

Carry = AB + BC + AC

Observations:

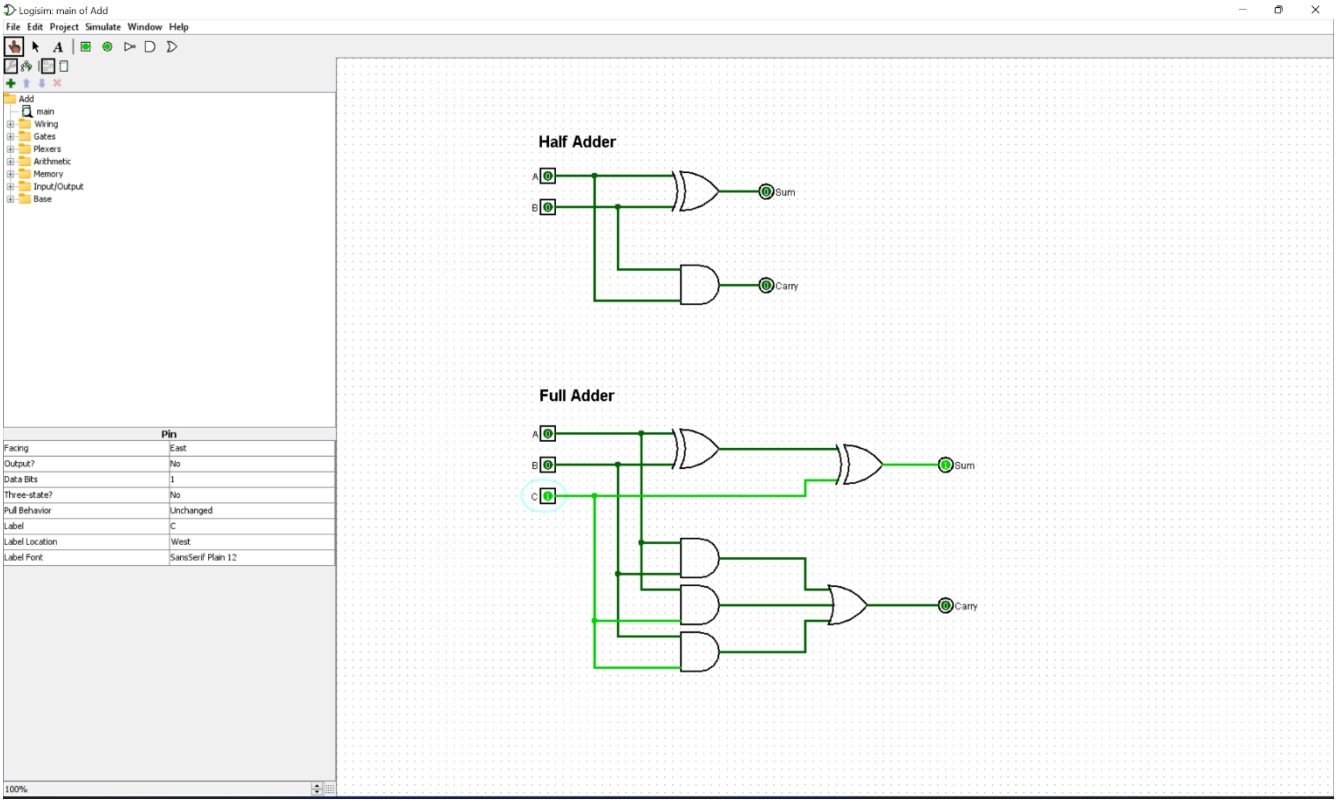
When A = 0, B = 0 and C = 0:



Half Adder: Sum = 0, Carry = 0

Full Adder: Sum = 0, Carry = 0

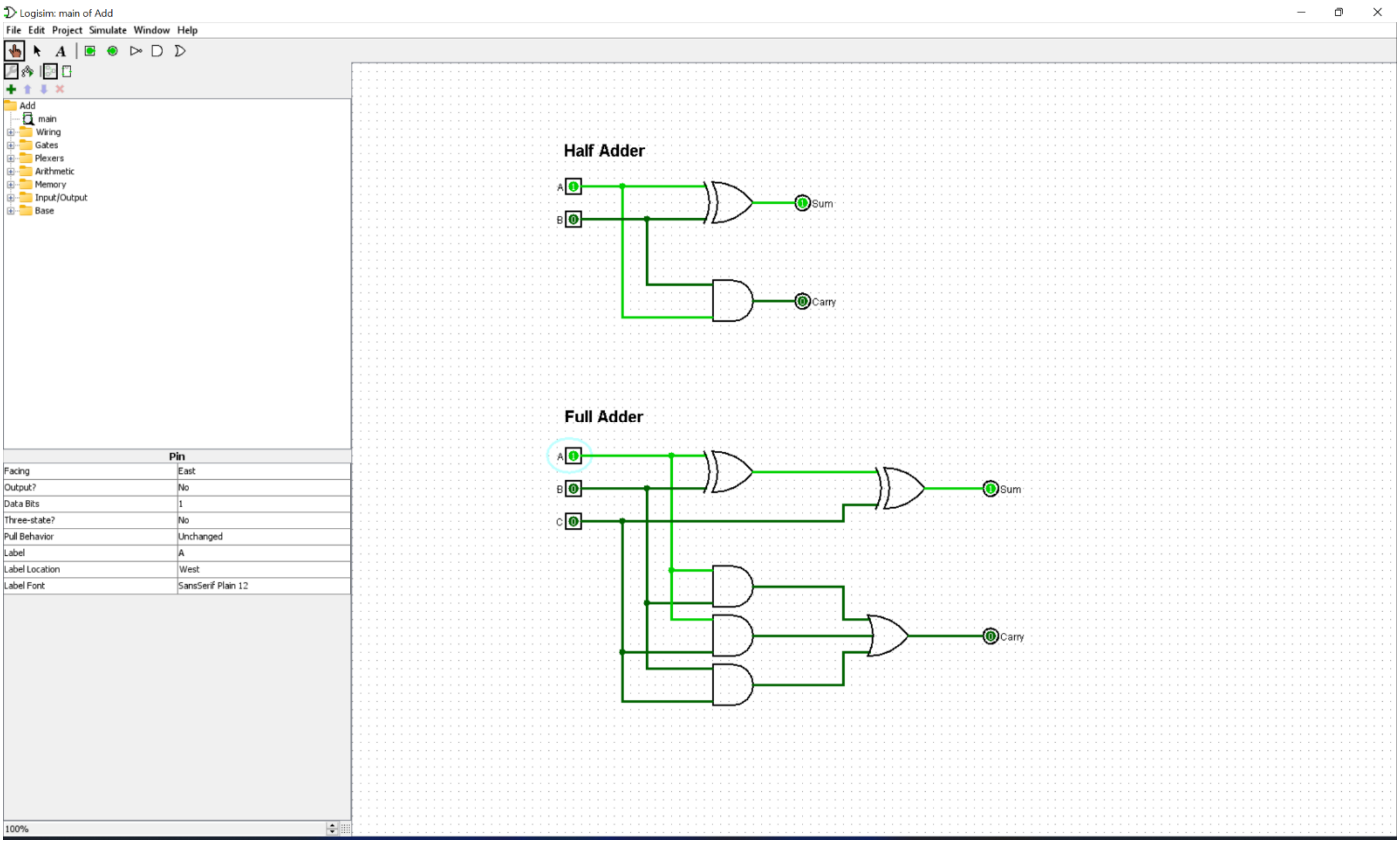
When A = 0, B = 0 and C = 1:



Half Adder: Sum = 0, Carry = 0

Full Adder: Sum = 1, Carry = 0

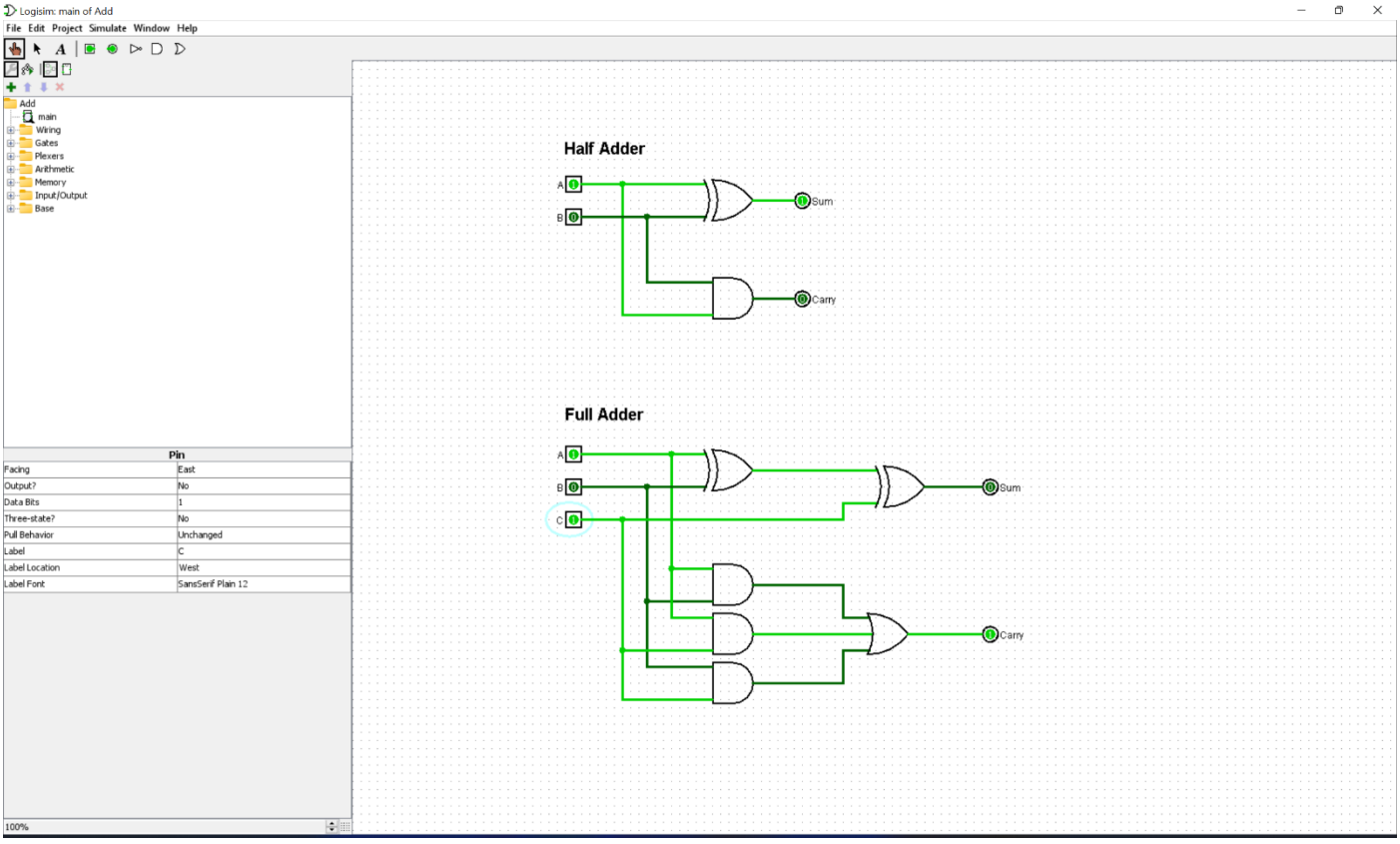
When A = 1, B = 0 and C = 0:



Half Adder: Sum = 1, Carry = 0

Full Adder: Sum = 1, Carry = 0

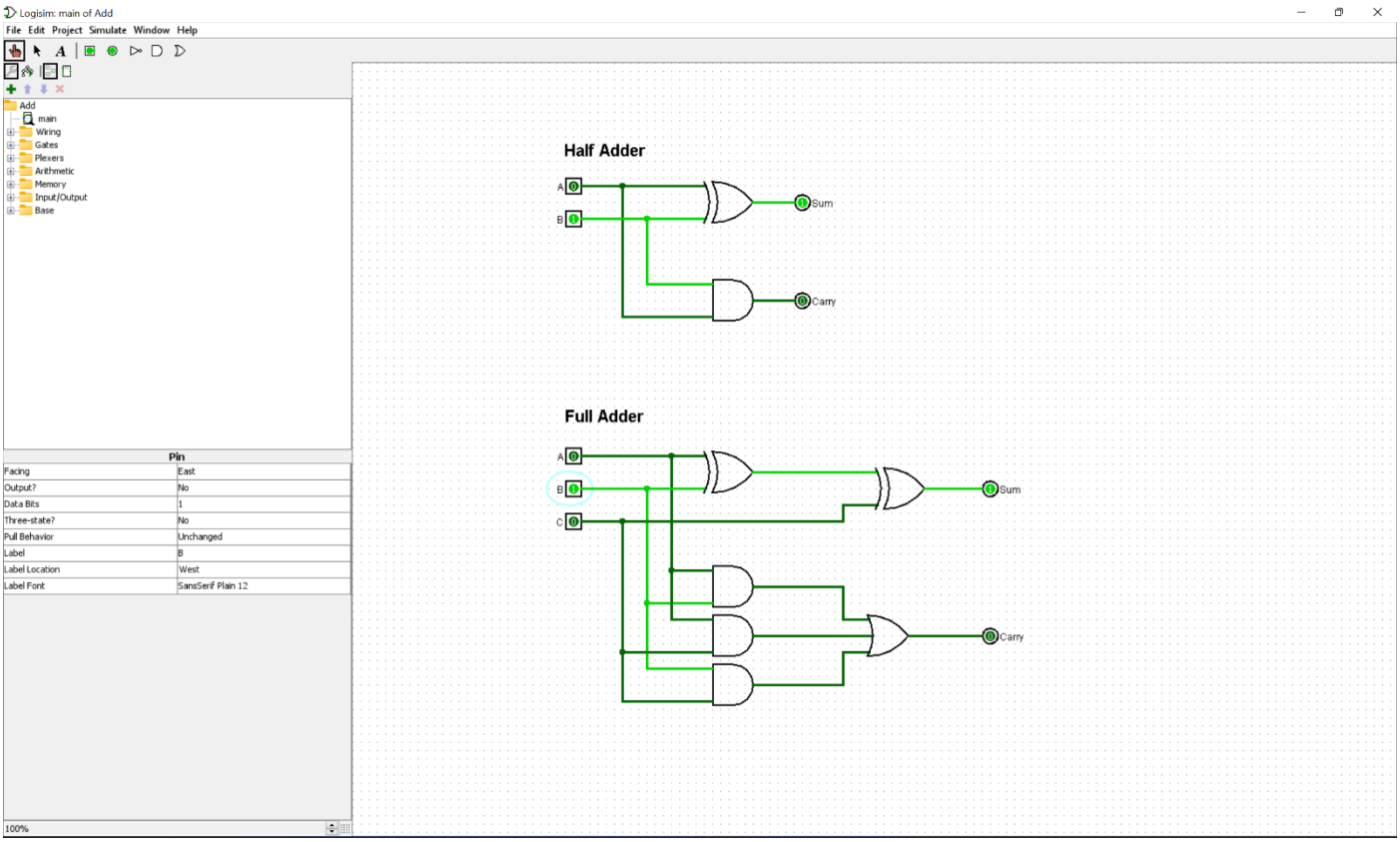
When A = 1, B = 0 and C = 1:



Half Adder: Sum = 1, Carry = 0

Full Adder: Sum = 0, Carry = 1

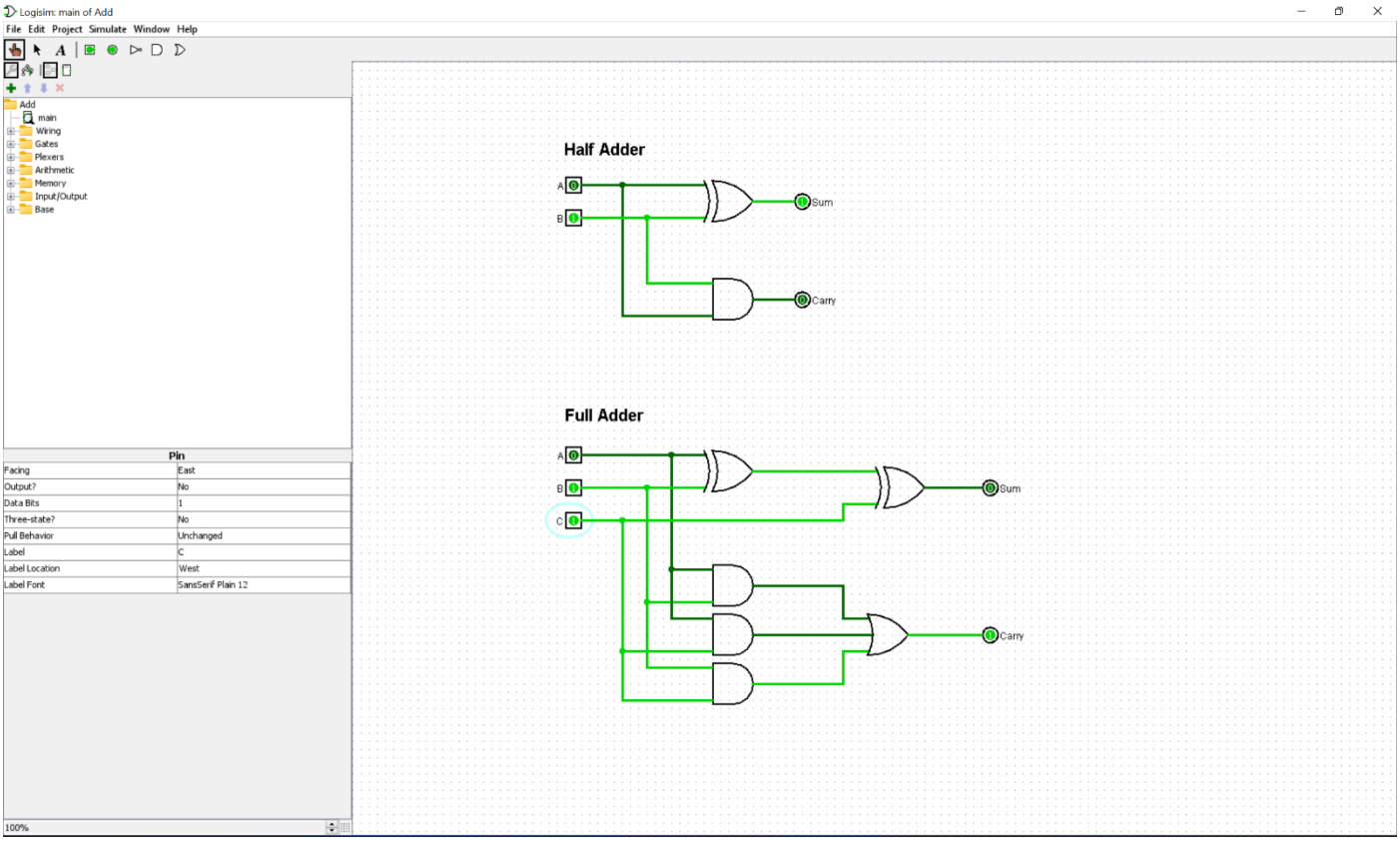
When A = 0, B = 1 and C = 0:



Half Adder: Sum = 1, Carry = 0

Full Adder: Sum = 1, Carry = 0

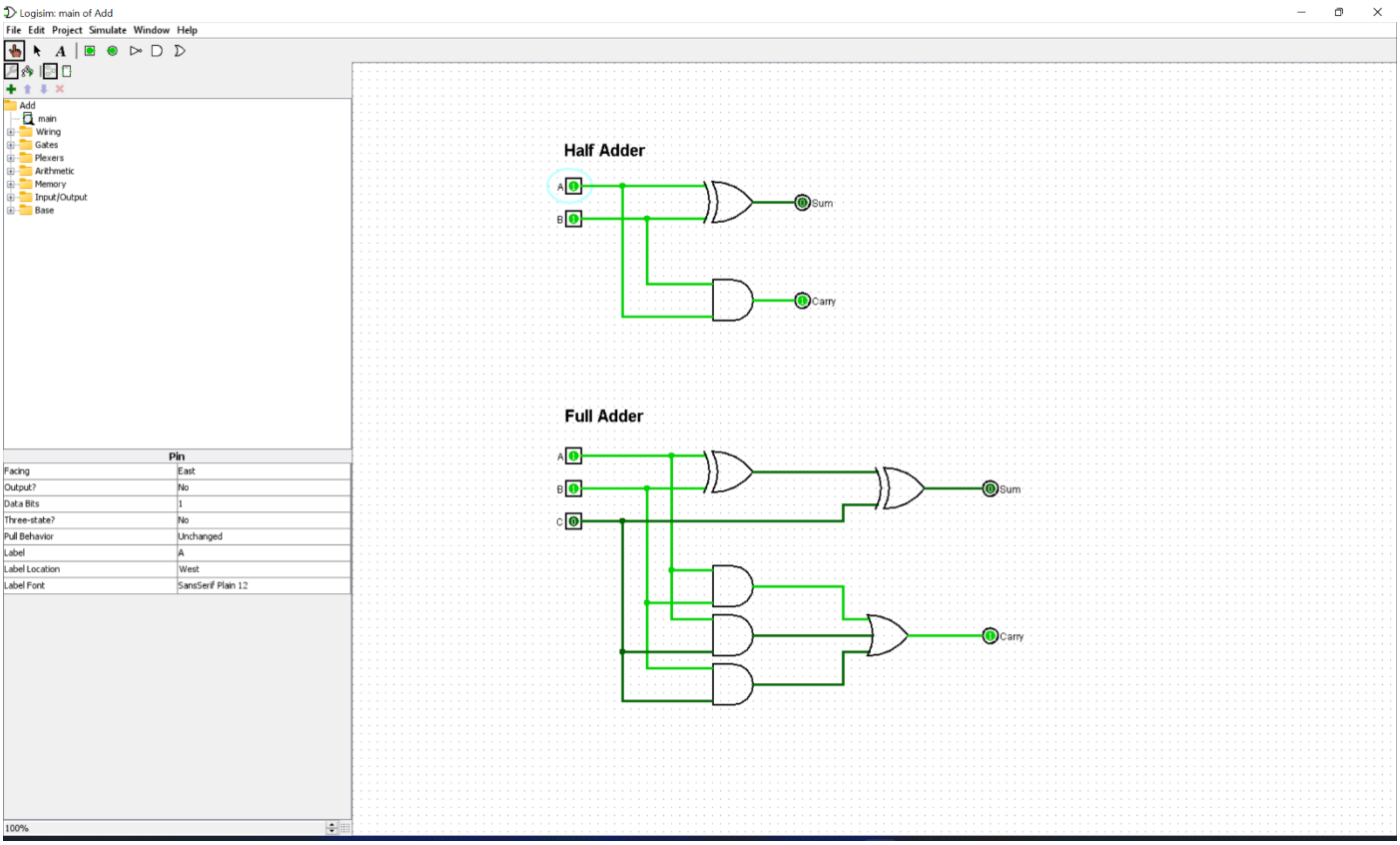
When A = 0, B = 1 and C = 1:



Half Adder: Sum = 1, Carry = 0

Full Adder: Sum = 0, Carry = 1

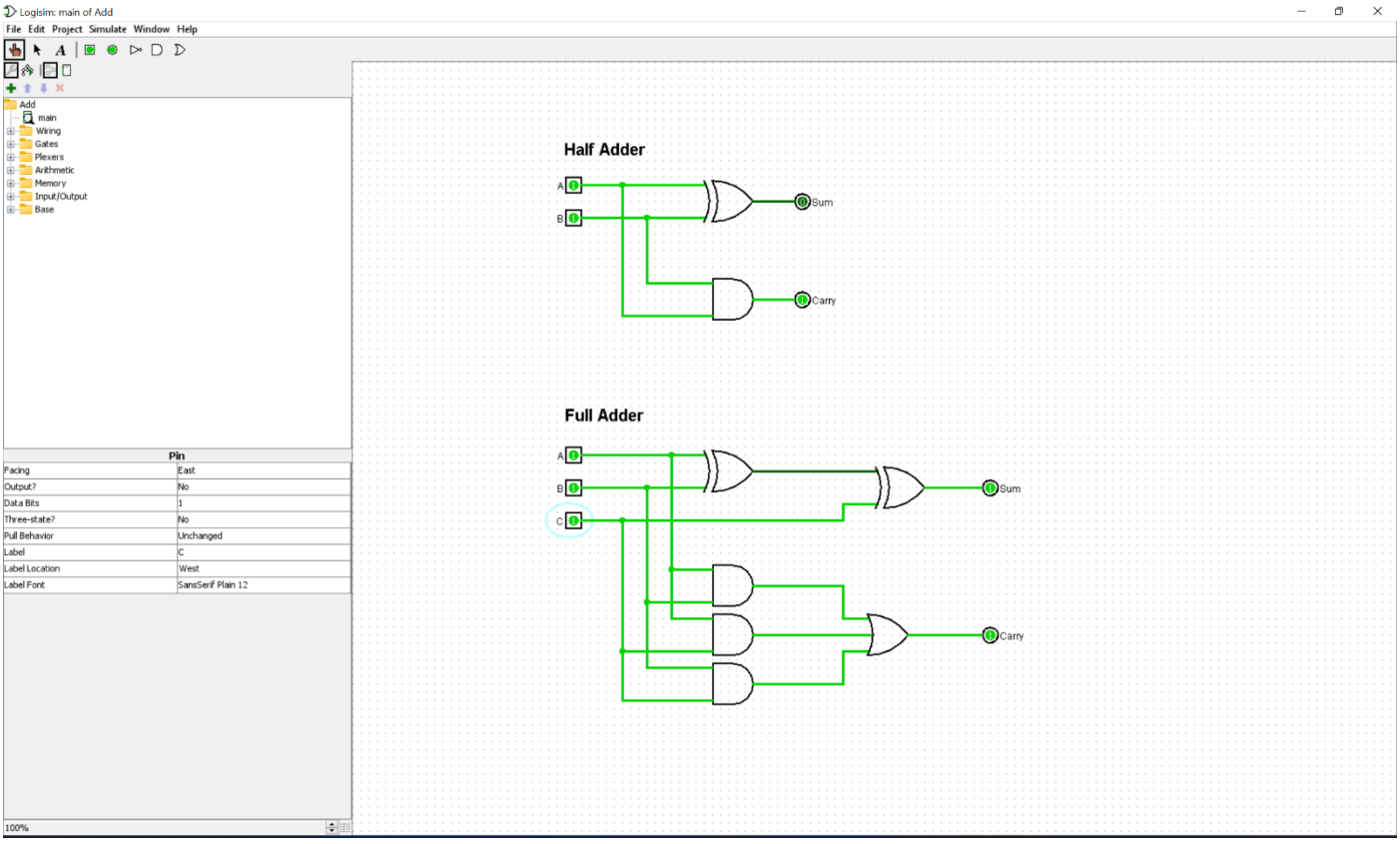
When A = 1, B = 1 and C = 0:



Half Adder: Sum = 0, Carry = 1

Full Adder: Sum = 0, Carry = 1

When A = 1, B = 1 and C = 1:



Half Adder: Sum = 0, Carry = 1

Full Adder: Sum = 1, Carry = 1