Experiment VI

AIM:

Design and study of Half and Full Subtracters

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 Subtracter:

Half subtractor is a combination circuit with two inputs and two outputs (difference and borrow). It produces the difference between the two binary bits at the input and also produces an output (Borrow) to indicate if a 1 has been borrowed.

Basic Binary Subtraction:

0 - 0 = 0

1 - 0 = 1

0 - 1 = 1 (1 Borrow)

1 - 1 = 0

Inputs		Outputs	
A	B	Diff	Borrow
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

Truth Table for Half Subtracter

The SOP(Sum of Products) form of the Difference and Borrow are as follows:

Difference = A'B+AB'

Borrow = A'B

Full Subtracter:

The full subtractor is a combinational circuit with three inputs A,B,C and two output D and B_{out}. A is the 'minuend', B is 'subtrahend', C is the 'borrow' produced by the previous stage, D is the difference output and B_{out} is the borrow output.

How to perform operation:

$A - B - C = (A - B) - C$

Inputs			Outputs	
A	B	Borrow$_{in}$	Diff	Borrow
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Logic Table for Full Subtracter

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

Difference = xyz′ + x'y′z + x′yz' + xyz

Borrow = x′y + x′z + yz

For the above Logic Table,

Difference = A′B′C + ABC′ + A′BC′ + ABC
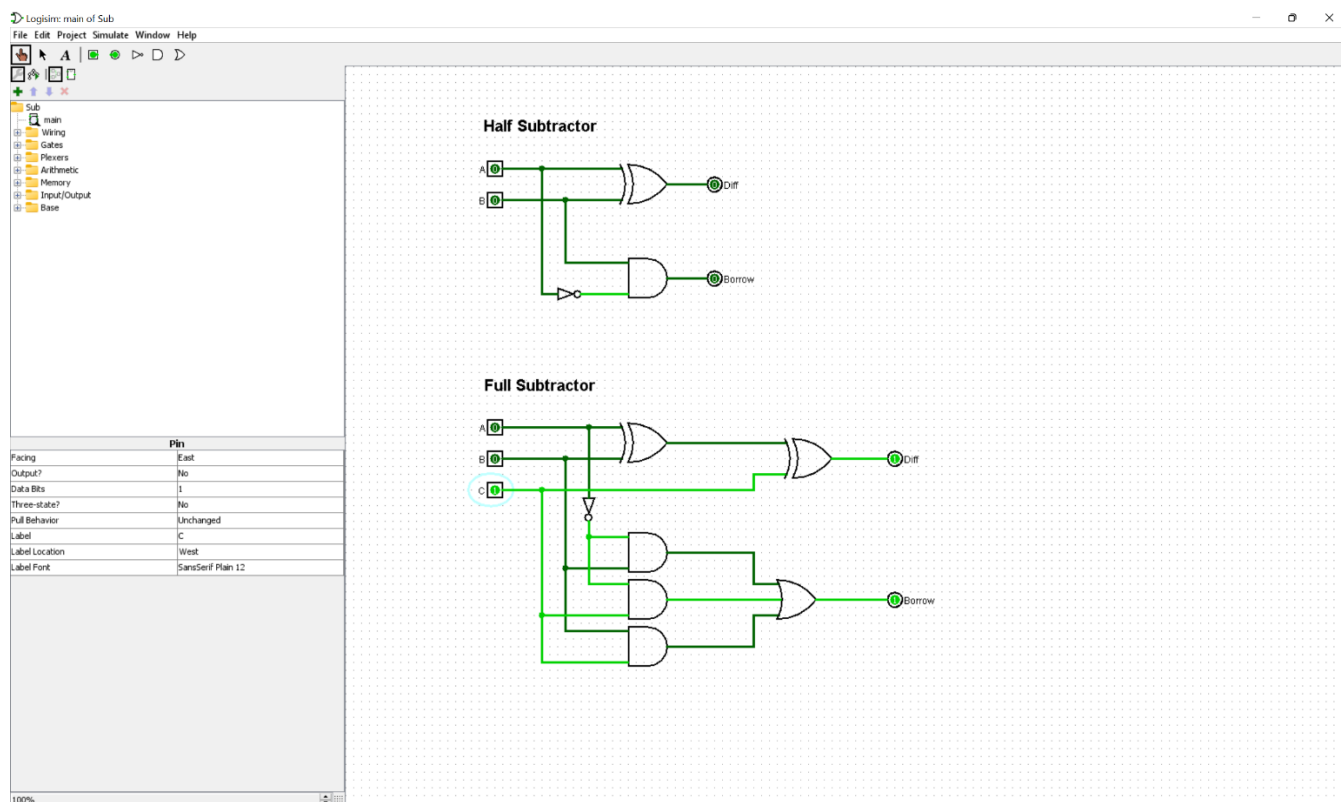
Borrow = A′B + BC + A′C

Observations:

When A = 0, B = 0 and C = 0:
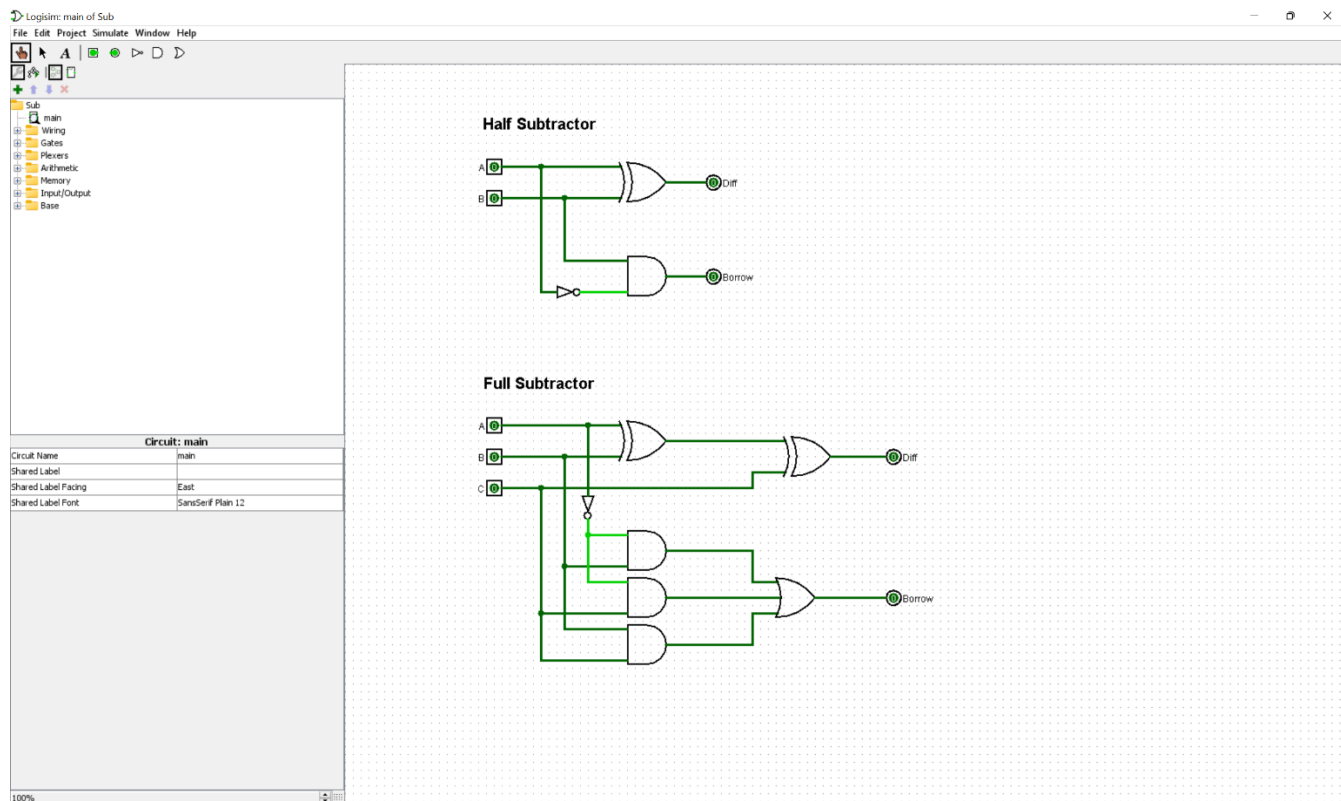
Half Subtracter: Difference = 0, Borrow = 0
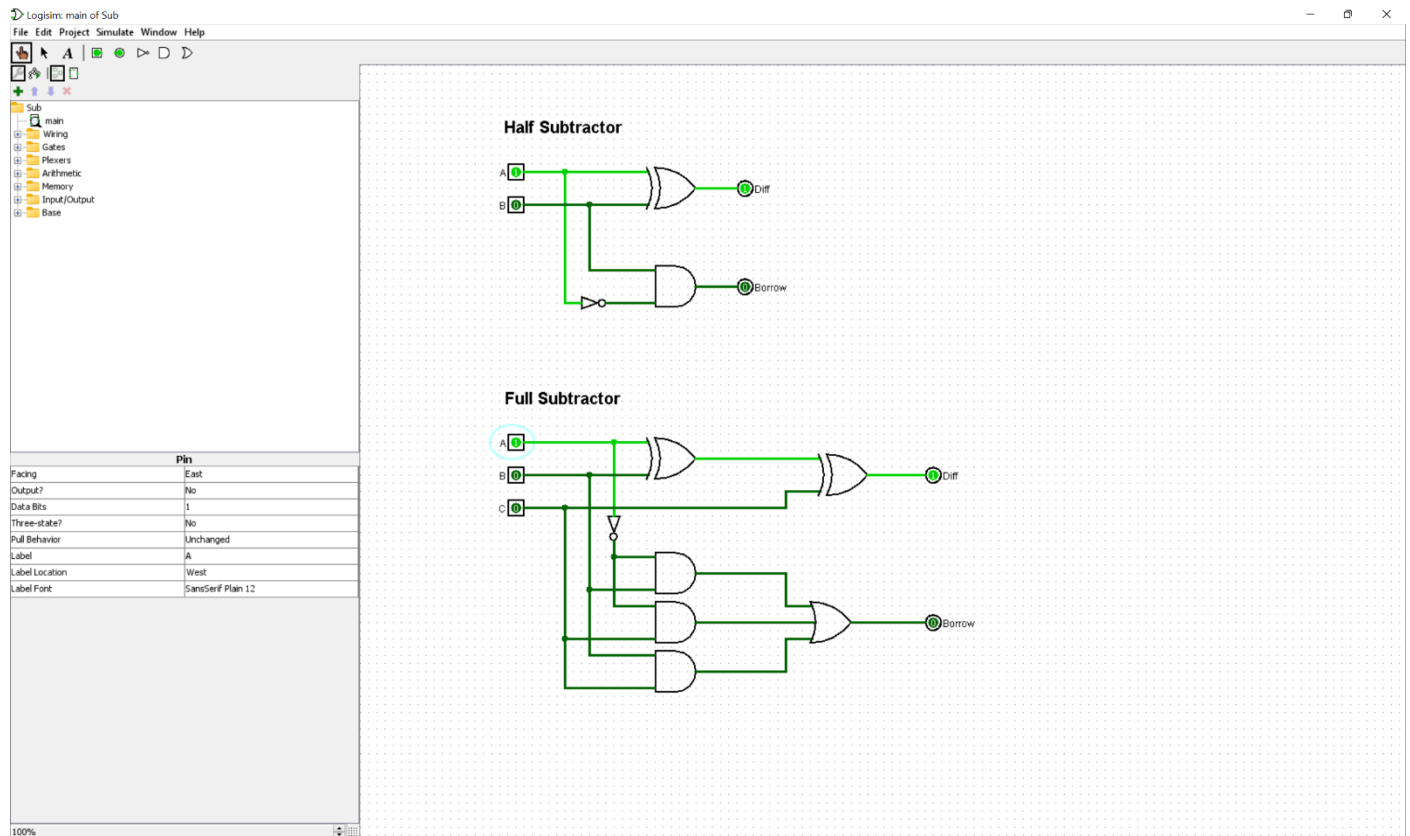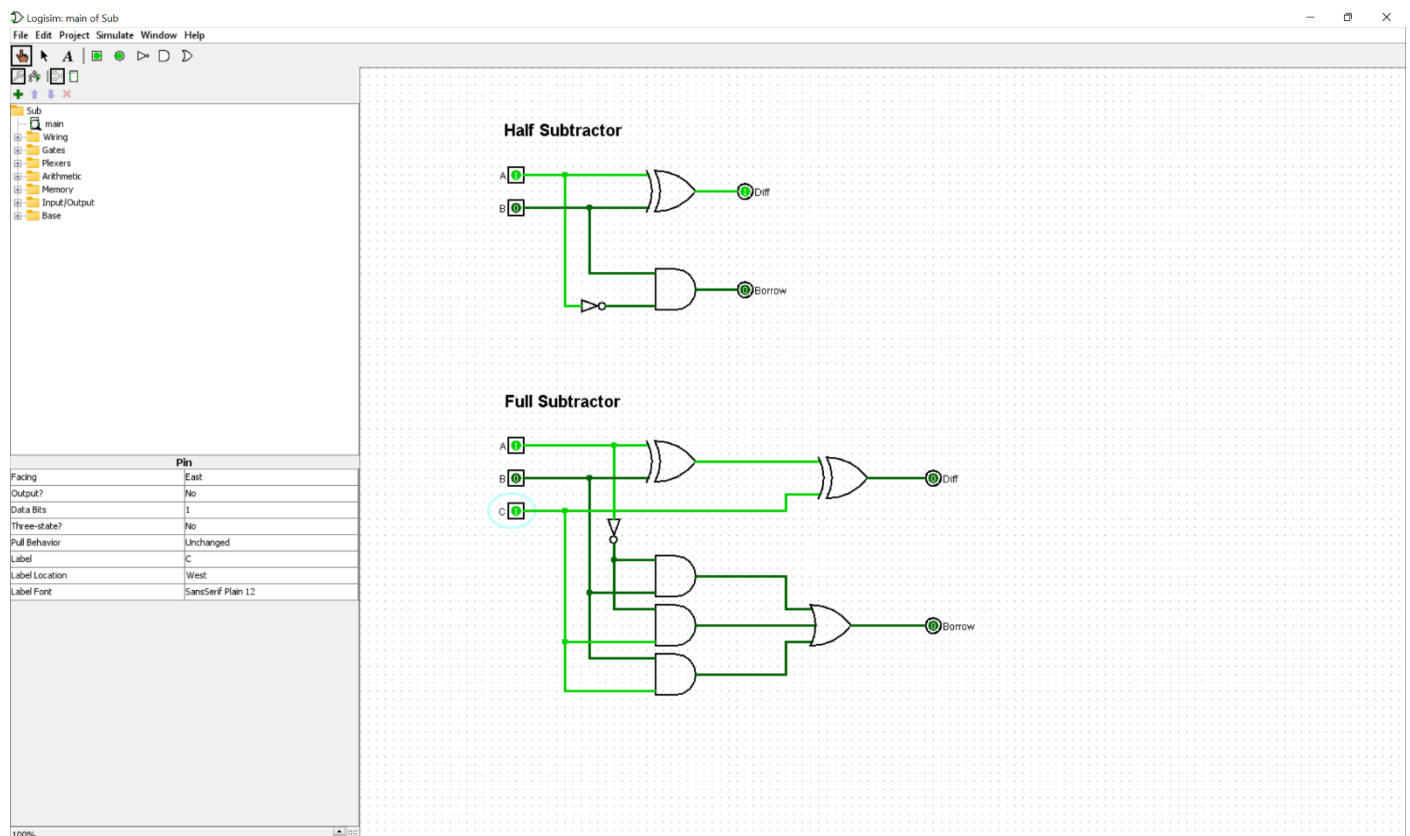
Full Subtracter: Difference = 0, Borrow = 0

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

Half Subtracter: Difference = 0, Borrow = 0

Full Subtracter: Difference = 1, Borrow = 1

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

Half Subtracter: Difference = 1, Borrow = 0
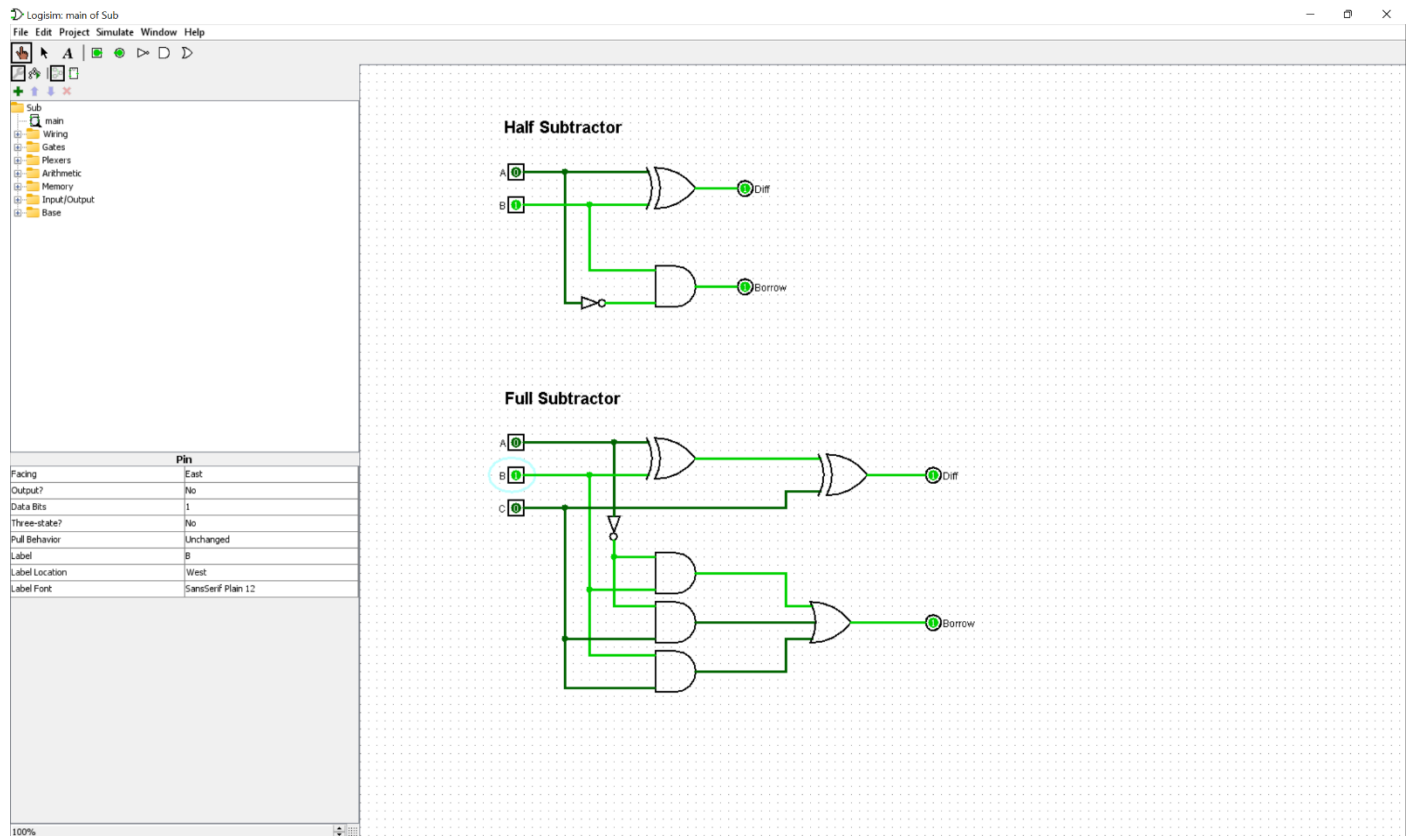
Full Subtracter: Difference = 1, Borrow = 0

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

Half Subtracter: Difference = 1, Borrow = 0
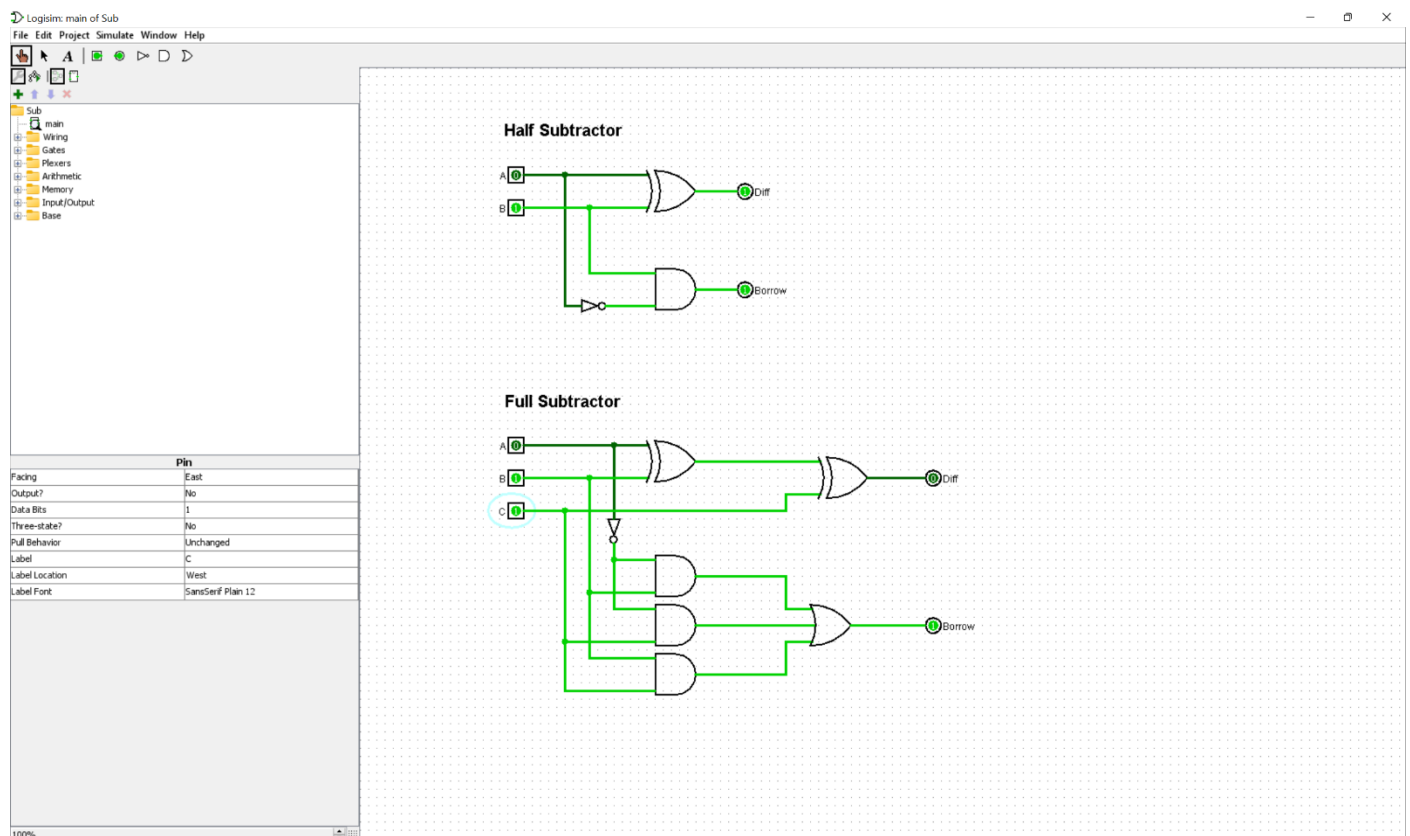
Full Subtracter: Difference = 0, Borrow = 0

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

Half Subtracter: Difference = 1, Borrow = 1
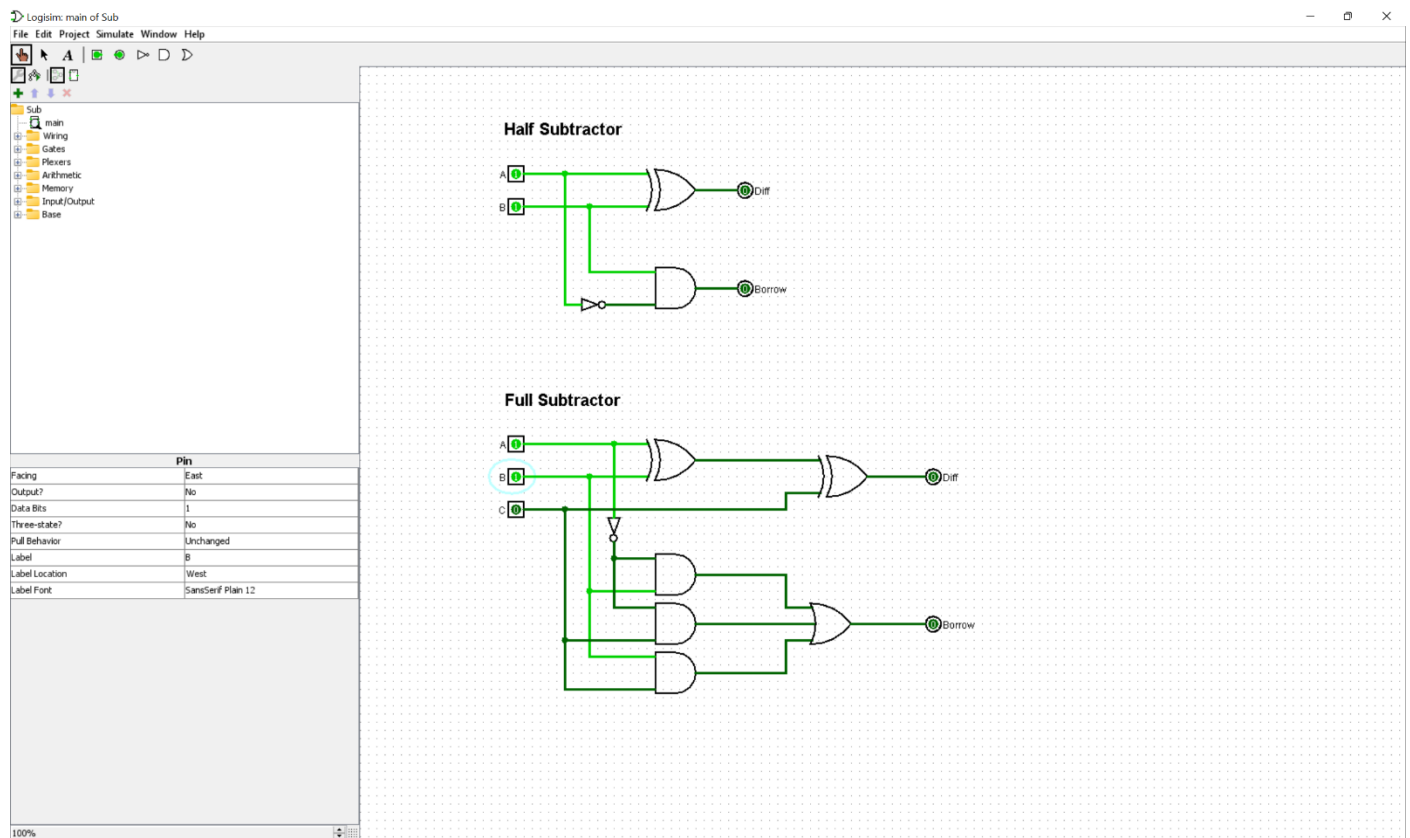
Full Subtracter: Difference = 1, Borrow = 1

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

Half Subtracter: Difference = 1, Borrow = 1
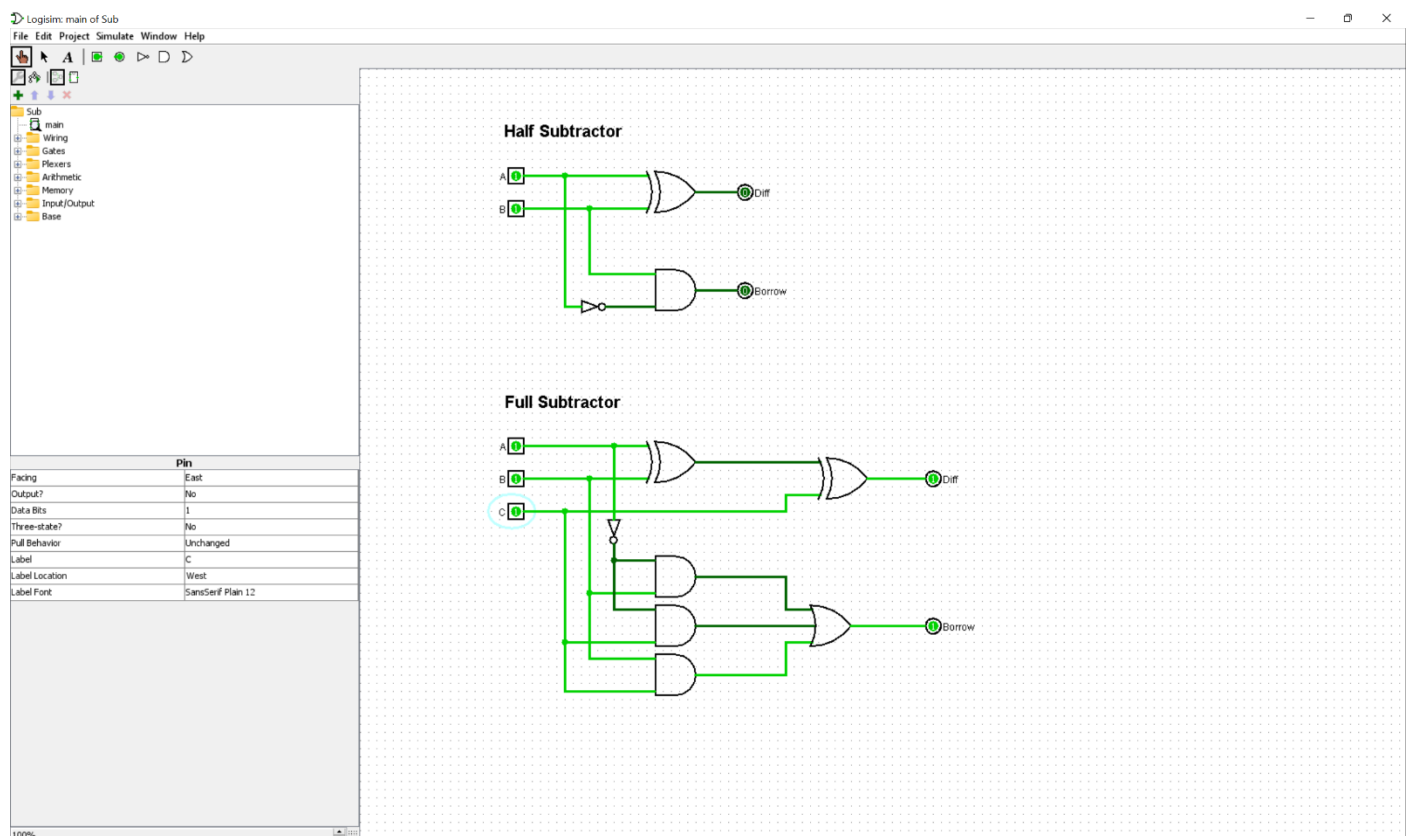
Full Subtracter: Difference = 0, Borrow = 1

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

Half Subtracter: Difference = 0, Borrow = 0

Full Subtracter: Difference = 0, Borrow = 0

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

Half Subtracter: Difference = 0, Borrow = 0

Full Subtracter: Difference = 1, Borrow = 1