CSC 347/ENS 211

Title and Experiment #	Lab2: DeMorgan's Theorem Verification
Name	Gianna Galard
Date Performed	20-Sep-21
Date Submitted	21-Sep-21

The student pledges this work to be their own *Gianna Galard*

Objective:

The main objective of this lab is to build circuits to verify DeMorgan's Laws of Boolean Algebra.

Equipment and Chip used:

- TinkerCad
- 74HCT**04** inverter
- 74HCT**08** Quad 2-input AND Gate
- 74HCT**32** Quad 2-input OR Gate

Design Procedure:

In this lab, the student built a circuit on a breadboard to demonstrate that the following DeMorgan's Laws are true:

(X+Y)'=X'Y' **(XY)'=X'+Y'**

Here is the truth table that splits DeMorgan's Laws into four separate functions ~

Figure 1. Truth Table displaying DeMorgan's Laws in four separate functions.

X Y	F1=(X+Y)'	F2=X'Y'	F3=(XY)'	F4=X'+Y'
0 0	1	1	1	1
0 1	0	0	1	1
1 0	0	0	1	1
1 1	0	0	0	0

Logic Diagram:

Figure 2. Logic Diagram for F1

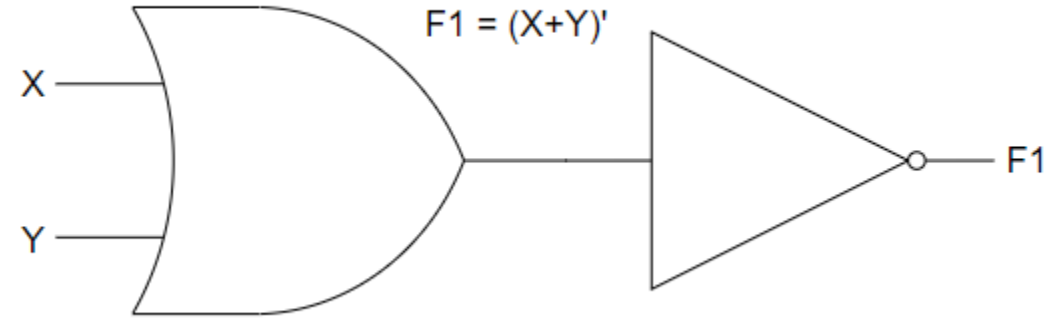


Figure 3. Logic Diagram for F2

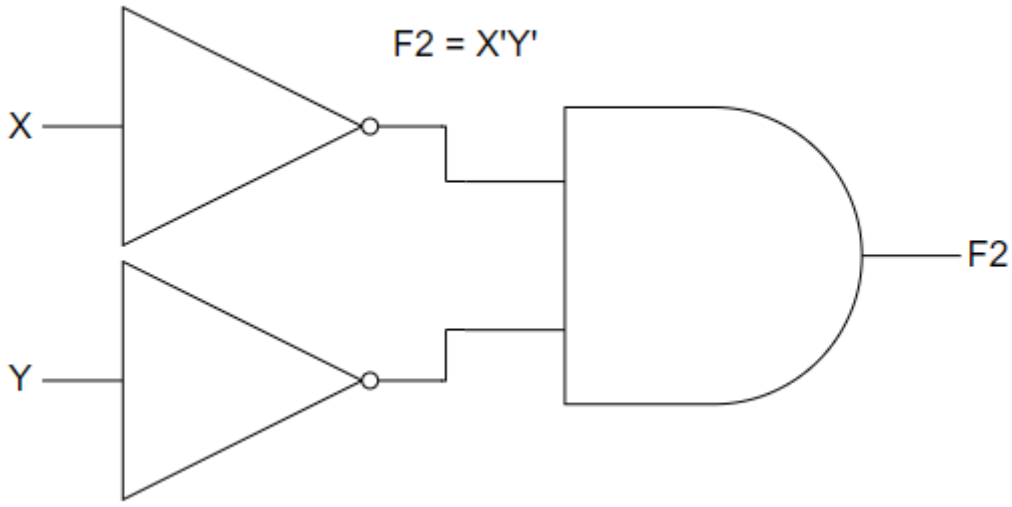


Figure 4. Logic Diagram for F3

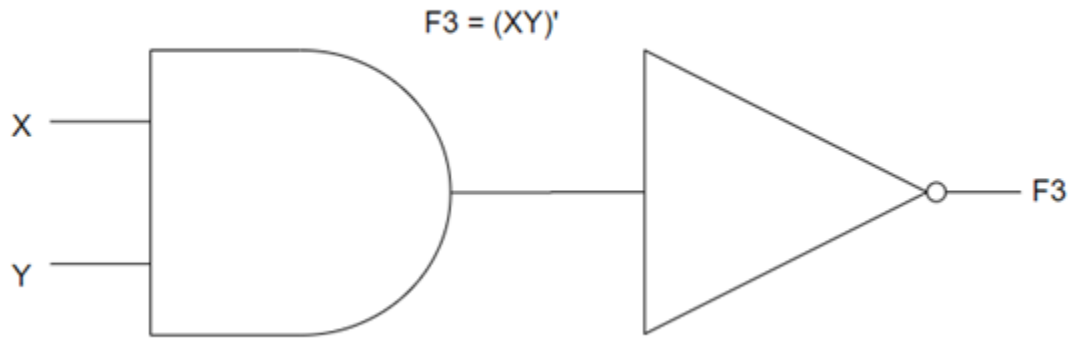
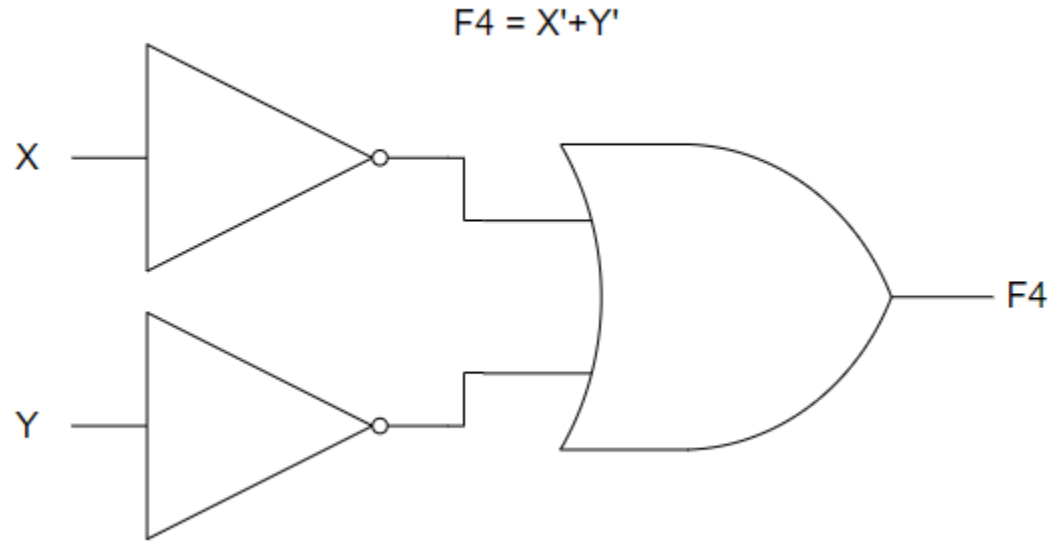


Figure 5. Logic Diagram for F4



Experiment:

After building the logic diagrams, the student used TinkerCad to begin circuit construction. It was built on a singular breadboard using the AND, OR, and NOT Gates. The student approached this in an organized manner by color coordinating the wires: **F1** is represented by **Grey**, **F2**

is represented by **Blue**, **F3** is represented by **Pink**, and **F4** is represented by **Purple**. The jump wires spawn from the red switchboard where **1** is the **X** variable and **2** is the **Y** variable. When both switches are turned off, all four LEDs are activated, *which is proven in Figure 6 below ~*

Figure 6.

X Y	F1=(X+Y)’	F2=X’Y’	F3=(XY)’	F4=X’+Y’
0 0	1	1	1	1
0 1	0	0	1	1
1 0	0	0	1	1
1 1	0	0	0	0

The student applied all four combinations during testing with the circuit board and proved this truth table (and DeMorgan’s Law) to be true.

Figure 7. Test 1.

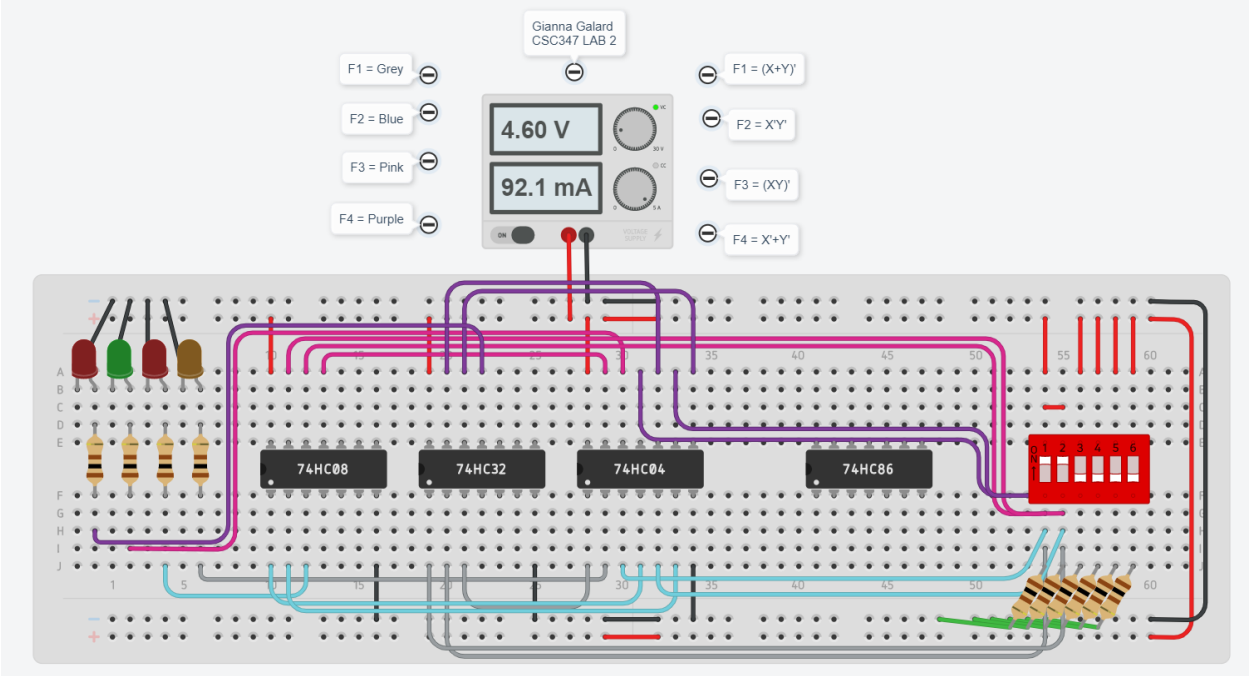


Figure 8. Test 2.

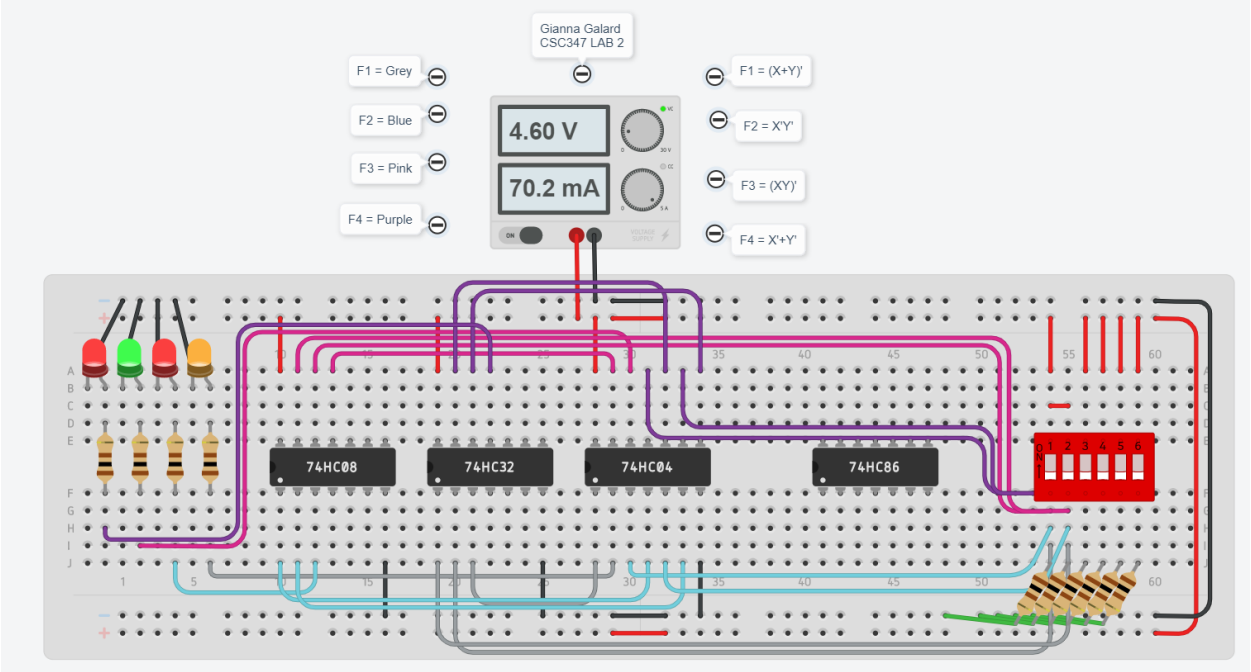


Figure 9. Test 3.

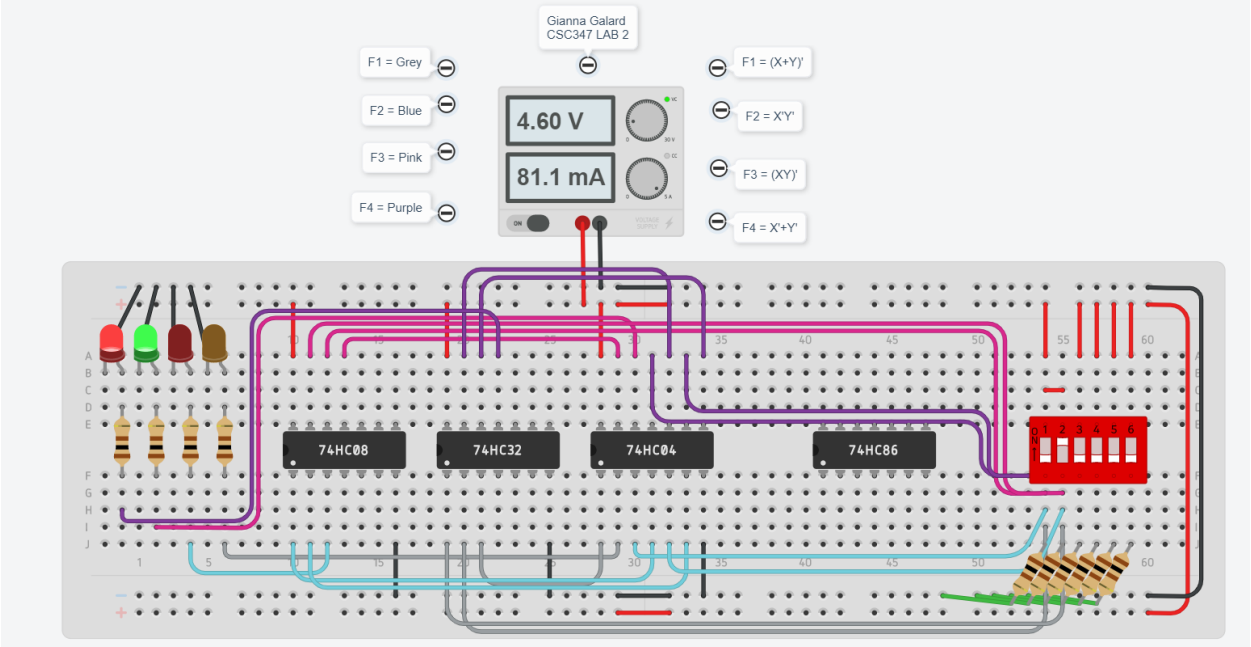


Figure 10. Test 4.

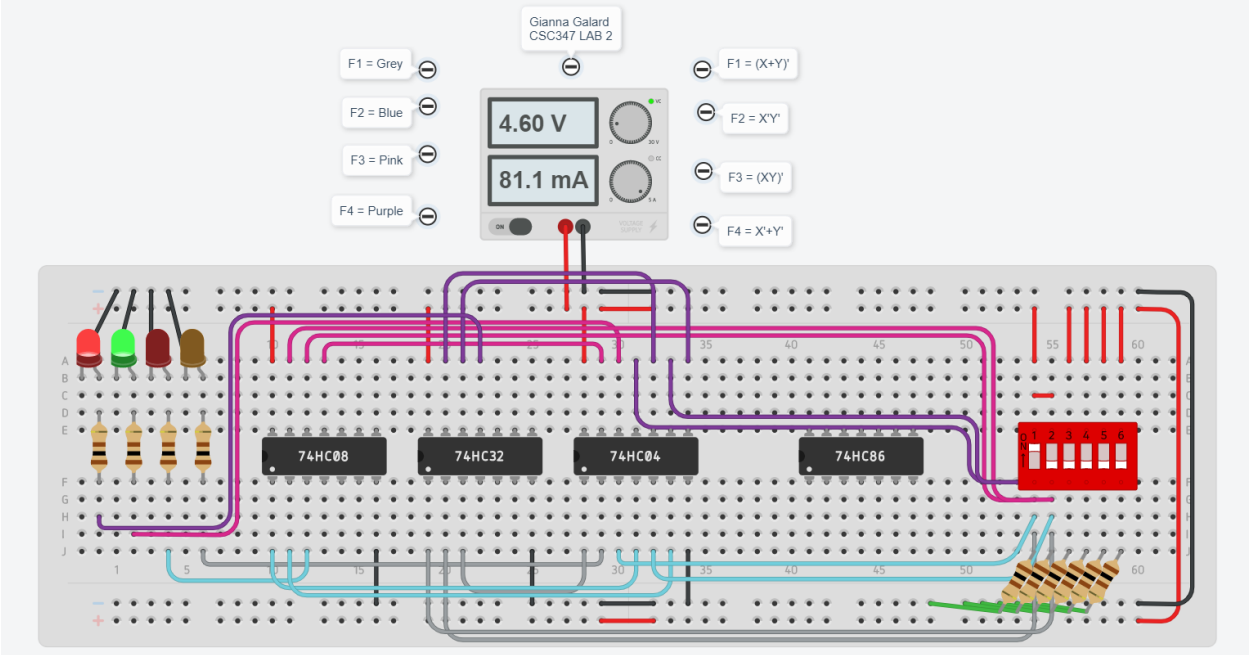
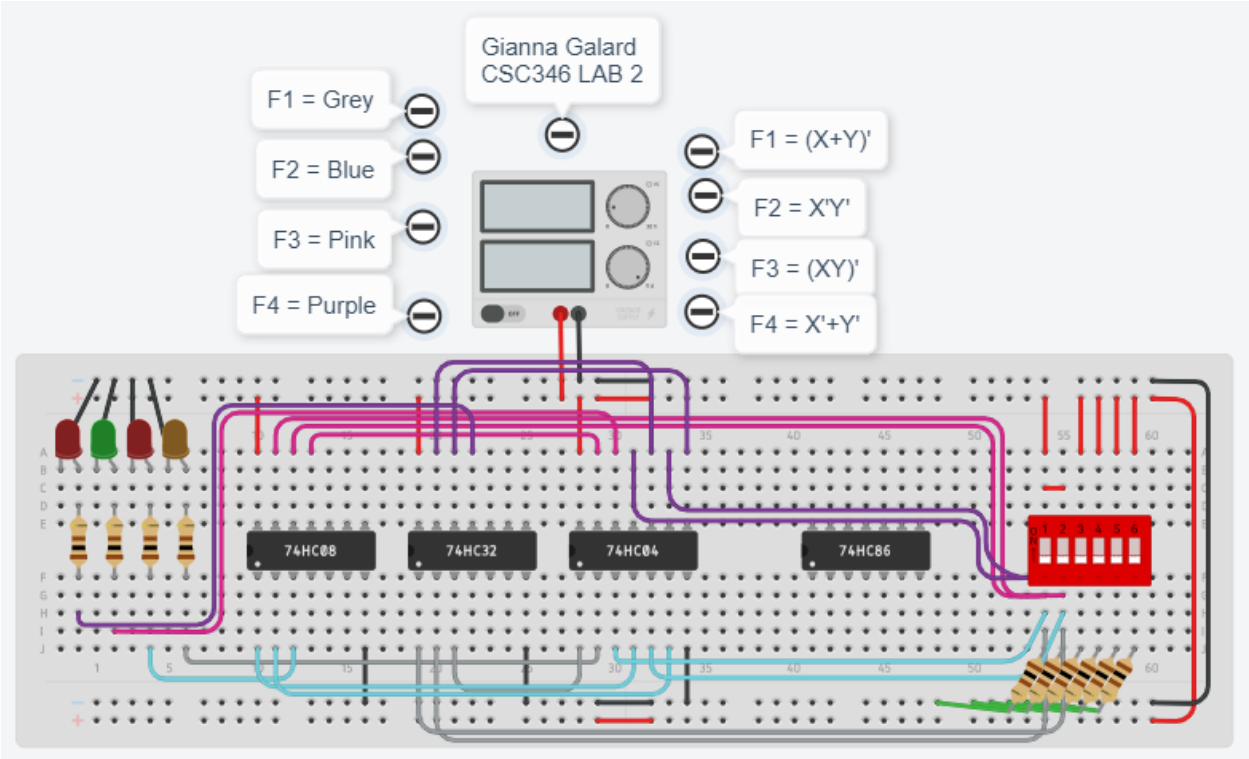


Figure 11. Circuit Board.



https://www.tinkercad.com/things/eJIg8HTydH1-copy-of-csc-347-starter-kit/editel?sharecode=Co85fg01GpKUbt3fGqaLRBm_9lkt9Elwa0dPVoz0pxE

Conclusion:

Throughout the lab, the student drew logic diagrams using DeMorgan's Laws. From here, one is also able to construct a circuit board using the created logic diagrams. While applying all combinations of DeMorgan's Laws in a truth table, the student was successfully able to prove that Boolean Algebra can be used when creating a circuit.

Homework:

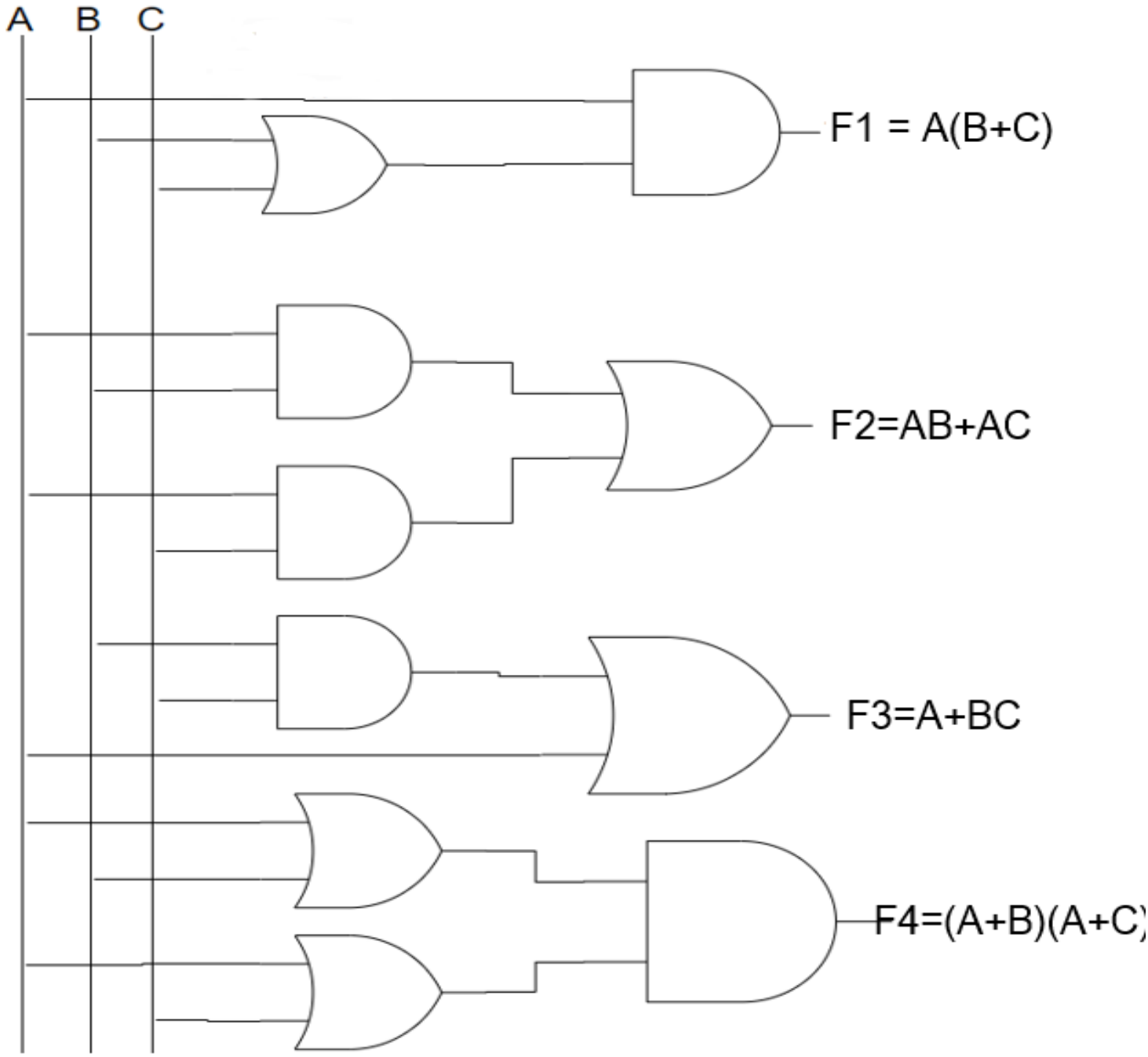
Design a circuit to prove the Distributive Laws using TinkerCad and include it (equation, truth table, logic diagram, screenshot of circuit) in your lab report.

A(B + C) = AB + AC **A + BC = (A + B)(A + C)**

Figure 12. Truth Table.

A	B	C	A(B+C)	AB+AC	A+BC	(A+B)(A+C)
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	0	0	0
0	1	1	0	0	1	1
1	0	0	0	0	1	1
1	0	1	1	1	1	1
1	1	0	1	1	1	1
1	1	1	1	1	1	1

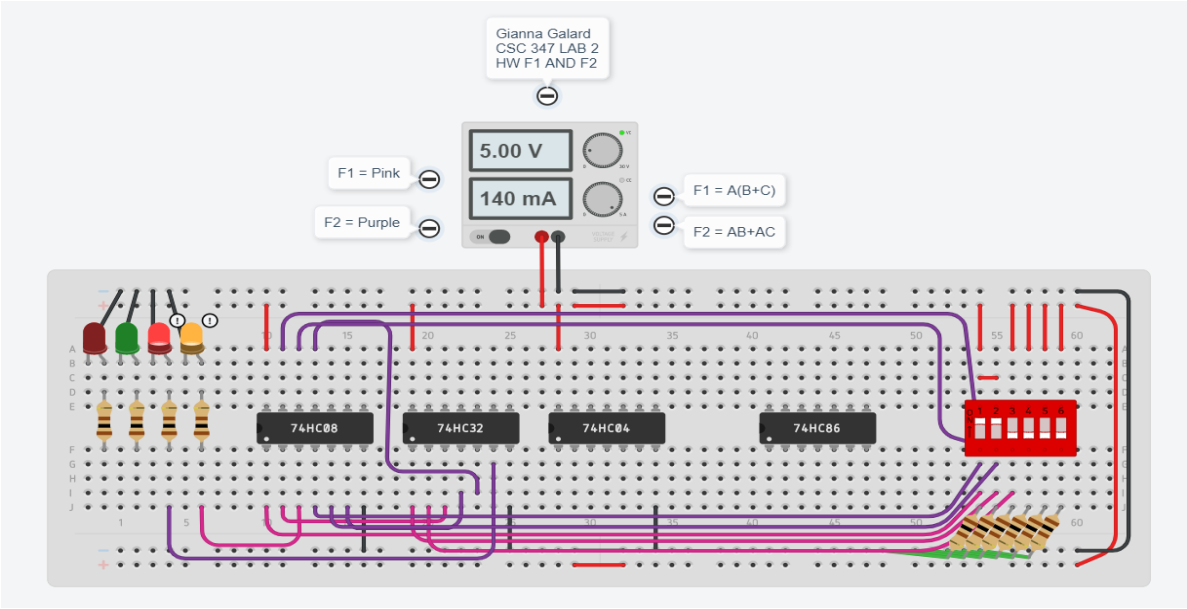
Figure 13. Logic Gates.



A: 1 B: 1 C: 0

F1: 1 F2: 1

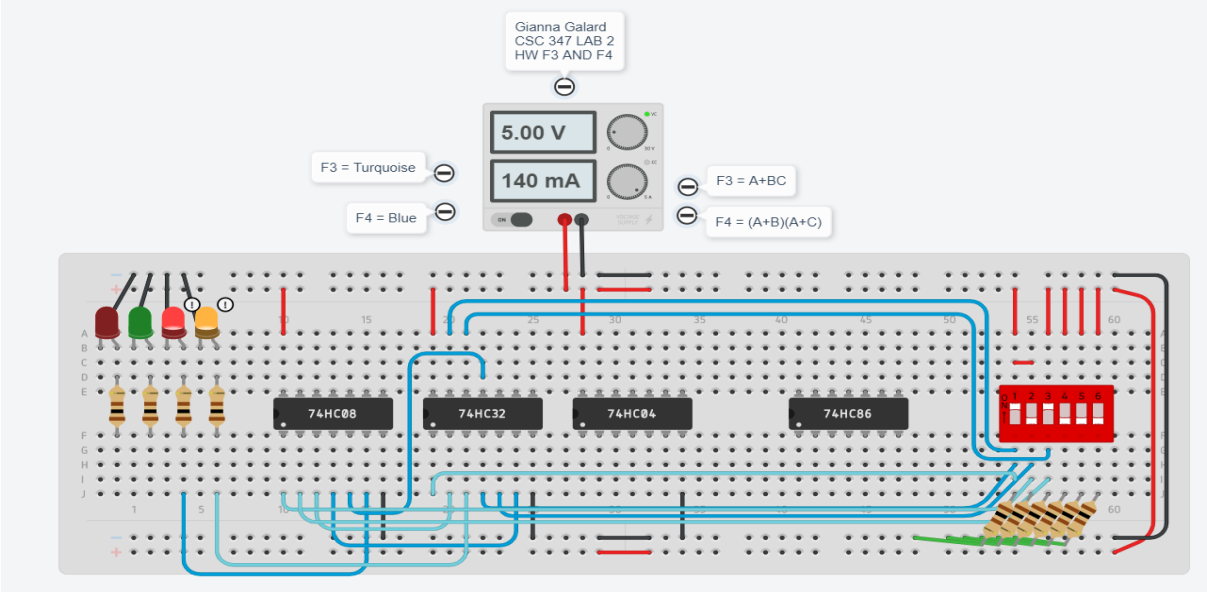
Figure 14. Circuit F1 and F2



A: 1 B: 0 C: 1

F3: 1 F4: 1

Figure 15. Circuit F3 and F4.



Resources:

Figure 11 -

https://www.tinkercad.com/things/eJIg8HTydH1-copy-of-csc-347-starter-kit/editel?sharecode=Co85fg01GpKUbt3fGqaLRBm_9lkt9Elwa0dPVoz0pxE

Figure 14 - (F1 and F2)

https://www.tinkercad.com/things/50ySGdyF5at-f1-and-f2/editel?sharecode=rjLP2670LItsuImrMcqYdoCeSDGtykK7H5ufOnmiGWs

Figure 15 - (F3 and F4)

https://www.tinkercad.com/things/7URVSxoGReX-copy-of-csc-347-starter-kit/editel?sharecode=P4RkvoLEMj6NUrPri0oG-ghWZwQjJ_DsdnhU3c-JH2U