Lab 1: Logic Gate

CpE64 Section 1

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Friday: 4:30 pm – 6:50pm

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Part 1: Examining the Breadboard

Description:

We try to familiarize our self-trying to figure out how the breadboard works, and which lines of continuity are connected.

Problem Definition:

Your instructor will describe it to you, but you may not understand it until you use it. The breadboard can be set up with both switches (for inputs) and Light Emitting Diodes, LEDs (for outputs). This board is used when for testing circuit designs. The circuit designs and programs should be created prior to coming to lab.

Engineering Data:

After checking out the beard board continuity lines, we were able to figure out that the breadboard is connected different from every section. On the side, with the negative (-) and positive (+) symbol, both relate to themselves. The positive (+) columns have a continuity with itself, the same thing with the negative (-) column. This section is the best place for inserting the power to test the current. In the middle, there are 10 rows labeled: A, B, C, D, E, F, G, H, I, J. there rows are connected vertically in a set of 5 throughout the whole breadboard. As featured in figure 1.

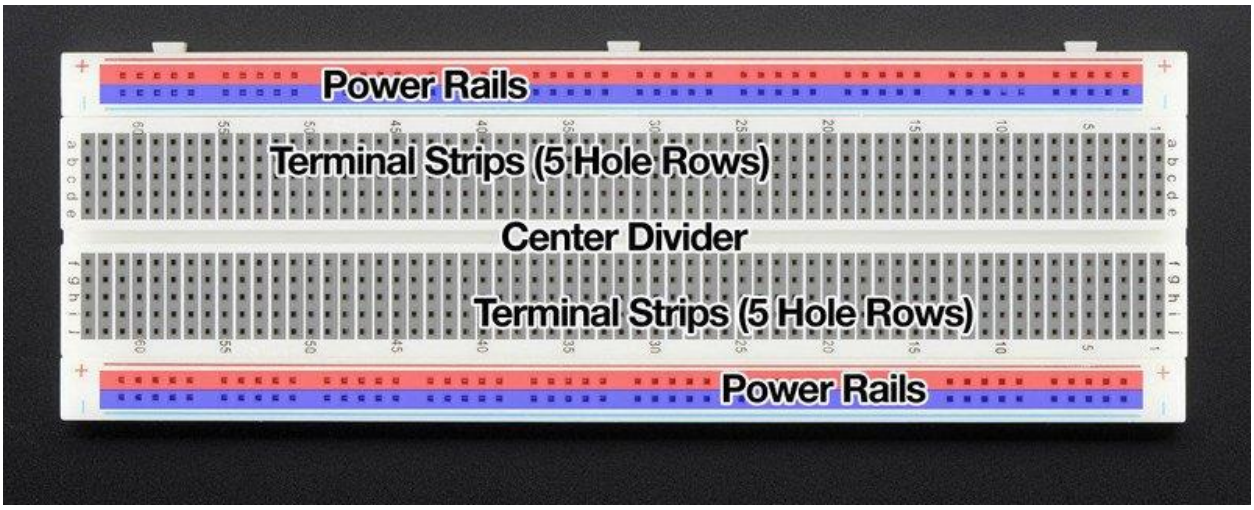


Figure 1: Breadboard

Part 2: 7400 Series TTL Gate

Description:

Identify the 7400 series TTL gate and create a truth table, and shows the logical symbol using function of equation.

Procedure:

Identify the 7400 Series TTL gates and look up their data sheets; 7400, 7404, 7408 and 7432 find the gate pin outs for each chip. Also, show their logic symbol, use the function in an equation and show the Truth Table for one gate in each of the integrated circuits. Record all the following information for lab report. This needs to be done for each of the four integrated circuits (ICs) (chips).

Engineering Data:

7400 Series gates (NAND gate):

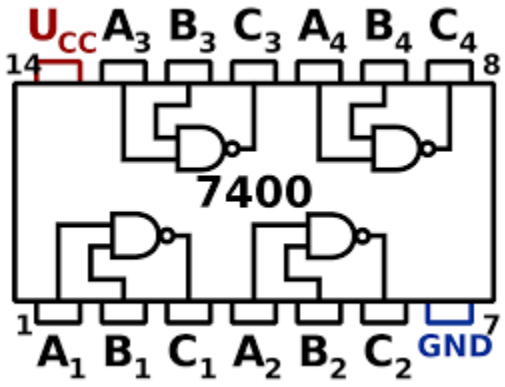
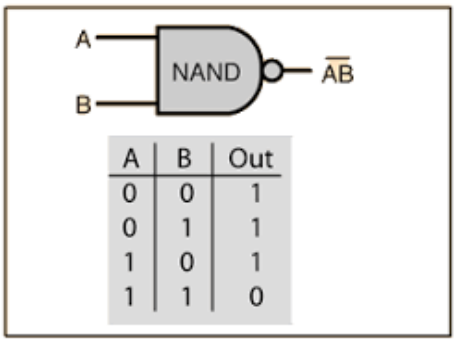


Figure 2: NAND gate

For the 7400 Series (figure 2) has a total of 14 pins, one side with the notch on it, indicate that the top, first pin is positive, and the bottom end is the ground point. Base on the diagram of 7400 series. It has 4 “NAND” gates. The “NAND” gate is a combination of an “and” gate followed by a “not” gate.



A	B	Out
0	0	1
0	1	1
1	0	1
1	1	0

Figure 3: Truth table

In Figure 3, it shows the truth table of the nand gate. Which is basically an inverted and gate.

Equation: F = (A * B)

7404 Series gates (NOT gate):

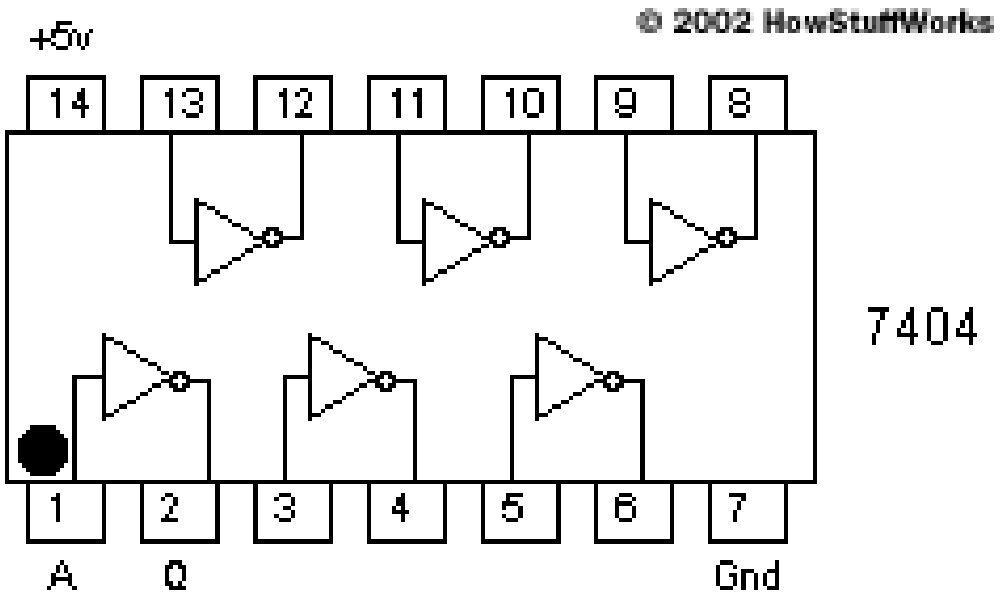


Figure 4: Not gate

These 7404 series, as shown in figure 4, are very similar to the 7400 series. The only difference is that instead of "and" gates, the 7404 is using "not" gate. Which is the opposite of whatever the input is. The "not" gate which only has 1 input and it reverses the logic state. If one's input is false then the other is true, vice versa. Shown in figure 5, the truth table.

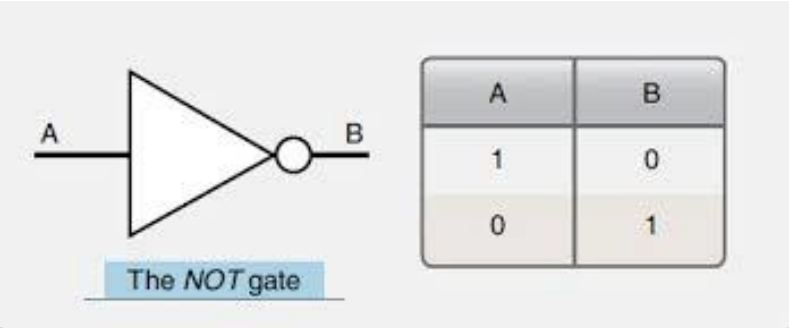


Figure 5: Not truth table

Equation: F = A

7408 Series Gate (And gate):

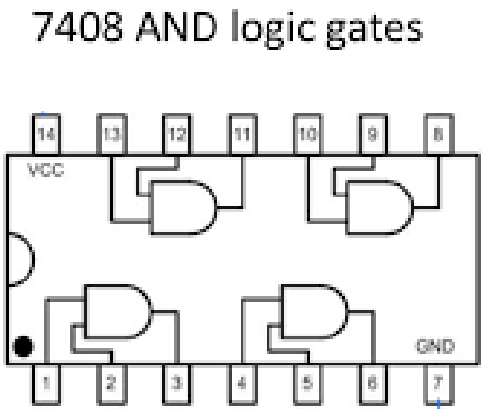
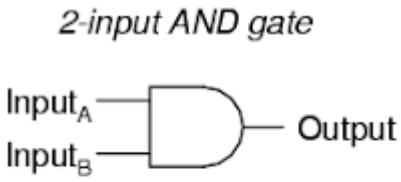


Figure 6:And gate

As shown in figure 6, the and gate has a total of 4 and gates inside of it. the 2 into goes toward 1,2, 4,5, 13 ,12, and 10, 9 where the input comes out of 3, 6, 11, and 8. Using the equation A x B = F to find the output. The "and" gate is a gate with 0 being false and 1 being true. It will almost always be going to be 0/false until both inputs are 1/true. As shown in figure 7.



A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1

Figure 7: And truth table

Equation: A * B

7432 series gates (OR gate):

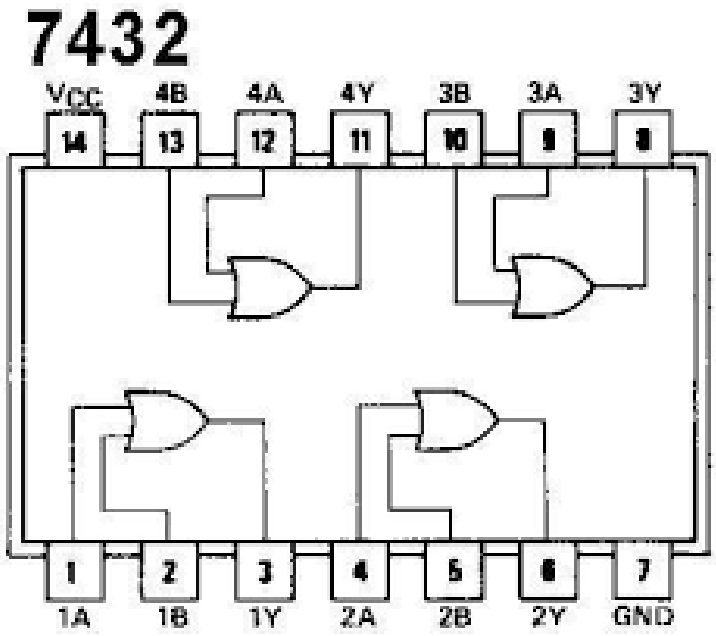


Figure 8: Or gate

As shown in figure 8, the 7432 series has a total of 4 or gates inside of it, with a Vcc and ground.

The “or” gate, is either true or false. If both inputs are the same, it is that one. As shown in figure 9.

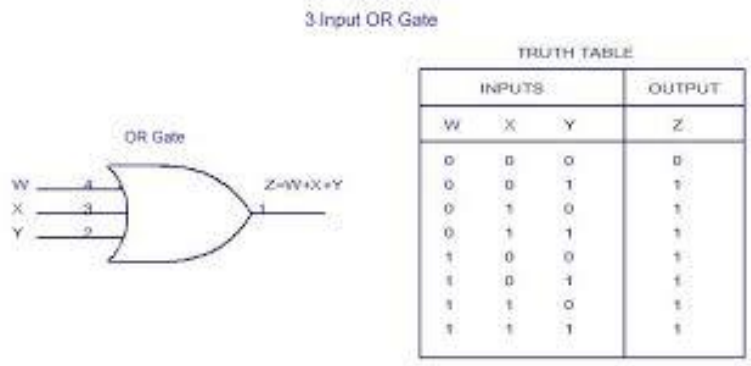


Figure 9: Or truth table

Part 3: Gate Testing

Description:

This part of the lab we uses multisim and test each gate: And, Or, Not, and Nand.

Procedures:

Test each gate in the simulator (MultiSim). Verify the truth table of each gate. Create a truth table base on the information gathered in part 2, have a column for both inputs (count in binary), a column for the output based on gate specification, another for the simulator results, and the last output column for the lab results. After testing each gate in the simulator, build up each gate on the breadboard. Use the components from the lab kit. Select the 7404 (a package of six INVERTERs – usually called a hex INVERTER package). Place the 7404 chips across the center line (horizontal line) of your white breadboard and seat the device firmly (push down) on the breadboard. Find the dot that marks Pin 1 (most device have a notch at one end – if so, Pin 1 is to the left of the notch and on the corner of the device.) Viewed from the top, pin numbers always go counter-clockwise. Using RED wire, connect Pin 14 to +5 volts. Using BLACK wire, connect Pin 7 to GROUND. One of the six INVERTERS have its input pin on Pin 1, and its corresponding output on Pin 2. Connect the INVERTER's input to a switch and the output to an LED. Test to see if the function works properly. Compare this output data to the truth table for this device. Go on and test to the other five "gates" as we call them. When you complete the 7404 IC, continue testing the other three Integrated Circuits (ICs). The 7400 is a quad NAND gate, the 7408 is a quad AND gate, and the 7432 is a quad OR gate. Test each gate of each Integrated Circuit (IC). Record your results for your lab report. Since each gate had two inputs, you must use two switches for each gate. You still only need one LED for the one output of each gate.

Engineering Data: NAND (figure 10):

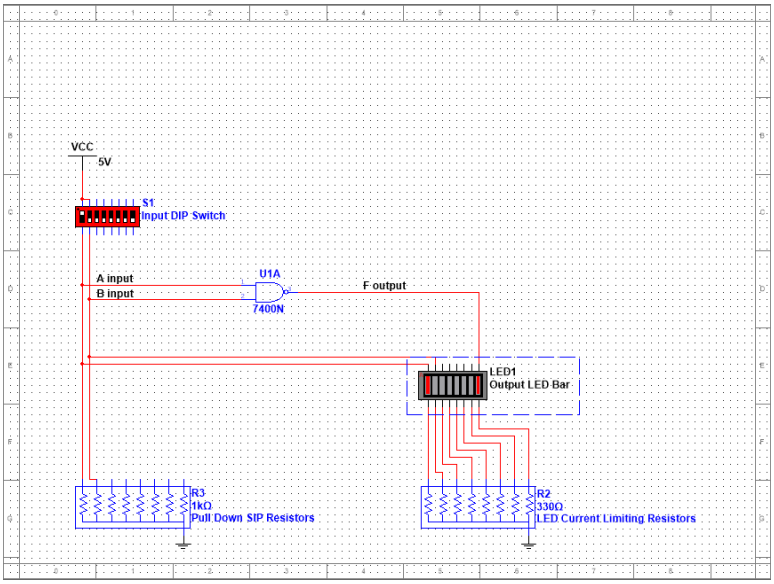


Figure 10: Nand

Input	Output theory	Simulator result	Lab result
A=0, B = 0	1	1	1
A=0, B=1	1	1	1
A=1, B=0	1	1	1
A=1, B=1	0	0	0

NOT (figure 11):

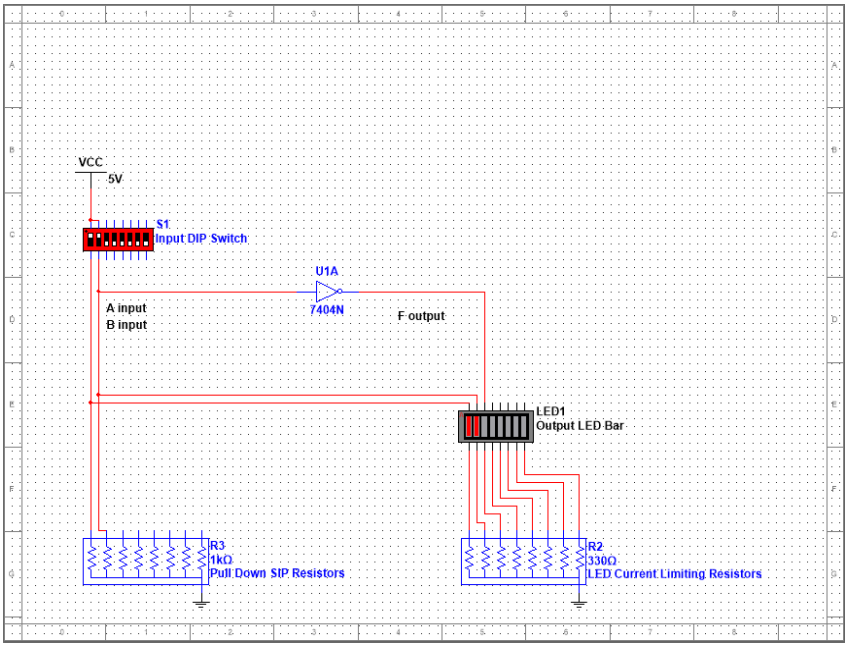


Figure 11: Not gate

Input	Output theory	Simulator result	Lab result
0	1	1	1
1	0	0	0

And Gate (figure 12):

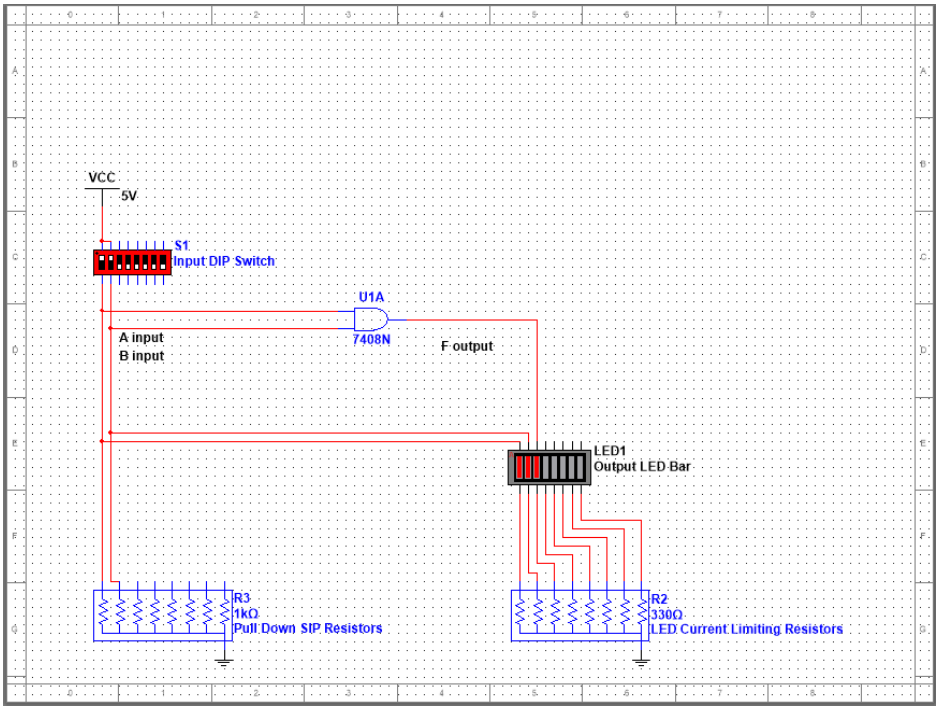


Figure 12: And gate

Input	Output theory	Simulator result	Lab result
A=0, B = 0	0	0	0
A=0, B=1	0	0	0
A=1, B=0	0	0	0
A=1, B=1	1	1	1

OR Gate (figure 13)

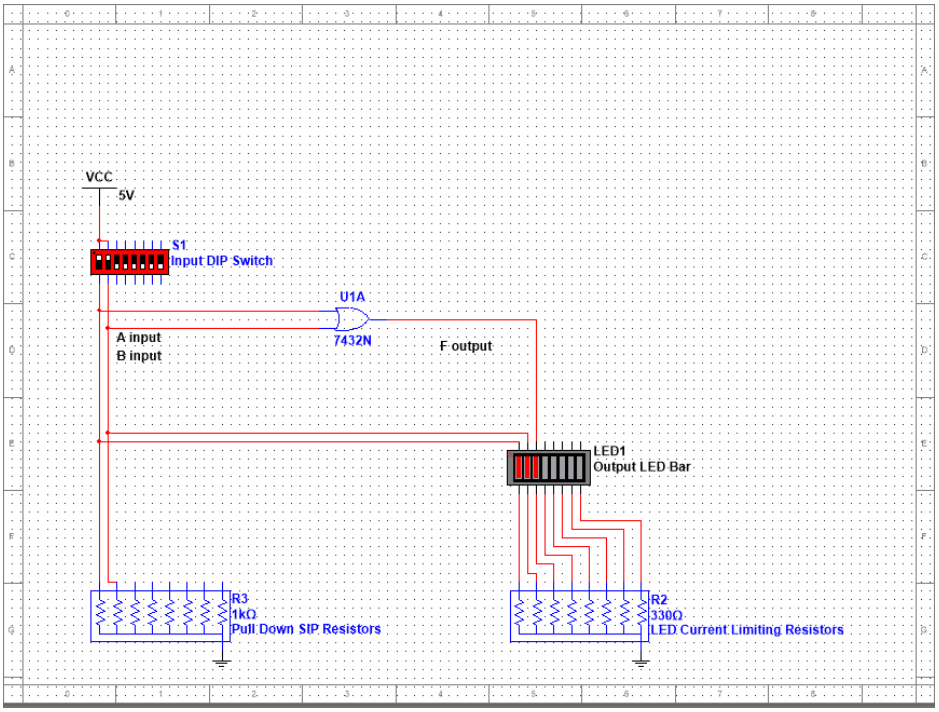


Figure 13: Or gate

Input	Output theory	Simulator result	Lab result
A=0, B = 0	**0**	**0**	**0**
A=0, B=1	**1**	**1**	**1**
A=1, B=0	**1**	**1**	**1**
A=1, B=1	**1**	**1**	**1**

Part 4: Connecting All Chips

Description:

For this part of the lab, we are to connect all the 4 chips and test each one of them with a LED lighting.

Procedure:

Test all four chips together, there should be two inputs and four outputs, there should be an output for each function or gate type. Before building the circuit on the breadboard test the circuit in the simulator (MultiSim). Wire up one LED to each of the gate function's output. ALL the LEDs are connected at the same time. There should be 4 LEDs used: one for the NAND (7400), one for the NOT or Inverter (7404), one for the AND (7408), and one for the OR (7432). That takes care of the outputs. For the inputs

you only need two switches that will connect to each gate. {note: the 7404 (inverter) only needs one switch connected to the input}. Your complete the circuit; it will have a total of 4 LEDS, and 2 switches (along with 4 ICs). Test and record the functions by observing the 4 outputs when you place the 4 possible input patterns – 00, 01, 10, 11 on the switches. Create a schematic for this Part and put it in your lab report.

Engineering Data:

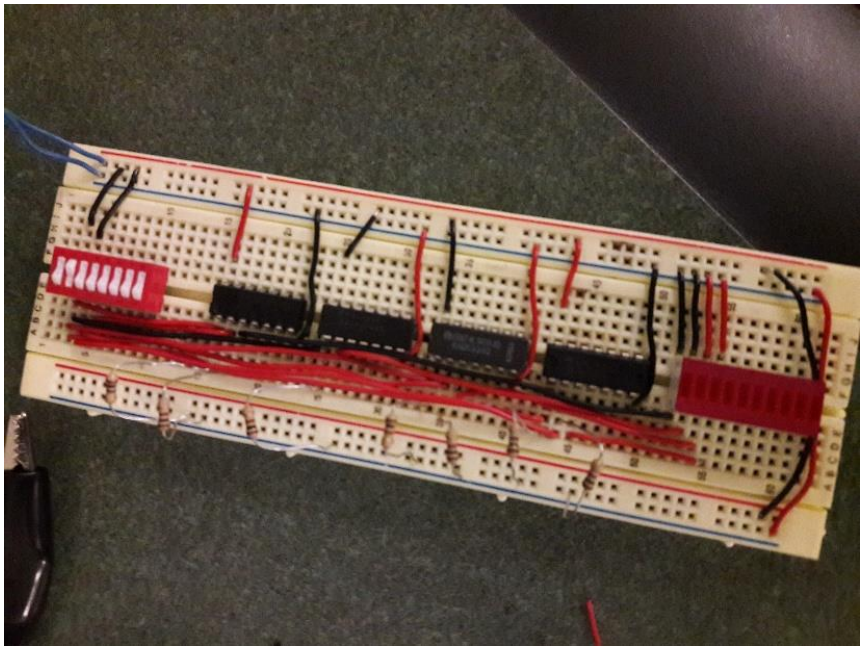


Figure 14: The build

Featured in figure 14, we had to make a Led bar using all the gates: the and, or, nand, and not gate. We must basically follow the diagram of each gates and figure out which on is the input and which one is the output, after connecting the switches to the gates, we must connect wires to the led bar so it will show the results. As shown in figure 16, the multisim of our breadboard was built there. In figure 15, we show the result of the multisim and also wrote down the result that was achieve from the breadboard.

INPUTS		EXPECTED OUTPUTS				SIMULATED OUTPUTS				ACTUAL OUTPUTS			
N1	IN2	AND	OR	NAND	NOT	AND	OR	NAND	NOT	AND	OR	NAND	NOT
0	0	1	1	0	0	1	1	0	0	1	1	0	0
0	1	1	1	0	1	1	1	0	1	1	1	0	1
1	0	1	0	0	1	1	0	0	1	1	0	0	1
1	1	0	0	1	1	0	0	1	1	0	0	1	1

Figure 15:Result

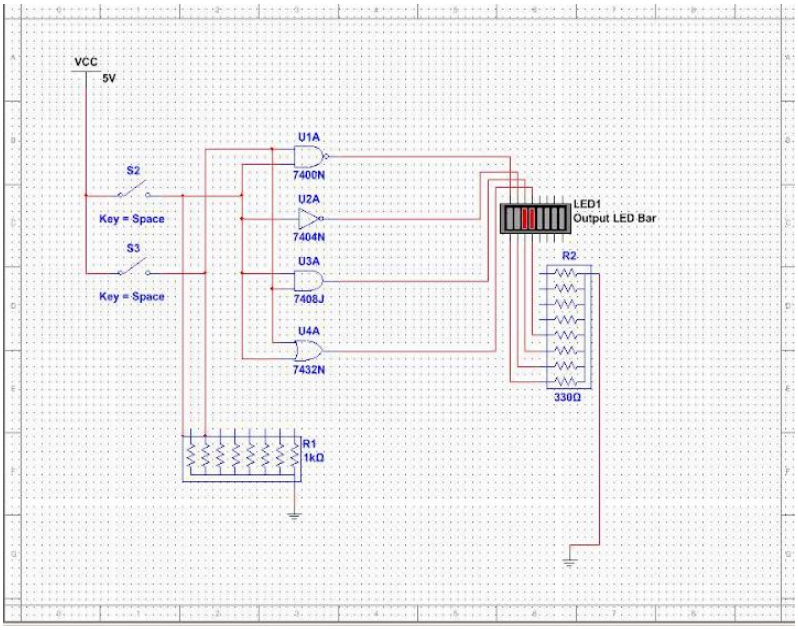


Figure 16: Multisim

Conclusion:

For this lab, connecting all the wires and chips was difficult since the wire get all messy and since my breadboard make it hard to push the wires inside. The wires connect from the LED to the not, and, nand, and or chips, and that is connected to a switch. There was time in this lab I thought my chips burned out since I might had putted them backward, but then it turns out that didn't happen which was a relief. The gates are was pretty easy to research online, hardest part about this lab was building the breadboard. To do the lab properly you had to look at each gates diagram and figure out where the input and output of the gate was, to be able to wire it properly.