Circuit Verse Workshop 4/14/20

Digital logic gates are the fundamental building blocks of integrated circuits where they are used to perform basic logical functions. Most logic gates have binary input and output values, 0 or 1. Depending on the circuit, it can range from having a few gates to millions of gates (like in a microprocessor). Figure 1 shows the symbols for the fundamental logic gates that you will be learning about in this workshop.

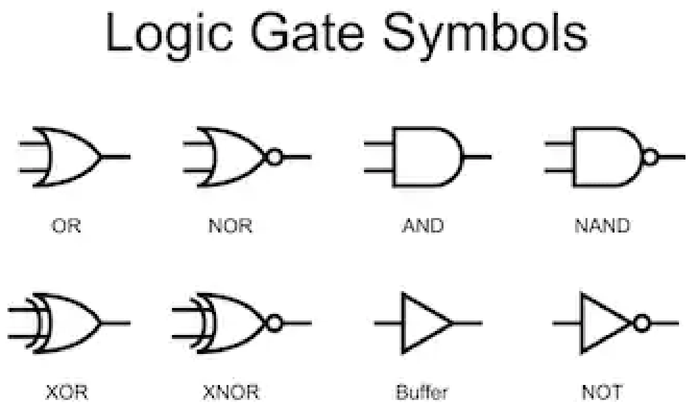


Figure 1: Fundamental Logic Gates

Truth tables are logic tables that represent all the possible outcomes of a scenario. Each row contains a boolean logic true or false value indicated by a 0 or a 1, while each column represents the premises of a scenario as well as its outcome.

We will be using circuitverse.org/simulator to create the circuits in this lab. This software allows you to place different digital circuit components and run simulations on how they behave with different input combinations.

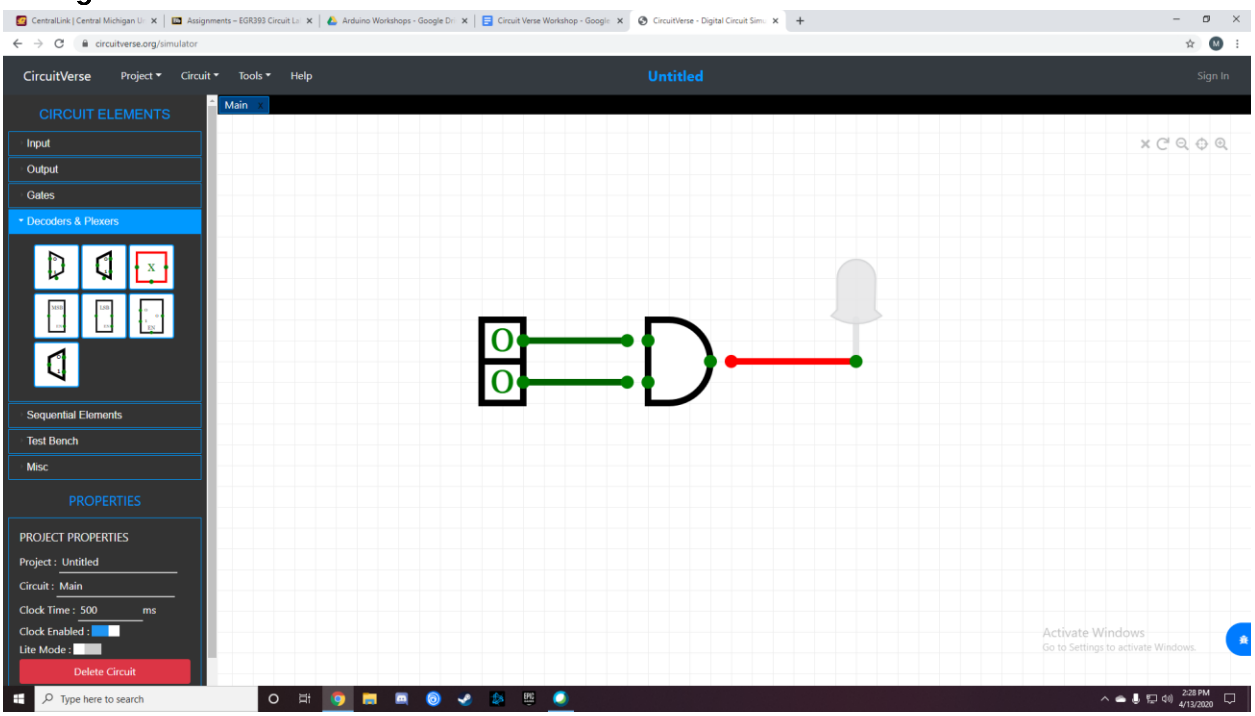
www.circuitverse.org/simulator

Part 1: Basic Gates

Recreate the given logic gate using circuitverse.org and fill out the remaining spaces in the truth tables. In order to create the circuits, you must find the required circuit element in the toolbar on the left side of the screen. Once you find it, you can drag it onto the schematic. Once you have it placed, wires can be drawn onto the schematic by clicking and dragging your mouse in order to connect the green dots on each part. In order to change the input, click on the box and it will switch from 0 to 1 and back to 0. Lastly, the output is shown by the LED, on is 1 and off is 0.

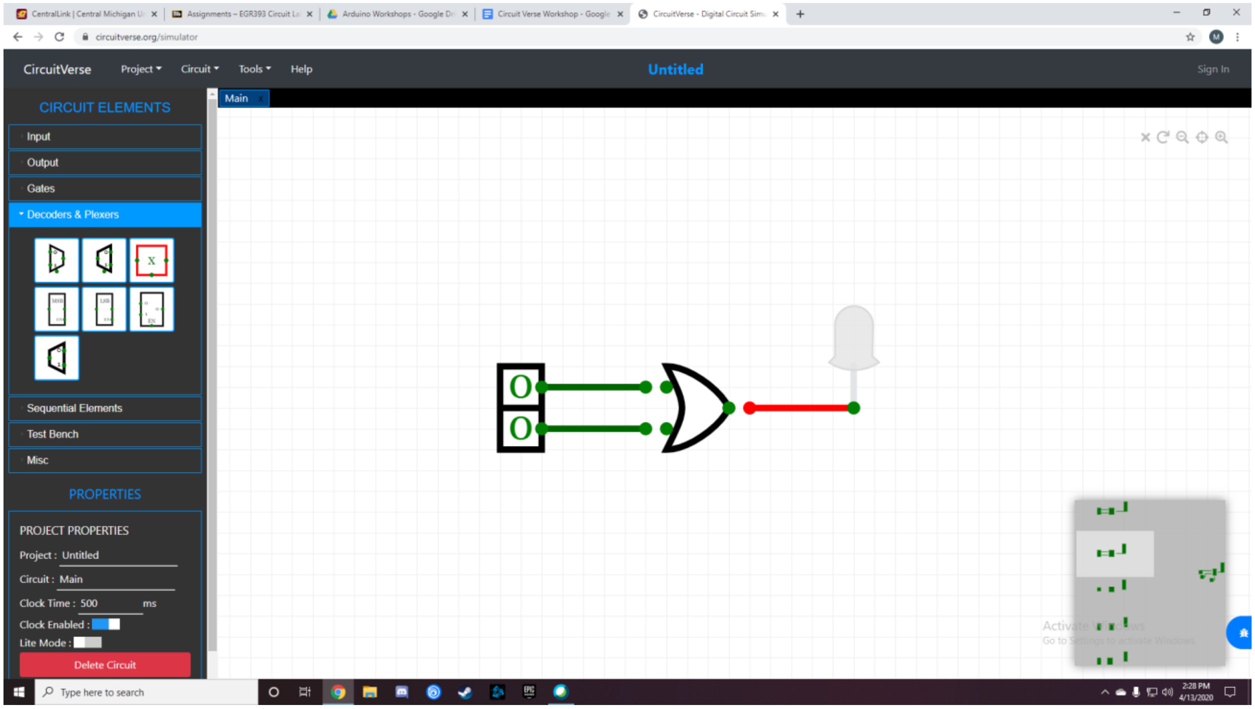
Below are six different gates that we will be looking at. For each gate there is a provided schematic and a truth table. Recreate the schematics (make sure to completely connect each wire) and go through the different input combinations in order to complete the truth tables and gain a better understanding of how each gate works.

AND gate-



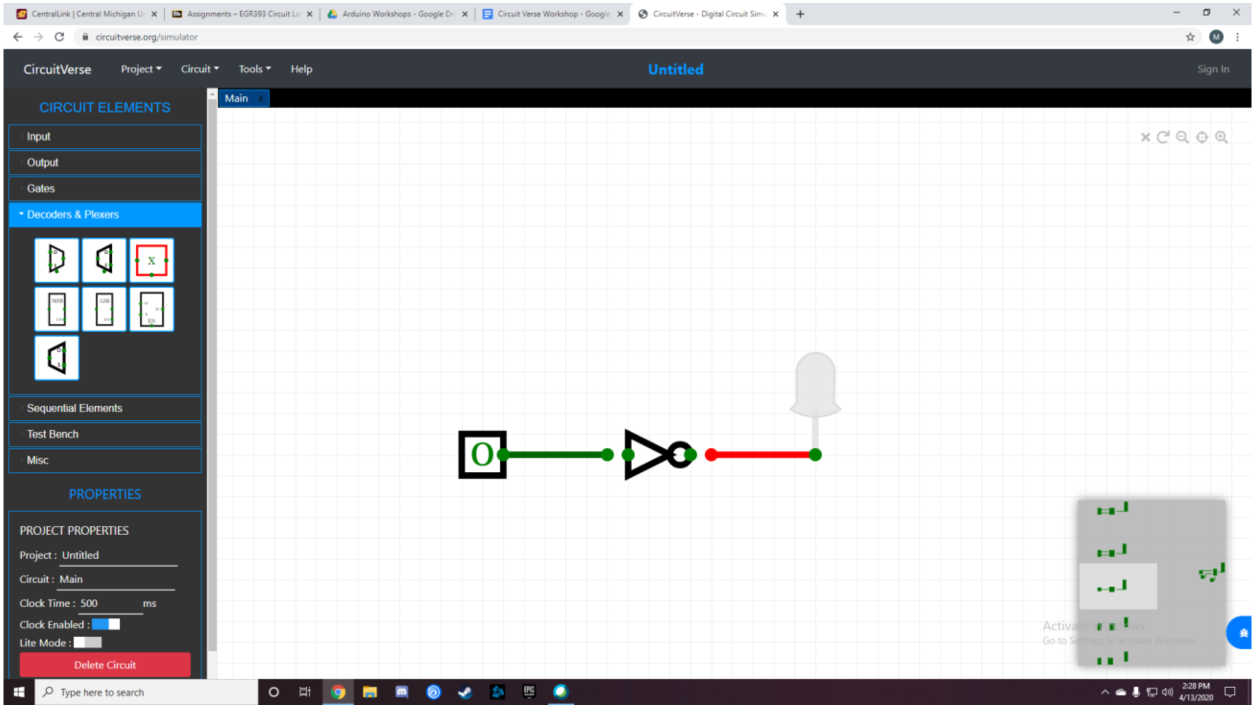
Input 1	Input 2	Output
0	0	
0	1	
1	0	
1	1	

OR gate-



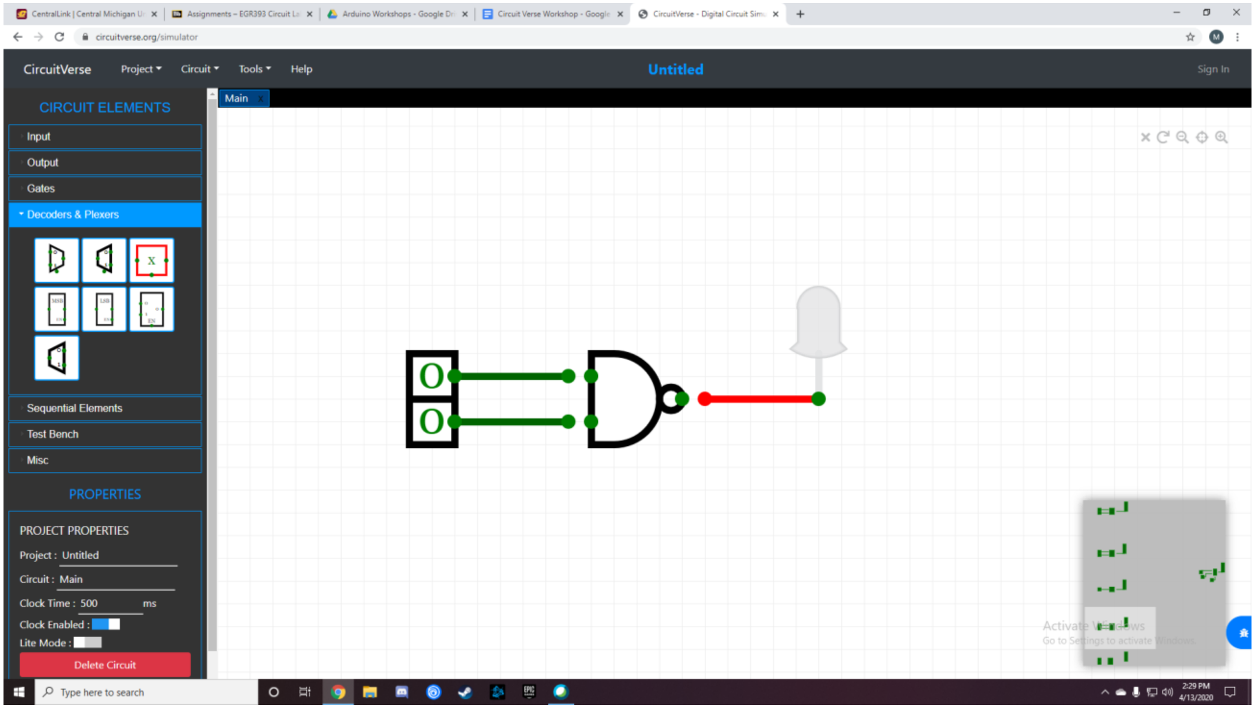
Input 1	Input 2	Output
0	0	
0	1	
1	0	
1	1	

NOT gate-



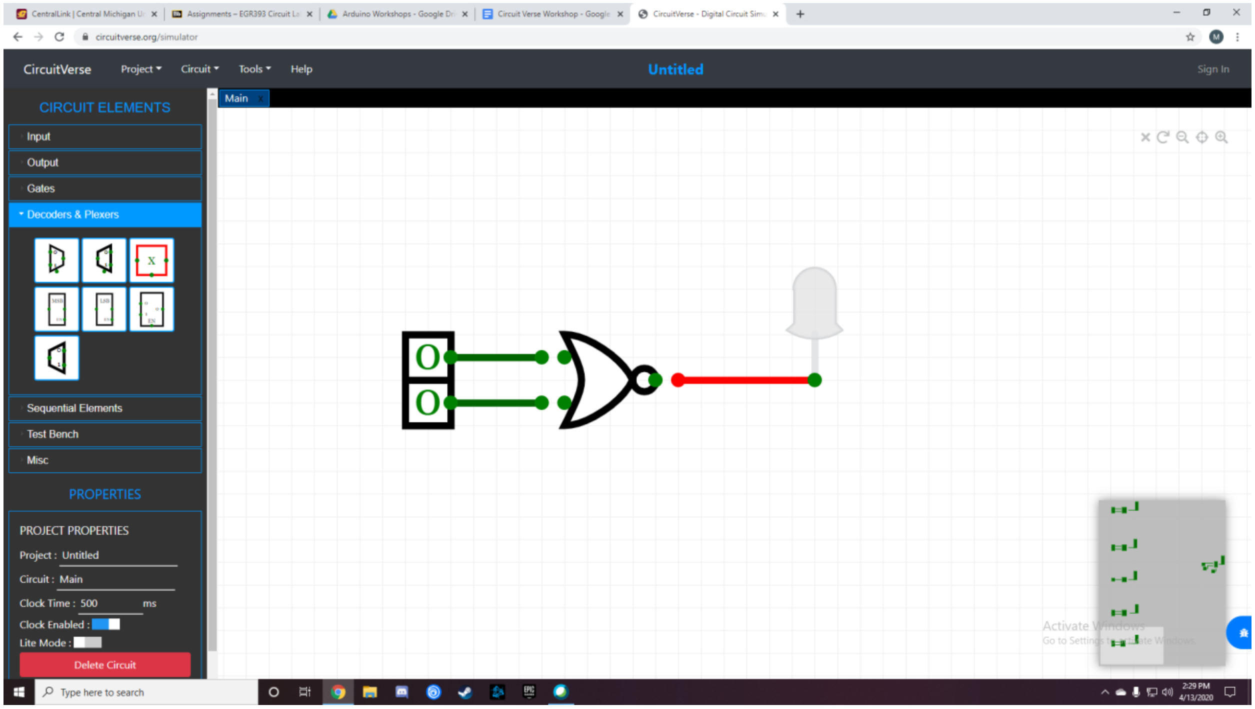
Input	Output
0	
1	

NOR gate-



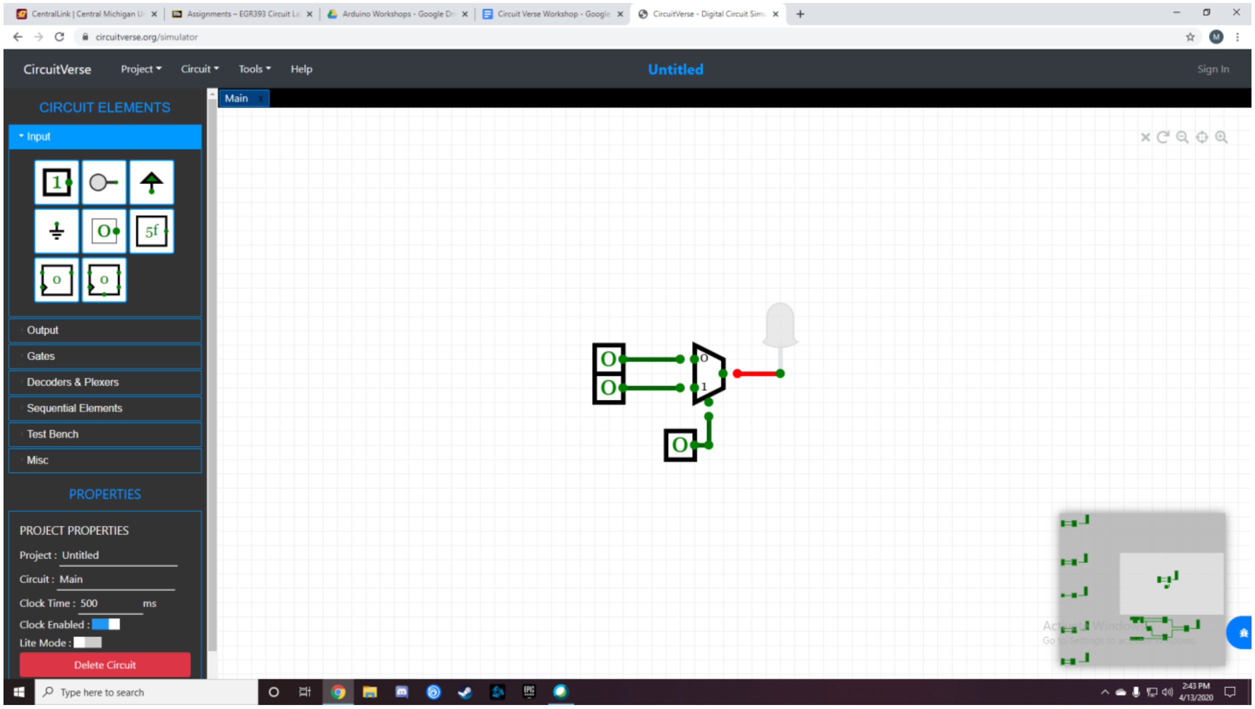
Input 1	Input 2	Output
0	0	
0	1	
1	0	
1	1	

NAND gate-



Input 1	Input 2	Output
0	0	
0	1	
1	0	
1	1	

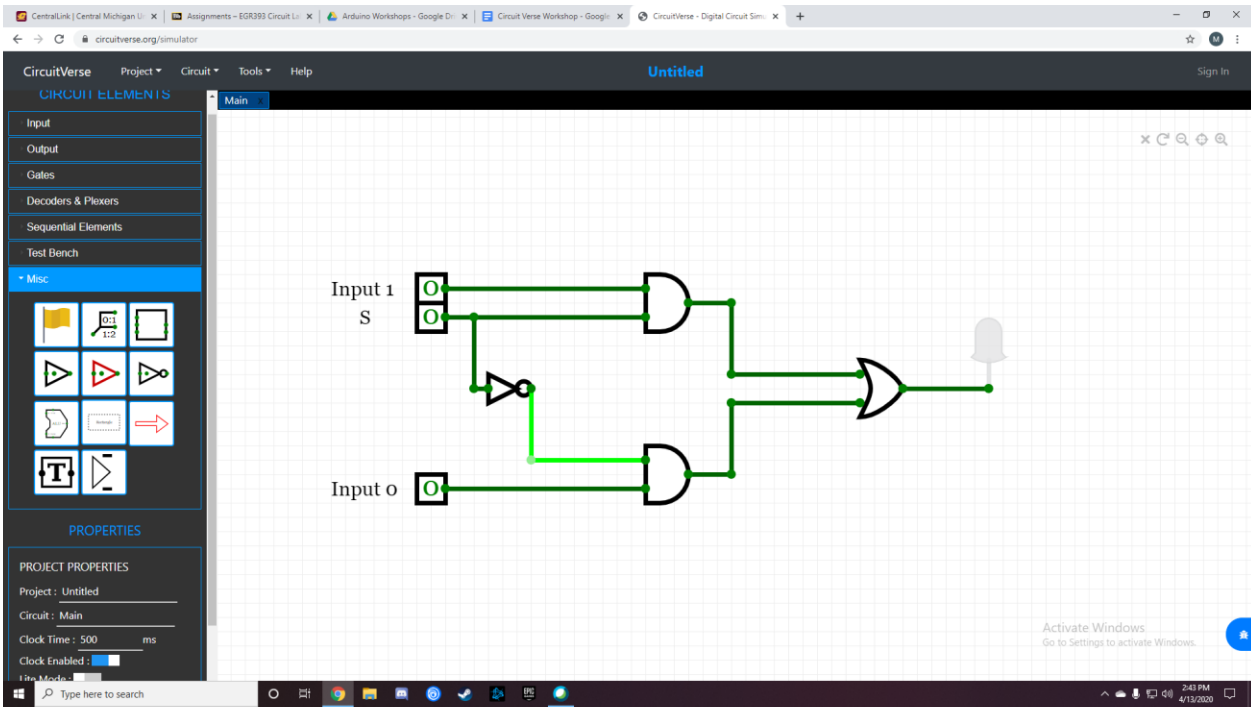
Multiplexer - MUX



S	**X1**	**X2**	**Y**
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Part 2: Creating a Multiplexer using Logic Gates

After seeing how the different basic logic gates are created and used, we can take these gates and use them in combinations to create more complex circuits. An example of using basic logic gates to create a more complex circuit is a multiplexer. As you have seen in the previous section, a multiplexer has its very own symbol and layout. A 2 to 1 multiplexer is actually constructed using four of the logic gates we used above. Now using these gates, construct and verify the truth table of the multiplexer.



S	X1	X2	Y
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Are the truth tables equivalent?