# Introduction to Logic Gate Simulator

During this topic, the software tool that will be used is Logic Gate Simulator. This is a tool that allows you to simulate the building and running of hardware at its lowest level i.e. individual gates, flip-flops, LEDs, clocks, etc. It will be used for the first Assignment in this unit.

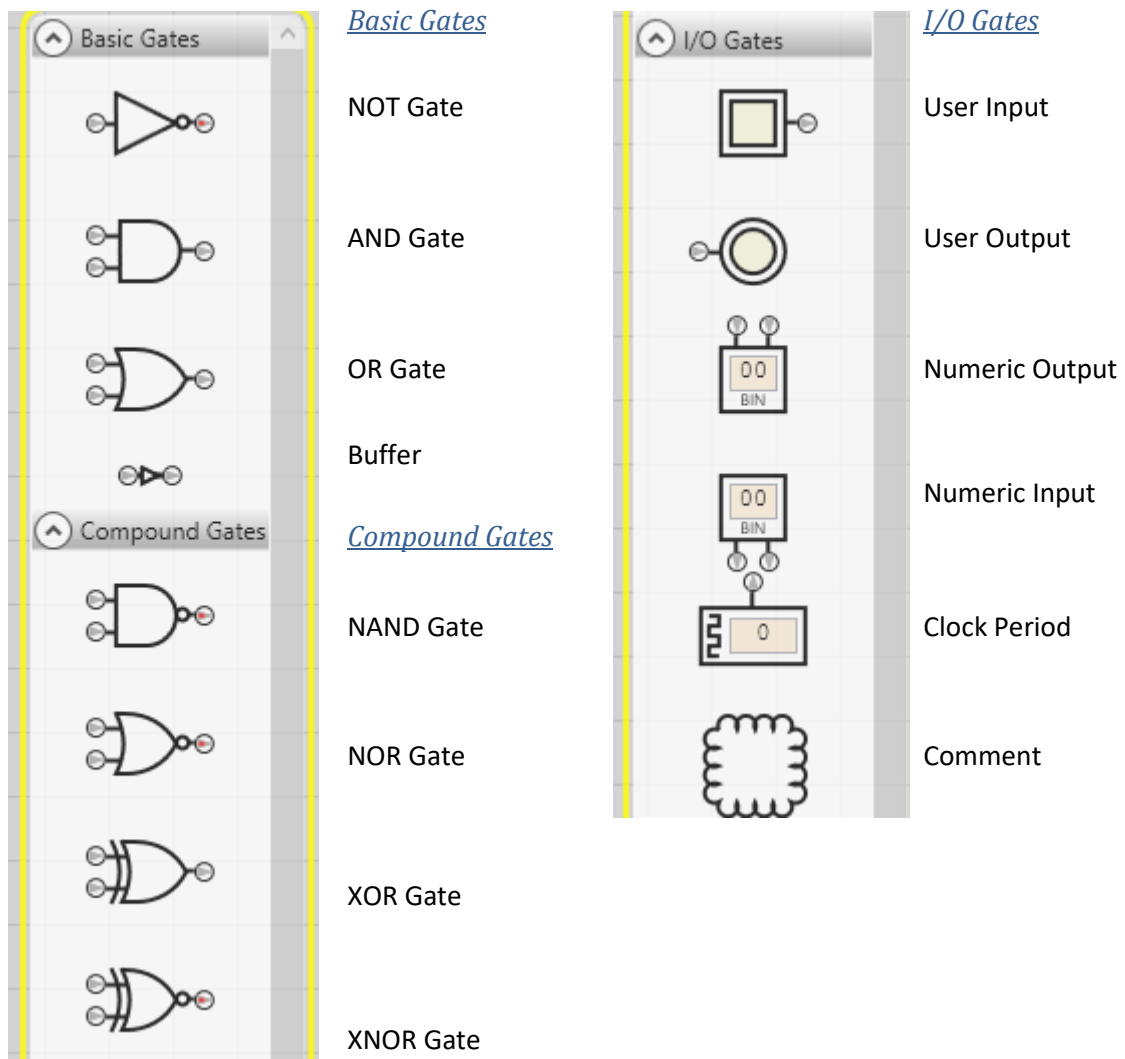The interface of Logic Gate Simulator is shown below as Figure 1.1.

Fig. 1.1
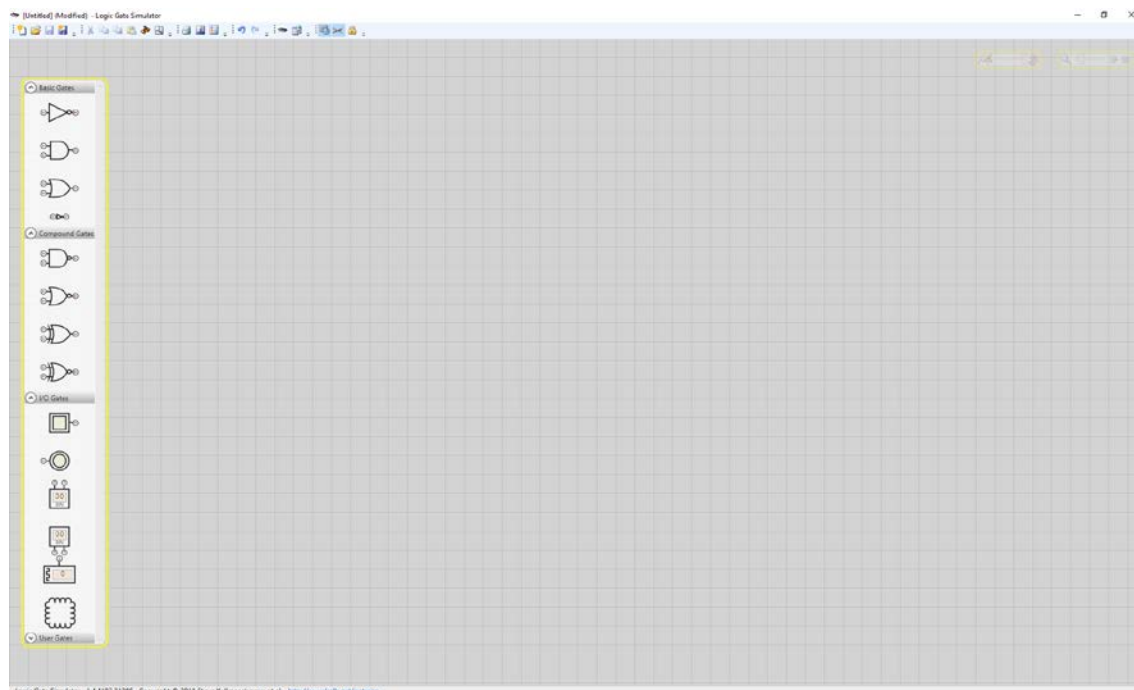
Below the menu bar is a fairly standard type of GUI toolbar with open new, open folder, save, cut, copy, paste and print buttons.

The toolbar on the left allows the user to select and drop components onto the canvas. The meaning of the icons on this toolbar are shown in Figure 1.2. It can be seen that they are grouped into four sections. These sections are Basic Gates, Compound Gates, I/O Gates and User Gates.

Fig. 1.2

Basic Gates

NOT Gate

AND Gate

OR Gate

Buffer

Compound Gates

NAND Gate

NOR Gate

XOR Gate

XNOR Gate

I/O Gates

User Input

User Output

Numeric Output

Numeric Input

Clock Period

Comment

All of these buttons can be dragged into the main canvas to create your circuits, with the comment tool allowing text annotations to be placed anywhere on the canvas.

To wire devices together you simply need to drag a wire from one output to another input. Where it is possible to connect a wire, the colour of the I/O will then change to blue.

The next toolbar down is the run-time toolbar, as shown in Figure 1.3
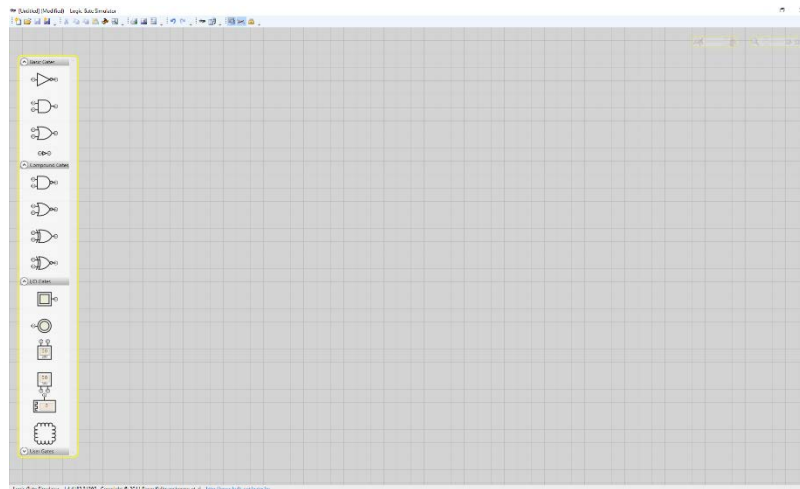
Fig. 1.3

The next toolbar down is the zoom toolbar, as shown in Figure 1.4

Fig. 1.4

Creating the circuits:

After running Logic Gate Simulator on your computer, you will get the initial screen shown below. A circuit is constructed by using the mouse to place gates on the screen or workspace, and 'wiring' the gates together.

Logic Gate Simulator - the initial screen

To create a circuit, first click on the pointer tool on the left row of icons, select a gate from the list by dragging the gate with the pointer tool, move to a suitable location in the workspace and drop. Do this each gate you require. Once the gates have been placed, you can tidy up the circuit by moving the gates within the work area to create a symmetrical layout. This can be done by select them one at a time with the mouse and dragging the gate wherever you want.

The next step is to wire up the gates to create a circuit. Position the cursor over the point at which you wish to connect a wire. The cursor changes to **wire** when it's over a point that can legally be connected to. Left press and hold down on your mouse, then drag to attach a wire and move the cursor to the point you wish to connect. Release the mouse button to create a connection.

It is recommended that you save the circuit regularly Click on the **File** function in the toolbar to bring down the menu, then select **Save**. You should now see a Save Circuit window. Enter LastnameF_ (where Lastname is your last name and F is you first initial), followed by the Lab number, as the name of your file. Logic Gate Simulator inserts the extension .gcg as the file type. Enter an appropriate location for your file. Click **Save** to save the file.

Exercises
INPUT/OUTPUT
With Logic Gate Simulator

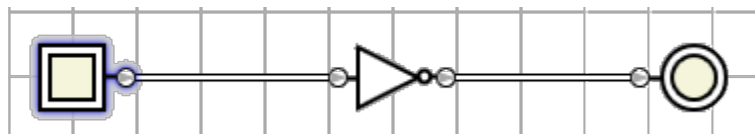1. Click on 'New' to generate a clean canvas. Now draw the following circuit:

The truth table for this could be written as;

Input	Output
1	1
0	0

INVERTOR

2. Now draw the following circuit

What does this do?

What would the truth table for this circuit look like?

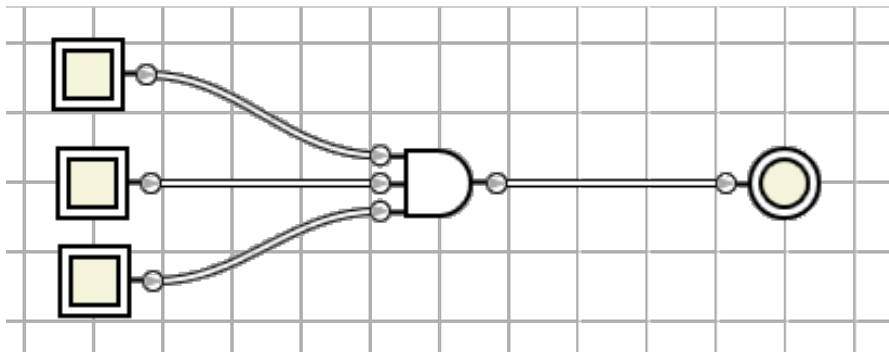| Input	Output
1	
0	

AND GATES

3. Now draw the following circuit:
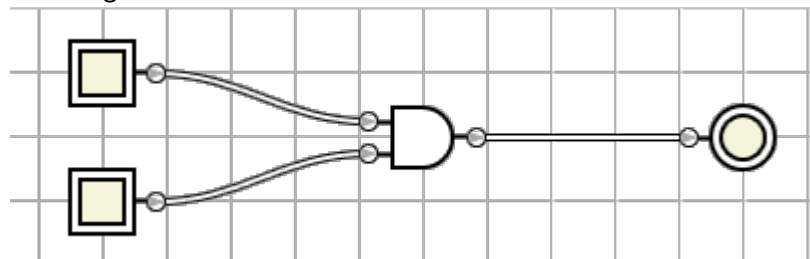
Run this circuit and interact with the 'Interactive Inputs'. What does it do? What would the truth table for this circuit look like?

Input A	Input B	Output

We will now add a third input to the gate. Right click on the OR gate and chose 'add input'. The gate will change from a two input to a three input gate. Confirm this by drawing up the following circuit and testing it:

What is the truth table for this circuit? Test the circuit to confirm this.

Input A	Input B	Input C	Output

OR GATES

4. Now draw the following circuit

What is its truth table? Test the circuit to confirm this.

Input A	Input B	Output

We will now add a third input to the gate. Right click on the OR gate and chose 'add input'. The gate will change from a two input to a three input gate. Confirm this by drawing up the following circuit and testing it:
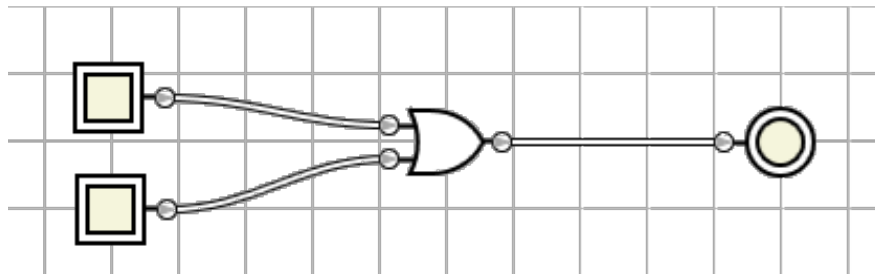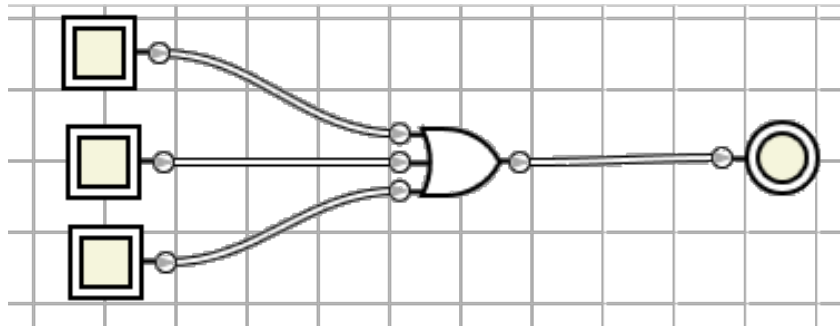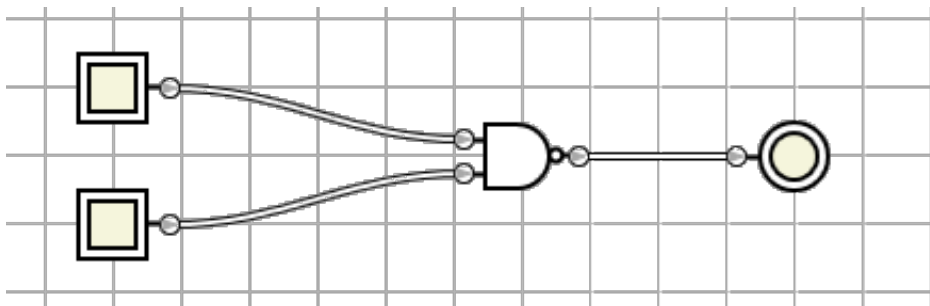
Input A	Input B	Input C	Output

NAND GATES

5. Now draw the following circuit

What is its truth table? Test the circuit to confirm this.

Input A	Input B	Output

We will now add a third input to the gate. Right click on the OR gate and chose 'add input'. The gate will change from a two input to a three input gate. Confirm this by drawing up the following circuit and testing it:
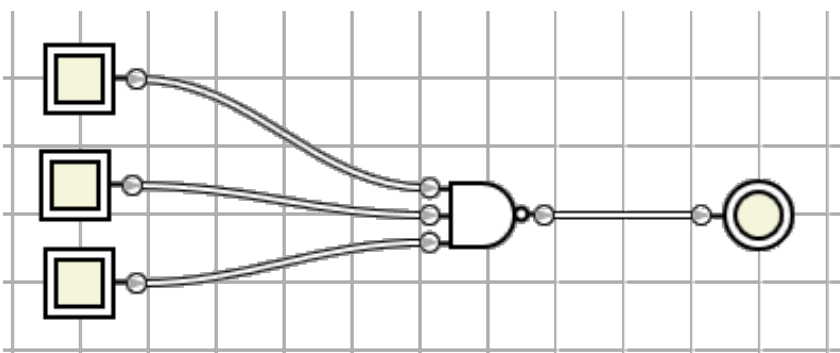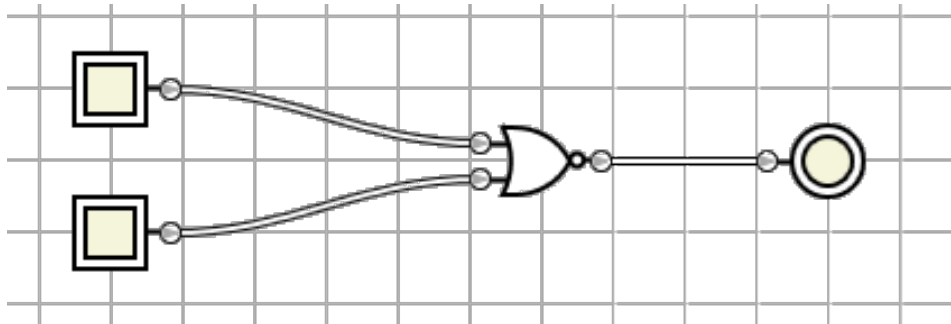
Input A	Input B	Input C	Output

NOR GATES

6. Now draw the following circuit

What is its truth table? Test the circuit to confirm this.

Input A	Input B	Output

We will now add a third input to the gate. Right click on the OR gate and chose 'add input'. The gate will change from a two input to a three input gate. Confirm this by drawing up the following circuit and testing it:
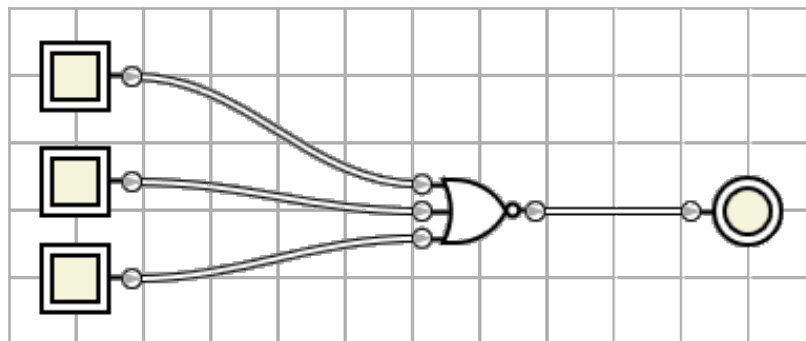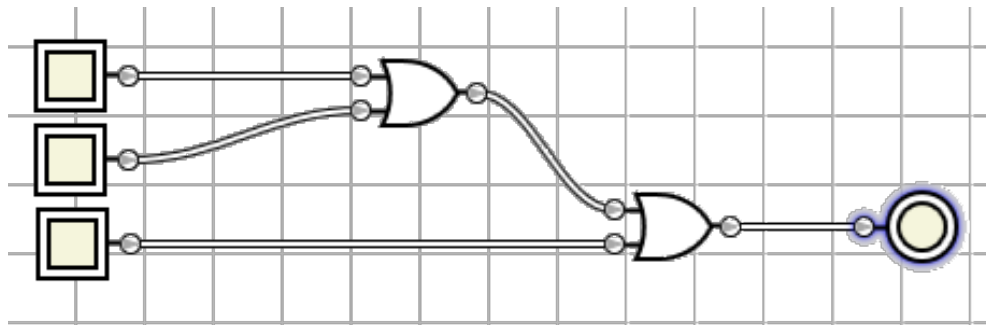

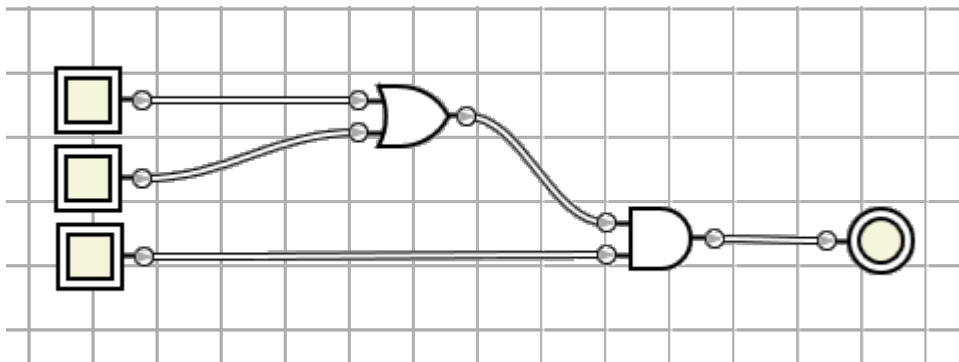| Input A	Input B	Input C	Output

COMBINATIONAL LOGIC GATES

7. Now draw the following circuit

What does this circuit do? How does it differ from the previous circuit?

8. Draw the following circuit. What does it do, and how does it differ from the circuit in question 7?

We will look at these combinations of logic gates in following workbooks.