Group Members

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1.0 Laboratory Activity 1 – Logic Gates

Hello Class, during this Laboratory Activity, we would be investigating the different digital logic gates which are fundamental components in a digital electronic system. During the lecture class, we discussed that the Boolean Data Type has only two data values, namely True (1) or False (0), which we can typically use on operations such as comparisons. Logic operations based on Boolean Algebra uses Boolean Data, which also produces a result of either True (1) or False (0). These Logic operations form the basis of Logic Gates, which are circuits that serve as basic building blocks of the CPU.

For this Laboratory Activity, we would see these Logic Gates in action and be able to determine if they are valid or work as expected based on what we learned from the lectures. To start, have one (1) member of the group go and kindly get the following equipment from the Lab Technicians, if the equipment is not yet on your tables:

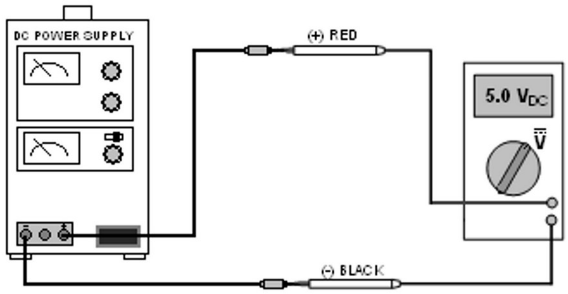
Equipment	Quantity	Description
74LS00 Quad 2-input NAND Gate	1pc	DIP IC with four independent NAND gates
74LS08 Quad 2-input AND Gate	1pc	DIP IC with four independent AND gates
74LS32 Quad 2-input OR Gate	1pc	DIP IC with four independent OR gates
74LS86 Quad Exclusive-OR (XOR) Gate	1pc	DIP IC with four independent Exclusive-OR (XOR) gates
Breadboard	1pc	Board used for prototyping or building circuits
Logic Probe or Digital VOM	1pc	The Logic Probe is a handheld probe with indicator lights to identify the logic state; high or true = 1, then low or false = 0 The Digital VOM (volt-ohm-milliammeter) is a measuring instrument that can measure multiple electrical properties such as voltage, resistance, current, etc.
DC Power Supply	1pc	Power supply which produces a regulated voltage output for electronic/electric devices
Connecting Wires		Assorted copper wires used to connect components

**Note: DIP means Dual In-line Package, and is one of the most common through-hole Integrated Circuit (IC) package. They are known to have two parallel rows of pins extending perpendicularly out of a black rectangular plastic housing.*

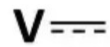
More information regarding the Connection Diagrams of the DIP ICs as well as how to use the breadboard may be found on the Appendix (last page) portion of the manual.

1.1 Procedure

1. Measure a supply voltage of **5V** using the DC power supply and digital VOM. Connect the Power Supply's **RED** alligator clip to the VOM's **RED** probe and the **BLACK** alligator clip to the VOM's **BLACK** probe. Set the VOM to measure DC voltage by turning the knob to the DC Voltage symbol. Turn on the power supply and set the voltage to **5V** by turning the proper knobs. Record the voltage measured.



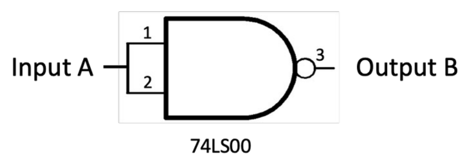
Measured VCC	5 V

DC Voltage Symbol = 

2. Connect the circuits below and complete the given truth table. Make sure that all **VCC** (Pin-14) are connected to **+5V** supply and all **GND** (Pin-7) are connected to **ground** (**-**). Using a **Logic Probe**, connect the alligator clips of the logic probe to the corresponding **power** and **ground** connections, then use it to verify the input to the pins as well as the output of the logic gate.

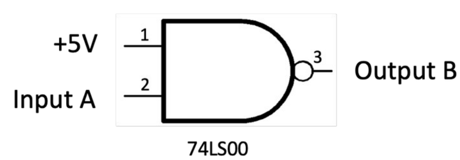
   Determine the output of the diagram below using the inputs given from the table. Answer the questions below by writing only **1** or **0** for the output. Note that the numbers shown in the diagram refer to the pins on the IC.

   a.) Pin-1 and Pin-2 are connected. Use a separate wire for the input.



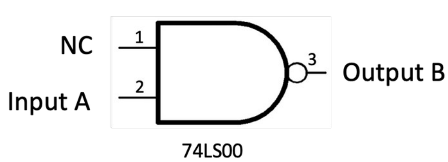
Input A	Output B
0	1
1	0

   b.) Modify the previous circuit by connecting one of the inputs to logic +5V.



Input A	Output B
0	1
1	0

   c.) Remove the logic +5V input from the gate, leaving it floating (not connected).



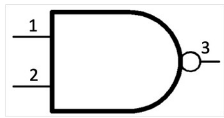
Input A	Output B
0	E
1	E

3. Connect the circuits below and complete the given truth table. Identify the function performed by each 2-input logic circuit.

a.) Logic Function: NAND

Input A

Input B



Output C

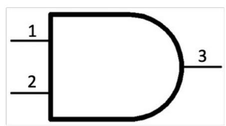
74LS00

Input A	Input B	Output C
0	0	1
0	1	1
1	0	1
1	1	0

b.) Logic Function: AND

Input A

Input B



Output C

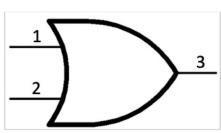
74LS08

Input A	Input B	Output C
0	0	0
0	1	0
1	0	0
1	1	1

c.) Logic Function: OR

Input A

Input B



Output C

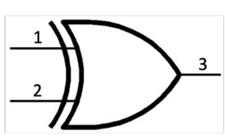
74LS32

Input A	Input B	Output C
0	0	0
0	1	1
1	0	1
1	1	1

d.) Logic Function: XOR

Input A

Input B

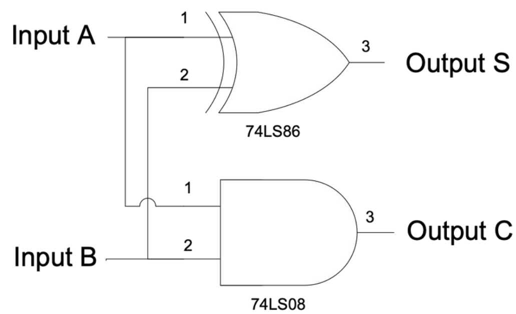


Output C

74LS86

Input A	Input B	Output C
0	0	0
0	1	1
1	0	1
1	1	0

4. Connect the circuits below and complete the given truth table. Identify the function performed by each 2-input logic circuit.



Input A	Input B	Output C	Output S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

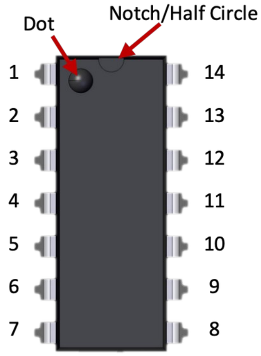
5. With all the tasks given to your group for this activity, can you summarize your learnings and findings by providing a Conclusion. The Conclusion may discuss some realizations on how logic gates work and what do you think is the role of logic gates and where they exist in a computer system. Use the space provided below:

Logic operations are the foundation on which all computer processes rest. The versatility of binary representation thanks to its direct correspondence with the values 'true' and 'false' (i.e., electrical signals) enables complex operations to be performed through a number of simpler logic gates in modern electronic devices. For instance, the basic operation of addition, which is central to algorithm design, can be accomplished with an XOR gate and an AND gate. In short, without logic gates and their basic ability to read inputs and return outputs, none of the more complex operations we tend to associate with computers would even be possible.

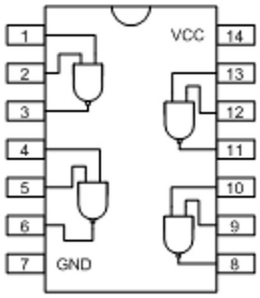
After completing the activity, don't forget to submit the completed manual in the respective assignment in AnimoSpace.

Have fun!

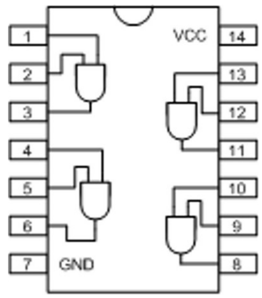
1.2 Appendix: Connection Diagrams



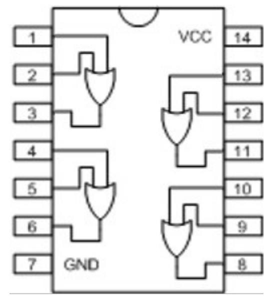
DIP IC



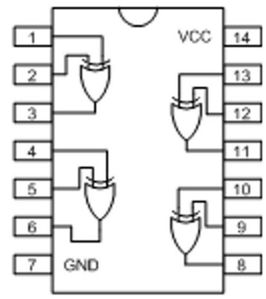
74LS00 – NAND



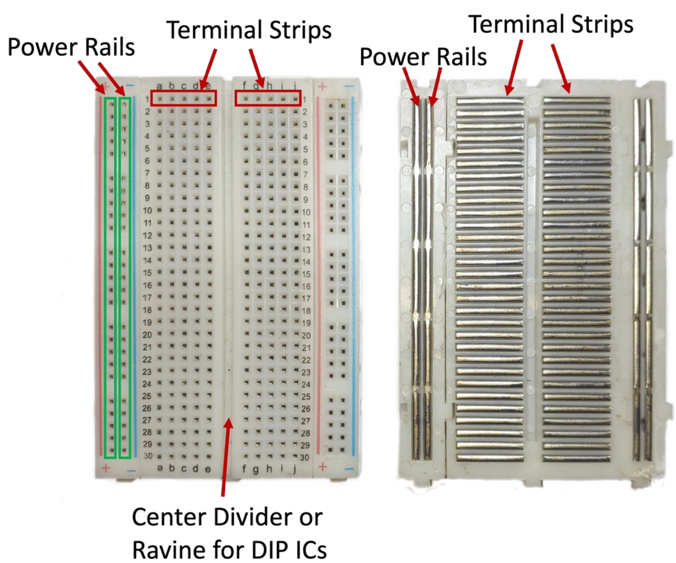
74LS08 – AND



74LS32 – OR



74LS86 – XOR



Parts of a Breadboard:

Power Rails – the very long set of connections seen on both sides of the breadboard. Each power rail is made up of two (2) long metal strips, which are used to distribute the **Power**/**Positive** and **Ground**/**Negative** connections along the circuit

Center Divider or **Ravine** – the space between the terminal strips on the breadboard. This is where the components (ICs, LEDs, Resistors, Buttons, etc) would be placed, allowing the component to be connected on either side of the terminal strips

Terminal Strips – the many but short 5-hole-long set of connections seen on the breadboard as the rows, following the orientation of the image on the left. Allows the components to be connected to other terminal strips or to the power rails

Setting up your IC on your breadboard:

1. Connect the **Power**/**Positive** of your power supply to the power rail with the (**+**) label. Then connect the **Ground**/**Negative** of your power supply to the power rail with the (**-**) label. This provides power and ground to the power rail on one side.
2. To connect the power rail on the other side, put a jumper wire from the (**+**) side of one power rail to the (**+**) side of the other power rail. Do the same on the (**-**) side, connecting the (-) sides of both power rails.
3. Gently place the DIP IC on the center divider or ravine, ensuring that the notch/dot is following the correct orientation (pointing north on the image).
4. Provide power to the DIP IC by putting a jumper wire on the same terminal strip where Pin-14 of the DIP IC is located, to any of the holes in the (**+**) **Power**/**Positive** power rail, and another jumper wire on the same terminal strip where Pin-7 of the DIP IC is located, to any of the holes in the (**-**) **Ground**/**Negative** power rail