Lab 1: Digital Logic Gates

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Objectives:
In this lab I will test a variety of logic gates to validate they are working correctly, and to confirm they behave as we were taught in lecture. I will apply high and low voltages to the input pins and record the voltage of the output to check if each gate is working as it should. Additionally, I will gain experience in working with various lab equipment including, a DC power source, digital multimeter, and a breadboard.

Design:
A simple circuit is necessary to test each logic gate. The DC power source is set to 5 volts, which is the rating listed for each gate. The terminals of the DC power source are then connected to the power rails on the breadboard. A lead is then connected from the positive power rail to the Vcc pin on the logic gate chip, and the ground pin is connected to the ground rail on the breadboard.

Since the inverter gate, SN7404, only takes one input, a single lead is connected to the A1 terminal on the gate. To send a high voltage, the lead is connected to the positive power rail and to send a low voltage, the lead is connected to the ground rail. To measure the output from the gate, the multimeter is set to read the voltage from the Y1 output pin.

This process is repeated for the other gates, 74LS00 (NAND), 74LS02 (NOR), 74LS08 (AND), 74LS32 (OR), and 74LS86 (XOR). These gates, however, require two inputs so an additional lead is connected to the B1 terminal on the gate. Thus, each gate has four possible states.

Results:
The results below were recorded from the multimeter. A reading in the range of 3.9-4.3 V correlates to a high reading, while a reading in the range of 40-150 mV correlates to a low voltage readings. The results are represented in a truth table, which is an abstract way to represent the logic of each gate. As shown in the tables, the gates behaved as they were predicted to and produced the same results as the logical operations: NOT, AND, OR, NAND, NOR, and XOR.

Not Gate		
	Volts	High/ Low
Low	4.0198V	High
High	45.756 mV	Low

AND and OR					
A	B	AND Volts	AND High/Low	OR Volts	Or High/Low
Low	Low	92.948 mV	Low	62.480 mV	Low
Low	High	92.880 mV	Low	3.9826 V	High
High	Low	92.858 mV	Low	3.9829 V	High
High	High	4.4107 V	High	3.9835 V	High

NAND NOR XOR							
A	B	NAND Volts	NAND High/Low	NOR Volts	NOR High/Low	XOR Volts	XOR High/Low
Low	Low	4.1520 V	High	4.0032 V	High	195.76 mV	Low
Low	High	4.1521 V	High	70.375 mV	Low	4.4457 V	High
High	Low	4.1523 V	High	70.327 mV	Low	4.4414 V	High
High	High	1261 mV	Low	69.480 mV	Low	203.62 mV	Low

Conclusion:

As shown by the tables, each gate yielded the expected output voltage for each possible input voltage. By following the steps in this lab, I have learned how to use the lab equipment to properly set up and test logic circuits. I have also verified that the logic gates perform as they should.

Questions:

Student Feedback Questions

What I liked about the lab: I thought the lab was a good introductory lab to get familiar with the equipment and materials. What I liked least was that some of the lab equipment such as the wires were difficult to make good connections with into the breadboard.

What I liked about the lab instructions: I liked the lab instructions, I thought that they were very detailed and gave good direction on how to perform the lab. They were also clear about the expectations of the assignment. One thing I disliked was that instructions contained information that wasn't necessary for the lab, such as the part about dip switches.

Suggestions: I thought the lab was good and I feel more confident in using the equipment. I don’t have any significant suggestions for the lab.