Lab 1: NOT, AND, OR gates
EECE 2106.05

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Abstract

Experiment 1 consisted of building several logic gates including NOT, AND, and OR utilizing a breadboard and their respective components to light up a LED to ensure that they function as intended. The design process for constructing the logic gates included looking upon the provided schematics provided on Blackboard (7404, 7408 & 7432) in which we sketched a similar design where we identified what pins the inputs/output go to. The most important technical results were the functionality of the logic gates in which, with an LED, we determined whether the logic was correct for the logic gate via voltage from a power source. Finally, resistors were used to mediate the electron flow, so that the LED lights were not damaged during this lab.

Components:

The components utilized to complete the experiment include:

- Gate 7404 (NOT gate)
- Gate 7408 (AND gate)
- Gate 7432 (OR gate)
- Three resistors, one per gate
- Breadboard
    - Cable wires
- Power supply (w/ 5v battery)
    - Multimeter

Experiment:

The purpose of this experiment was to create three functional logical gates (7404, 7408 & 4732) in which we feed the gates an input via a power supply and determine whether or not it was working based on the respective gate's truth tables. We decided to work on one logic gate at a time instead of working at multiple at the same time.

7404 NOT Gate

The 7404 gate (figure 2) takes an input and outputs the inverted input signal. Building a 7404 gate consisted of putting the 7404 gate in the gap between the breadboard strips and giving power to the gate (pin 14)/breadboard to allow components to be powered. To power the breadboard we connected a wire from the power supply to the positive (red) strip and from there another wire to the other positive strip to allow power to the entire 7407 IC and components

(similar concept done with the ground). We then obtained two cables, one going to pin 1 of the NOT gate (Figure 1) and the other cable going into pin 7 where it will be grounded. We then put our LED's anode on pin 2 of the 7404 gate as its output and the cathode in a hole shared with a resistor that is grounded to prevent burnout. We then would alternate the input from logic 0 (< 0.8 volts) and logic 1 (> 2.0 volts) and record their values to compare with its respective truth table. When calculating the truth table for the NOT gate (7404) invert the input to obtain the output.

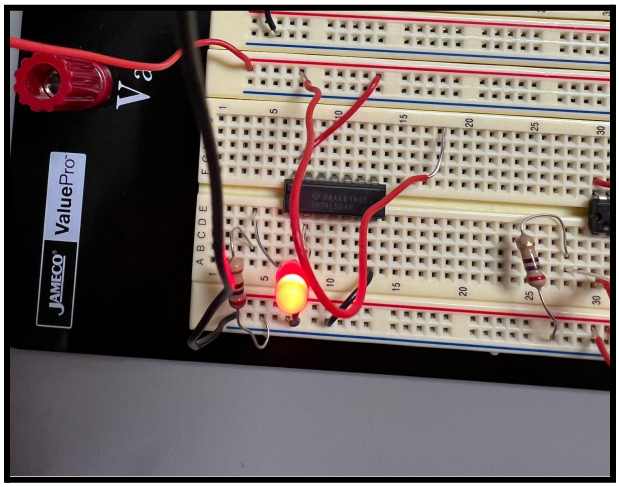

Figure 1: 7404 (NOT) gate

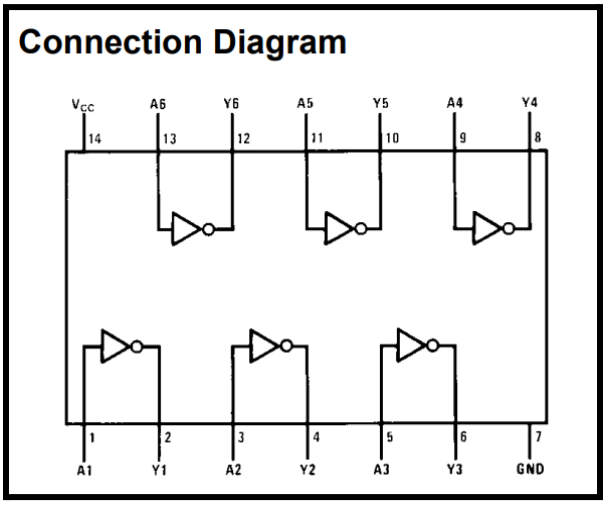

Figure 2: 7404 (NOT) gate pin schematic/connections

Observations made from **7407 (NOT)** gate experiment. Low voltage (L/0) and high voltage(H/1) were alternated during testing to gather the following observations and were then compared to the practice truth table to see if the results matched with the intended logic gate's outcome.

Datasheet Truth Table	
Inputs	**Outputs**
L	H
H	L

Function Table	
Inputs (V)	**Outputs (V)**
0	3.1
3.3	0

Practice Truth Table	
Inputs	**Outputs**
0	1
1	0

7408 AND Gate

The 7408 AND gate (figure 3) takes two inputs and outputs a signal of logic 1 if both inputs are logic 1 while other variations return a logic of 0. Similarly to the previous gate, you power up the 7408 in the same fashion but instead of having only one cable to pin 1, you also have a cable on pin 2 as it requires two inputs. The 7408's 7th pin is still reserved for the ground and the LED's anode goes to pin 3 as pin 2 is now taken from the additional input (the cathode doesn't change; it remains grounded alongside a resistor).

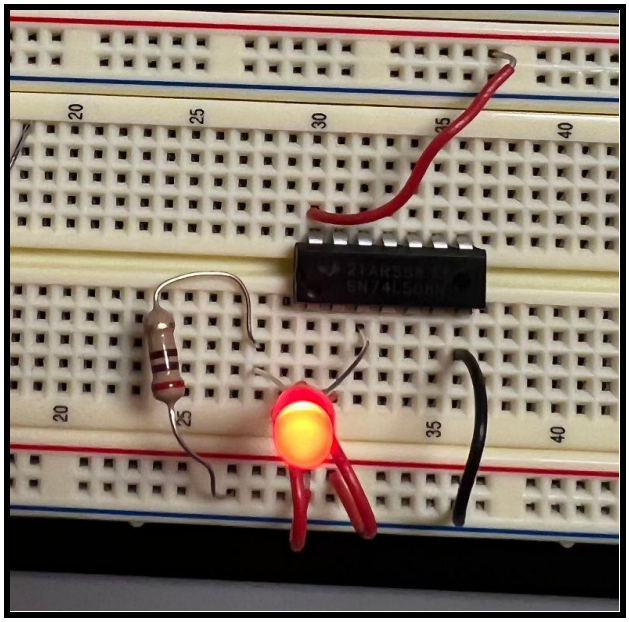

Figure 3: 7408 (AND) gate

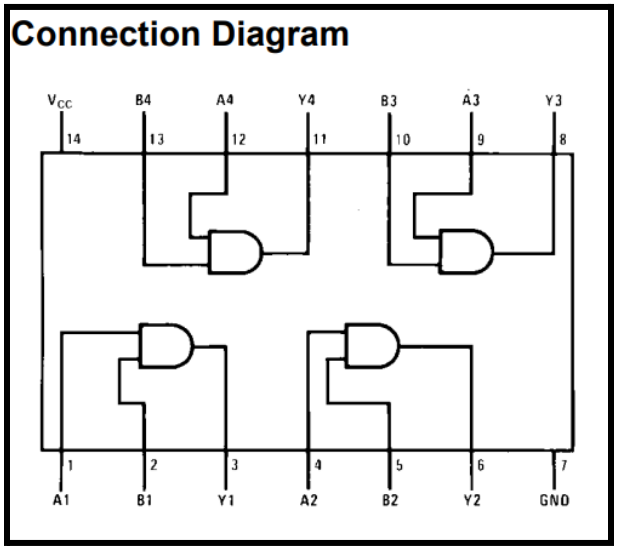

Figure 4: 7408 (AND) gate pin schematic/connections

Observations made from **7408 (AND)** gate experiment. Low voltage (L/0) and high voltage(H/1) were alternated during testing to gather the following observations and were then compared to the practice truth table to see if the results matched with the intended logic gate's outcome.

Datasheet Truth Table		
Inputs		**Outputs**
L	L	L
L	H	L
H	L	L
H	H	H

Function Table		
Inputs (V)		**Outputs (V)**
0	0	0
0	3.6	0
3.8	0	0
3.6	3.7	3.9

Practice Truth Table		
Inputs		**Outputs**
0	0	0
0	1	0
1	0	0
1	1	1

7432 OR Gate

Just like the previous gates, the 7432 OR gate (Figure 5) is powered in the same manner and is grounded utilizing the same pins. The OR gate has the exact same layout as the 7408 (AND) gate but their truth tables differ as the former requires only one of the two inputs to be of logic 1 to return logic 1. If both inputs are logic 0 then the 7408 gate will output a logic of 0.

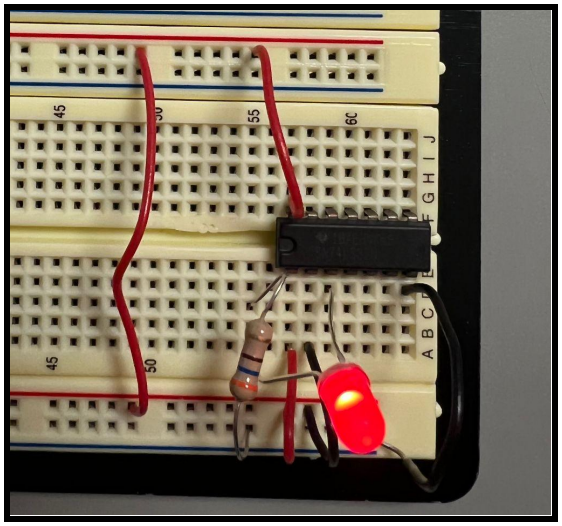

Figure 5: 7432 (OR) gate

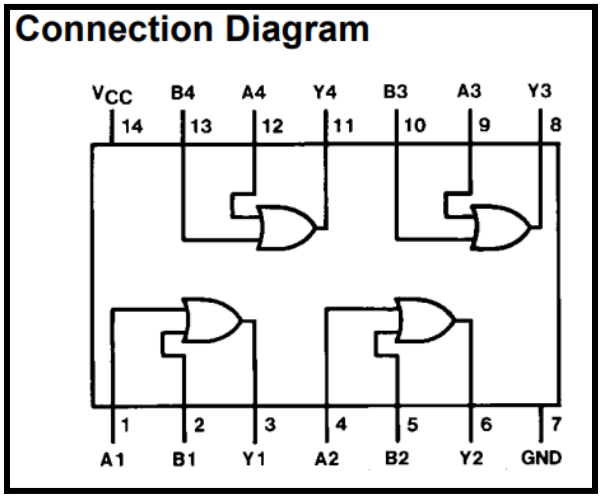

Figure 6: 7432 (OR) gate pin schematic/connections

Observations made from **7432 (OR)** gate experiment. Low voltage (L/0) and high voltage(H/1) were alternated during testing to gather the following observations and were then compared to the practice truth table to see if the results matched with the intended logic gate's outcome.

Datasheet Truth Table		
Inputs		**Outpus**
L	L	L
L	H	H
H	L	H
H	H	H

Function Table		
Inputs (V)		**Outputs (V)**
0	0	0
0	3.2	3.1
3.6	0	3.4
3.1	3.3	3.5

Practice Truth Table		
Inputs		**Outpus**
0	0	0
0	1	1
1	0	1
1	1	1

Conclusion:

After lengthy trial and error, the three gates (NOT, AND, OR) work as intended (Figure 7). Comparing the Datasheet Truth Table to the Function Tables for each gate, we can see that Low corresponds to 0, High corresponds to 1, and that each gate changed outputs according to the wired input. Therefore, the gates work as intended. Samuel Lee wrote this conclusion, parts of the abstract/components list, and was responsible for the majority of the breadboard circuit construction. Carlos Alvizo wrote the majority of this lab report, and aided in breadboard circuit construction.

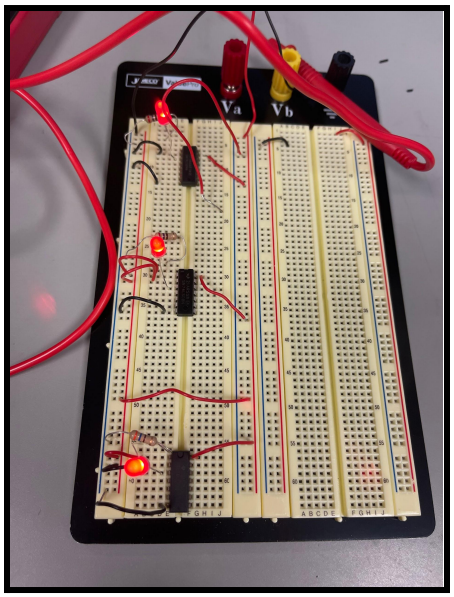

Figure 7: Breadboard with all 3 completed logic gates