

**Digital Lab - Part 1 (Lab 2)**  
**Worksheet**

Name \_\_Hunter Befort\_\_

Section     007    

Please complete the following steps to complete the lab:

1. Take the blue LED and a 220 ohm resistor (red-red-brown) in series as shown in the circuit above and connect them across the red and blue distribution strip at a point by the USB connector so it is out of the way for the next steps. It should glow.
2. Locate a 74HC08 (AND gate) chip on the breadboard. It should already be powered through red and a black wires connected from pins 14 and 7 of the chip to the 5V and 0V (red and blue) distribution strips. Again, red is used for 5V and black is used for 0V.
3. Connect the center connection of two slide switches to the A and B inputs of the AND gate (use any of the 4 AND gates in the chip). Now, connect a red LED and resistor in series and connect to the center connection of one of the switches. Repeat this using a different red LED and resistor for the another switch. You should be slide the switch from left to right and see the LED turn on and off for the corresponding switch. You are now sending '1'/true and '0'/false signals to the two inputs of an AND gate.
4. Measure the voltage of the two slide switches which provide the AND gate inputs and record below the voltages and LED status below:

Switch A	Voltage at A input of gate	Red LED on?
'0' (connected to the black wire)	0 V	NO
'1' (connected to the red wire)	5.056 V	YES
Switch B	Voltage at B input of gate	Red LED on?
'0' (connected to the black wire)	0 V	NO
'1' (connected to the red wire)	5.041 V	YES



5. Connect the output of the AND gate to an orange LED and resistor in series. Now, slide the two switches to all four combinations and record the observations below.

Switch A	Switch B	Voltage at Y output	Orange LED on?
0	0	0 V	NO
0	1	0 V	NO
1	0	0 V	NO
1	1	4.8 V	YES

An LED on indicates the output of the gate is true/'1'. Verify that this matches the table shown in the introduction. The orange LED shows the evaluation of A & B.

6. Locate a 74HC32 (OR gate) chip on the breadboard. It should already be powered through red and a black wires connected from pins 14 and 7 of the chip to the 5V and 0V (red and blue) distribution strips. Connect the A and B inputs of the AND gate to the A and B inputs of the OR gate.
7. Connect the output of the OR gate to a yellow LED and resistor in series. Now, slide the two switches to all four combinations and record the observations below.

Switch A	Switch B	Voltage at Y output	Yellow LED on?
0	0	0 V	NO
0	1	4.62 V	YES
1	0	4.61 V	YES
1	1	4.61 V	YES



An LED on indicates the output of the gate is true/'1'. Verify that this matches the table shown in the introduction. The yellow LED shows the evaluation of  $A \mid \mid B$ .

8. Locate a 74HC04 chip on the breadboard. It should already be powered through red and a black wires connected from pins 14 and 7 of the chip to the 5V and 0V (red and blue) distribution strips. Connect the A input of a NOT gate to output of the OR gate.
9. Connect the output of the NOT gate to a green LED and resistor in series. Now, slide the two switches to all four combinations and record the observations below.

Switch A	Switch B	Voltage at Y output	Green LED on?
0	0	4.63 V	YES
0	1	0 V	NO
1	0	0 V	NO
1	1	0 V	NO

An LED on indicates the output of the gate is true/'1'. Verify that the output of the yellow and green are the inverted versions of each other. The green LED shows the evaluation of  $\neg(A \mid \mid B)$ .

10. Write a short C program compiled with GCC on your Raspberry Pi that:

- a. Prints your name, ID number, and course section number to the screen.
- b. Accepts two integers (A and B) from the user.
- c. Displays the value of  $A \&\& B$ ,  $A \mid \mid B$ , and  $\neg(A \mid \mid B)$  on the screen.
- d. Verify that these outputs match the values in steps 5, 7, and 9.

11. Lab checkout steps:

- a. Show your working circuit and program to the grader.
- b. Create a file, lastname\_netid\_lab2.zip, (lastname and netid are your lastname and ID number) that includes the following files:
  - This completed lab worksheet with all data completed (named lastname\_netid\_lab2.pdf)
  - A JPEG image of your working circuit (named lastname\_netid\_lab2.jpg)



- The source code of your program  
(named lastname\_netid\_lab2.c)
  - The screen capture of the output of all 4 input combinations of the program using `scrot`  
(named lastname\_netid\_lab2.png)
- c. Upload the zip file to Canvas.
- d. After you have shown your working lab to the grader, taken your picture, and uploaded your zip file, dismantle your circuit and return everything to the box on the shelf. Do not remove the USB adapter, ICs, slide switches, or the pre-loaded red and black wires.

Thank you for attending the lab. We hope some of this material was new and interesting to you.

- Professors Losh and Davis

## **Lab 2 Rubric**

### Prerequisite:

-40: Did not complete familiarization quiz on time

### Assignment:

- 30: No completed worksheet
- 20: No image of working circuit
- 20: No source code for program
- 20: No output of source code
- 10: Wrong file name(s)

