Lab 1

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Task 1

The breadboard is connected to arduino where the pins are switched from high and low. The red lights are the inputs and the yellow light is output. A turned on light signals that the pin is high. The inputs are connected to a NAND gate and there are four possible combinations, one of them is redundant. See pictures in figure 2 for results.

Input	Input	Output
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

Figure 1 - NAND truth table

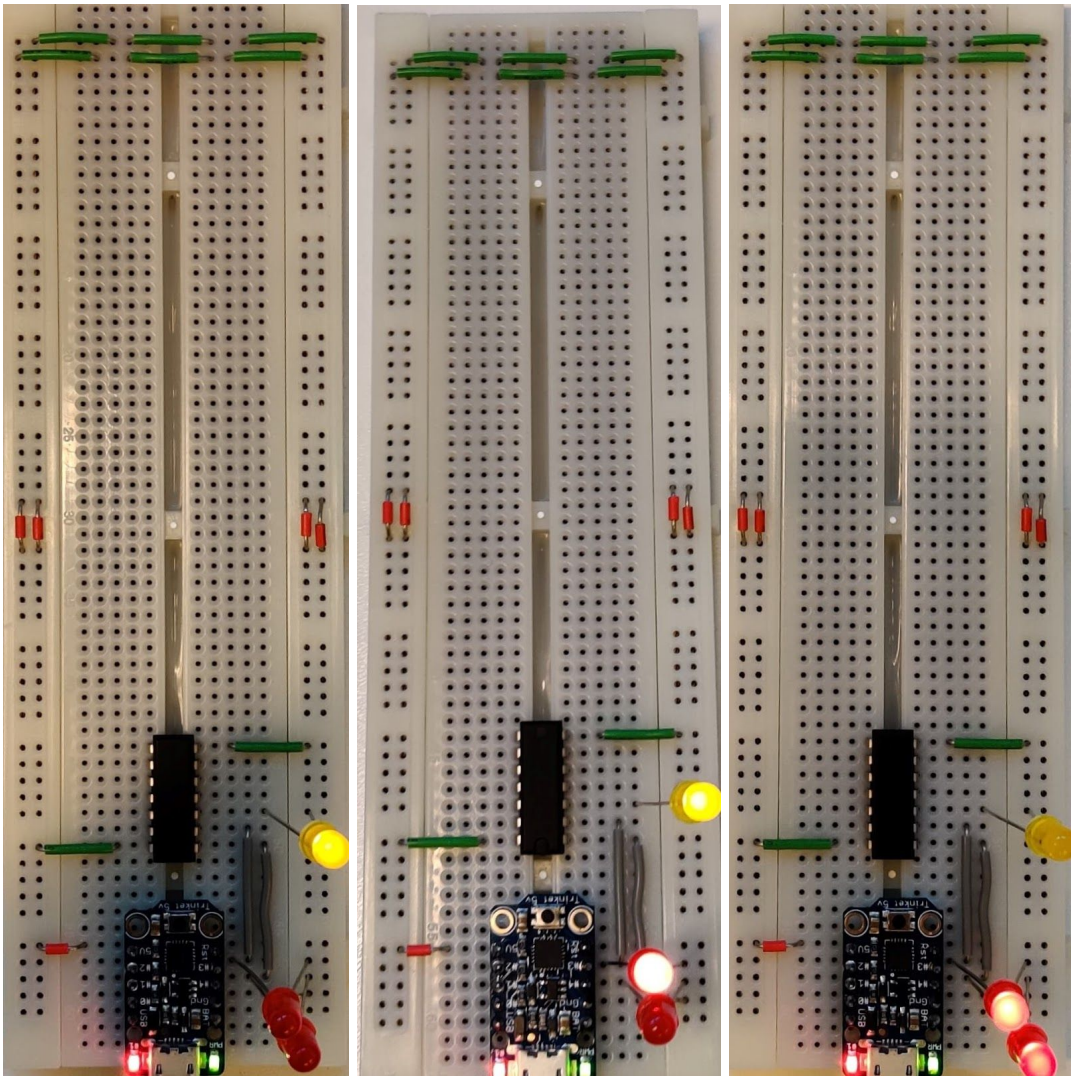


Figure 2 - NAND gate with all possible outcomes

Task 2

Building a half adder with two input bits which outputs the sum and a carry bit. The half adder was constructed with a NAND and NOR gate as depicted in figure 4. There are four combinations and just like in task 1 one of them is redundant.

Truth Table			
Input		Output	
A	B	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Figure 3 - Half adder truth table

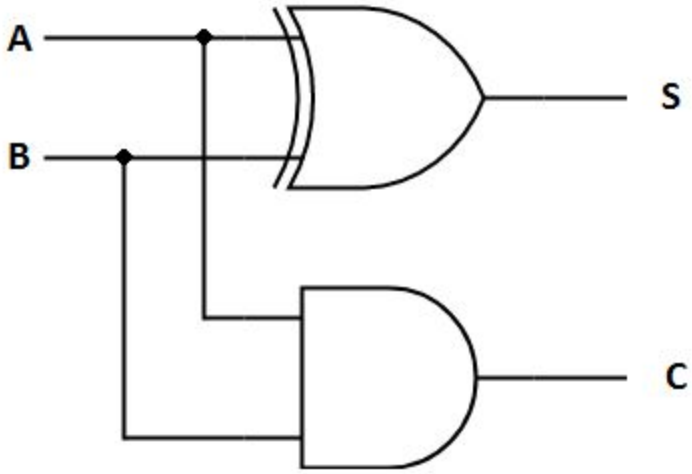


Figure 4 - Half adder circuit diagram

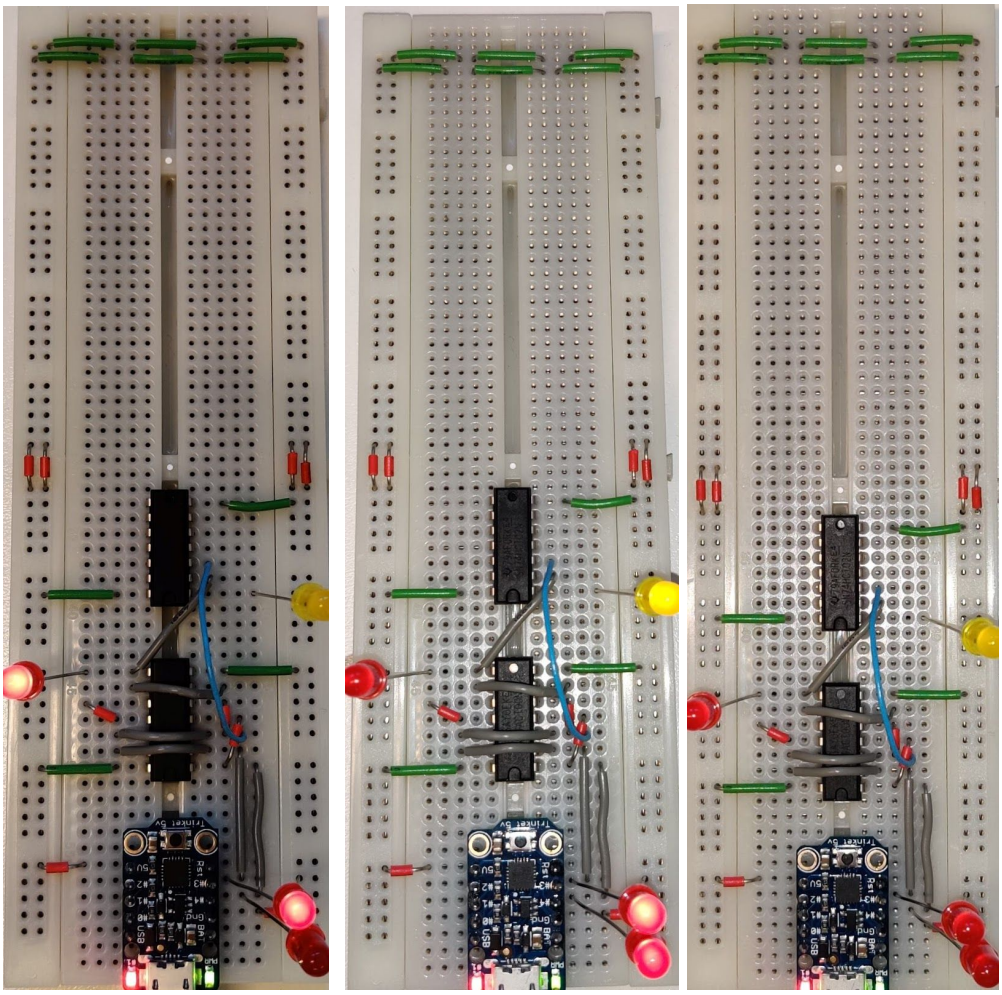
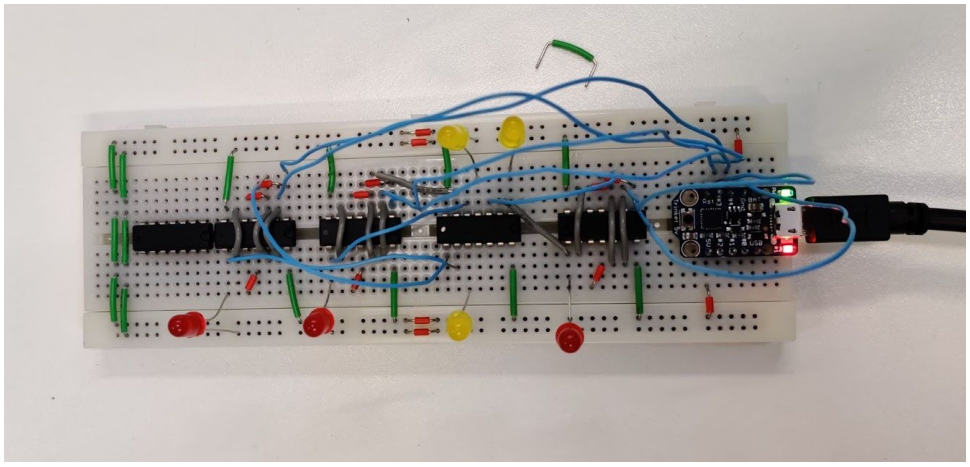


Figure 5 - Half adder

Task 3

This task is a follow up on task two. As previously mentioned we implemented a half adder circuit in task 2. Where we had two input and output signals respectively, one being the sum bit and the other the carry bit. The objective in task 3 however was to add another half adder, with the result being a full adder. The idea is to input 3 signals (value A & B, carry), and output a sum & carry bit.

We started by adding two additional half adders. At this point we have 5 ICs on our breadboard (three NAND chips, and two NOR). This can be viewed in the picture below.

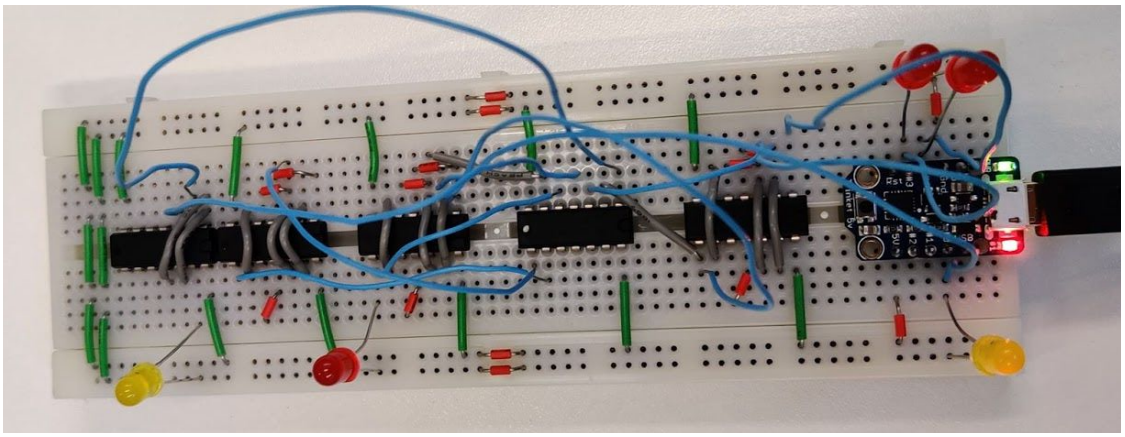


(Figure 4)

We needed however to add a carry bit as input to complete the full-adder. We then tested it with this truth table. Added images prove that the full-adder works.

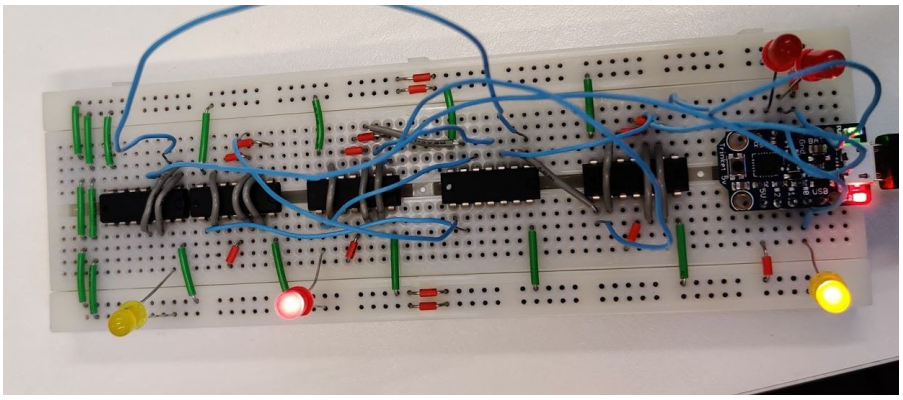
Input			Output	
A	B	Cin	Sum	Carry
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

(figure 5)

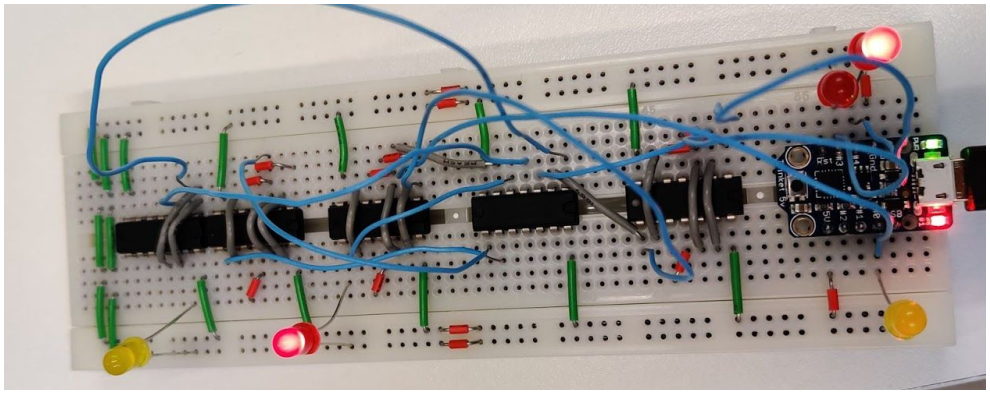


(figure 6)

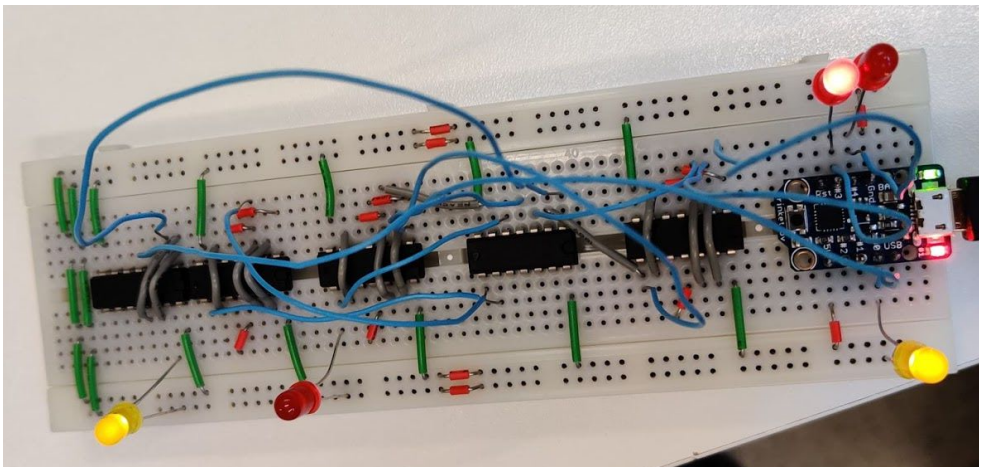
This image is shows the first calculation (row 1). Where the two red lights on the top right corner are the input bits, and the yellow one being the carry-in bit. The lights two the left represent the output bits. The red one represents the output value bit, and the yellow the carry-out bit. The images that will follow will.



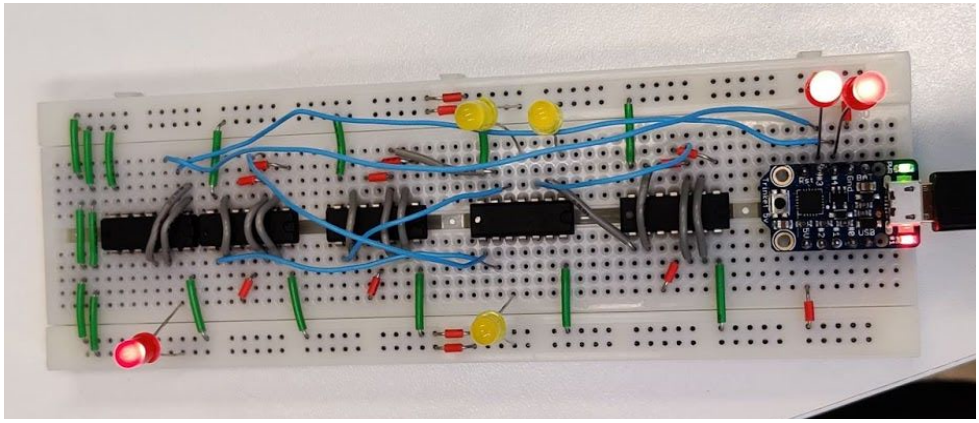
(Figure 7)



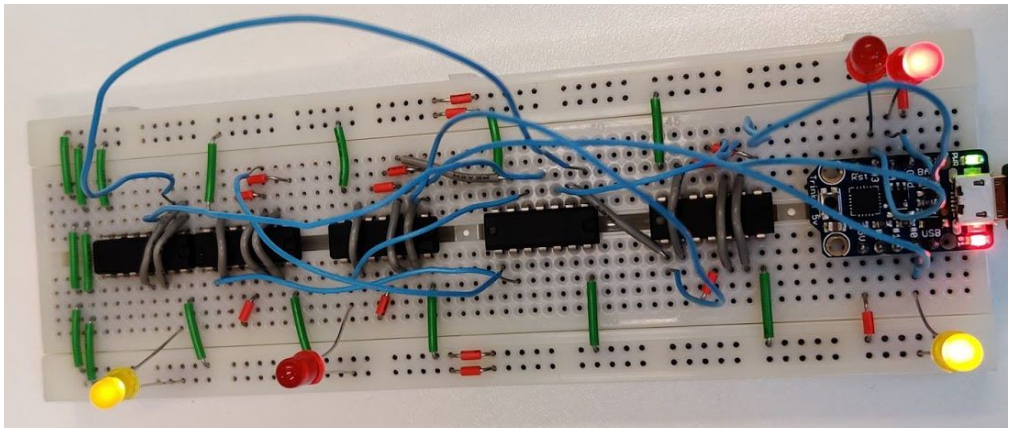
(Figure 8)



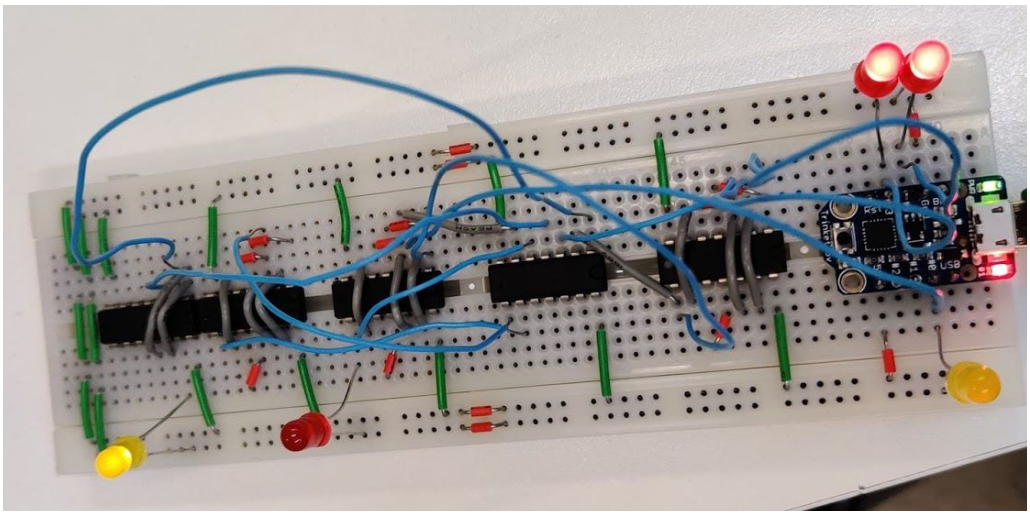
(Figure 9)



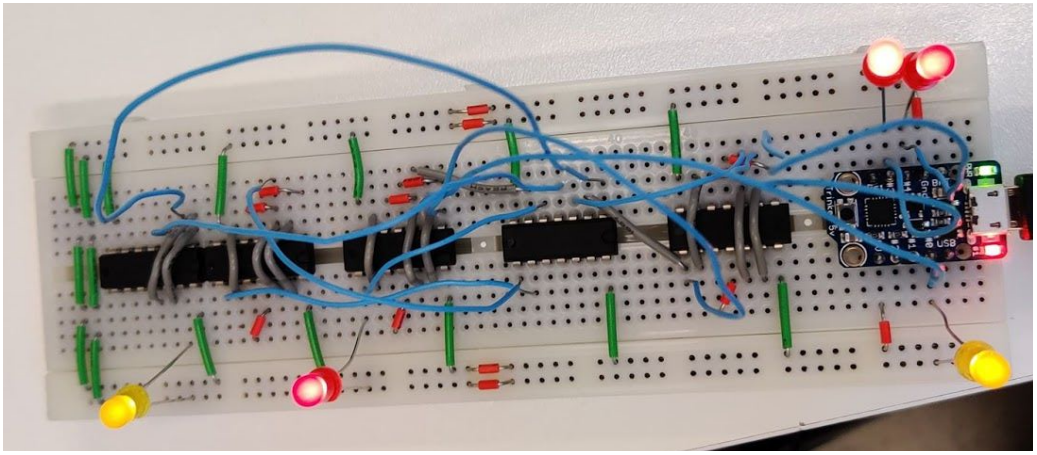
(Figure 10)



(Figure 11)



(Figure 12)



(Figure 13)

We did not however succeed in building the two bit full adder circuit. We couldn't figure why, and didn’t have enough time to troubleshoot the issue.