# Datateknik
# Lab 1: Digital Logic Circuits

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## Materials

The Following materials were used in the following tasks.

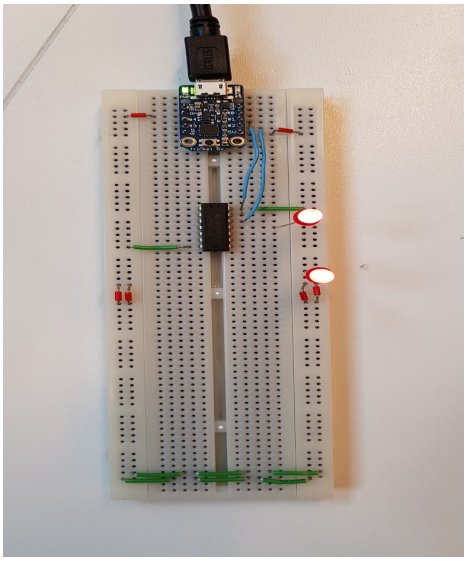
• A solderless breadboard.
• An Adafruit Trinket microcontroller board.
• Wiring kit.
• Micro USB cable.
• LED set.
• 1x 7400-series (SN74ACT00) quad NAND gate arrays.
• 1x 7402-series (SN74HCT02) quad NOR gate arrays.

We started by installing Arduino IDE, connecting Adafruit Trinket board and verifying that code can be uploaded to the microcontroller.

## Task 1:

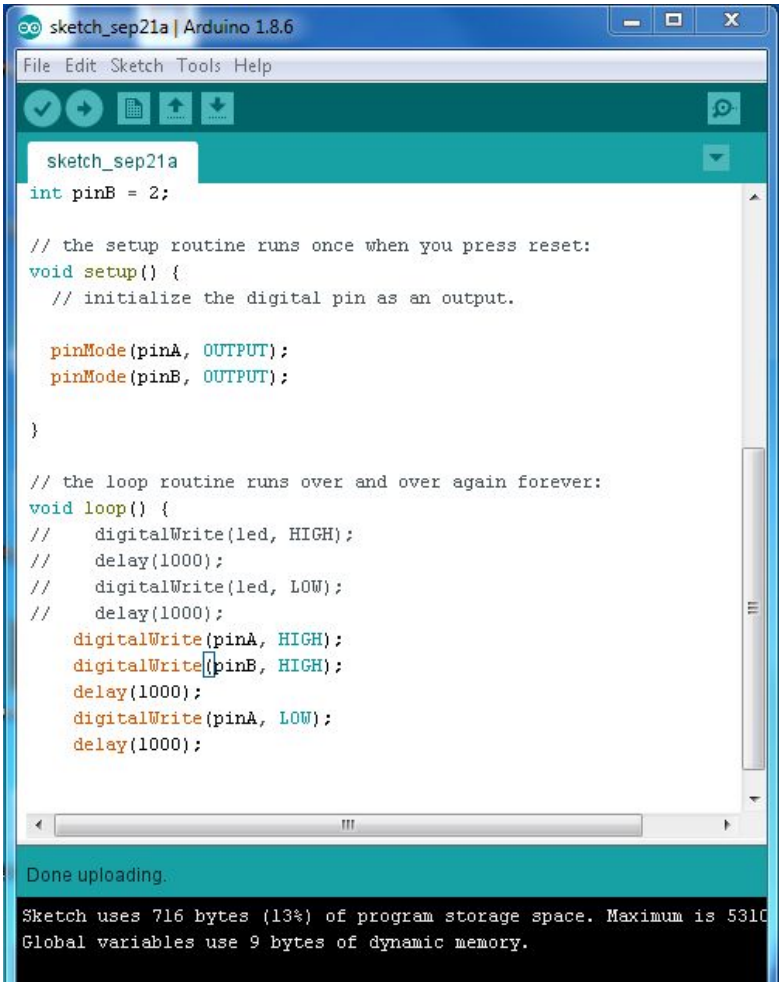
Setting up our breadboard took a lot of our Lab time because after following all the instructions and changing some materials we came up and find out that there were something wrong with our breadboard at the beginning and we changed it, after that we changed our microcontroller because for some reason it didn't work.

Finally with the operating materials we were able to build our breadboard by following task 1 as shown in Fig1(a) from instruction. Used a red LED to test if power is flowing through the circuit. Once we knew that the circuit works we added a NAND gate across the breadboard, connected PINS 1 and 2 of the microcontroller to the inputs 4Y and 4B of the NAND, output 4A of NAND through an LED to the ground of NAND. We got a almost similar setup as Fig2(b) in the instruction. Down below in the picture you can see the breadboard setup for task 1.



*Picture of our setup breadboard for task 1*

Here is a screenshot of the sketch(implementation) of the task1 using Arduino.




*Sketch of the task 1*

| A | B | Q |
|---|---|---|
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

*NAND truth table*

## Result:

Implementation of the code and following the truth table of the NAND gate. What happens inside the loop is when both A and B is HIGH, the light is off following after 1 second delay A becomes LOW and this LED is on, due to the loop the LED will blink. As expected the NAND gate works.

## Task 2:

This task was to create a half adder using NAND and NOR gate. So how did we do this? Following the Figure 1 is the circuit for half adder using XOR and NOR gate. 4 NAND gate can be manipulated into 1 XOR gate as we demonstrated in Figure 2 we connected the NOR gate with XOR gate using the logic truth table Figure 3 and half adder table  Figure 4.

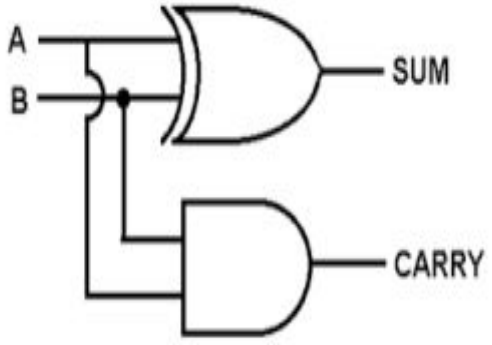
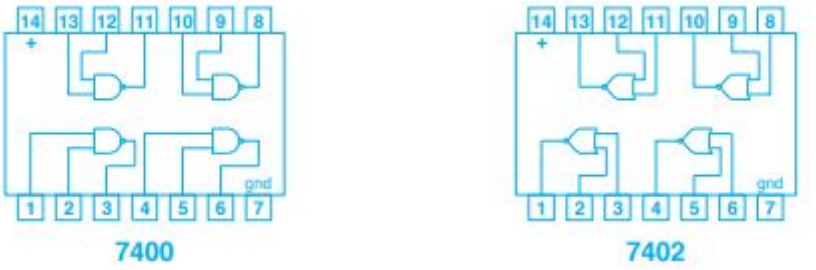



*Figure 1 Half adder circuit*

Illustrations of the pin connection for NAND gate and NOR gate from the book down below, shows all input and output pins. By using this illustrations and truth table for NAND and NOR gate in Figure 3 we were able to demonstrate and implement a XOR gate and connect it with a AND gate, as seen in Figure 2.




*Illustrations of the pin connection in NAND and NOR*

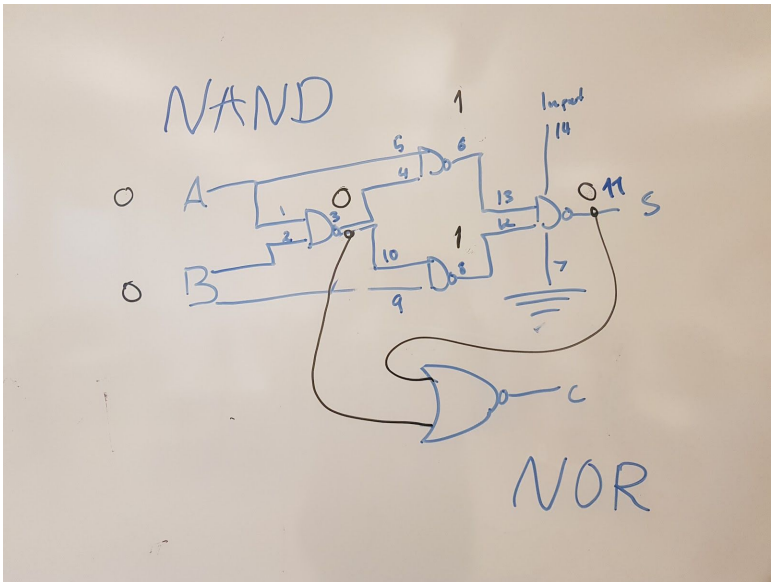



*Figure 2 Demonstration of our NAND and NOR connection*

| INPUTS | | OUTPUTS | | | | | |
|---|---|---|---|---|---|---|---|
| A | B | AND | NAND | OR | NOR | EXOR | EXNOR |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 |
| 1 | 0 | 0 | 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |

*Figure 3 Truth table of different logic gates*

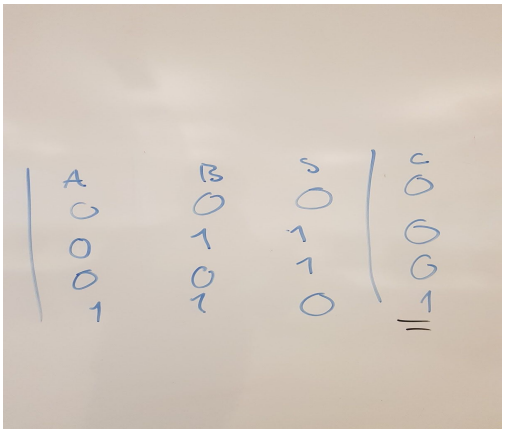



*Figure 4 Half-adder table with sum and carry*

## Bread Board Set Up

We kept the previous set up from task 1 and connected our NAND gate to XOR by following the circuit that we made from Figure 2. Two LED was put on A and B to check the input. One LED for XOR and one NOR gate to check if everything works as it should.

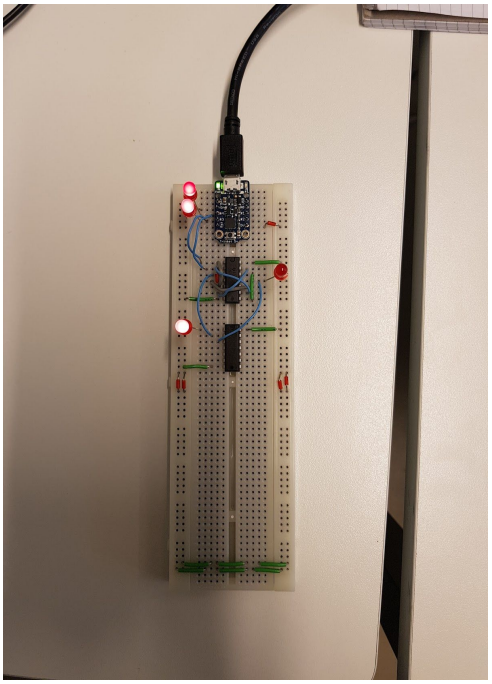


*Figure 5 of our setup breadboard for task 2*

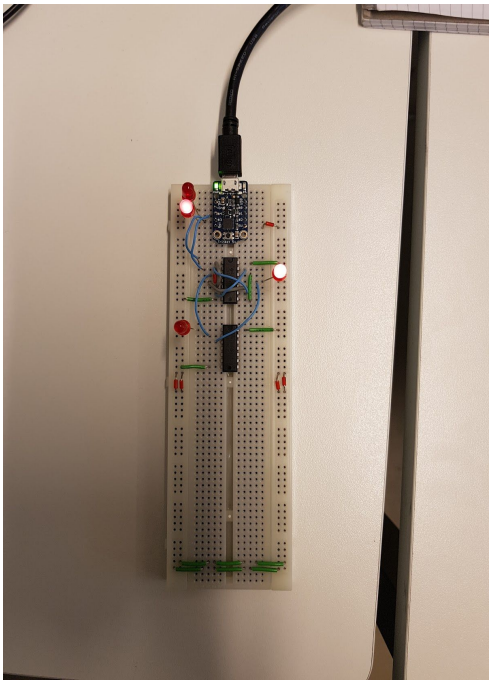
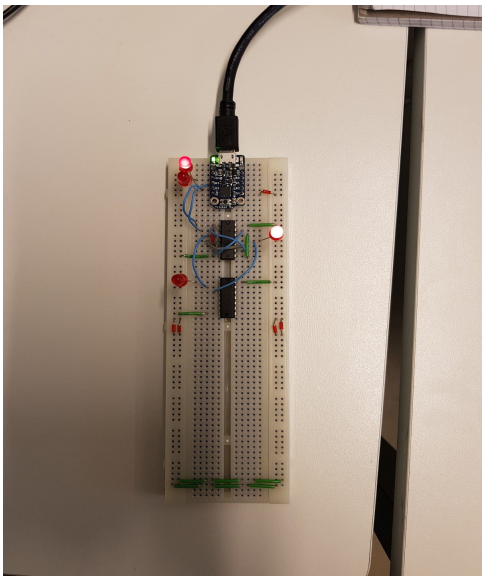


*Figure 6 of our setup breadboard for task 2*

Here you can see three different pictures from the breadboard circuit for task 2. Each one of the pictures showcases the output of the half-adder circuit, and it will be explained in **Result**.



*Picture 7  of our setup breadboard for task 2*

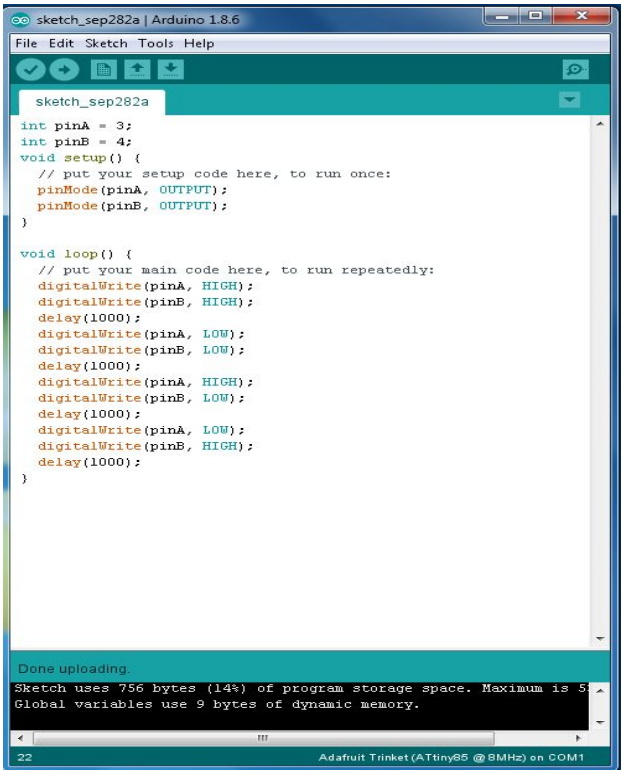



*Figure 8 our code to test all the combination of the input*

**Result:**

As result following the implementation of code in Figure 8 and the breadboard circuit. When input on A and B is 1 XOR is 0 and NOR is 1. LED A and B is on, LED on XOR is off and LED on NOR is on Figure 5. Which means it carries, this is also correct if we look at the half adder truth table. If A is 0 and B is 1 which means LED B is on XOR LED is on and no carry,so in that case LED on NOR is off as you can see in Figure 6 and the same behaviour if A is 1 and B is 0 as shown in Figure 7. This means our half adder circuit works.