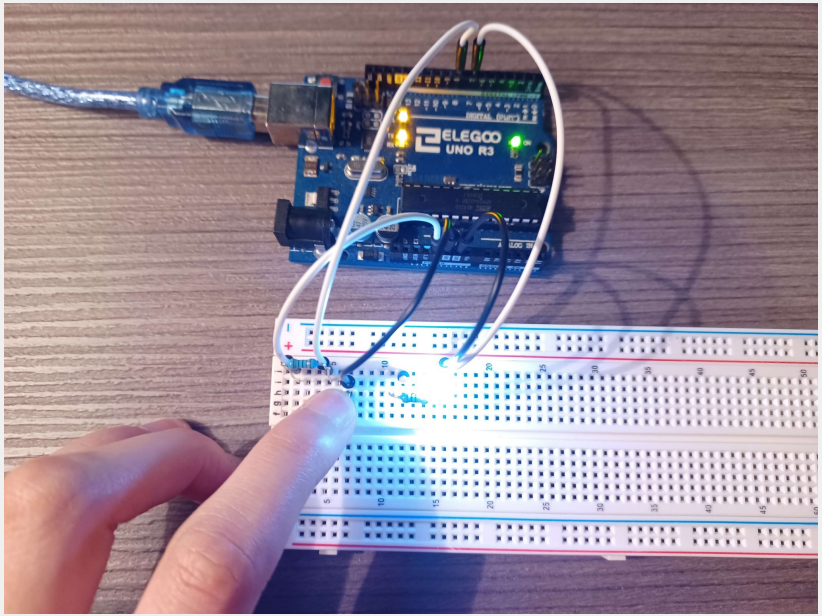
Introduction to Arduino Push Switches



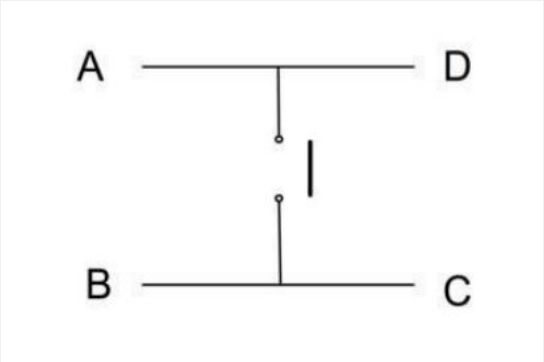
Keyword: button

Inside an Arduino push switch

A push switch has 4 lead connections, where connections A and D (the top) *and* B and C (the bottom) are connected.

In an unpushed button, the top and bottom leads are not connected, and are equivalent to an **open** circuit.

In a pushed button, the circuit is **completed** by connecting the top and bottom wires.



3 ways of implementing a push switch

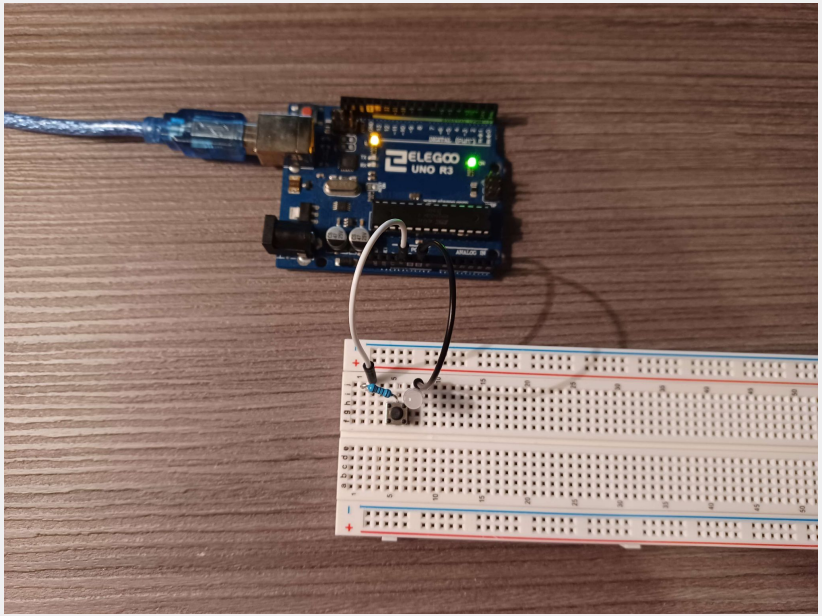
1. Implementing with only hardware
2. Implementing with both hardware and software and using pull-up resistors
3. Implementing with both hardware and software and using pull-down resistors

1. Hardware implementation

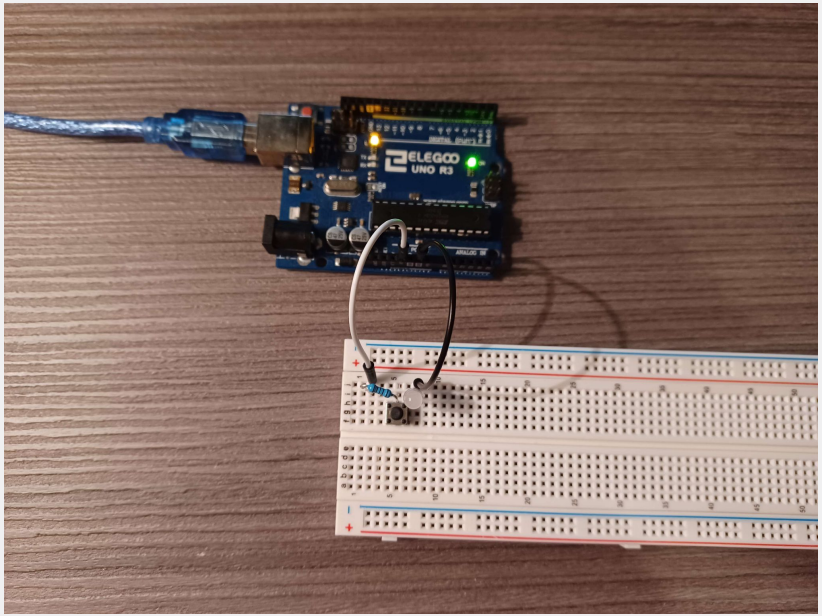
The white wire is connected to 5V and the black wire connects to GND. A 10K resistor connects the 5V to the switch. An LED is connects the switch to the GND.

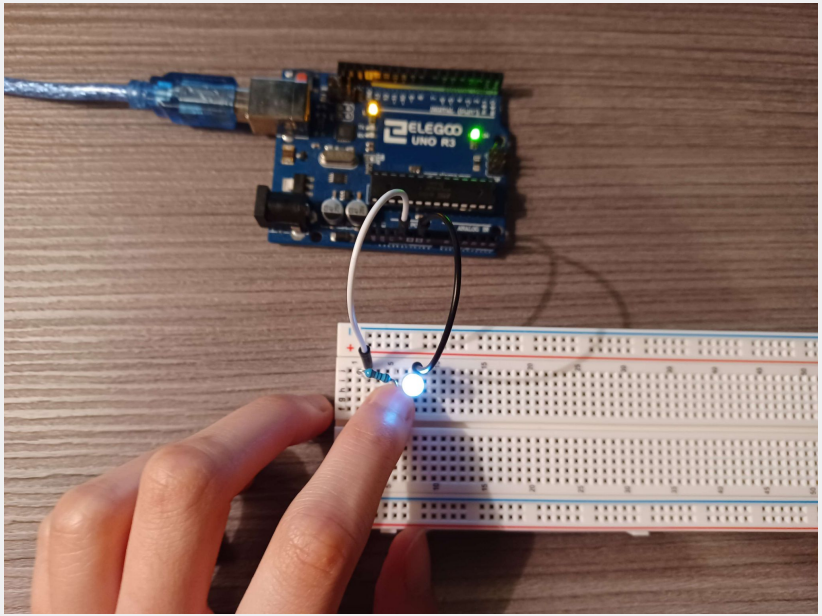
As a reminder, when the button is not pushed, it is an open circuit. Since there is no voltage drop, there is no current flowing through the LED.

When the button is pushed, the circuit is complete. There is a voltage drop from the 5V to GND, causing the LED to light up.



1. Hardware implementation





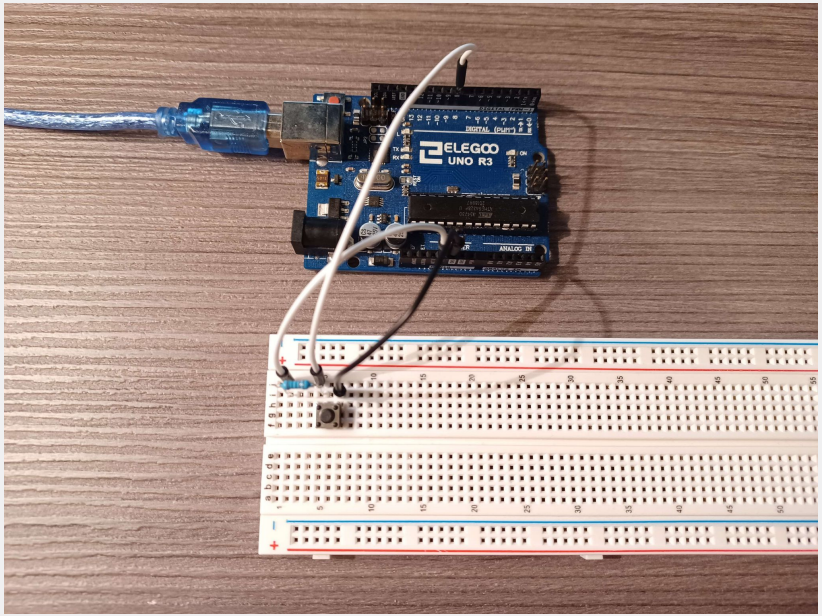
2. Pull-up resistor implementation

How does a pull-up resistor work?

The left white wire is connected to 5V, the right white wire is connected to a digital pin (where information can be read from this pin), and the black wire connects to GND. A 10K resistor connects the 5V to the switch.

As a reminder, when the button is not pushed, it is an open circuit. Therefore, when the right white wire reads a value, it will read a 1, meaning there is 5V where it is reading. This is due to it being an open circuit, where there is no voltage drop.

When the button is pushed, the circuit is complete. This time when the right white wire reads a value, it will read a 0, because it is at 0V. This is because it is connected to GND.



2. Pull-up resistor implementation

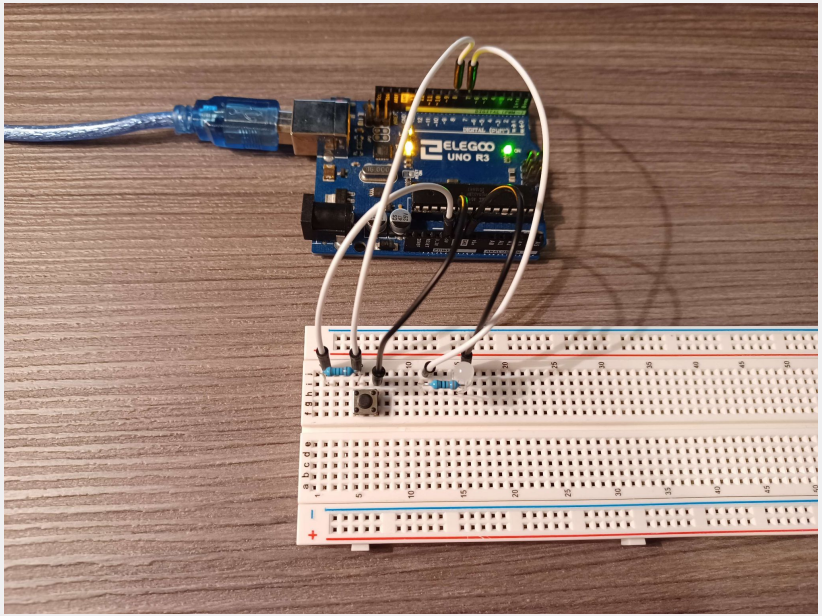
How do I use the digital pin to light the LED?

The rightmost white wire (in this new diagram) connects a digital pin as a voltage source to an LED. A 330 resistor connects the digital pin to the LED. The rightmost black wire connects the LED to GND.

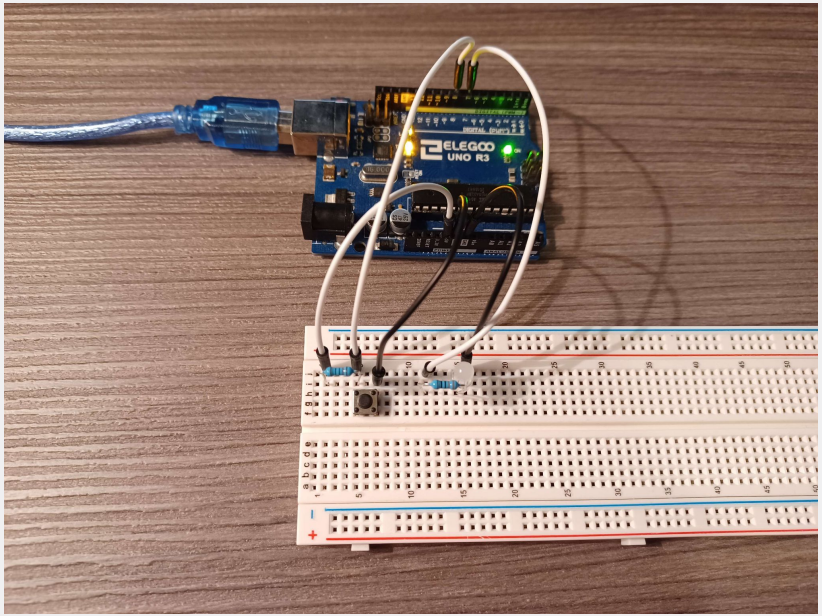
The digital pin will **read** a value of 1 or 0, where a 1 indicates 5V and a 0 indicates 0V (GND).

The digital pin can also be used to **write**. In this circuit, we will use the write command to light up the LED.

In order to properly read and write, we need to use the **Arduino IDE**.



2. Pull-up resistor implementation

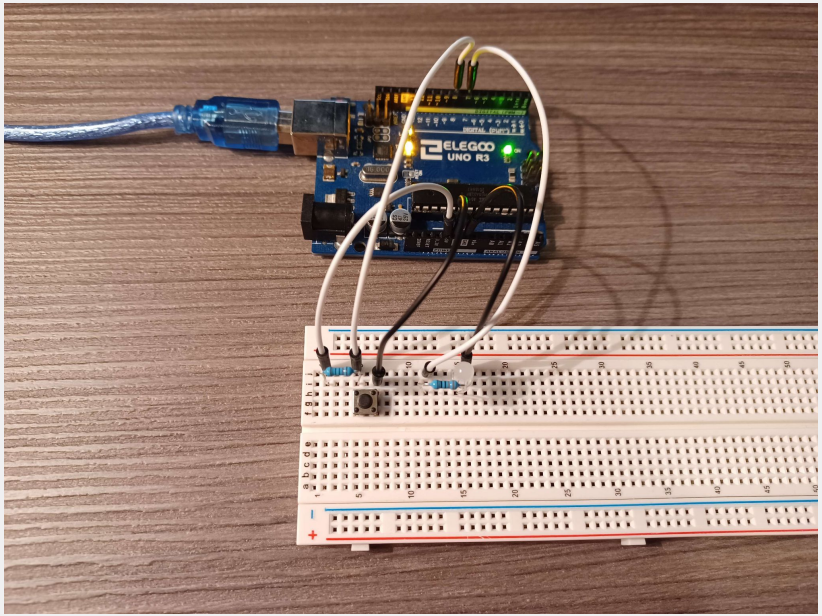


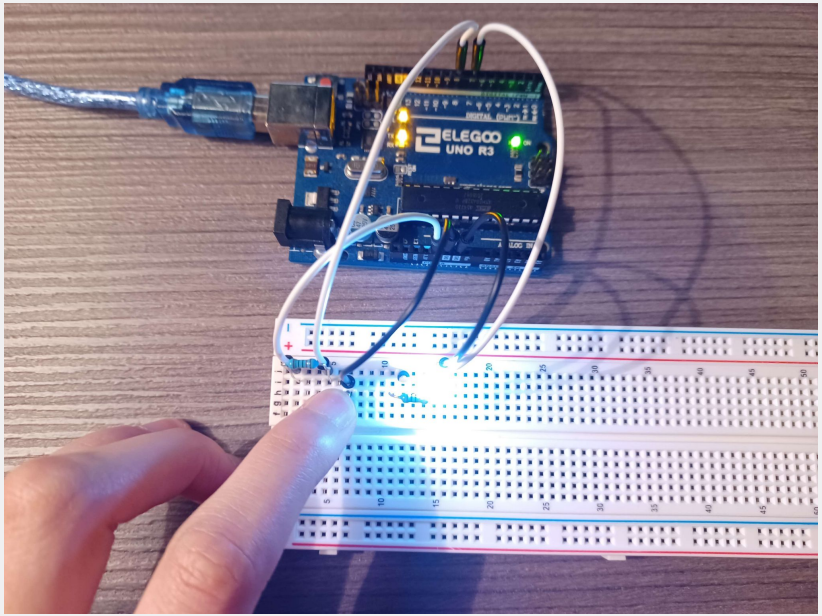

```
//instantiate variables
int LEDPin = 7;
int buttonPin = 8;
int buttonRead;

//set input and output pins
void setup() {
  pinMode(LEDPin, OUTPUT);
  pinMode(buttonPin, INPUT);
}

//write to the LED
void loop() {
  buttonRead = digitalRead(buttonPin);
  if (buttonRead == 1) {
    digitalWrite(LEDPin, LOW);
  }
  else {
    digitalWrite(LEDPin, HIGH);
  }
}
```

2. Pull-up resistor implementation





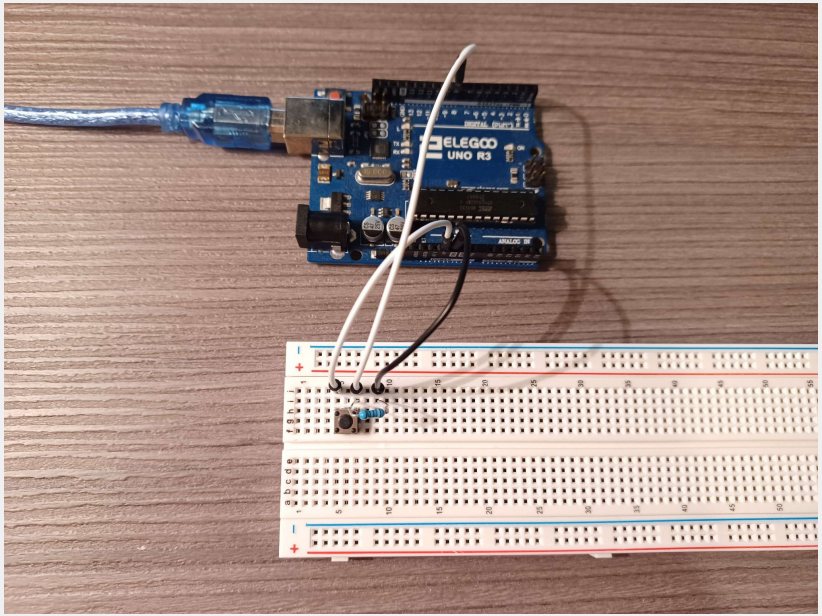
3. Pull-down resistor implementation

How does a pull-up resistor work?

The left white wire is connected to 5V, the right white wire is connected to a digital pin (where information can be read from this pin), and the black wire connects to GND. A 10K resistor connects **GND to the switch**.

As a reminder, when the button is not pushed, it is an open circuit. Therefore, when the right white wire reads a value, it will read a **0, meaning there is 0V** where it is reading. This is due to it being an open circuit, where there is no voltage drop, **and it is reading the GND value**.

When the button is pushed, the circuit is complete. This time when the right white wire reads a value, it will read a 0, because it is at 0V. This is because it is connected to GND.



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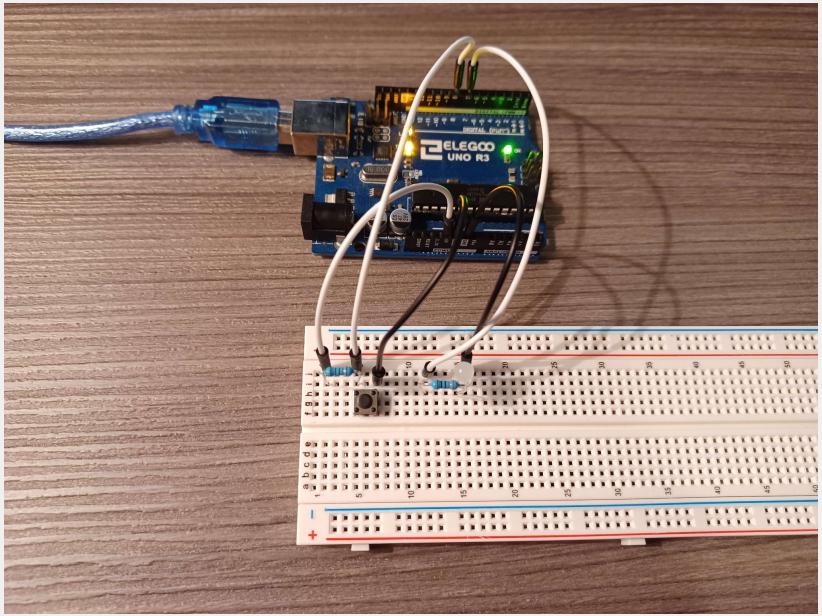
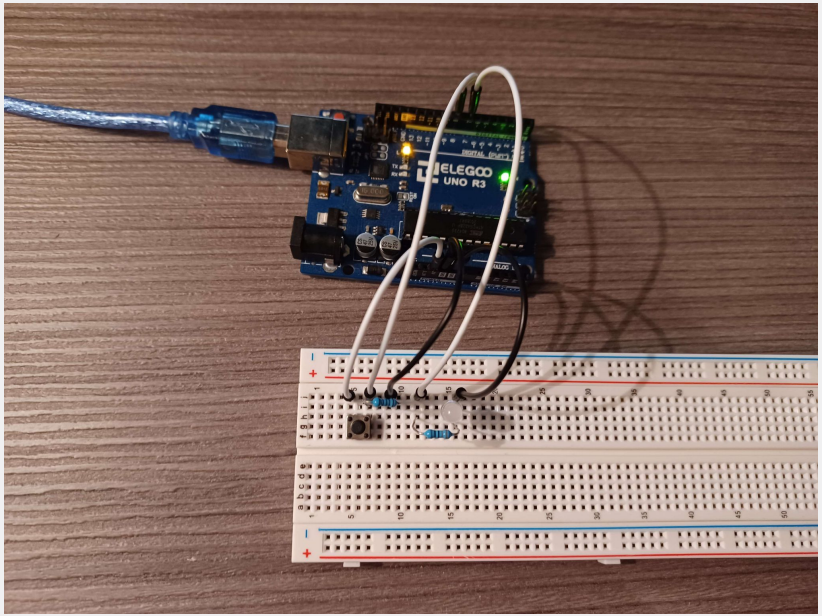


3. Pull-down resistor implementation

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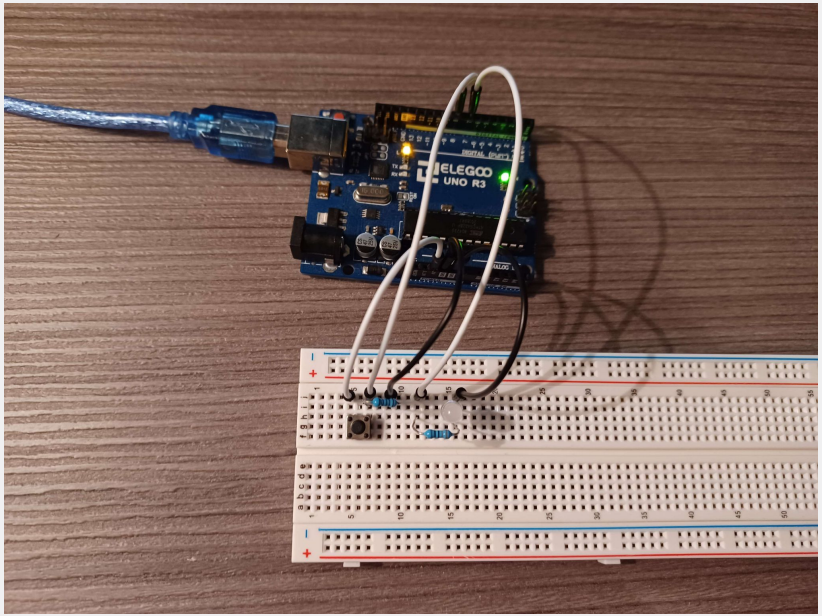
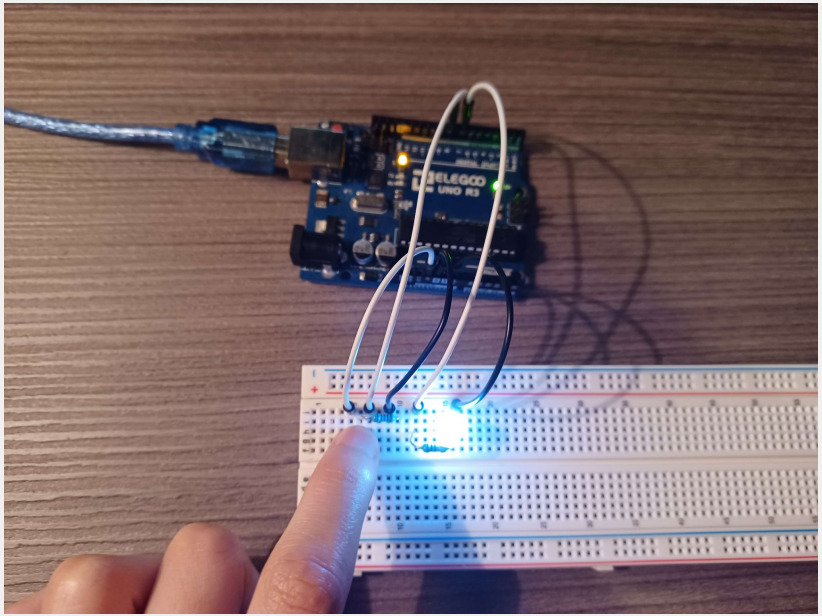
int buttonPin = 8;
int buttonRead;

//set input and output pins
void setup() {
  pinMode(LEDPin, OUTPUT);
  pinMode(buttonPin, INPUT);
}

//write to the LED
void loop() {
  buttonRead = digitalRead(buttonPin);
  if (buttonRead == 0) {
    digitalWrite(LEDPin, LOW);
  }
  else {
    digitalWrite(LEDPin, HIGH);
  }
}
```

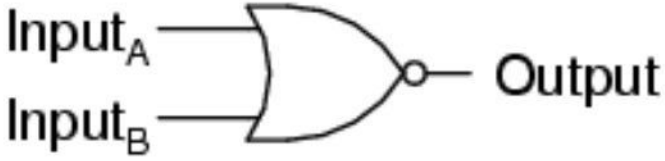
3. Pull-down resistor implementation





Assignment: Program 2 buttons, one as a toggle button, the other as a push button. When they are a logical NOR, light up an LED.

NOR gate



A	B	Output
0	0	1
0	1	0
1	0	0
1	1	0

Push button

Button State	1	1	0	0	0	1	1
LED State	off	off	on	on	on	off	off

Toggle button

Button State	1	1	0	0	1	0	0
LED State	off	off	on	on	on	off	off

1	0	0	0	1	1	0
off	on	on	on	on	on	off