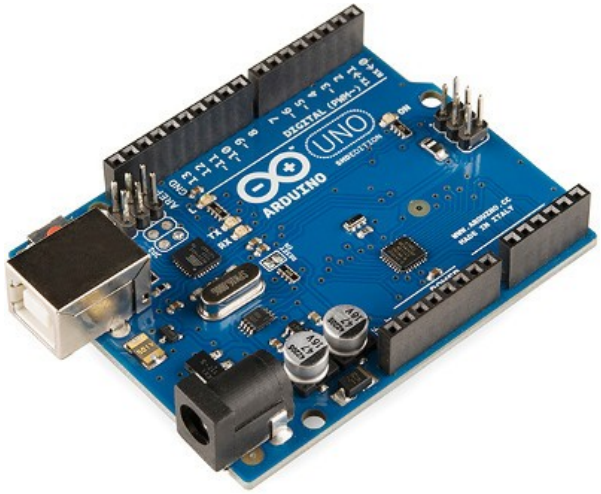

Scratch for Arduino

Programming, Electronics, and Giant Killer Robots*

* Giant Killer Robots may be omitted due to budget constraints.

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Before we start...

- We believe in open access to knowledge
- All our slides are shared online for free
- You can print it, share it, modify it, use it to run your own courses
- This current set of slides can be found here
  (* You can also find the URL on your hand-out)

Slides available at: http://a9i.sg/huayi

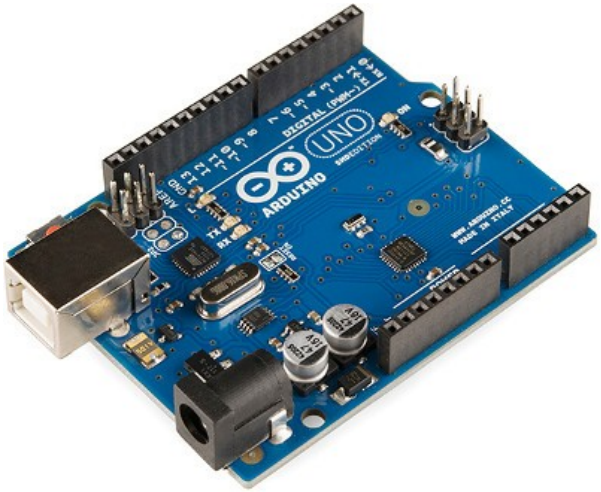
About Us

YONI
Spent 15 years developing software for big banks, now developing the next generation of Makers and Coders.

CORT
Ex-Navy engineer managing big engines, powerful generators, and easily choked toilets. Codes and builds stuff because he's too cheap to buy

Slides available at: http://a9i.sg/huayi

What is an Arduino?



Short Answer:
This is an Arduino...

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What is an Arduino?

- First we'll need to know what is a "micro-controller"

ATtiny 85

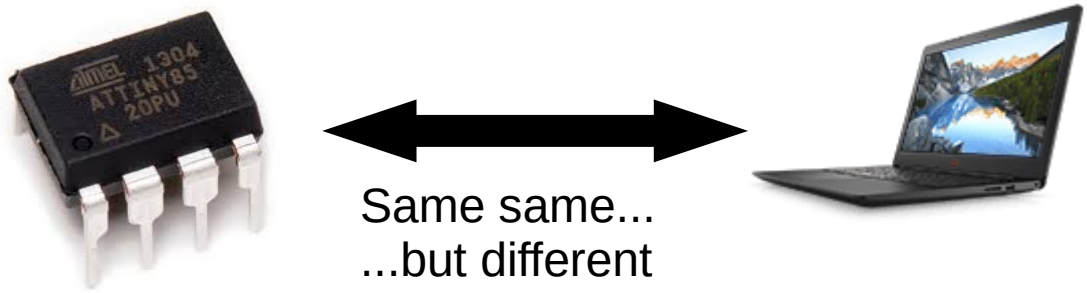
ATmega 328

What is an Arduino?

Micro-controllers are...

Like a miniature computers...

- Contains processor, RAM, storage, and more
- Can be programmed like a computer



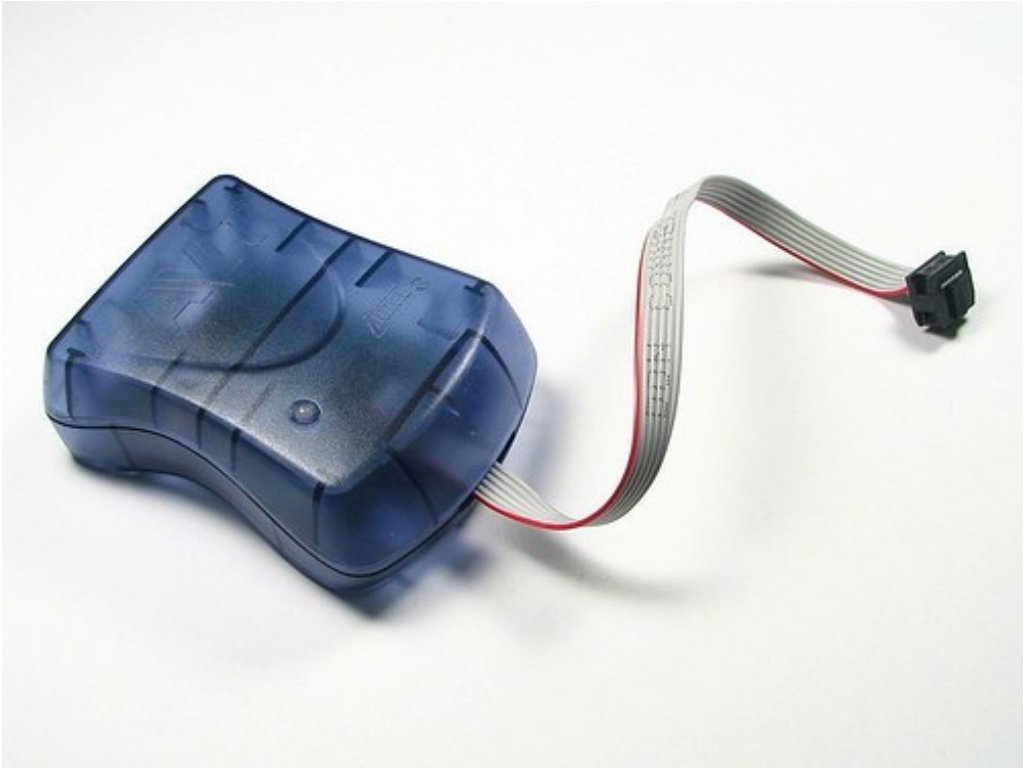
Unlike a computer...

- Provides direct electrical connection to external devices
- Can’t run Minecraft or Fortnite...

What is an Arduino?

Micro-controllers can be a pain…

- Require a special device to program...



AVRISP (In-System Programmer)

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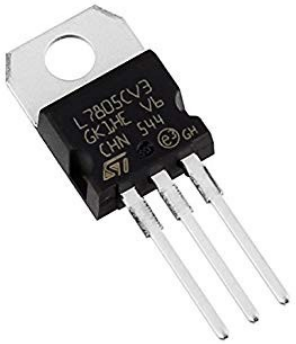
What is an Arduino?

Micro-controllers can be a pain…

- Require external parts to work (eg. voltage regulator, crystal oscillator, decoupling capacitors)



Voltage Regulator
(...this is the simple type)

Crystal Oscillator

Capacitor

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What is an Arduino?

So what is an Arduino?

- Combines a micro-controller with all the other components into a single device

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What is S4A?

This is an easy one. It’s a version of Scratch that works with Arduino.

All of you have already done Scratch right?

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What is S4A?

- Opensource modification of MIT's Scratch
- Modified to communicate with Arduino boards

What is S4A?

Why use S4A?

- Code is very similar to Arduino
- Block-based, so less likely to make mistakes

Arduino

```
void setup() {
  pinMode(13, OUTPUT);
}

void loop() {
  digitalWrite(13, HIGH);
  delay(1000);
  digitalWrite(13, LOW);
  delay(1000);
}
```

S4A

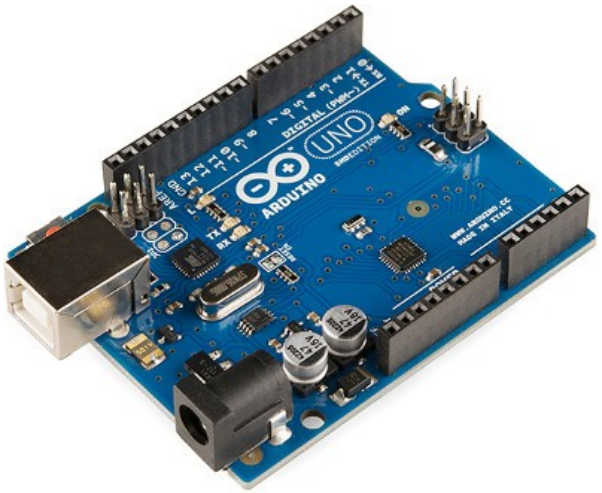
What is S4A?

- Code runs in the computer and sends commands to the Arduino

Runs on Computer

Commands
(eg. digital write)

Readings
(eg. digital read)



Getting Started

(The fun part...)

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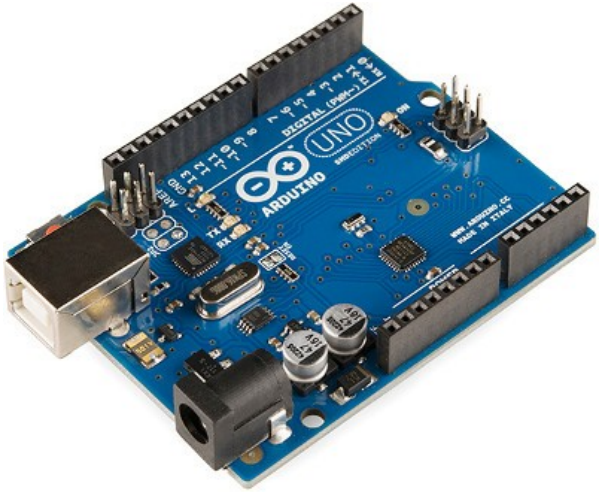
Physical Connection



Some of the LED on the Arduino should light up after connection

This end to computer

This end to Arduino

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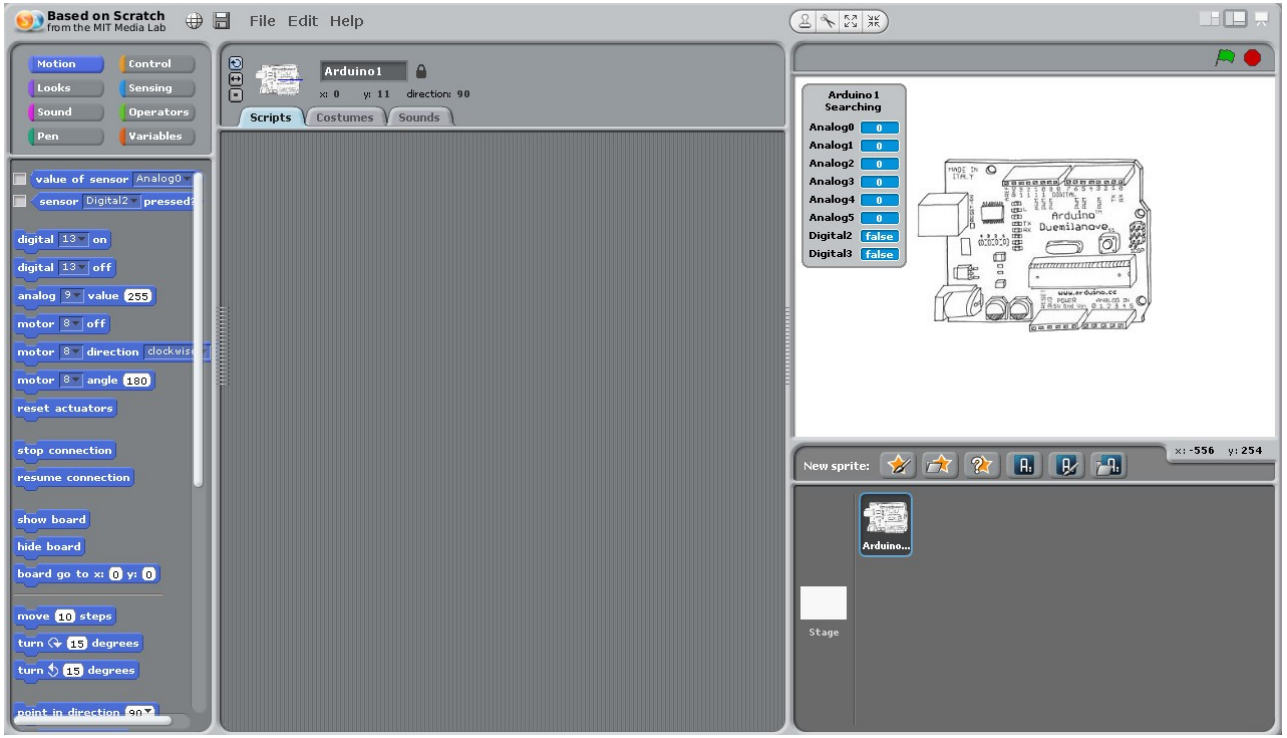
Software Connection

1) Look for this icon and run it

2) You should have a screen like this...



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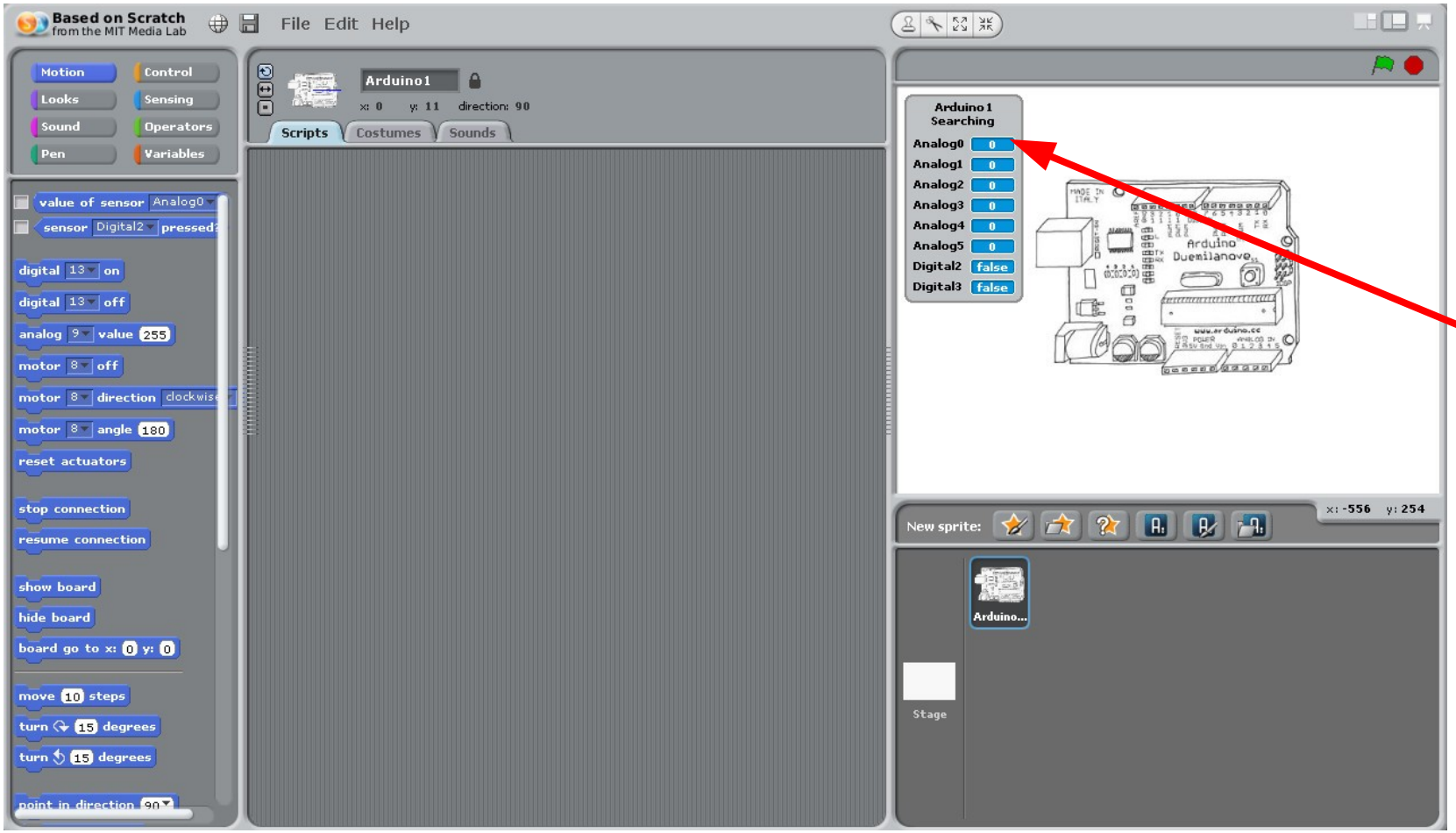
Software Connection

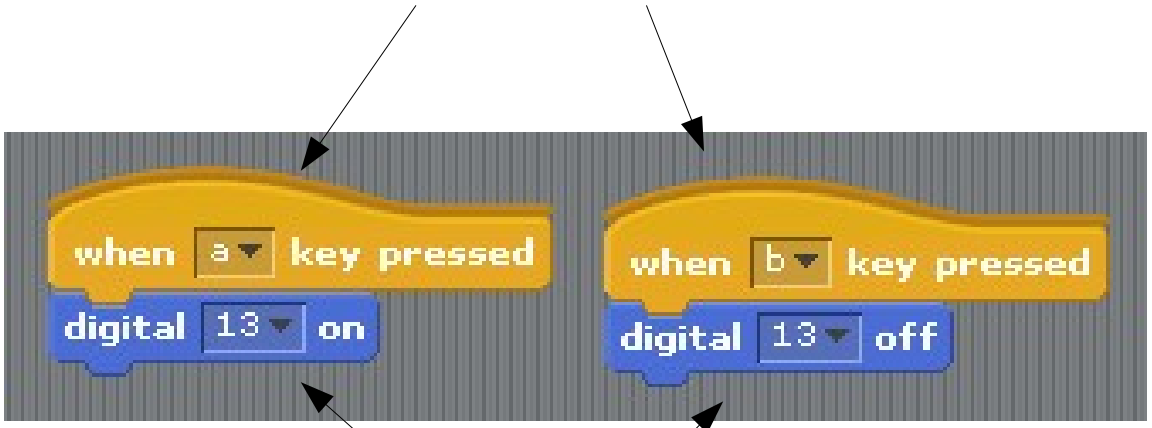
3) Wait for it to connect to your Arduino



Once connected, it will no longer show "Searching"

First Program

These are key press “events” (found under “Control”).
They run the script beneath them when their keys are pressed.
(If greyed out, check that you’re connected in “Live” mode)



These turn digital pin 13 on and off.
Digital pin 13 is connected to a built-in LED, so you can see its effect without having to connect anything.

Test it out!

Exercise 1a
External LEDs

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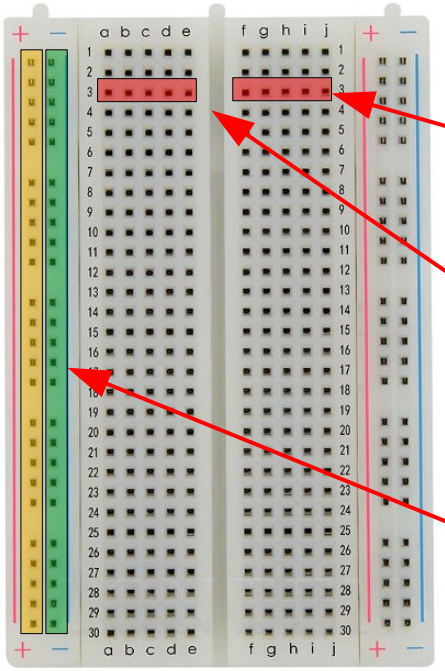
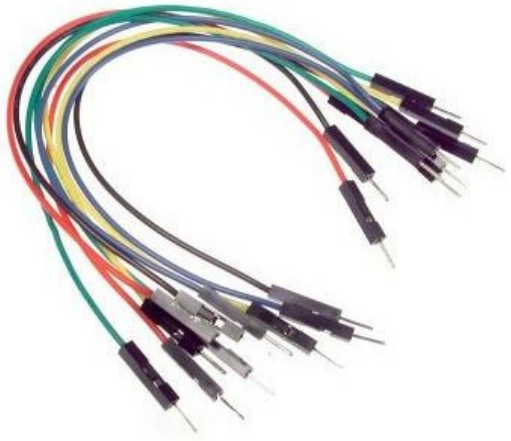
Breadboard

- Helps to make electrical connections
- Many components (eg. LEDs) can be plugged in directly
- Use dupont wires to make connections





Dupont wires
The colors doesn't matter; they all work the same

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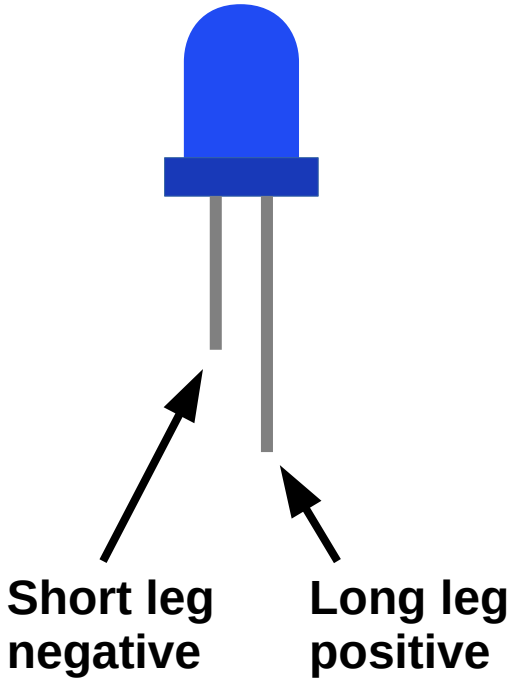
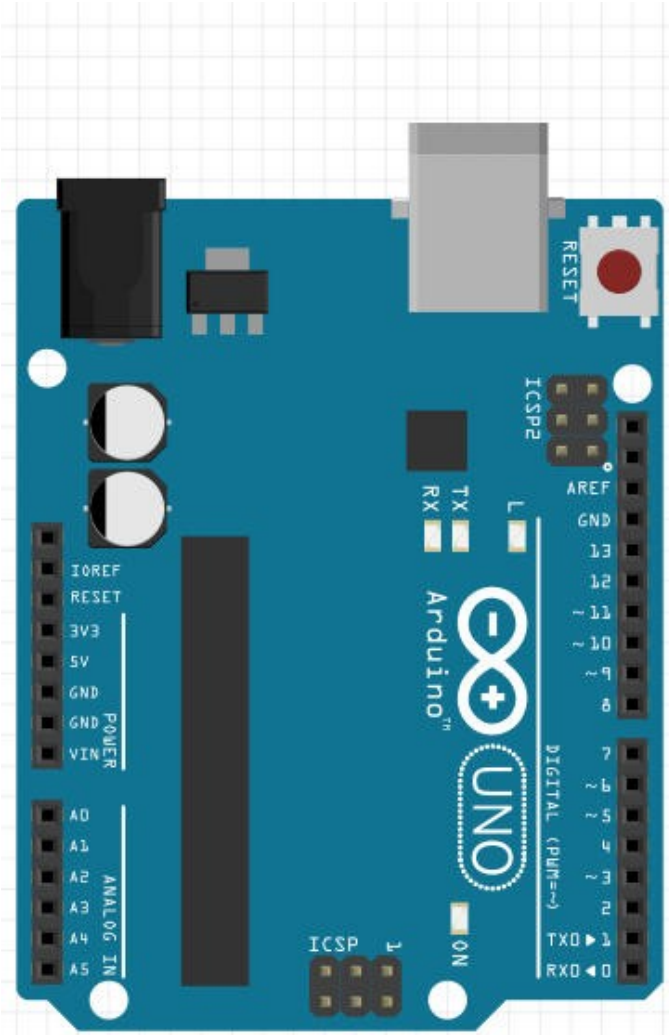
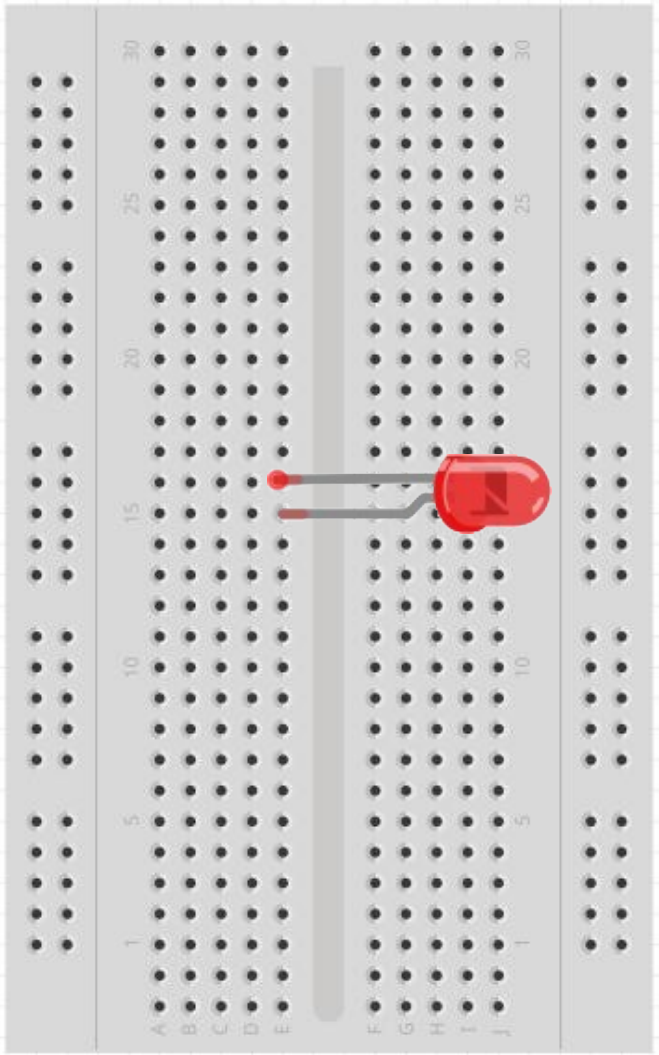
LED

- Light Emitting Diode
- Longer leg connects to positive
- Shorter leg connects to ground (0V)
- **Doesn’t work if connected in reverse**



Connecting an LED



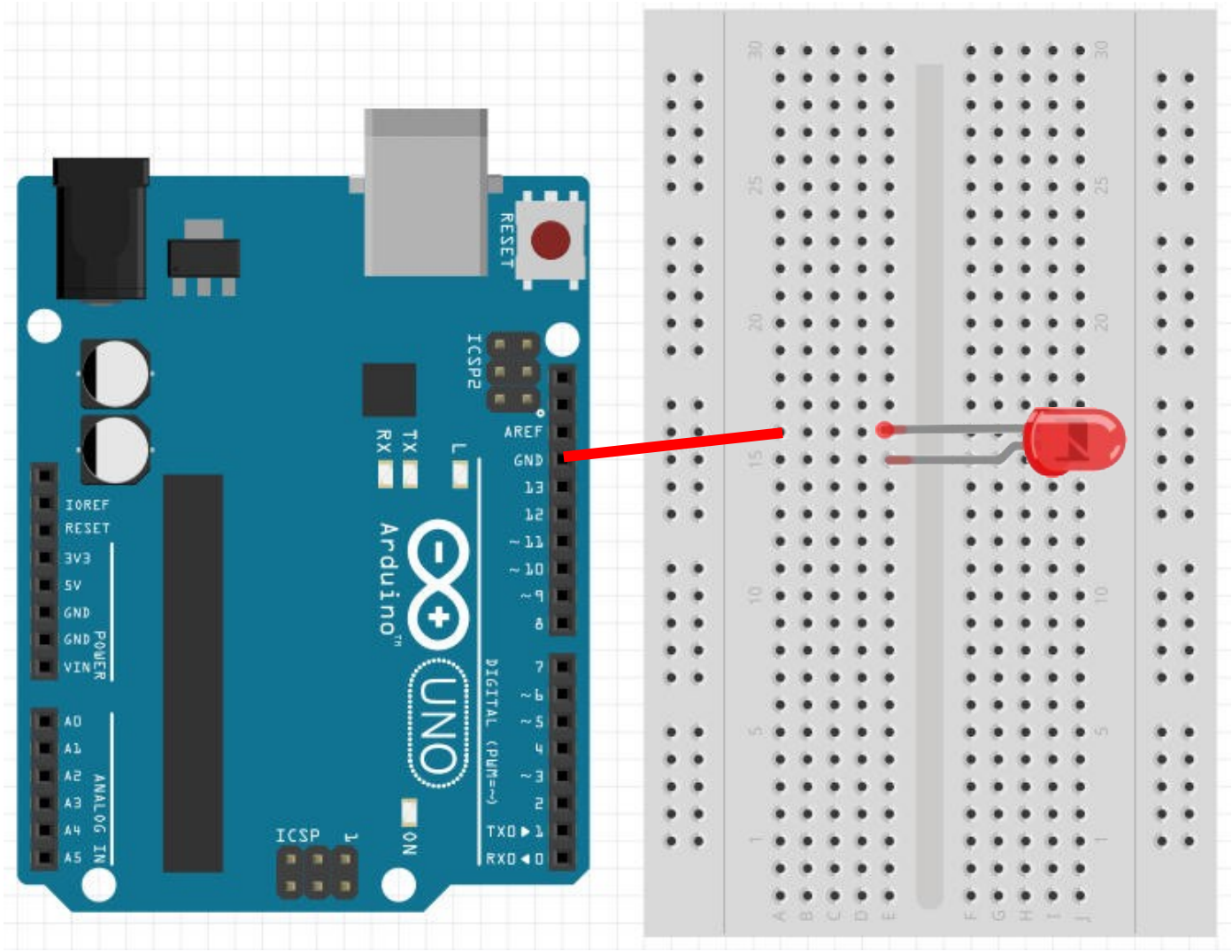


Important!!!
Take note of which leg of the LED is longer

In this example, the bottom leg is longer.

Long leg : Positive
Short leg : Gnd

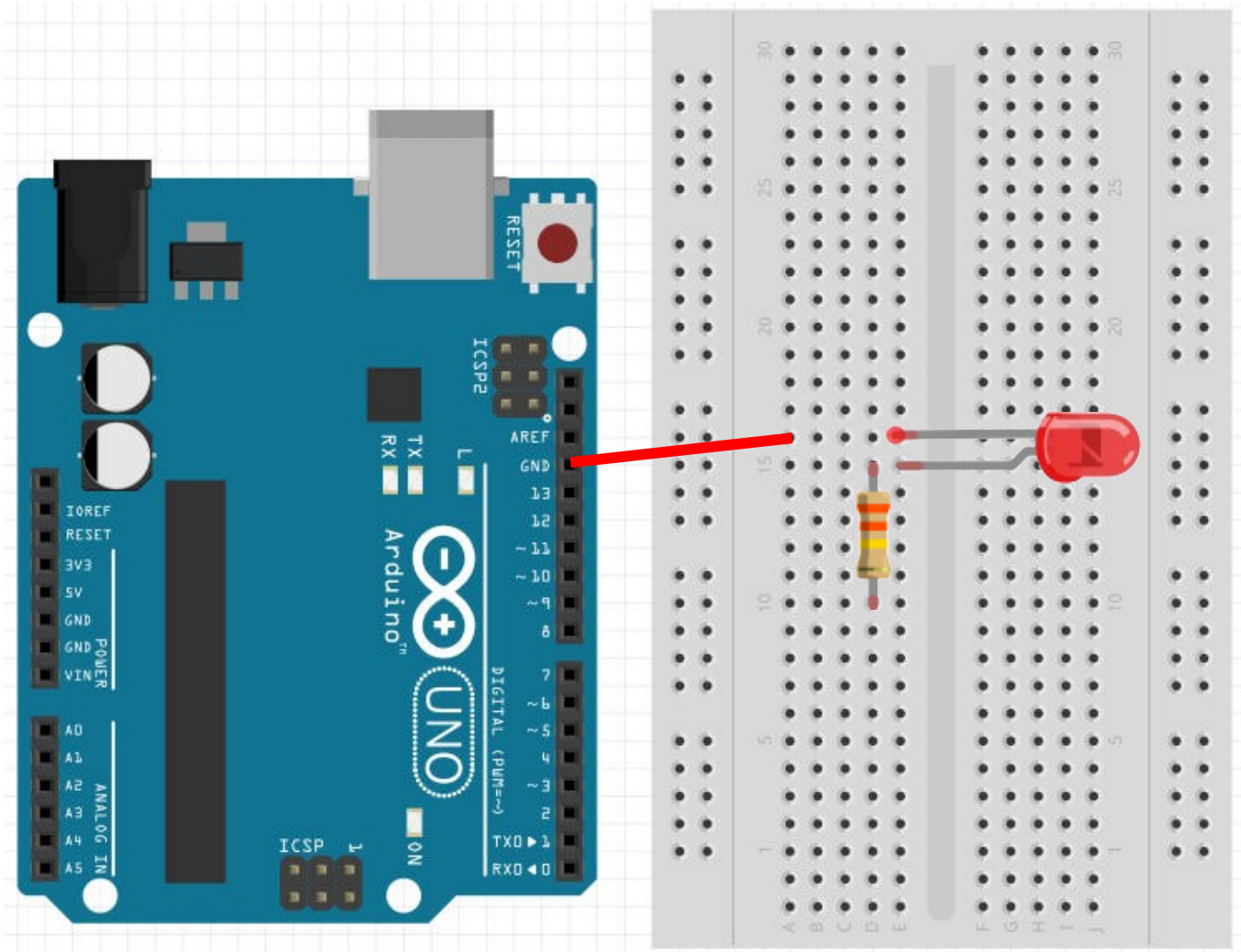
Connecting an LED



Connect a wire from “GND” to the shorter LED leg.

*** My shorter leg is on top.**

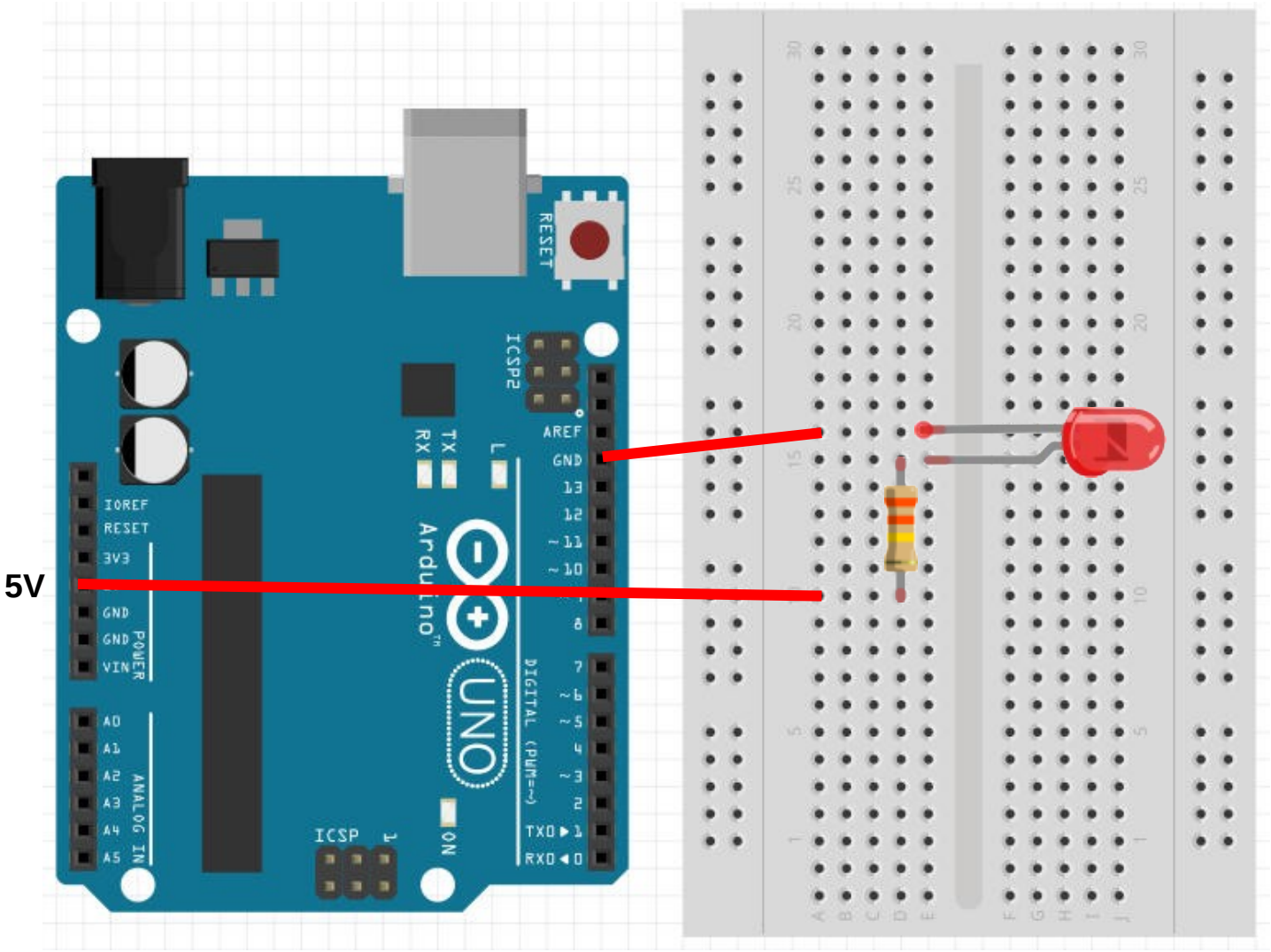
Connecting an LED



Add a 330 ohm resistor.

Connect one end to the long LED leg, and the other end to an empty row.

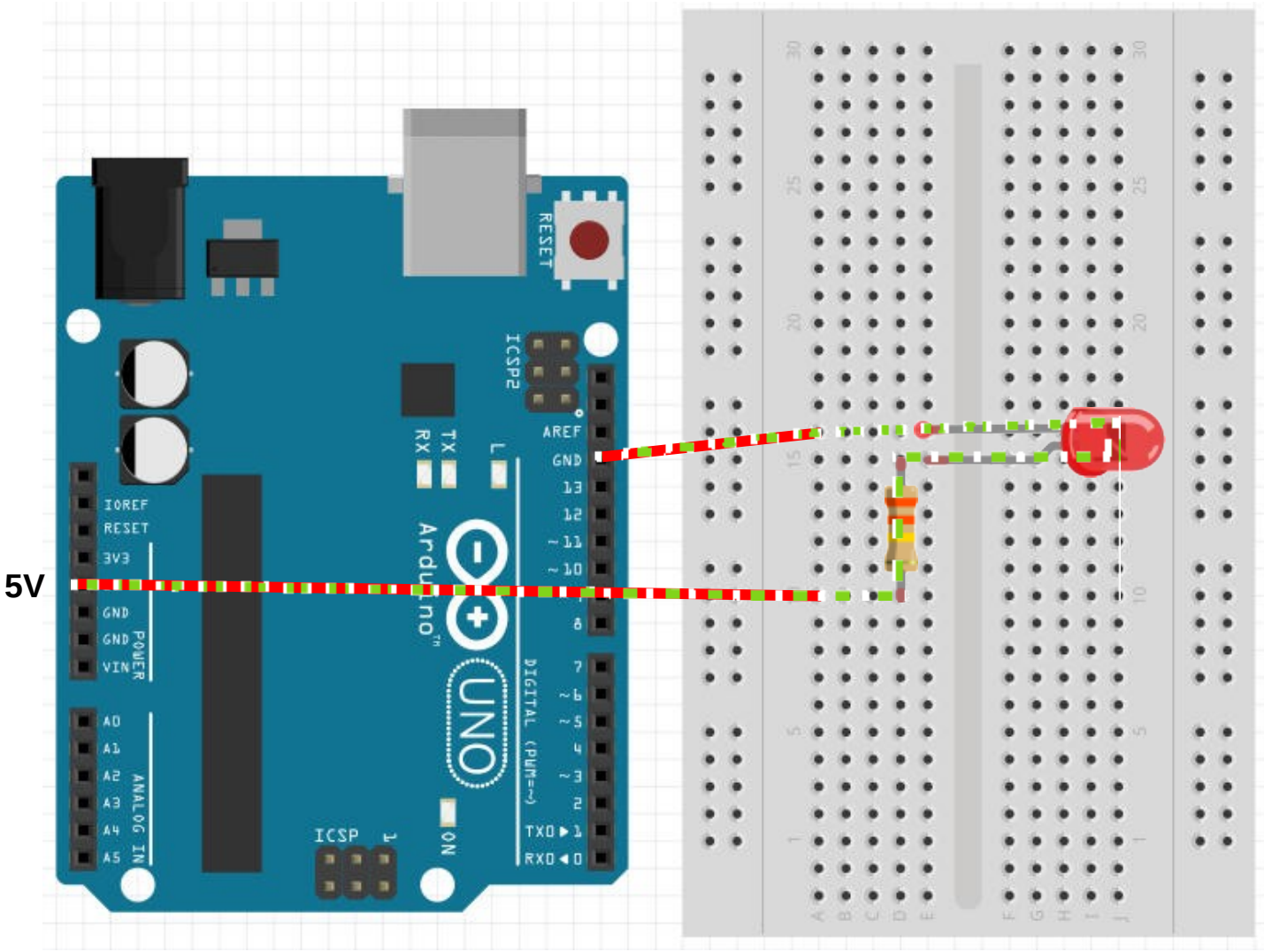
Connecting an LED



Connect the other end of the resistor to the “5V” pin

The LED should light up immediately!

Connecting an LED

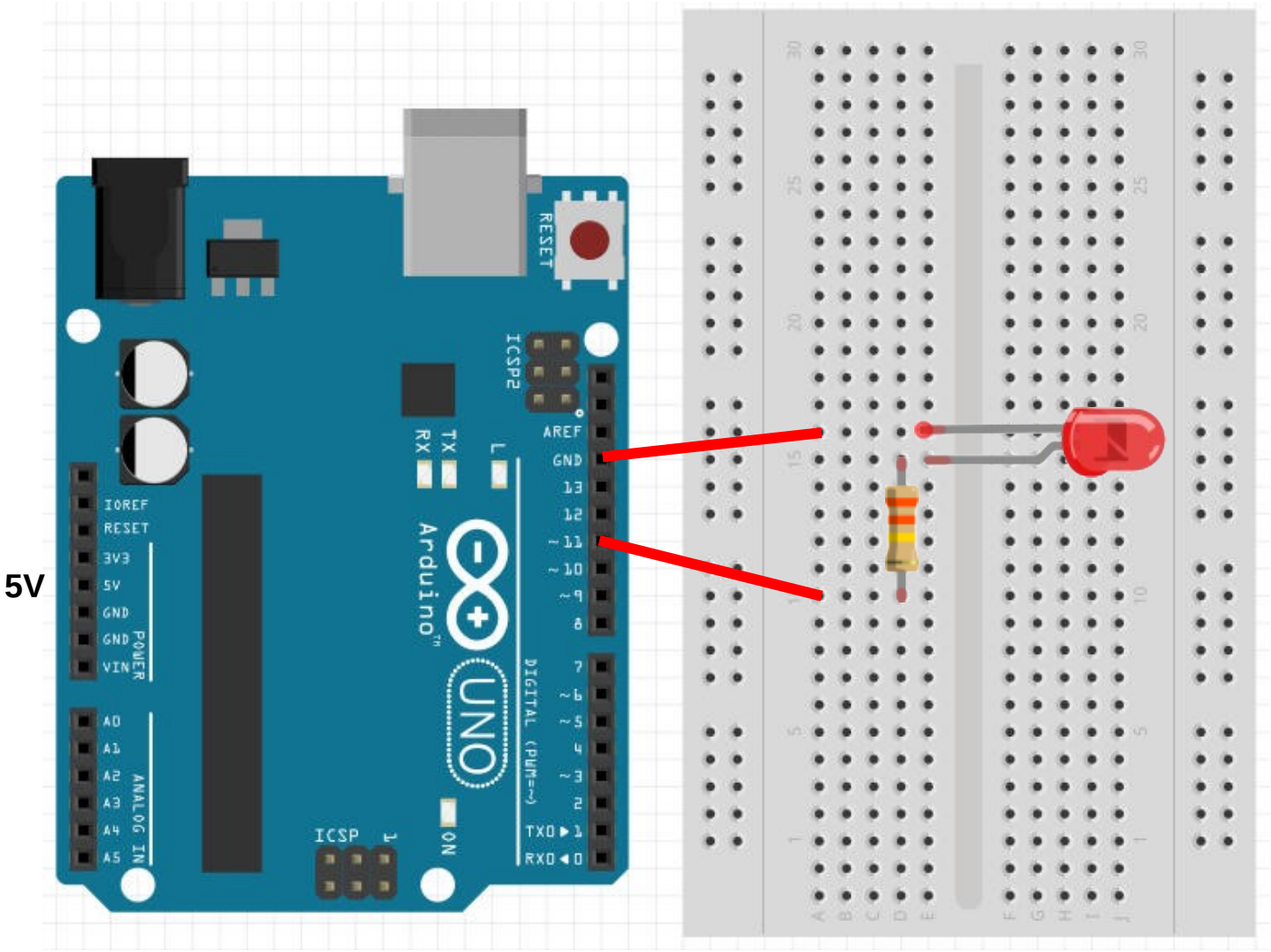


This is how the electricity is flowing

From…

- **5V to…**
- **Resistor to…**
- **LED to…**
- **GND**

Connecting an LED



Controlling the LED

To control the LED, we need to connect it to an output pin instead of 5V.

- **Disconnect it from 5V.**
- **Connect it to Pin 11.**

Challenges

1) Modify your earlier program to control the external LED instead of the internal LED.

2) Program the connected LED blink continuously

Why the resistor?

- Arduino pins provide **5V**
- Different color LEDs require different voltages
  - Red, Yellow, Infra-red: **1.8V**
  - Blue, White, UV: **3.3V**
  - Green: Depends. Try **1.8V** first.
- **Resistor helps to reduce the voltage**
- What happens when you connect 5V to a Red LED without a resistor?

Exercise 1b
External Inputs

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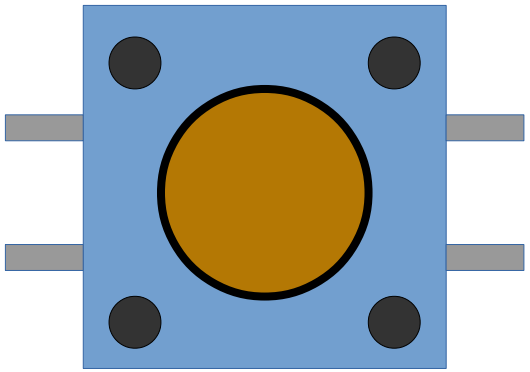
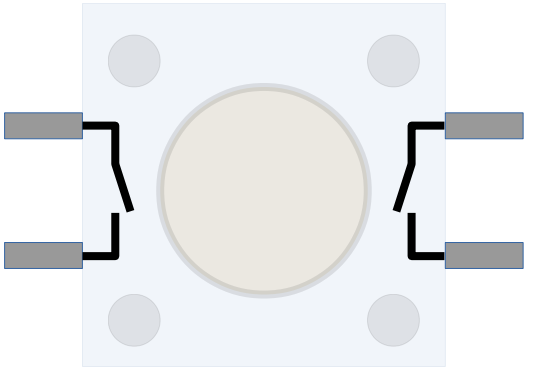
Push Button Switch

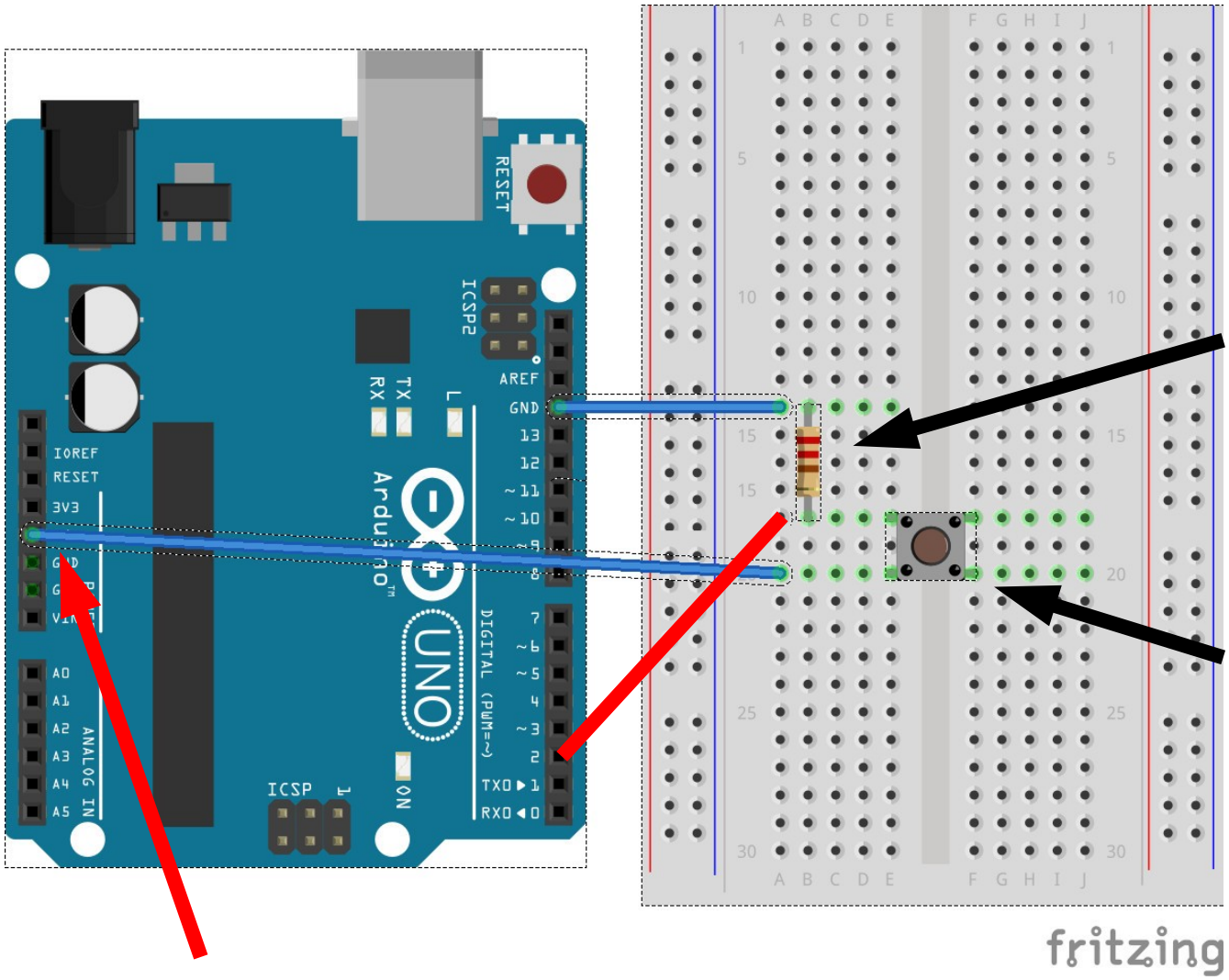


External View



Internal View

Connecting a Switch



Connected to 5V

Make these connections

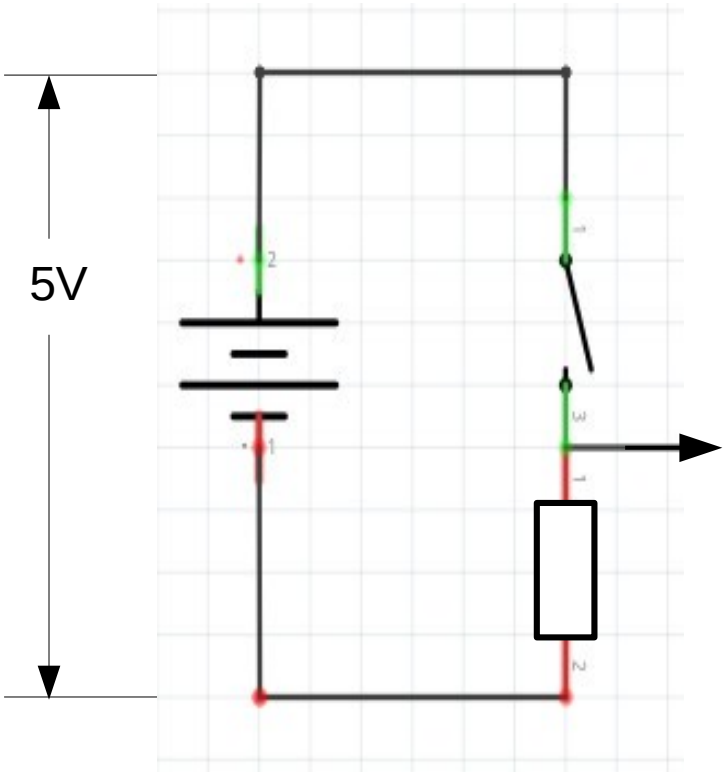
Resistor
Value isn't as important as before. Recommend to pick 1000 ohm, but most other values will do as well.

Push button switch
Connects the adjacent pins. Only need to use one side...

Connecting a Switch

- When switch is open…
- Pin 2 is connected to 0V via the resistor
- Pin 2 not connected to 5V

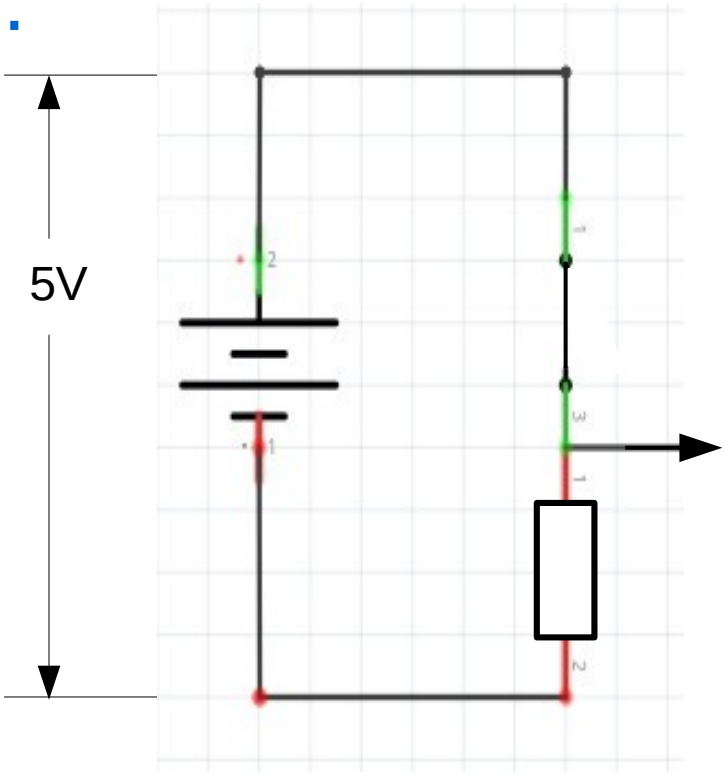
Voltage of pin 2
= 0 V
= False
= Low



Connecting a Switch

- When switch is closed…
- Pin 2 is connected to 0V via the resistor
- Pin 2 is connected to 5V **directly**

Voltage of pin 2
= 5 V
= True
= High



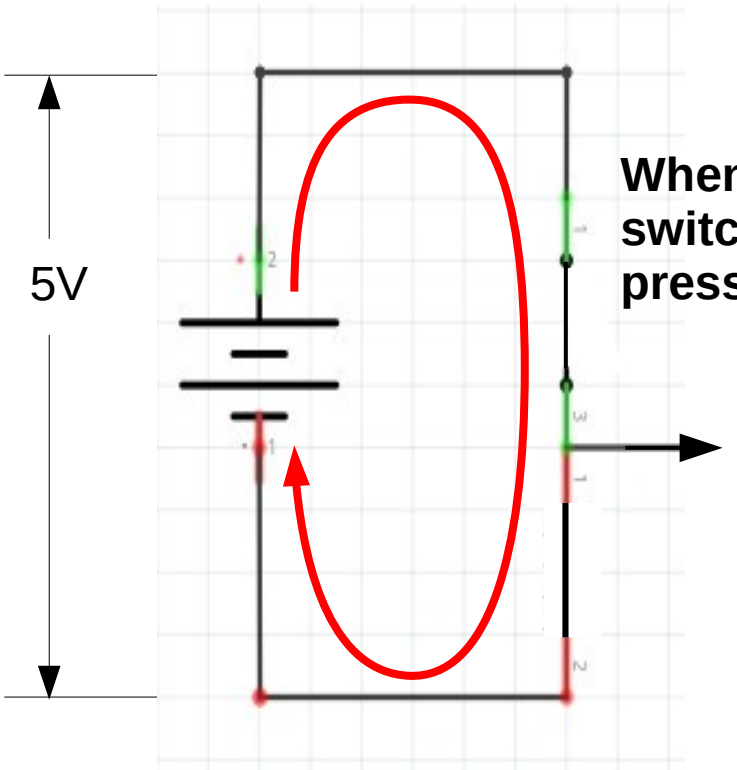
Connecting a Switch

- This resistor is call a **pull-down resistor**, because it pulls the voltage down to 0V when the switch is open

- We can also connect the resistor to 5V and the switch to Gnd. This is call a **pull-up resistor**.

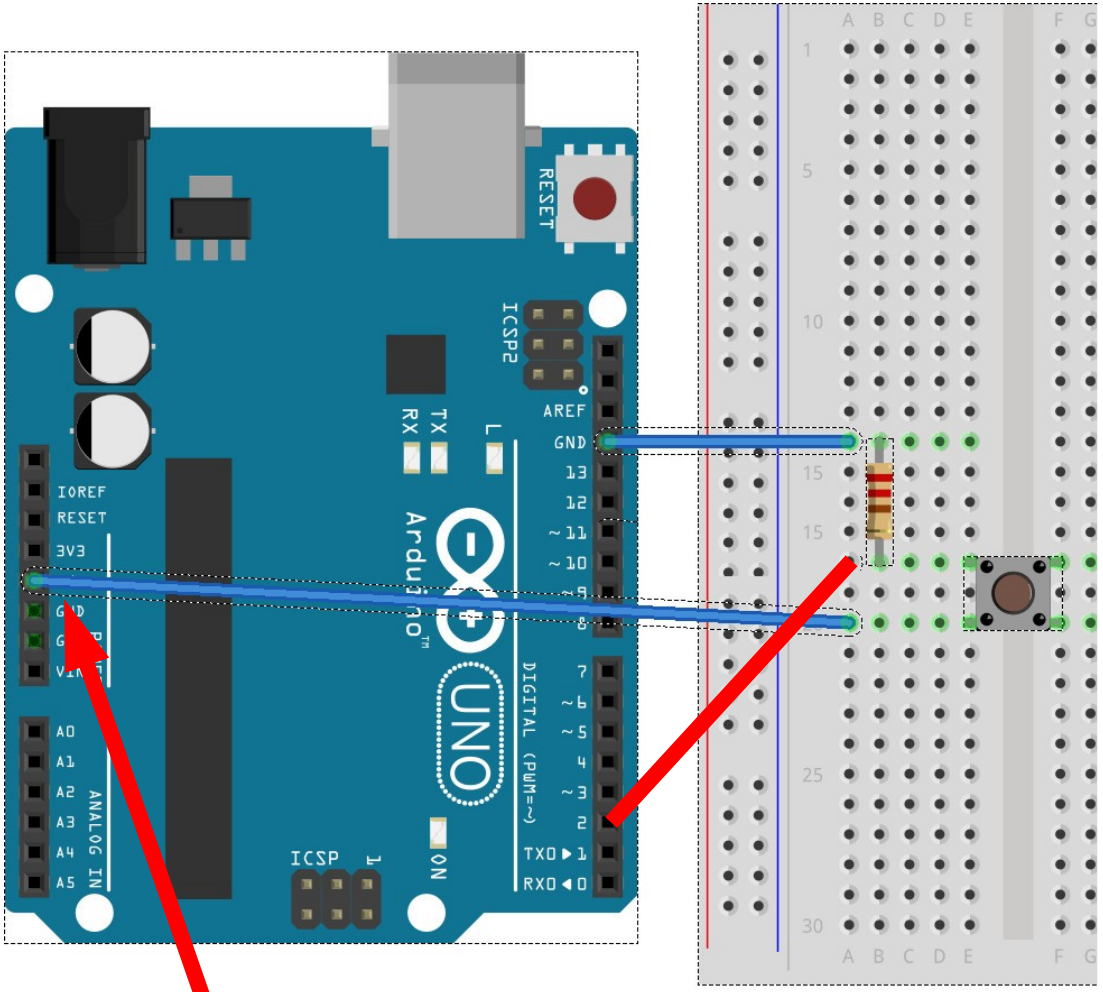
Connecting a Switch

- Can we connect the switch to Gnd without a resistor?
  - NO! Without the resistor, we will have a short circuit when the switch is pressed



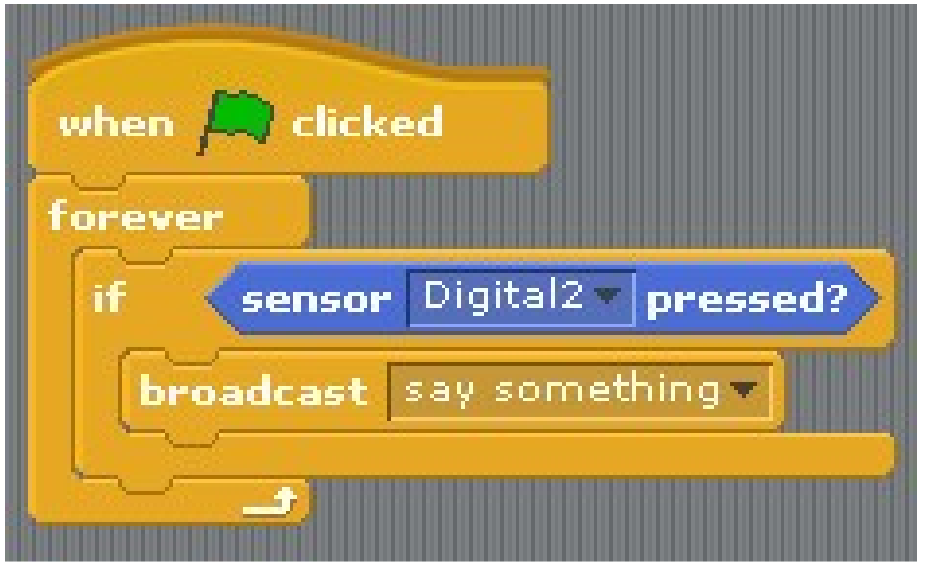
Positive connected directly to negative.
Short circuit!

Connecting a Switch



Connected to 5V

Add this script to your “Device”



Add this script to your “Sprite”

Challenges

1) Make an LED blink rapidly for 2 seconds when the button is pressed

2) Make an LED toggle between on and off when the button is pressed

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