# 4-H Career Explorations:
## Mechanical and Aerospace Engineering


25 - 27 June 2019
Cornell University

ROBOTS!

# WHO WE ARE

## Beatriz

1st year PhD

**Research:**

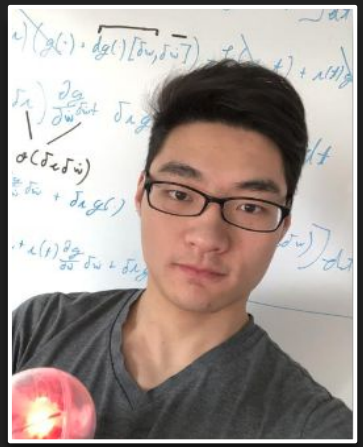
Multi-robot teams and uncertainty

## Adam

3rd year PhD

**Research:**

Formal logic for specification encoding



## Ji

3rd year PhD

**Research:**

Verifiable controller design for swarm systems

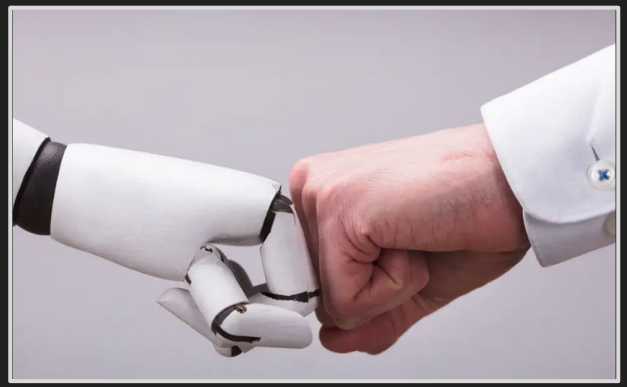
## Autumn

2nd year PhD

**Research:**

Soft robotics

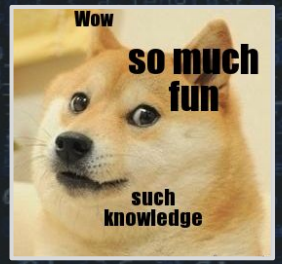
Yesterday we learned how to build robots...



...but how can we make them do what we want?

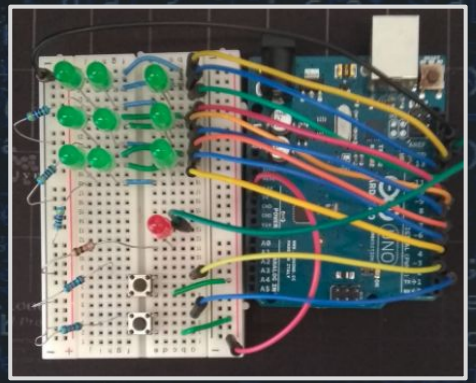
# We need to program them!

Today we will be building a circuit and coding...




...we are going to play Tic Tac Toe using an Arduino.

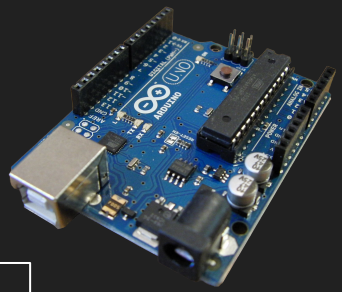
Pair up!



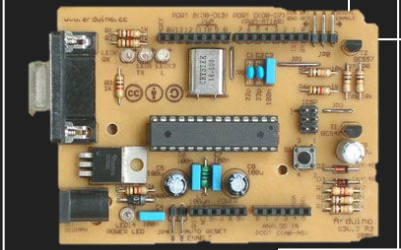
# What is an Arduino?

- Single-board microcontroller
- Can be used in many [many] projects
- Developed by undergrads of a Design school in Italy (2005)
- **Open source** hardware and software: *www.arduino.cc*
- Program language similar to C/C++
- Similar boards: Freeduino, funduino, seeeduino, kuman

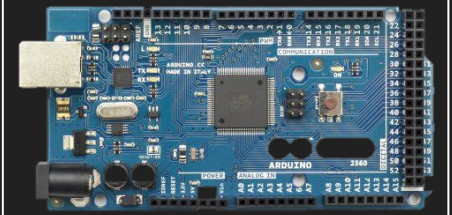
Arduino UNO



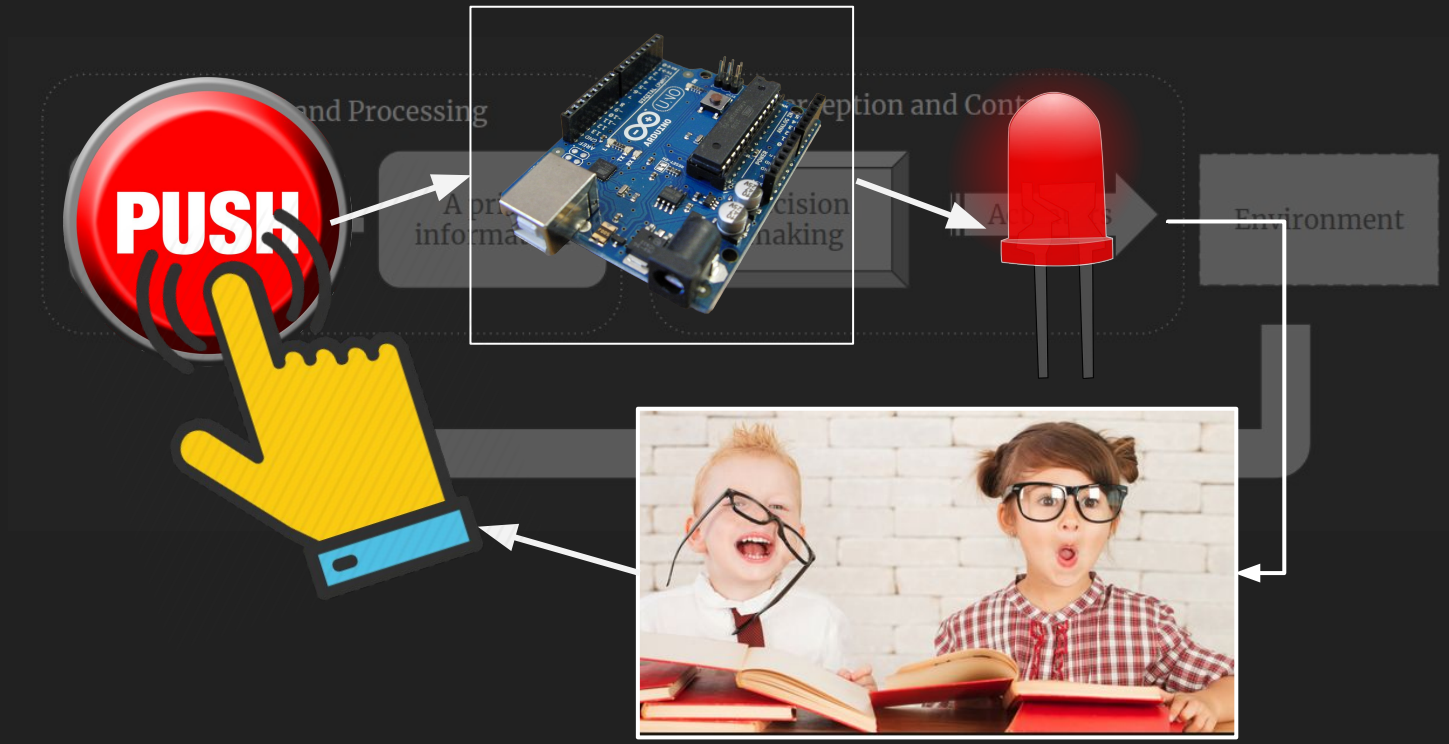
Hand-made Arduino



Arduino MEGA



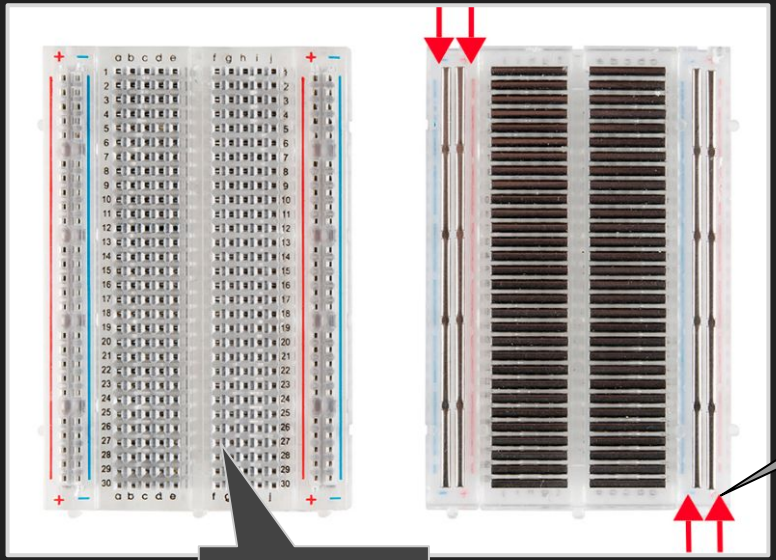
# What does Tic Tac Toe have to do with Robotics?



# First things first

## **DO NOT** short circuit your Arduino

NEVER connect two legs of the LED in the same **row**



Holes in EACH row are connected

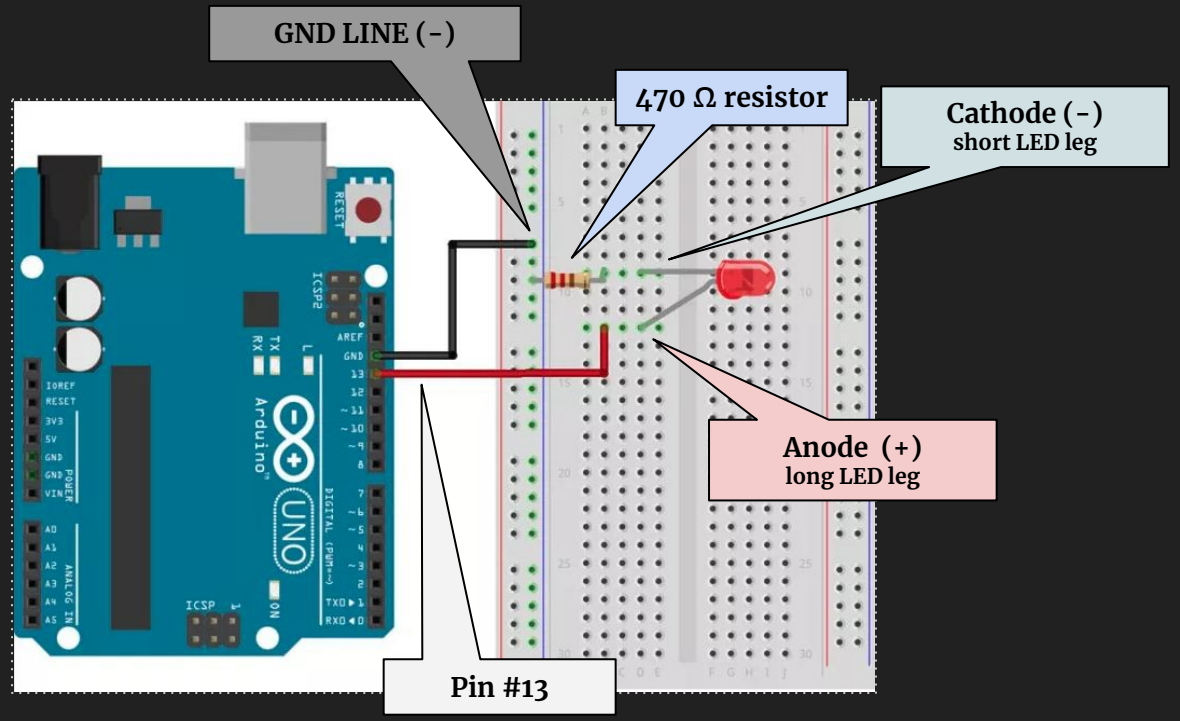
Holes in this column are connected **GROUND LINE (-)**

Holes in this column are connected **POWER LINE (+)**

NEVER connect POWER and GND directly

# Let’s connect an LED

NEVER
connect two legs of the LED in the **same row**

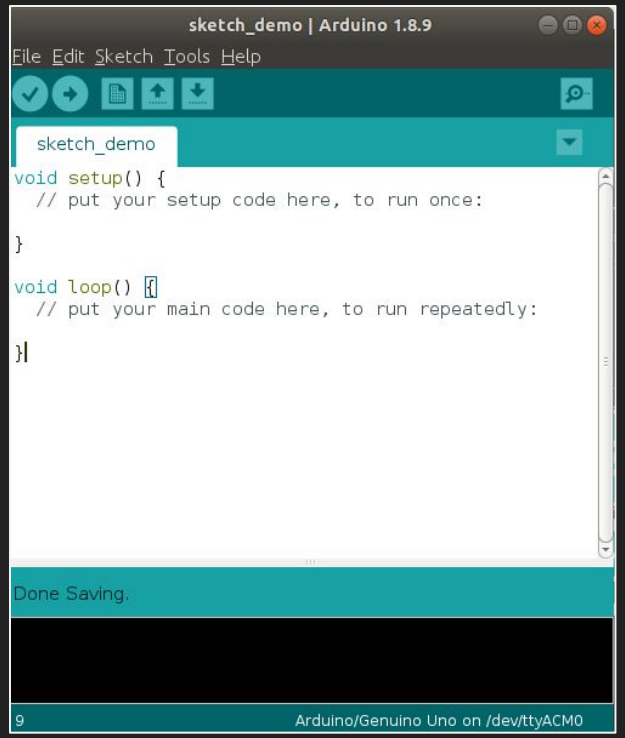


# Power the Arduino

Make sure your LED connection is right before doing this

1. Connect the Arduino with the computer using the USB cable

2. Click here




3. Go to **Tools > Board**
Select : Arduino/Genuino UNO

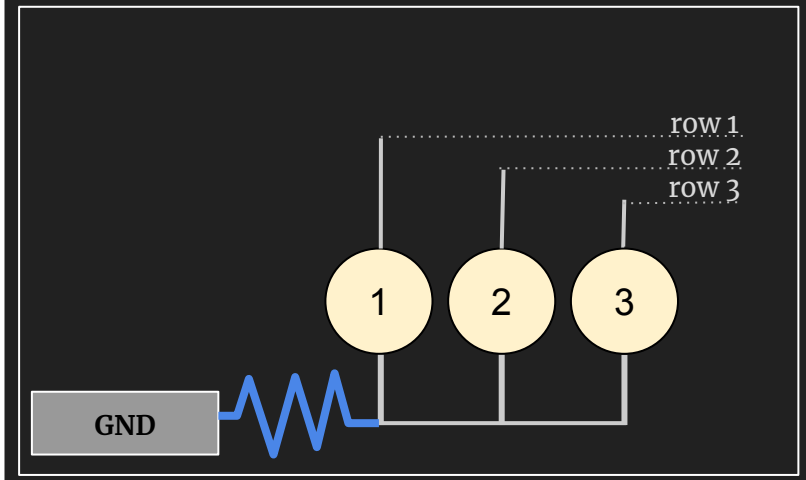
3. Go to **Tools > Port**
Select : COM # that shows a board

NEVER connect two legs of the LED in the **same** row

# Make the LED blink

| | | |
|---|---|---|
| int ledPin = 13;<br><br>void setup( ) {<br>pinMode(ledPin, OUTPUT);<br>}<br>void loop( )<br>{<br>digitalWrite(ledPin, HIGH);<br>delay(1000);<br>digitalWrite(ledPin, LOW);<br>delay(1000);<br>} | **Declare variables** | **Int:** variable takes integer values<br>ledPin is the name of the variable, 13 is the pin number on Arduino |
| | **Program setup** | Give the specifics of your program (run once):<br>Define your pin as an OUTPUT pin |
| | **Loop: the actual program logic** | This logic will be repeated every loop iteration (until you reset the Arduino)<br><br>set pin status HIGH (on),<br>Wait 1 second<br>Set pin status LOW (off),<br>Wait 1 second<br><br>[repeat] |

# Place the others LEDs in a 3x3 Matrix



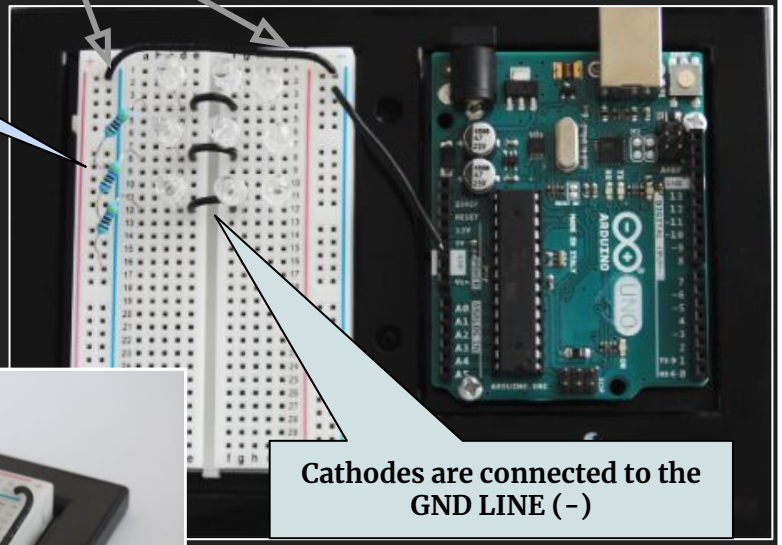

and so on...

GROUND LINE (-)

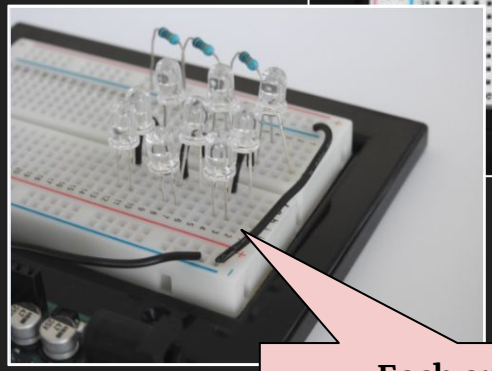
Disconnect the Arduino from the power first!

470 Ω resistors

=



Cathodes are connected to the GND LINE (-)



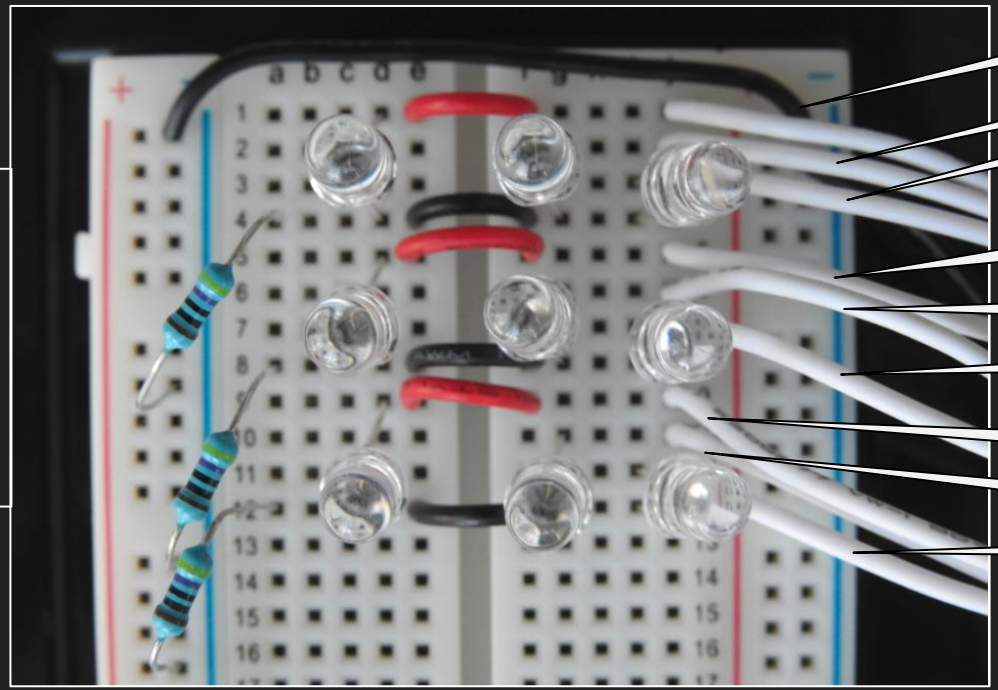
Each anode (+) gets a row

Picture: Leon Zamel

# Connect each LED to an Arduino pin, from 12 to 4

Make sure your LED connections are right before doing this

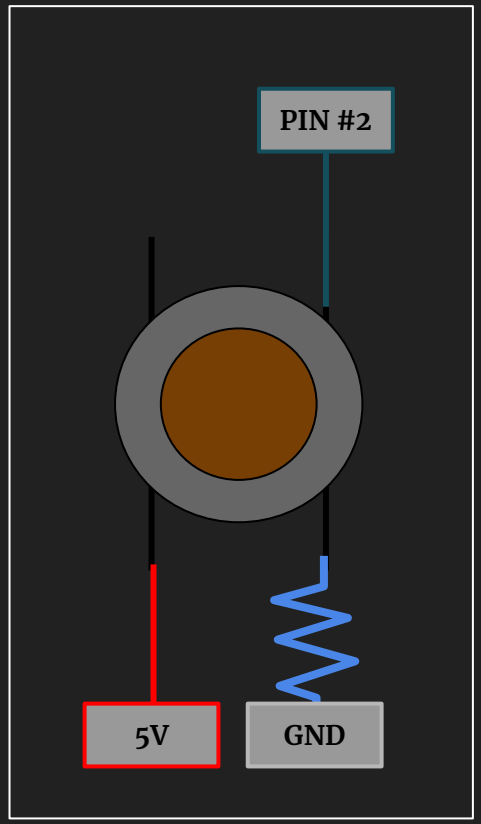
Change the pin variable on your previous code and **test each LED**




NEVER connect two legs of the LED in the **same row**

# Let’s connect the push button

The resistor bridges the POWER and GND

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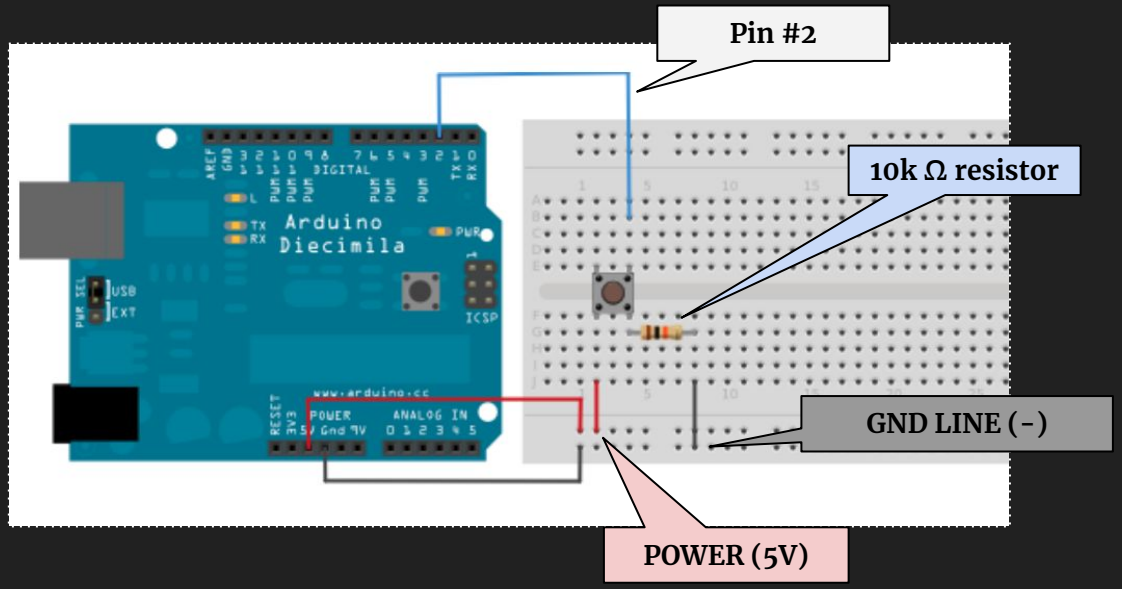



Do the same for the other push button with **pin #3**

NEVER connect POWER and GND directly

# Make the LED blink using the **push button**

```
int ledPin = 13;
Int buttonPin = 2;
int prevButtonValue = 0;
int buttonValue = 0;

void setup( ) {

pinMode(buttonPin, INPUT);
pinMode(ledPin, OUTPUT);
Serial.begin(9600);
}

void loop( )
{
buttonValue = digitalRead(buttonPin);

  if (buttonValue != prevButtonValue && buttonValue == 1) {
     Serial.println("Button Pressed");
     digitalWrite(ledPin, HIGH);
     delay(1000);
     digitalWrite(ledPin, LOW);
  }
}
```

**Declare variables**

**Program setup**

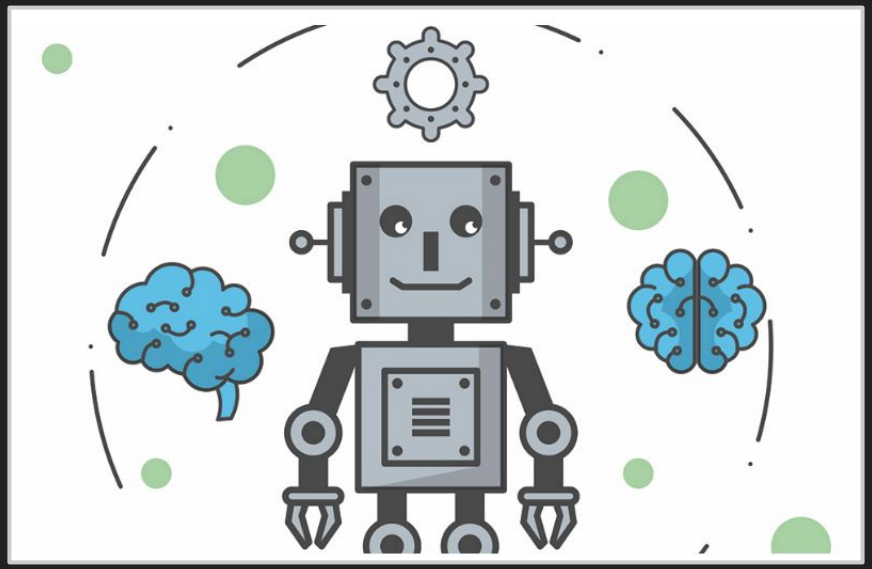
**Loop: the actual program logic**

# Let’s play!


1. Make sure all connections are OK
2. Go to: https://github.com/basfora/arduino_tictactoe.git
3. Download **tictactoe.ino**
4. Run the code!

# Let’s play!

# How could we play against the computer?



CMO.

# Artificial Intelligence and Autonomy