

introduction to Digital Electronics

Serial & Arduino Communication

MIT ILLUMINATIONS SEMINAR

Hello!

Warm Up!

Come up with as many uses as possible for
flying red lightbulbs



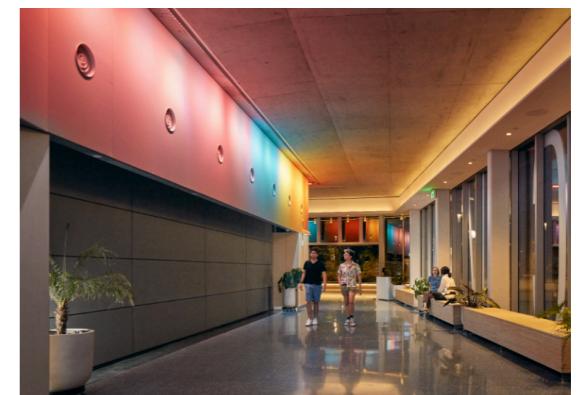
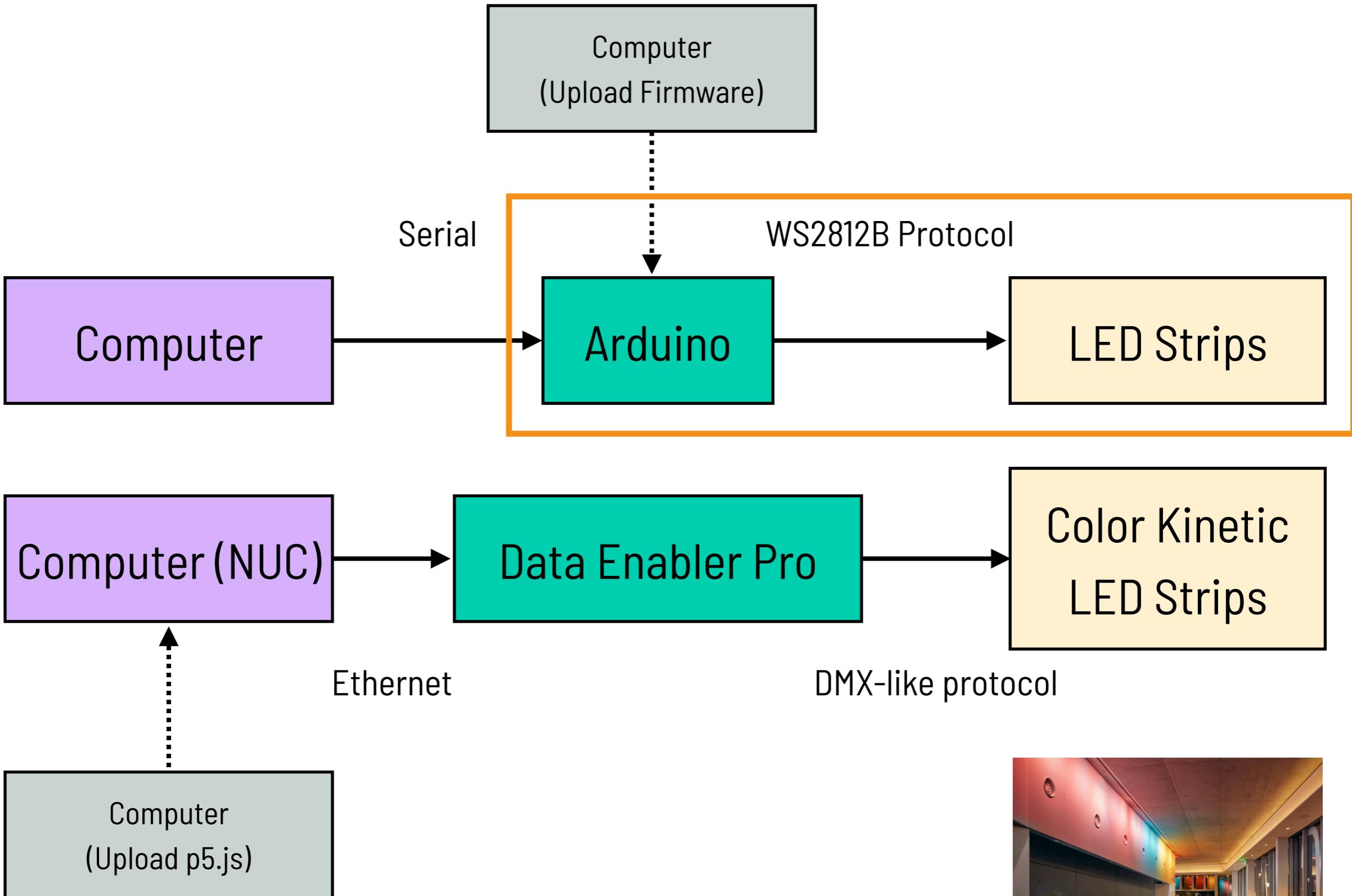
Today

WS2812B & LED Array Recap

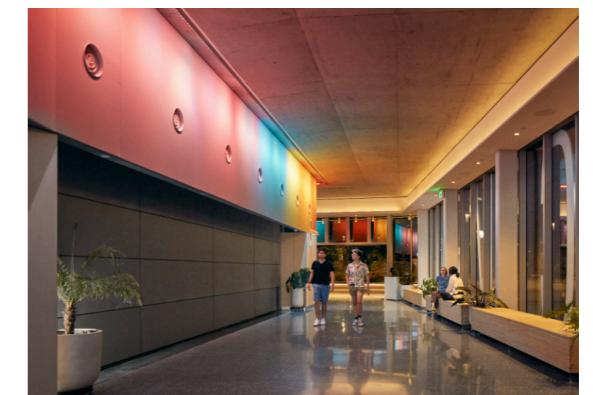
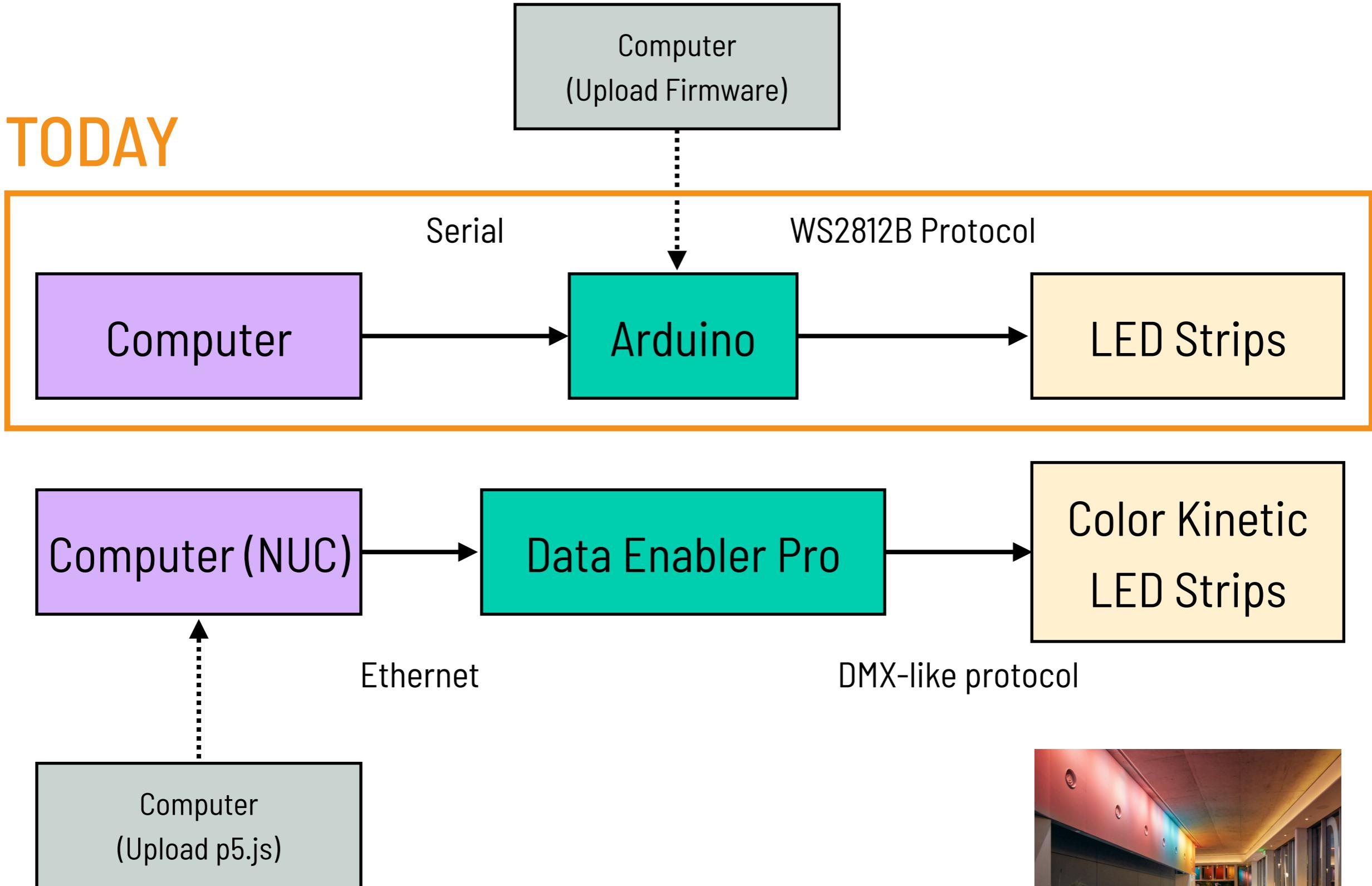
Serial Communication

Arduino & Node.js

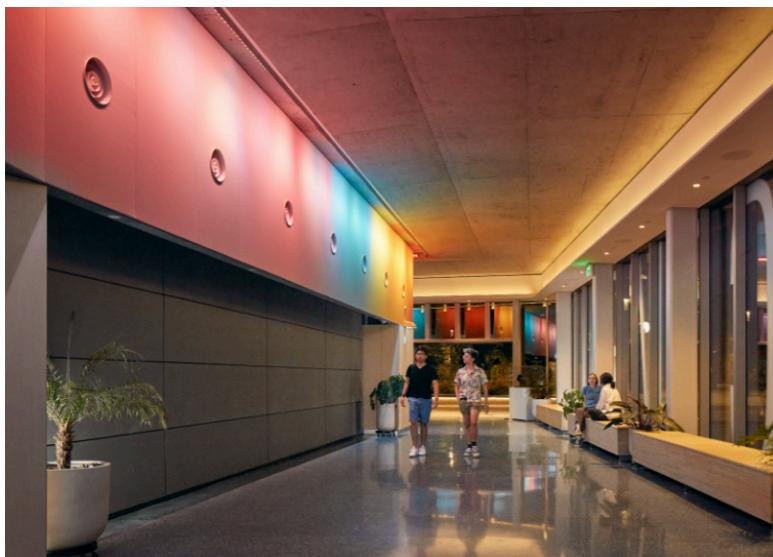
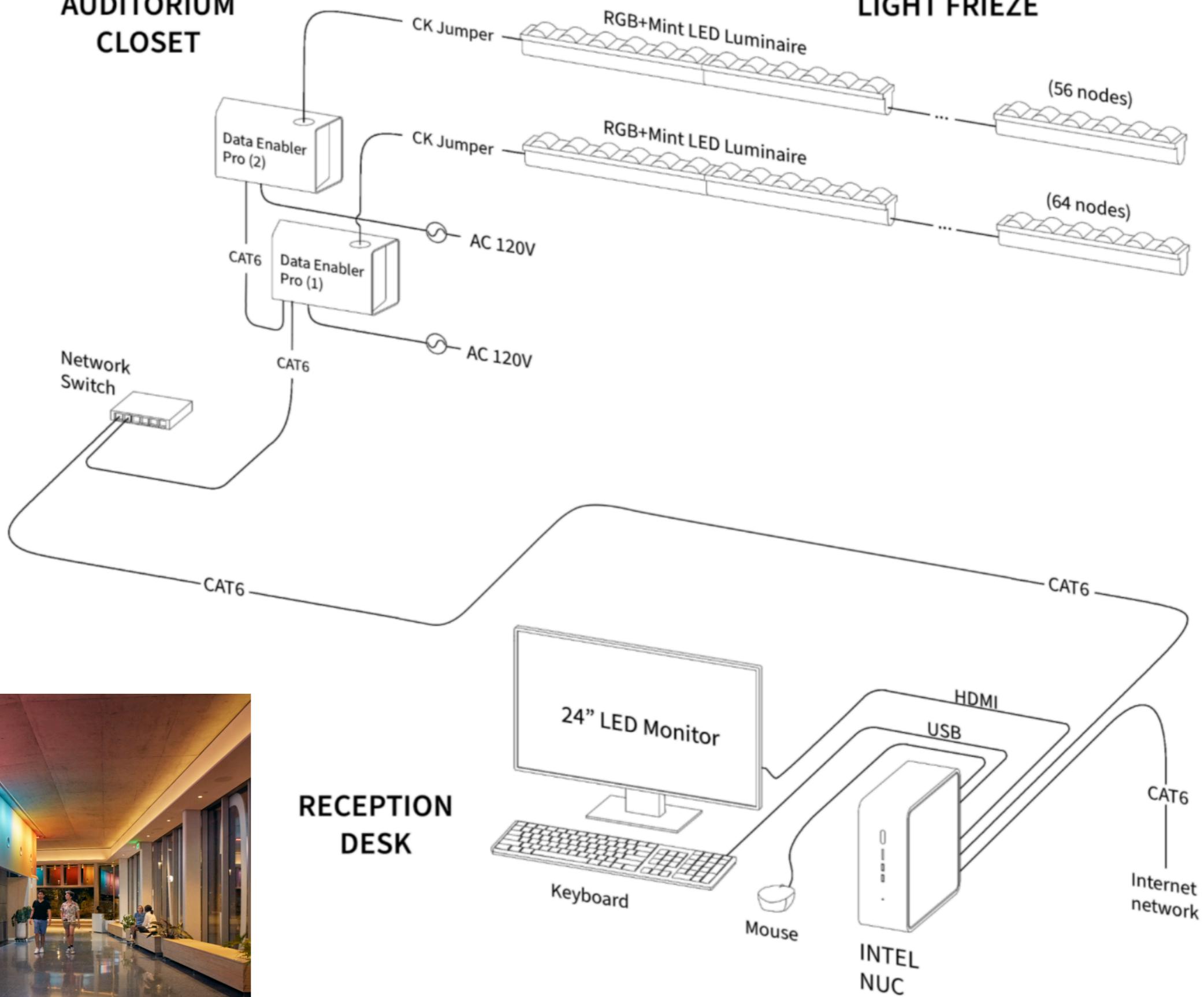
Plenty of time to play with the LEDs!



TODAY



AUDITORIUM CLOSET



Recap

Recap

MINDQUIZ

Recap

MINIQUIZ

```
void loop() {  
    for(int i = 0; i < NUM_LEDS; i++) {  
        leds[i] = CRGB(255, 255, 255);  
        // Show the leds  
        FastLED.show();  
        delay(100);  
    }  
  
    delay(2000);  
  
    FastLED.clear();  
}
```

1. What is the name of the LED strip we've been playing with? (no peaking!)

W - - - - -

2. What does PWM stand for?
Describe or draw a graphic to show what it is.
3. When this code to the left is run (assuming the 'setup' function is correct), the lights turn on one at a time (100ms delay). It's **supposed** to wait 2000ms then turn off. But why doesn't it? How do you fix it?

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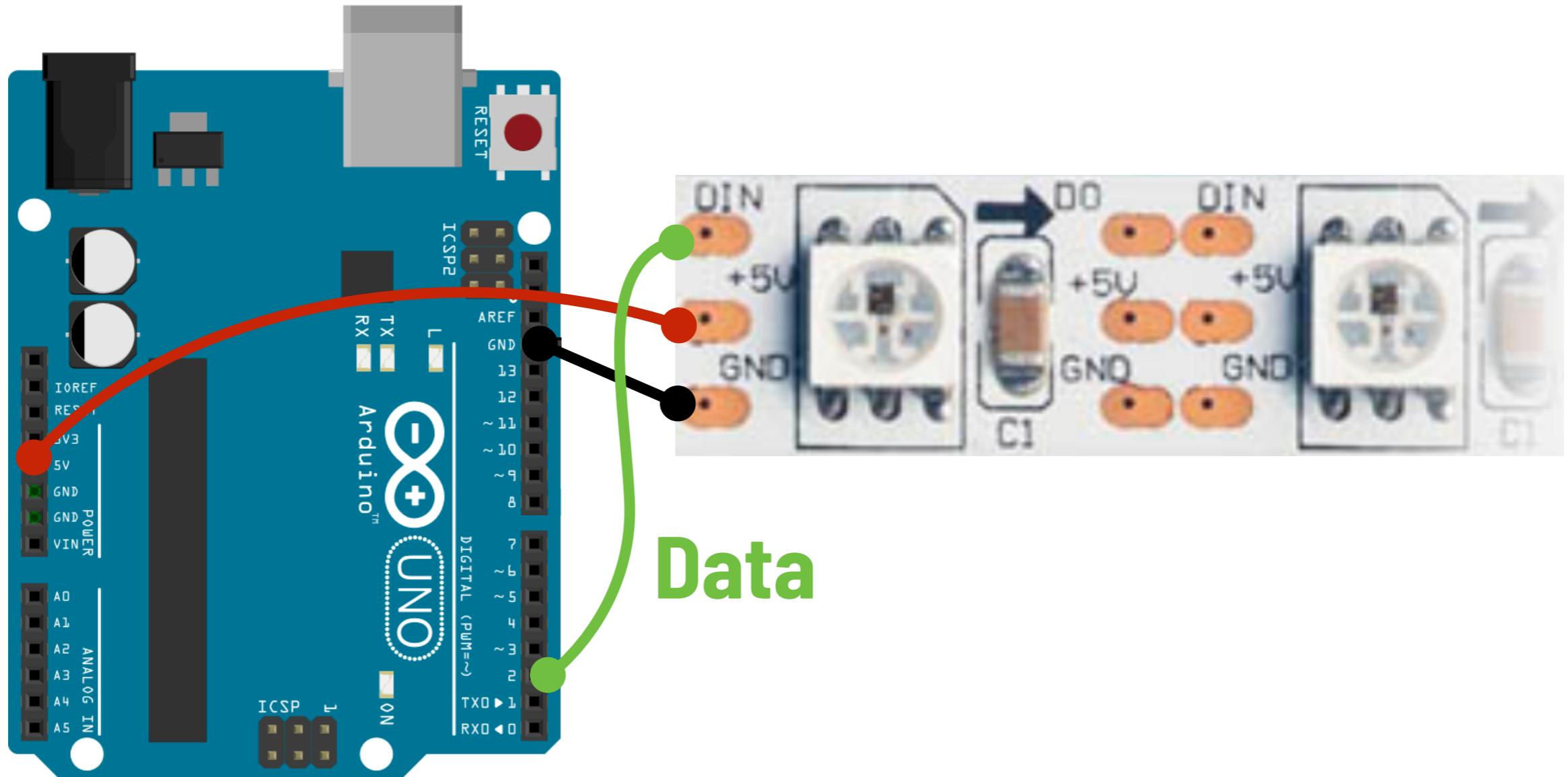
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Recap

WS2812B Leds



Recap

WS2812B Leds

A Quick Gut Check

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Let's modify some of the code. Take a quick look through the Arduino Sketch. Note the line that says:

```
#define NUM_LEDS 10
```

This tells the code how many LEDs are in your strip. You have a much longer LED strip, so let's go ahead and change that number to **300** (you actually have 300 LEDs on this strip!)

While we're at it, let's make it brighter. Let's change:

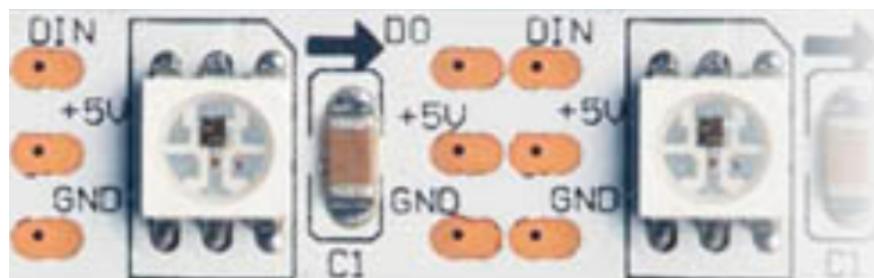
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FastLED.setBrightness(60);
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What does brightness do? According to the FastLED Documentation: ***Brightness is a 0-255 value for how much to scale all leds before writing them out***

Hit UPLOAD!



What happened?

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50mA white

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50mA current draw white

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50mA current draw white

(15mA red, 15mA green, 15mA blue)

Recap

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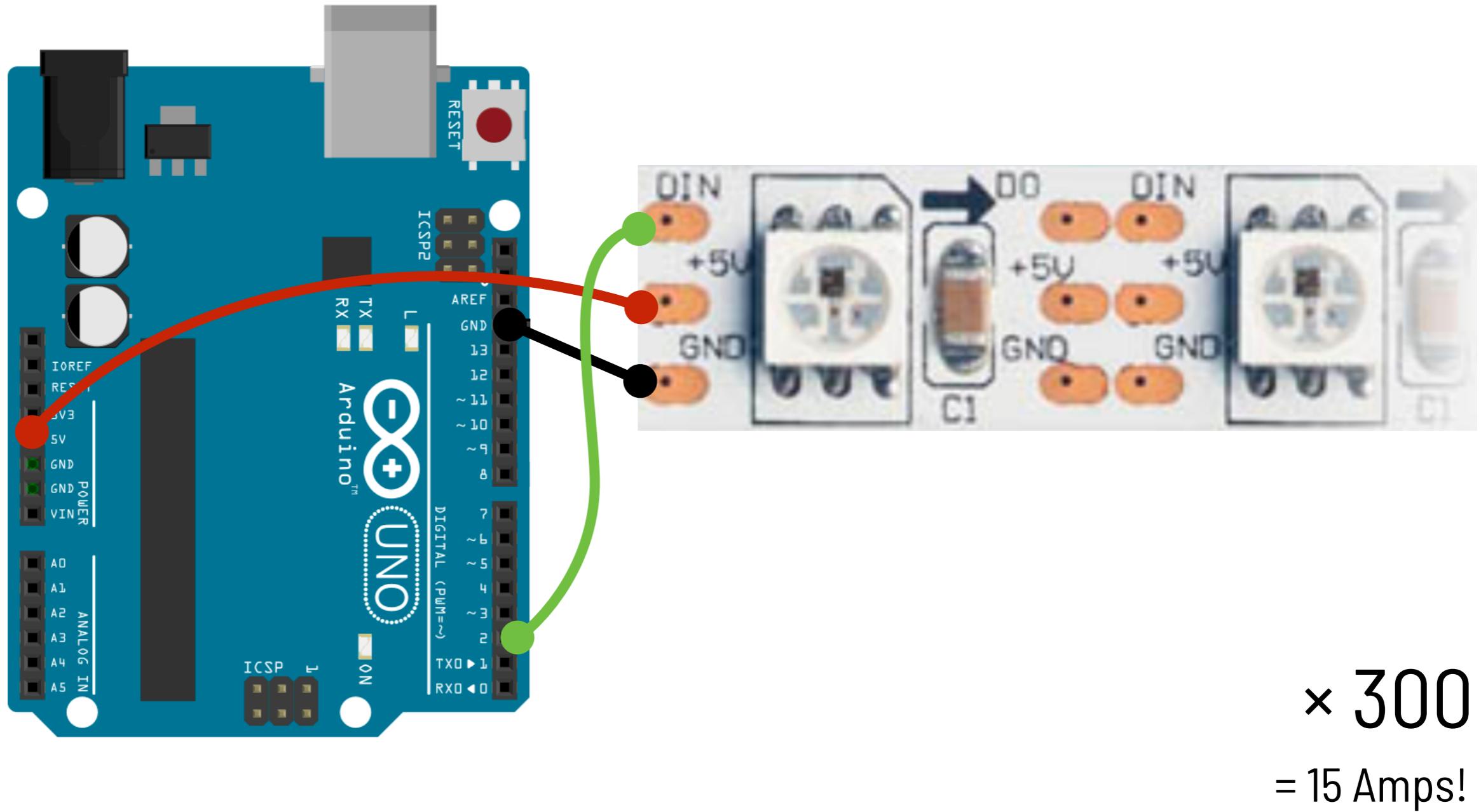
Hit UPLOAD!



50mA current draw white $\times 300$
(15mA red, 15mA green, 15mA blue) $= 15$ Amps!

Recap

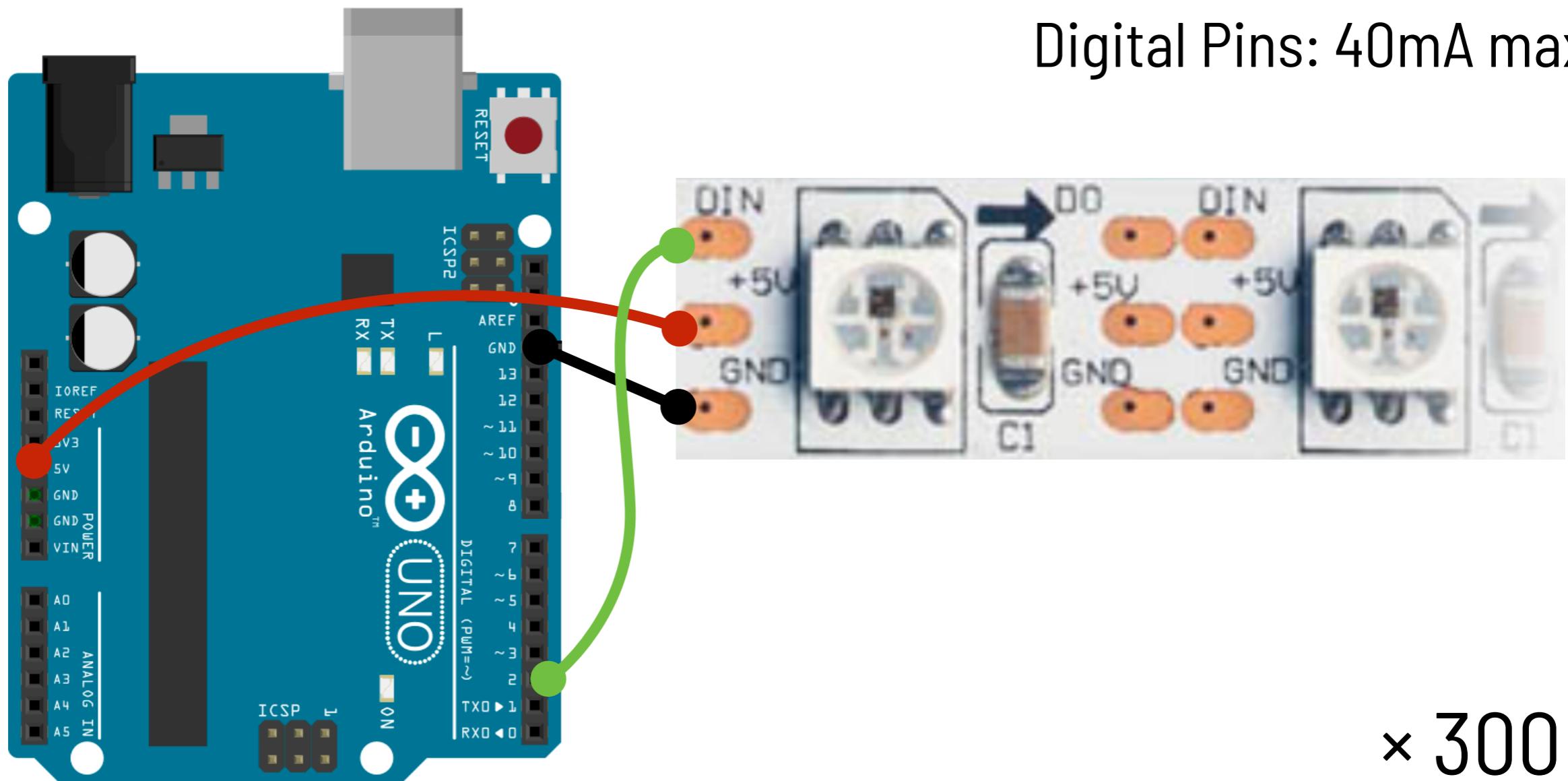
Maximum Current Output



Recap

Maximum Current Output

5V Pin: ~1A max
Digital Pins: 40mA max



Recap

Current Draw: Intuition



**12V
1A**

Recap

Current Draw: Intuition



12V
1A



12V
>1A

Recap

Current Draw: Intuition



12V
1A



12V
5A

Recap

Current Draw: Intuition

Voltage Must Match



12V
1A

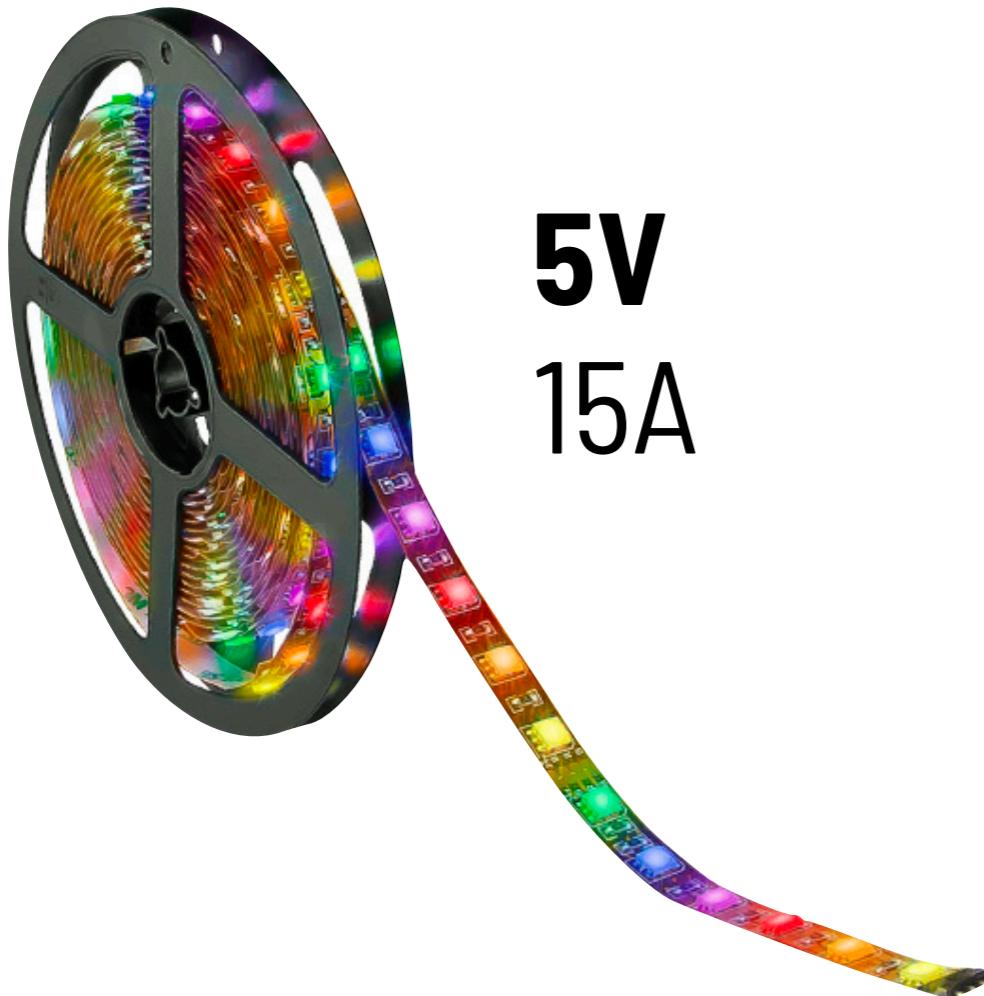


12V
5A

Recap

Current Draw: Intuition

Voltage Must Match



**5V
15A**

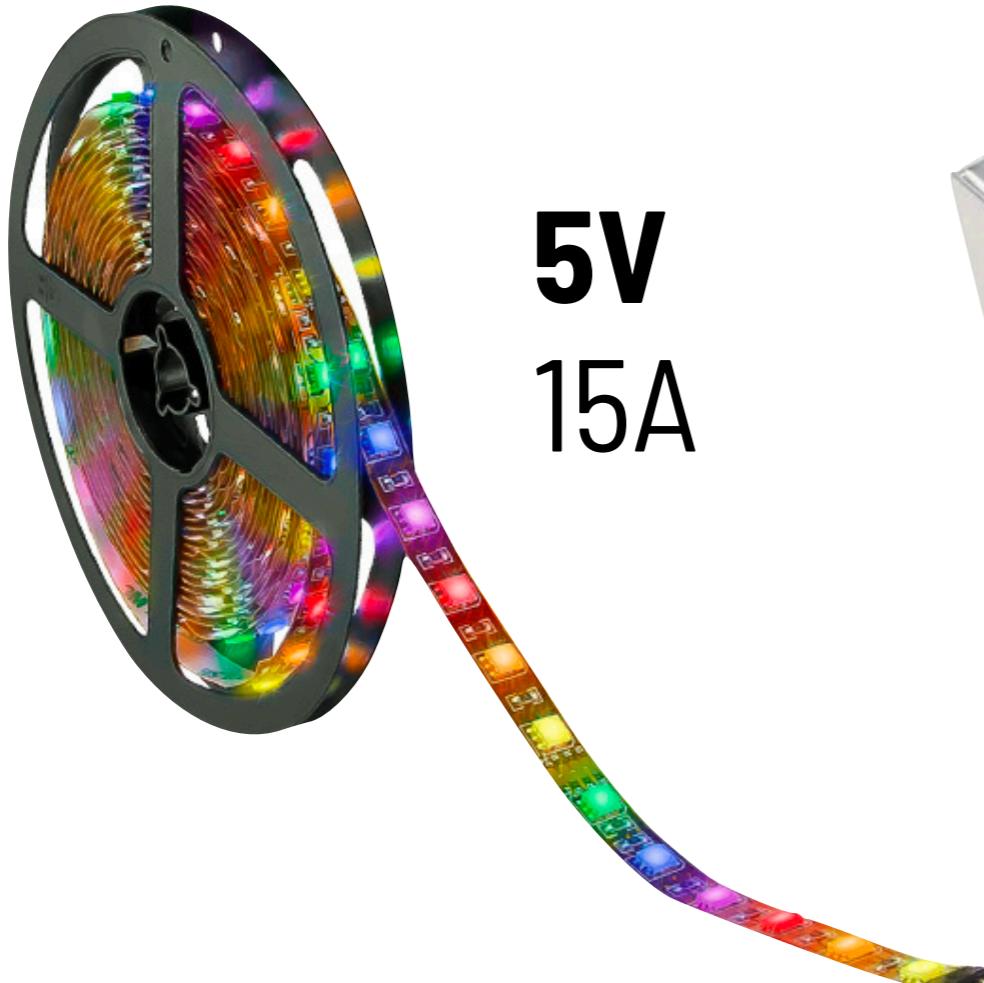


**12V
5A**

Recap

Current Draw: Intuition

Voltage Must Match

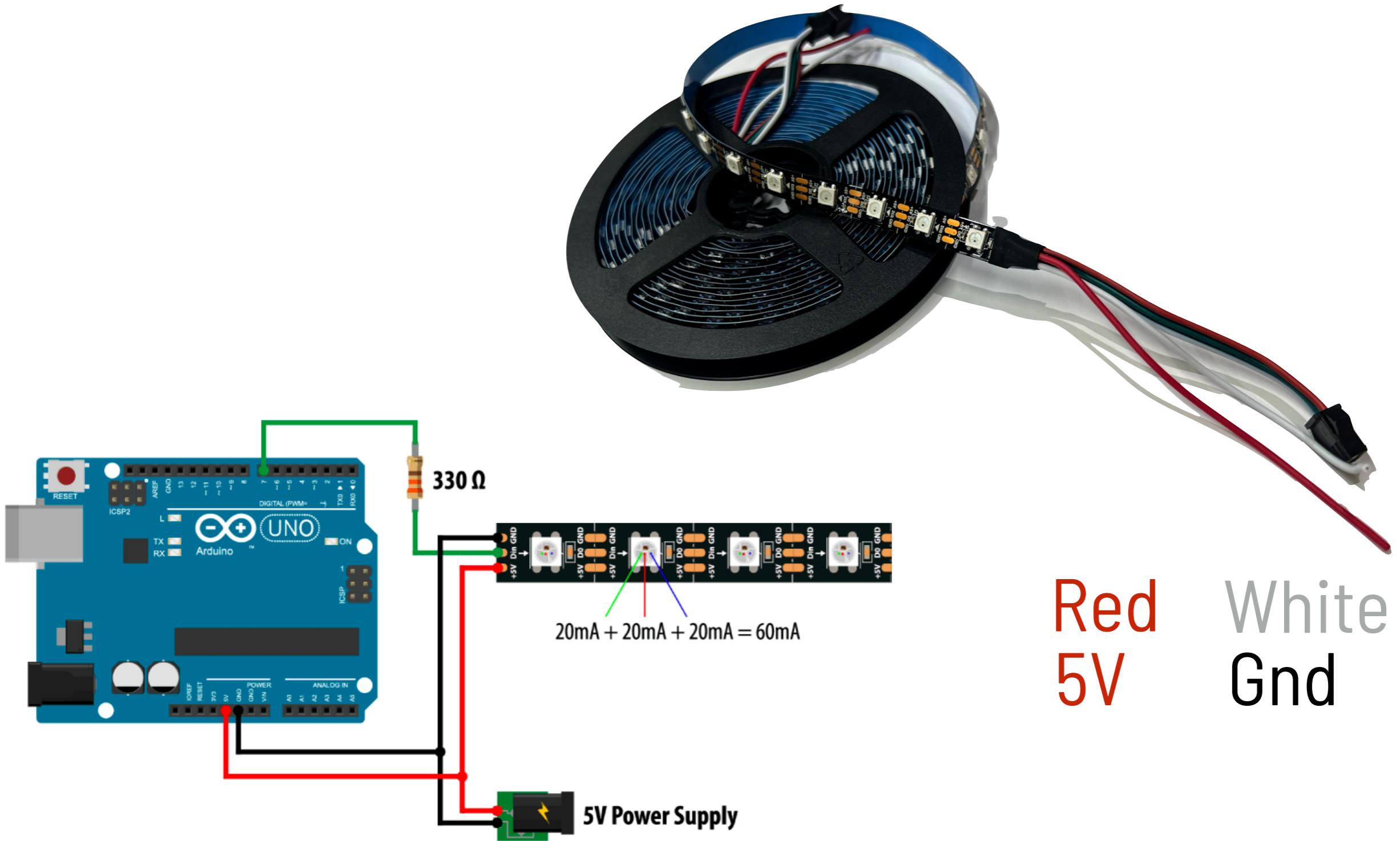


**5V
15A**



**5V
60A**

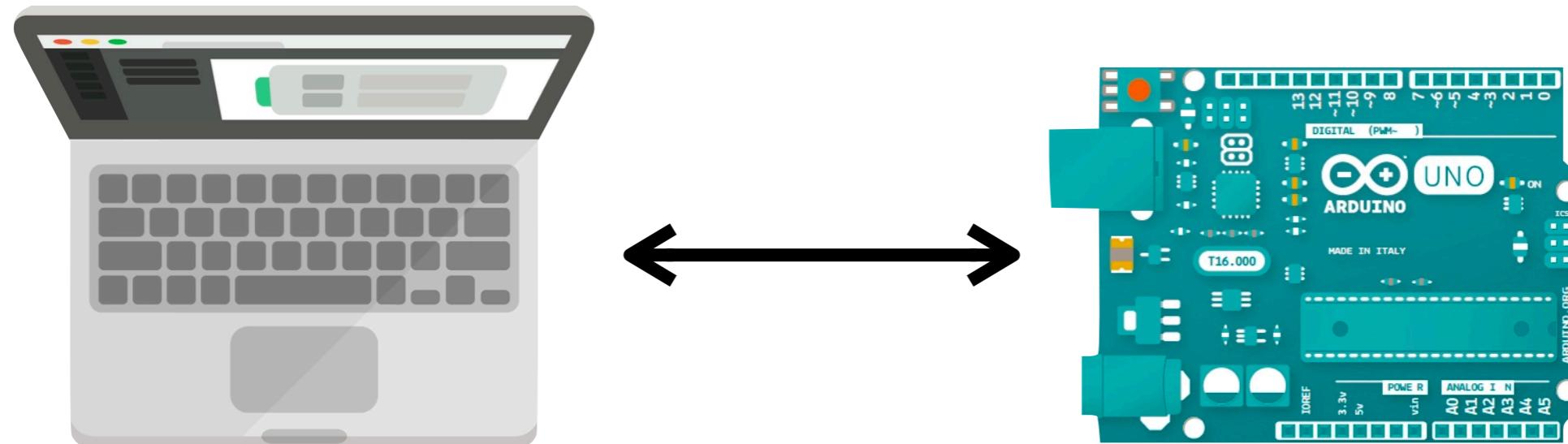
Supplying Power to the WS2812B



The background of the slide features a dark blue, textured surface with glowing, translucent blue and white lines and shapes. These elements include a grid-like pattern, a circular shape with radiating lines, and several arrows pointing towards the center. The overall effect is futuristic and technological.

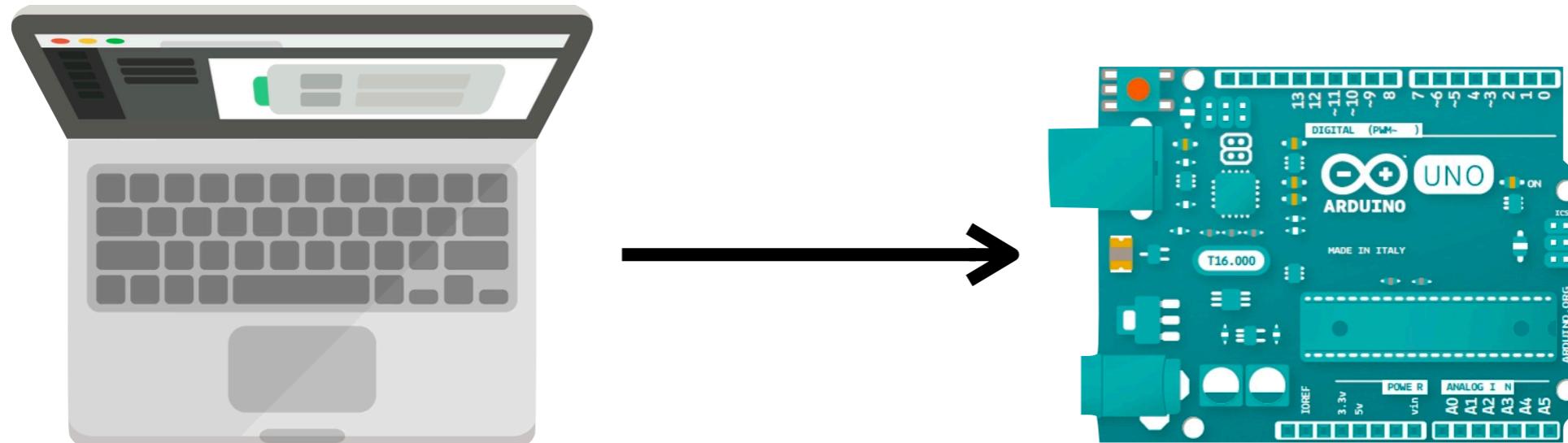
ARDUINO COMMUNICATION

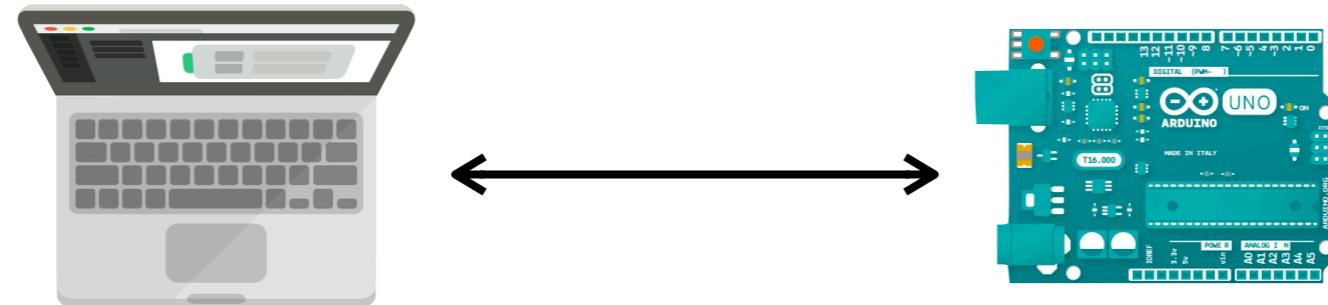
Communicating between the Arduino & the Computer



Communicating between the Arduino & the Computer

What happens when you hit upload?





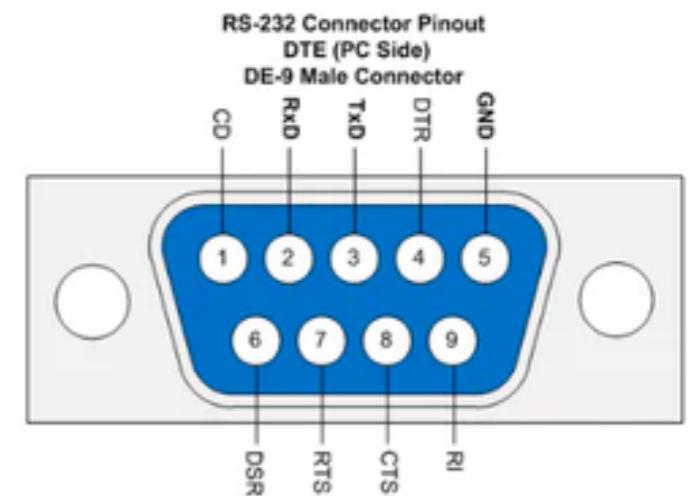
Serial Communication

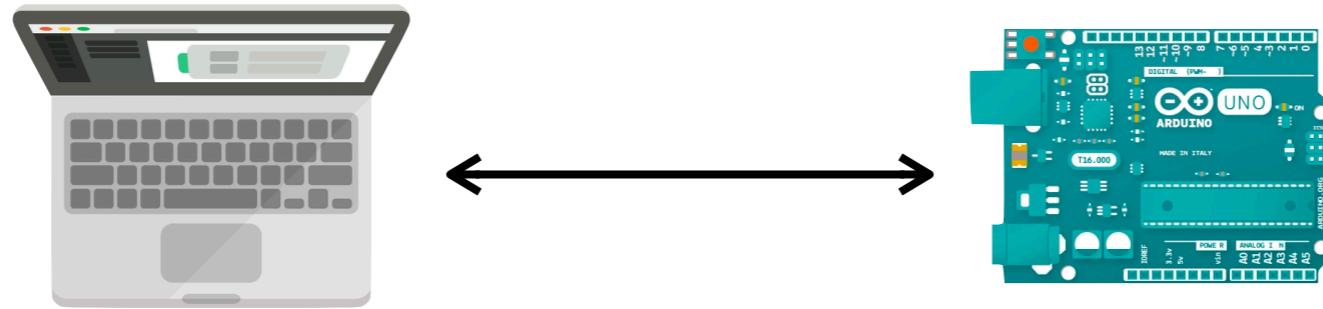
Series of 1s & 0s

Most common serial standard is RS-232

USB is not this serial

Through the USB on the Arduino, or Pins TX/
RX on the Arduino



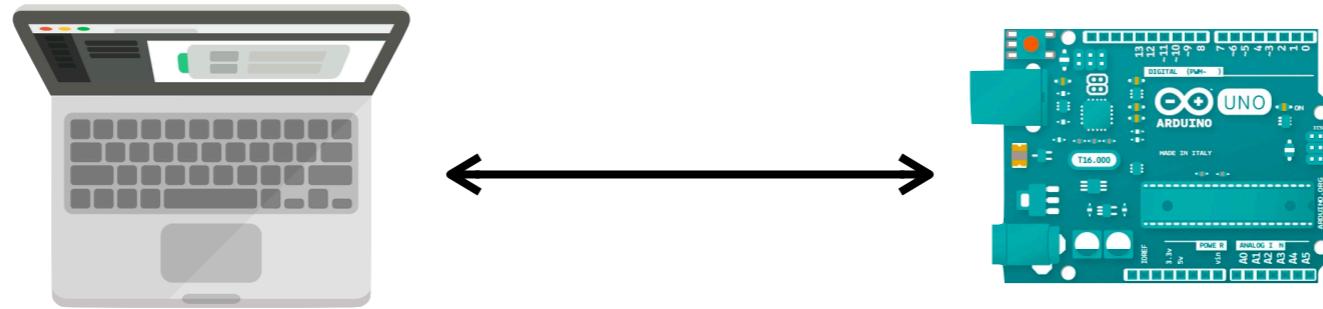


Serial Communication

Baud Rate: Rate of Information Transfer

Default: 9600...

...bits per second!



Serial Communication

What are we communicating?

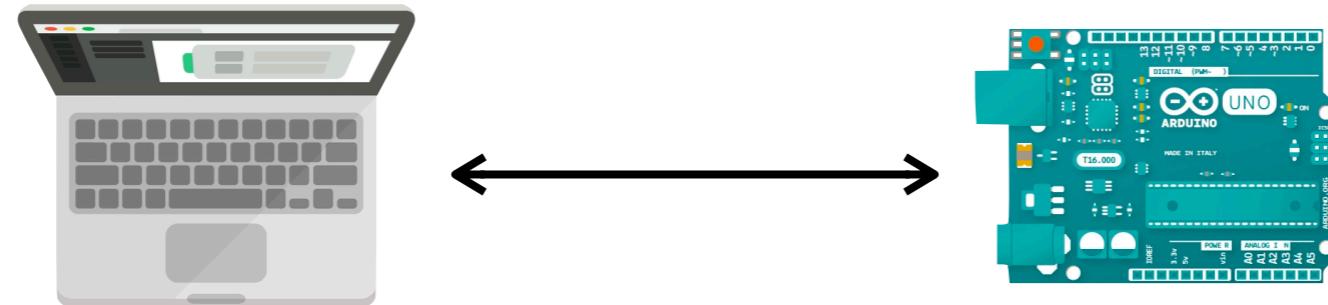
What **should** we communicate?

00:00

Done!

00:00

Done!



Serial Communication

What are we communicating?

Passthrough - Arduino is just a 'translator'

Macro Commands - Actions stored in the
Arduino to be called

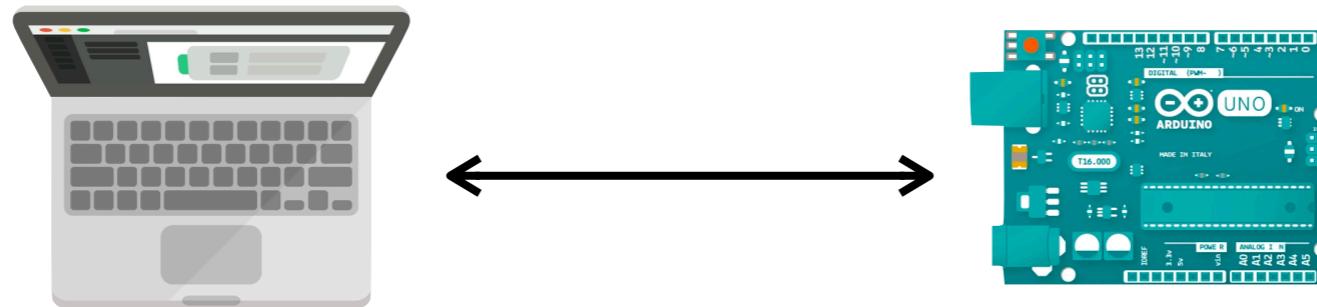
```
// digital pin 2 has a pushbutton attached to it. Give it a name:  
int pushButton = 2;  
  
// the setup routine runs once when you press reset:  
void setup() {  
    // initialize serial communication at 9600 bits per second:  
    Serial.begin(9600);  
    // make the pushbutton's pin an input:  
    pinMode(pushButton, INPUT);  
}  
  
// the loop routine runs over and over again forever:  
void loop() {  
    // read the input pin:  
    int buttonState = digitalRead(pushButton);  
    // print out the state of the button:  
    Serial.println(buttonState);  
    delay(1);          // delay in between reads for stability  
}
```

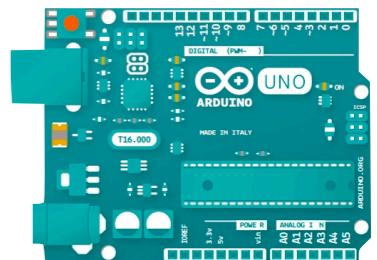
Serial Communication

Arduino Serial Monitor



We can also use it for debugging!





Node.js (Node) is an open source development platform for executing JavaScript code **server-side**.

Our “listening” app

```
1  /*  
2   | Simple Node App to Listen to the Serial Port  
3   */  
4  
5  import { SerialPort, ReadlineParser } from "serialport";  
6  
7  // Use a `\\r\\n` as a line terminator  
8  const parser = new ReadlineParser({  
9    delimiter: "\\r\\n",  
10});  
11  
12 const port = new SerialPort({  
13  path: "/dev/cu.usbmodem14401",  
14  baudRate: 9600,  
15});  
16  
17 port.pipe(parser);  
18 port.on("open", () => {  
19  console.log("Port open");  
20});  
21 parser.on("data", (data) => {  
22  console.log(data);  
23});
```

JSON

```
const person = {  
  name: "Chris Peterson",  
  age: 32,  
  home: {  
    city: "Boston",  
    state: "MA",  
  },  
};
```

Arrow Function

```
(variable) => {  
  console.log(variable);  
}
```

See you next week!

Try to complete the non-bonus parts of the handout

Office Hours! On learn.illuminations.mit.edu. Come ask questions, hang out, etc.

We'll be on Slack if you have any questions or need any help!