

Creating a Luminous Fabric Swatch

Welcome to this introduction to wearable technology! Today you will be making a luminous fabric swatch using the Adafruit Flora microprocessor and Adafruit NeoPixels.

This workshop will involve some circuit building, some programming and a bit of sewing.

The digital copy of this workshop can be found at <https://people.bath.ac.uk/ogr20/>. You will need this later.

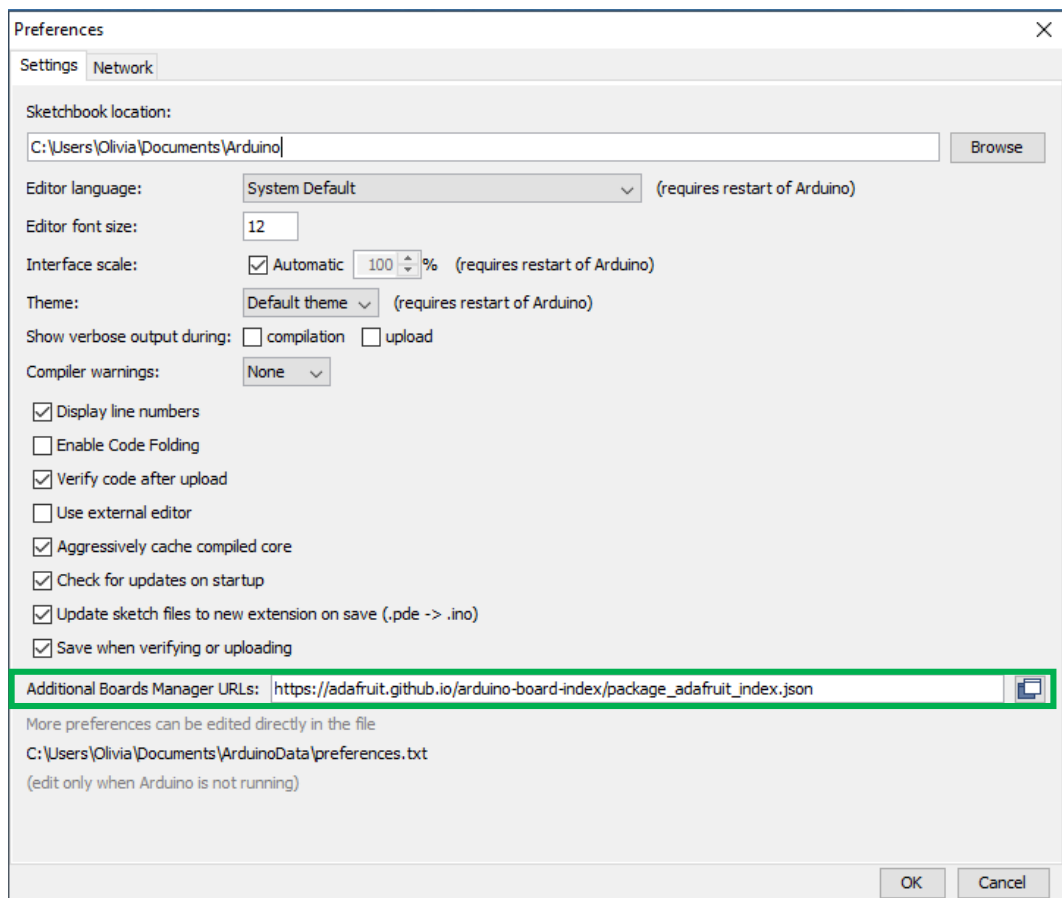
Set Up

For the programming we will be using the Arduino IDE. Before we start making, we need to do some set up. When working in the field of Computer Science, you'll be using lots of different software and each one will require some level of set up. So its good to practice!

Start by opening up the Arduino IDE. You can find this by searching for 'Arduino' in the Start Menu.

Adding Flora Support

Click 'File' in top left-hand corner, then click 'Preferences'.



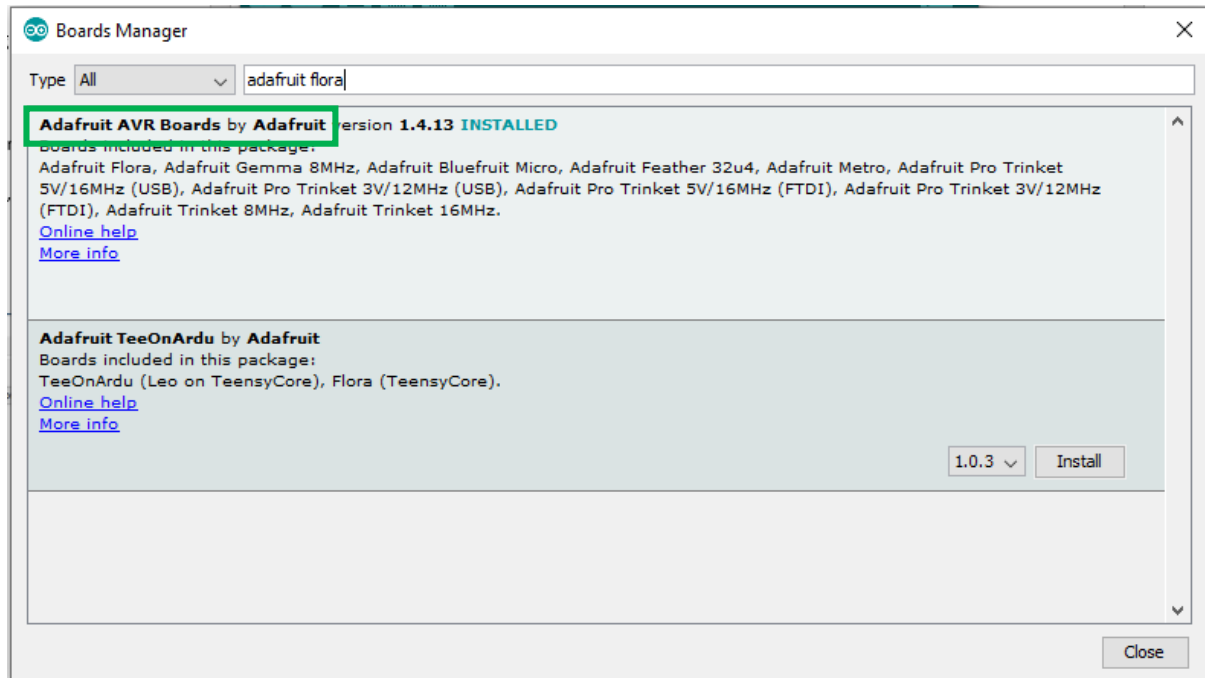
This dialog should open. In the box 'Additional Boards Manager URLs' copy and paste the following:

https://adafruit.github.io/arduino-board-index/package_adafruit_index.json

Then click 'OK'.

Click 'Tools' and go down to 'Board: "Arduino/Genuino Uno"'. Then click 'Boards Manager'.

This should open the following dialog box:



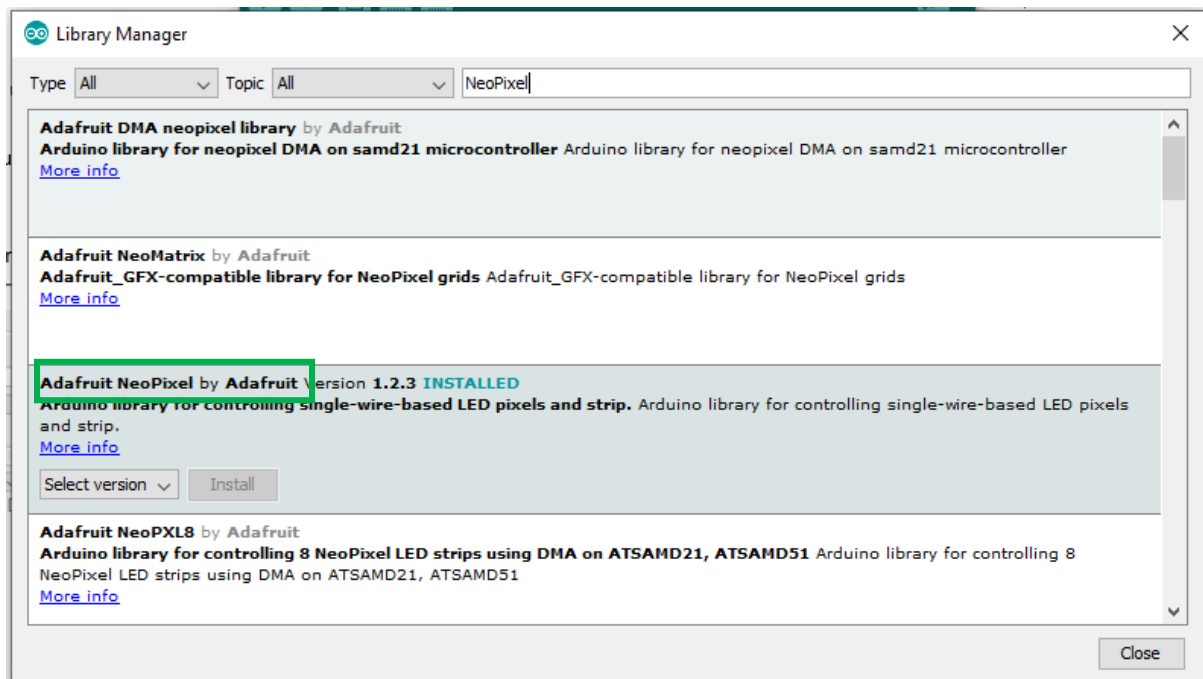
In the search bar type 'Adafruit Flora'. Click on the package called 'Adafruit AVR Boards by Adafruit', then click 'Install'. You can then close this dialog box.

We can now set the board. Click on 'Tools' again then 'Board: "Arduino/Genuino Uno"' then scroll down, to near the bottom of the list, and select Adafruit Flora.

Installing the NeoPixel Library

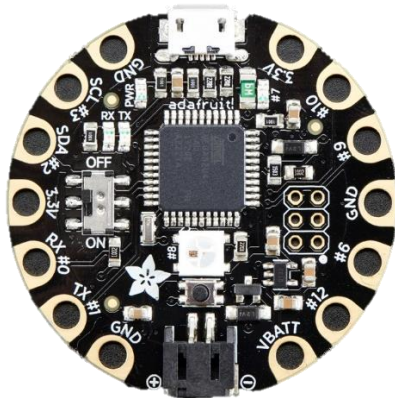
Click 'Sketch' and go down to 'Include Library'. Then click 'Manage Libraries'

This should open the following dialog:



In the search bar type 'NeoPixel'. Click on the library called 'Adafruit NeoPixel by Adafruit', then click 'Install'. You can then close this dialog box.

Constructing the Circuit

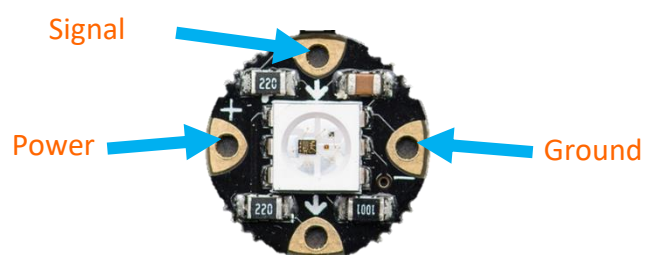


We will be using an Adafruit Flora which is similar Arduino boards. The Flora is specifically designed for use in e-textiles and prototyping wearable technology

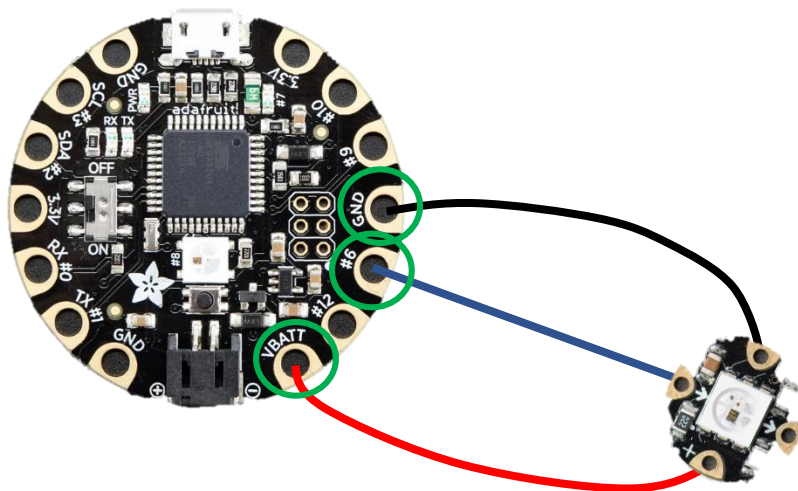
Not actual size.

The NeoPixel are individually programmable, RGB colour pixels. Each NeoPixel has three pins it uses to connect to the Flora: signal, power and ground.

Not actual size.



The pins on the NeoPixel connect to three pins on the Flora: VBATT, #6, and GND.



Use a needle and conductive thread to sew connections between the pins on the Flora and the Neo Pixel.

Starting with the Flora, sew around the GND pin several times before stitching a line to the ground (-) pin on the NeoPixel. To complete the connection, sew around the ground (-) pin several times before tying off the thread.

Repeat with the other two connections.

Programming the NeoPixels

Flora can be programmed in a variation of the programming language C.

Below is a program adapted from the strand test example in the NeoPixel library. This program lights up each pixel in turn in various colours.

```

/*****
Edited from the NeoPixel Library example strandtest 01/07/2019
*****/

// A basic everyday NeoPixel strip test program.
#include <Adafruit_NeoPixel.h>

// Which pin on the Arduino is connected to the NeoPixels?
#define LED_PIN    6

// How many NeoPixels are attached to the Arduino?
#define LED_COUNT 60

// Declare our NeoPixel strip object:
Adafruit_NeoPixel strip(LED_COUNT, LED_PIN, NEO_GRB + NEO_KHZ800);
// Argument 1 = Number of pixels in NeoPixel strip
// Argument 2 = Arduino pin number (most are valid)
// Argument 3 = Pixel type flags, no need to change!

// setup() function -- runs once at startup -----
void setup() {

    strip.begin();           // INITIALIZE NeoPixel strip object
    strip.show();           // Turn OFF all pixels ASAP
    strip.setBrightness(50); // Set BRIGHTNESS to about 1/5 (max = 255)
}

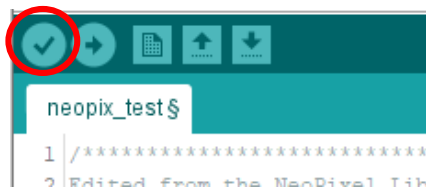
// loop() function -- runs repeatedly as long as board is on -----
void loop() {
    // Fill along the length of the strip in various colors...
    colorWipe(strip.Color(255,  0,  0), 50); // Red
    colorWipe(strip.Color( 0, 255,  0), 50); // Green
    colorWipe(strip.Color( 0,  0, 255), 50); // Blue
}

// Function for Creating Animated Effects-----
```

```
// Fill strip pixels one after another with a color.
void colorWipe(uint32_t color, int wait) {
  for(int i=0; i<strip.numPixels(); i++) { // For each pixel in strip...
    strip.setPixelColor(i, color);        // Set pixel's color (in RAM)
    strip.show();                          // Update strip to match
    delay(wait);                           // Pause for a moment
  }
}
```

Clear the sketch window in the Arduino IDE then copy and paste in the code above.

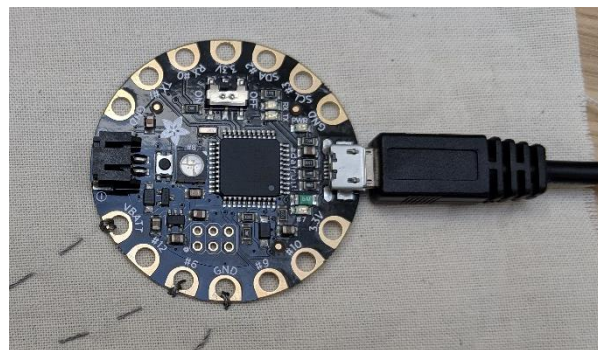
Before compiling, we need to save the program. Click 'File' then 'Save as...'. Give the program a suitable name e.g., 'neopixel_test' and save in the 'Arduino' folder.



Compile the program by clicking on the green circle with a tick in the top left corner.

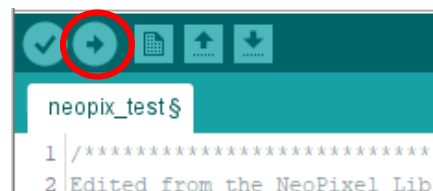
The program should compile with no problems. Now to connect the circuit to the computer and upload the program.

Connect the micro to USB cable to the circuit, as shown below, then connect the USB to the computer.



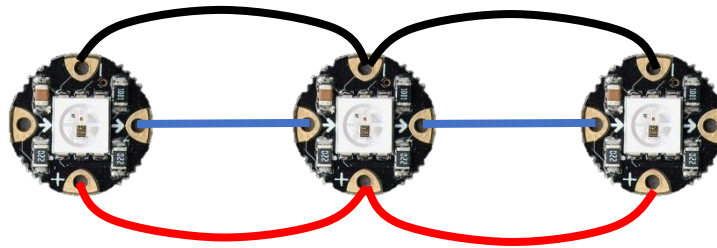
Before uploading the program to board check the port. Click on 'Tools' then go down to 'Port'. Select the port in the form 'COM[number] (Adafruit Flora)' where the number may differ between PC.

To upload the program to the circuit, click the green circle with an arrow in the top left corner.



Once upload is complete, the NeoPixel should begin to change colour.

Once you have this working, you can start working with multiple NeoPixels. NeoPixels can be chained together as shown below. Each NeoPixel can be programmed individually.



Here are a few lines that may help you to start experimenting and editing the given code.

`strip.setPixelColor(i, R, G, B);` This sets the colour of pixel *i*. The first pixel in a strip is **0**, the following is 1, and so on. The colour is a combination of R, G, and B values. The maximum value for each is 255.

Work out the value combinations for Yellow, Cyan, and Magenta.

`strip.setBrightness();` Sets the brightness of the pixel. The maximum value is 255.

`strip.show();` This updates the NeoPixels. Whenever you make a change to the colour or brightness, remember to include this line afterwards.

`delay(num);` Pauses the program for the given number of milliseconds.

Use delay() to create different light patterns.

I hope you have enjoyed this workshop and it's got you thinking about other applications of computer science! This is just an introduction to wearable technology and e-textiles. If you are interested in learning more check out the Arduino and Adafruit websites for more project ideas. There are also loads of videos on YouTube to get you inspired.

Adafruit Flora Project Ideas - <https://learn.adafruit.com/category/wearables>

Arduino's Wearable Tech Board - <https://www.arduino.cc/en/Main/ArduinoBoardLilyPad/>

Becky Stern on YouTube - https://www.youtube.com/channel/UCsl_41SZafKtB5qE46WjIQQ