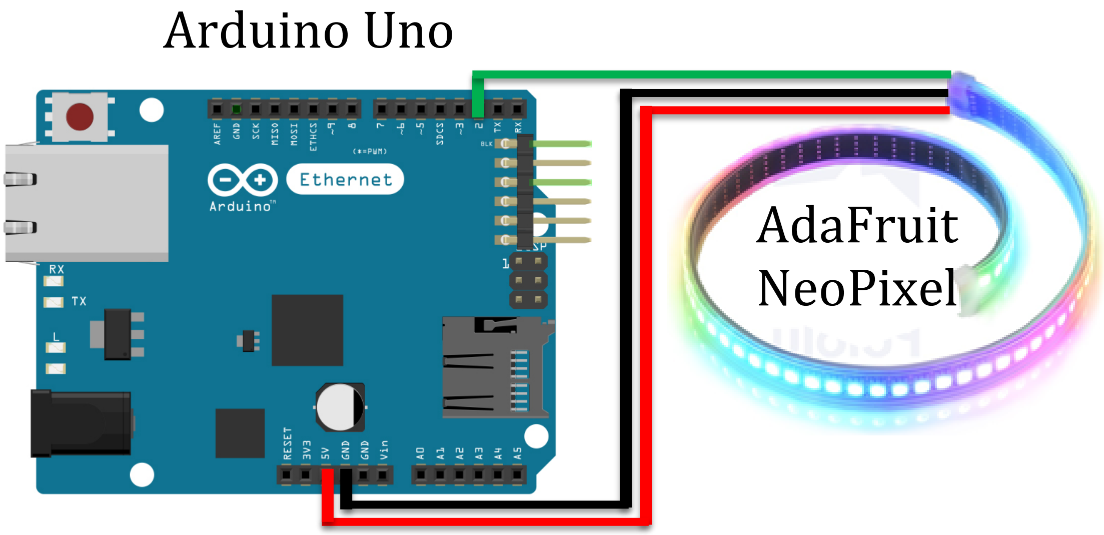
Creative Programming With LEDs

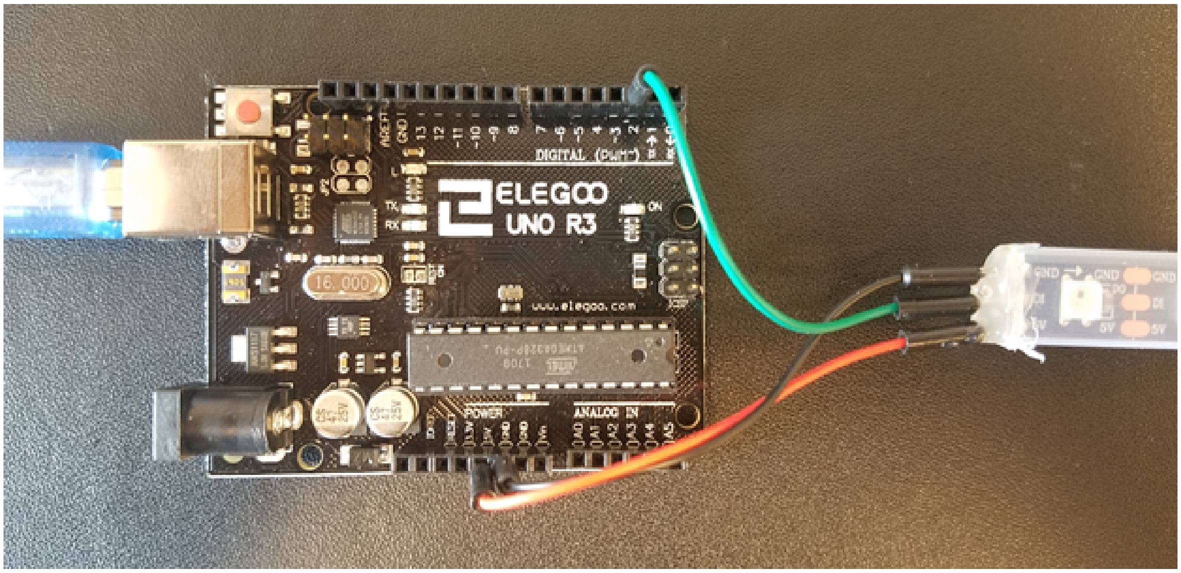
Girls Inc. Eureka Workshop – U. Massachusetts July 2019

Part 1: Build it!

Objective: Building LED art often requires setting up custom hardware. For this lab we will use Arduino Uno and AdaFruit Neopixel, which needs to be connected as follows. The **green wire** will need to connect to 2, the **black wire** need to connect the GND pin (one of the two GNDs), and the **red wire** needs to connect to 5V



Your connections should look something like the following.



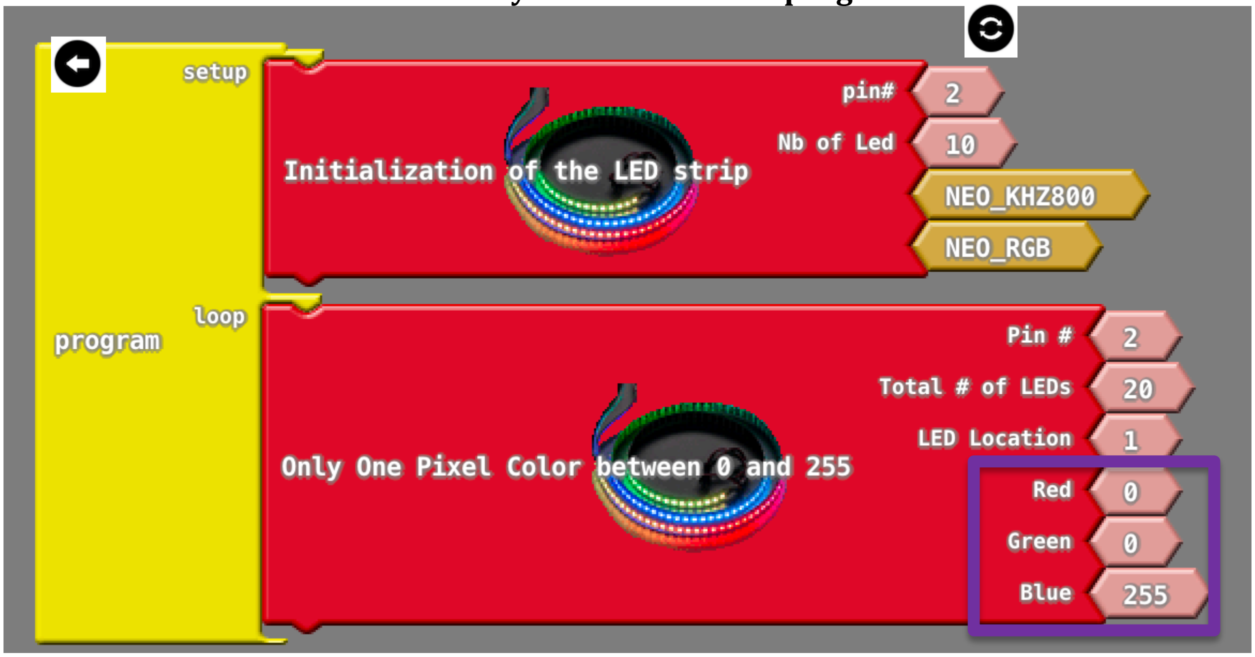
Part 2: Getting familiar with the LEDs

Objective: The objective of this part of the activity is to become familiar with running code and making changes to existing code. You will learn how to change the LED's color and location.

Activity 1: Run your first program!

- Navigate to the Labs folder.
- Open the Lab 1 folder.
- Double click on "Exercise1.abp"

Welcome to your first Arduino program!



program

setup

Initialization of the LED strip

pin# 2

Nb of Led 10

NEO_KHZ800

NEO_RGB

loop

Only One Pixel Color between 0 and 255

Pin # 2

Total # of LEDs 20

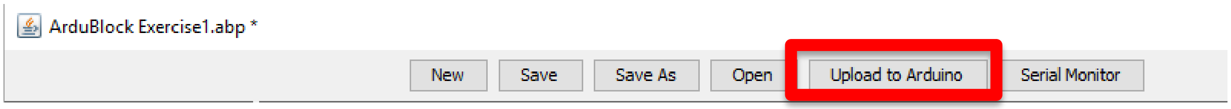
LED Location 1

Red 0

Green 0

Blue 255

To run your program click "Upload to Arduino" in this menu that is above the sketch.



ArduBlock Exercise1.abp *

Based on what the LEDs are doing can you guess how the **Only One Pixel Color** block is working?

Can you modify the code to make the LED change color?

Activity 2: Experiment with color

Color is specified using 3 values representing the amount of red, green and blue.

What happens if you specify larger numbers for each color (e.g., set them all to a given value)? Try: 255, 127, 23, 0.

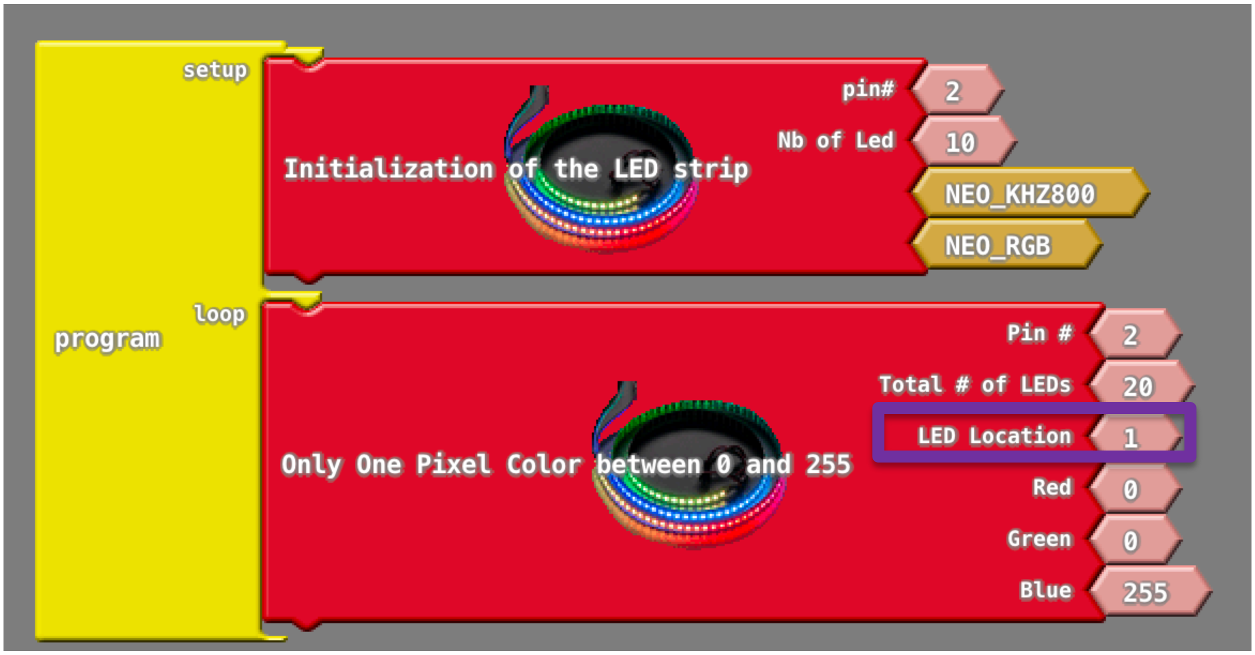
Can you make the LED purple? Green? Yellow?

Activity 3: Light up more LEDs

Can you modify your program to light up an LED at a different location?

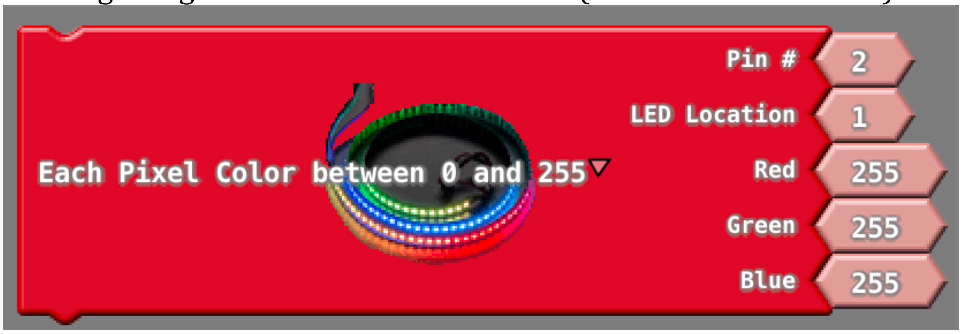
Try lighting up LEDs at different positions on your strip

What is the smallest value you can specify for position? The largest? What happens if you give invalid input? Try using multiple of the **Only One Pixel Color** block with different input values. What does it do?



program
setup
Initialization of the LED strip
pin# 2
Nb of Led 10
NEO_KHZ800
NEO_RGB
loop
Only One Pixel Color between 0 and 255
Pin # 2
Total # of LEDs 20
LED Location 1
Red 0
Green 0
Blue 255

Try the same thing using the **Each Pixel Color** block (in the **Girls Inc** menu)



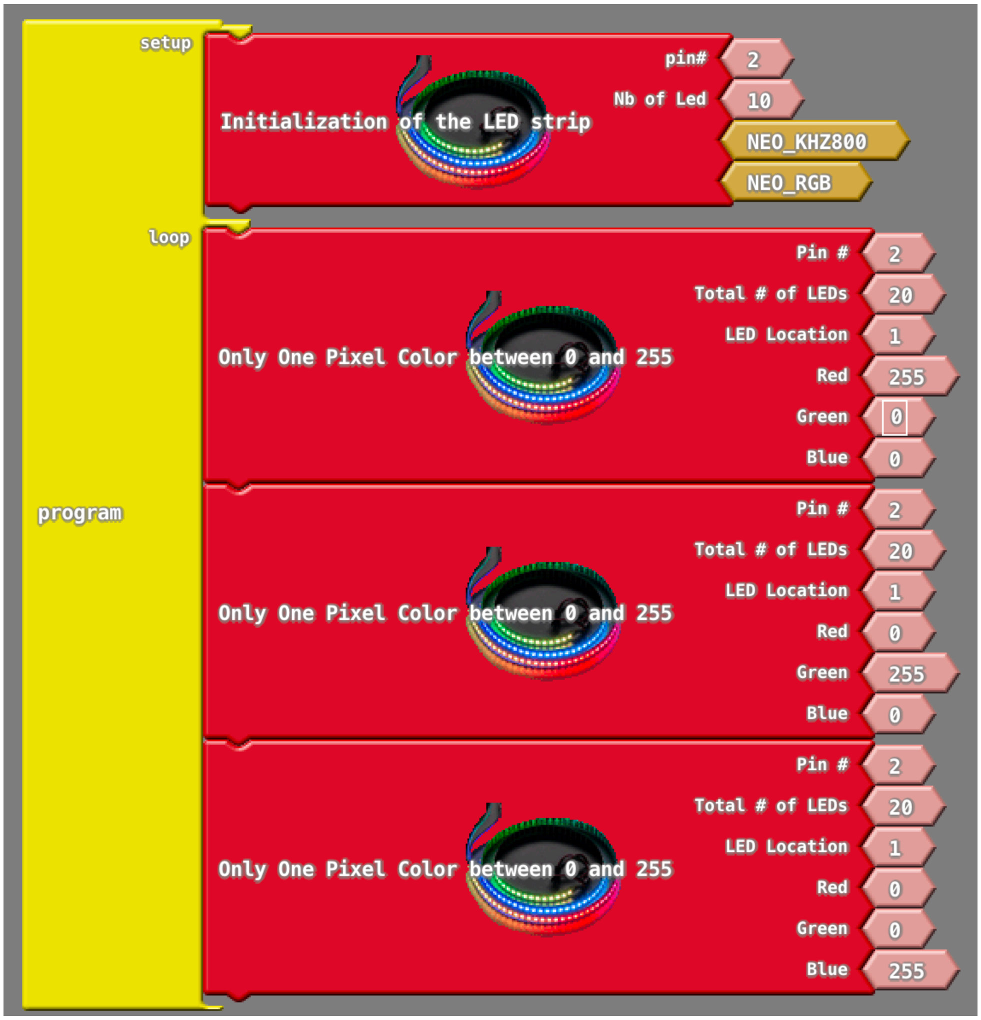
Each Pixel Color between 0 and 255
Pin # 2
LED Location 1
Red 255
Green 255
Blue 255

Part 3: Telling the Arduino what to do

Objective: In this activity, you will learn how to modify the code to have the program perform multiple actions. You will learn about how we can specify what we want the LEDs to do.

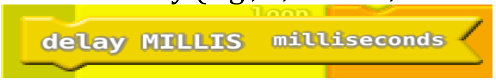
Activity 1: Have the LED change colors once per second

Click on the **Girls Inc** menu. Select the "**Only One Pixel Color**" block and drag it into your loop. Repeat this to put multiple commands into the loop function. Try the example below:



```
program
  setup
    Initialization of the LED strip
      pin# 2
      Nb of Led 10
      NEO_KHZ800
      NEO_RGB
  loop
    Only One Pixel Color between 0 and 255
      Pin # 2
      Total # of LEDs 20
      LED Location 1
      Red 255
      Green 0
      Blue 0
    Only One Pixel Color between 0 and 255
      Pin # 2
      Total # of LEDs 20
      LED Location 1
      Red 0
      Green 255
      Blue 0
    Only One Pixel Color between 0 and 255
      Pin # 2
      Total # of LEDs 20
      LED Location 1
      Red 0
      Green 0
      Blue 255
```

Try running your code. What do you observe?
Click on the "**Control**" menu. Drag and drop the "**delay**" function into your loop.
Experiment with different values of delay (e.g., 1,000 ms, 500 ms)



```
delay MILLIS milliseconds
```

Activity 2: Make the LED "move"

Edit the parameters of the "**Only One Pixel Color**" function to "move" your LED 4 positions to the right (you may need to get more blocks from the **GirlsInc** menu for this).

Can you make it 4 positions to the left?

What about changing colors while it moves?

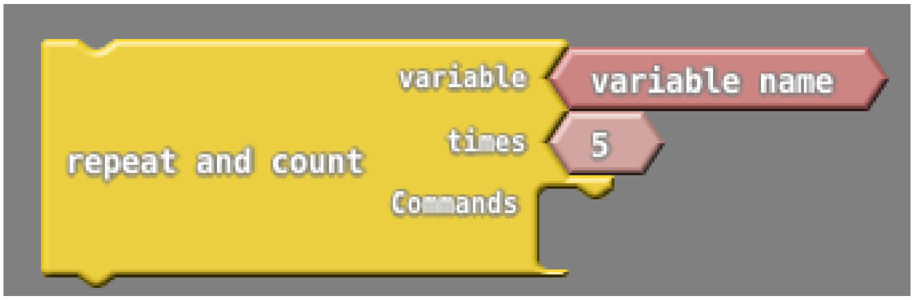
What happens if you insert the "Delay" command between the "**Only One Pixel Color**" functions?

Part 4: Control structures, making your life easier!

Objective: In the last exercise, you saw how issuing multiple commands can change the behavior of the LEDs. We will now see how programmers use loops and variables to make this easier.

Activity 1: Using a loop to move the LED

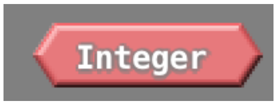
Under the yellow control menu, drag the "Repeat & Count" block. (You may want to remove any blocks within your loop before placing the new block).



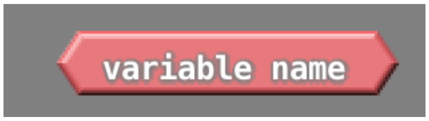
This block allows you to repeat the command within the block a given number of times. It also allows you to keep a count of how many times it has executed using the variable, called "**variable name**". The block above will repeat the items in "commands" 5 times.

Using a variable:

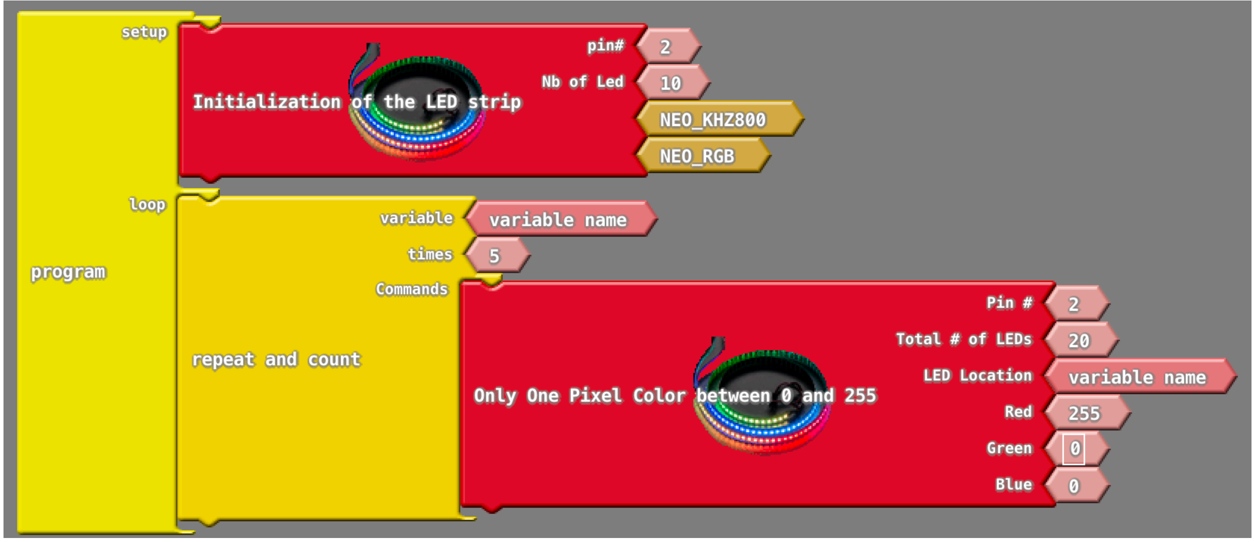
To use the "**variable name**" in your loop, select the "**Integer**" block from the "**Variables/Constants**" menu. It will look something like this:



Click on the "**Integer**" block and type "**variable name**". This block will now carry the value of our variable called "**variable name**". It will look like this:



You now need to place your variable where you would like to use it. In the below example, we have dragged the value of **LED Location** out of the **Only One Pixel Color** block, and replaced it with our variable that we made in the previous step.

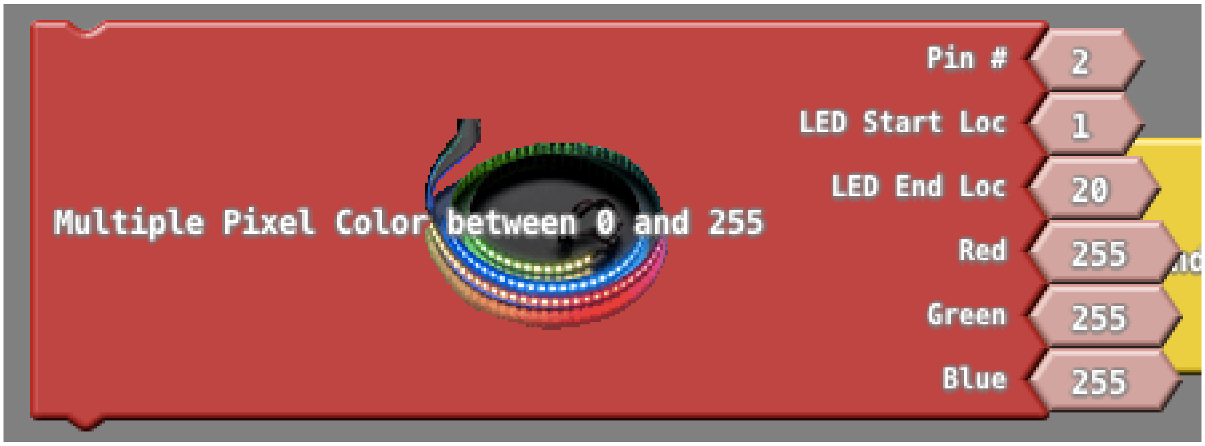


program
setup
Initialization of the LED strip
pin# 2
Nb of Led 10
NEO_KHZ800
NEO_RGB
loop
repeat and count
variable variable name
times 5
Commands
Only One Pixel Color between 0 and 255
Pin # 2
Total # of LEDs 20
LED Location variable name
Red 255
Green 0
Blue 0

Try running the example above. What does the code do? Can you use the **delay** block to change the speed of this code? Can you change the color of the pixel in this example code?

Activity 2: Color multiple pixels using a new function

Under the **Girls Inc** menu, select the "**Multiple Pixel Color**" function.

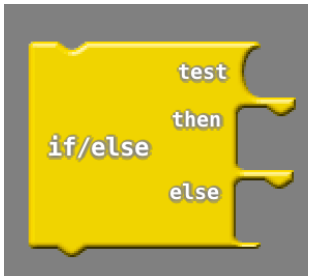


Multiple Pixel Color between 0 and 255
Pin # 2
LED Start Loc 1
LED End Loc 20
Red 255
Green 255
Blue 255

Try using this function to turn all the LEDs a single color (e.g., Red, Purple, etc.). What happens if you change **LED Start Loc? LED End Loc?**

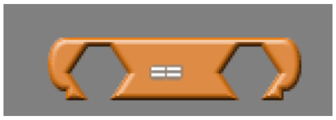
Now, use a loop and this new function to change colors of the LEDs in a specific sequence (e.g., Red→Green→Blue).

Here we will use an "**If/Else**" block from the **Control** menu. It looks like this:



If the condition in the "**test**" position is true, then the commands in the **then** block will be executed. Otherwise commands in the **else** block will be executed.

To form a **test** click on the **tests** category and select the equals test (as an example). It looks like the following:

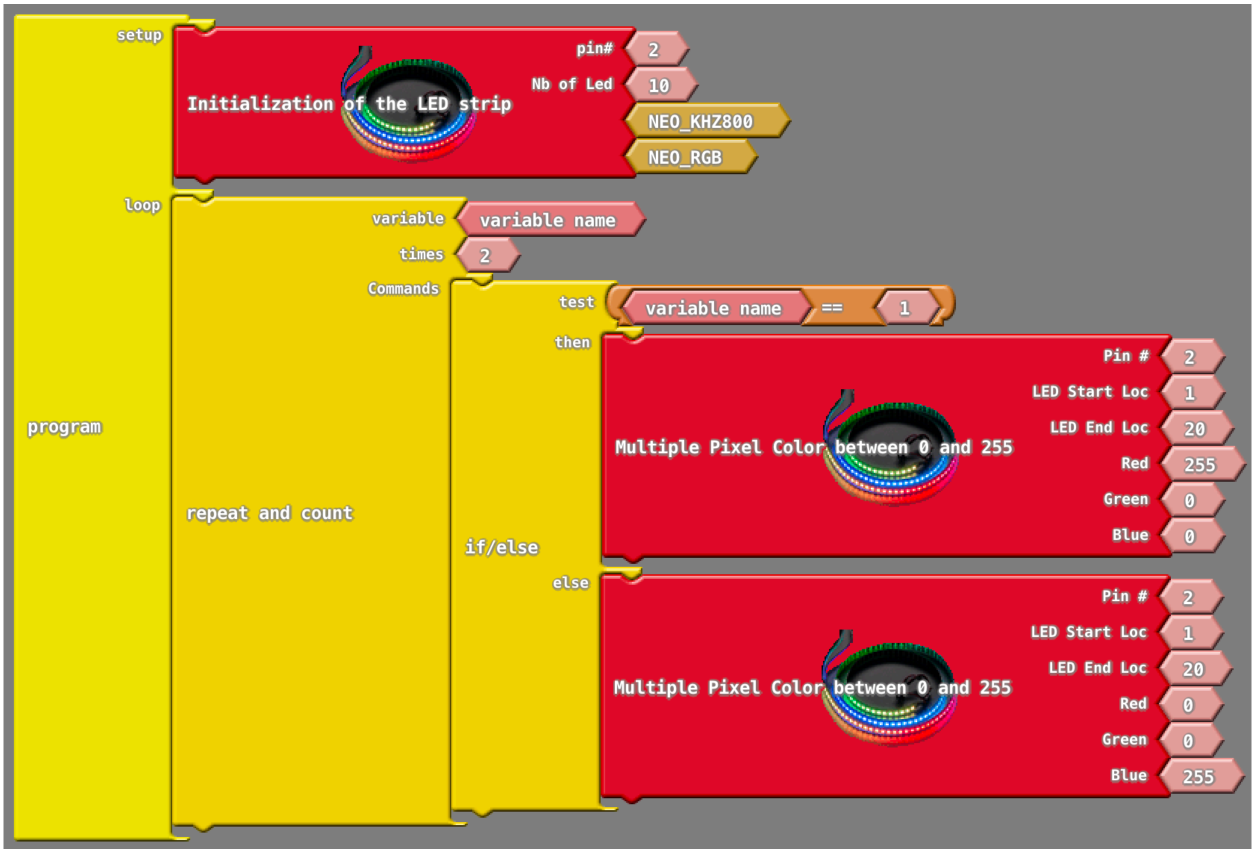


We can put a variable (like how we used "variable name" in the prior example) in one side of the test, and a constant value in the other side. This allows us to take a specific action if the variable has a specific value.

You can get a constant value by clicking on **Variables/Constants** and selecting the light pink block with a '1' in it:

You can change the value of this constant by clicking and typing a different numerical value.

Try the example code below. Try reading the code to figure out what it is doing before you run it. It might help to write out the different steps it will take.



```
program
  setup
    Initialization of the LED strip
      pin#          2
      Nb of Led     10
                    NEO_KHZ800
                    NEO_RGB
  loop
    repeat and count
      variable      variable name
      times         2
      Commands
        if/else
          test      variable name == 1
          then
            Multiple Pixel Color between 0 and 255
              Pin #          2
              LED Start Loc  1
              LED End Loc    20
              Red            255
              Green          0
              Blue           0
          else
            Multiple Pixel Color between 0 and 255
              Pin #          2
              LED Start Loc  1
              LED End Loc    20
              Red            0
              Green          0
              Blue           255
```

Can you update this code to alternate between three different colors? **Hint:** You will want to increase the **Repeat and count** to repeat 3 **times** . You may also consider adding another if-statement.

Activity 3 (Challenging Mission): Using a loop to move the LED but with alternating colors

In Activity 1, you made a code that moves the LED from one location to another. Now, why don't you choose two favorite colors of yours that will be alternated throughout the LED sweep! For example, if your favorite colors and PINK and BLUE, you want to have something like:

Location #1 (pink) → Location #2 (blue) → Location #3 (pink) → … → Location #30 (blue)

If you successfully make this code, try different "delay" lengths and see what happens.
This is a challenging mission, but why don't you give it a try!
Hint: you need a repeat-and-count block, an if-statement, and some math functions to detect odd/even numbers!