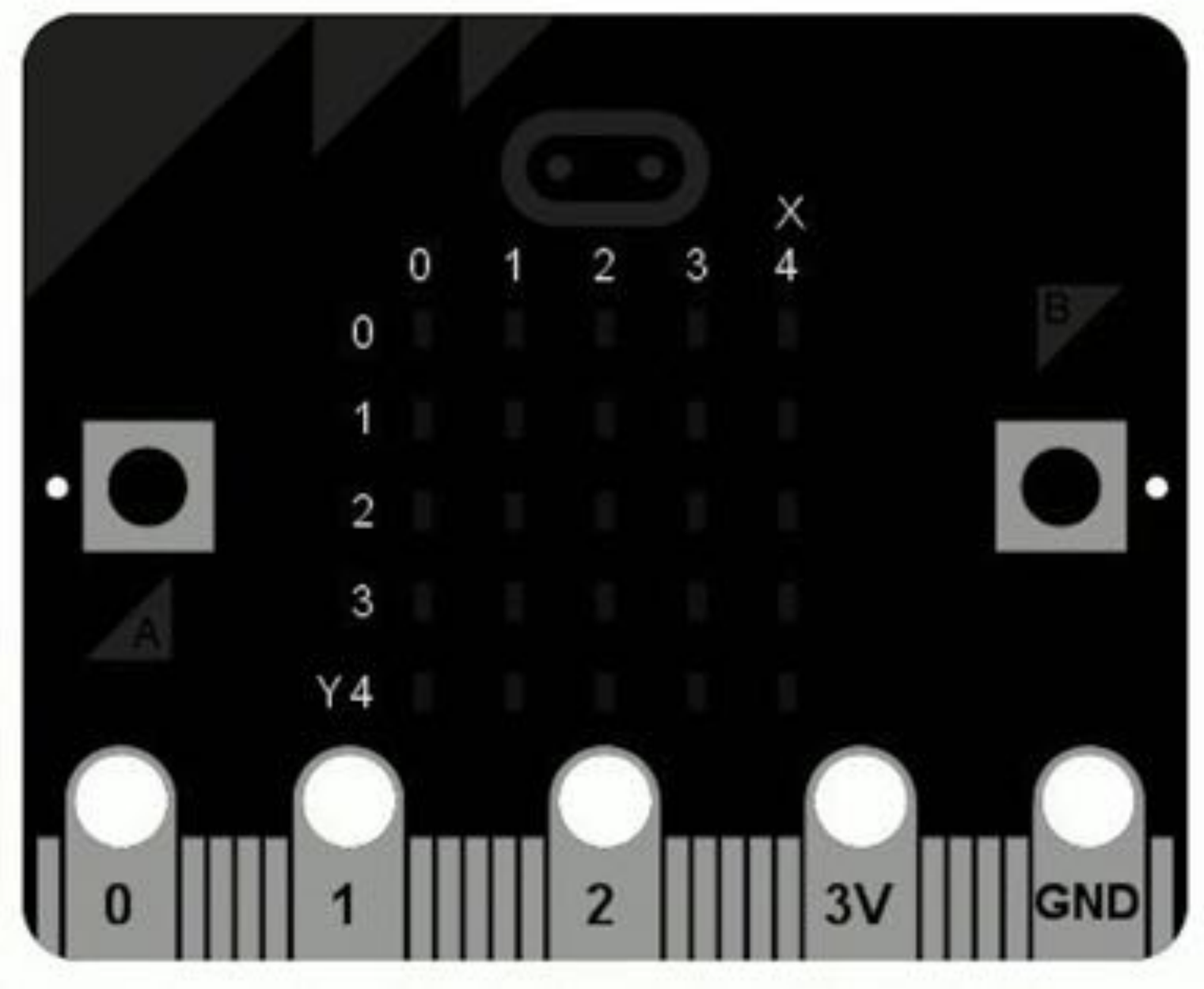
Micro:bit Advanced Level

Instructor Guide

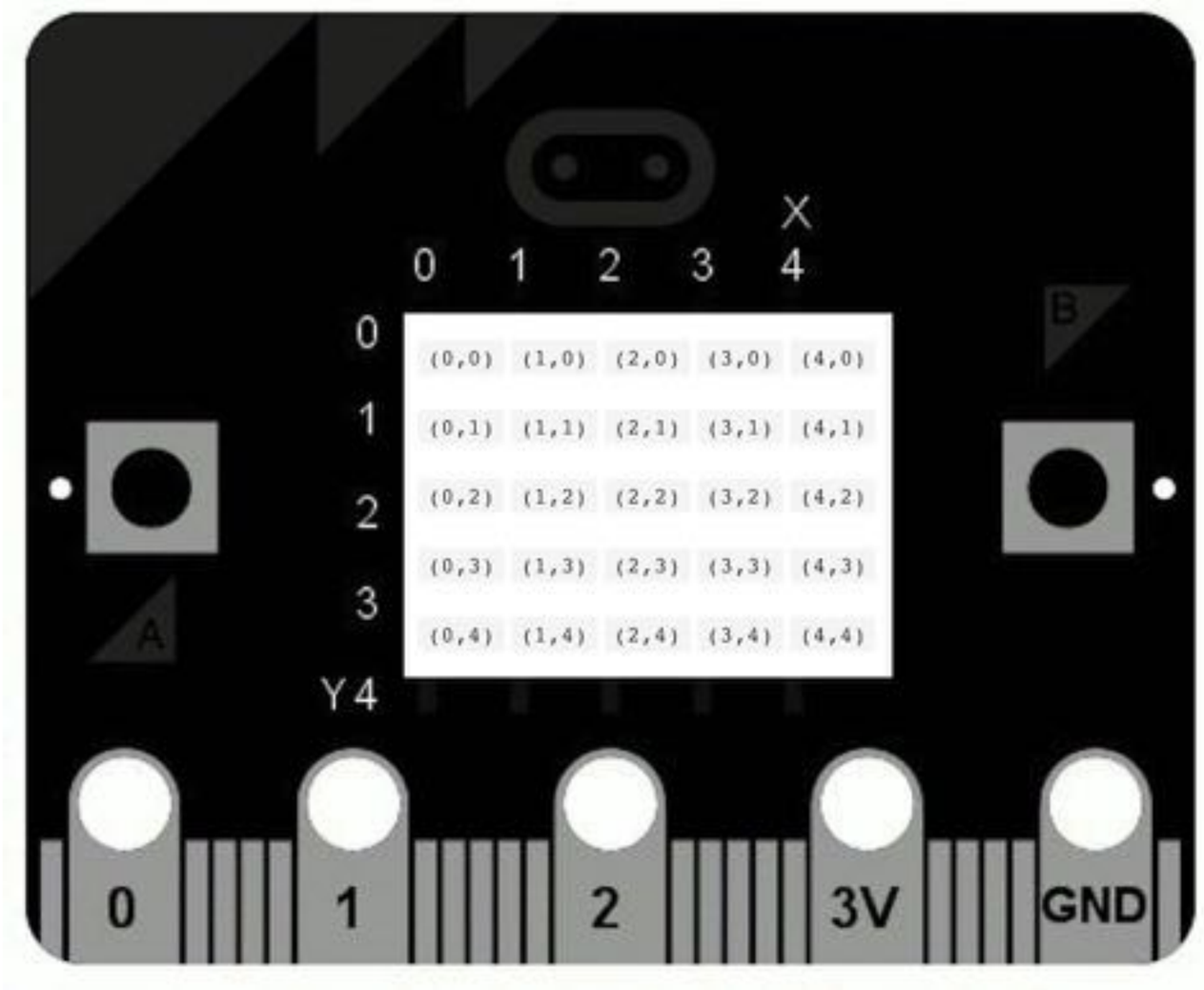
Timeless Lifeskills
FOUNDATION

CONTENTS

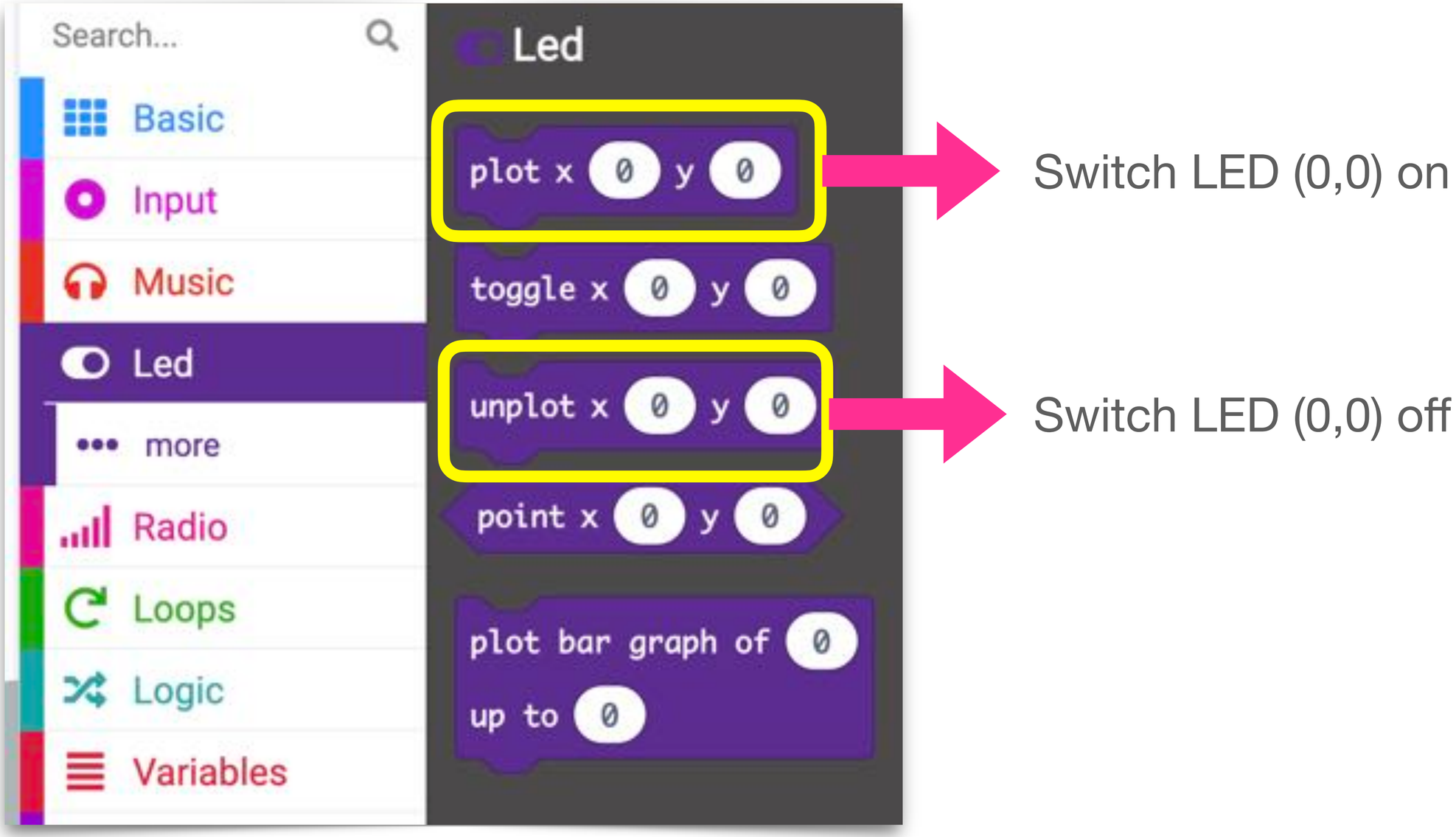
Plotting LEDs



LEDs form a Coordinate Plane



(x,y) coordinates of the 25 LEDs


Search...
Basic
Input
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more
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Logic
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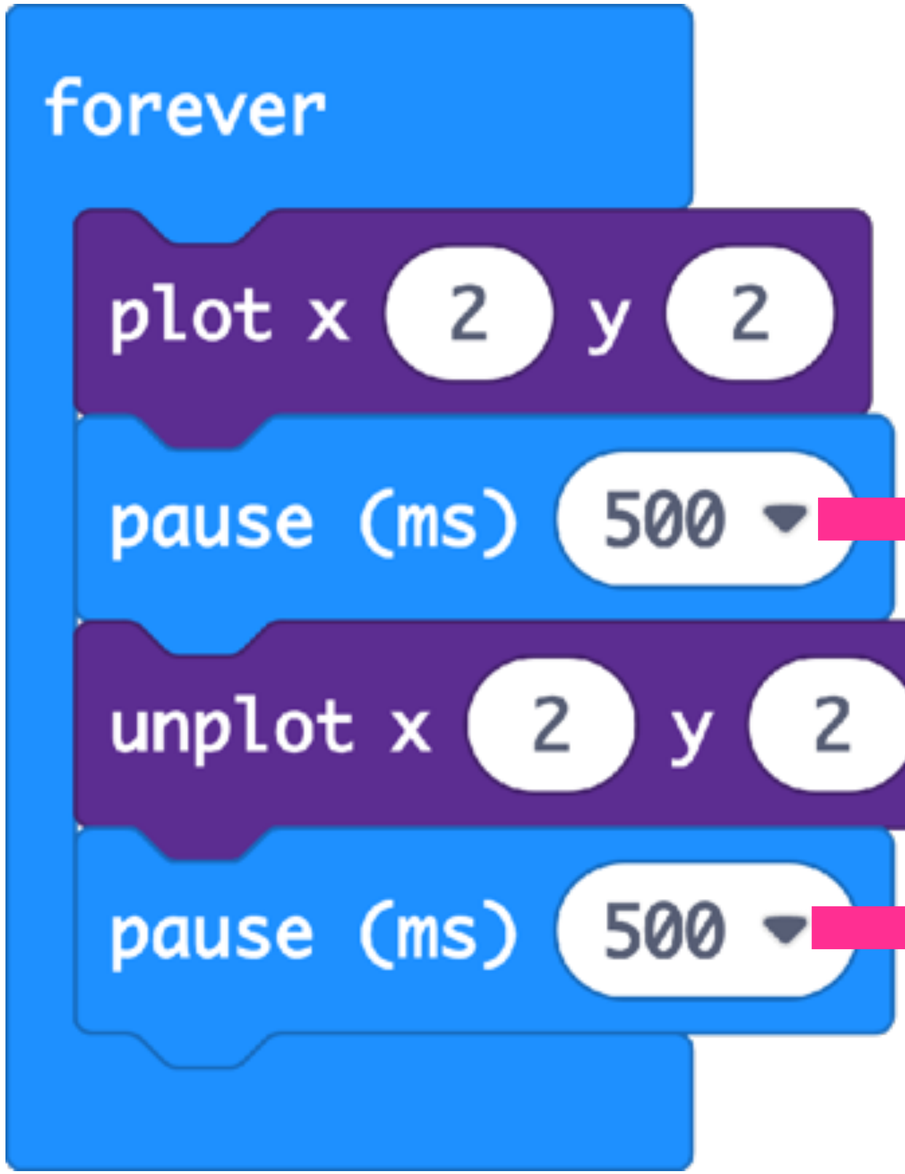
Led
plot x 0 y 0
toggle x 0 y 0
unplot x 0 y 0
point x 0 y 0
plot bar graph of 0
up to 0
Switch LED (0,0) on
Switch LED (0,0) off

CHALLENGE

Make Middle LED Blink

- Centre LED, i.e. x=2, y=2, should be on for 1 second
- Then it should be off for 1 second
- This should repeat forever



Change value to change the rate of blinking

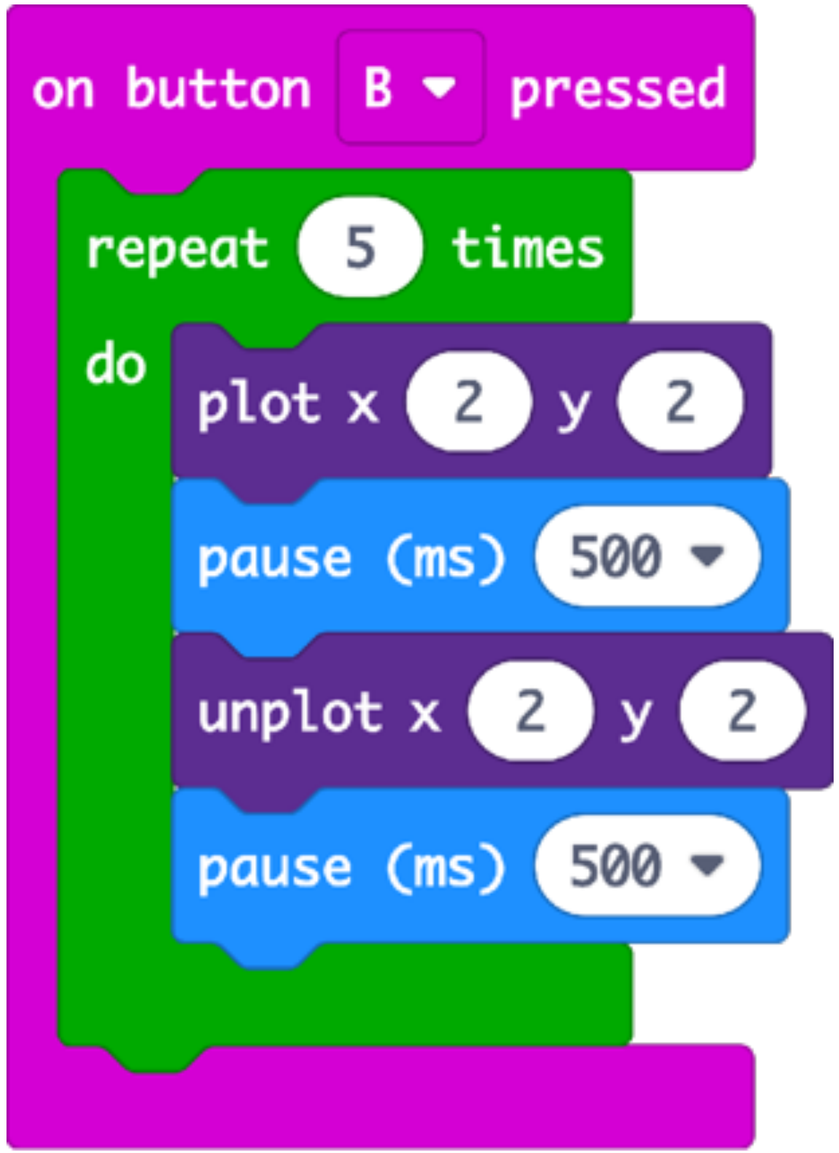
Change value to change the rate of blinking

CHALLENGE

Fun with LEDs

- On button-A pressed, the LEDs on the top row should light up one at a time.
- On button-B pressed, the centre LED should blink 5 times.
- Every time button-A+B is pressed, a different random pattern of LEDs should get created

On button-A pressed, the LEDs on the top row should light up one at a time.



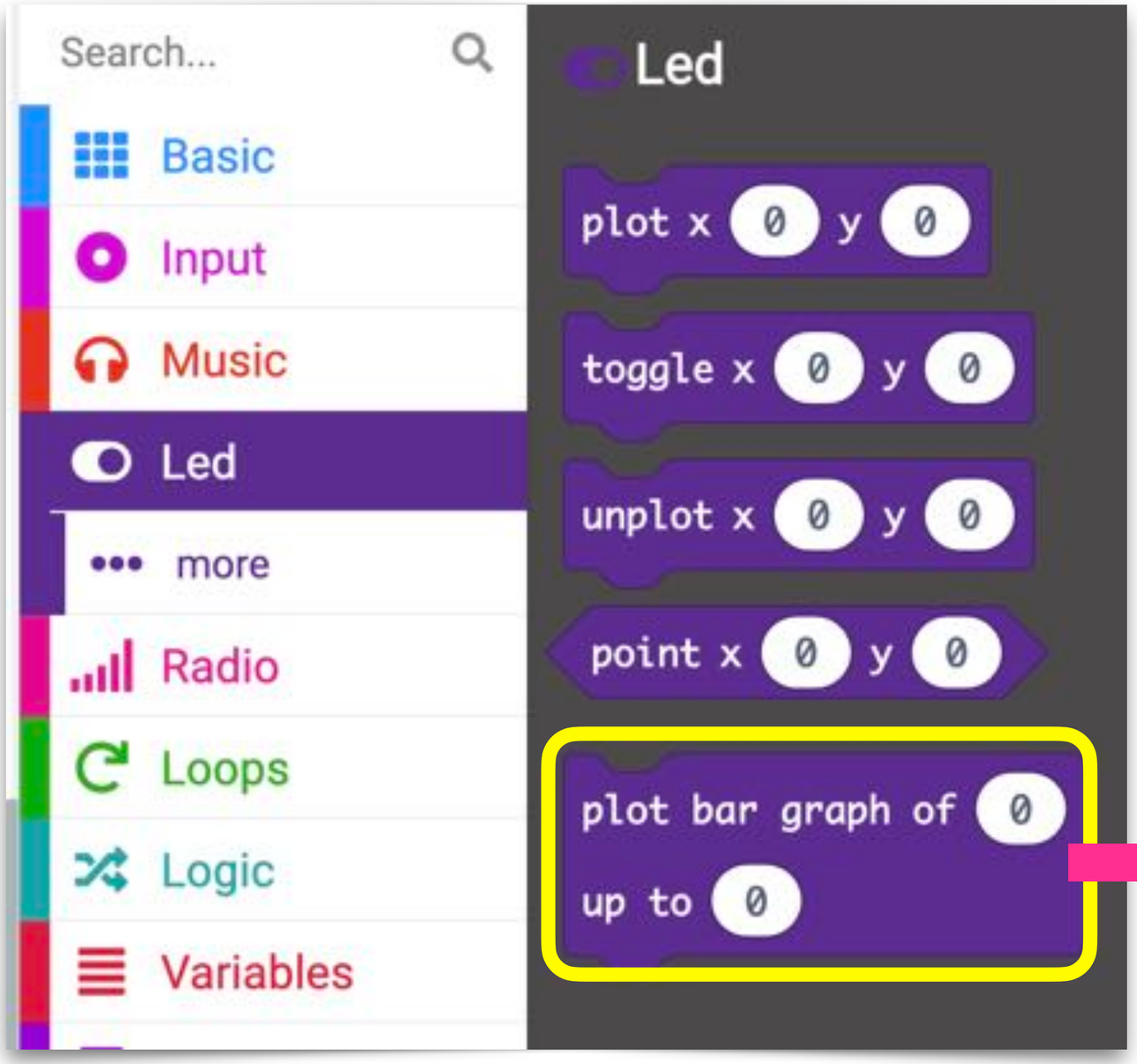
On button-B pressed, the centre LED should blink 5 times

(using a loop or iteration)

Every time button-A+B is pressed, a different random pattern of LEDs should get created.

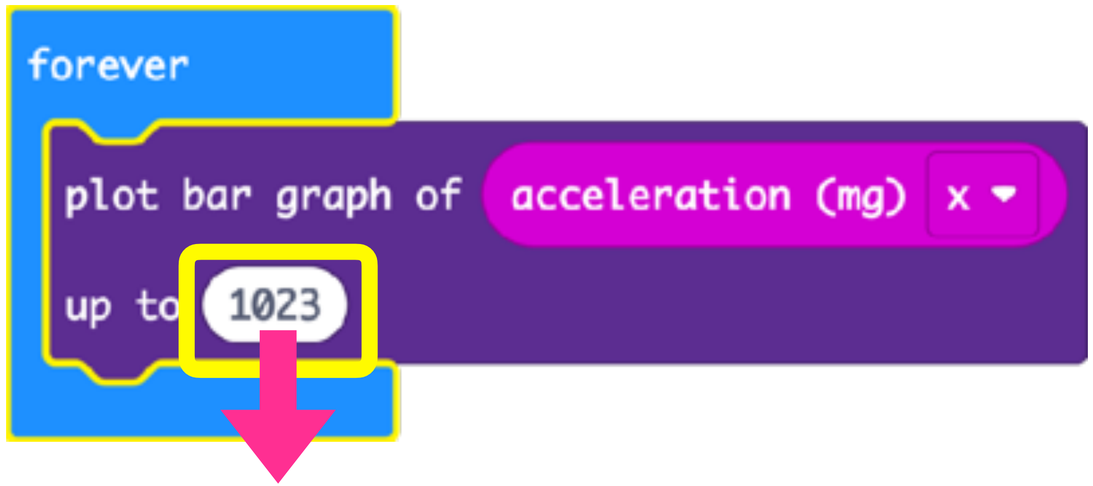
(Loop + Random Number Math Operator)

Plotting a Bar Graph



Makes the LEDs display a bar graph for a number value (parameter).

Plotting Bar Graph of Acceleration

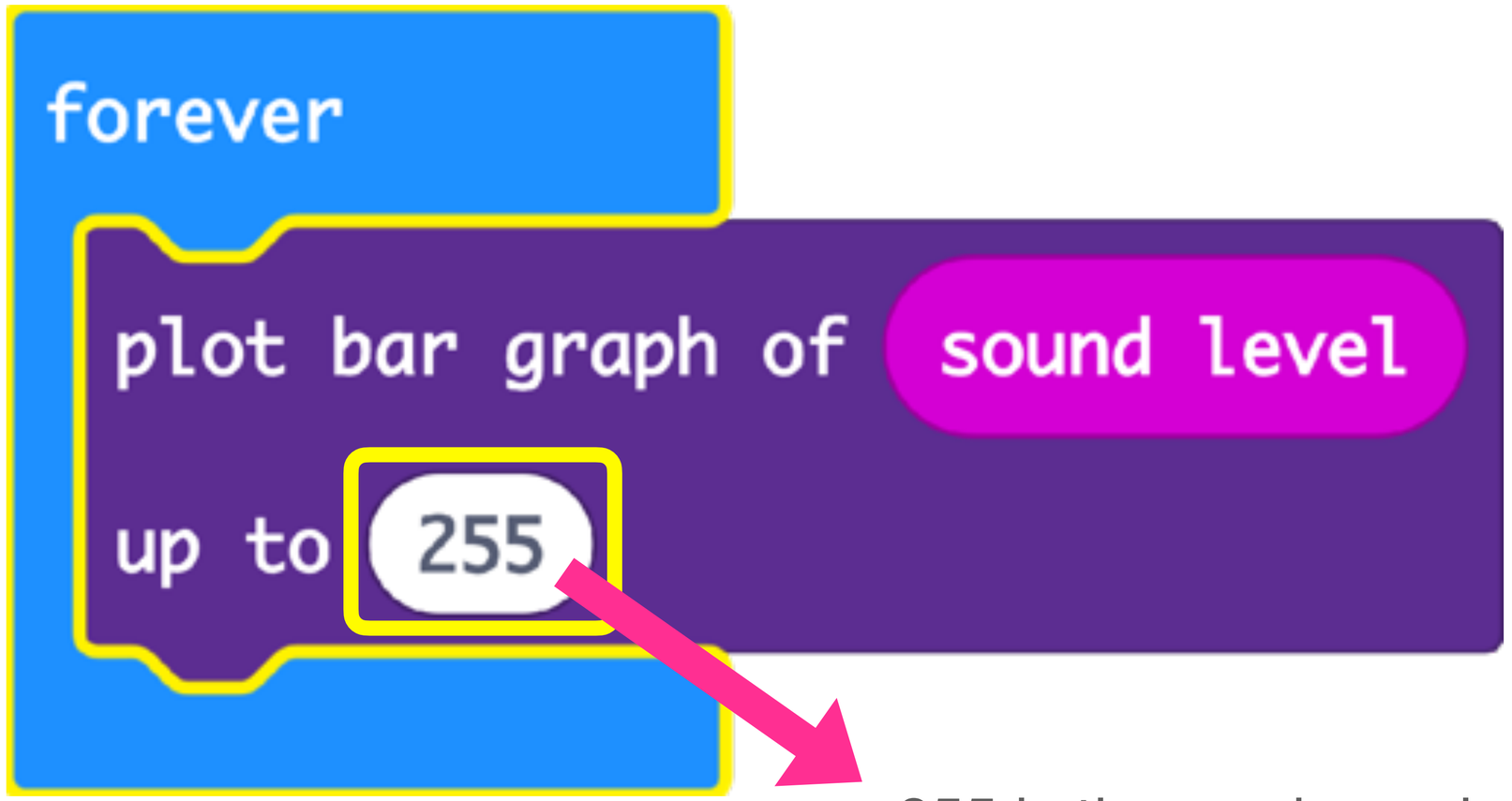


(+)1023 to (-)1023 is the maximum range of acceleration

CHALLENGE

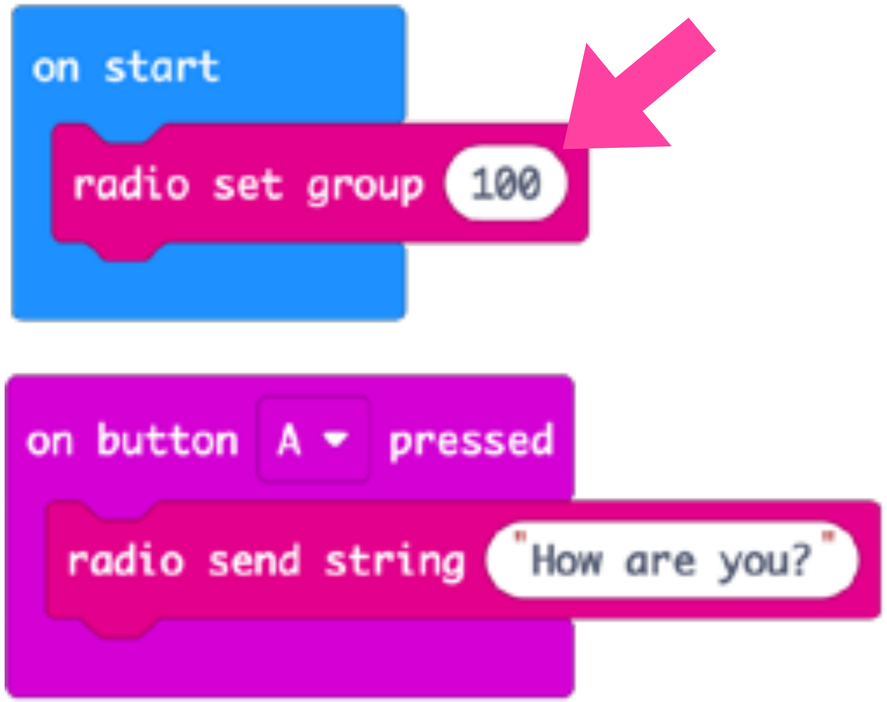
Loudest Singer!

- The LEDs on the microbit should plot the graph of the sound level.
- Find out who can sing or blow the loudest.



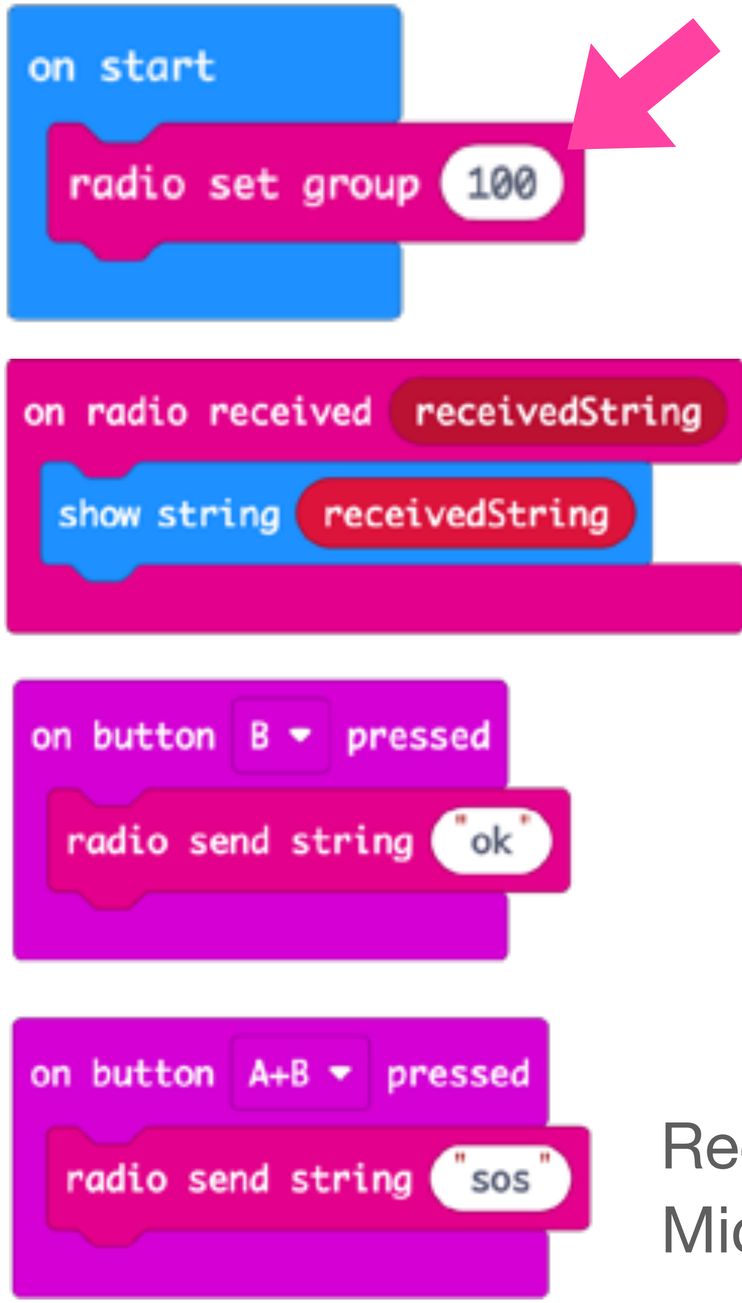
255 is the maximum level of sound detected on the microbit.

Radio



Transmitting
Microbit Code

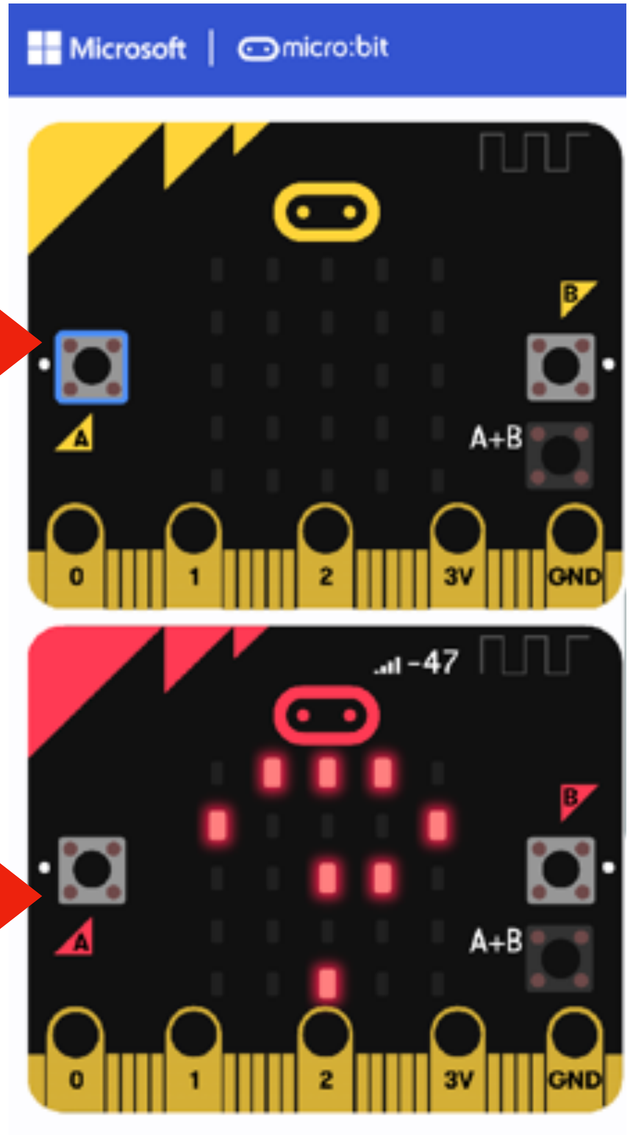
Both Microbits have to set to the same Radio Group

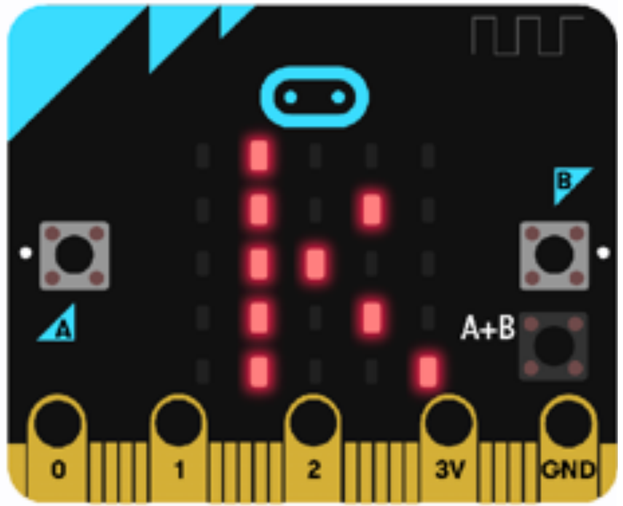


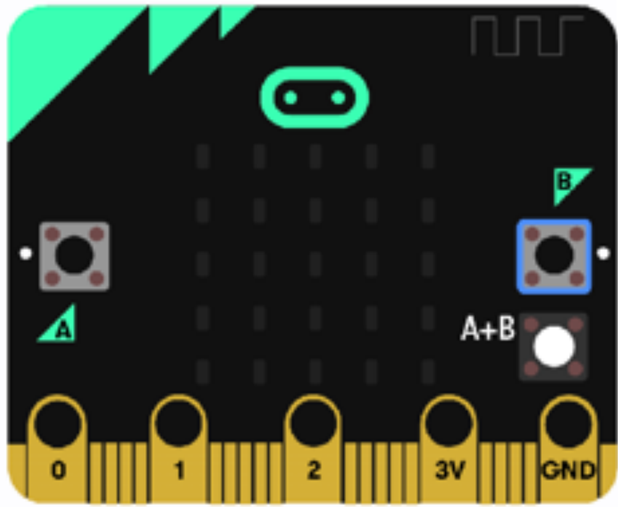
Receiving
Microbit Code

Transmitting Microbit

Receiving Microbit

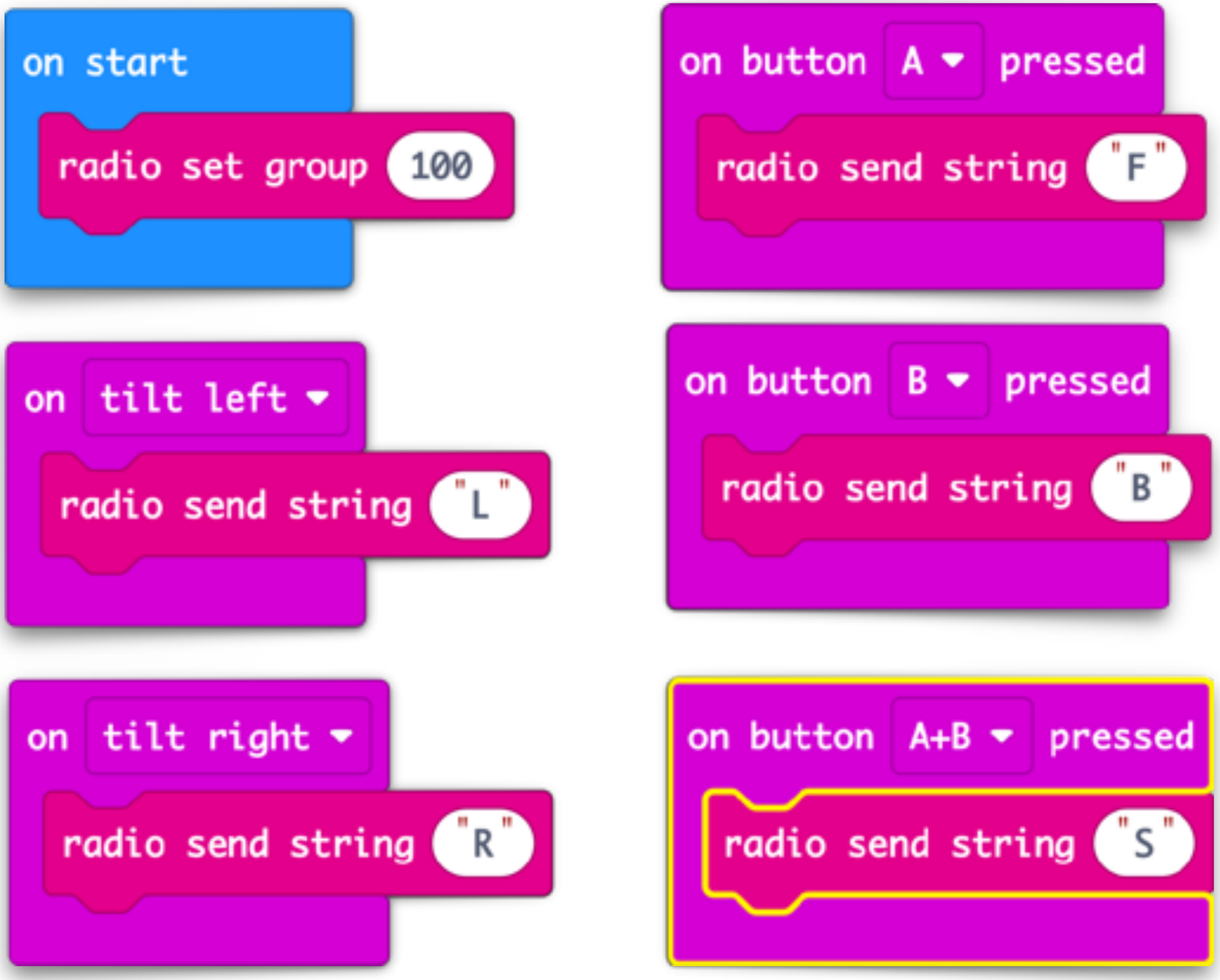




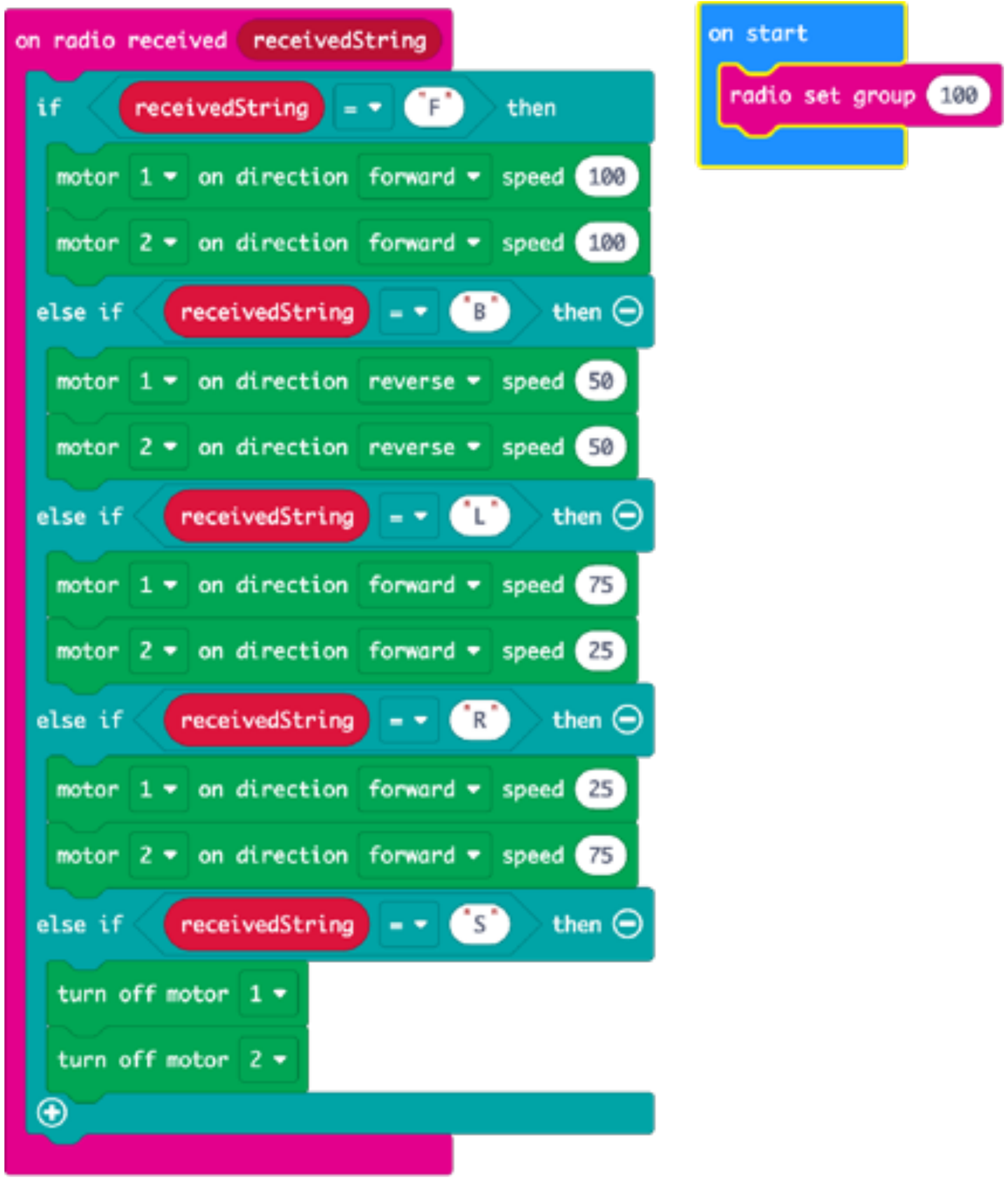


Radio - Remote Control Bot

Transmitting
Microbit Code



Receiving Microbit Code



Stay Fit Step Counter

FitBit

Electronic devices like the Fitbit and health apps use the accelerometer sensor to tell us how much exercise we are doing. In this project, we will use the Microbit to make a Step Counter.

Objective: use the accelerometer sensor (on-shake) to create a Step Counter.

Problem:

- If we walk with a Microbit tied to our shoe, on every step the Microbit will get shaken. Students need to use this property to create a Step Counter that will keep track of the number of steps taken and on pressing button-A it should show the total number of steps taken.
- Students will need a basic understanding of Variables.

In computer programming, a **Variable** is simply a location in the computer memory where we store value of something that keeps changing when the programme runs. For example, Score in a game is a variable because it keeps changing. Whereas Player Name is a constant because it does not change when a programme is executed.

Micro:bit
Step Counter

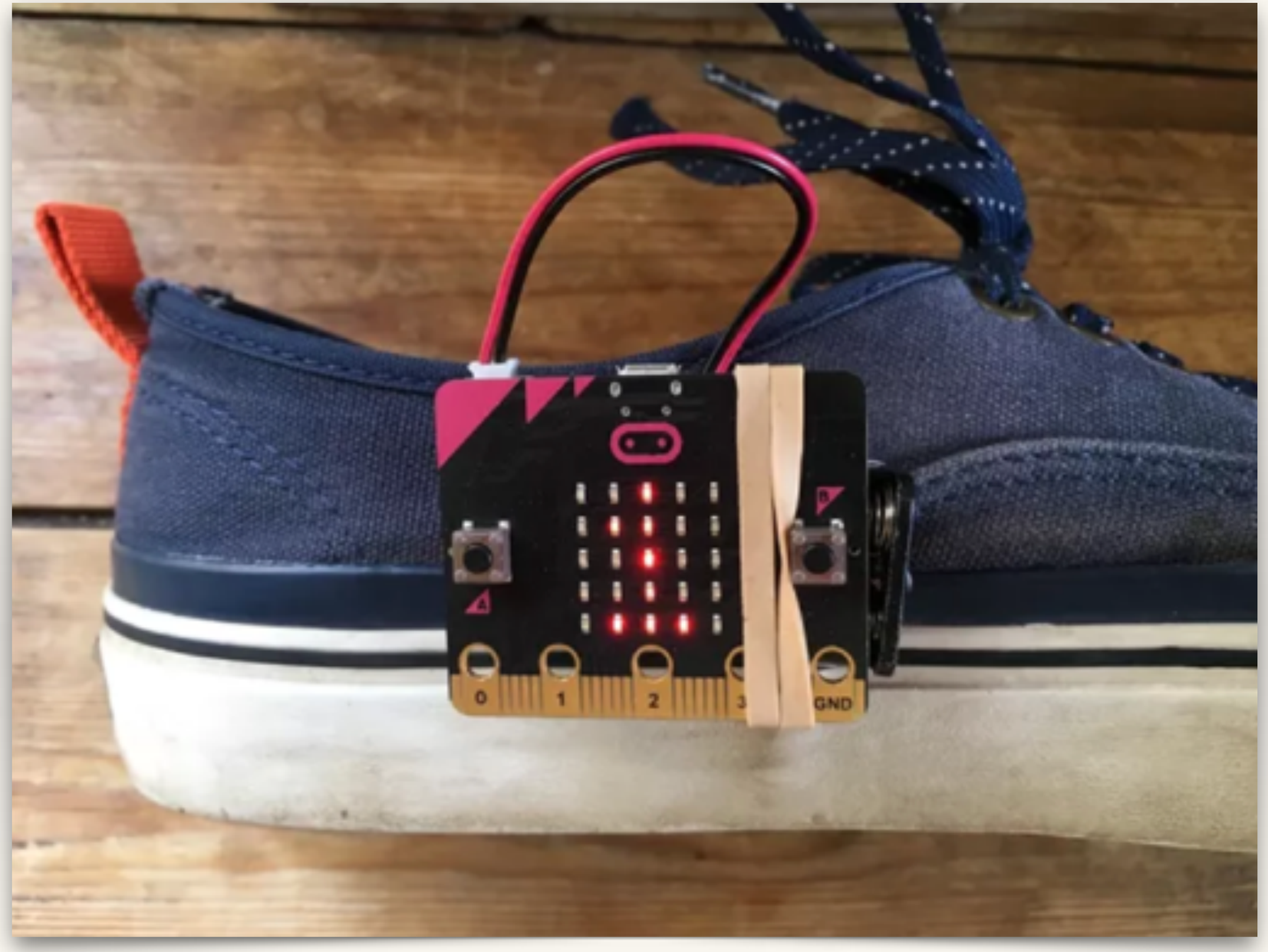
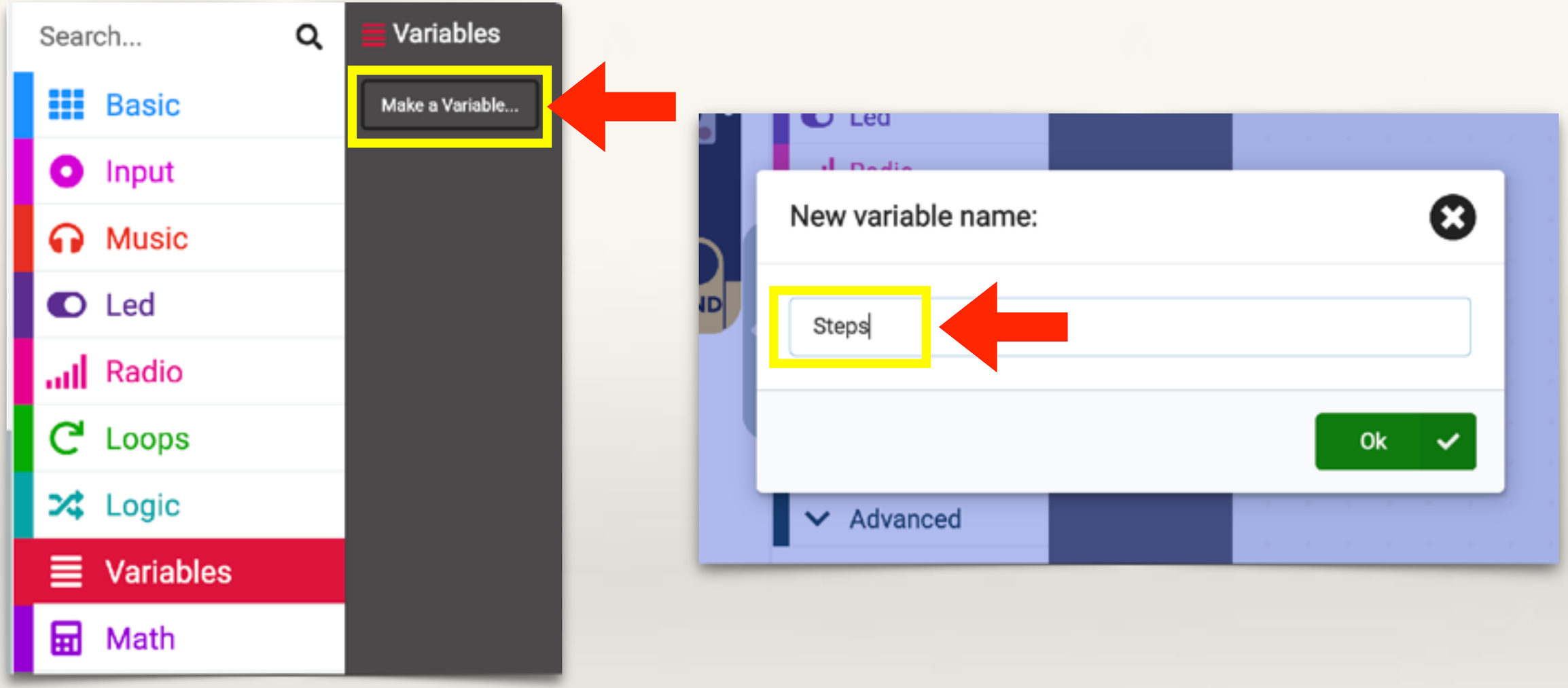


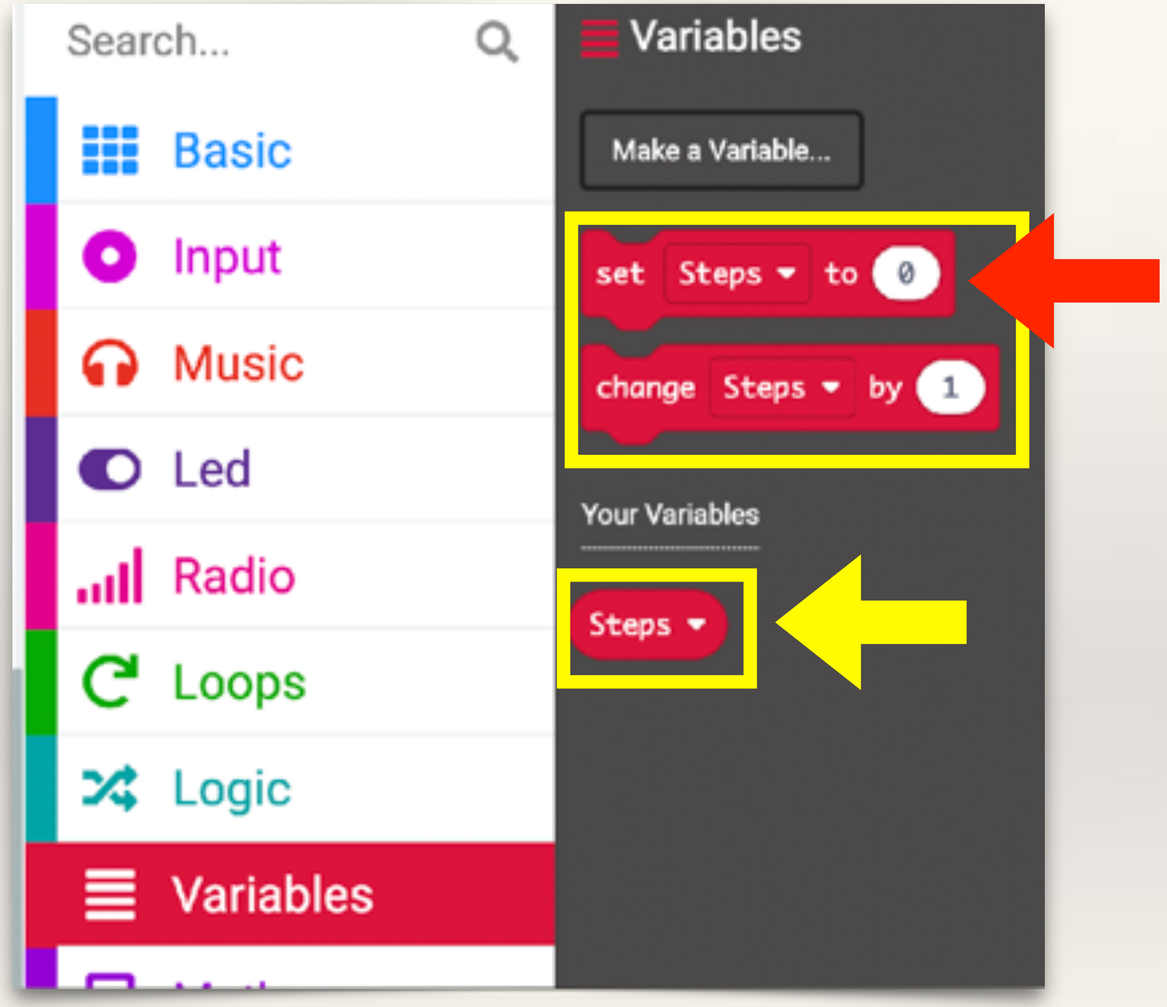
Image Source: https://microbit.org/projects/make-it-code-it/sensitive-step-counter/



To keep track of the number of steps taken (on each shake event), we will need to create a variable. Go to Variables > click Make a Variable > Type an appropriate variable name e.g. Steps

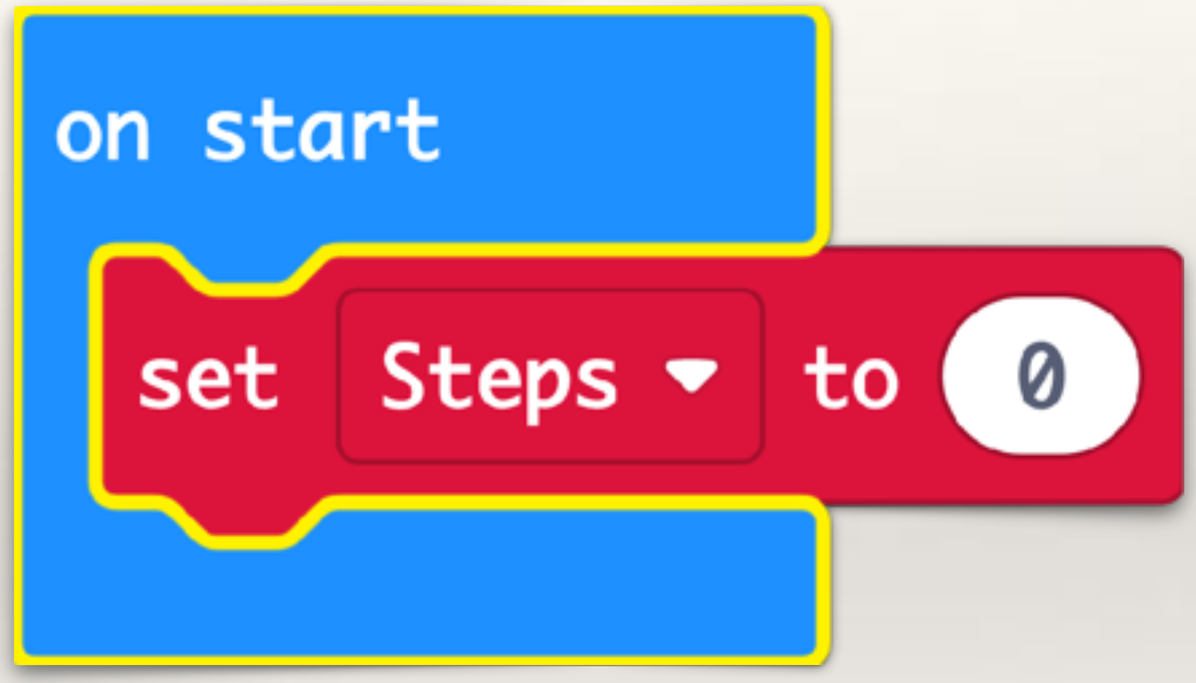
Once a new variable is created, new blocks will appear under ‘Variables’ - Set, Change, and the new variable (in this case ‘Steps’).

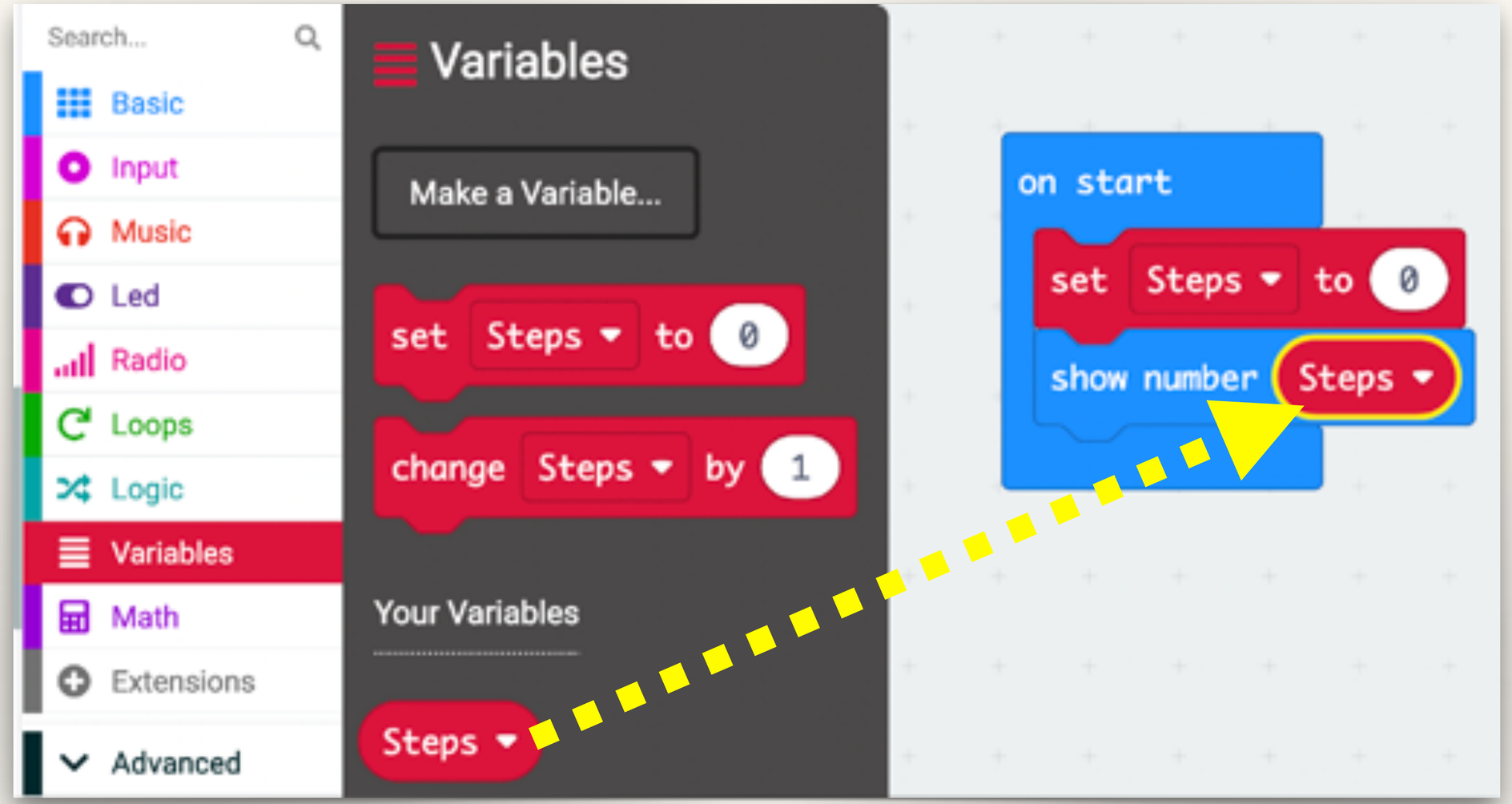
Drag out the ‘Set Number’ block and ‘Steps’ variable.



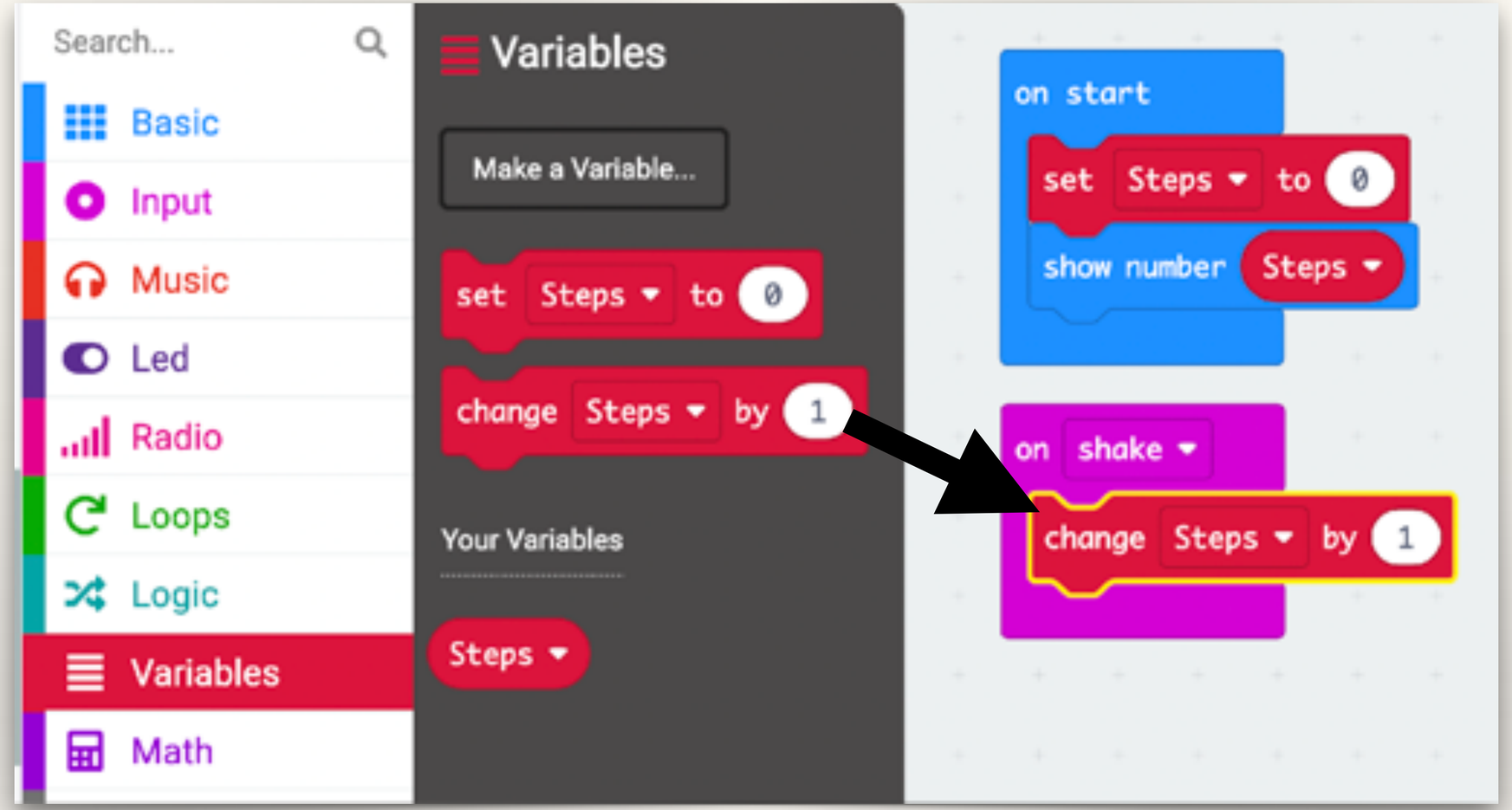
From ‘Basic’ drag out an ‘On Start’ block and put the ‘Set Steps’ command inside ‘On Start’ block.

This will ensure that whenever our programme restarts, the value of the variable called ‘Steps’ is set to 0.





From ‘Basic’ drag out ‘Show Number’ block and put the ‘Steps’ variable inside ‘Show Number’ block. This will confirm to the user that whenever the programme starts or restarts, the value of the variable called ‘Steps’ is set to 0.



From ‘Input’ drag out an ‘On Shake’ event block and put the ‘Change Steps’ command inside ‘On Shake’. Set the value to 1. Now, whenever the microbit gets shaken, the value of the variable called Steps will get incremented by 1.

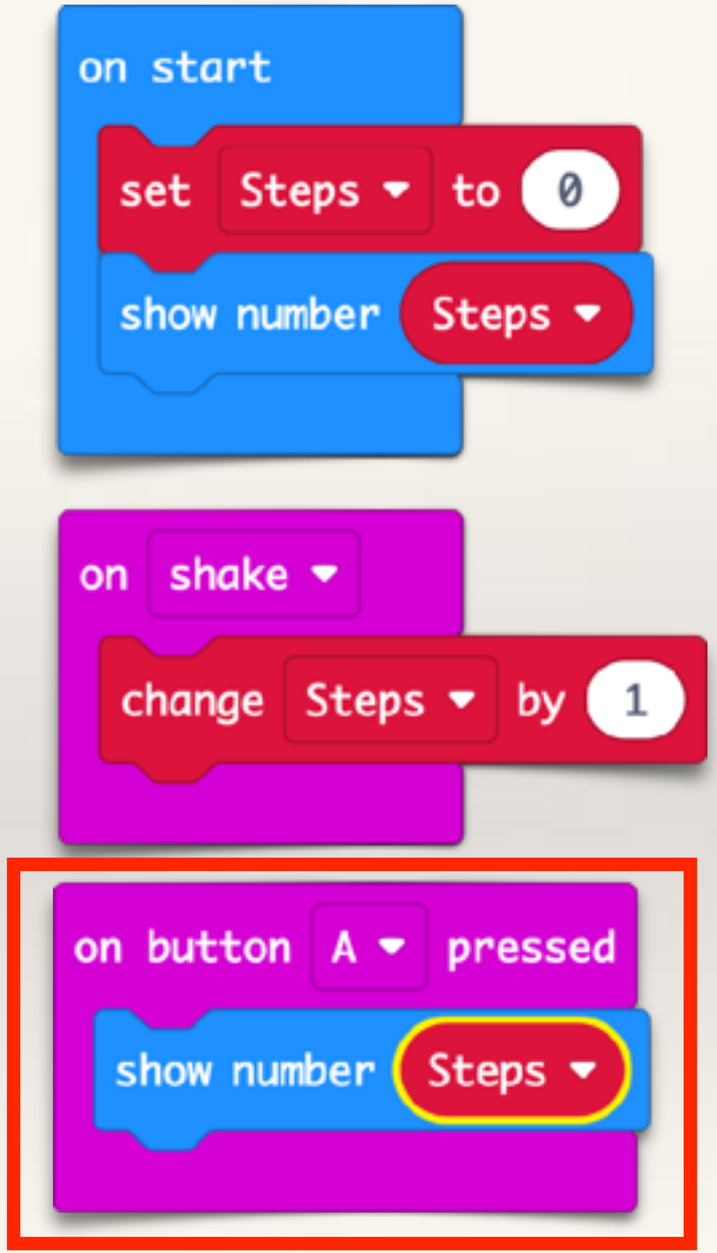
From ‘Input’ drag out an ‘On button-A Pressed’ event block.

From ‘Basic’ drag out a ‘Show Number’ block.

Put the variable ‘Steps’ inside ‘Show Number’ command.

Now, after the microbit has been shaken a few times, what is the total value of the variable Steps can be known by pressing button-A.

Our basic Microbit Step Counter is ready. But we can make it look better.

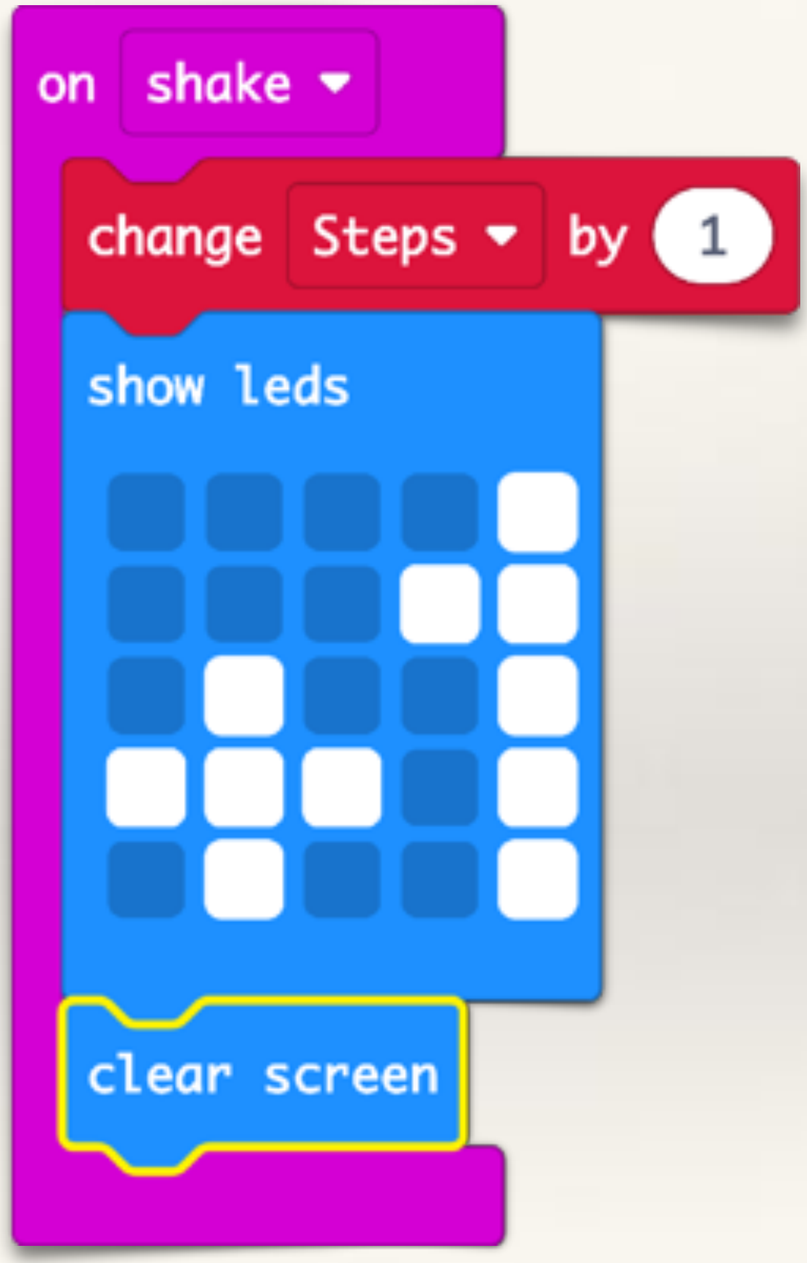


From ‘Basic’ drag out a ‘Show LEDs’ command. Put it in the On Shake block, under ‘Change Steps’ command.

Light up the appropriate LEDs to display “+1”.

From ‘Basic’ drag out a ‘Clear Screen’ command. Put this below the ‘Show LEDs’ command.

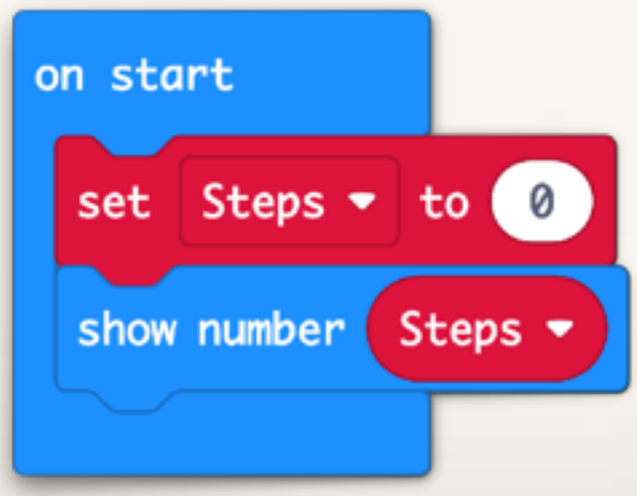
Now, each time the microbit detects a shake, it will display “+1” briefly.

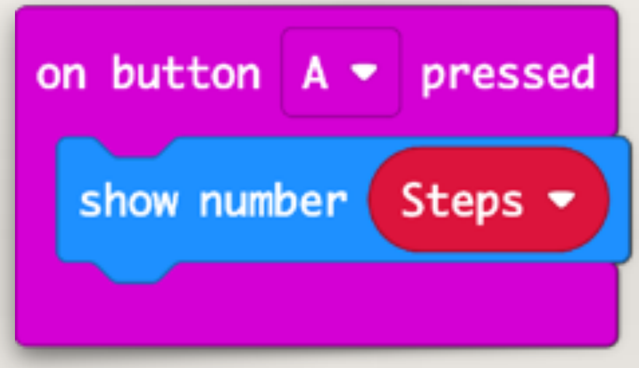


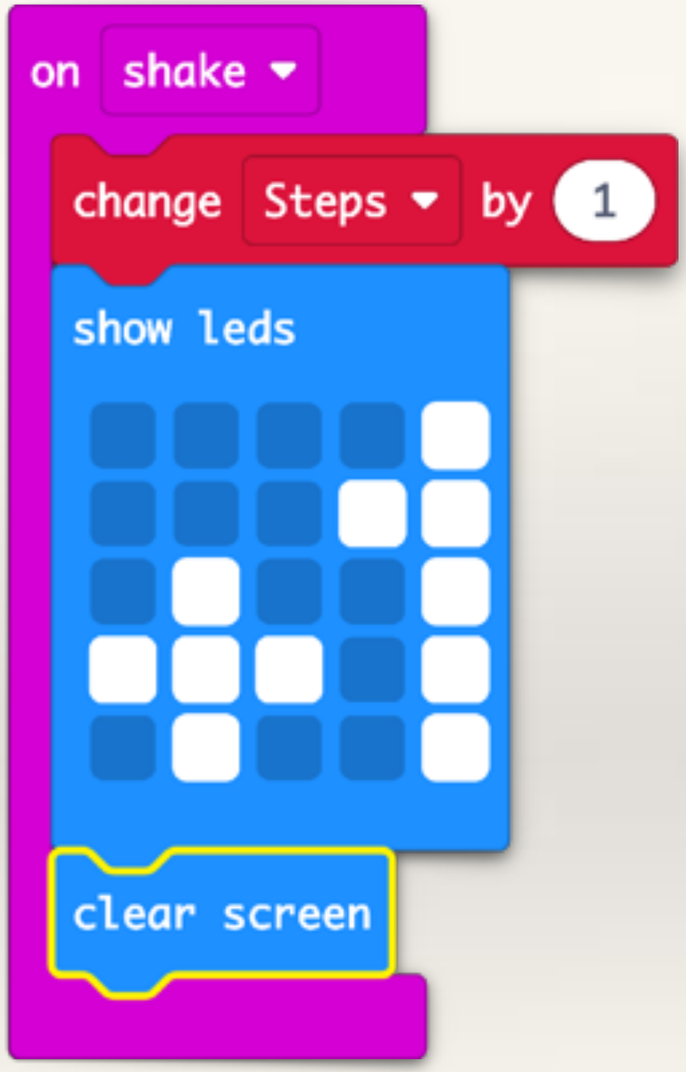
Attach the 3 volt battery-pack to the microbit and put both of them inside your socks.

Whenever you take a step, the microbit will detect a shape and increment the variable called Steps by 1.

You can see the total number of steps you have taken by pressing button-A







Complete code for Microbit Step Counter

Neopixels

Go Back

Extensions

?

neopixel

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Import File

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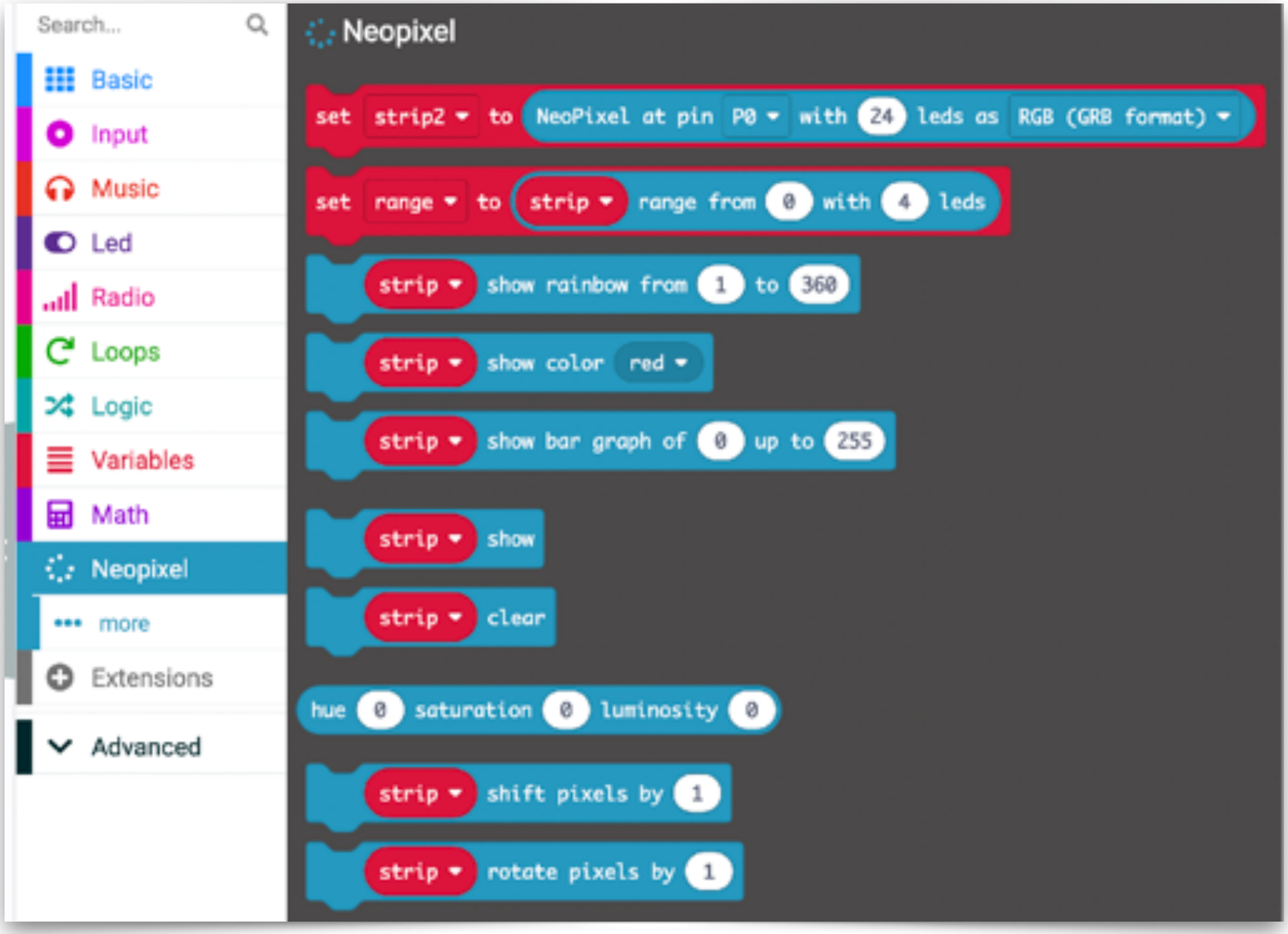
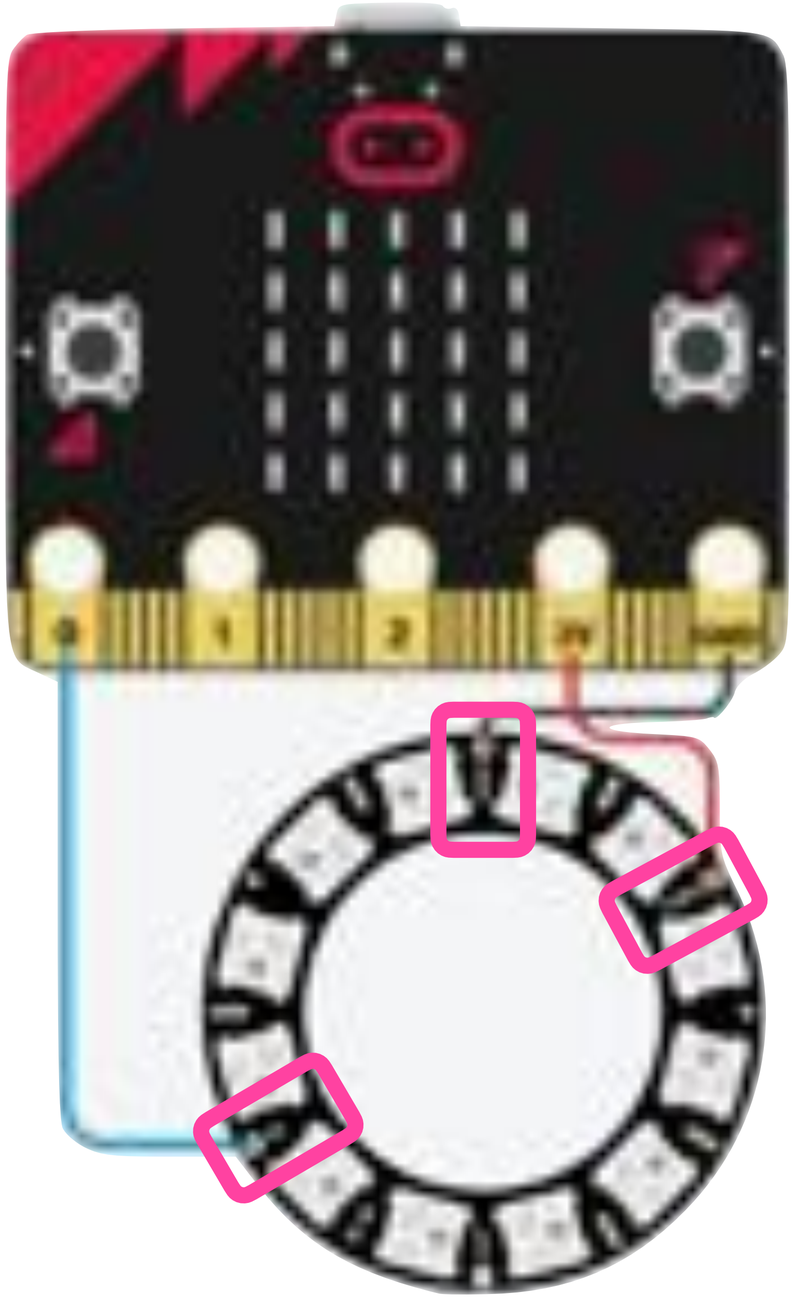
A Microsoft MakeCode package for Seeed Studio Grove module

Environment-and-Science-IoT

Environment and Science IoT Kit for micro:bit

Neopixel Programming Blocks



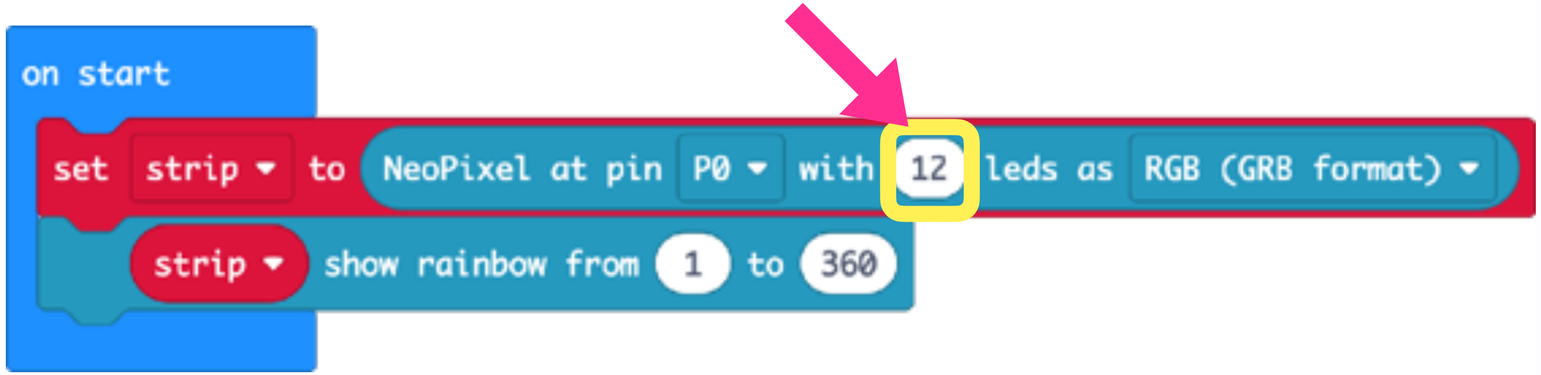


Connecting the Neopixels

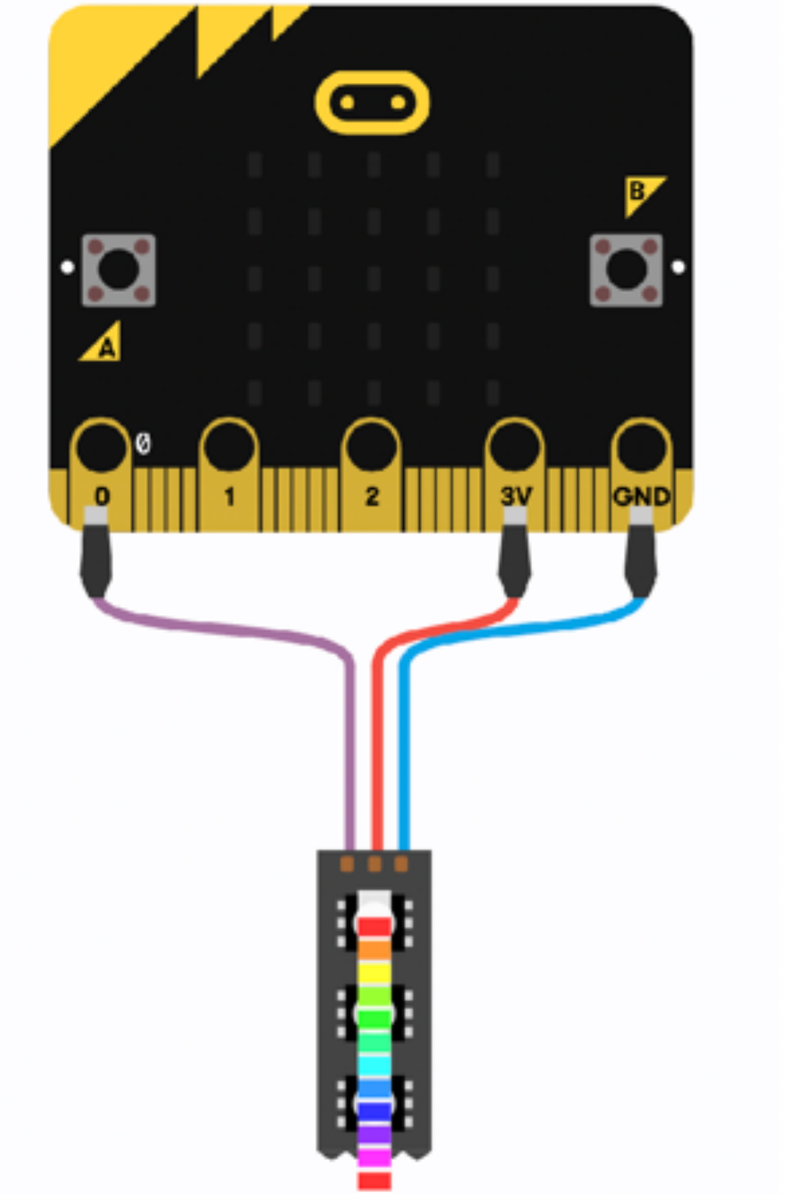
For 8-12 neopixels, you can connect the strip directly to the microbit. If you want to connect more neopixels, it may be safer to use an external power supply for the neopixel strip.

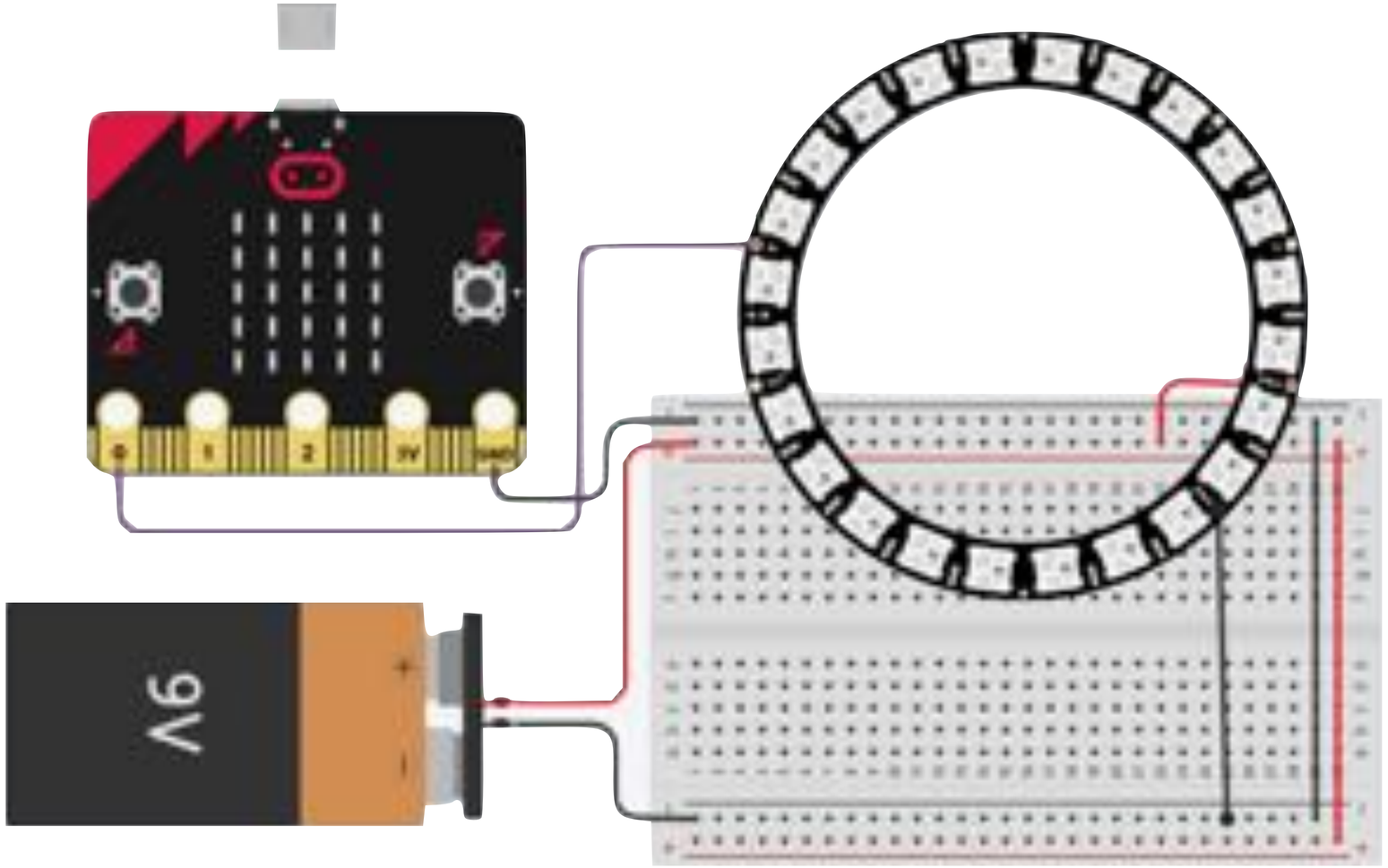
<u>Direct to Microbit</u>

- Connect DI (input) pad on the neopixel to pin 0, 1 or 2 on the microbit
- Connect PWR pad on the neopixel to 3V pin on the microbit
- Connect GND pad on the neopixel to ground pin on the microbit



1. Initialise the Neopixels with Set Strip command
2. Define the number of pixels your strip has (in this case it is 12)
3. Drag out Show Rainbow command
4. Transfer your code to the microbit, see result

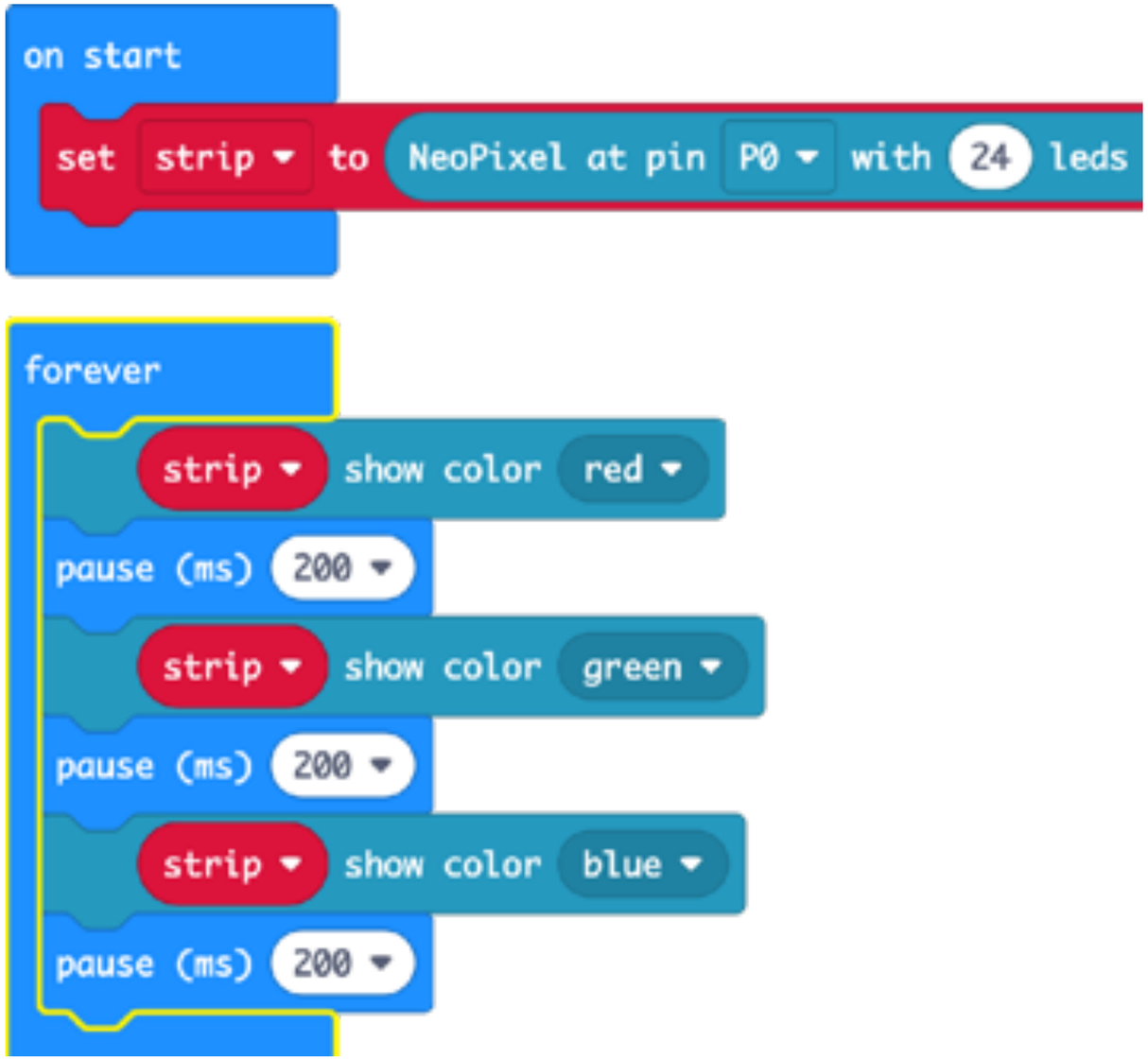


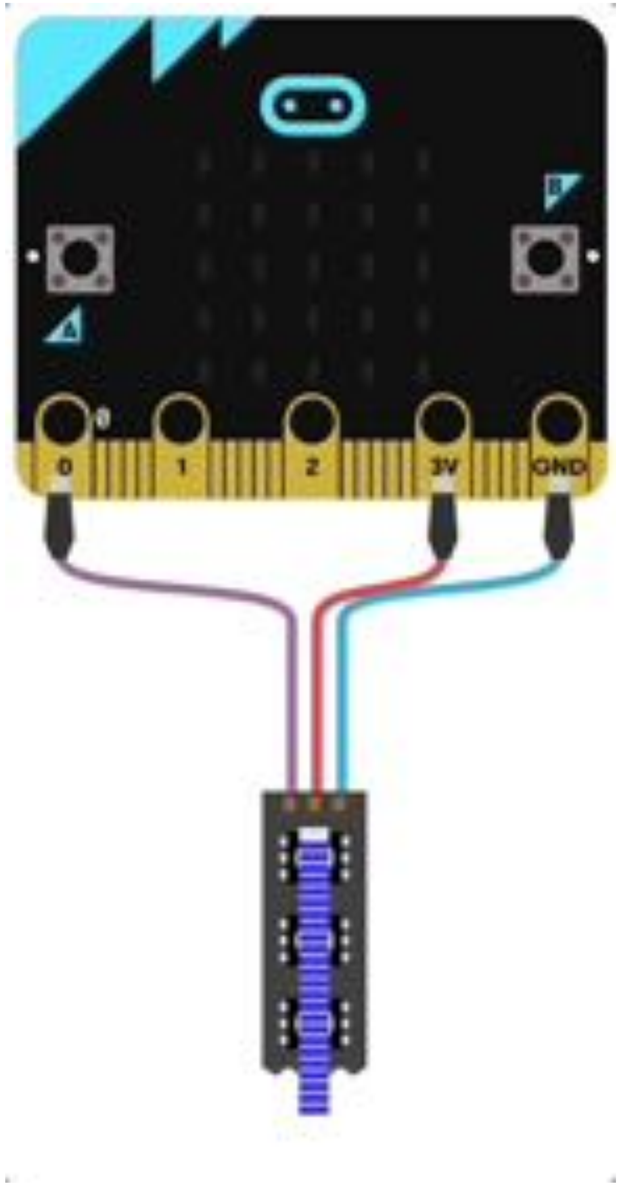


Connecting the Neopixels to a battery pack / power supply

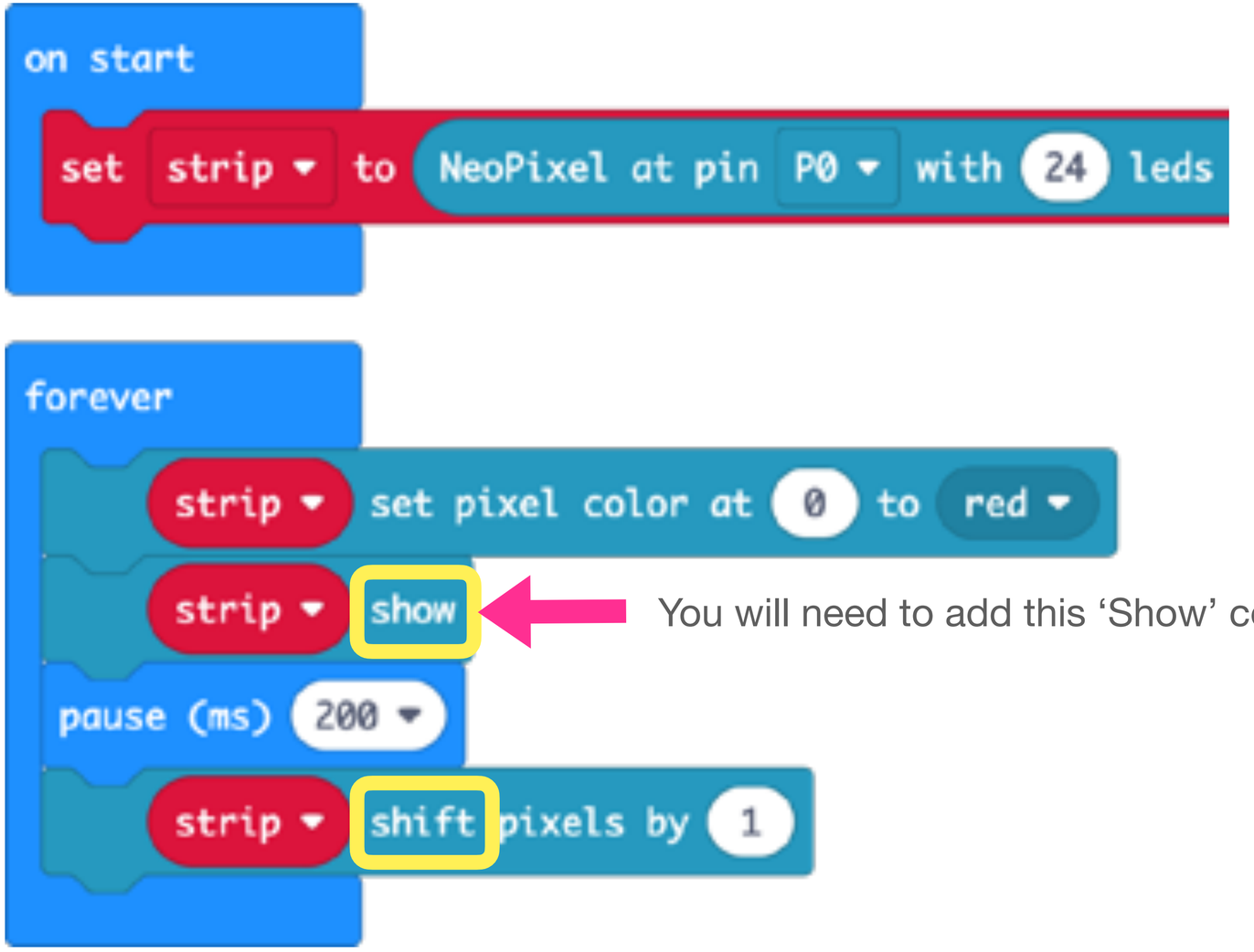
- Connect Di (input) pad on the neopixel to pin 0, 1 or 2 on the microbit
- Connect PWR pad on the Neopixel to the positive terminal of the battery
- Connect GND pad on the Neopixel to the negative terminal of the battery
- Connect GND of the microbit to the negative terminal of the battery (to have common ground for all components)

Change Colour of the Entire Neopixel Strip

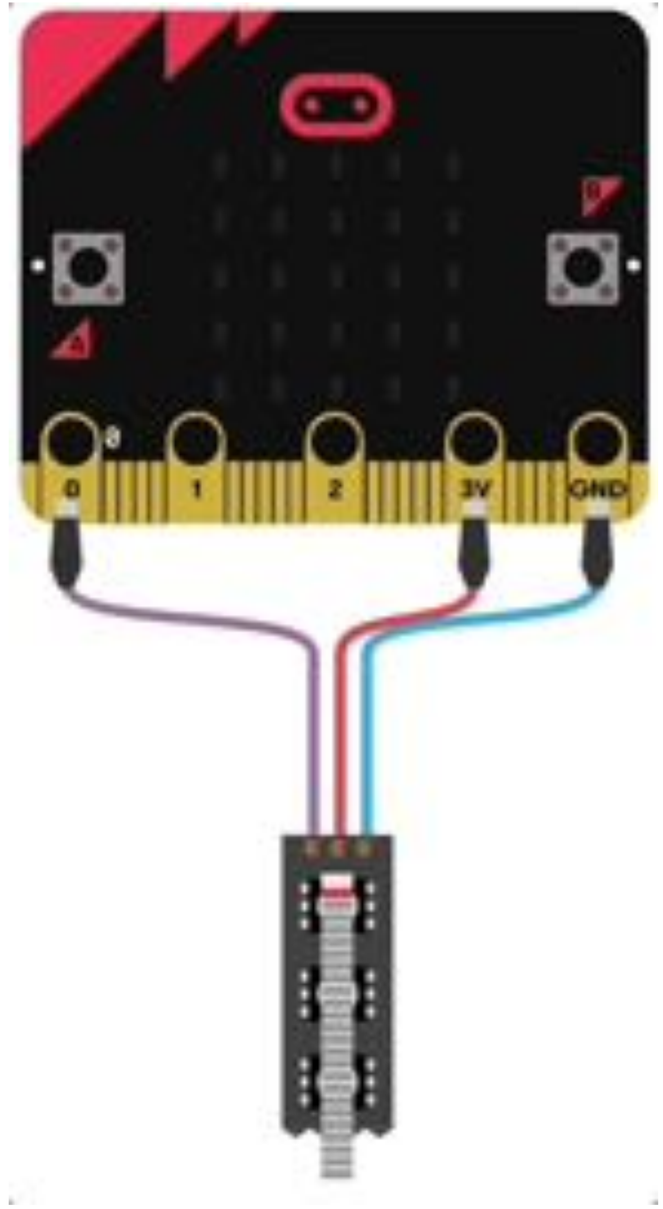




Shift Pixel and Show Command



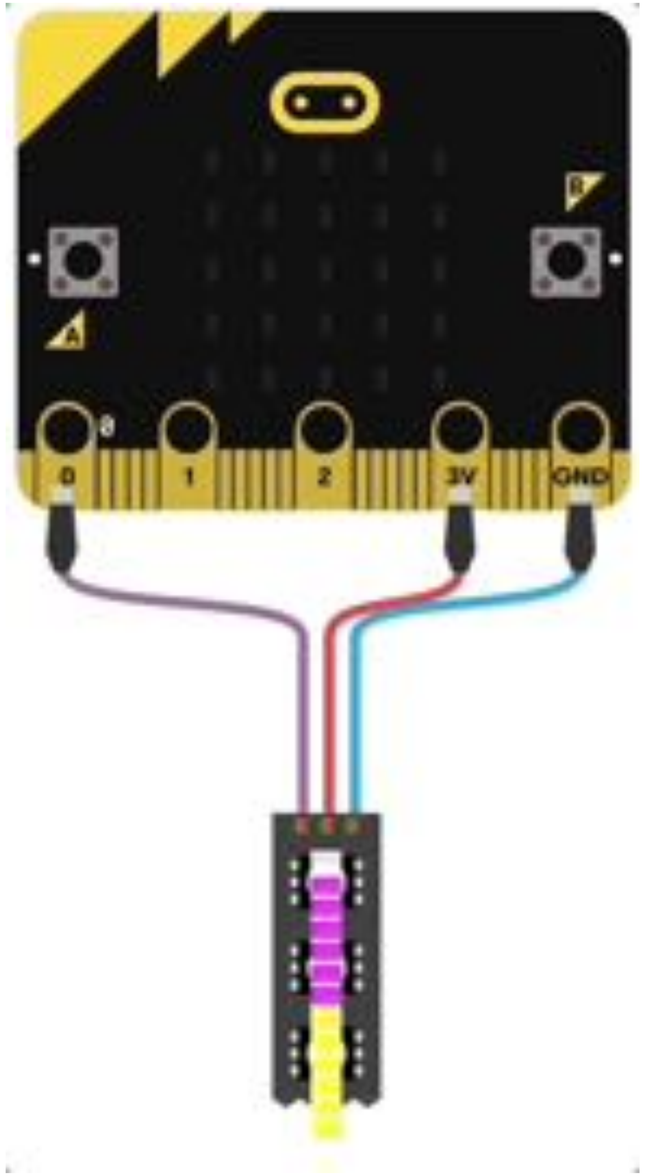
You will need to add this ‘Show’ command



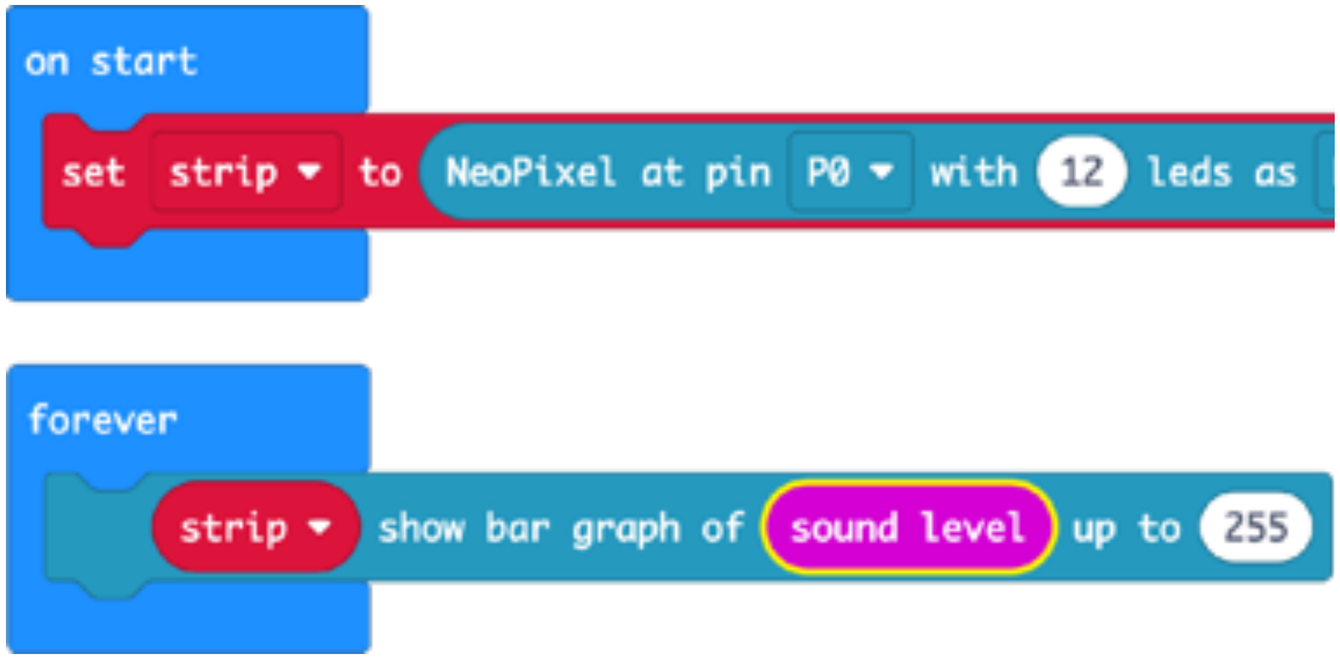
Using Loops to Control Colour

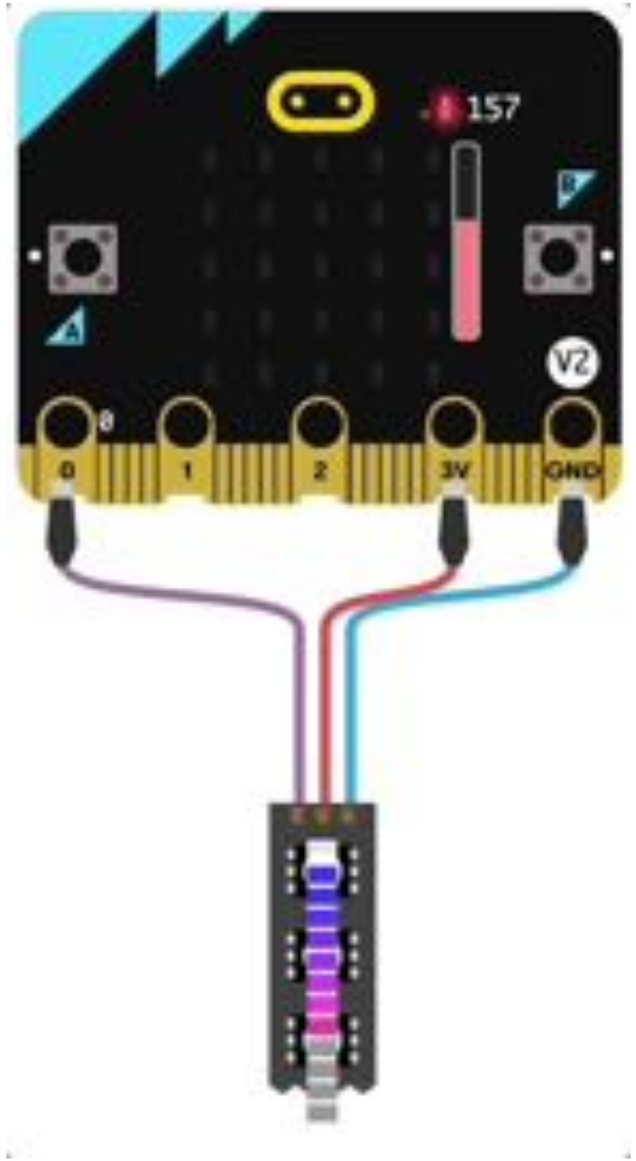
```
on start
    set strip to NeoPixel at pin P0 with 12 leds as RGB (GRB format)

forever
    for index from 0 to 11
    do
        strip set pixel color at index to purple
        strip show
        pause (ms) 100
    for index from 0 to 11
    do
        strip set pixel color at index to yellow
        strip show
        pause (ms) 100
```



Neopixel Bar Graphs





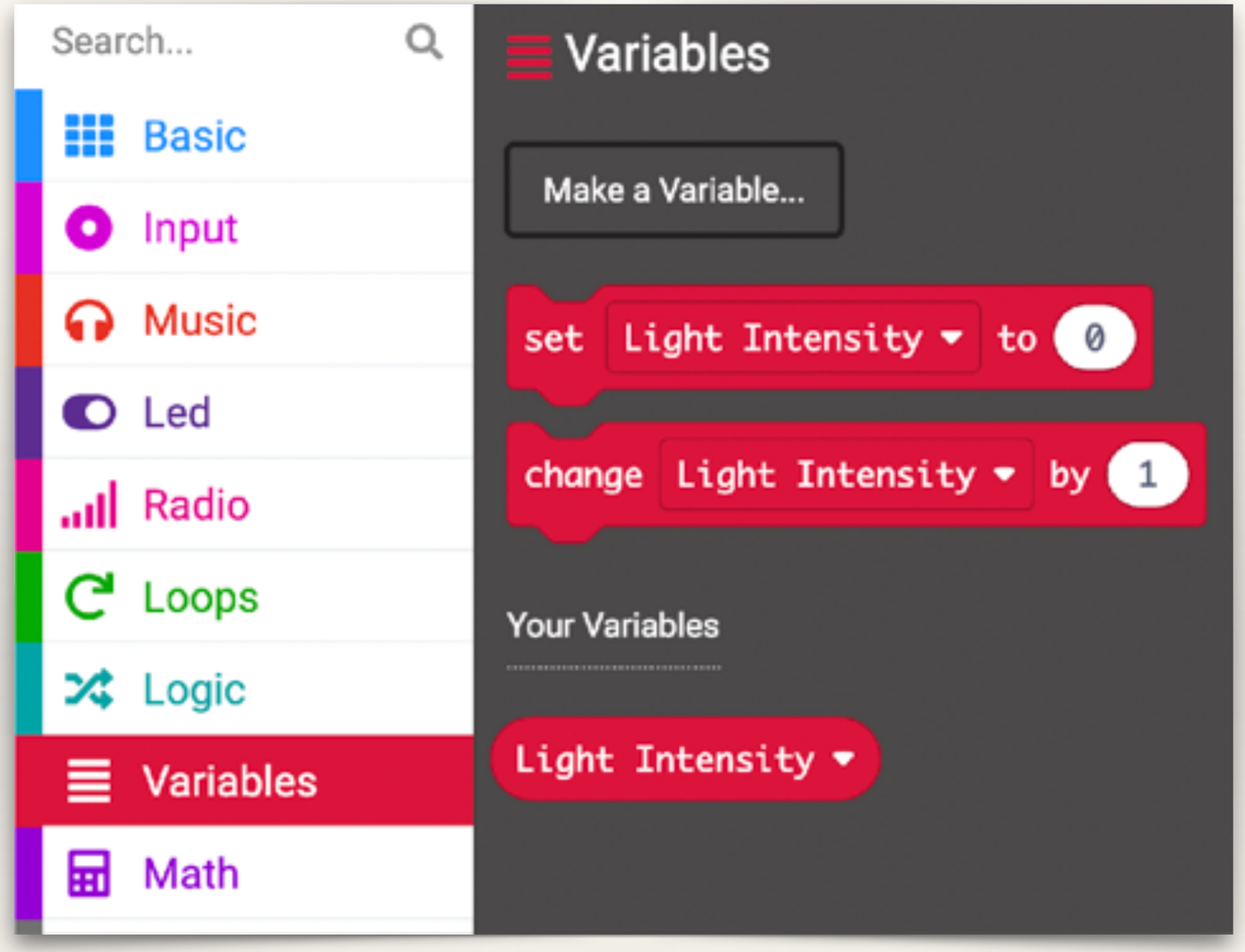
Smart Street Light

Objective: to learn about the light sensor and how it can be used.

Problem: use the light sensor to create a smart street light. When the Sun is shining, the light sensor reading is high (200+) and when the Sun sets the light sensor reading is low (less than 100). Use this property to glow some onboard LEDs on the microbit when the light level is less than 100. The onboard LEDs depict a street light which automatically switches on when the sun sets and it starts to become dark.

This project requires basic knowledge of Variables and If-Then conditional statements.

Create a new variable and give it an appropriate name. Here, we are calling our variable ‘Light Intensity’

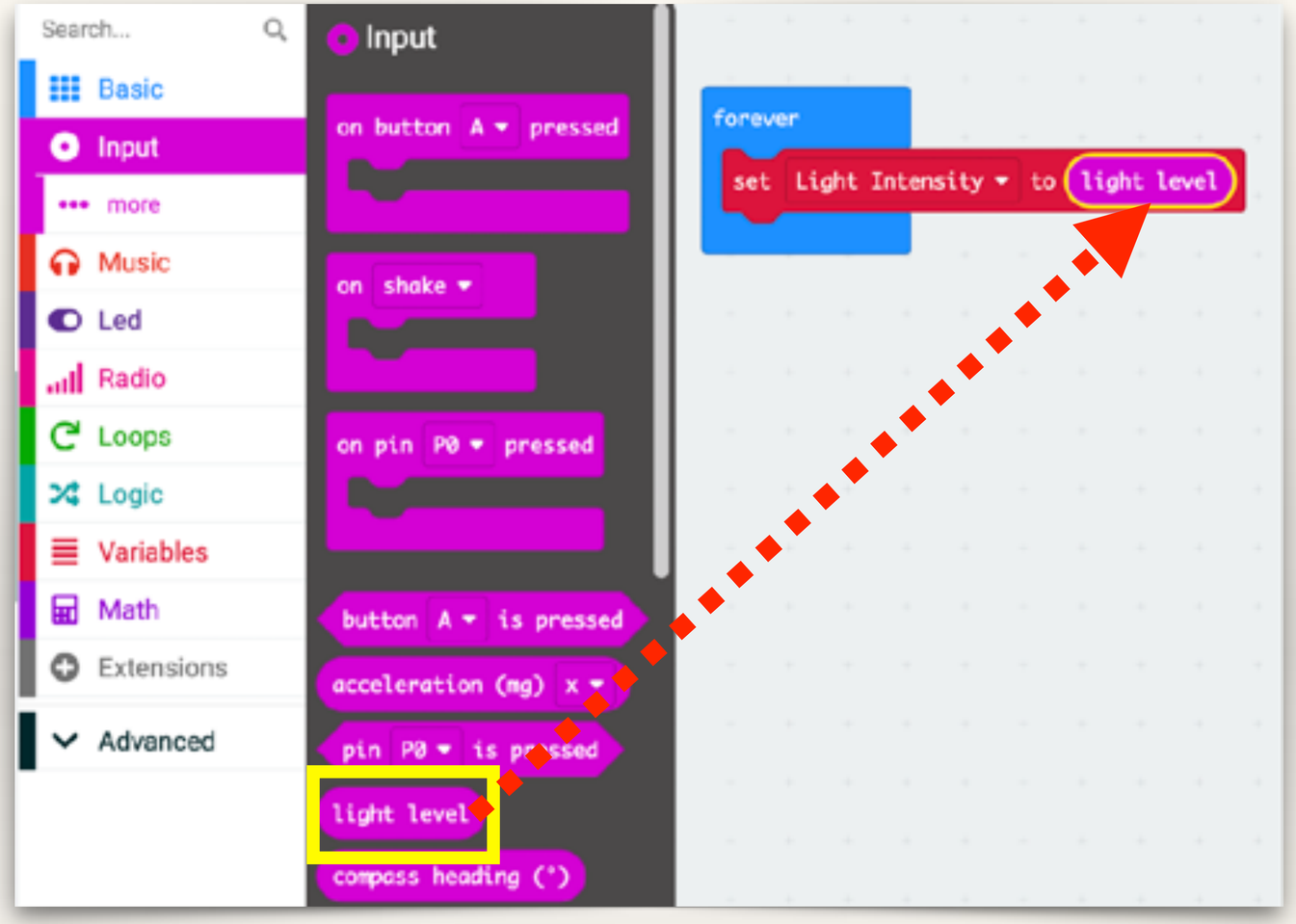


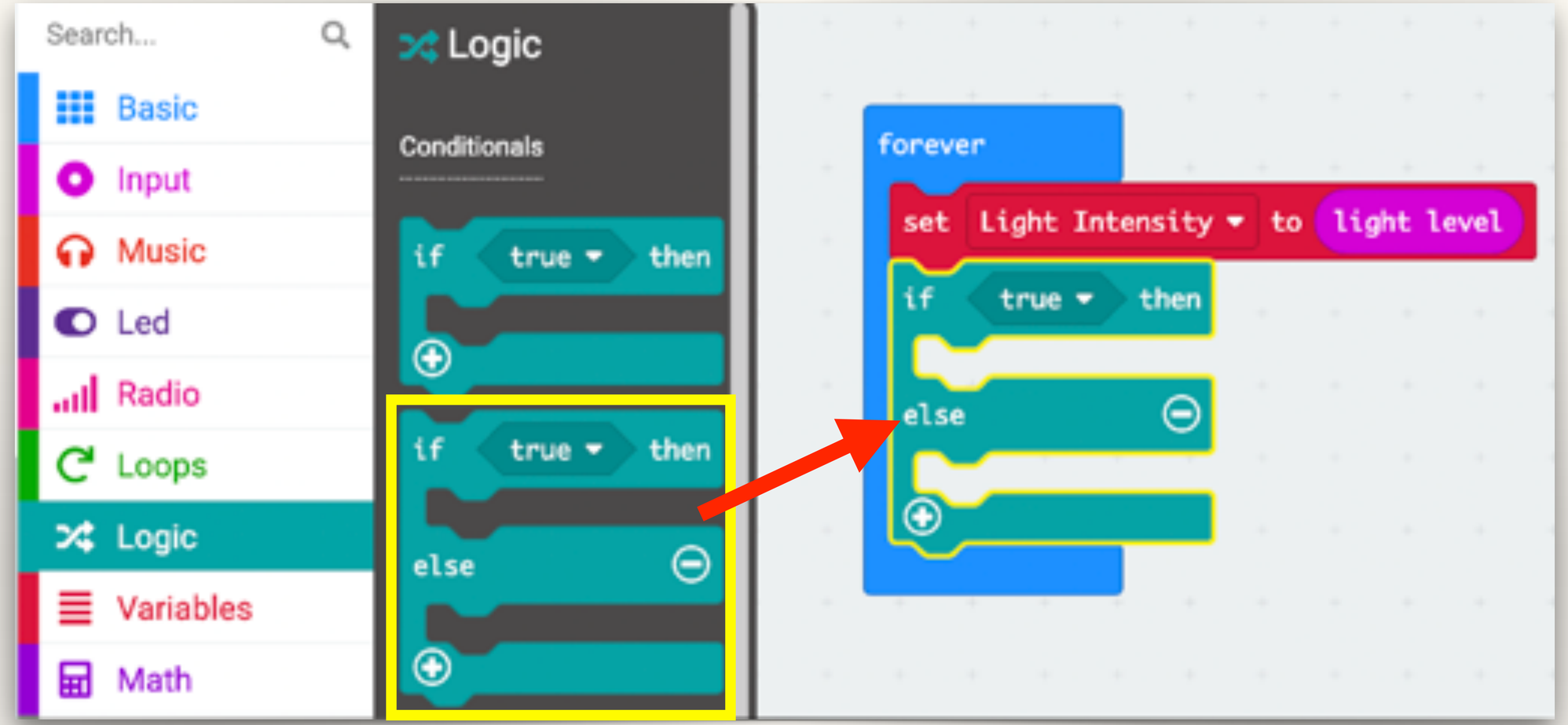
From ‘Basic’ drag out a ‘Forever’ block.

From ‘Variables’ drag out a ‘Set Variable’ block and put it inside the Forever block.

From ‘Input’ drag out ‘Light Level’ block and put it inside the Set Light Intensity block.

Now, whatever is the level of light falling on the microbit, it will get updated and stored in the variable called Light Intensity.

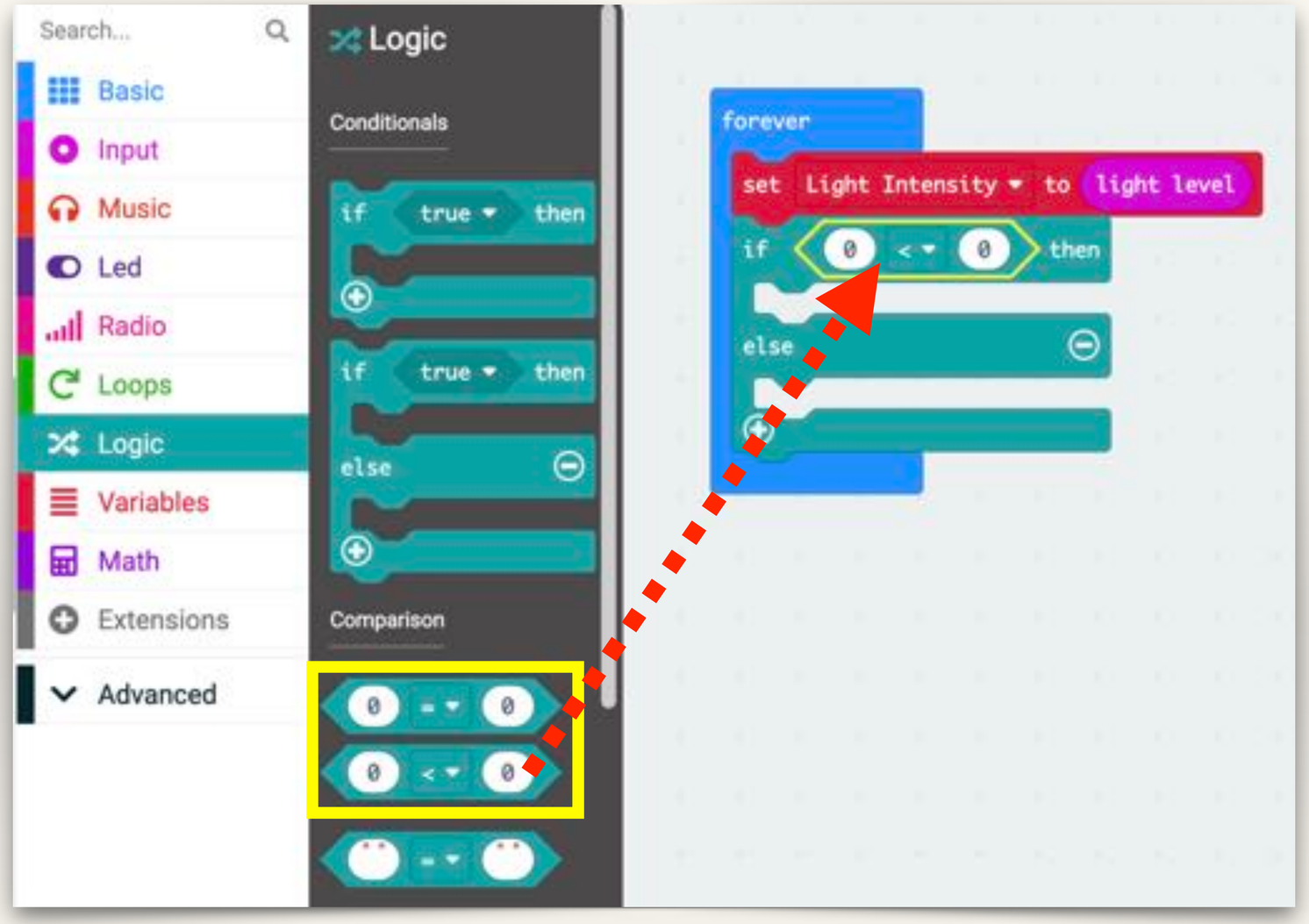




From ‘Logic’ drag out an ‘If-Then-Else’ block.

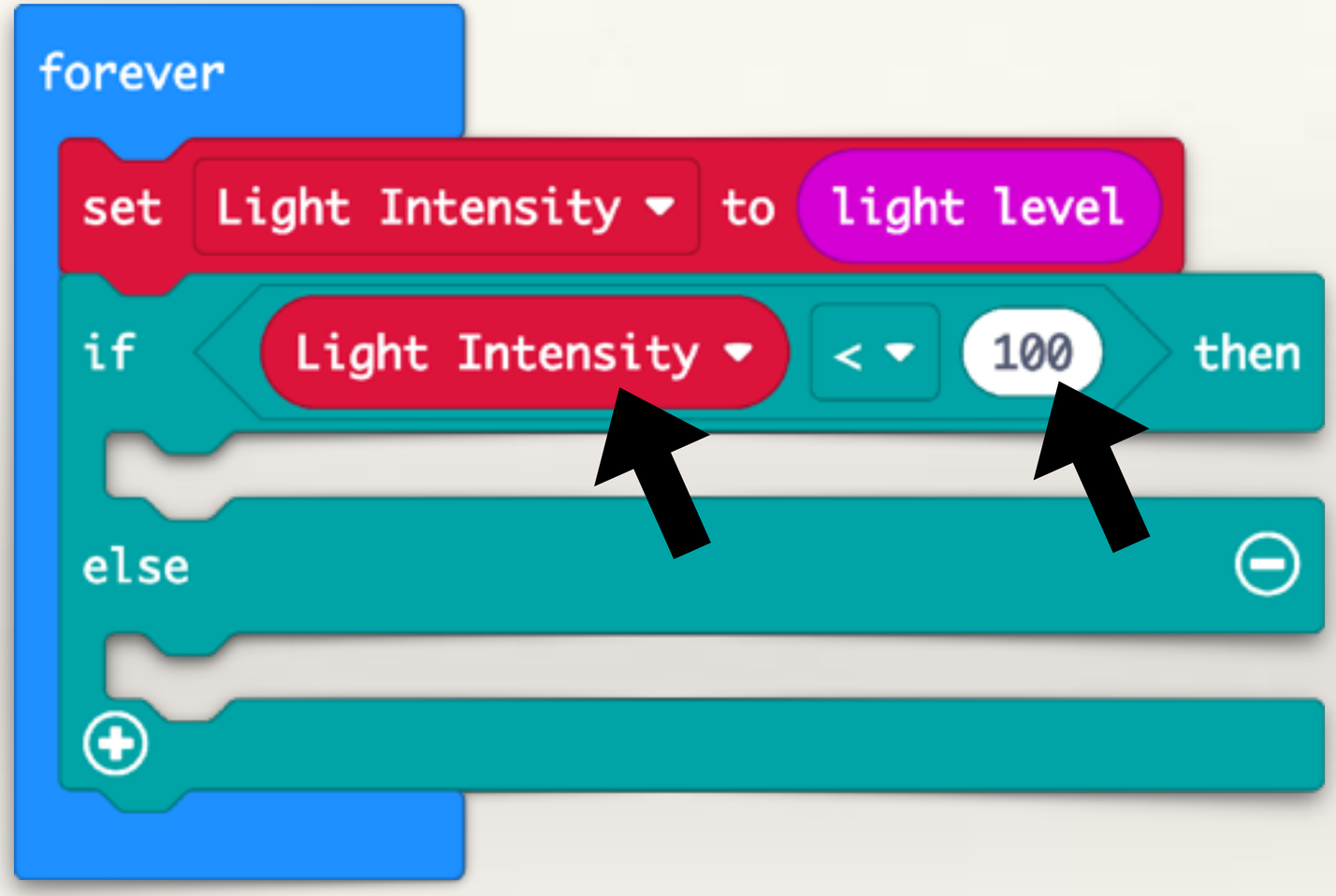
From Logic > Comparison > drag out a ‘Less Than’ block.

Put it inside the If-Then block (where it says ‘True’)



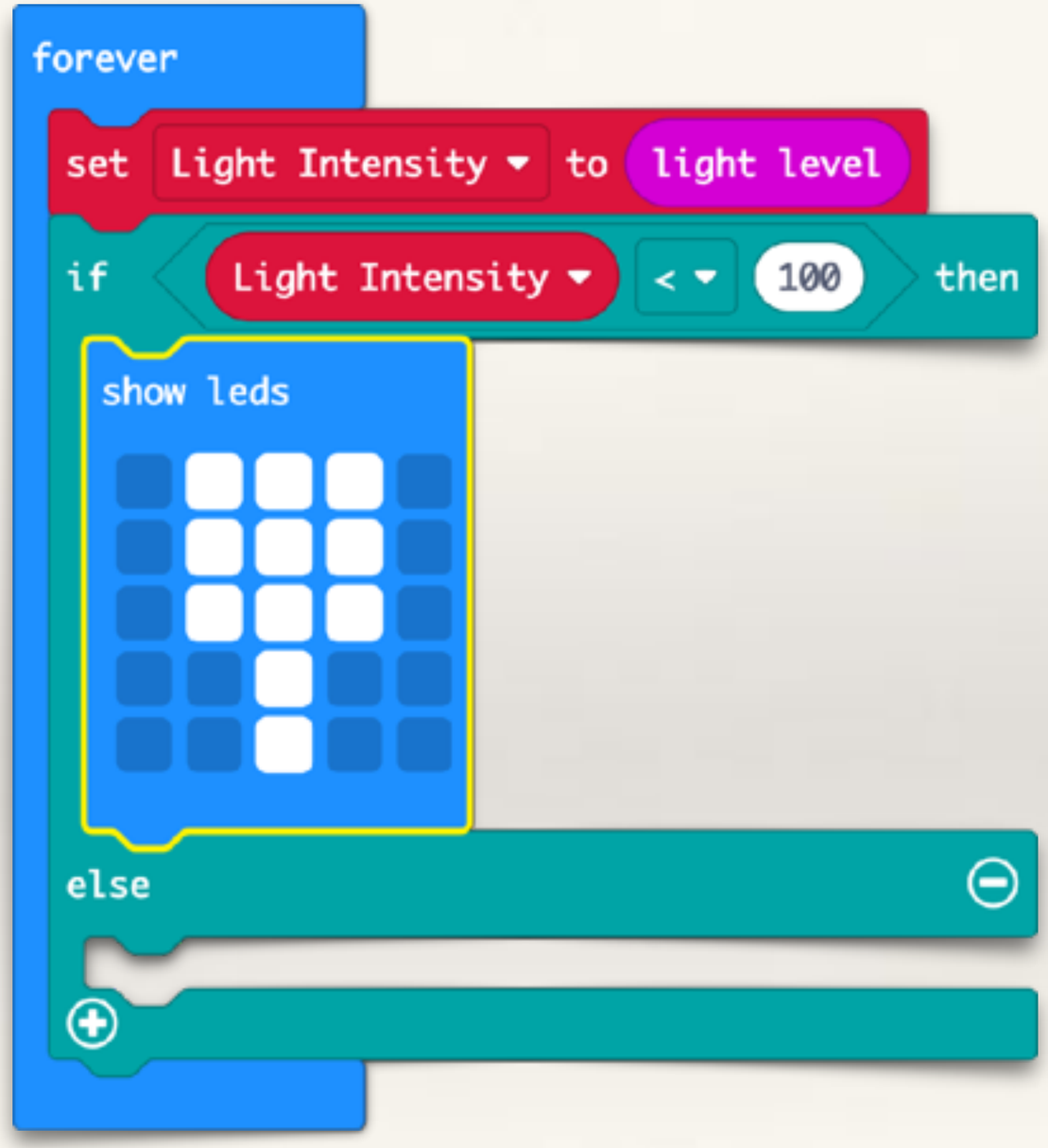
Let’s check the condition needed for our Smart Streetlight - that Light Level falling on the microbit should be less than 100.

If this condition is true, which means Sun is setting and it is getting dark, so we want the streetlight to switch on.



From ‘Basic’ drag out the ‘Show LEDs’ block. Light up a few LEDs to depict a street light.

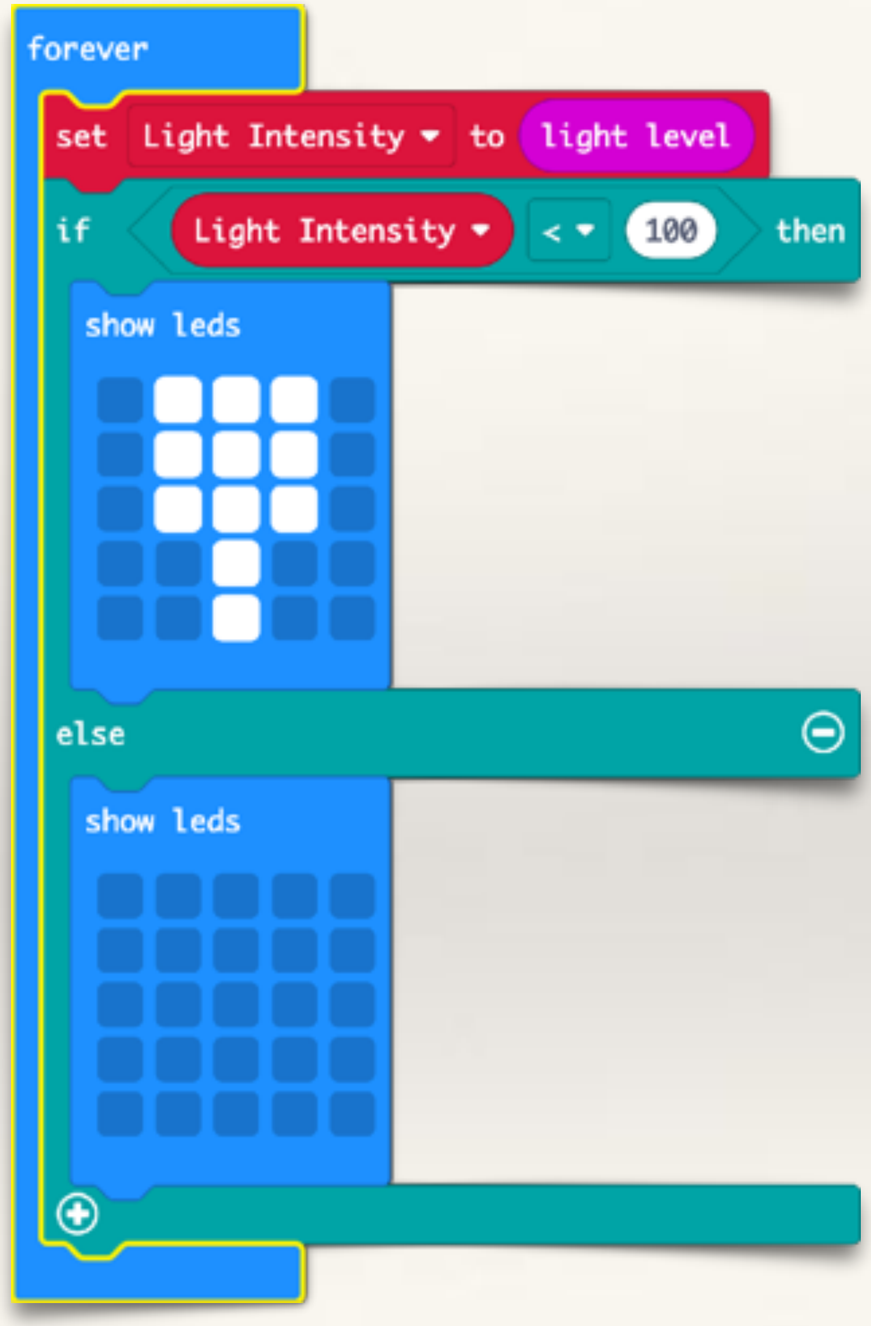
Now, if it is getting dark and the light level falling on the microbit is less than 100, this LED display will show.

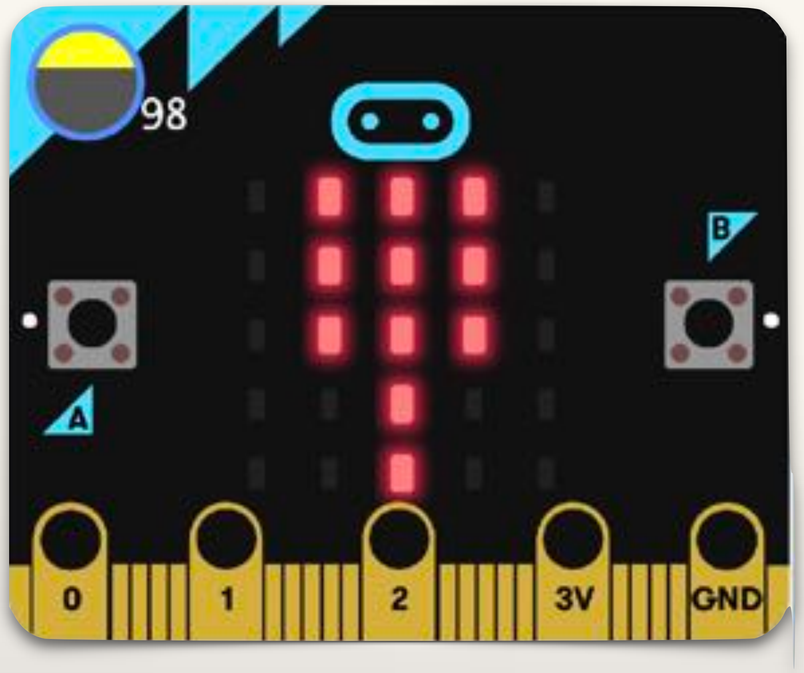


The only other condition we want to check is if the light level falling on the microbit is more than 100.

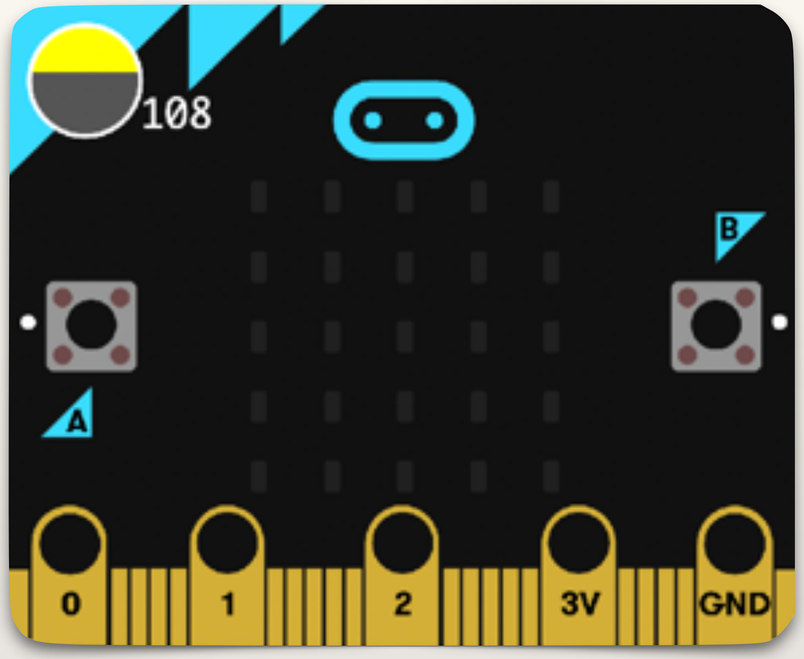
So we only need to use the Else condition (i.e. if the condition “Light Level < 100” is NOT true).

In this case, we want the streetlight to switch off. This is depicted by none of the LEDs lighting up.





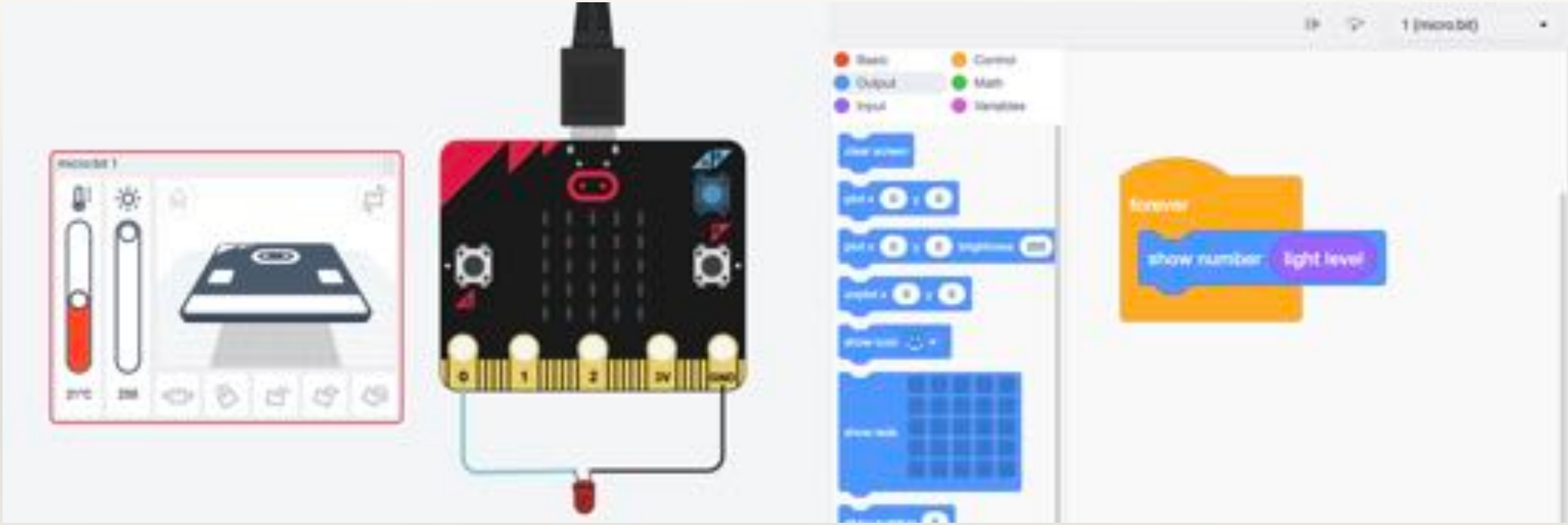
In the simulator, if the light level (stored in the variable called Light Intensity) is less than 100, LEDs will glow.

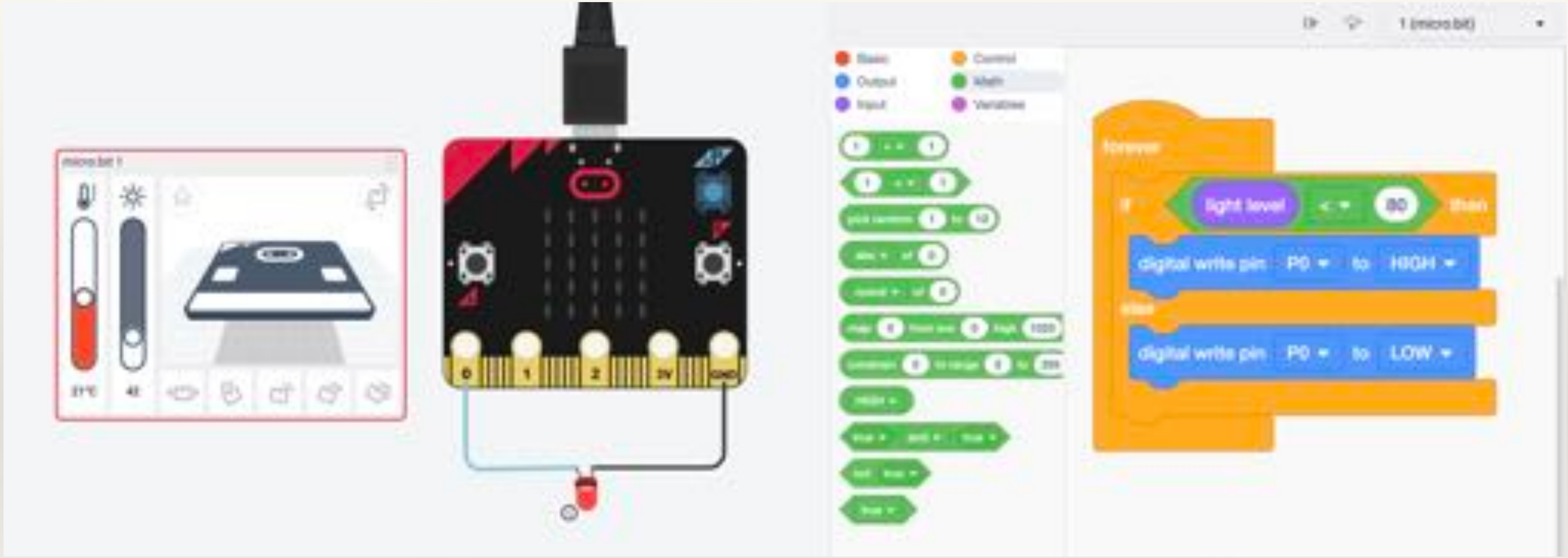


In the simulator, if the light level (stored in the variable called Light Intensity) is more than 100, LEDs will not glow.

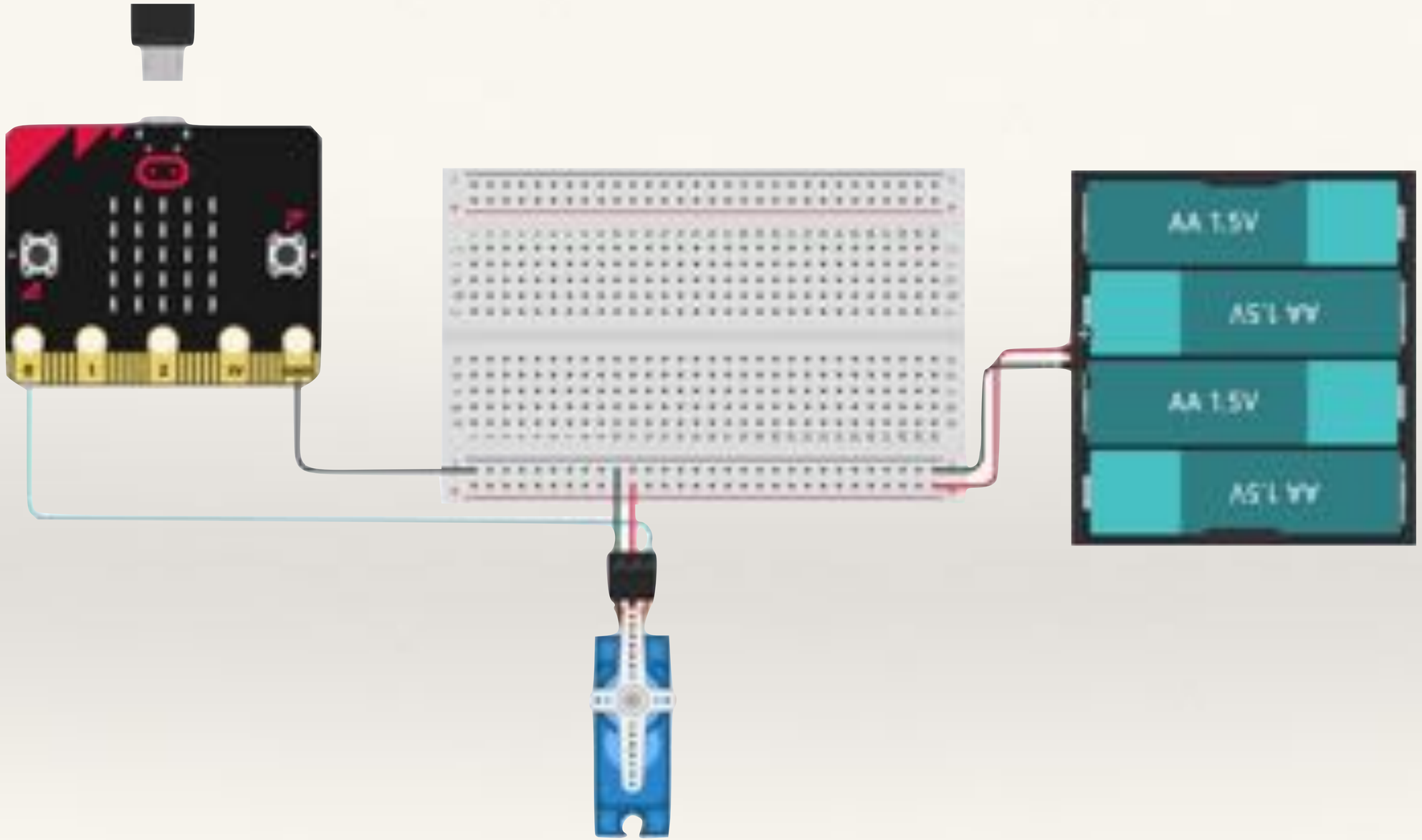
By using sensors, we can make machines ‘autonomous’ that is, machines that are capable of taking decisions on their own. For example, in this case, we don’t have to physically switch the streetlight on and off, based on the light sensor reading, the streetlight will detect if it is becoming dark and switch on by itself.

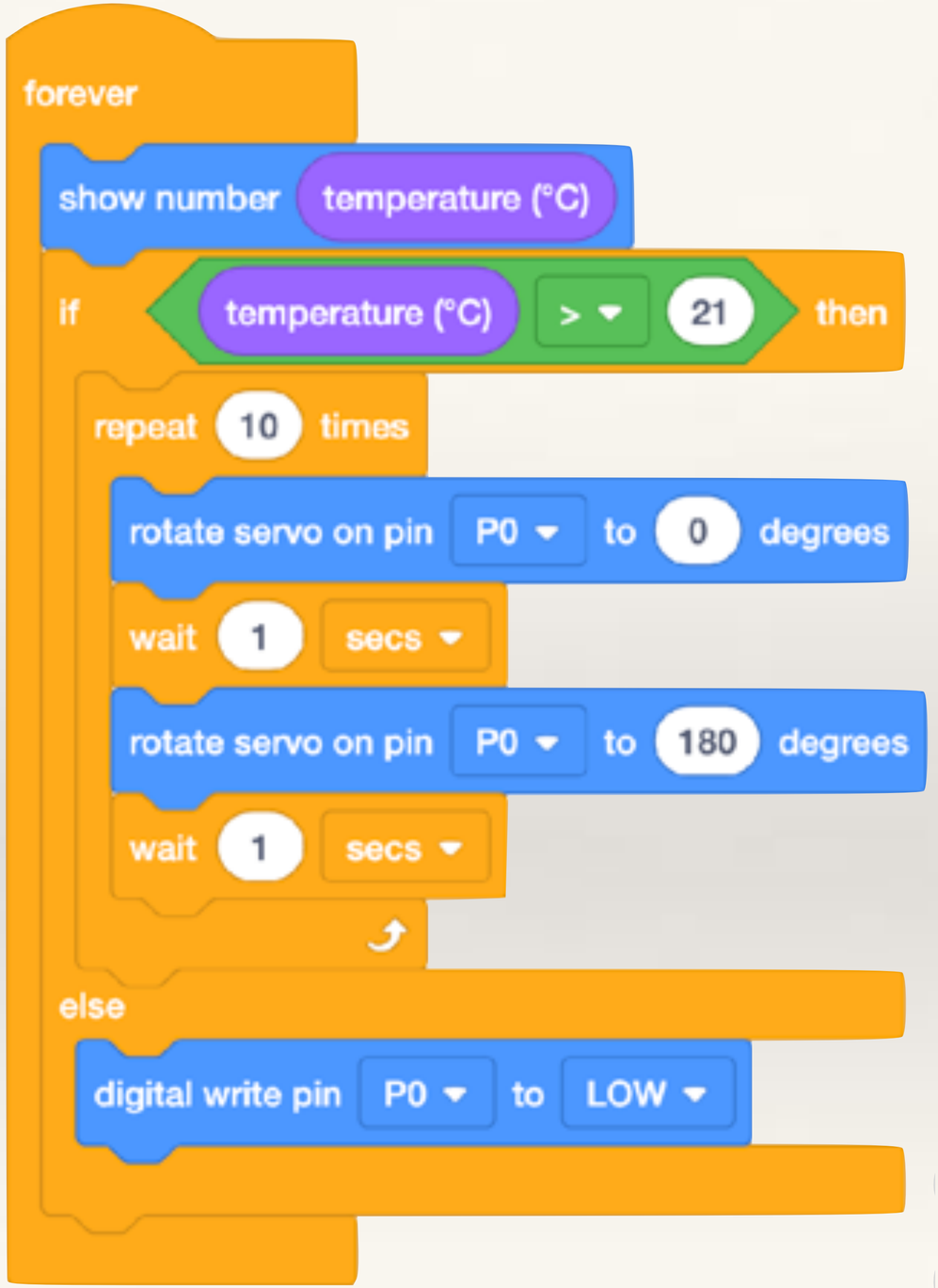
Smart Street Light
on TinkerCad


Basic
Control
Output
Math
Input
Variables
forever
show number
light level

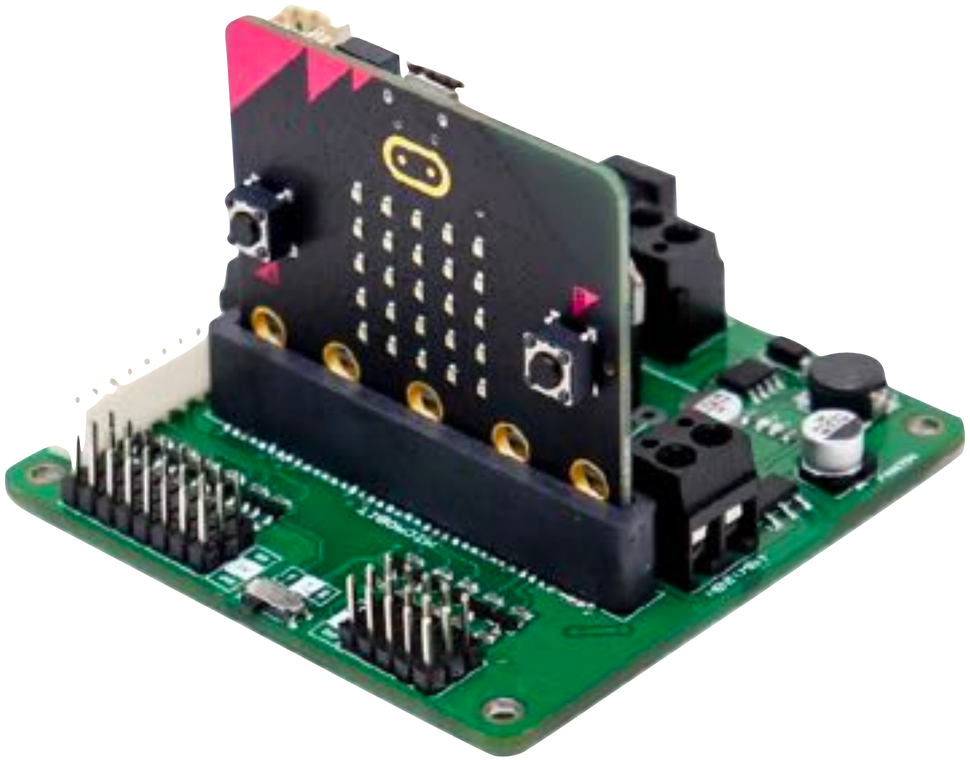

micro:bit
21°C
48
0
1
2
3V
GND
1 (micro:bit)
Basic
Input
Output
Control
Math
Variables
forever
if
light level
<
80
then
digital write pin
P0
to
HIGH
else
digital write pin
P0
to
LOW

Smart Fan
on TinkerCad

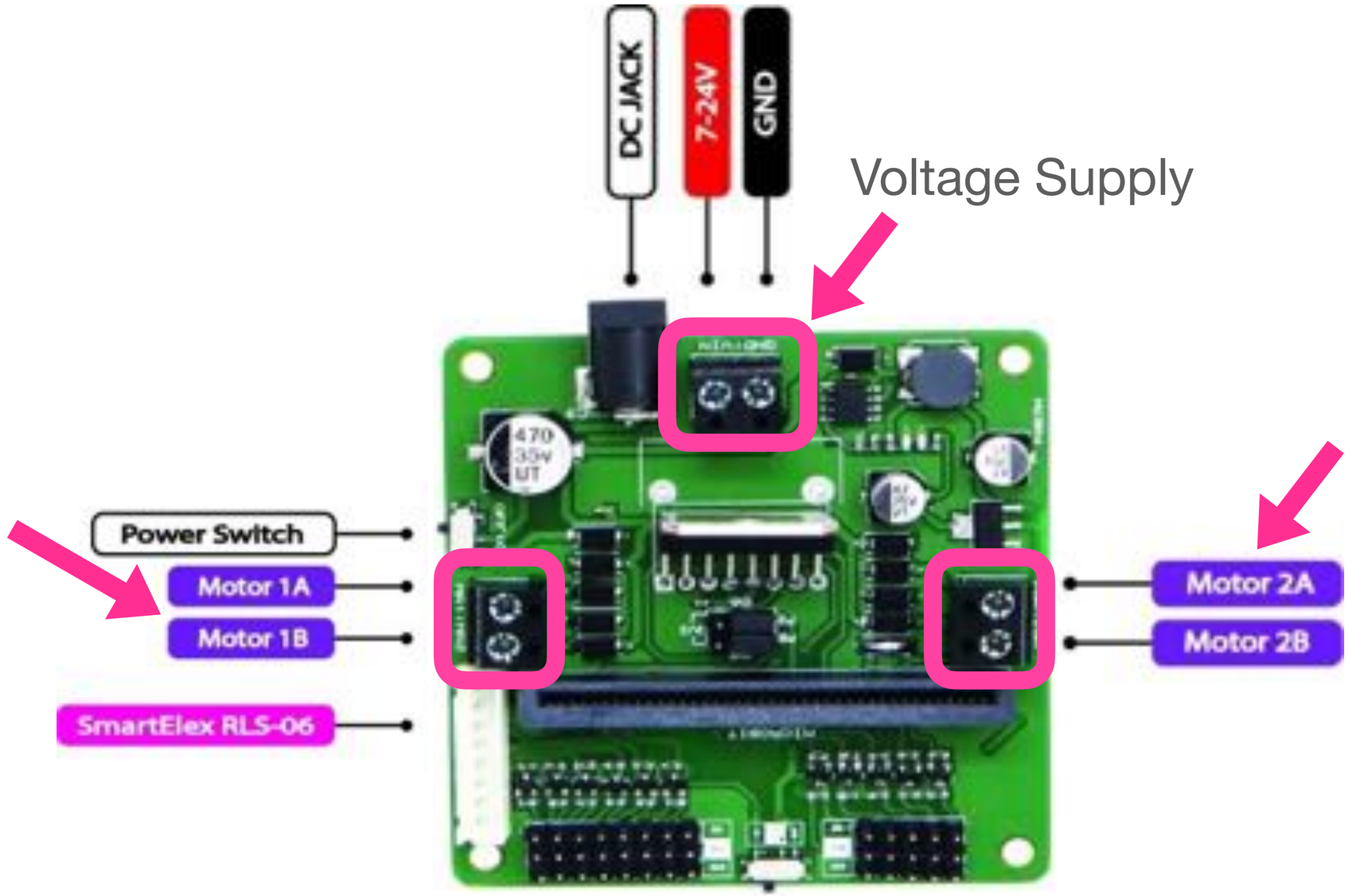

AA 1.5V
AA 1.5V
AA 1.5V
AA 1.5V


forever
show number temperature (°C)
if temperature (°C) > 21 then
repeat 10 times
rotate servo on pin P0 to 0 degrees
wait 1 secs
rotate servo on pin P0 to 180 degrees
wait 1 secs
else
digital write pin P0 to LOW

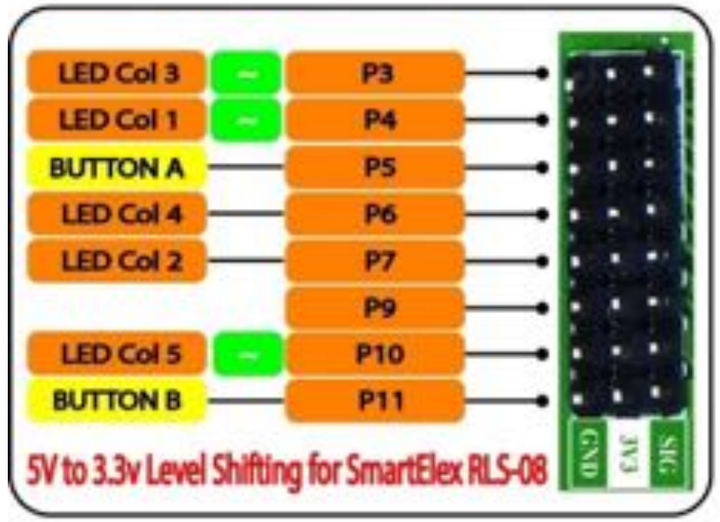
Motor Driver



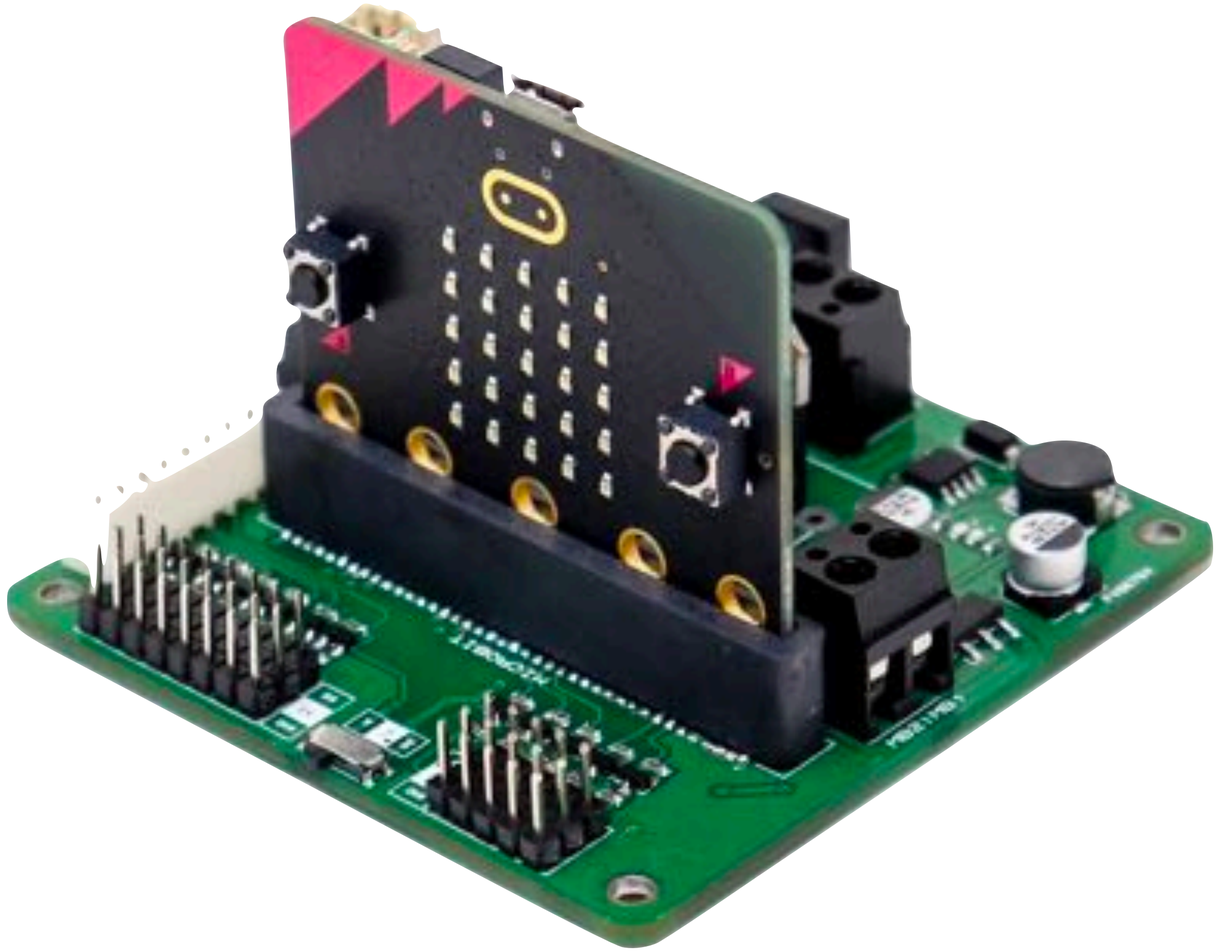
Motor Driver Board - SmartElex



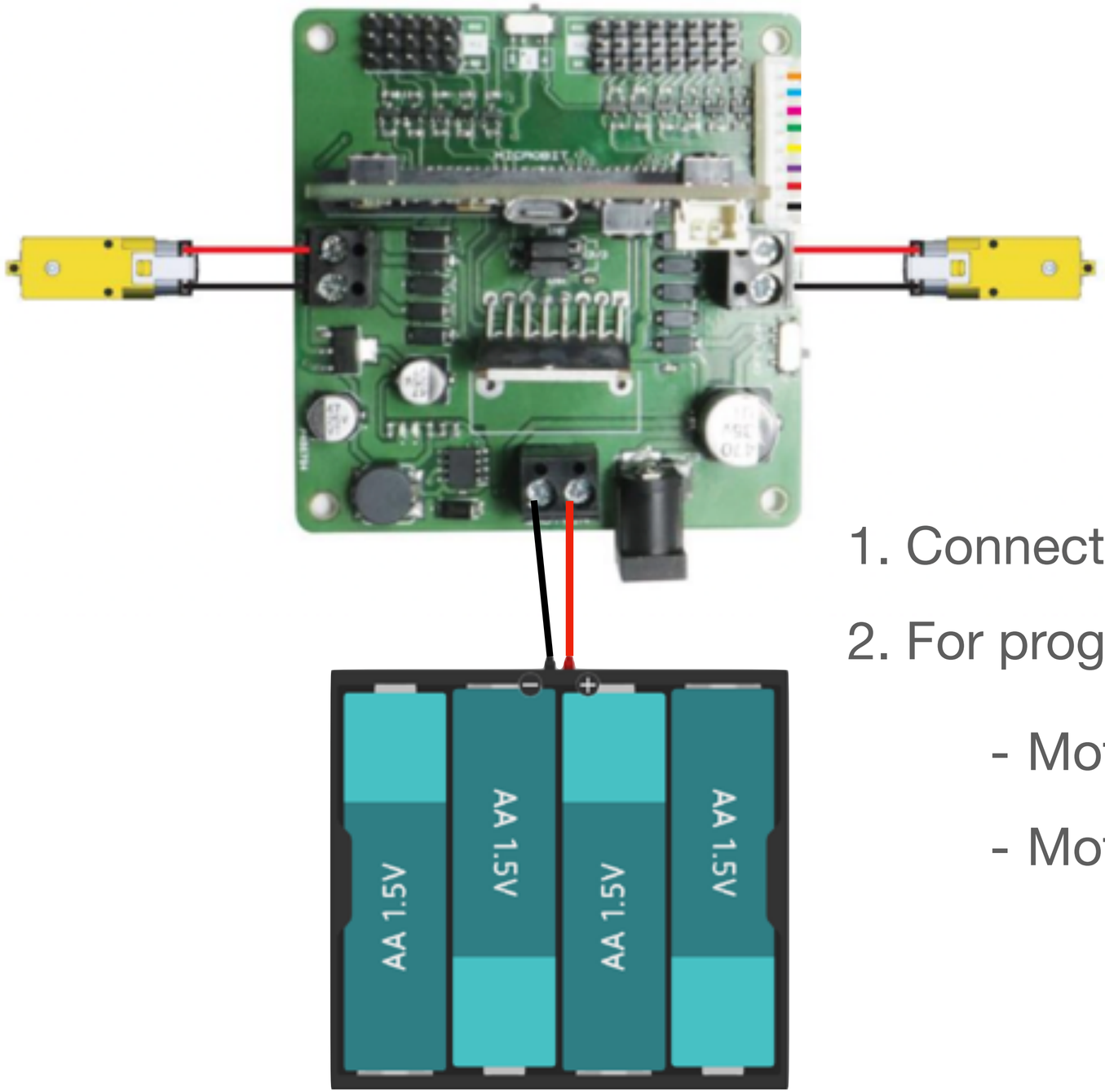
Complete PinOut for Motor Driver Board - SmartElex



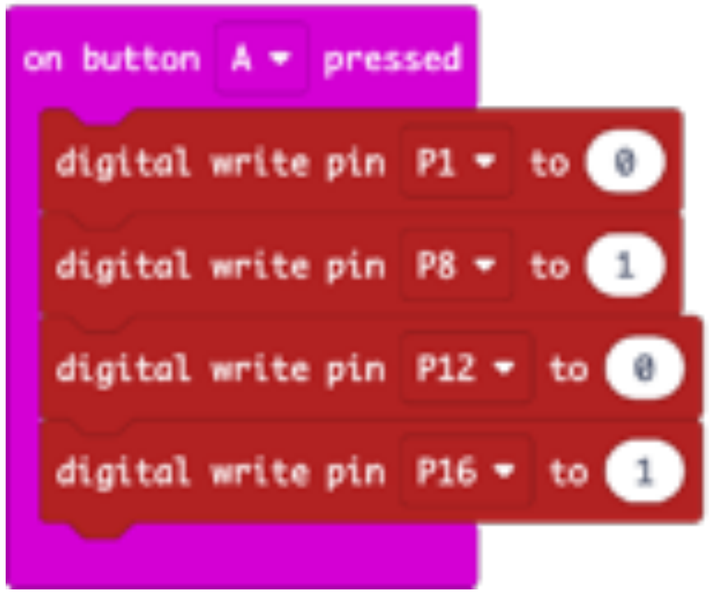
Data Sheet:
https://robu.in/wp-content/uploads/2021/07/SmartElex-MicroBit-L298n-Driver.pdf



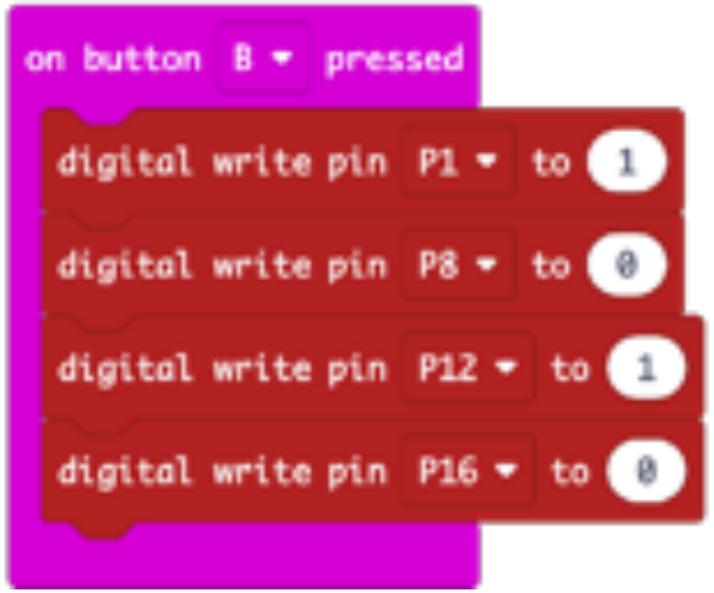
Insert the Microbit into its slot on the Motor Driver Board



1. Connect two geared DC motors as shown
2. For programming in MakeCode:
    - Motor-1: Pin-1 and Pin-8
    - Motor-2: Pin-12 and Pin-16



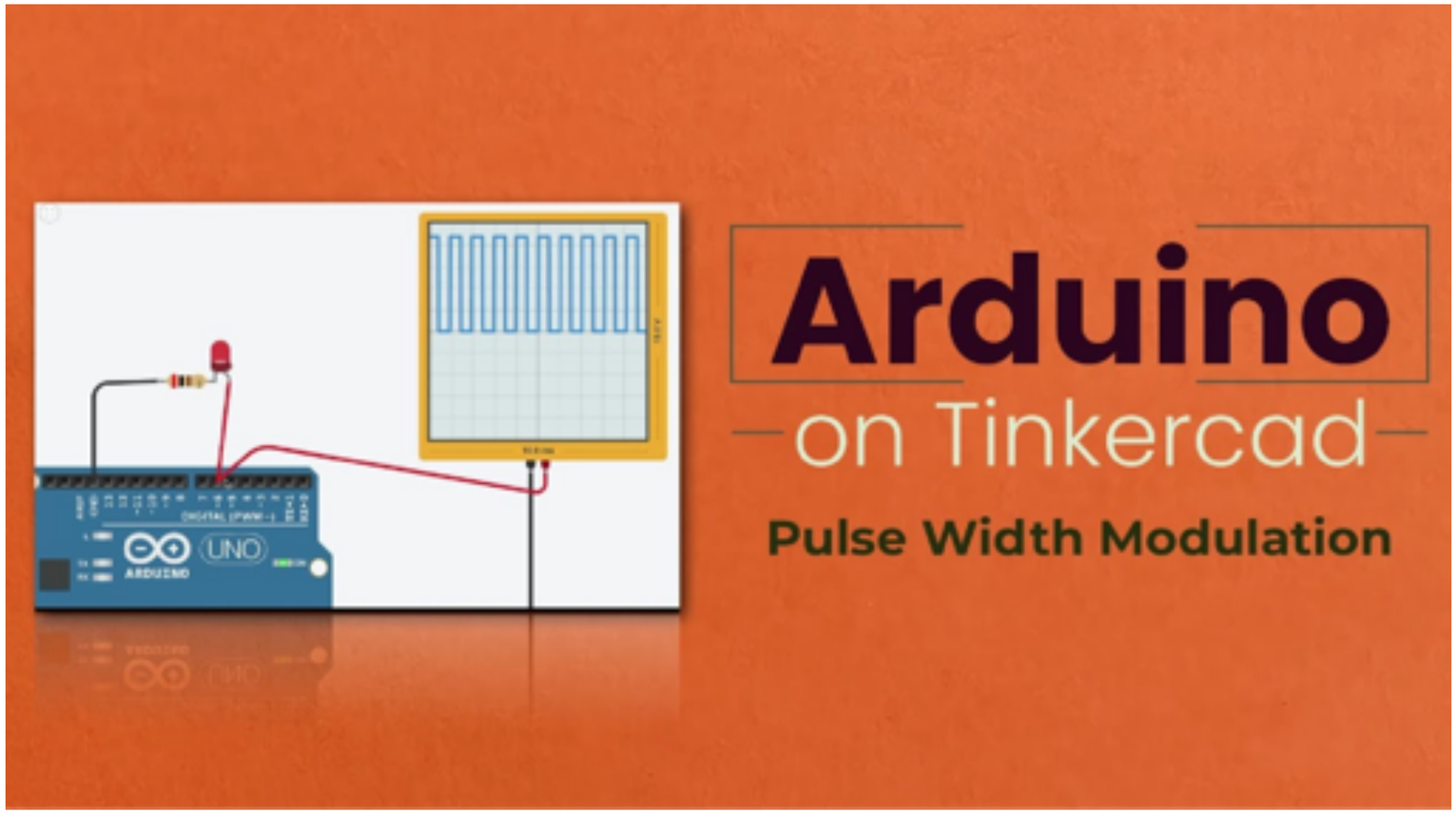
Forward



Reverse

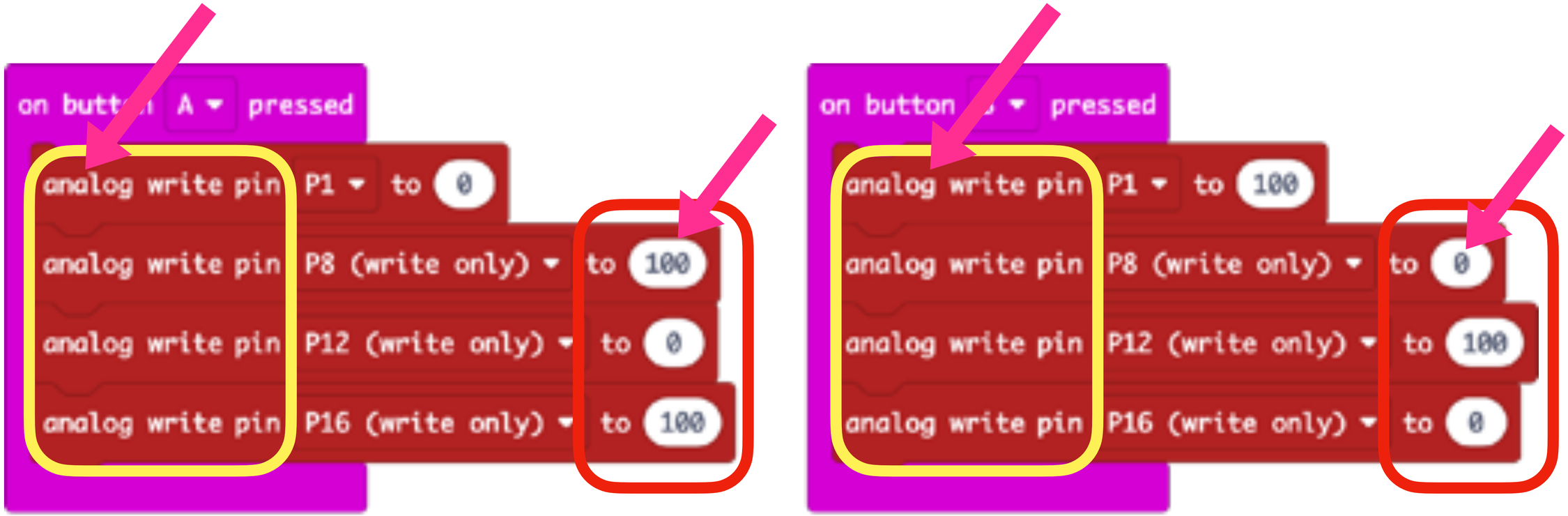
Stop

Controlling the Speed - Understanding PWM



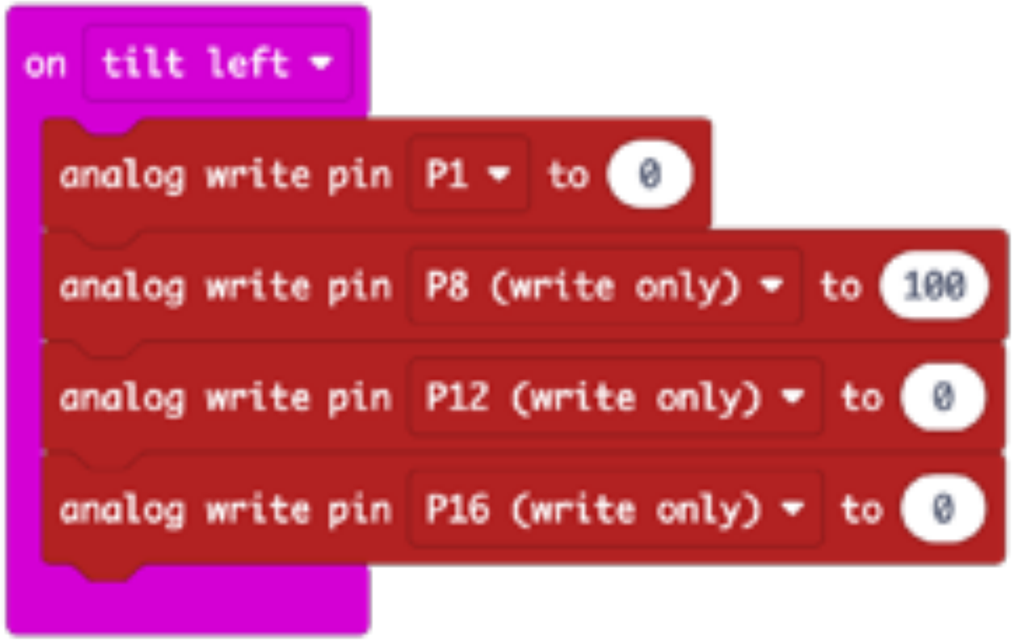
https://youtu.be/bGZZ2FMwsuA

Controlling the Speed with PWM

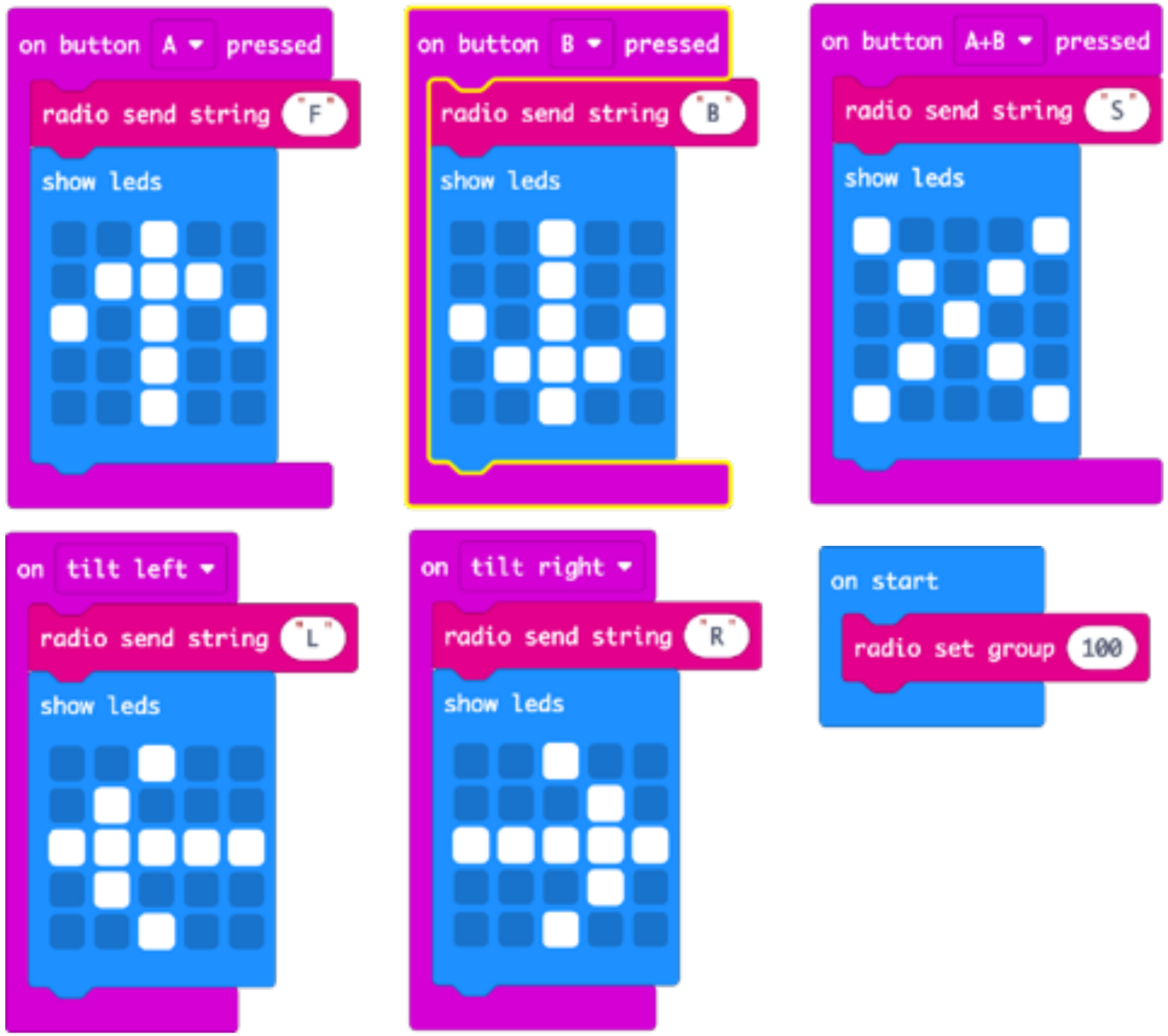


Using Analog Write Command and put Numerical values

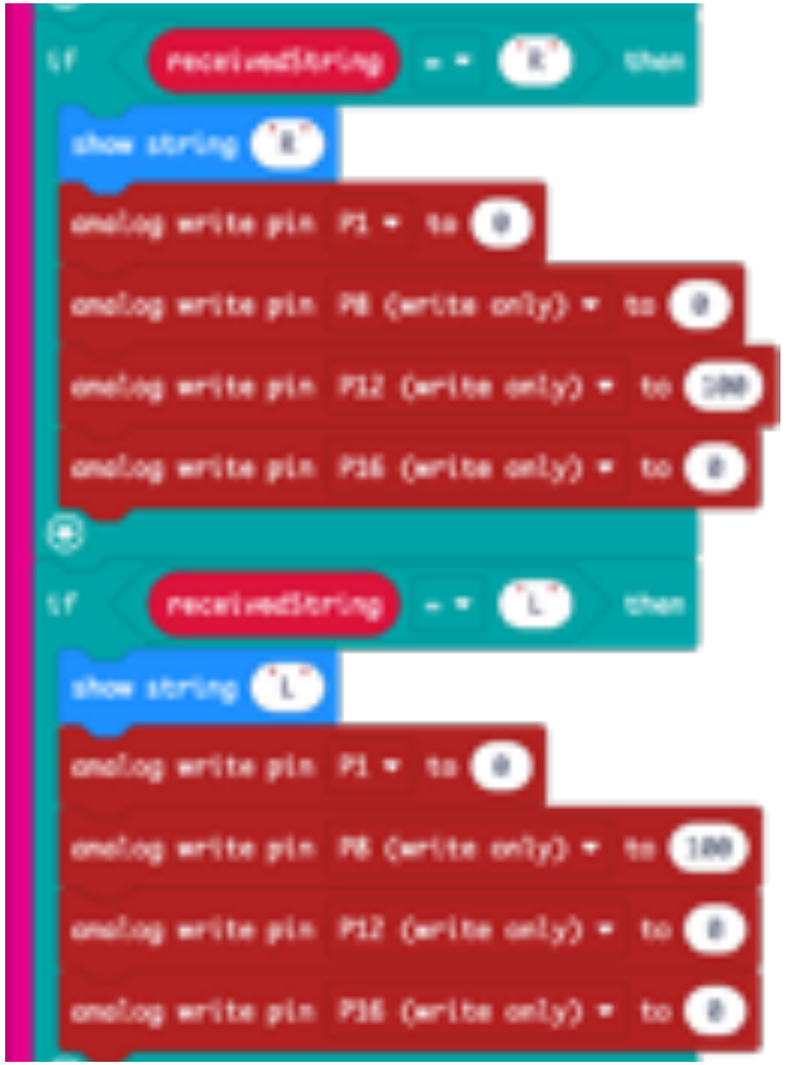
Use Gesture (tilt left or right) to Turn



Microbit Radio-Controlled Car: TRANSMITTER



Microbit Radio-Controlled Car - RECEIVER



8x8 LED Display

Max7219 8x8 LED Display - Pin Out

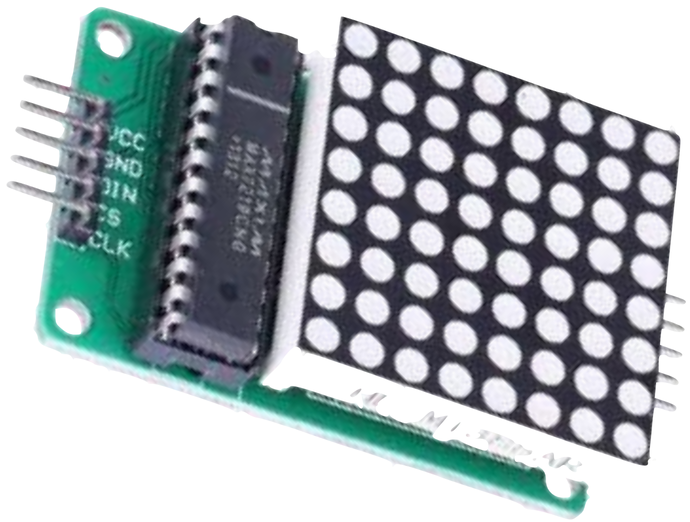
Voltage

Ground

Data In

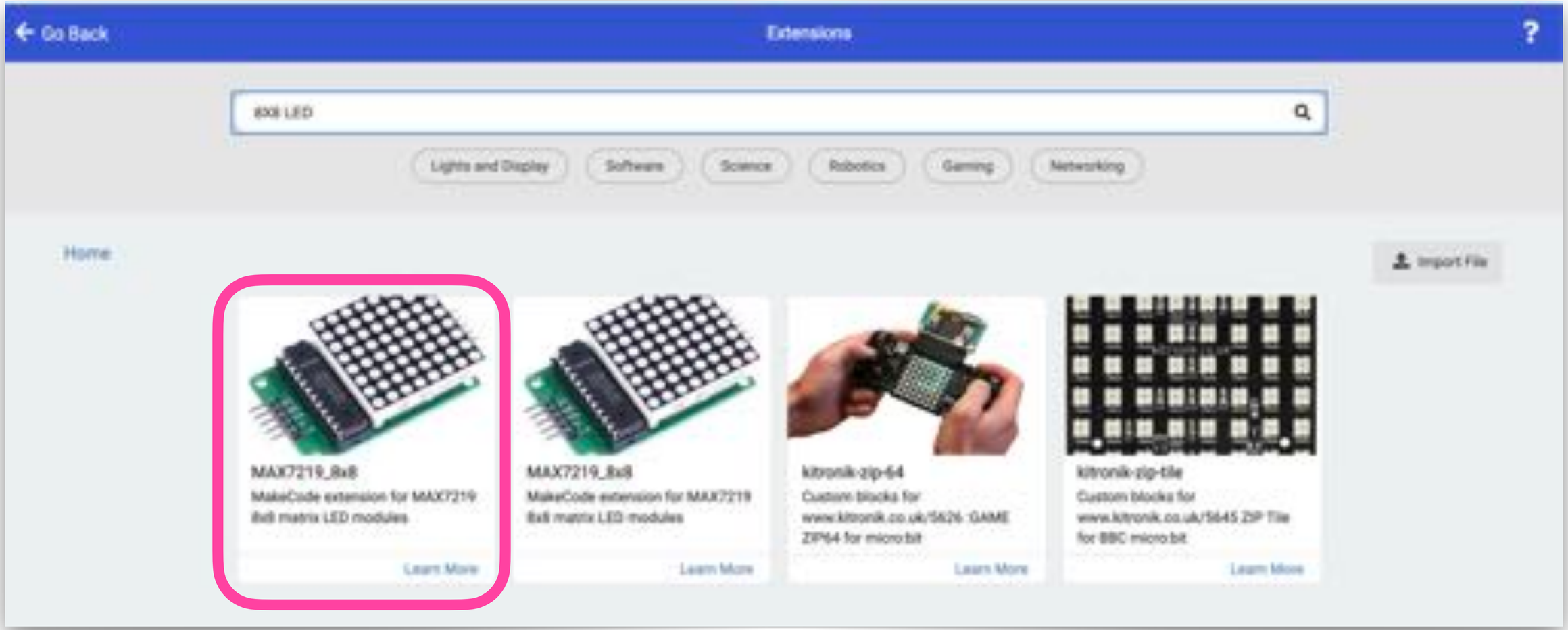
CS (chip select)

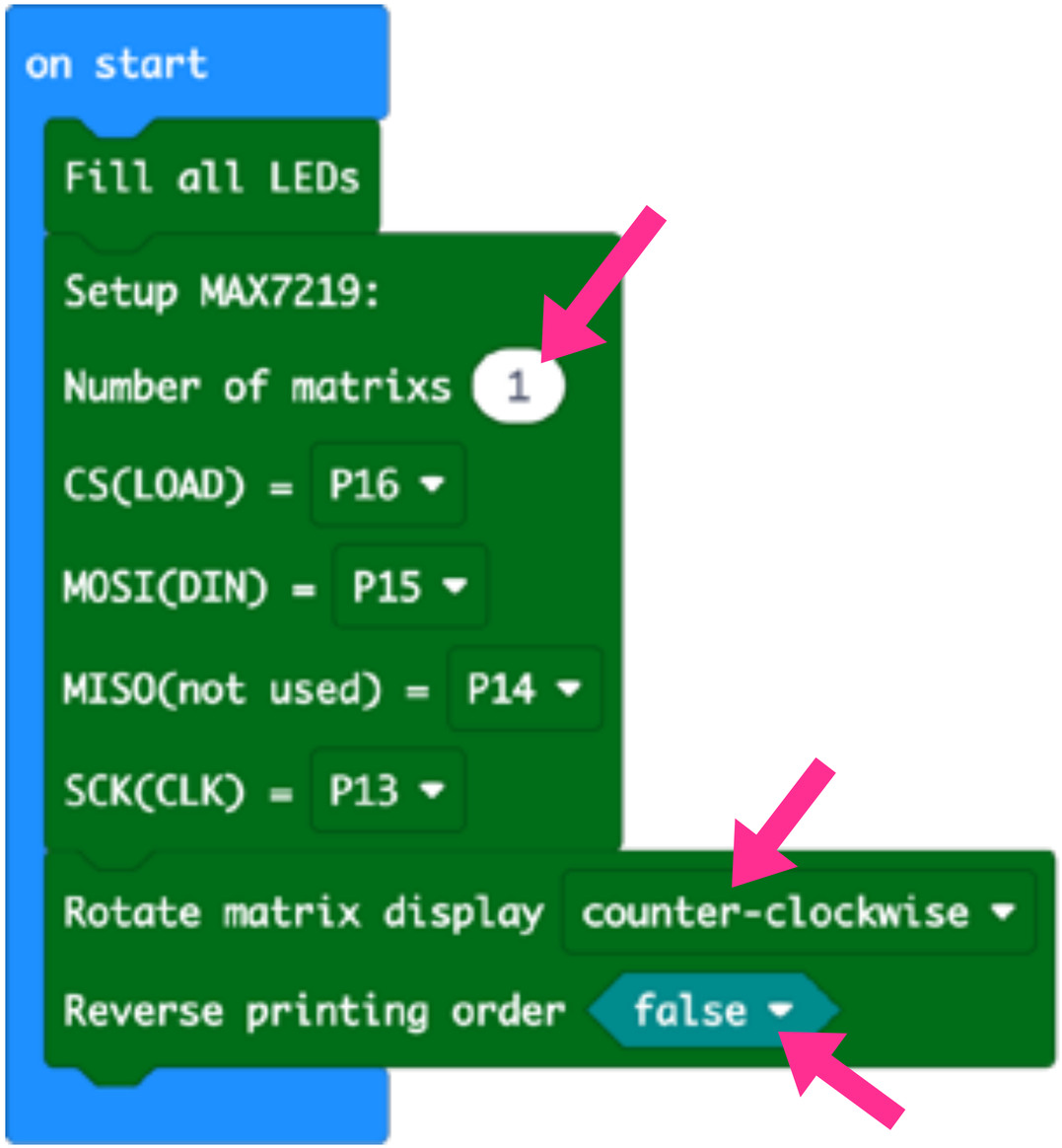
CLK (clock)

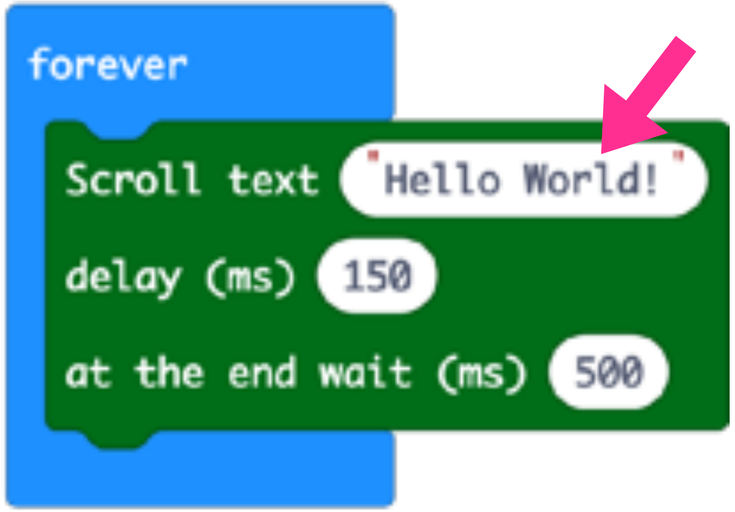


Data Out
(to connect to more panels)

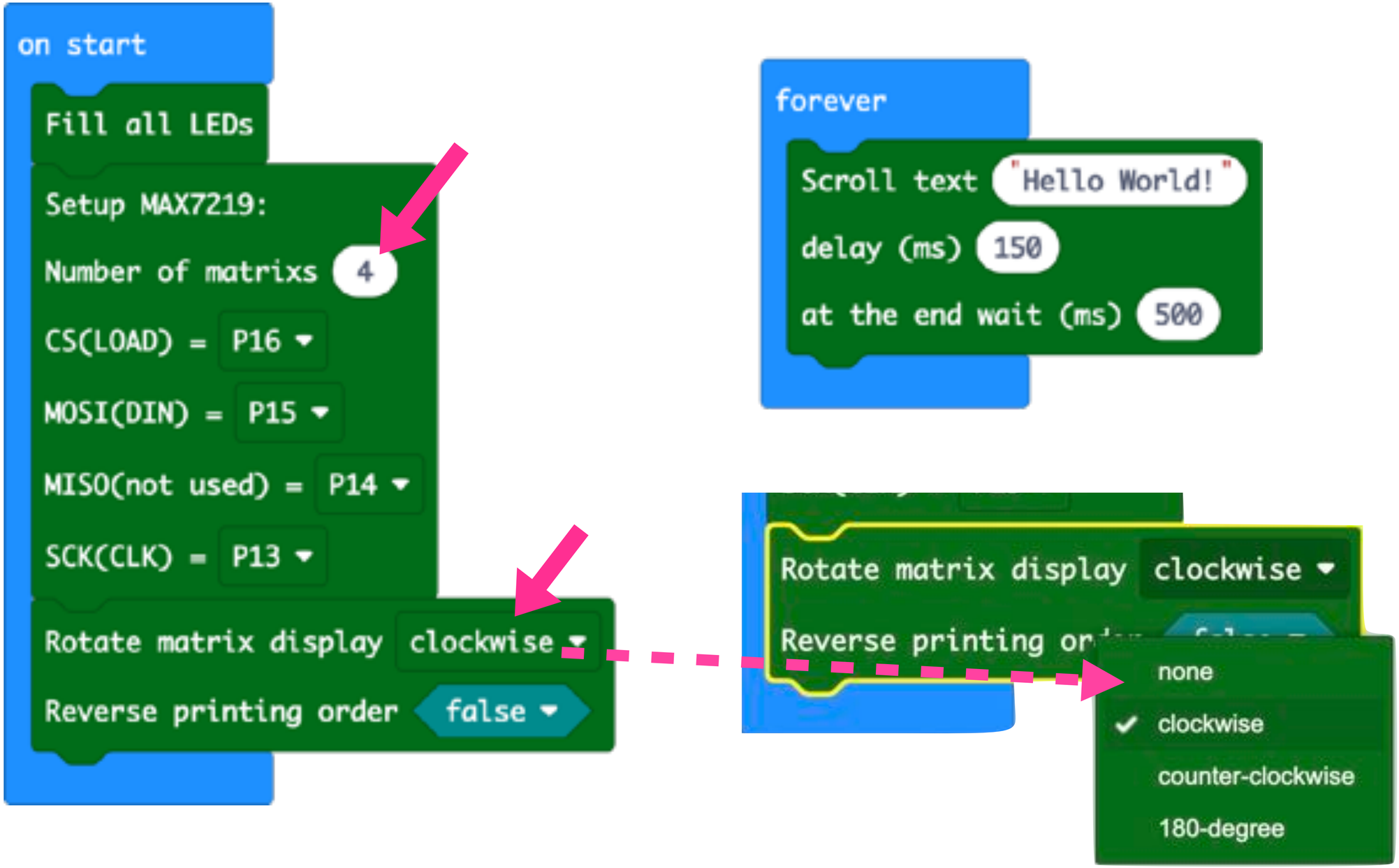
Add Extension - MAX7219_8x8





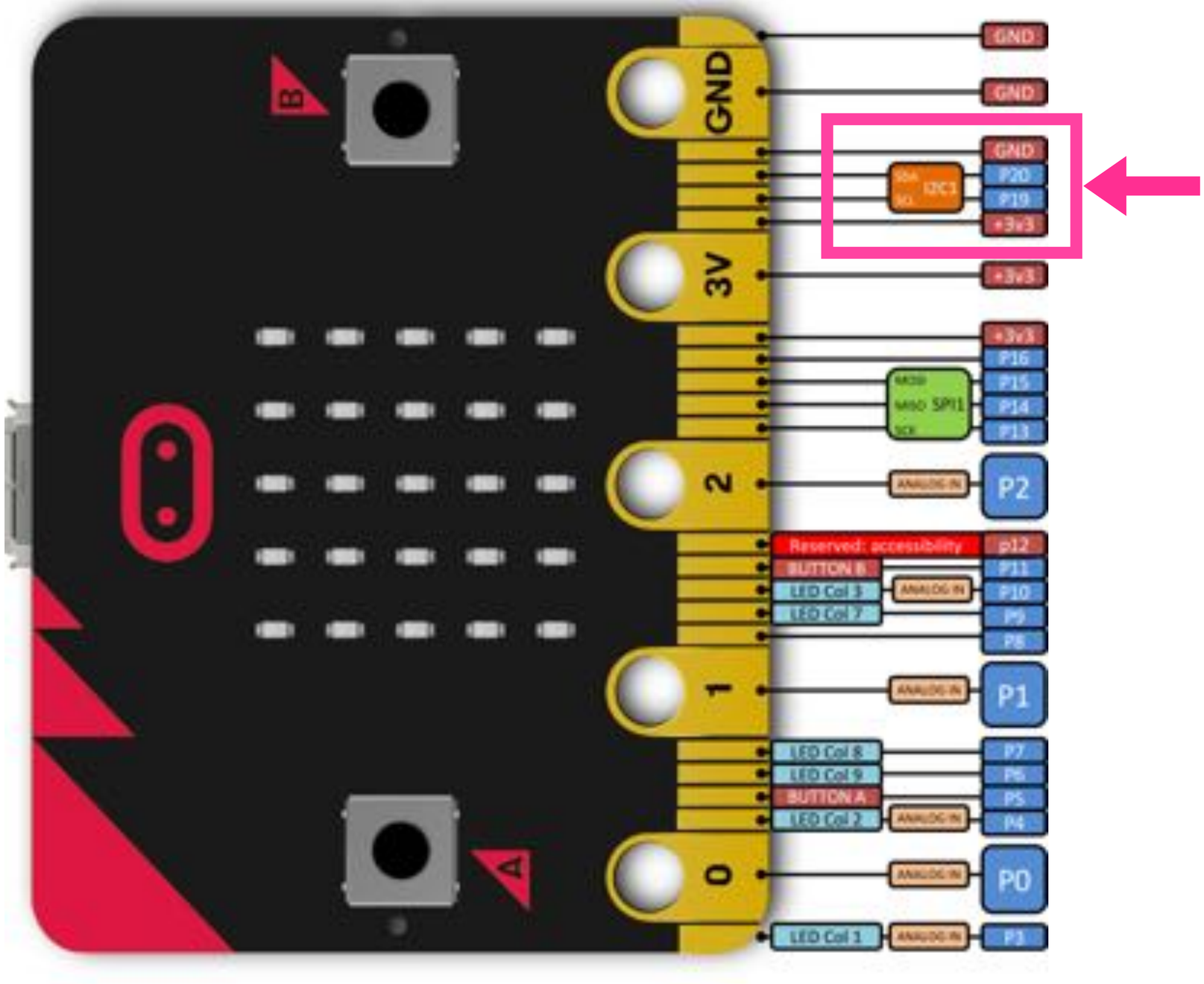


Code for “Hello World!”


on start
Fill all LEDs
Setup MAX7219:
Number of matrixs 4
CS(LOAD) = P16
MOSI(DIN) = P15
MISO(not used) = P14
SCK(CLK) = P13
Rotate matrix display clockwise
Reverse printing order false
forever
Scroll text "Hello World!"
delay (ms) 150
at the end wait (ms) 500
Rotate matrix display clockwise
Reverse printing or
none
clockwise
counter-clockwise
180-degree

i2c LCD Display

I2C and SPI 1602 Serial Character LCD for Micro:bit by Cytron Technologies



The i2c LCD needs to be connected to pin-19 (SCL) and pin-20 (SDA) of the microbit.

Note that the Cytron Technologies 1602 LCD runs on 3 volts that is why we can connect it directly to the microbit.

i2c (inter-integrated circuit) bus is a chip-level serial communications mechanism that operates over just two wires - SCL (serial clock) line and SDK (serial data) line.

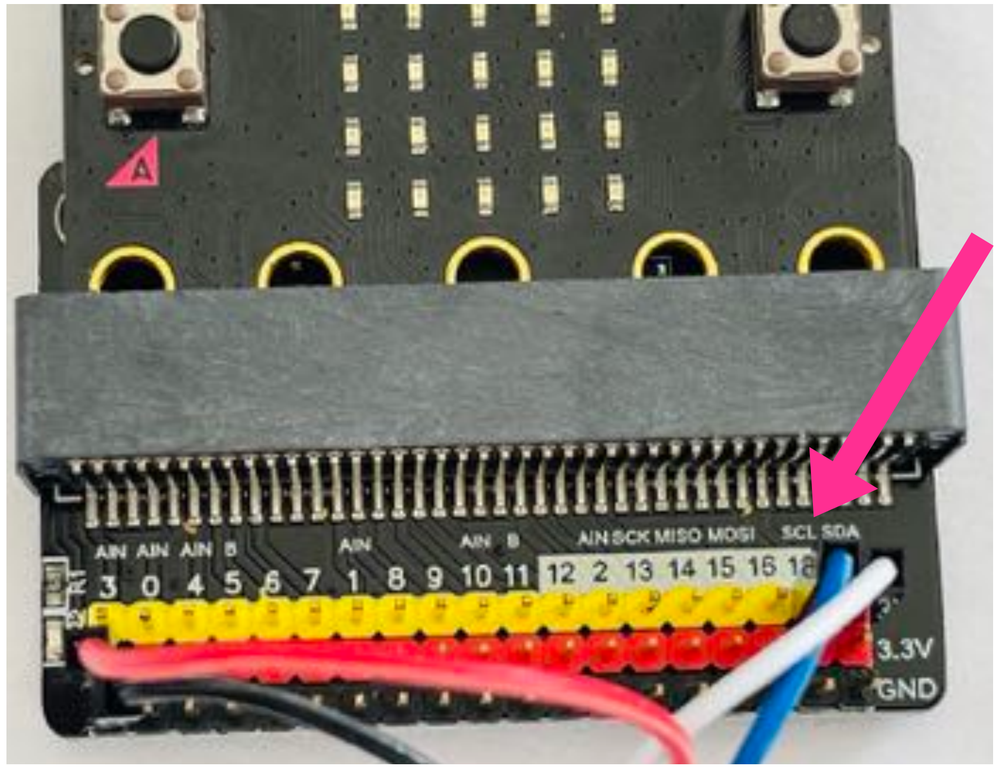
Connecting the LCD with Micro:bit

VSS = Ground pin on microbit

VDD = Voltage pin on microbit

SCK = SCL (serial clock) Pin 19

SDK = Serial Data, Pin 20

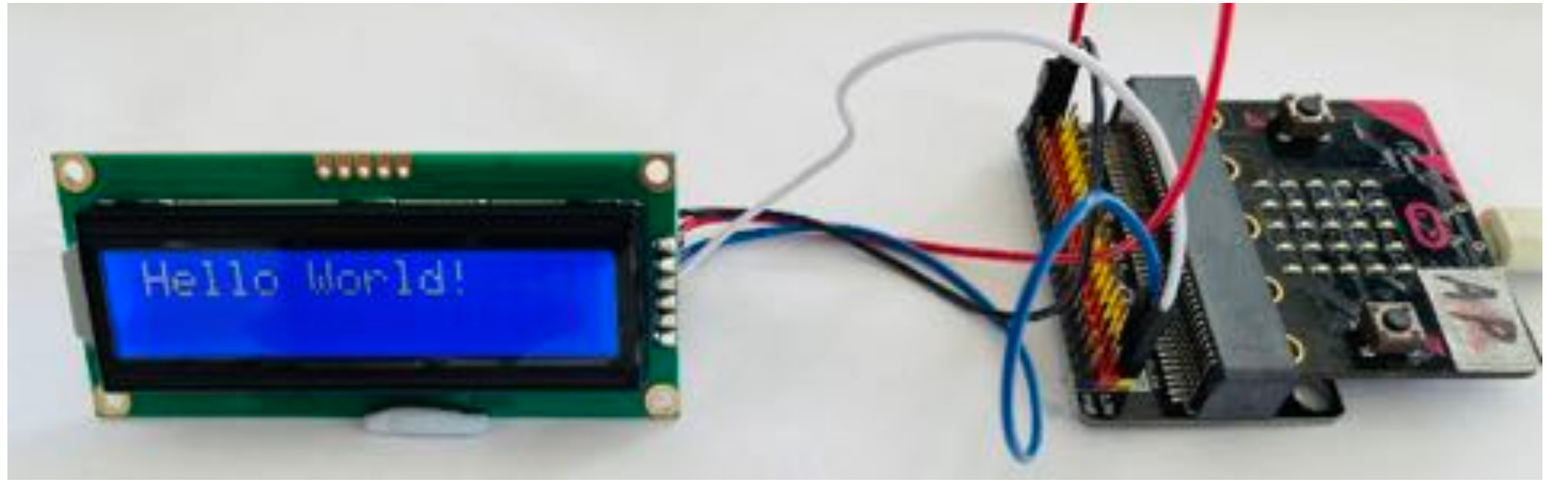


Micro:bit on a Breakout Board

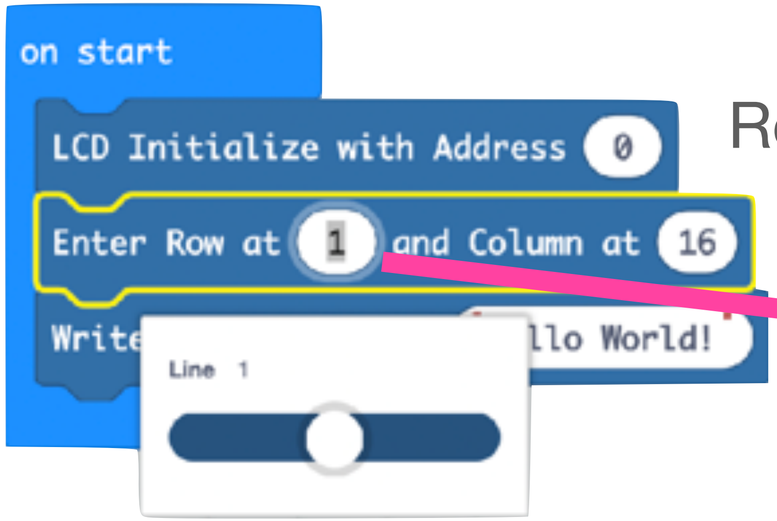
On MakeCode Extensions, paste this URL:
https://github.com/CytronTrainee/microbit-LCM1602-14-LCD-extension
and install the extension.

You will get these additional programming blocks

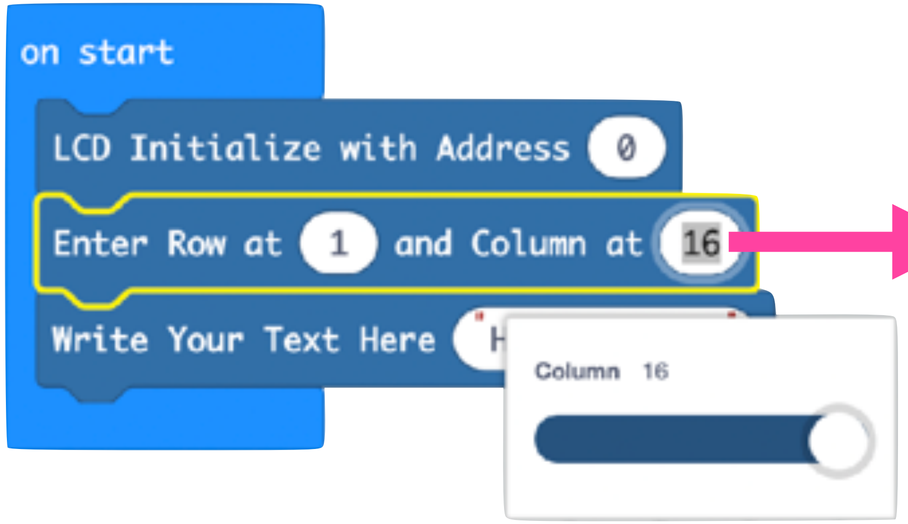
Simple “Hello World!” Display



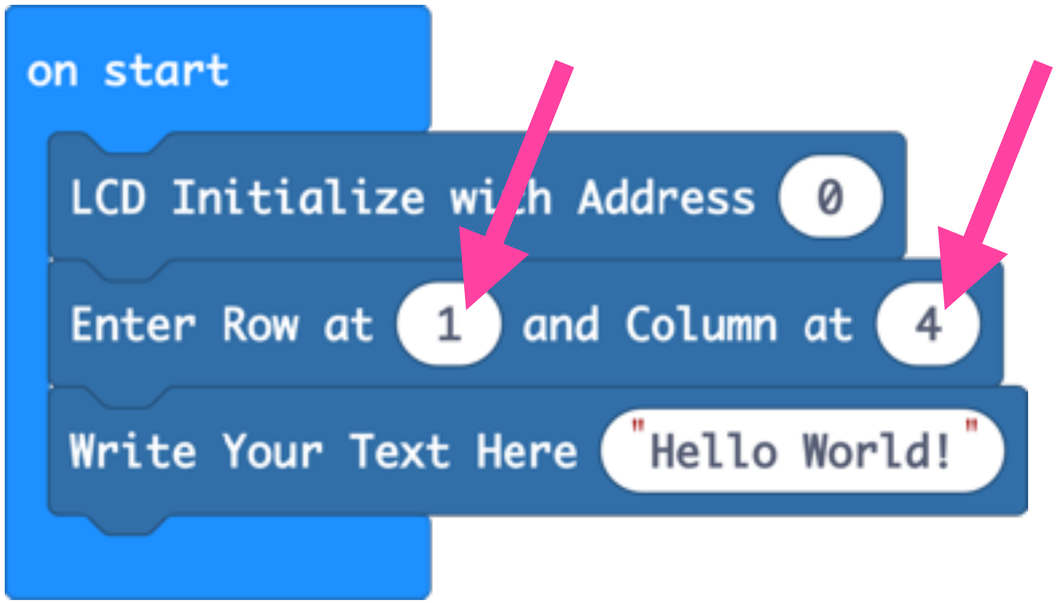

```
on start
    LCD Initialize with Address 0
    Enter Row at 0 and Column at 0
    Write Your Text Here "Hello World!"
```

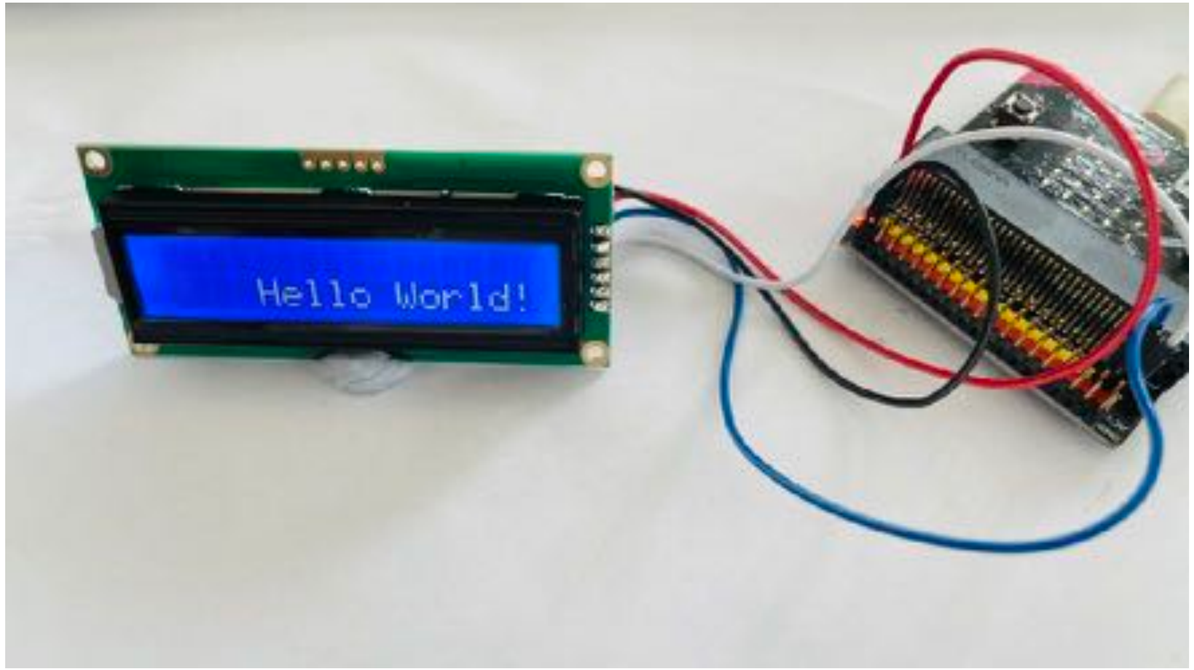


Row can be the top row or bottom row



Columns represent the 16 characters that can be displayed


on start
LCD Initialize with Address 0
Enter Row at 1 and Column at 4
Write Your Text Here "Hello World!"

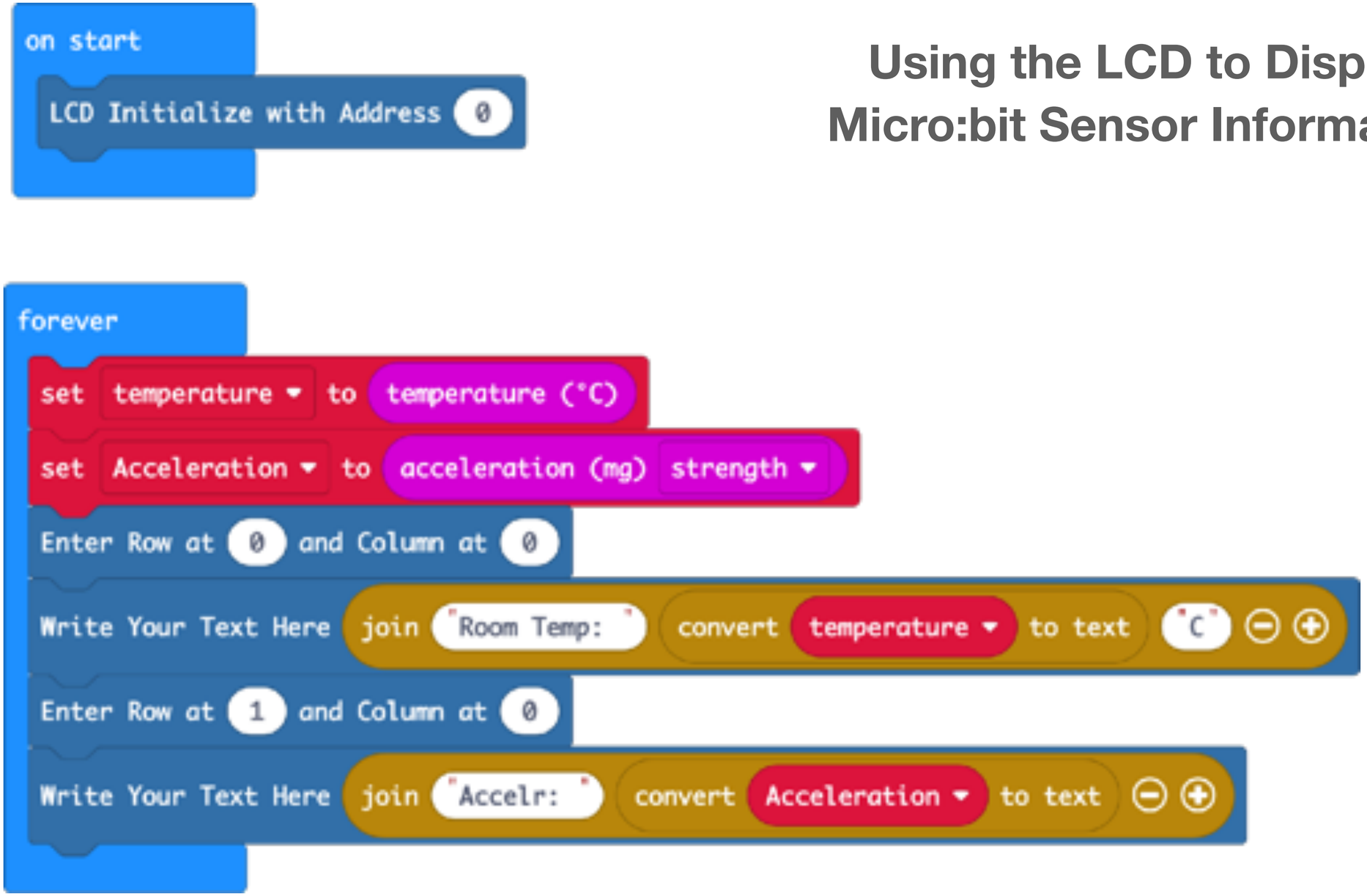

Hello World!

```
on start
    LCD Initialize with Address 0
    Enter Row at 1 and Column at 4
    Write Your Text Here "Hello World!"

forever
    LCD Display Scroll Left
    pause (ms) 500
```

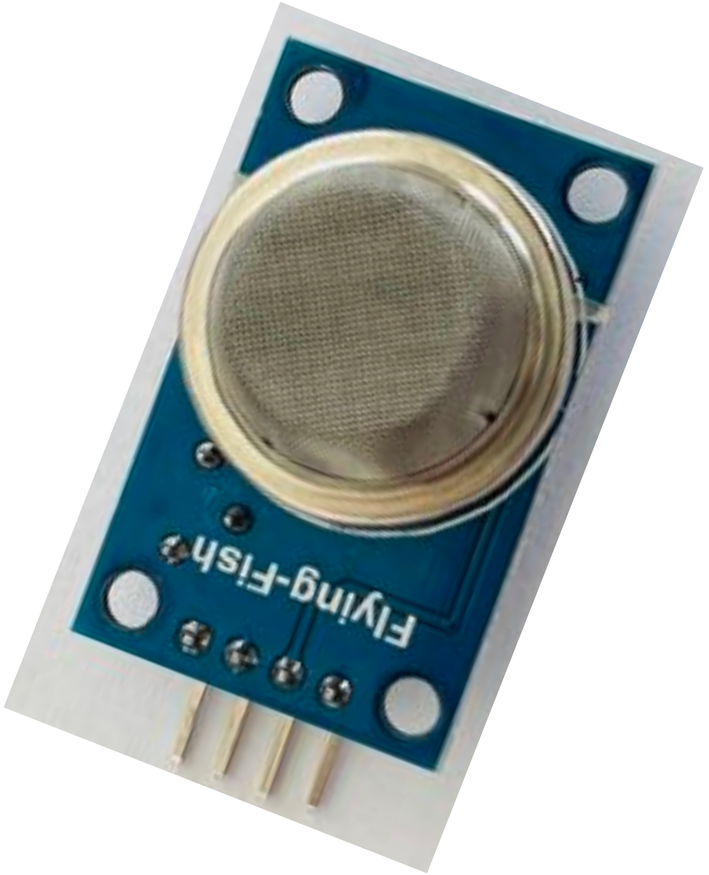
Scrolling the Display and Controlling the Speed of the Scroll

Using the LCD to Display Micro:bit Sensor Information



MQ Sensors

MQ Sensors



MQ-135: Air Quality Sensor

MQ-2: Methane, Butane, LPG, Smoke

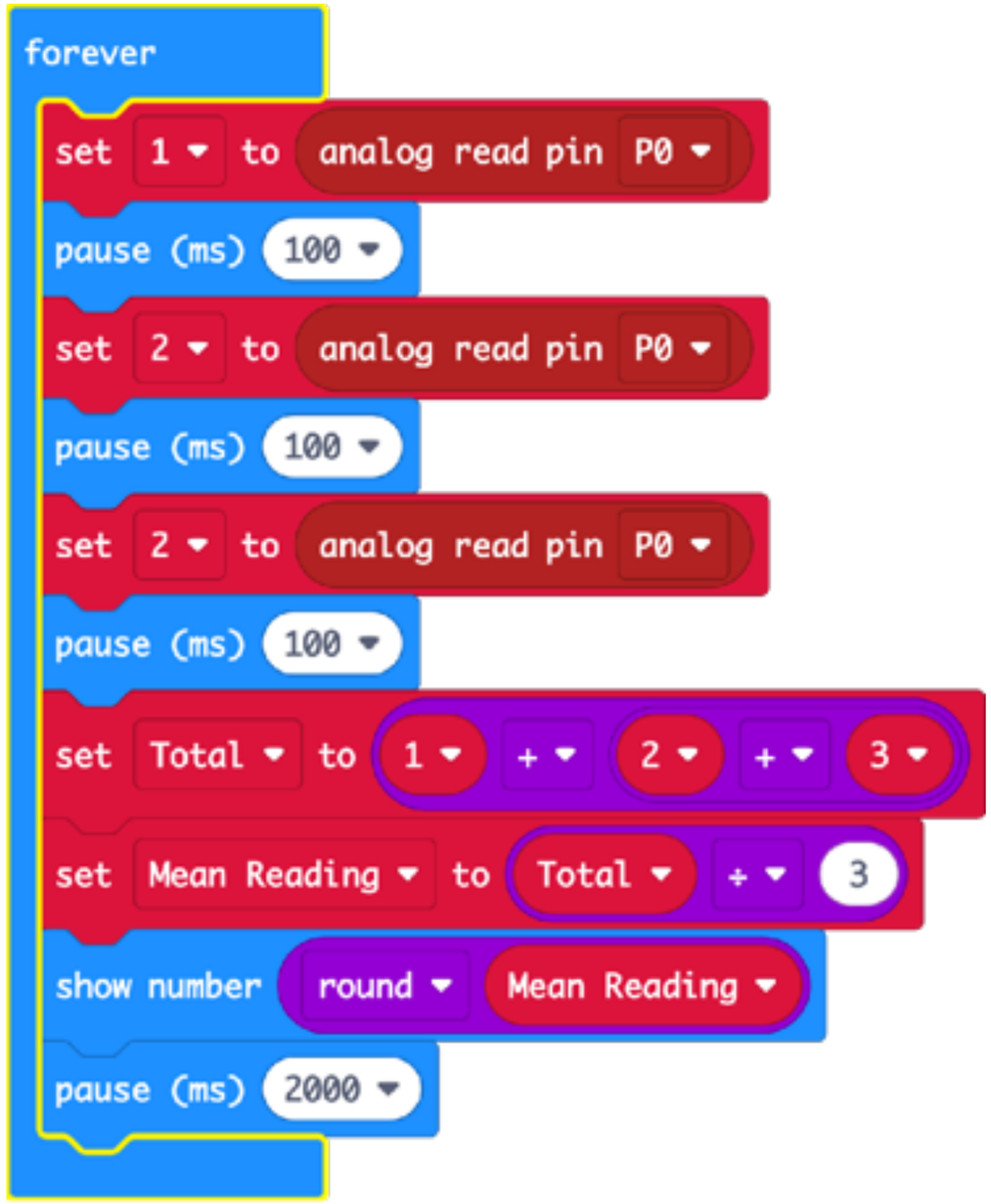
MQ-3: Alcohol, Ethanol, Smoke

MQ-9: Carbon Monoxide, flammable gasses

There are several more

MQ Sensors Pin Out

Voltage
Ground
Digital Out
Analog Out



1. We are connecting the sensor with the Microbit - VCC to 3v, Gnd to Gnd, and Analog Out to Pin-0
2. We are taking three readings from the MQ sensor using ‘Analog Read Pin’ command
3. We are storing the three readings into three variables (1, 2, 3)
4. Then we are taking the average of these three readings and displaying that.

1. Once we know the average reading in normal circumstances, we should introduce the change factor.
2. For example, if we are checking for smoke, we should introduce smoke (say by lighting an incense stick) and take fresh average reading.
3. Using the base (normal) reading and the reading with the change factor (smoke) we can write code to create the project we want.
4. For example, to make a Smoke Detection alarm, we can use a conditional statement

    IF sensor detects <smoke present reading> THEN sound alarm
    IF sensor detects <normal reading> THEN do nothing

Hope you enjoyed
making these projects :-)