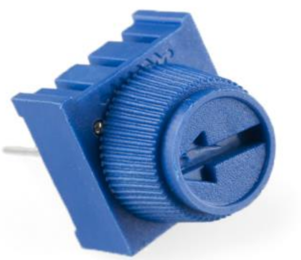
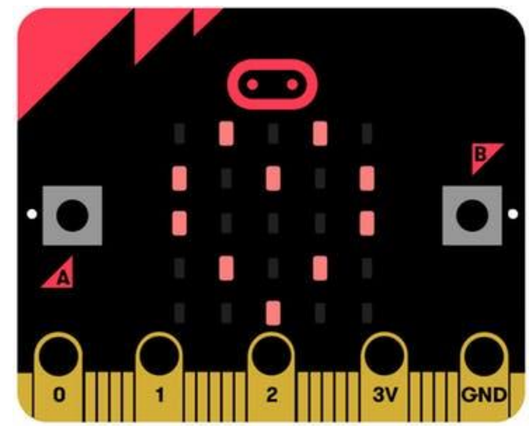
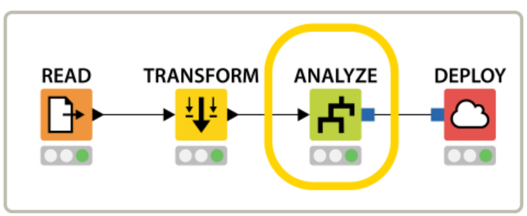
Prototyping Predictive Analytics Techniques

Class 4: Monitoring and Analyzing an Analog Signal using the BBC micro:bit







March 21, 2019

Don Wilcher

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DesignNews

CEC CONTINUING EDUCATION CENTER

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Class 4: Monitoring and Analyzing an Analog Signal using the BBC micro:bit…

Agenda

- Mini Lab Activities:

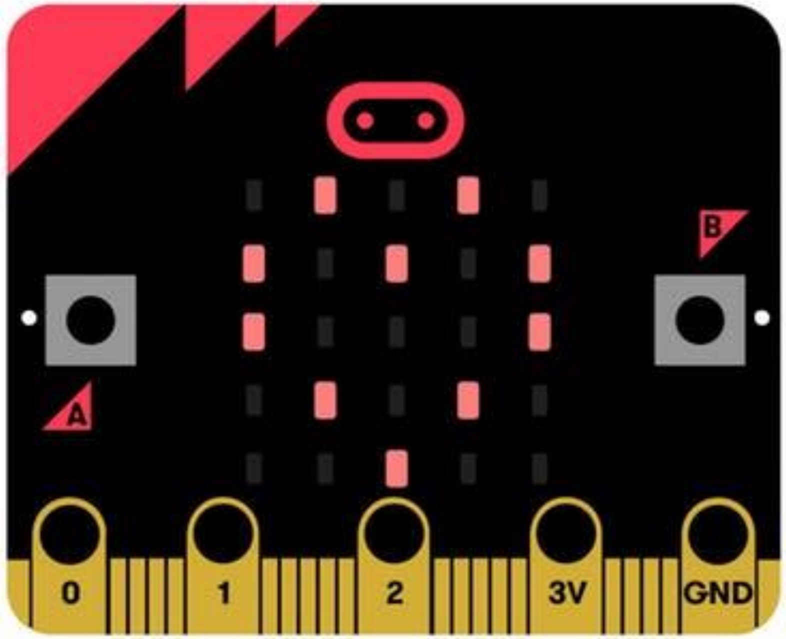
  a) Reading an Analog Signal with a micro:bit

  b) Analyzing an Analog Signal using Python (Linear Regression)

- Lab Project: Build a Motor Speed Controller with a micro:bit.

Mini Lab Activities: Reading an Analog Signal with a micro:bit…

Question: Can the micro:bit read an analog signal?



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Mini Lab Activities: Reading an Analog Signal with a micro:bit…

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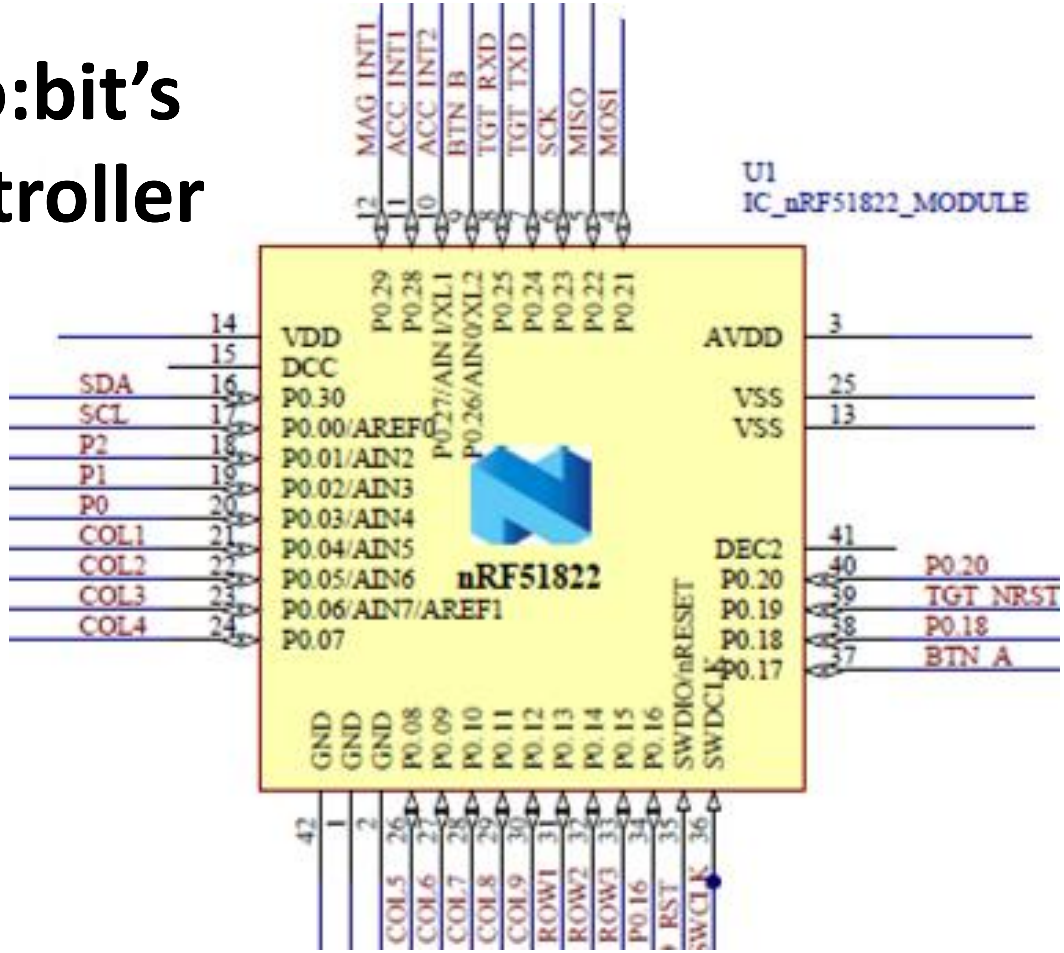
Mini Lab Activities: Reading an Analog Signal with a micro:bit…

The micro:bit's microcontroller



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Mini Lab Activities: Reading an Analog Signal with a micro:bit…

The nRF51822 Quick Specs:

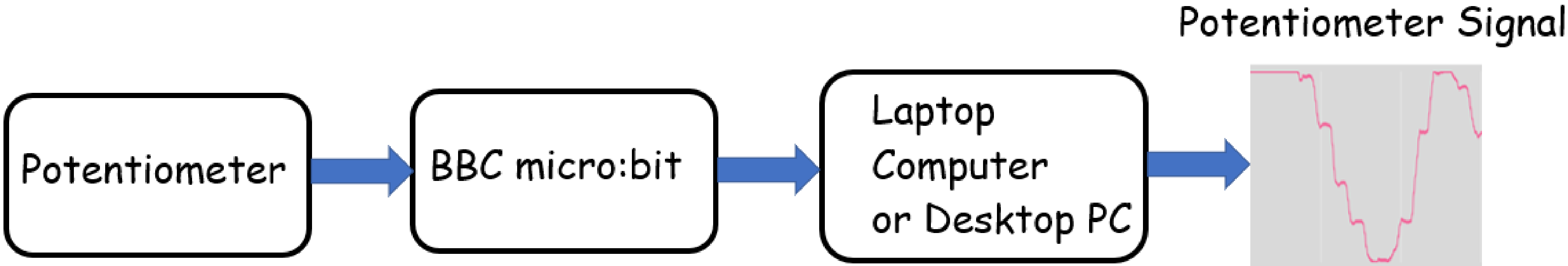
- An ARM Cortex MO 32bit processor
- 2.4GHZ transceiver
- 256kB or 128kB embedded flash programmable memory
- 16KB or 32kB RAM
- Supply Voltage Range: 1.8V – 3.6VDC
- 8/9/10 Analog to Digital Converters (ADC) – 8 configurable channels
- 1-32bit timer and 2-16bit timers with counter mode

Question 1:

What processor powers the BBC micro:bit?

Mini Lab Activities: Reading an Analog Signal with a micro:bit…

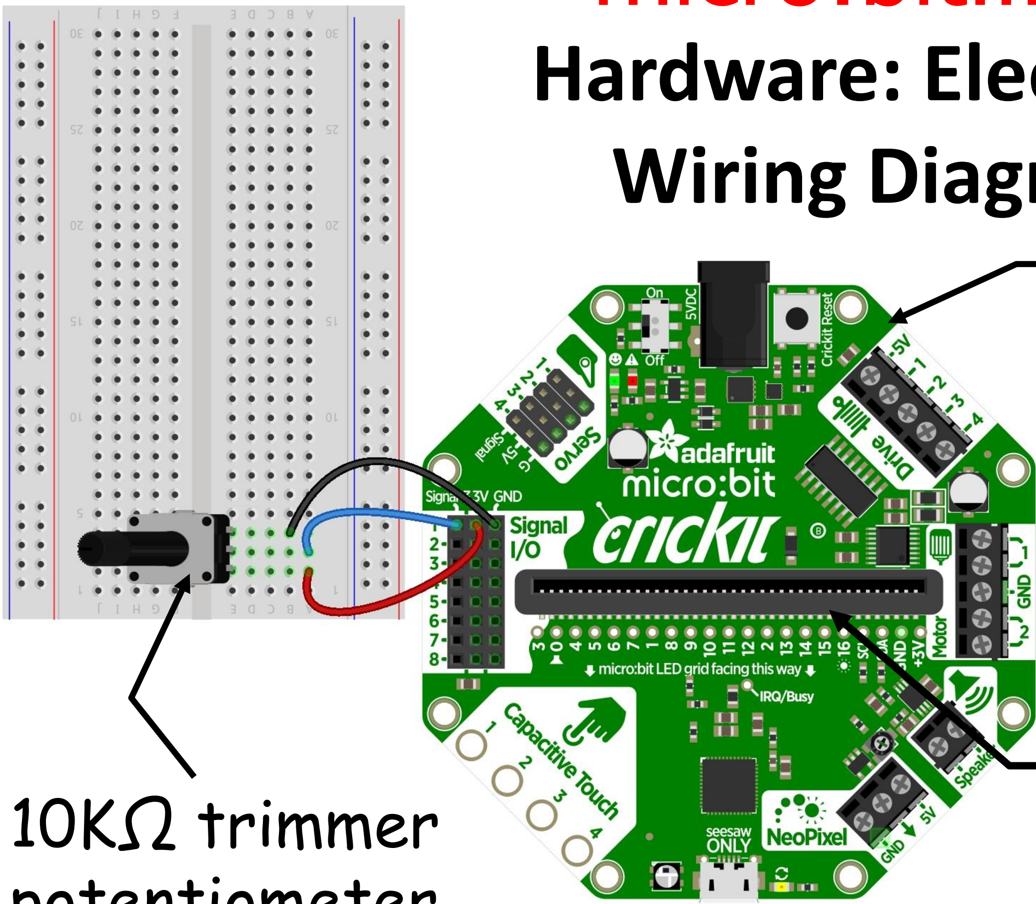
Question: Can the micro:bit read an analog signal?



Reading a potentiometer signal Block Diagram

Mini Lab Activities: Reading an Analog Signal with a micro:bit…

Hardware: Electrical Wiring Diagram



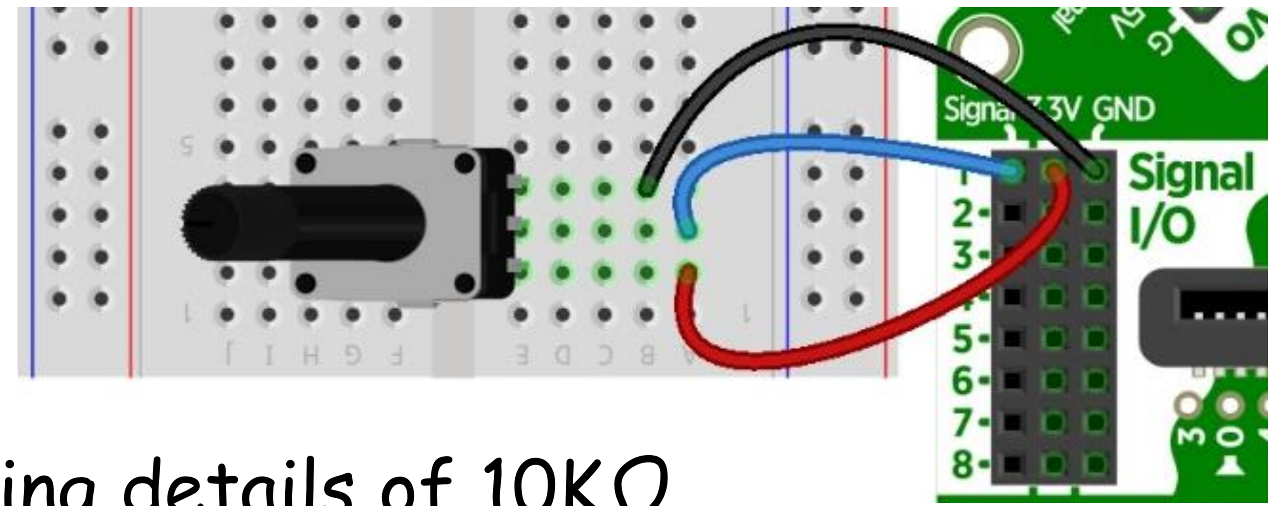
Crickit

micro:bit inserts here

10KΩ trimmer potentiometer

Mini Lab Activities: Reading an Analog Signal with a micro:bit…

Hardware: Electrical Wiring Diagram



Wiring details of 10KΩ trimmer potentiometer and Crickit

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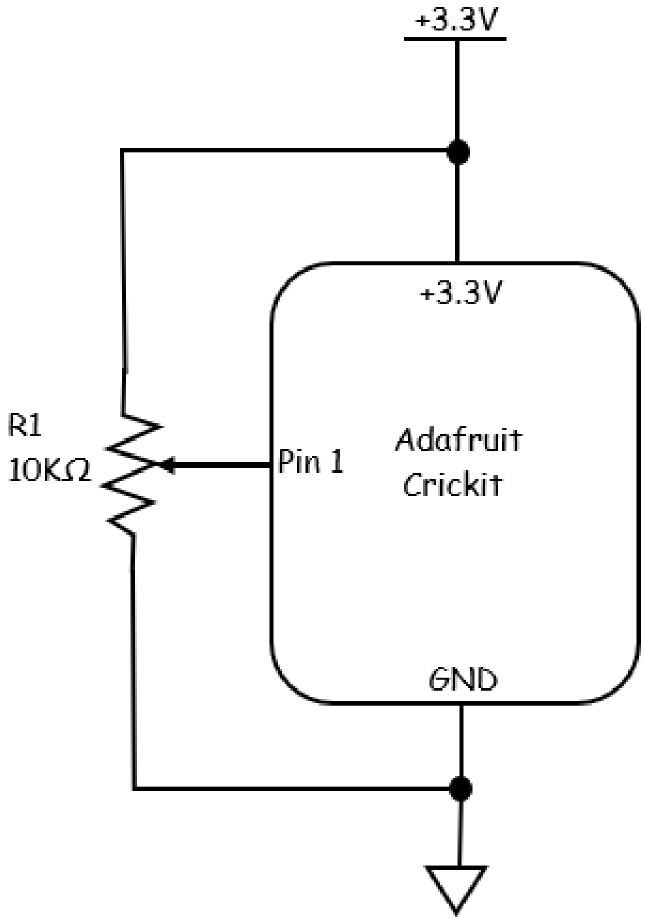
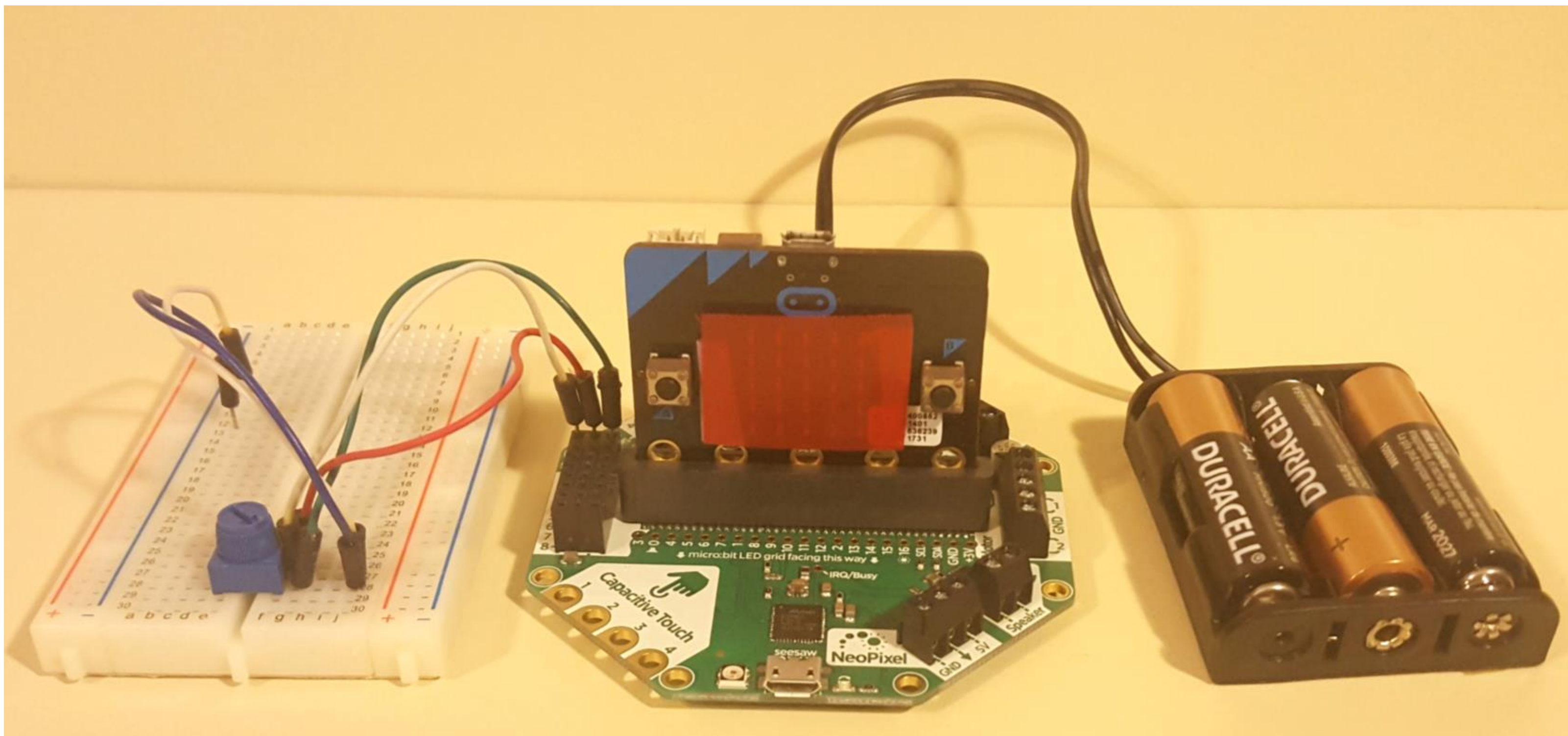
Mini Lab Activities: Reading an Analog Signal with a micro:bit…



Hardware: Electronic Circuit Schematic Diagram Diagram

Mini Lab Activities: Reading an analog signal with a micro:bit…

Hardware: Completed Device

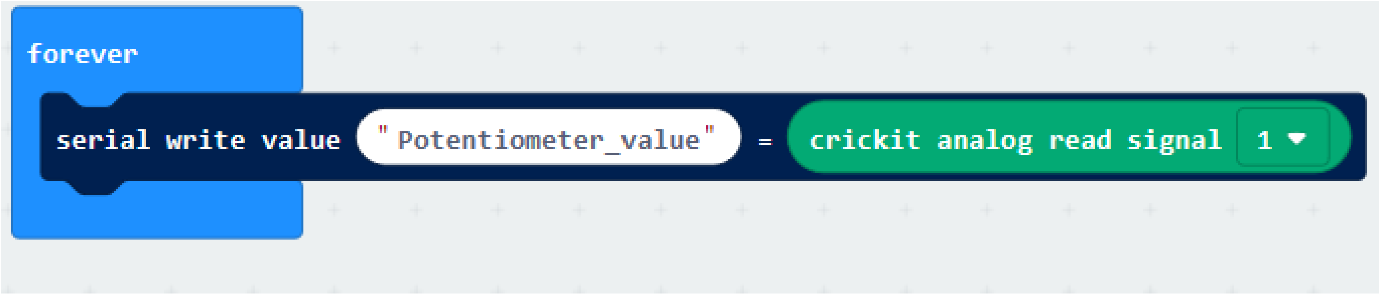


Question 2:

True of False: The wiper of the 10KΩ trimmer potentiometer is wired to +3.3V supply?

Mini Lab Activities: Reading an Analog Signal with a micro:bit…

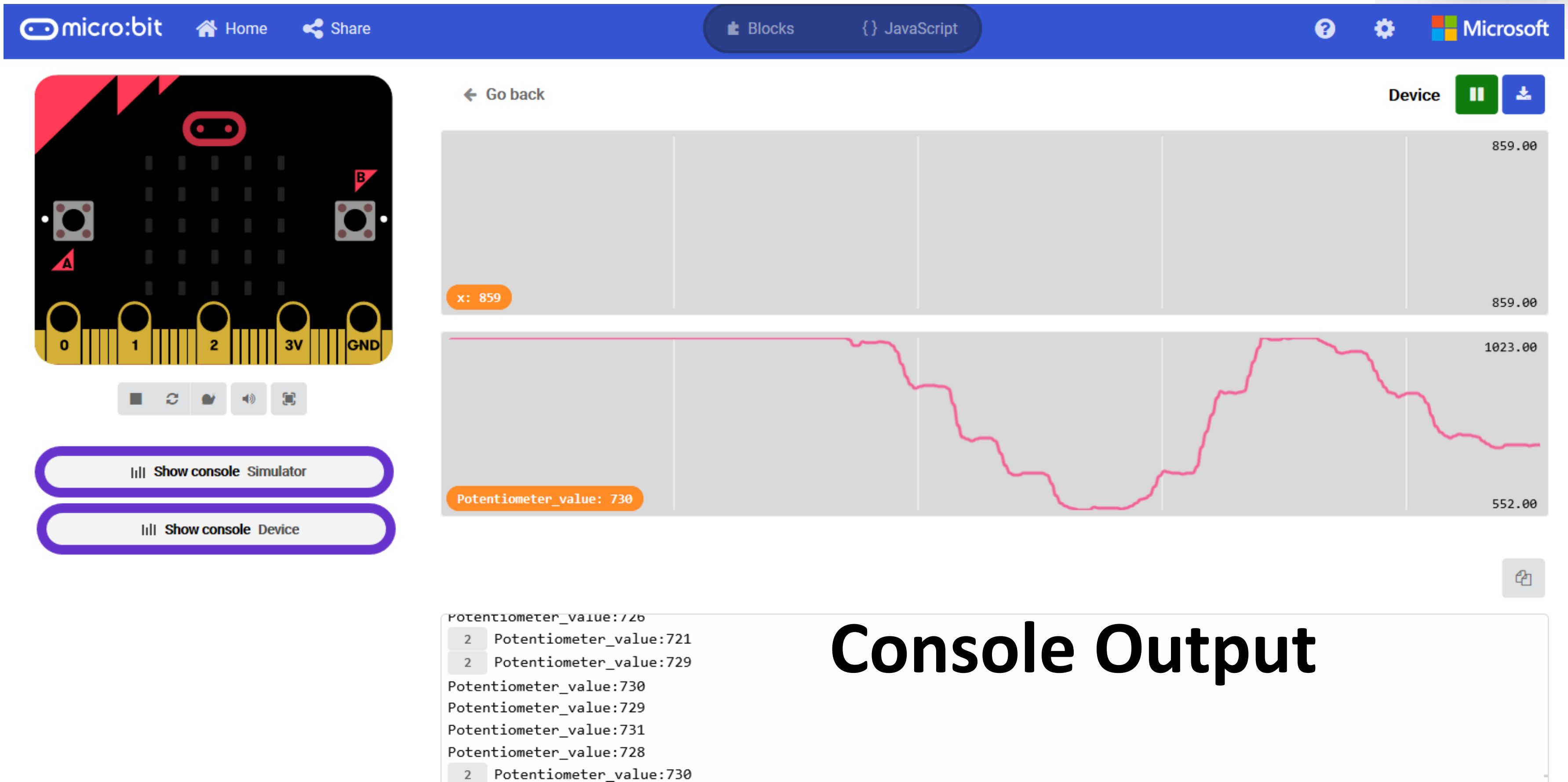
Software: Blockly Code



Javascript

```
basic.forever(function () {
    serial.writeValue("Potentiometer_value", crickit.signal1.analogRead())
})
```

Mini Lab Activities: Reading an Analog Signal with a micro:bit…

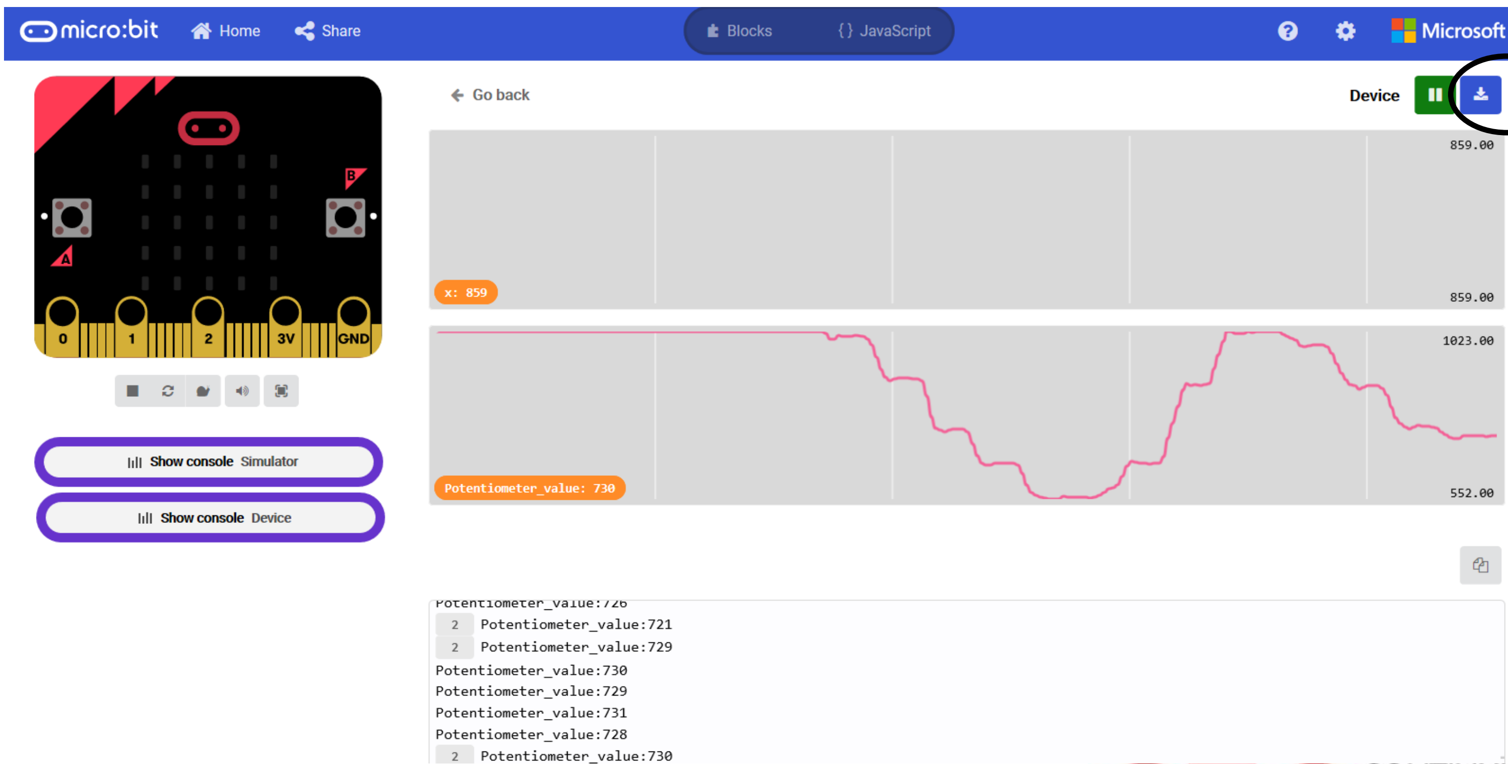


Question 3 :

What blockly instruction block allows the micro:bit to communicate with a desktop PC or laptop computer?

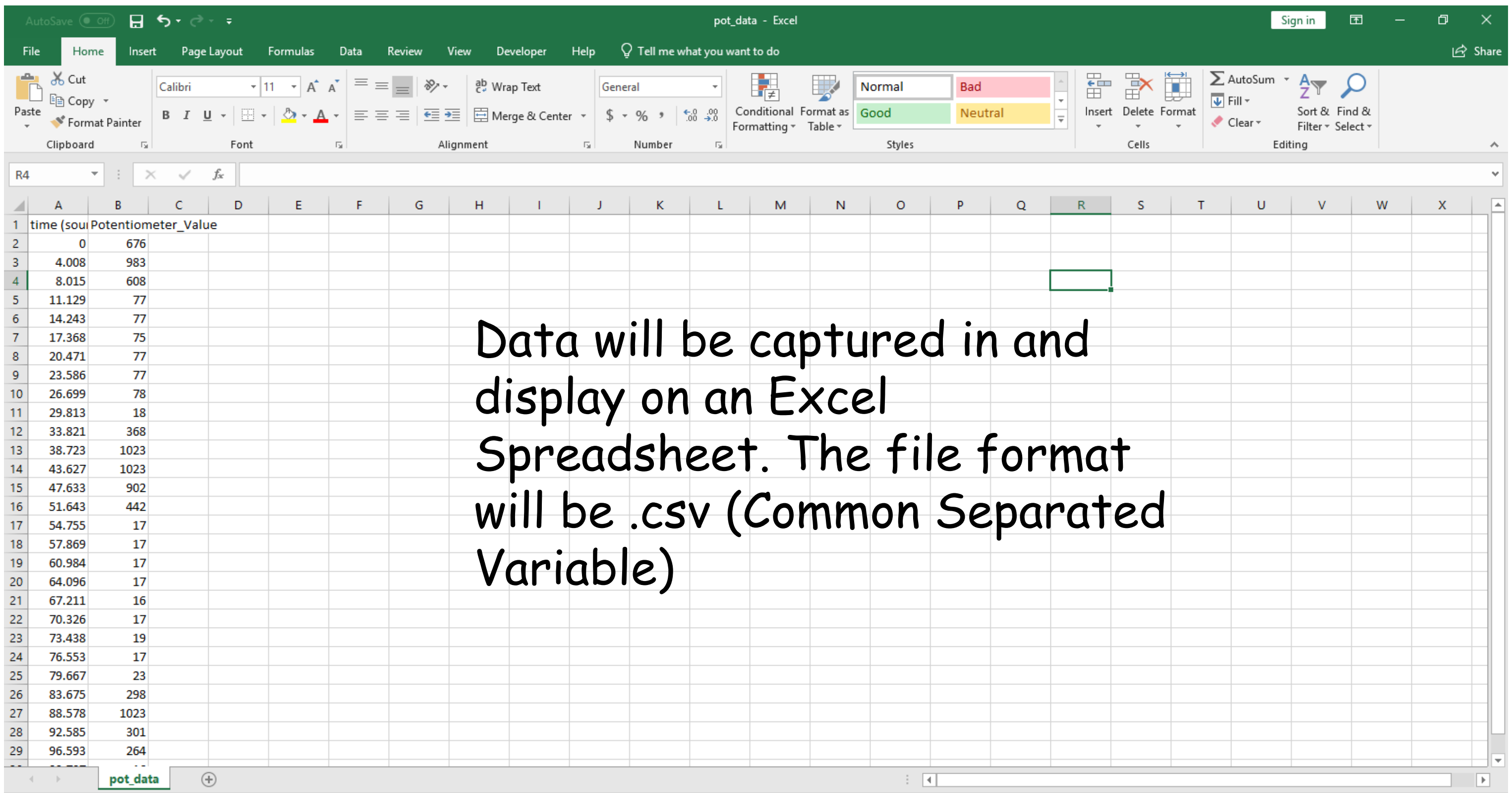
Mini Lab Activities: Analyzing an Analog Signal with Python…

How to download data from the Potentiometer Lab.



Click here to down load data

Mini Lab Activities: Analyzing an Analog Signal with Python…



time (sou	Potentiometer_Value
0	676
4.008	983
8.015	608
11.129	77
14.243	77
17.368	75
20.471	77
23.586	77
26.699	78
29.813	18
33.821	368
38.723	1023
43.627	1023
47.633	902
51.643	442
54.755	17
57.869	17
60.984	17
64.096	17
67.211	16
70.326	17
73.438	19
76.553	17
79.667	23
83.675	298
88.578	1023
92.585	301
96.593	264

Data will be captured in and display on an Excel Spreadsheet. The file format will be .csv (Common Separated Variable)

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Question 4 :

Clicking the down button on the micro:bit development console window automatically open what Microsoft application?

Mini Lab Activities: Analyzing an Analog Signal using Python…

Linear Regression Python Code

```
# Importing Necessary Libraries
%matplotlib inline
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
plt.rcParams['figure.figsize'] = (20.0, 10.0)

# Reading Data
data = pd.read_csv('pot_data.csv')
print(data.shape)
data.head()

# Collecting X and Y
X = data['time (source1)'].values
Y = data['Potentiometer_Value'].values

# Mean X and Y
mean_x = np.mean(X)
mean_y = np.mean(Y)
```

Mini Lab Activities: Analyzing an Analog Signal using Python…

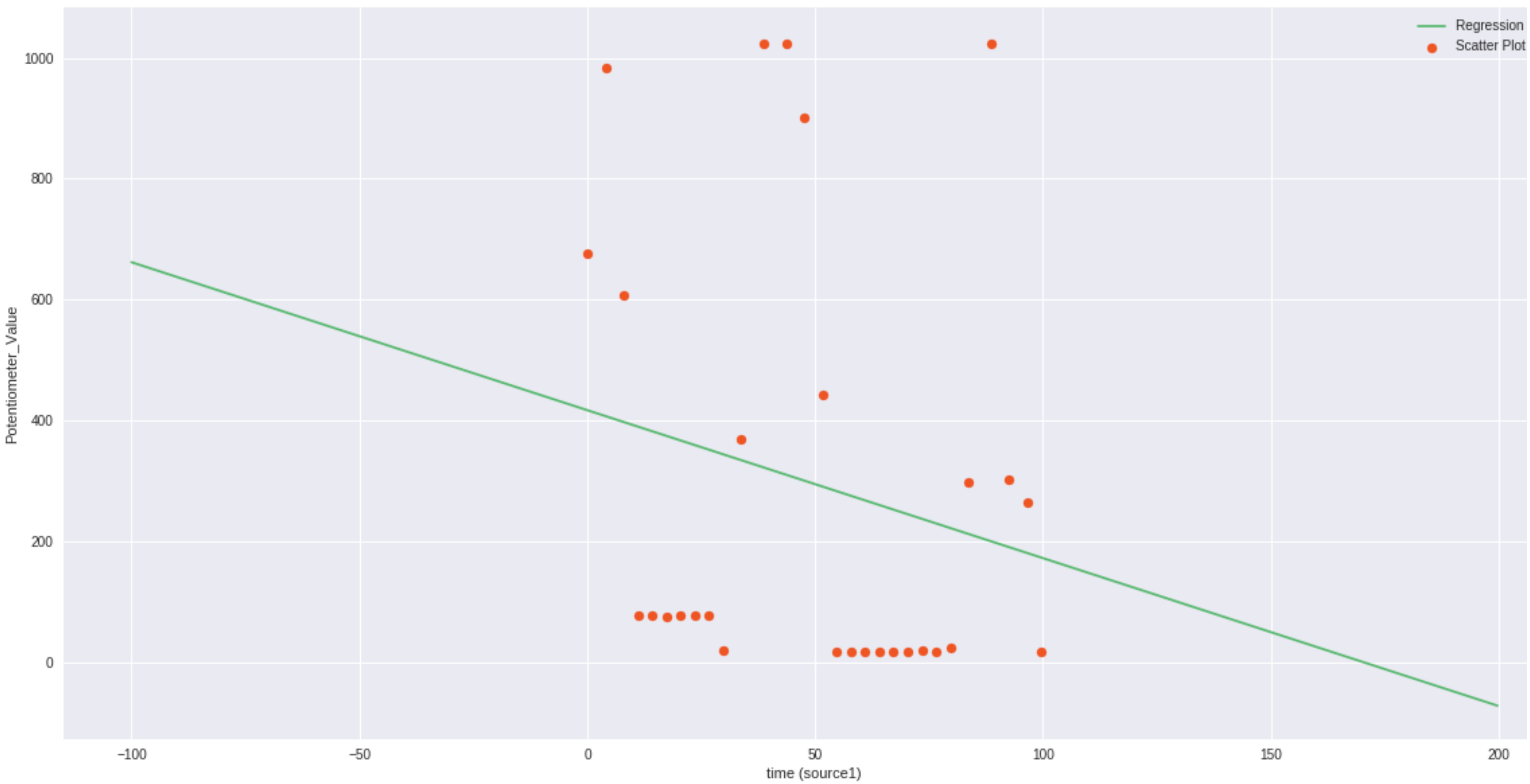
Linear Regression Python Code..

```
# Total number of values
m = len(X)

# Using the formula to calculate b1 and b2
numer = 0
denom = 0
for i in range(m):
    numer += (X[i] - mean_x) * (Y[i] - mean_y)
    denom += (X[i] - mean_x) ** 2
b1 = numer / denom
b0 = mean_y - (b1 * mean_x)

# Print coefficients
print(b1, b0)

# Plotting Values and Regression Line

max_x = np.max(X) + 100
min_x = np.min(X) - 100

# Calculating line values x and y
x = np.linspace(min_x, max_x, 1000)
y = b0 + b1 * x

# Ploting Line
plt.plot(x, y, color='#58b970', label='Regression Line')
# Ploting Scatter Points
plt.scatter(X, Y, c='#ef5423', label='Scatter Plot')

plt.xlabel('time (source1)')
plt.ylabel('Potentiometer_Value')
plt.legend()
plt.show()
```

Mini Lab Activities: Analyzing an Analog Signal using Python…

Linear Regression Model Results

```
(29, 2)
-2.449601952200695 416.74576822597214
```



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Mini Lab Activities: Analyzing an Analog Signal using Python…

Linear Regression Model Results

Coefficients for the Linear Regression Model:

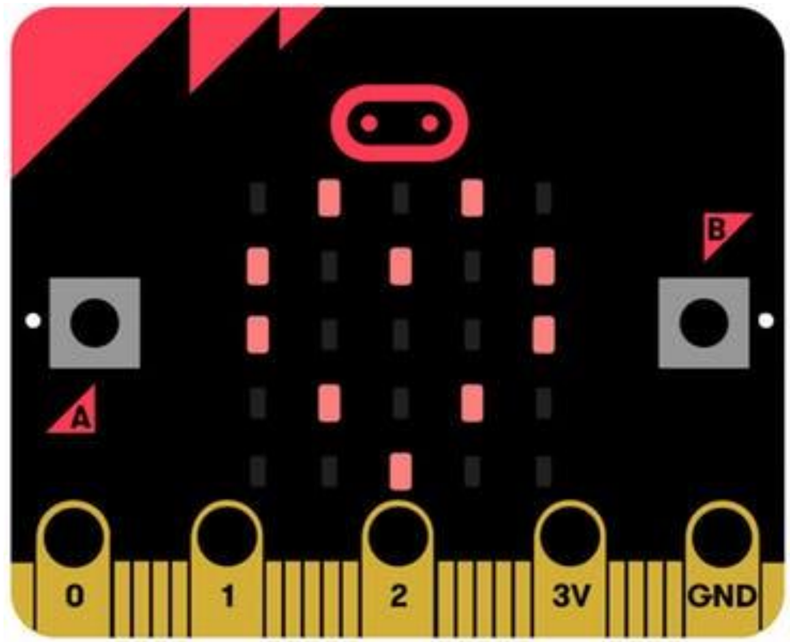
```
-2.449601952200695 416.74576822597214
```

Linear Regression Equation:

$$y = -2.45x + 416.75$$

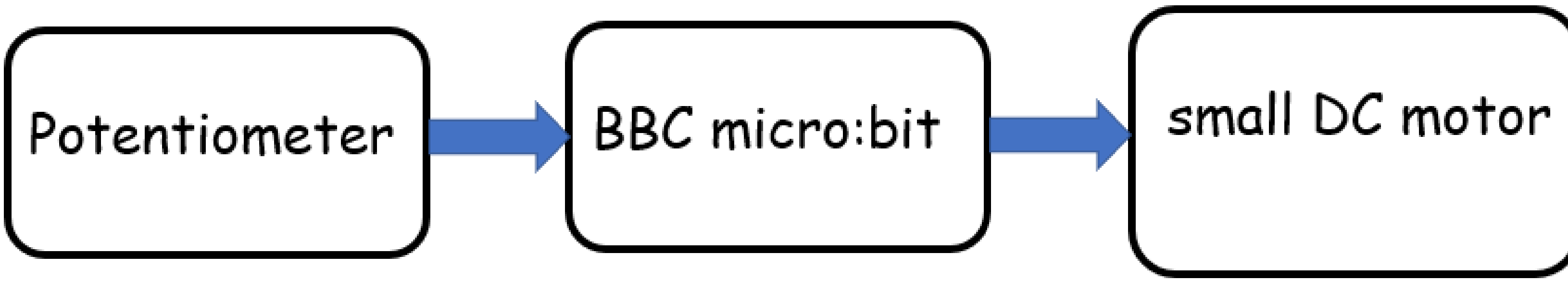
Lab Project: Build a Motor Speed Controller using a micro:bit

Question: Can the micro:bit drive a small dc motor?



Lab Project:
Build a Motor Speed Controller using a micro:bit…

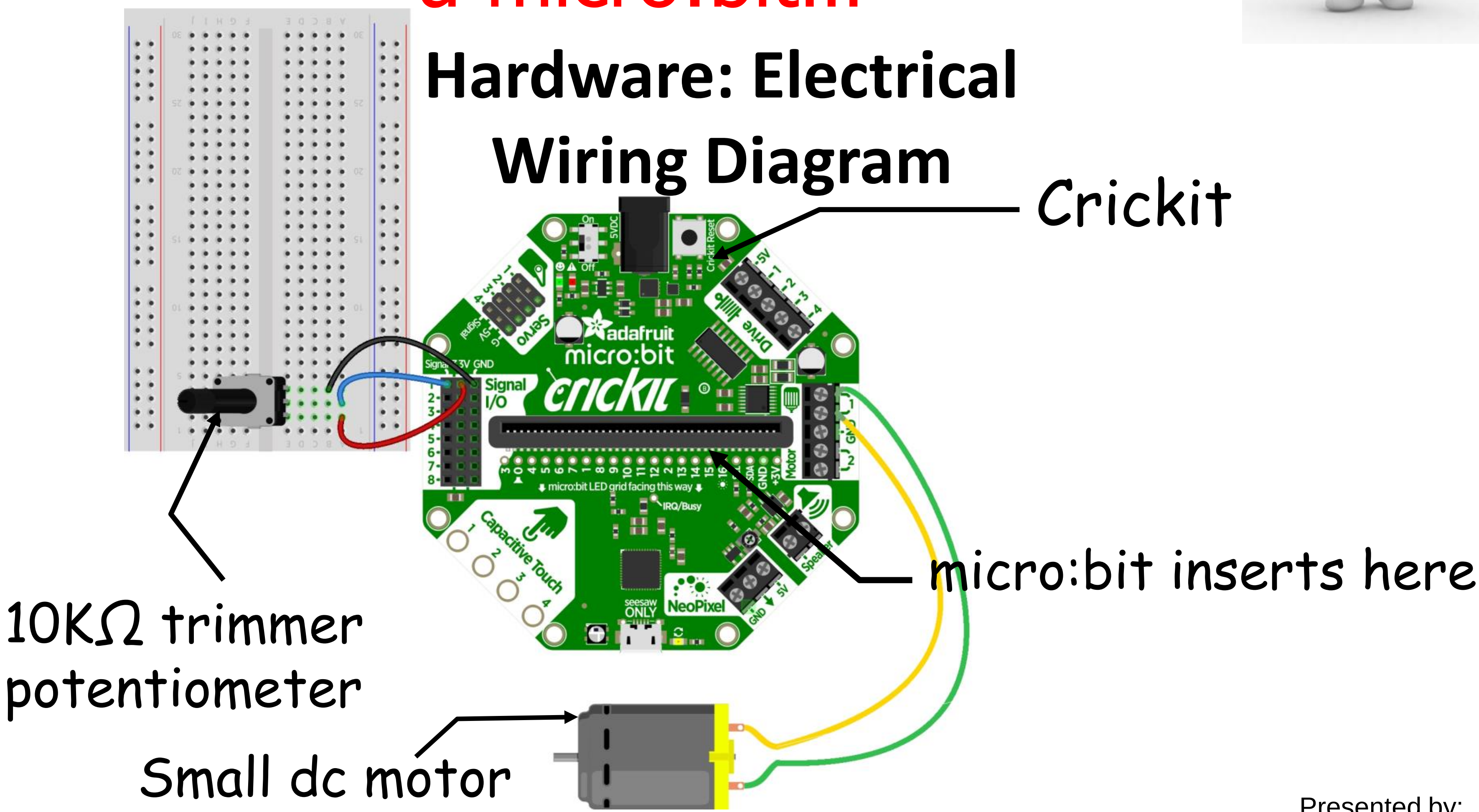
Question: Can the micro:bit drive a small dc motor?



DC motor speed controller with a potentiometer
Block Diagram

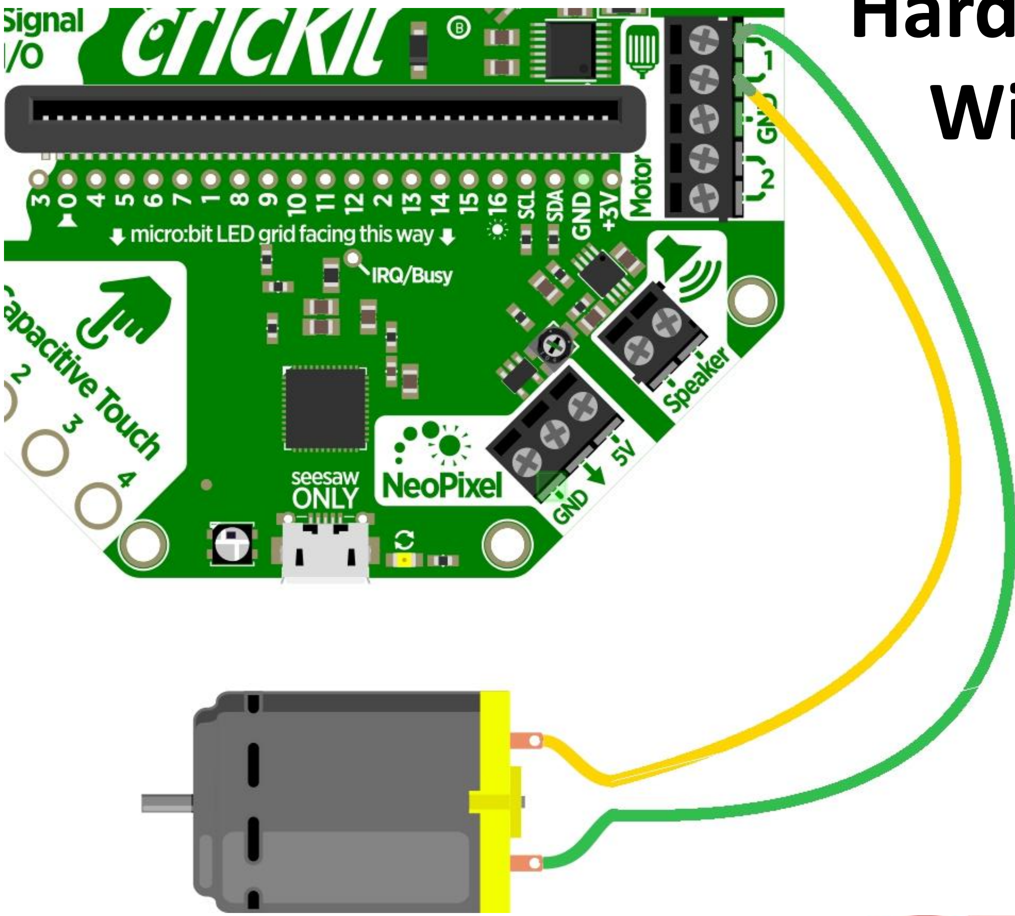
Lab Project: Build a Motor Speed Controller using a micro:bit…

Hardware: Electrical Wiring Diagram



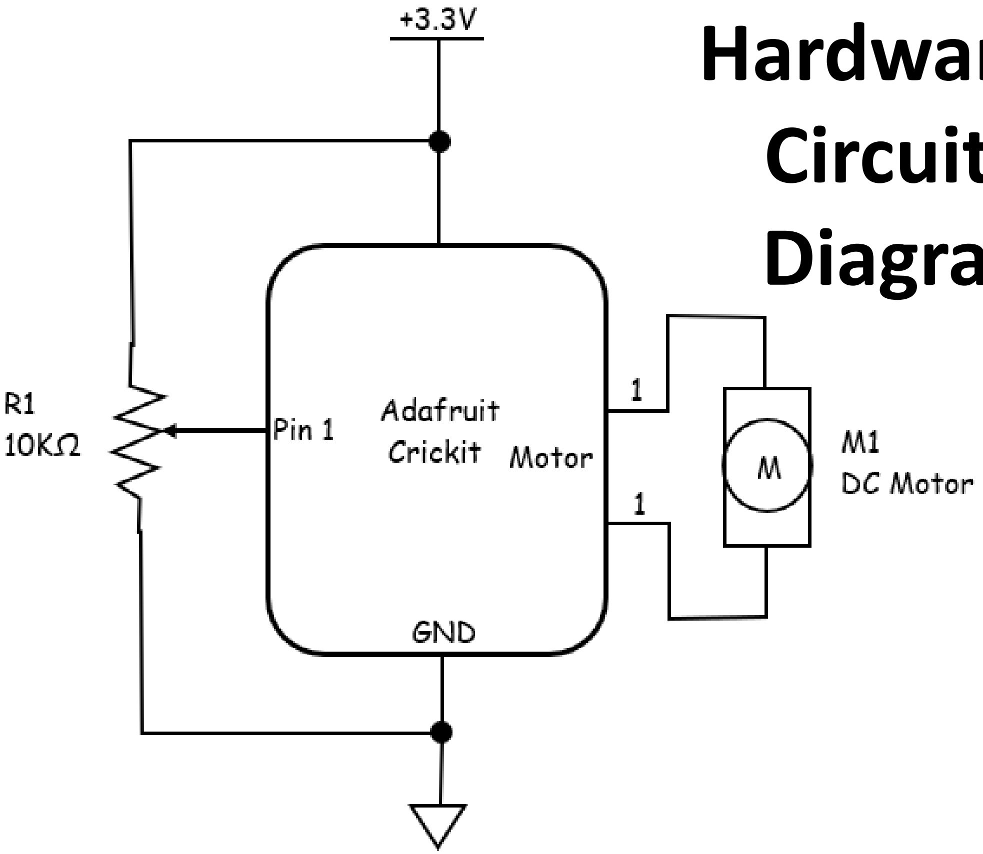
Lab Project: Build a Motor Speed Controller using a micro:bit…

Hardware: Electrical Wiring Diagram



Wiring details of DC motor Crickit

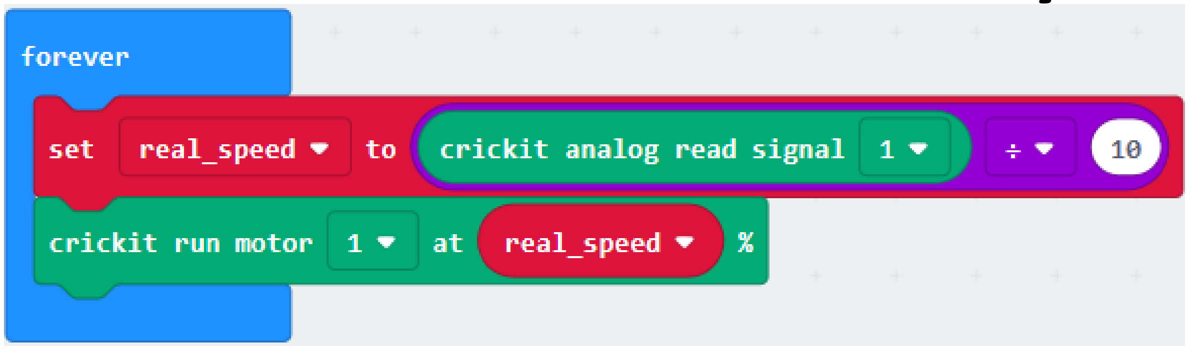
Lab Project:
Build a Motor Speed Controller using a micro:bit…



Hardware: Electronic Circuit Schematic Diagram Diagram

Lab Project: Build a Motor Speed Controller using a micro:bit…

Software: Blockly Code

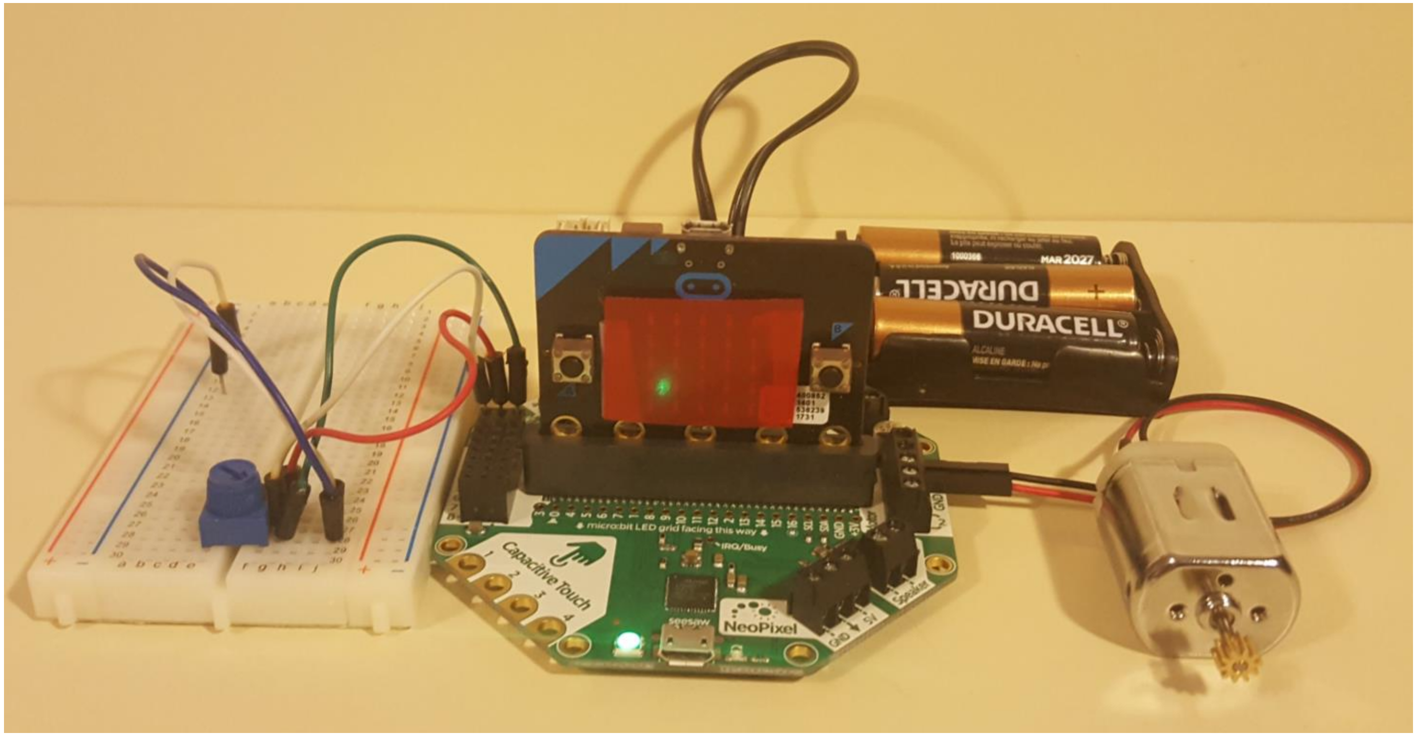


Javascript

```
let real_speed = 0
basic.forever(function () {
    real_speed = crickit.signal1.analogRead() / 10
    crickit.motor1.run(real_speed)
})
```

Lab Project:
Build a Motor Speed Controller using a micro:bit…

Hardware: Completed Device



Question 5 :

Write the javascript that converts the ADC value to real speed.