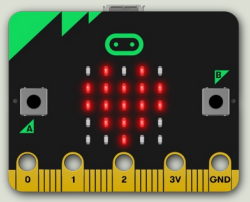
https://www.halvorsen.blog



micro:bit and Logging Sensor Data

Hans-Petter Halvorsen

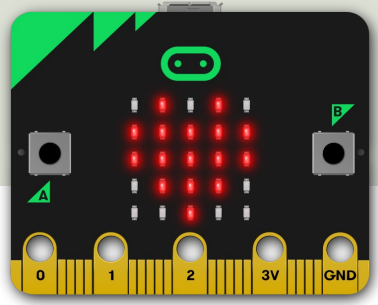
Contents

Introduction to micro:bit

Hans-Petter Halvorsen

Table of Contents

micro:bit



- micro:bit is a small microcontroller
- micro:bit is smaller than a credit card
- Price is about 150-400NOK ($15-30)
- It can be used by kids and students to learn programming and technology
- micro:bit can run a special version of Python called MicroPython
- MicroPython is a down-scaled version of Python

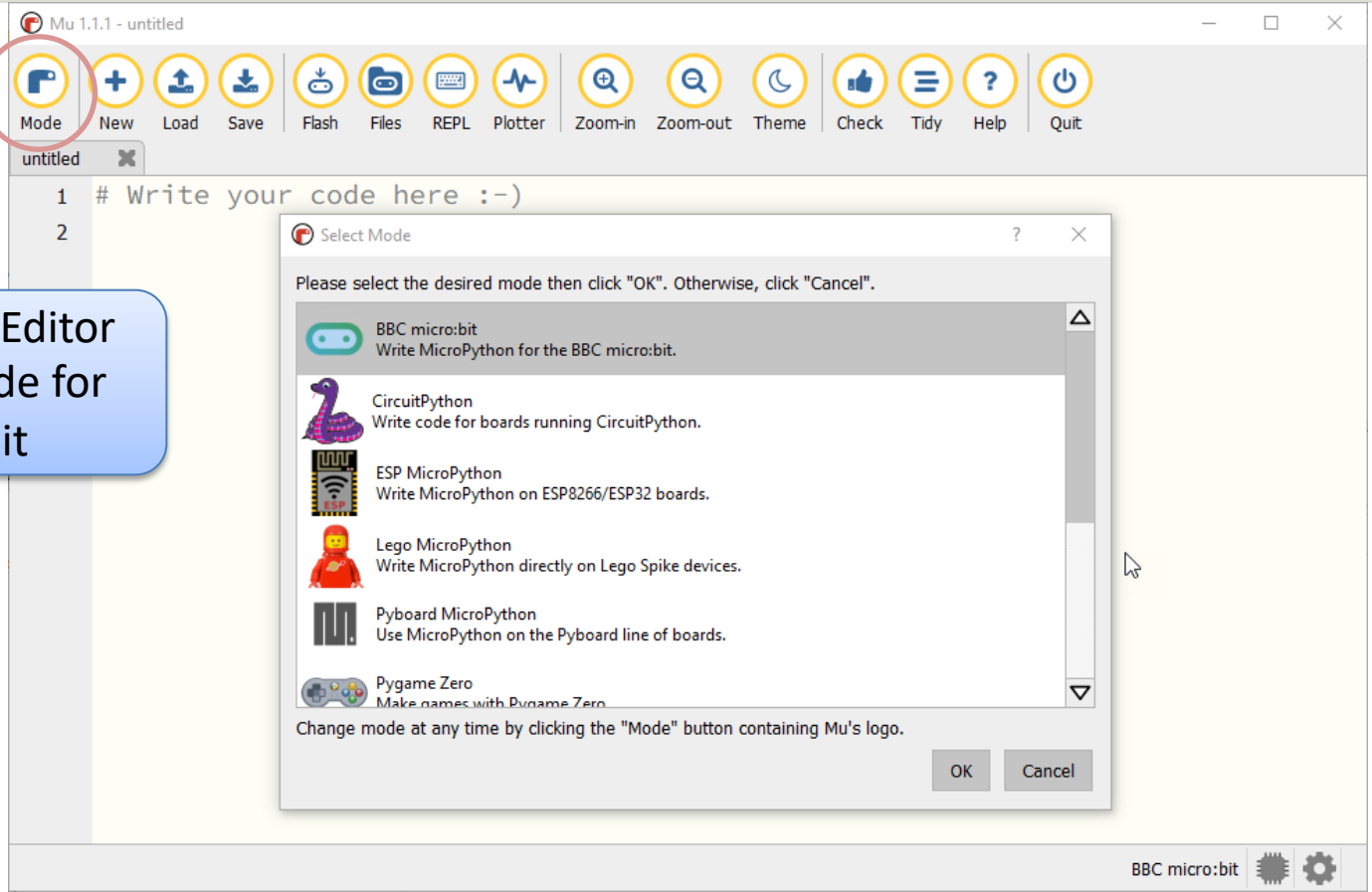
https://microbit.org

Mu Python Editor

- Mu is a Python code editor for beginners
- It is tailor-made for micro:bit programming
- Mu has a “micro:bit mode” that makes it easy to work with micro:bit, download code to the micro:bit hardware, etc.
- Mu and micro:bit Tutorials: https://codewith.mu/en/tutorials/1.0/microbit

Mu Python Editor

The Mu Python Editor has built-in Mode for the micro:bit



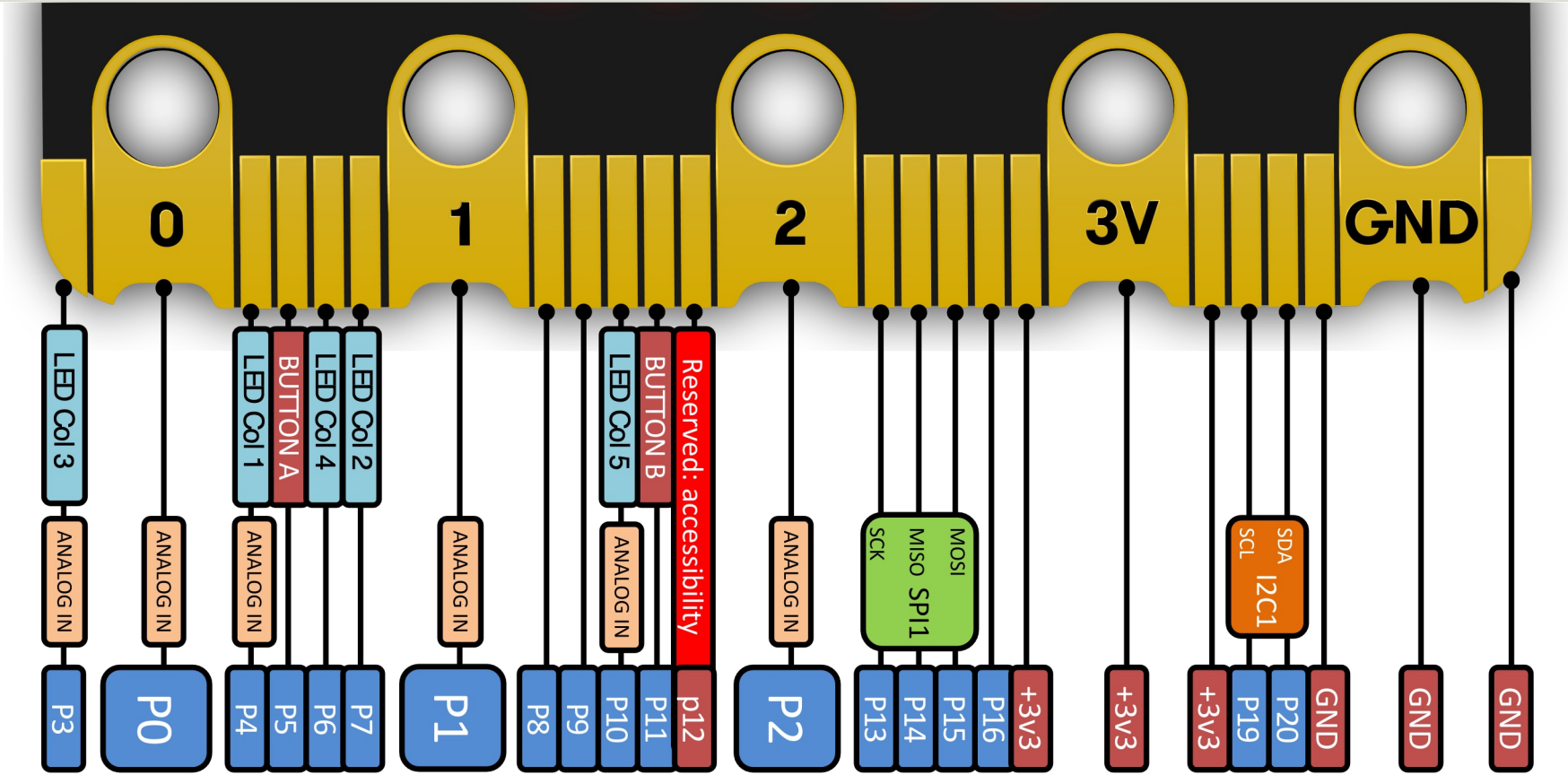
micro:bit I/O Pins

Hans-Petter Halvorsen

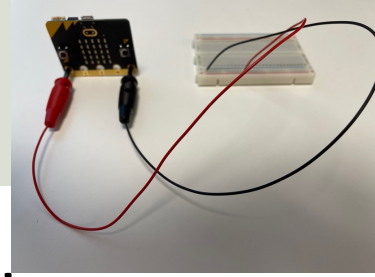
Table of Contents

https://microbit.pinout.xyz/

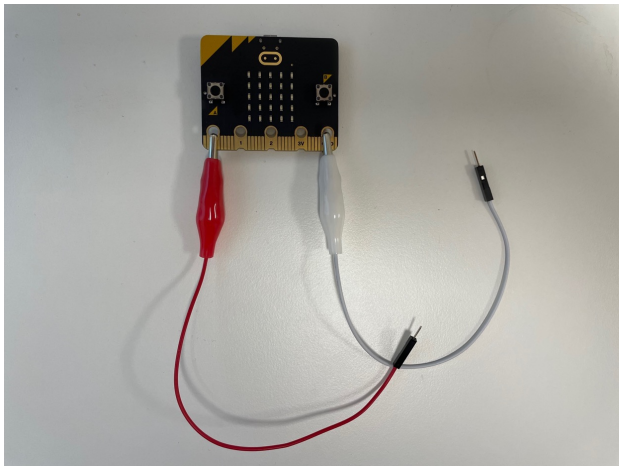
micro:bit I/O Pin Overview



I/O Pins



- We use the I/O pins to connect external components like LEDs, different types of Sensors, etc.
- You can use 4mm Banana plugs or Alligator/Crocodile clips
- Typically, you also want to use a Breadboard



https://tech.microbit.org/hardware/edgeconnector/

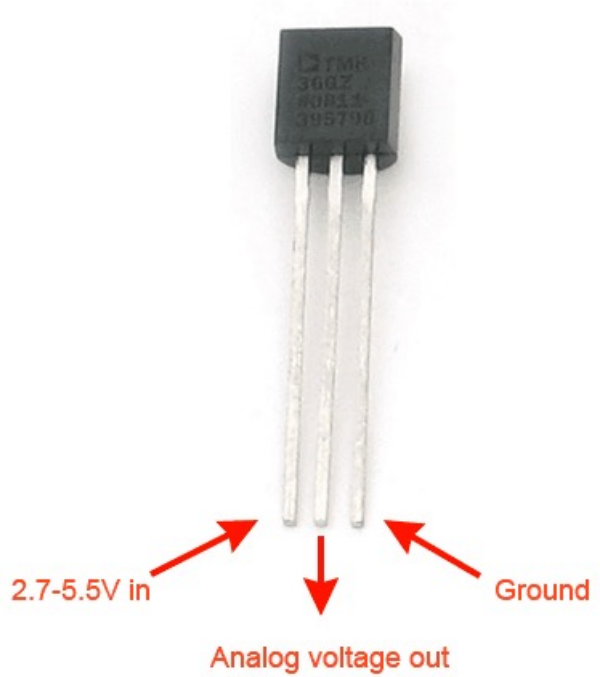
https://makecode.microbit.org/device/crocodile-clips

TMP36 Temperature Sensor

Hans-Petter Halvorsen

Table of Contents

TMP36 Temperature Sensor

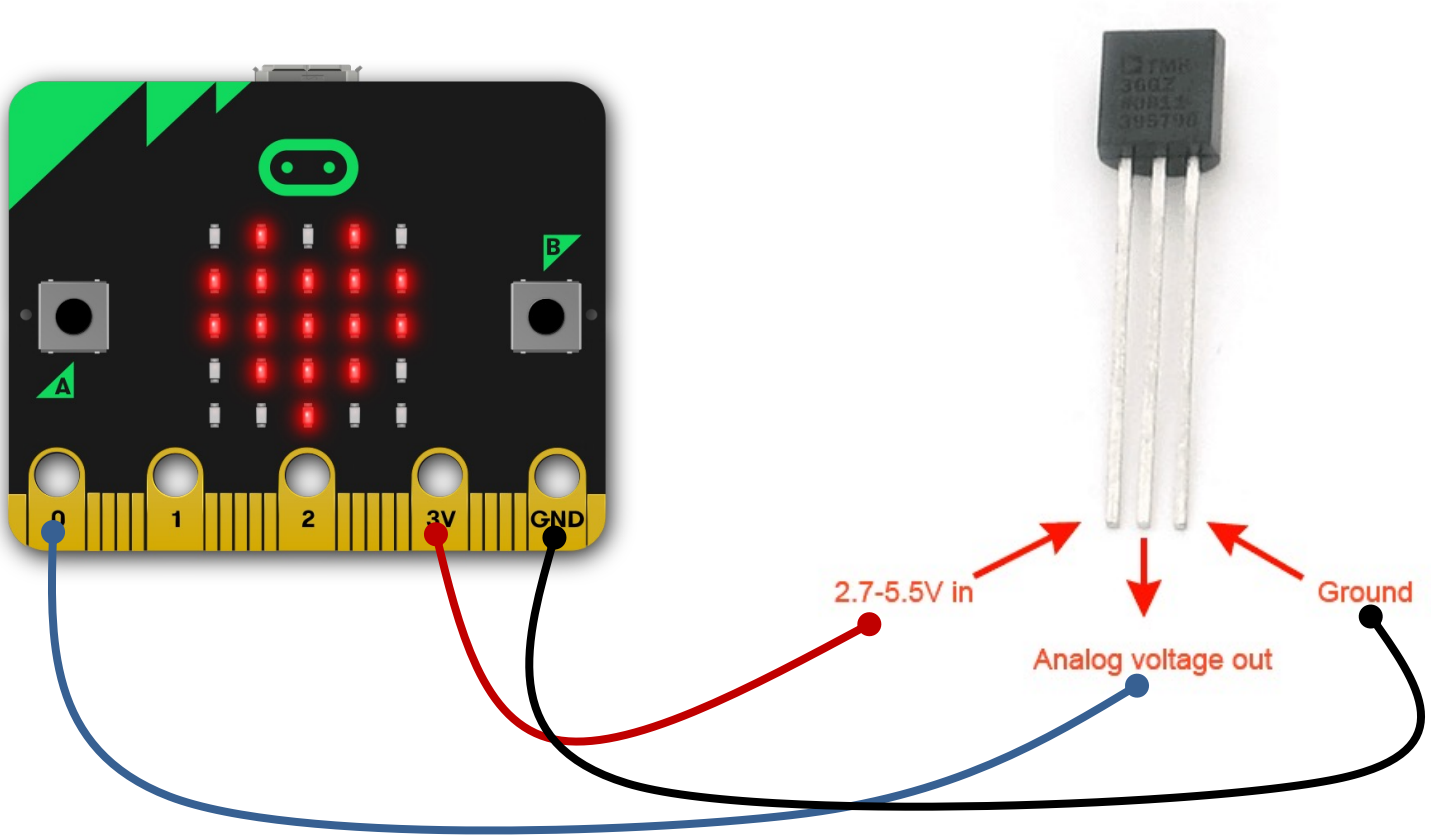


A Temperature sensor like TM36 use a solid-state technique to determine the temperature.

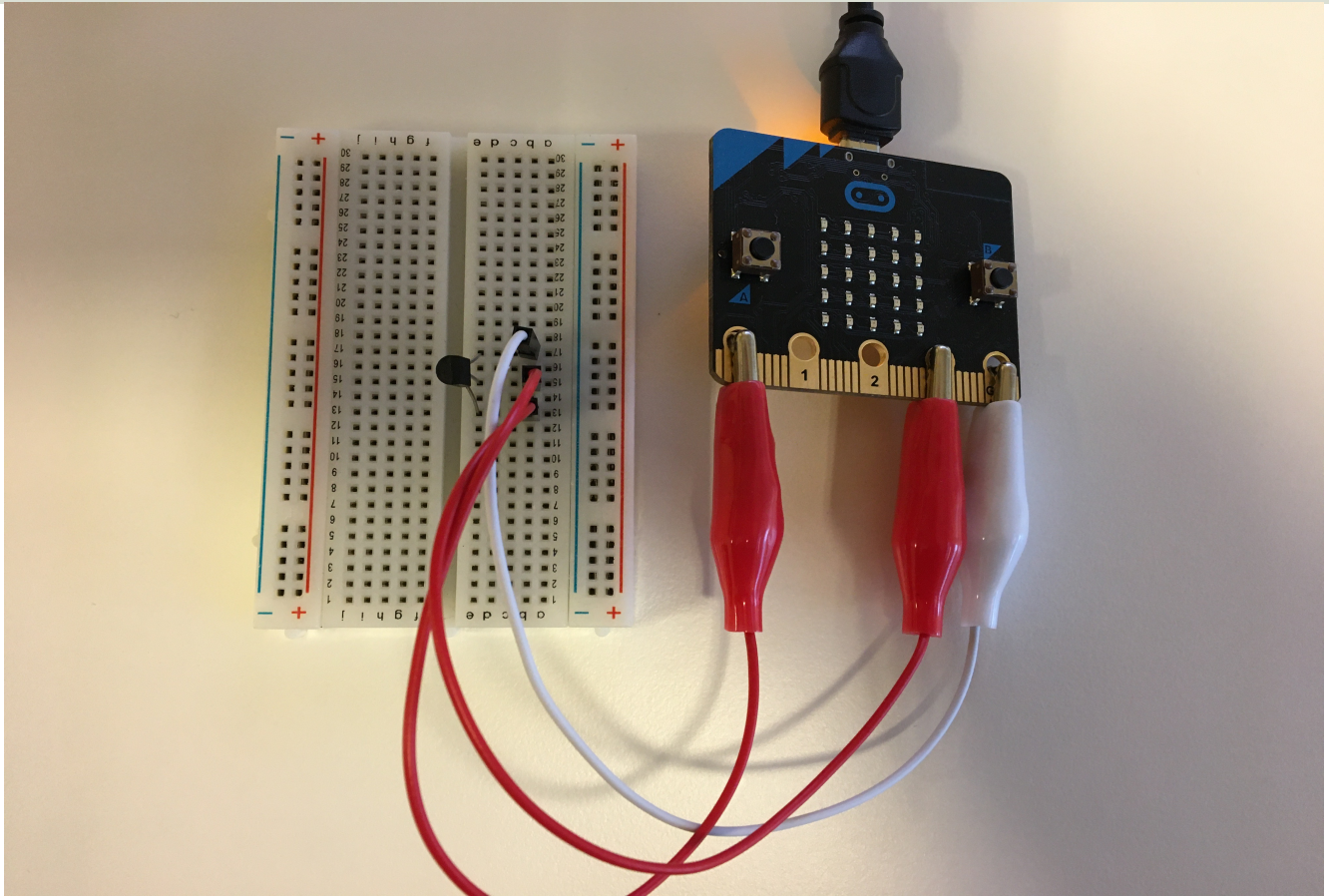
They use the fact as temperature increases, the voltage across a diode increases at a known rate.

https://learn.adafruit.com/tmp36-temperature-sensor

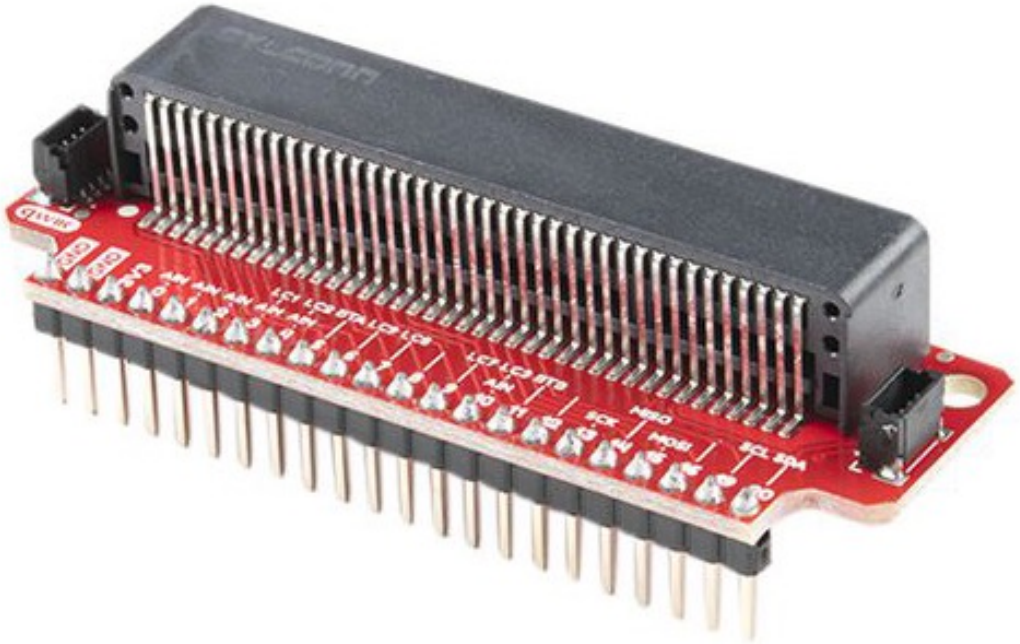
Wiring



Breadboard and Crocodile clips



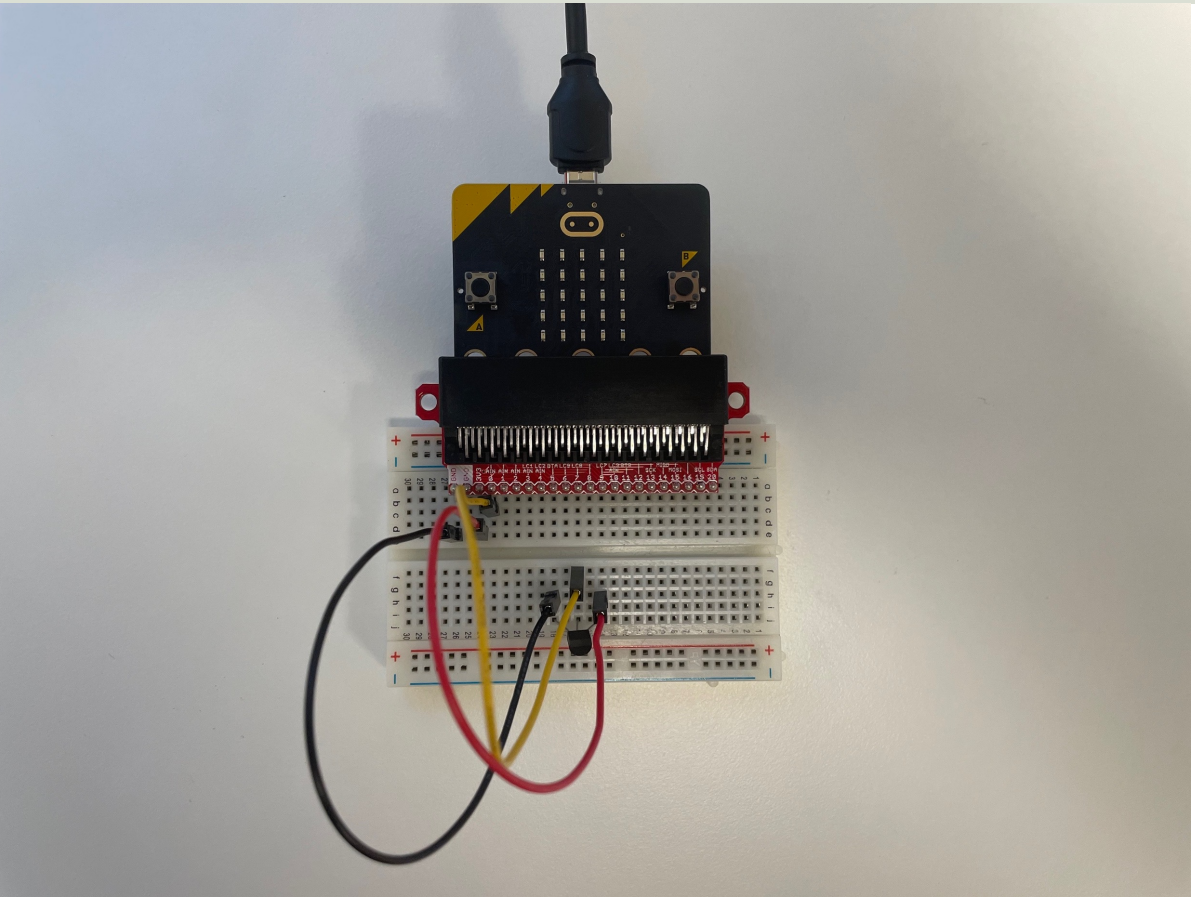
Adapter Breakout Board for micro:bit



We can also use an **Adapter Breakout Board for micro:bit** instead of Alligator/Crocodile clips

This makes it easier to wire for more advanced circuits and use of more in inputs/outputs pins

Adapter Breakout Board for micro:bit



Here you see see the wirings using an Adapter Breakout Board for micro:bit

Python

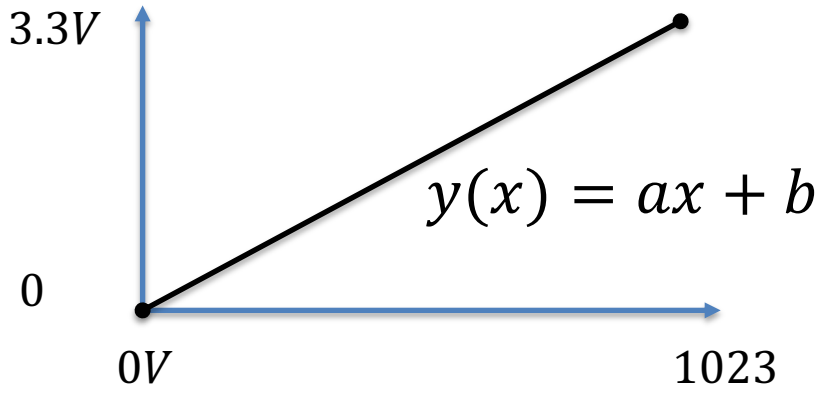
```
from microbit import *

while True:
    adc = pin0.read_analog()
    display.scroll(adc)
    sleep(5000)
```

ADC Value to Voltage Value

Analog Pins: The the built-in analog-to-digital converter (ADC) on micro:bit is 10bit, producing values from 0 to 1023.

The function `pin0.read_analog()` gives a value between 0 and 1023. It must be converted to a Voltage Signal 0 - 3.3v

ADC = 0 -> 0v
ADC = 1023 -> 3.3v



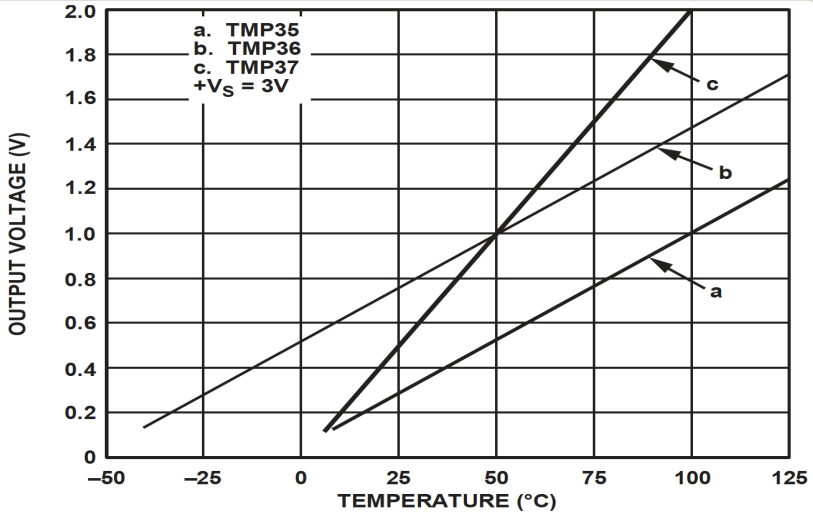
This gives the following conversion formula:

$$y(x) = \frac{3.3}{1023}x$$

Python

```
from microbit import *

while True:
    adc = pin0.read_analog()
    volt = (3.3/1023)*adc
    display.scroll(volt)
    sleep(5000)
```

Voltage to degrees Celsius



This gives:

$$y - 25 = \frac{50 - 25}{1 - 0.75}(x - 0.75)$$

Then we get the following formula:

$$y = 100x - 50$$

Convert form Voltage (V) to degrees Celsius

From the Datasheet we have:

$$(x_1, y_1) = (0.75V, 25°C)$$
$$(x_2, y_2) = (1V, 50°C)$$

There is a linear relationship between Voltage and degrees Celsius:

$$y = ax + b$$

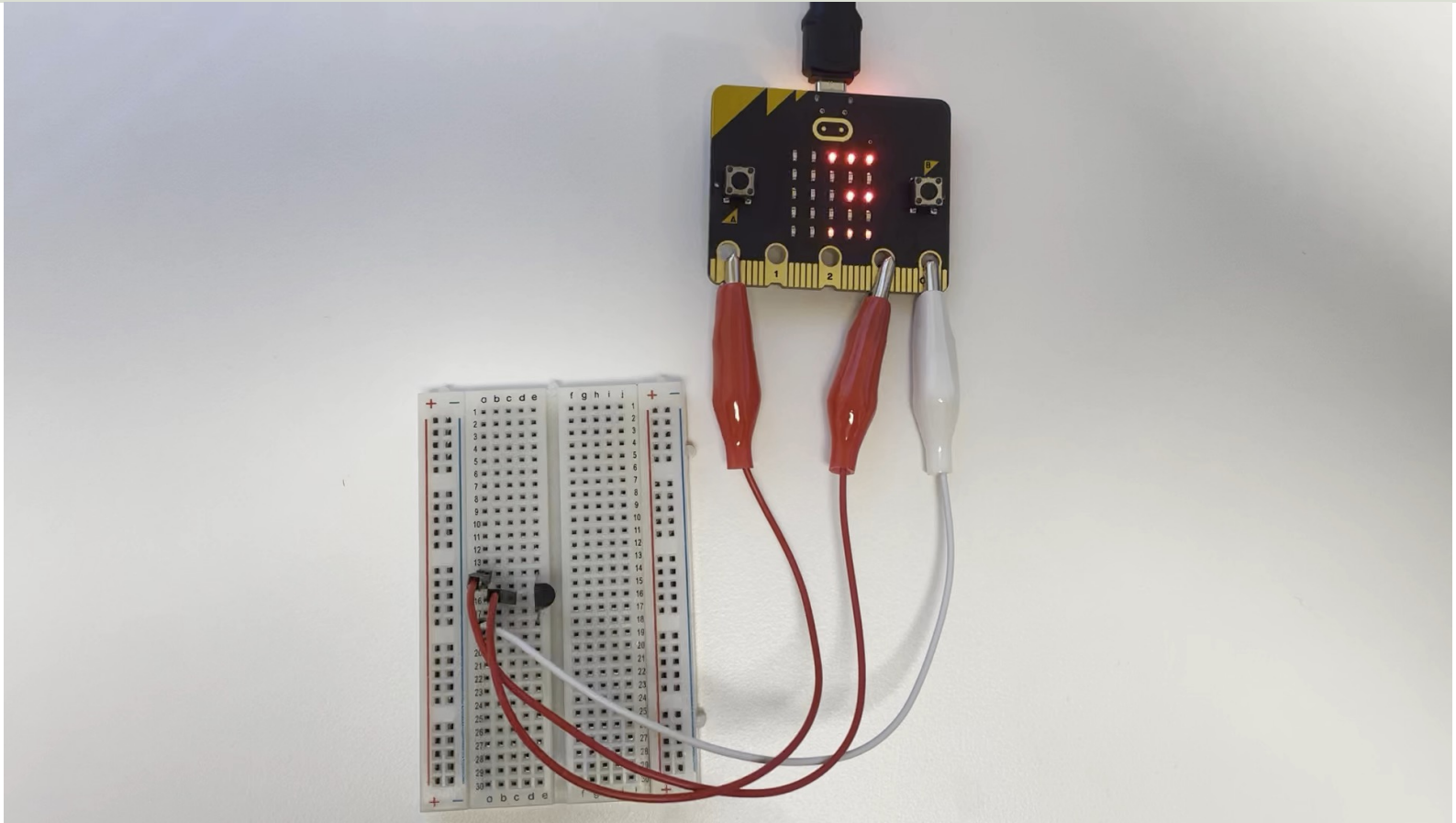
We can find a and b using the following known formula:

$$y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$$

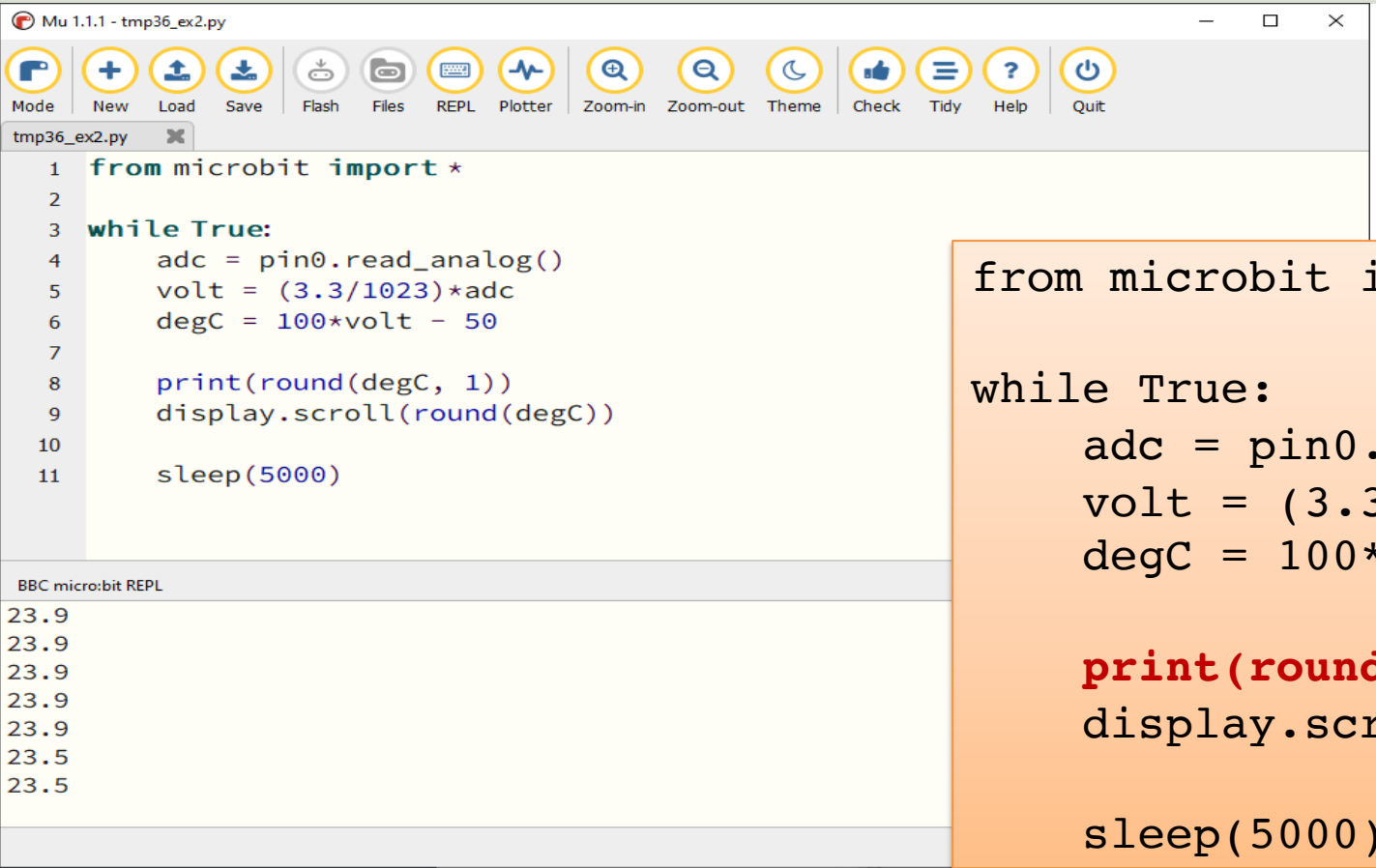
Python

```
from microbit import *

while True:
    adc = pin0.read_analog()
    volt = (3.3/1023)*adc
    degC = 100*volt – 50
    display.scroll(round(degC))
    sleep(5000)
```

Results

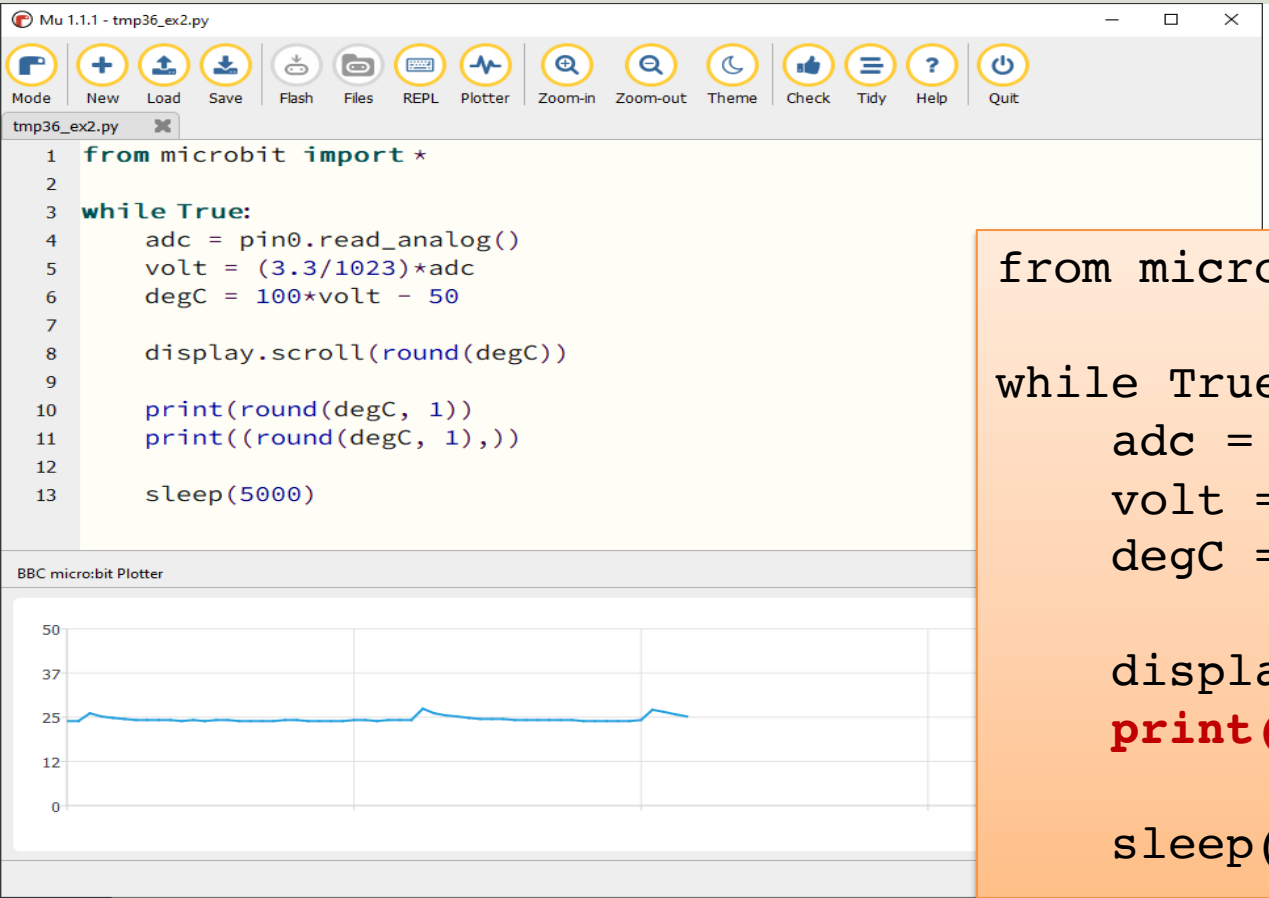


Printing to REPL




```
from microbit import *

while True:
    adc = pin0.read_analog()
    volt = (3.3/1023)*adc
    degC = 100*volt - 50

    print(round(degC, 1))
    display.scroll(round(degC))

    sleep(5000)
```

Plotting




```
from microbit import *

while True:
    adc = pin0.read_analog()
    volt = (3.3/1023)*adc
    degC = 100*volt - 50

    display.scroll(round(degC))
    print((round(degC, 1),))

    sleep(5000)
```

Data Logging

Hans-Petter Halvorsen

Table of Contents

Data Logging

It is possible to Log Data from different Sensors, etc. to a Text File that is stored on the micro:bit device

Main Functions:

Replace x, y, etc. with the name you will use

```
log.set_labels('x', 'z', 'z')
```

```
log.delete()
```

```
log.add({
        'x': datax,
        'y': datay,
        'z': dataz
    })
```

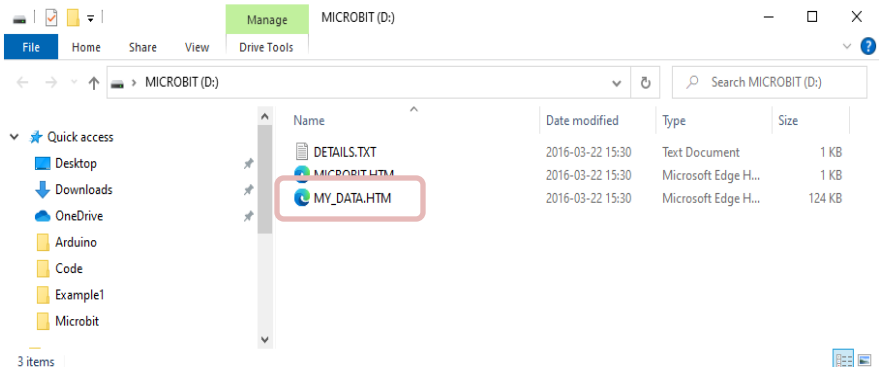
You can also choose mirror the data logging to the serial output (REPL):

```
log.set_mirroring(True)
```

https://microbit.org/get-started/user-guide/data-logging/

Data Logging

- The micro:bit can log sensor data to a file on the micro:bit.
- After logging your data, plug the micro:bit into a computer and open **MY_DATA.HTM** on the MICROBIT drive to view your data in a web browser
- You can also download it as a CSV file for use in a spreadsheet like Excel, etc.



Python

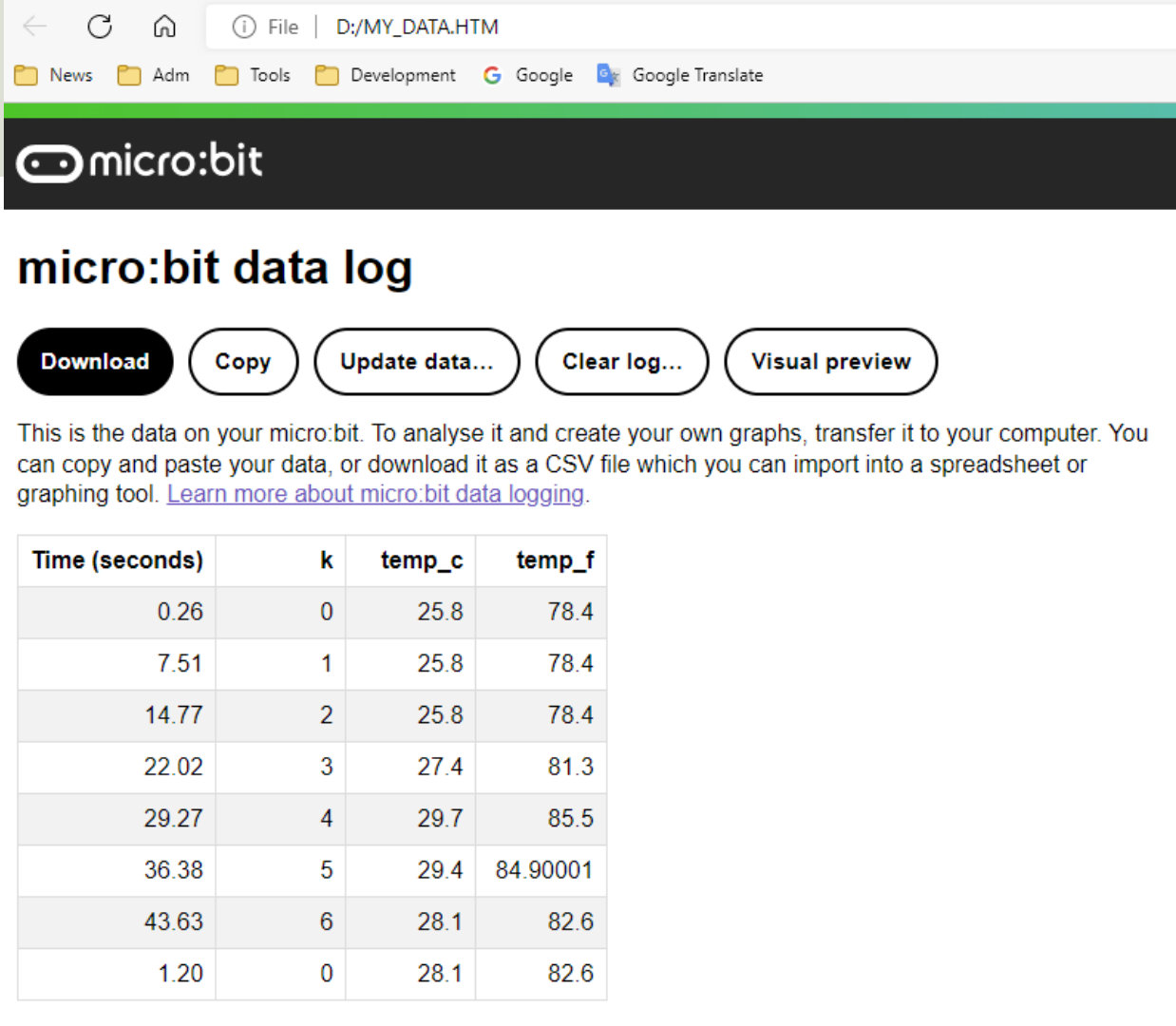
```
from microbit import *
import log

log.set_labels('k', 'temp_c', 'temp_f')
```

```
def tempTmp36():
    adc = pin0.read_analog()
    volt = (3.3/1023)*adc
    degC = 100*volt - 50

    degC = round(degC, 1)

    return degC

def c2f(Tc):
    Tf = (Tc*9/5) + 32
    Tf = round(Tf, 1)
    return Tf

def saveData(temp):
    fahr = c2f(temp)
    log.add({
        'k': k,
        'temp_c': temp,
        'temp_f': fahr
    })
```

```
while True:
    degC = tempTmp36()
    saveData(degC)

    display.scroll(round(degC))
    print(round(degC, 1))
    k = k + 1
    sleep(5000)
```

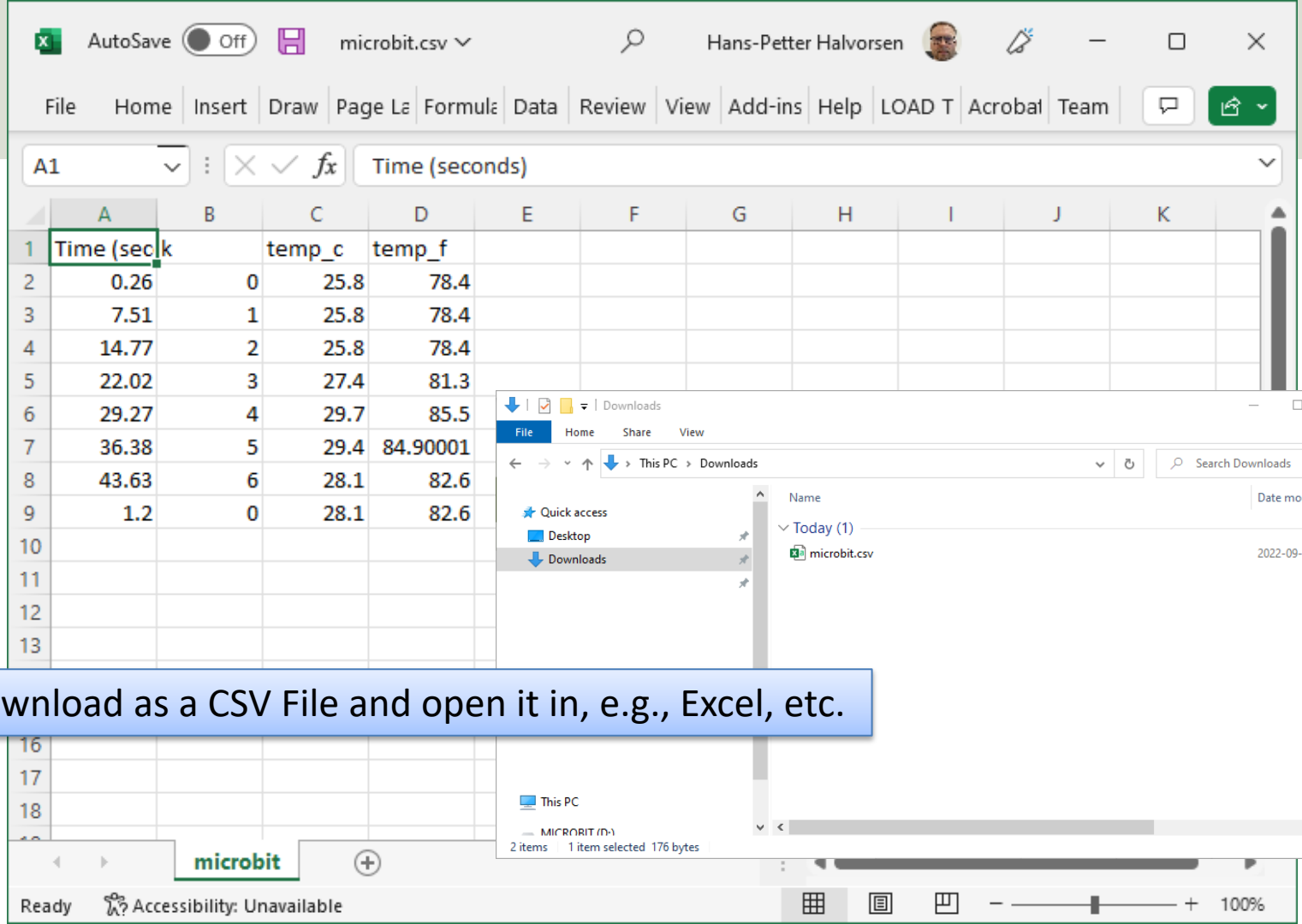
Data

The Data are stored in a File **MY_DATA.HTM**



Time (seconds)	k	temp_c	temp_f
0.26	0	25.8	78.4
7.51	1	25.8	78.4
14.77	2	25.8	78.4
22.02	3	27.4	81.3
29.27	4	29.7	85.5
36.38	5	29.4	84.90001
43.63	6	28.1	82.6
1.20	0	28.1	82.6

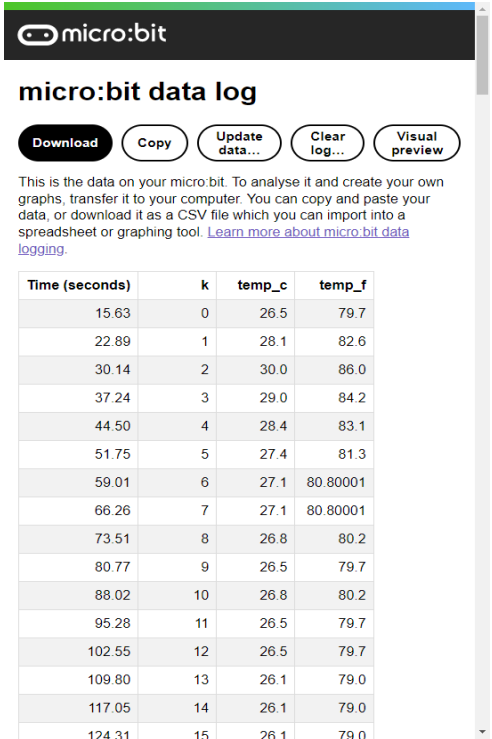
CSV



You cab download as a CSV File and open it in, e.g., Excel, etc.

Improved Ex.

Here, the Logging starts when pushing the “Button A” on the micro:bit


micro:bit

micro:bit data log

Download | Copy | Update data... | Clear log... | Visual preview

This is the data on your micro:bit. To analyse it and create your own graphs, transfer it to your computer. You can copy and paste your data, or download it as a CSV file which you can import into a spreadsheet or graphing tool. Learn more about micro:bit data logging.

Time (seconds)	k	temp_c	temp_f
15.63	0	26.5	79.7
22.89	1	28.1	82.6
30.14	2	30.0	86.0
37.24	3	29.0	84.2
44.50	4	28.4	83.1
51.75	5	27.4	81.3
59.01	6	27.1	80.80001
66.26	7	27.1	80.80001
73.51	8	26.8	80.2
80.77	9	26.5	79.7
88.02	10	26.8	80.2
95.28	11	26.5	79.7
102.55	12	26.5	79.7
109.80	13	26.1	79.0
117.05	14	26.1	79.0
124.31	15	26.1	79.0

```
from microbit import *
import log

def tempTmp36():
    adc = pin0.read_analog()
    volt = (3.3/1023)*adc
    degC = 100*volt - 50

    degC = round(degC, 1)

    return degC

def c2f(Tc):
    Tf = (Tc*9/5) + 32
    Tf = round(Tf, 1)
    return Tf

def saveData(temp):
    fahr = c2f(temp)
    log.add({
        'k': k,
        'temp_c': temp,
        'temp_f': round(fahr,1)
    })

logging = False
display.scroll("Push A")
while True:
    if button_a.was_pressed(): # Start Logging when pressing Button A
        logging = True
        k = 0
        log.delete()
        log.set_labels('k', 'temp_c', 'temp_f')

    if logging:
        degC = tempTmp36()
        saveData(degC)

        display.scroll(round(degC))
        print(round(degC, 1))

        k = k + 1
    else:
       display.scroll("Push A")

    sleep(5000)
```

micro:bit Resources and References

- micro:bit Python User Guide
  https://microbit.org/get-started/user-guide/python/
- micro:bit MicroPython documentation
  https://microbit-micropython.readthedocs.io
- MicroPython: https://microbit-micropython.readthedocs.io/
- Learn micro:bit (Adafruit): https://learn.adafruit.com/bbc-micro-bit-lesson-number-0
- Online Python Editor: https://python.microbit.org
- Micro:bit Datalogging: https://microbit.org/get-started/user-guide/data-logging/

Hans-Petter Halvorsen

University of South-Eastern Norway

www.usn.no

E-mail: hans.p.halvorsen@usn.no

Web: https://www.halvorsen.blog