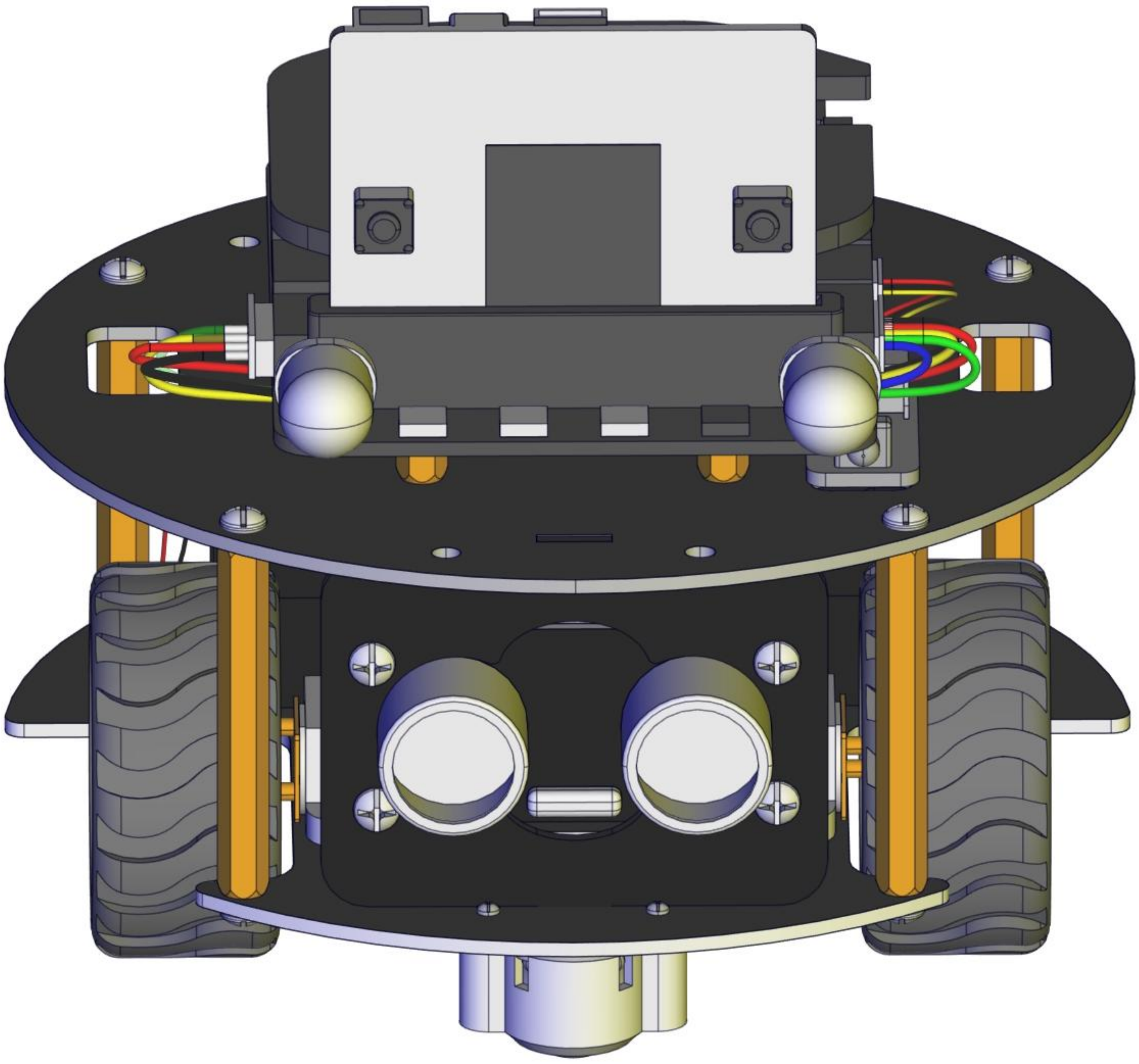
Keyestudio Micro：bit Mini Smart Tortoise Car



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1. Description

With the popularity of programming like Python, a large number of parents enrol their children in STEM lessons to stimulate their interest and creativity.

MicroPython is a tiny open source Python programming language interpretor that runs on small embedded development boards. With MicroPython you can write clean and simple Python code to control hardware instead of having to use complex low-level languages like C or C++ (what Arduino uses for programming).

To make you have a better understanding of Python, we provide test code and projects.

Launched by KEYES group, Keyestudio micro:bit smart car integrates obstacle avoidance, line tracking and IR and Bluetooth control. It is made up of DC geared motors, wheels , sensors and acrylic boards. In addition, it cooperates a passive buzzer with music play function, 4 pcs WS2812RGB LEDs and 2 pcs RGB lights.

We believe that your imagination and creativity can be stimulated through DIY smart car and acquire how to code through Makecode, a new method to program.

2. Specification

Connector port input: DC 6V---9V

Operating voltage of drive board system: 5V

Standard operating power consumption: about 2.2W

Maximum power: Maximum output power is 12W

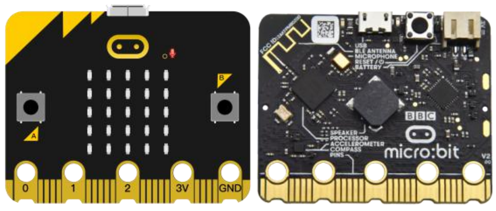
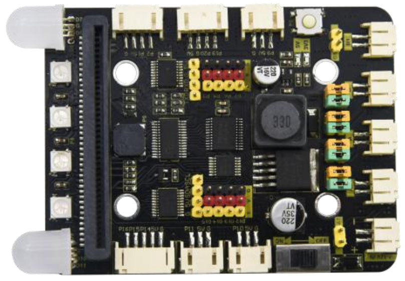
Motor speed: 100RPM/1min

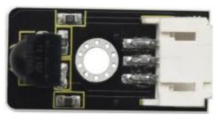
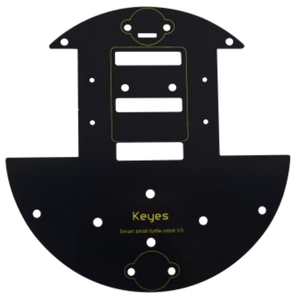
Working temperature range: 0-50℃

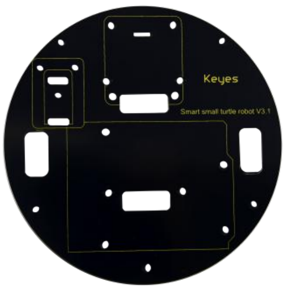
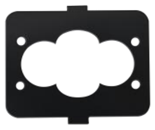
Size: 120*120*120mm

Environmental protection attributes: ROHS

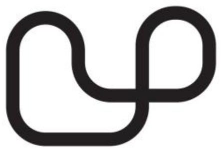
3. Kit

Components			
#	Model	QTY	Picture
0	Micro:bit main board **is Not Included** in KS4014 Kit		
0	Micro:bit main board is **Included** in KS4024 Kit	1	
1	Keyestudio Micro:bit Driver Shield	1	

2	Keyestudio Quick Connectors IR Receiver	1	
3	Keyestudio Quick Connectors Line Tracking Sensor	1	
4	Keyestudio Quick Connectors Ultrasonic Sensor	1	
5	Micro USB Cable AM/MK5P(micro)	1	
6	Keyestudio JMFP-4 17 Key	1	
1	Keyestudio Baseplate for Smart Small Turtle Robot V2.0	1	

2	Keyestudio Round Board	1	
3	Keyestudio Acrylic Top Board	1	
4	Micro:bit Fixed Mount	1	
5	Keyestudio Quick Connectors 12FN20 Motor A	1	
6	Keyestudio Quick Connectors 12FN20 Motor B	1	
7	N20 Motor White Mount	2	
8	Car Wheels	2	
9	Universal Wheel	2	
10	Dual head JST-PH2.0MM-5P	1	

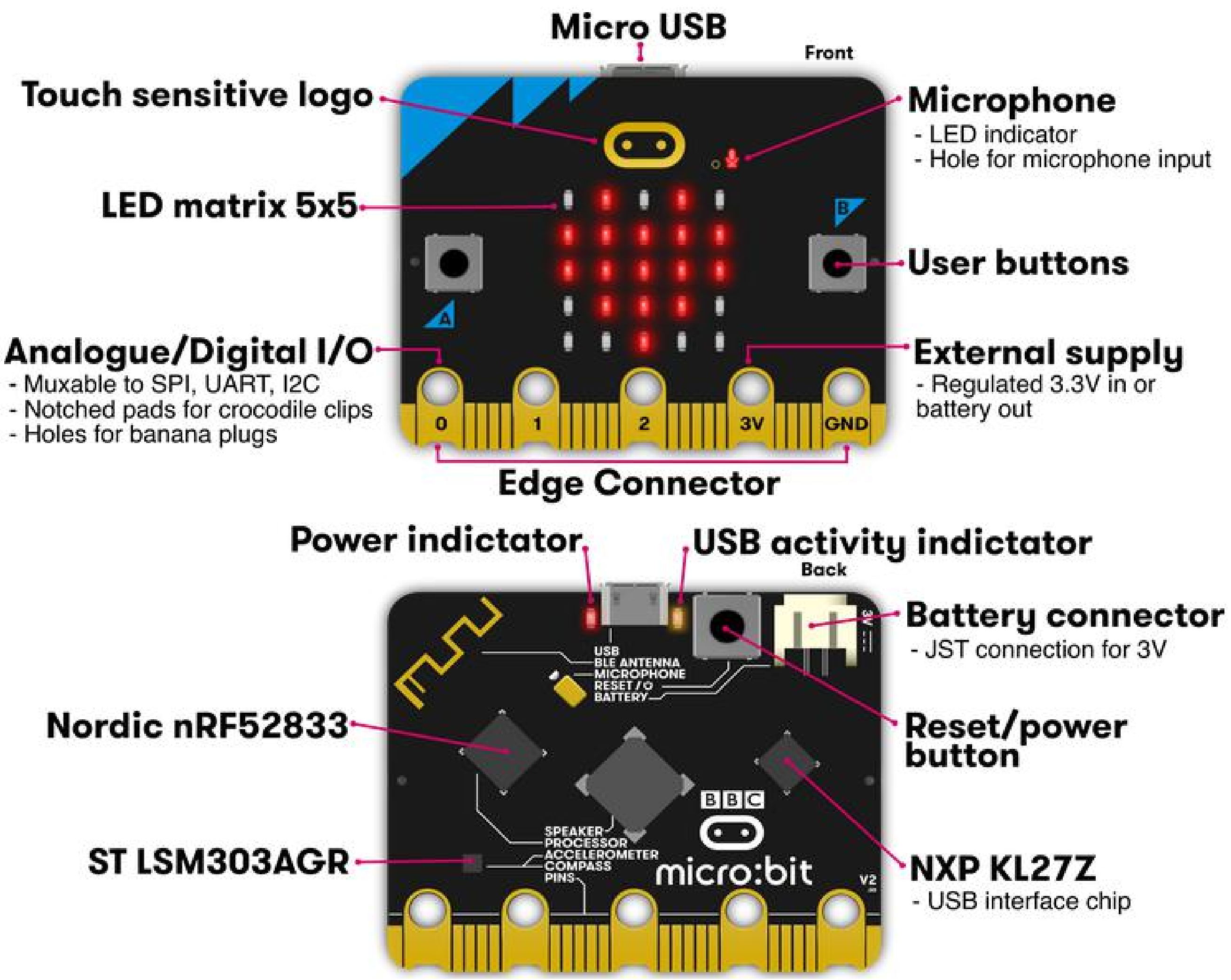
	Dupont Line		
11	Dual head JST-PH2.0MM-4P Dupont Line	1	
12	Dual head JST-PH2.0MM-3P Dupont Line	1	
13	Dual head JST-PH2.0MM-2P Dupont Line	2	
14	18650 2-Slot Battery Holder with 15cm Lead	1	
Nuts/Screws			
1	M2*12MM Round Head Screws	6	
2	M2 Nickel Plated Nuts	6	
3	M3*6MM Round Head Screws	20	

4	M3*8MM Round Head Screws	8	
5	M3*10MM Flat Head Screws	4	
6	M3 Nickel Plated Nuts	12	
7	M3*15+6MM Hex Copper Bush	4	
8	Dual-pass M3*12MM Hex Copper Bush	4	
9	Dual-pass M3*40MM Hex Copper Bush	4	
Tools			
1	3*40MM Screwdriver	1	
2	Map	1	
3	Black Ties 3*100MM	5	

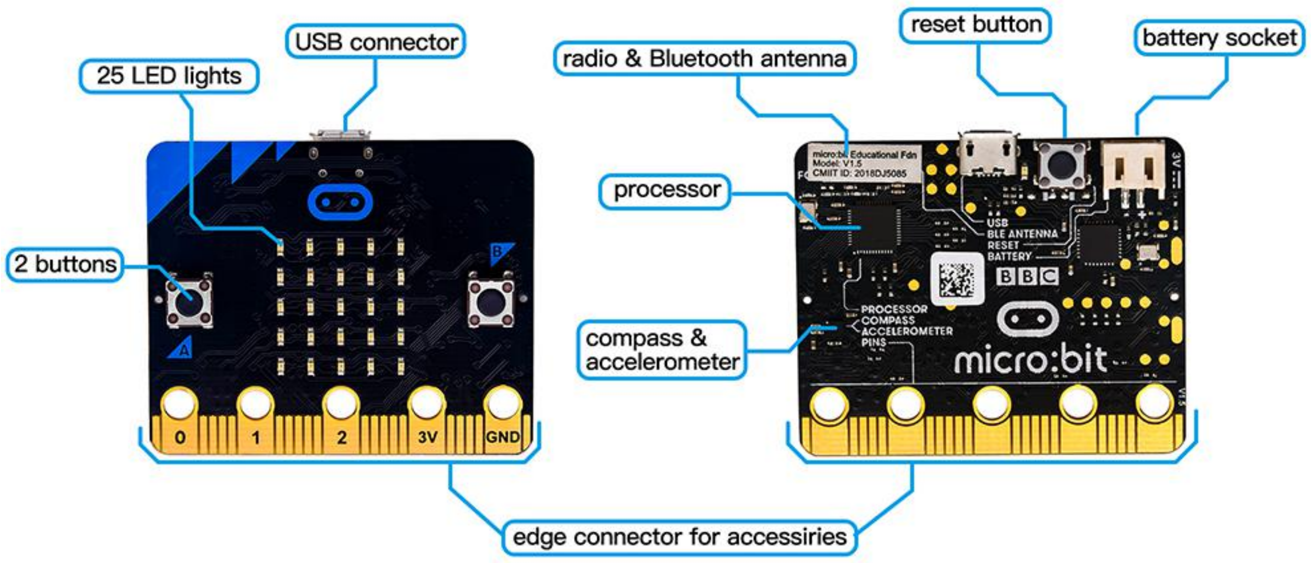
4	18650 Battery (not included)	2	

4. Micro:bit

4.1 Comparison between V2.0 & V1.5



Micro:bit main board V2.0



Micro:bit main board V1.5

More details:

	V1.5	V2
PROCESSOR	Nordic Semiconductor nRF51822	Nordic Semiconductor **nRF52833**
MEMORY	256KB Flash, 16KB RAM	**512KB** Flash, **128KB** RAM
INTERFACECHIP	NXP KL26Z, 16KB RAM	NXP **KL27Z, 32KB** RAM
MICROPHONE	N/A	**MEMS microphone and LED indicator**
SPEAKER	N/A	**On board speaker**
TOUCH	N/A	**Touch sensitive logo**
EDGE CONNECTOR	25pins,PWM,I2C,SPI and Extension interface. 3 ring pins for connectin crocodile clips/banana plugs.	
	3 dedicated GPIO	**4 dedicated GPIO Notched for easier connection**
I2C	Shared (mux) I2C bus	**Dedicated I2C bus**
WIRELESS	2.4GHz Radio/BLE Blutooth 4.0	2.4GHz Radio/BLE **Blutooth 5.0**
POWER	Micro USB 5V power supply, 3V port or battery power supply	Micro USB 5V power supply, 3V port or battery power supply **LED Indicator, Power off (push and hold power button)**
CURRENT AVAILABLE	90mA	**200mA**
MOTION SENSOR	ST LSM 303	
PROGRAMMING SOFTWARE	C++, Makecode, Python, Scratch	
SIZE	5cm(W) x 4cm(H)	

For the Micro: Bit main board V2, pressing the Reset & Power button , it will reset the Micro: Bit and rerun the program.If you hold it tight, the red LED will slowly get darker.When the power indicator becomes darker, releasing the button and your Micro: Bit board will enter sleep mode for power saving .This will make your battery more durable. And you could press this button again to ‘wake up’ your Micro:bit.

For more information,please resort to following links：

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

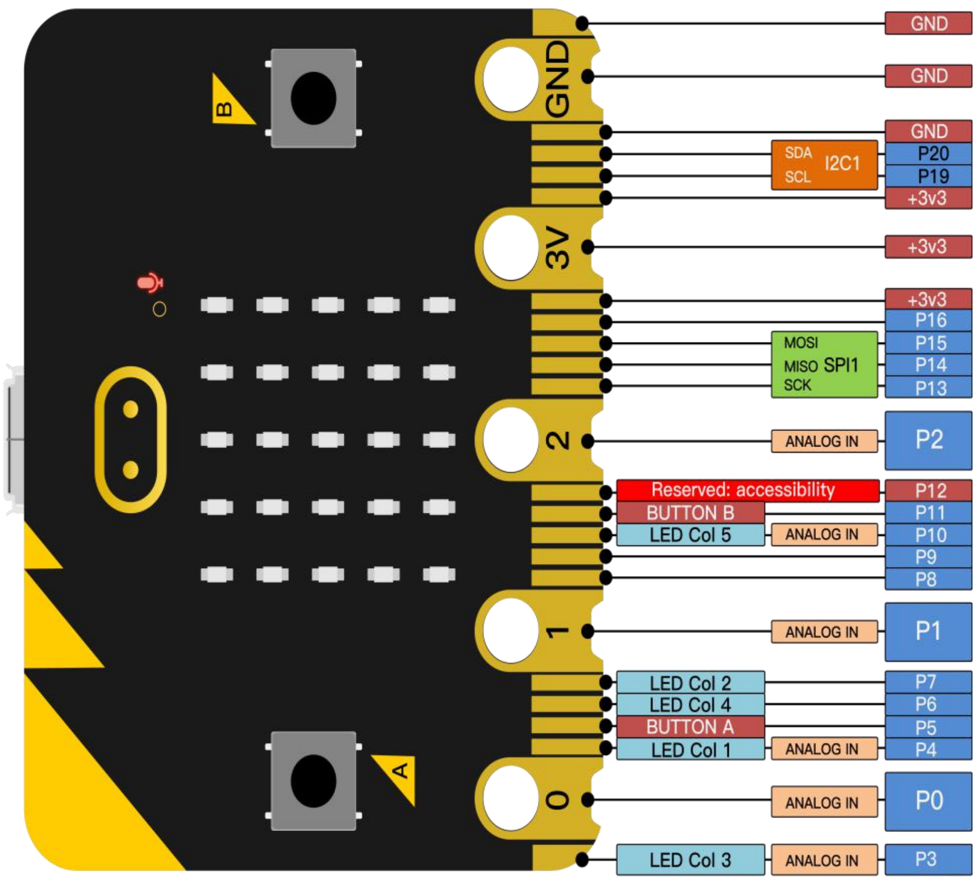
https://microbit.org/new-microbit/

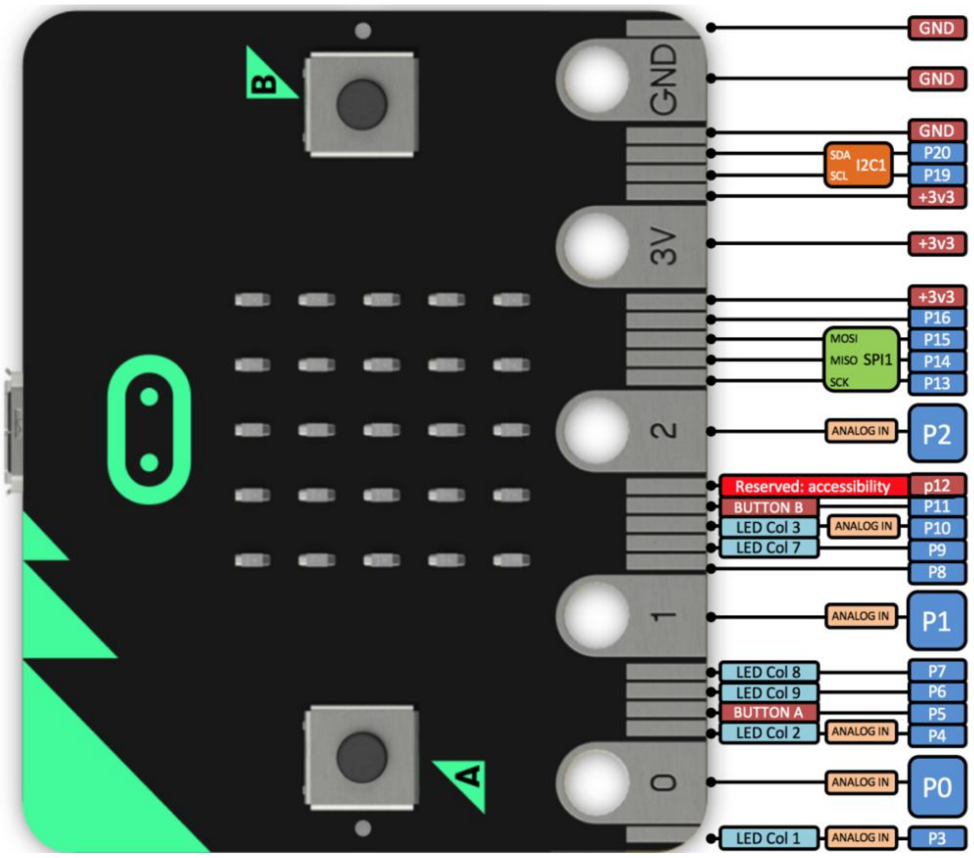
https://www.microbit.org/get-started/user-guide/overview/

https://microbit.org/get-started/user-guide/features-in-depth/

4.2 Pinout

Micro:bit main board V2.0 VS V1.5


GND
GND
GND
SDA
SCL
I2C1
P20
P19
+3v3
3V
+3v3
+3v3
P16
MOSI
MISO SPI1
SCK
P15
P14
P13
2
ANALOG IN
P2
Reserved: accessibility
P12
BUTTON B
P11
LED Col 5
ANALOG IN
P10
P9
P8
1
ANALOG IN
P1
LED Col 2
P7
LED Col 4
P6
BUTTON A
P5
LED Col 1
ANALOG IN
P4
0
ANALOG IN
P0
LED Col 3
ANALOG IN
P3
A
B


GND
GND
GND
SDA
SCL
I2C1
P20
P19
+3v3
3V
+3v3
+3v3
P16
MOSI
MISO SPI1
SCK
P15
P14
P13
2
ANALOG IN
P2
Reserved: accessibility
p12
BUTTON B
P11
LED Col 3
ANALOG IN
P10
LED Col 7
P9
P8
1
ANALOG IN
P1
LED Col 8
P7
LED Col 9
P6
BUTTON A
P5
LED Col 2
ANALOG IN
P4
0
ANALOG IN
P0
LED Col 1
ANALOG IN
P3
A
B

Browse the official website for more details:

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

https://microbit.org/guide/hardware/pins/

4.3 Notes for the application of Micro:bit main board V2.0

a. it is recommended to cover it with a silicone protector to prevent short circuit for it has a lot of sophisticated electronic components.

b. its IO port is very weak in driving since it can merely handle current less than 300mA. Therefore, do not connect it with devices operating in large current,such as servo MG995 and DC motor or it will get burnt. Furthermore, you must figure out the current requirements of the devices before you use them and it is generally recommended to use the board together with a Micro:bit shield.

c. It is recommended to power the main board via the USB interface or via the battery of 3V. The IO port of this board is 3V, so it does not support sensors of 5V. If you need to connect sensors of 5 V, a Micro: Bit expansion board is required.

d.When using pins(P3, P4, P6, P7, P10)shared with the LED dot matrix, blocking them from the matrix or the LEDs may display randomly and the data about sensors maybe wrong.

e.The battery port of 3V cannot be connected with battery more than 3.3V or the main board will be damaged.

f. Forbid to use it on metal products to avoid short circuit.

To put it simple, Micro:bit V2 main board is like a micro computer which has made programming at our fingertips and enhanced digital innovation. And about programming environment, BBC provides a website: https://microbit.org/code/, which has a graphical MakeCode program easy for use.

5. Install Micro:bit Driver

If you have downloaded micro:bit driver, then no need to download it again.

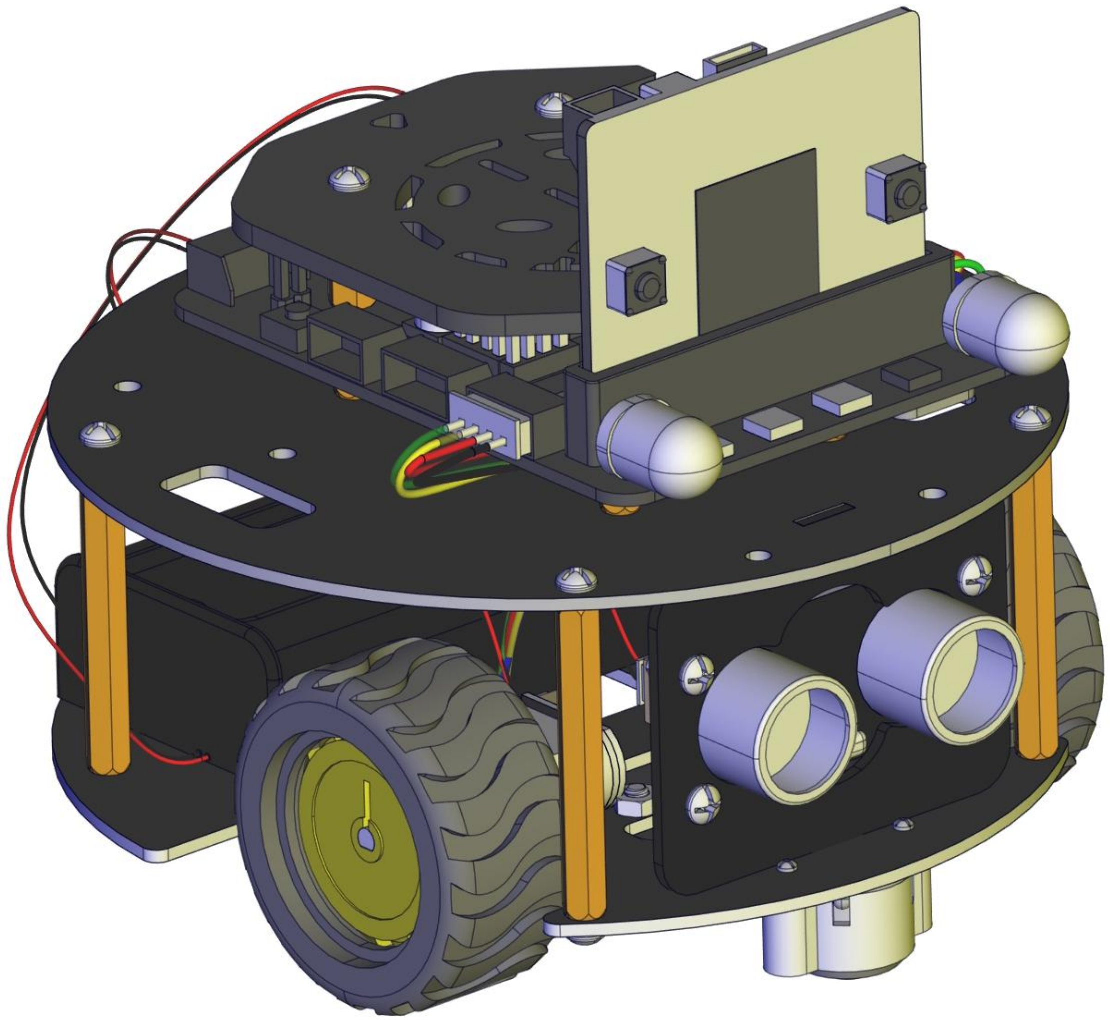
If it is you first time to use micro:bit main board, then you will have to download the driver.

You have to install the driver of micro:bit if it' s your first time to use micro:bit.

Download link: https://fs.keyestudio.com/KS4014Driver

You could download driver file (mbed_usb_2020_x64_1212.exe) in the 2. Install Microbit Driver folder.

6. Keyestudio Micro:bit Mini Smart Turtle Car



Connection of Micro:bit and Turtle Smart Car

Pins of Micro:bit	Components of Keyestudio micro:bit Robot Car
P0	Passive Buzzer
P1	Trig （T) of ultrasonic sensor

P2	Echo（E）of ultrasonic sensor
P8	4 pcs WS2812RGB
P11	IR Receiver
P14	Left TCRT5000 IR tubes of line tracking sensor
P15	Middle TCRT5000 IR tubes of line tracking sensor
P16	Right TCRT5000 IR tubes of line tracking sensor

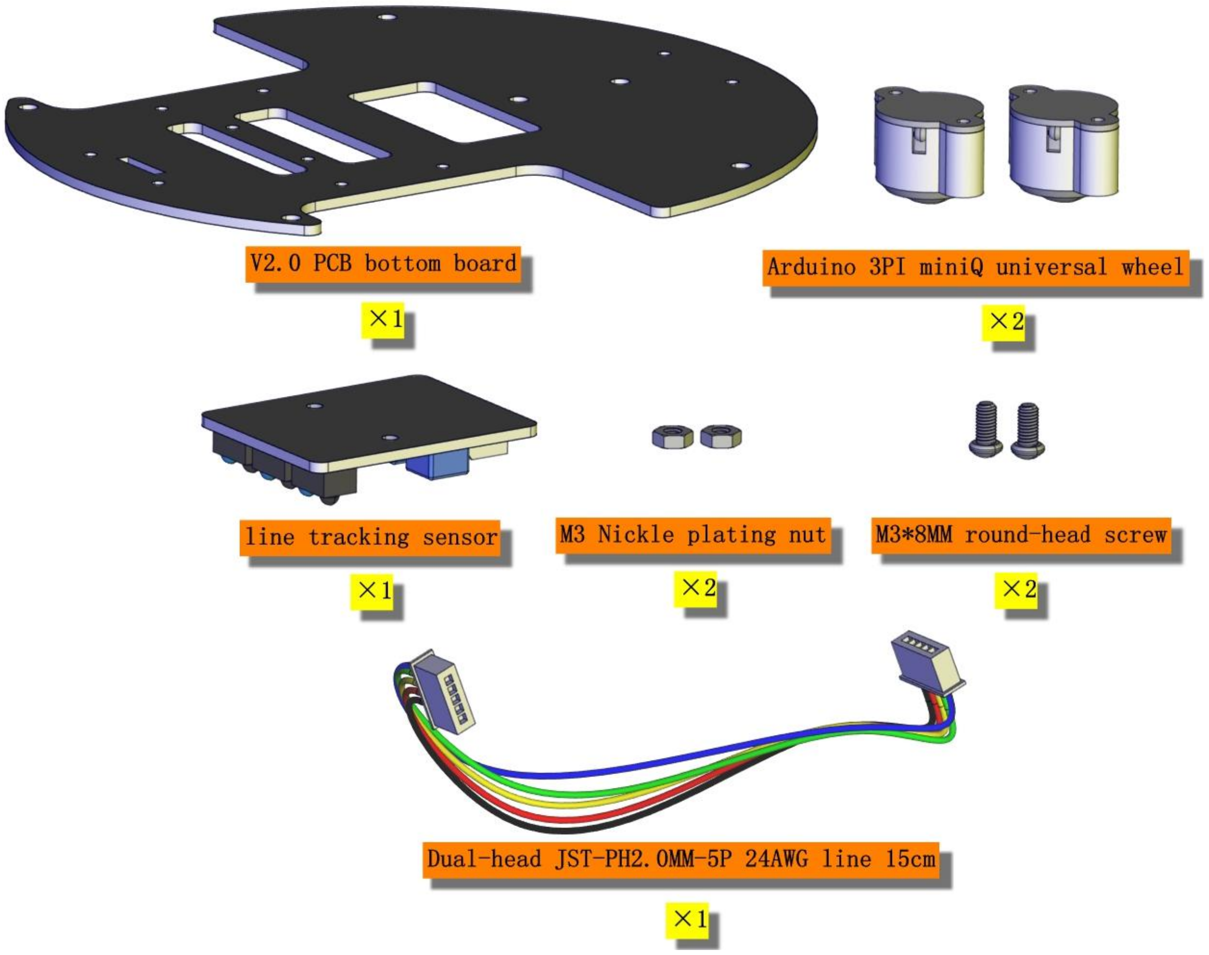
Supply Power

This smart car is powered by 2pcs 18650 batteries. And battery holder is chargeable.

Note: battery is not included.

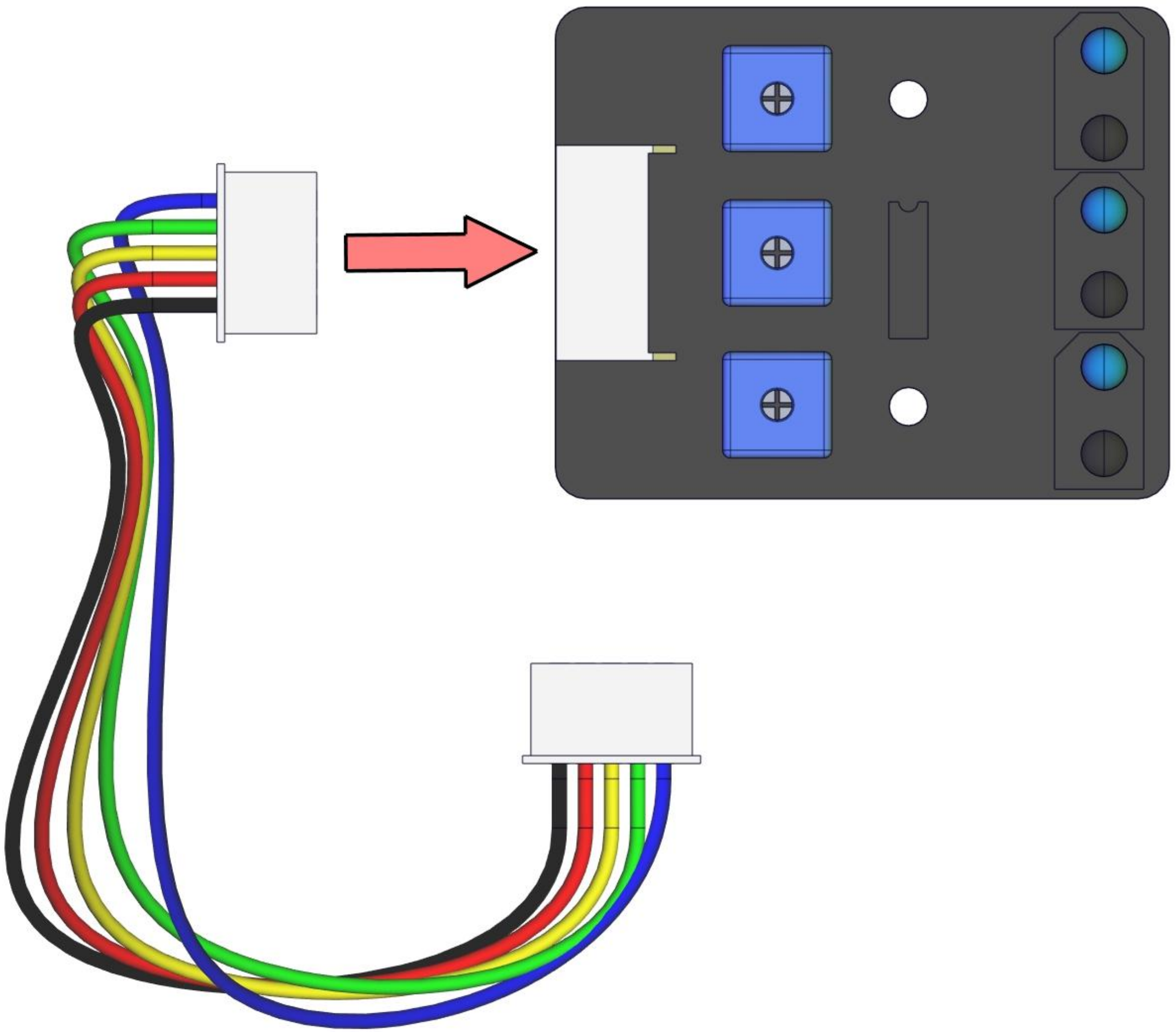
6.1 Install Micro:bit Mini Turtle Smart Car

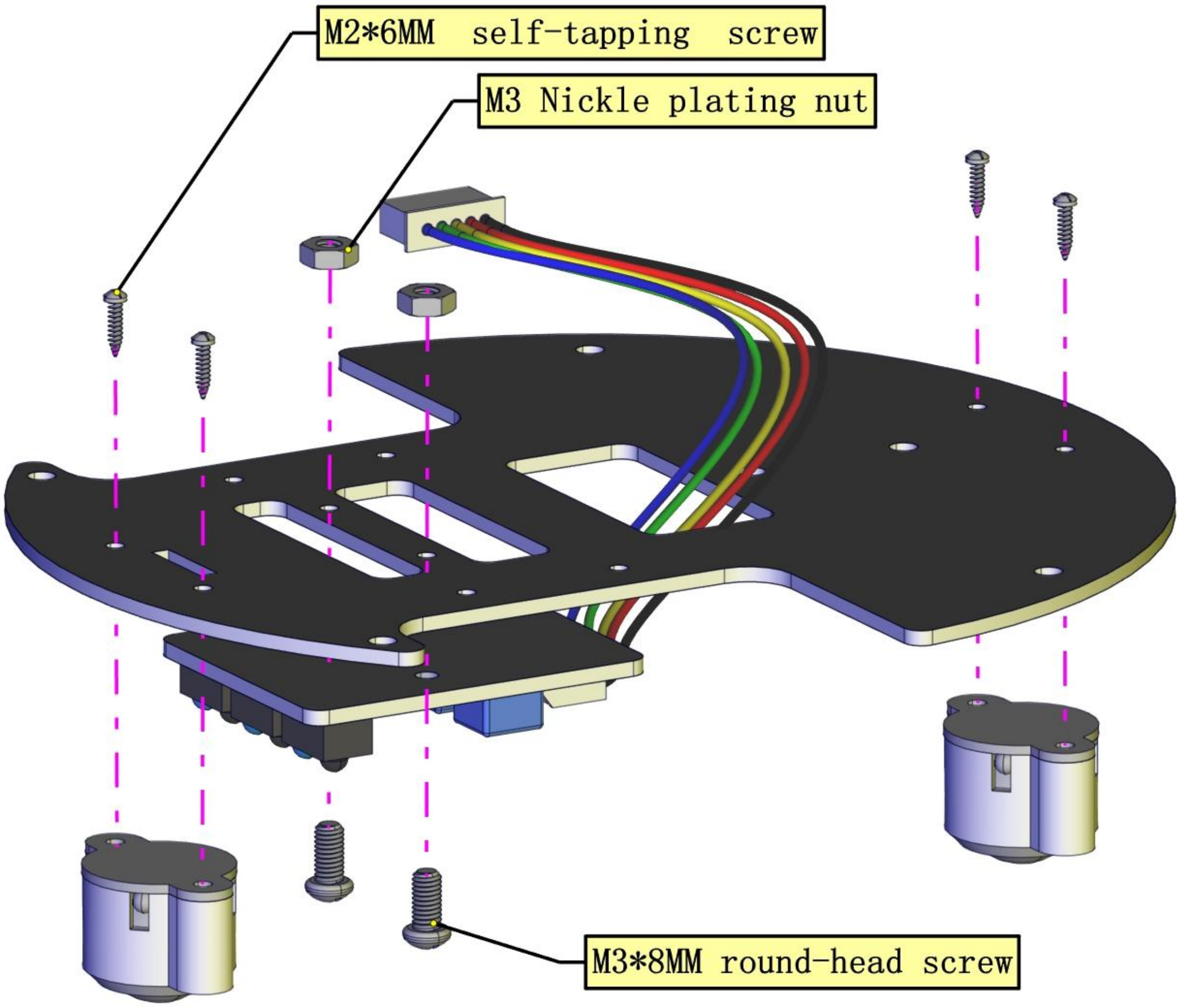
1. Install baseplate and line tracking sensor

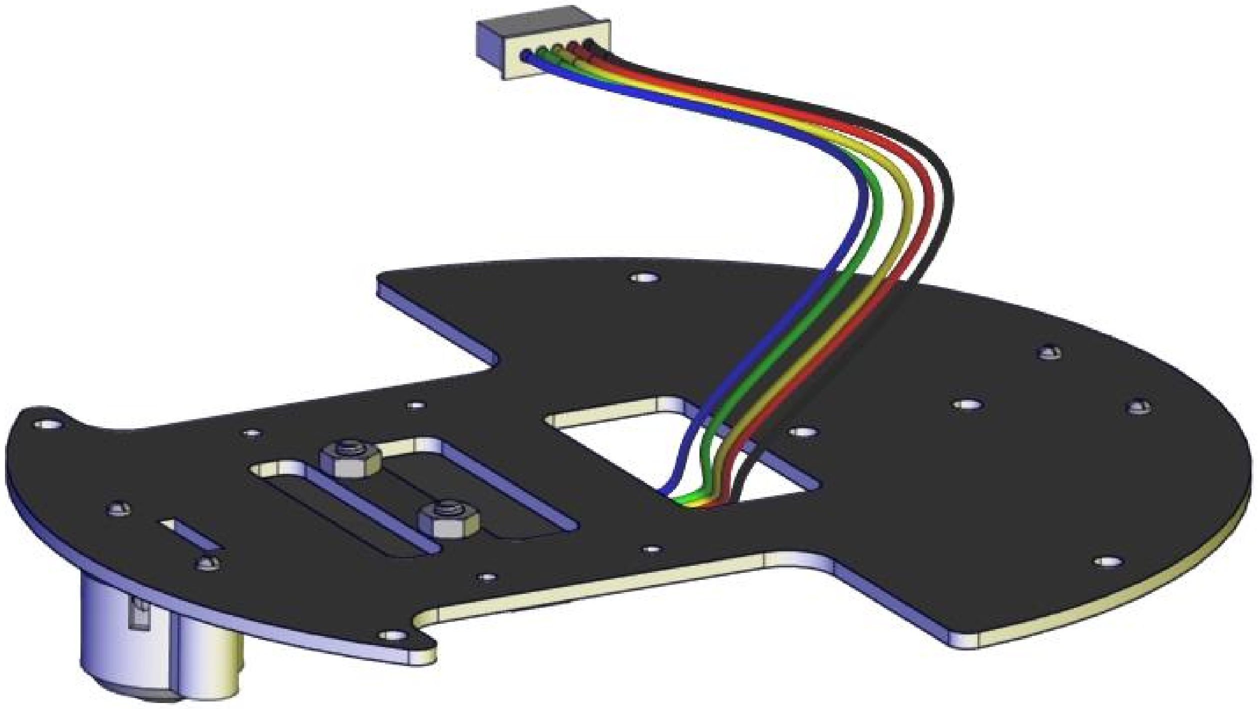


Note: we screw out the two self-locking screws first, and install universal wheel on V2.0 baseplate with these screws(don’ t screw too tightly)

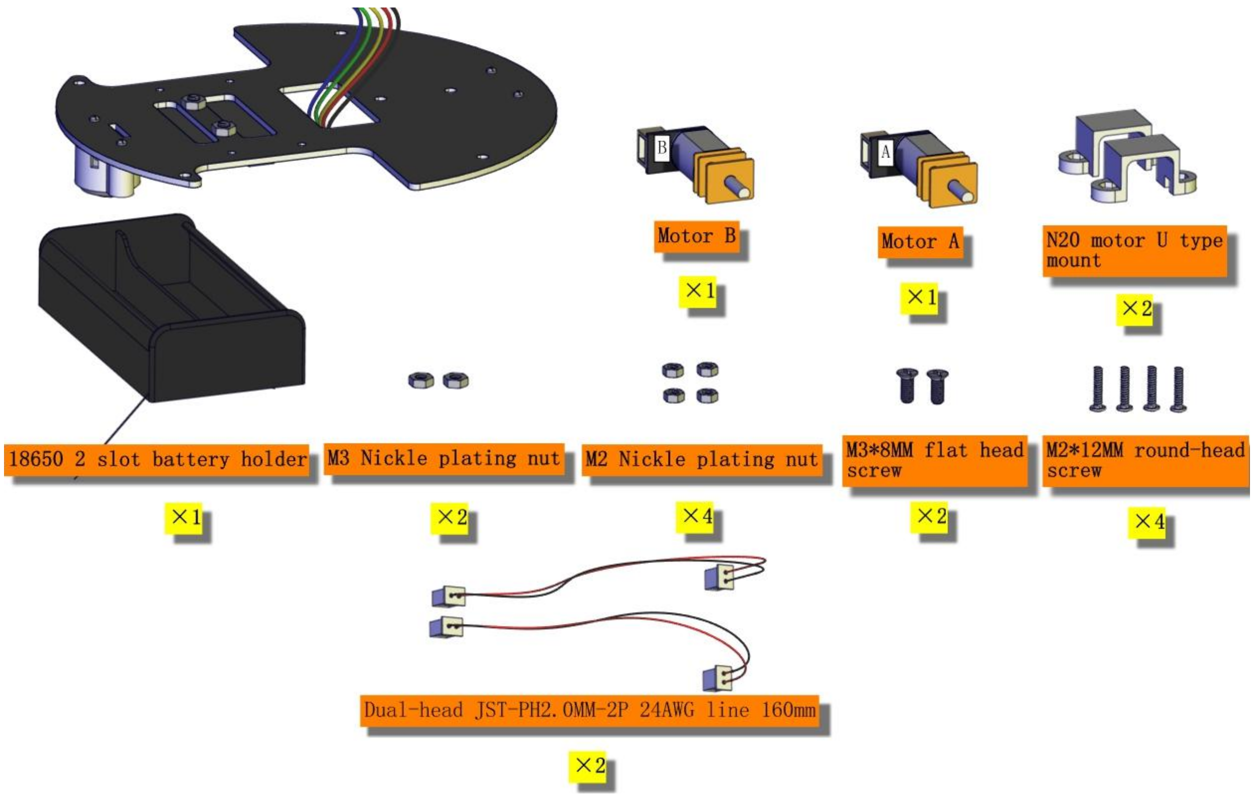
Make the side printed “Keyes” downward.

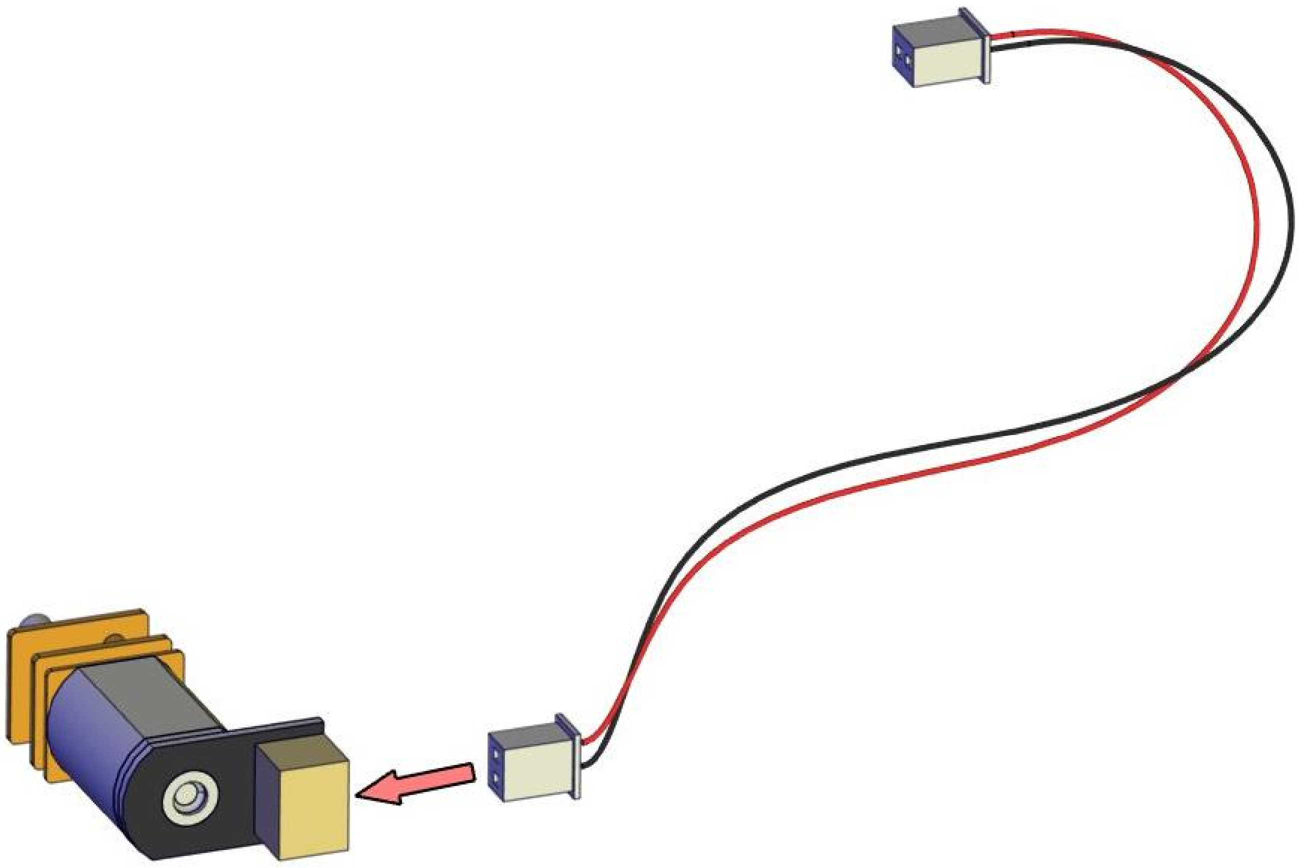


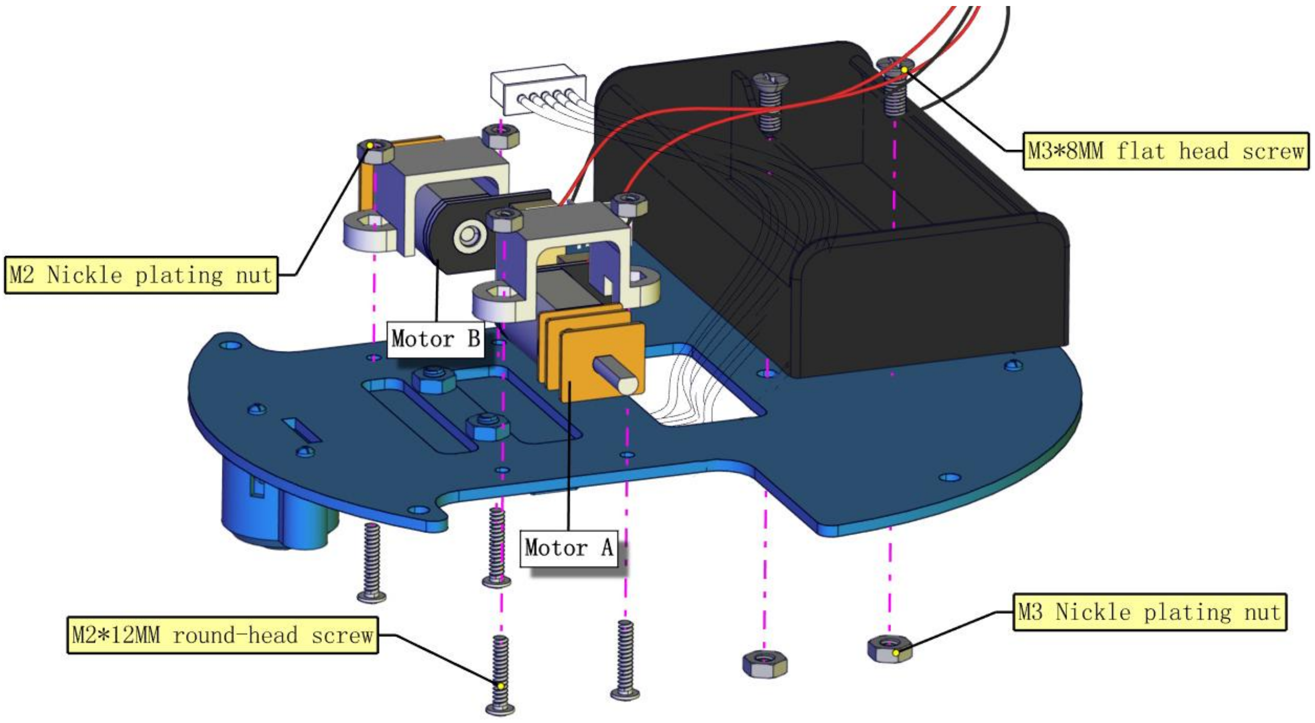

M2*6MM self-tapping screw
M3 Nickle plating nut
M3*8MM round-head screw

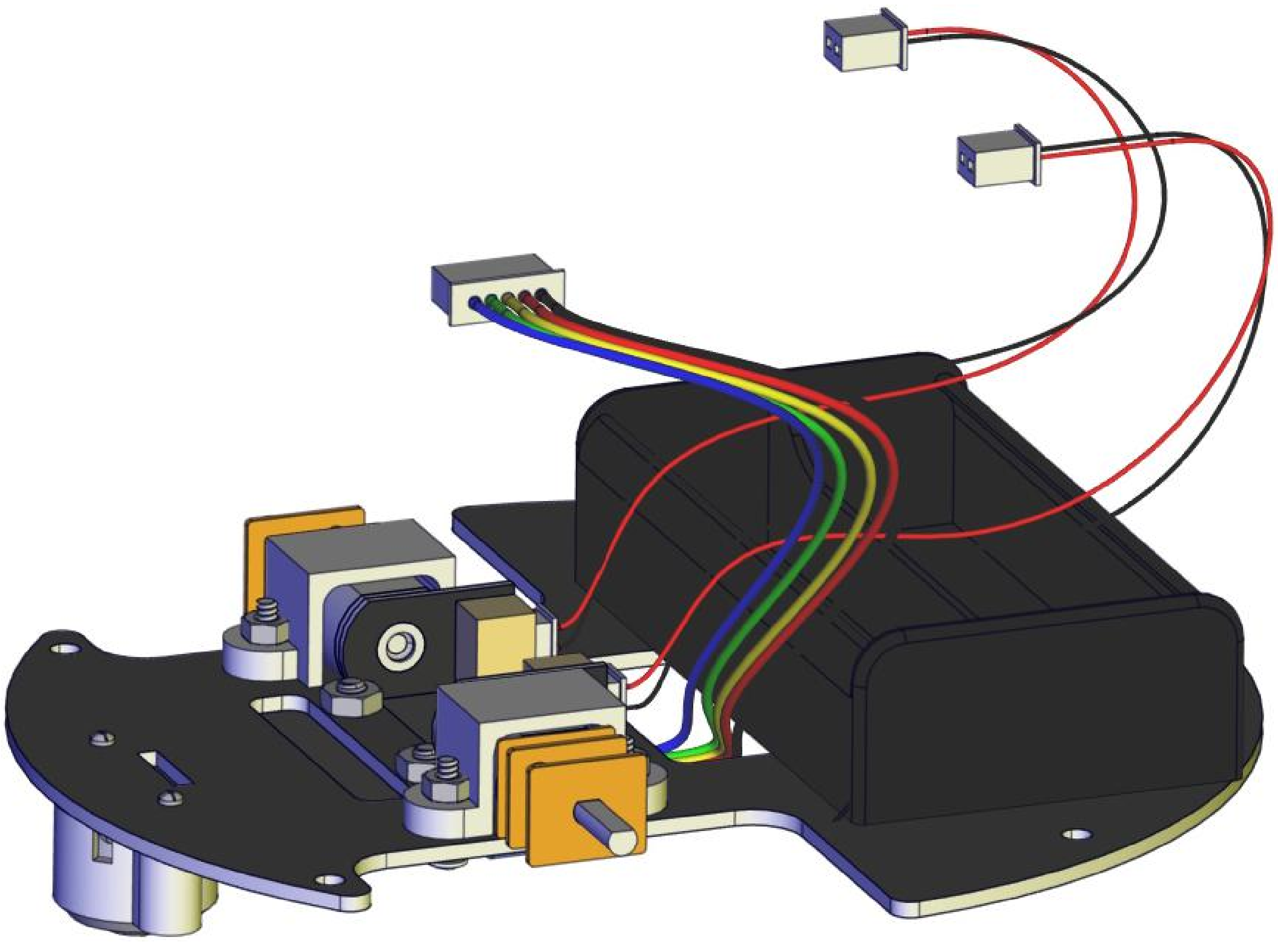


1. Mount Motor and Battery Holder

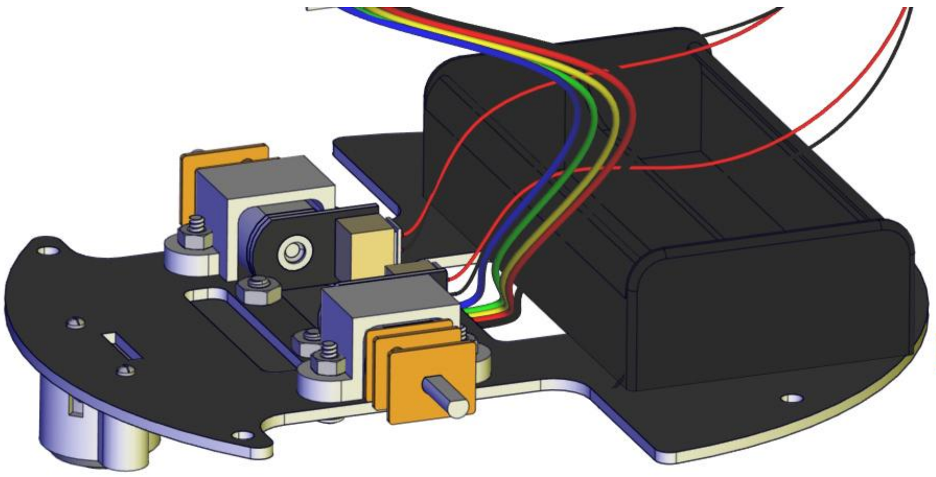





M3*8MM flat head screw
M2 Nickle plating nut
Motor B
Motor A
M3 Nickle plating nut
M2*12MM round-head screw

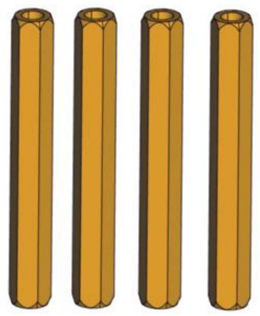


3. Assemble Car Wheels and Dual-pass Hex Copper Bushes



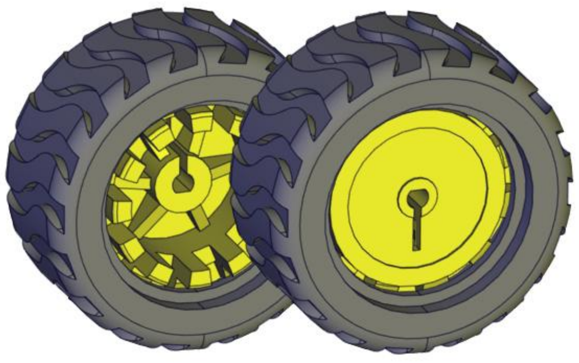
M3*6MM round-head screw

×4



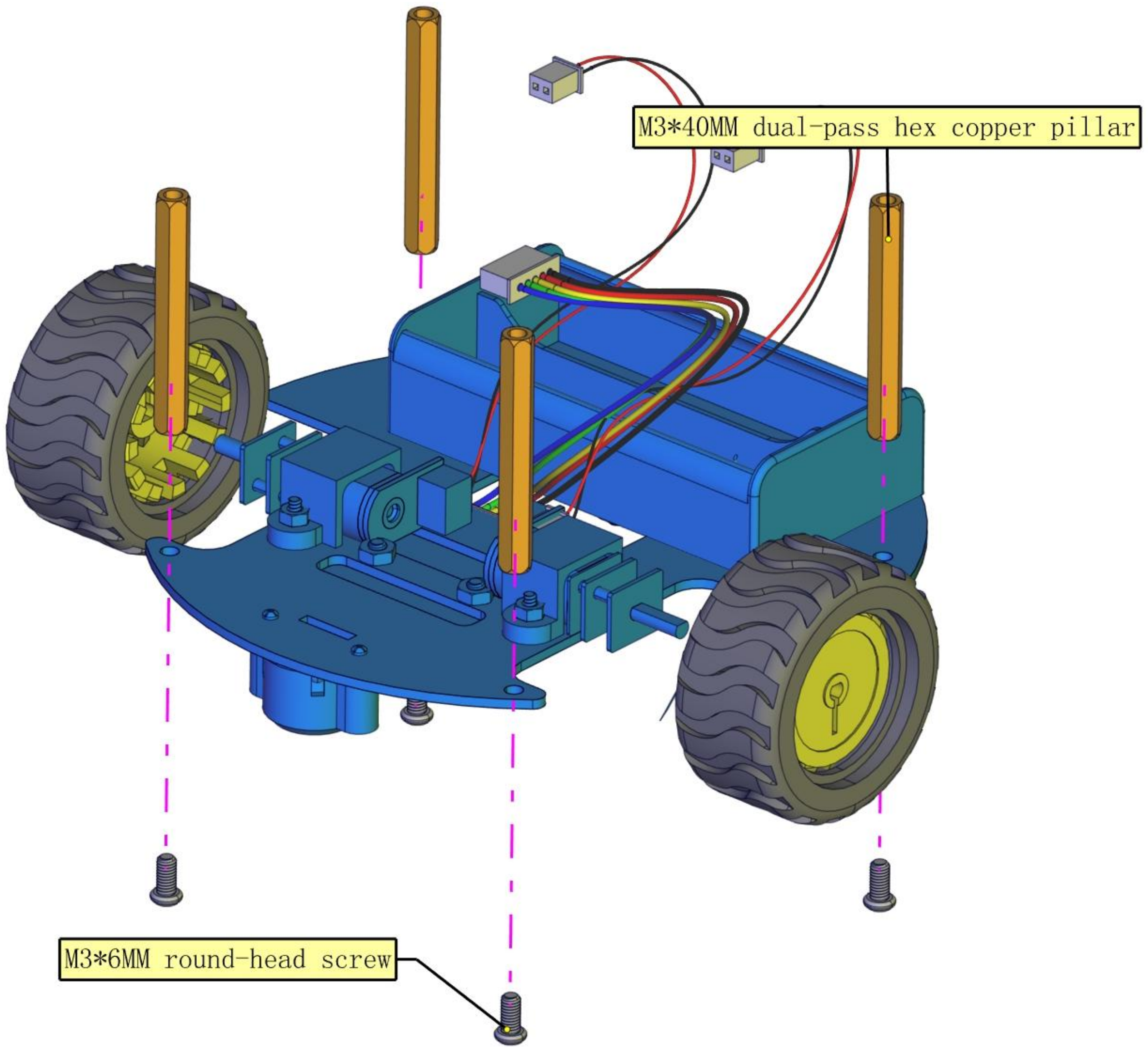
M3*40MM dual-pass hex copper pillar

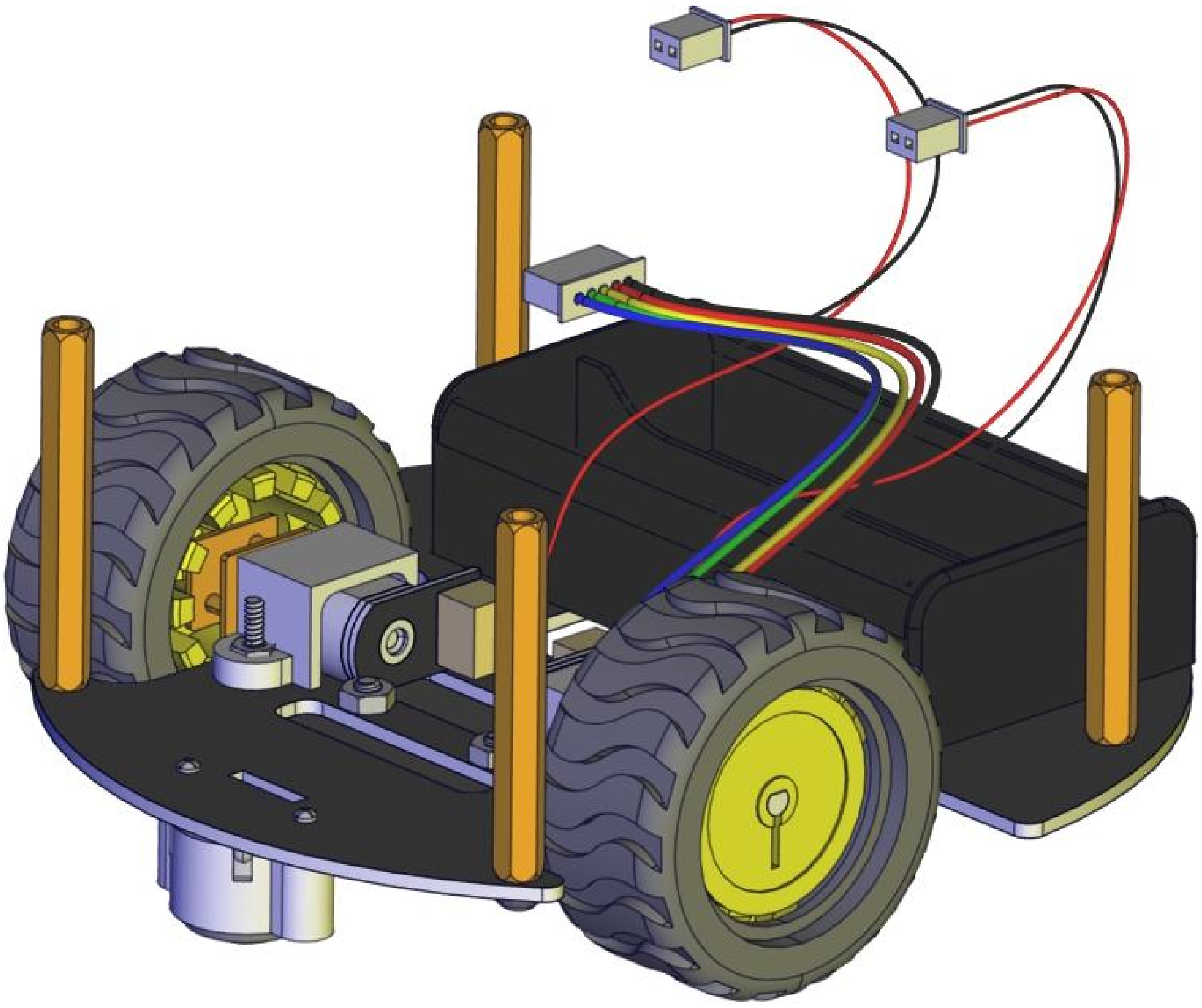
×4



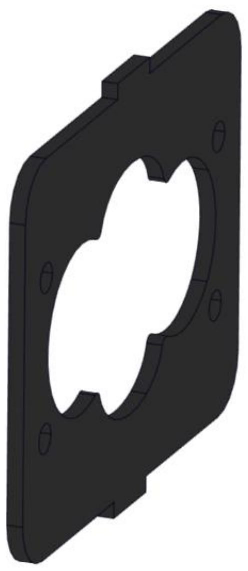
N20 motor special wheel

×2

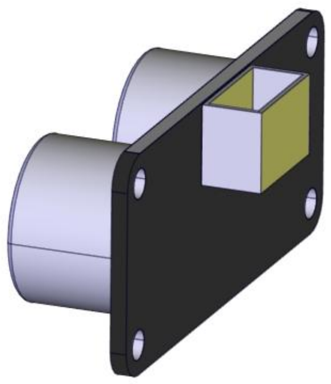

M3*40MM dual-pass hex copper pillar
M3*6MM round-head screw



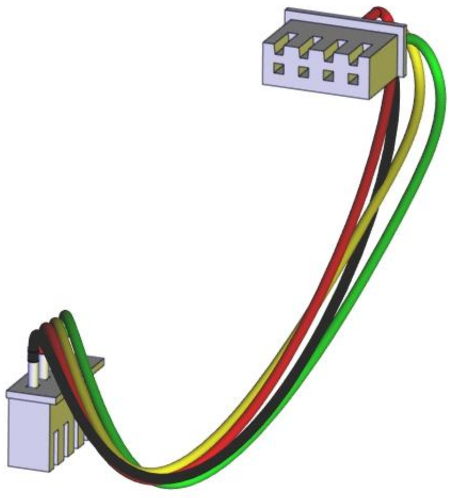
2. Install Ultrasonic Sensor


Ultrasonic fixed mount

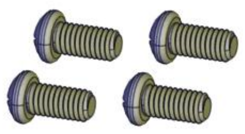
×1


ultrasonic module

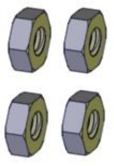
×1


Dual-head JST-PH2.0MM-4P 24AWG line 8cm

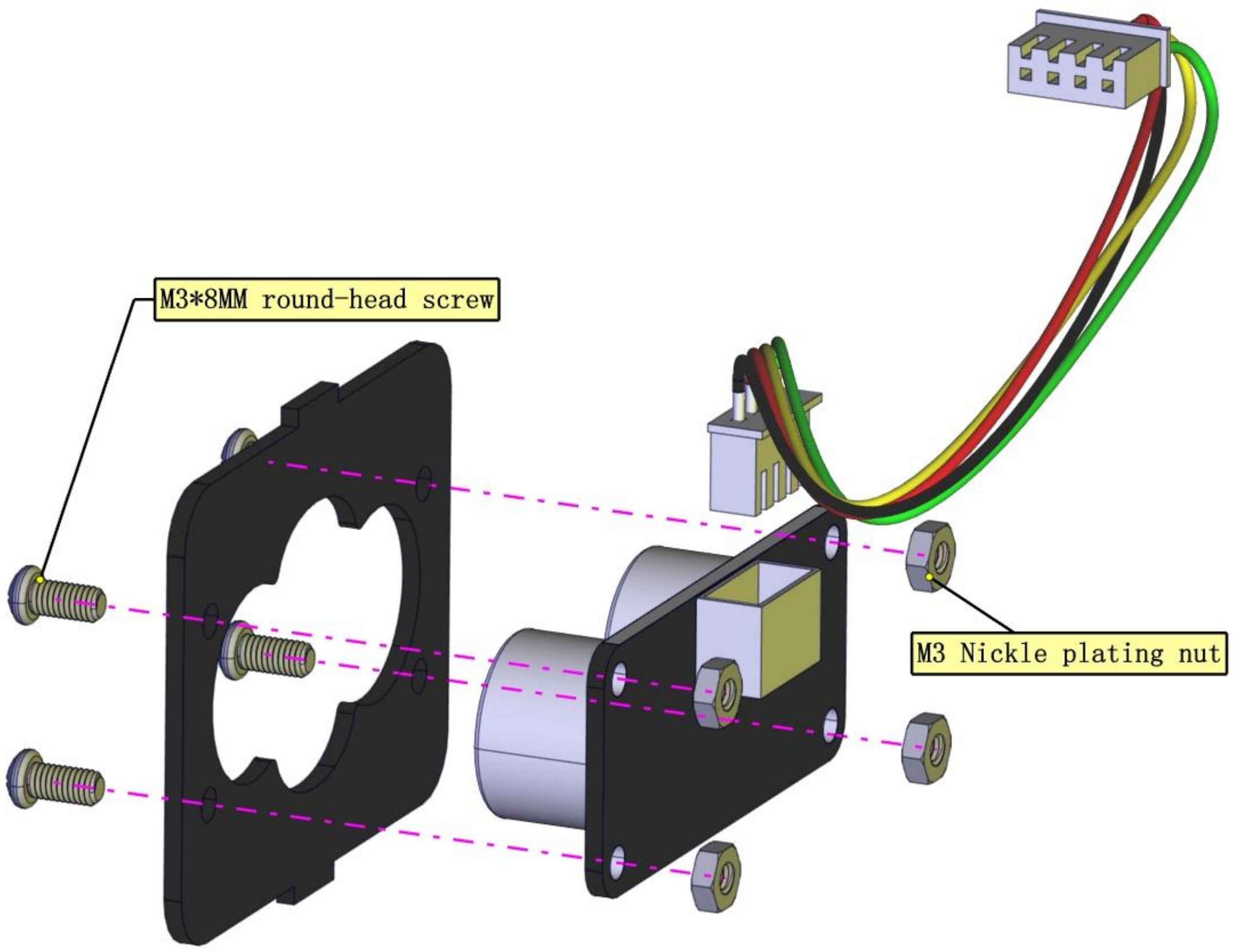
×1

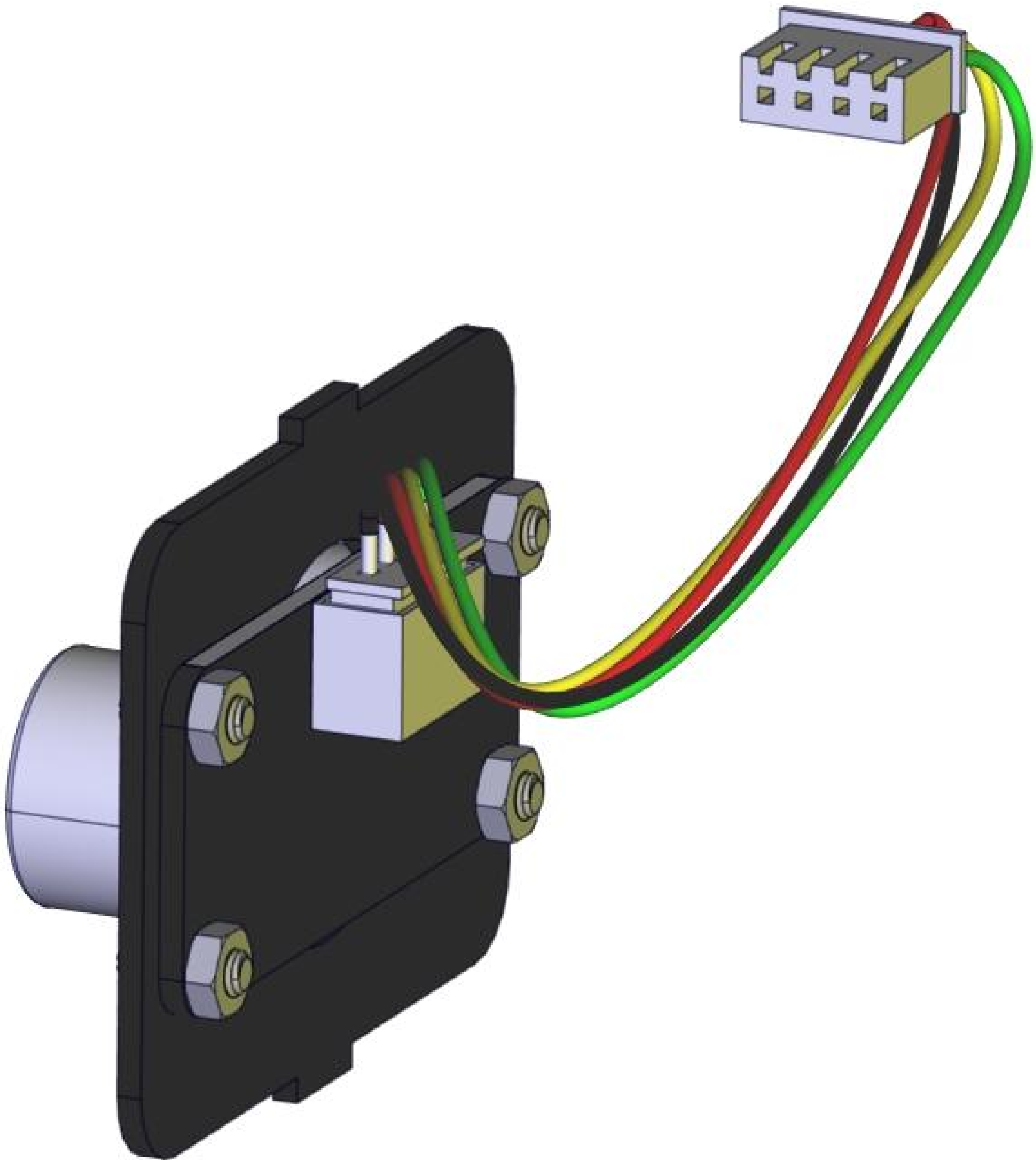

M3*8MM round-head screw

×4

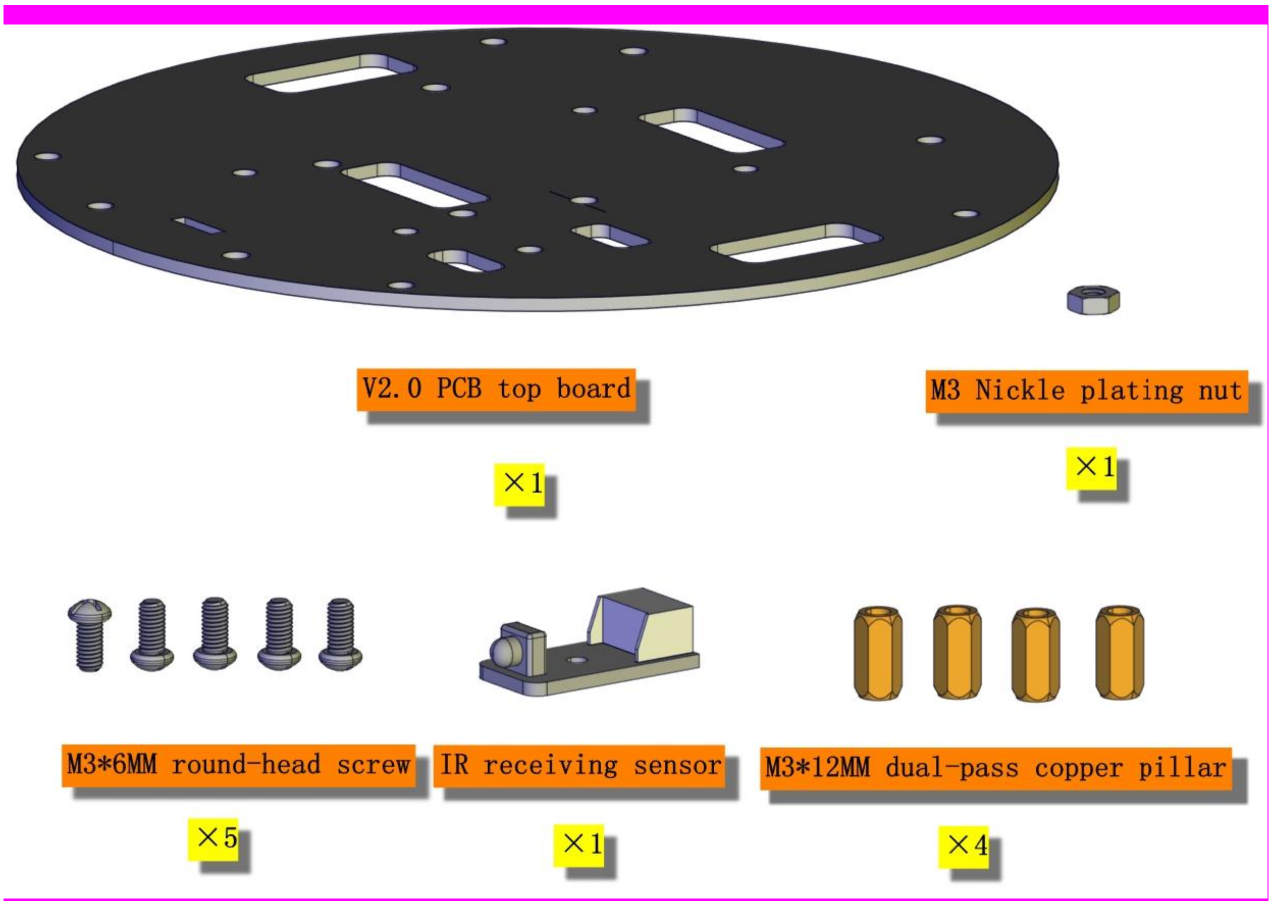

M3 Nickle plating nut

×4

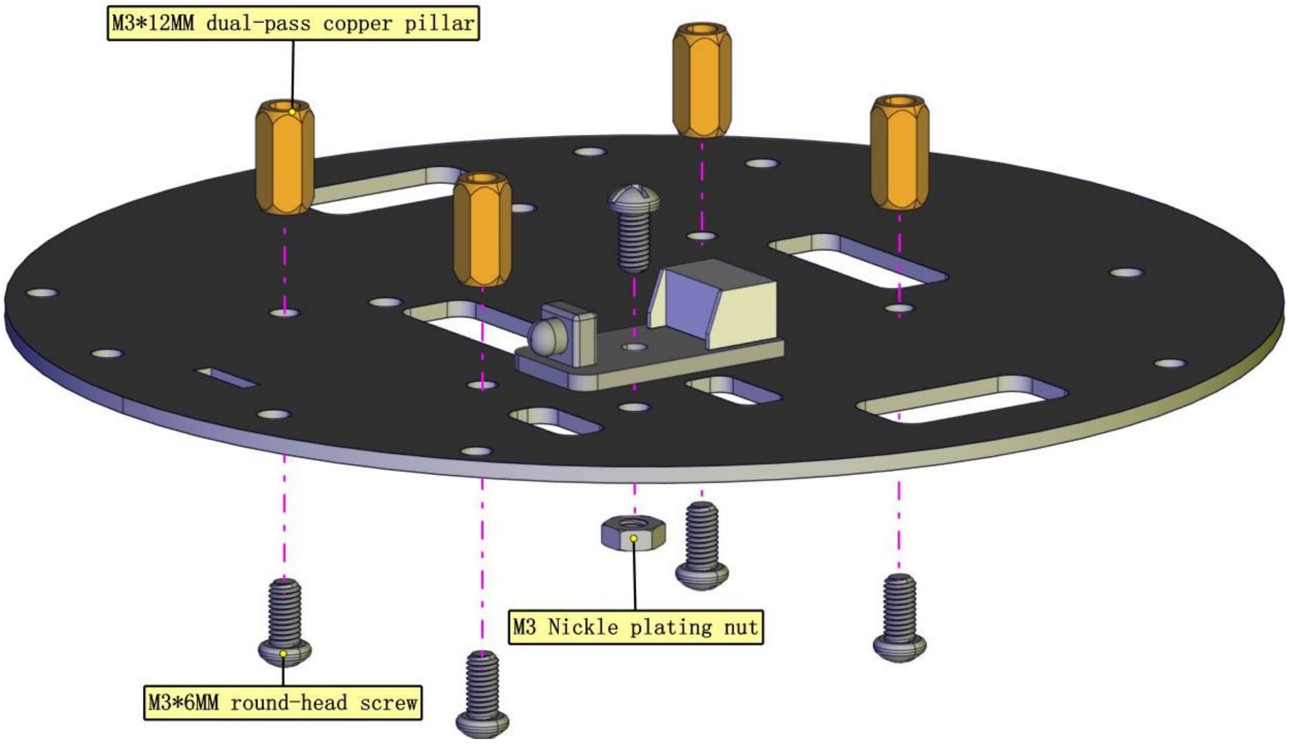

M3*8MM round-head screw
M3 Nickle plating nut

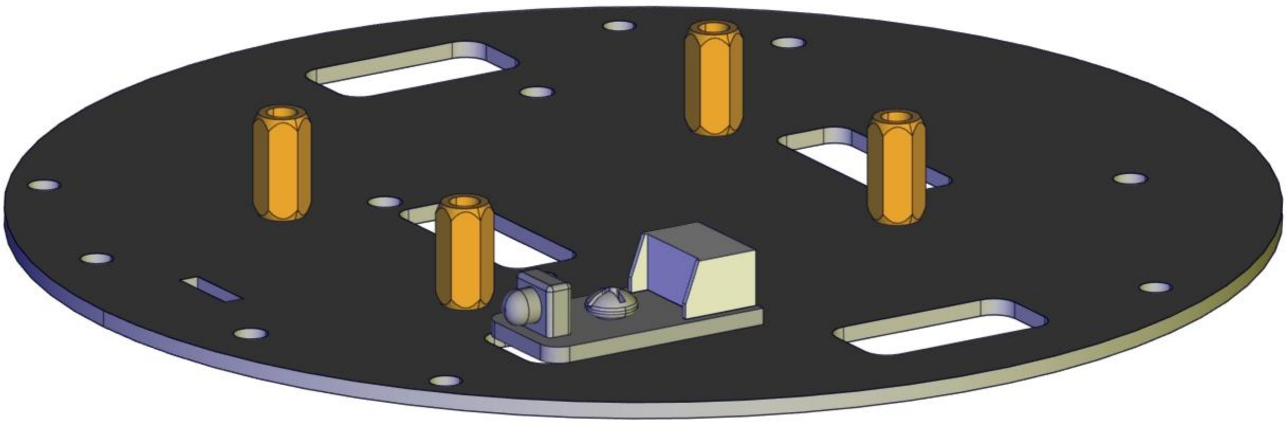


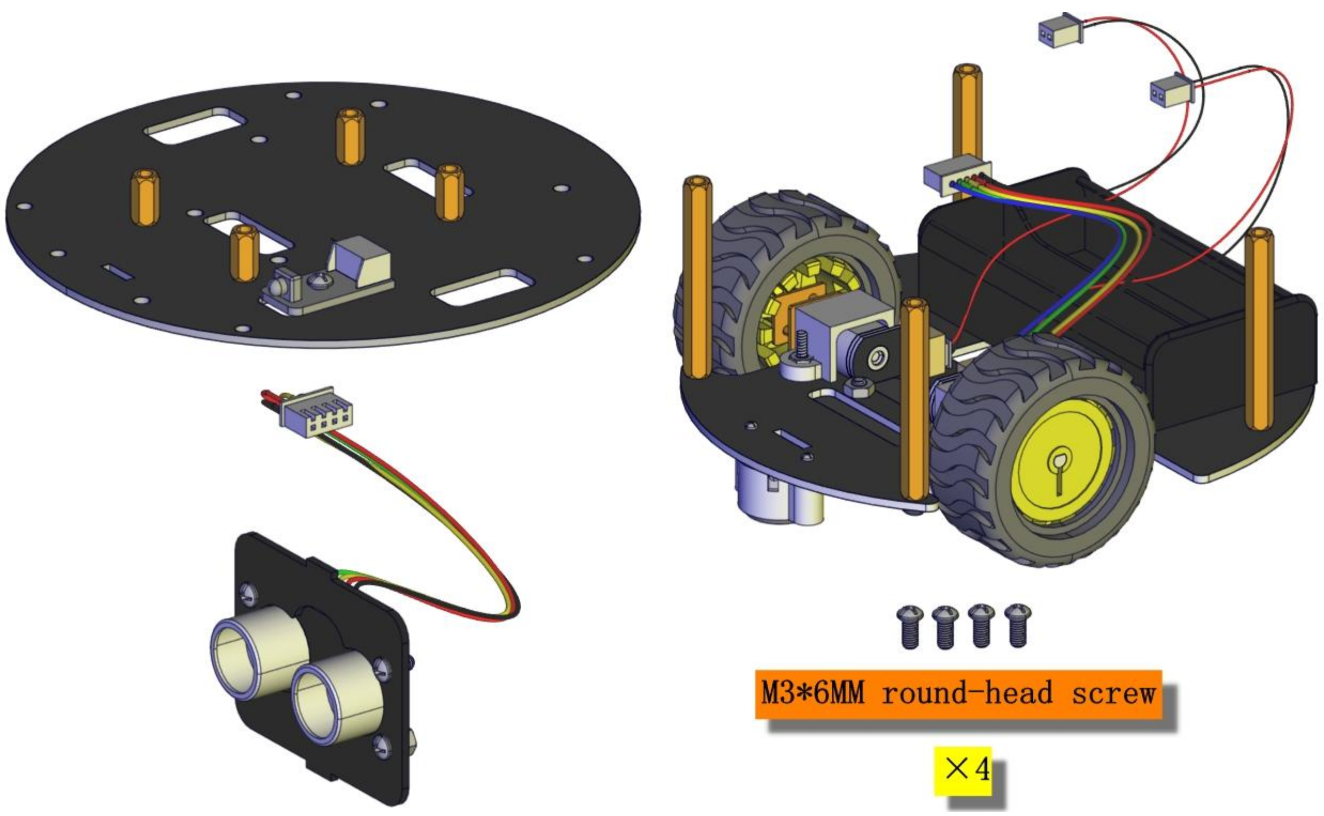
3. Mount the Middle Board and IR Receiver

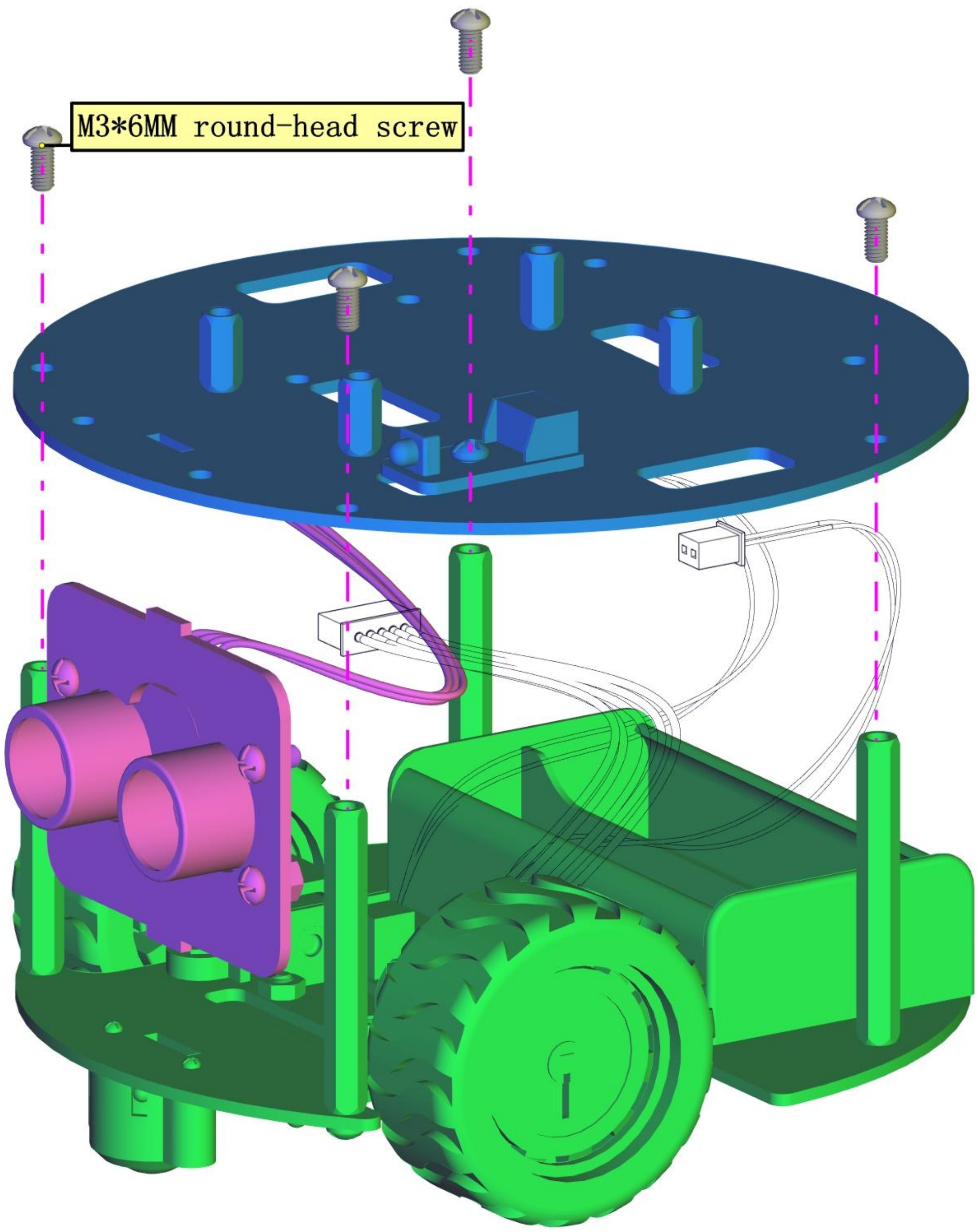


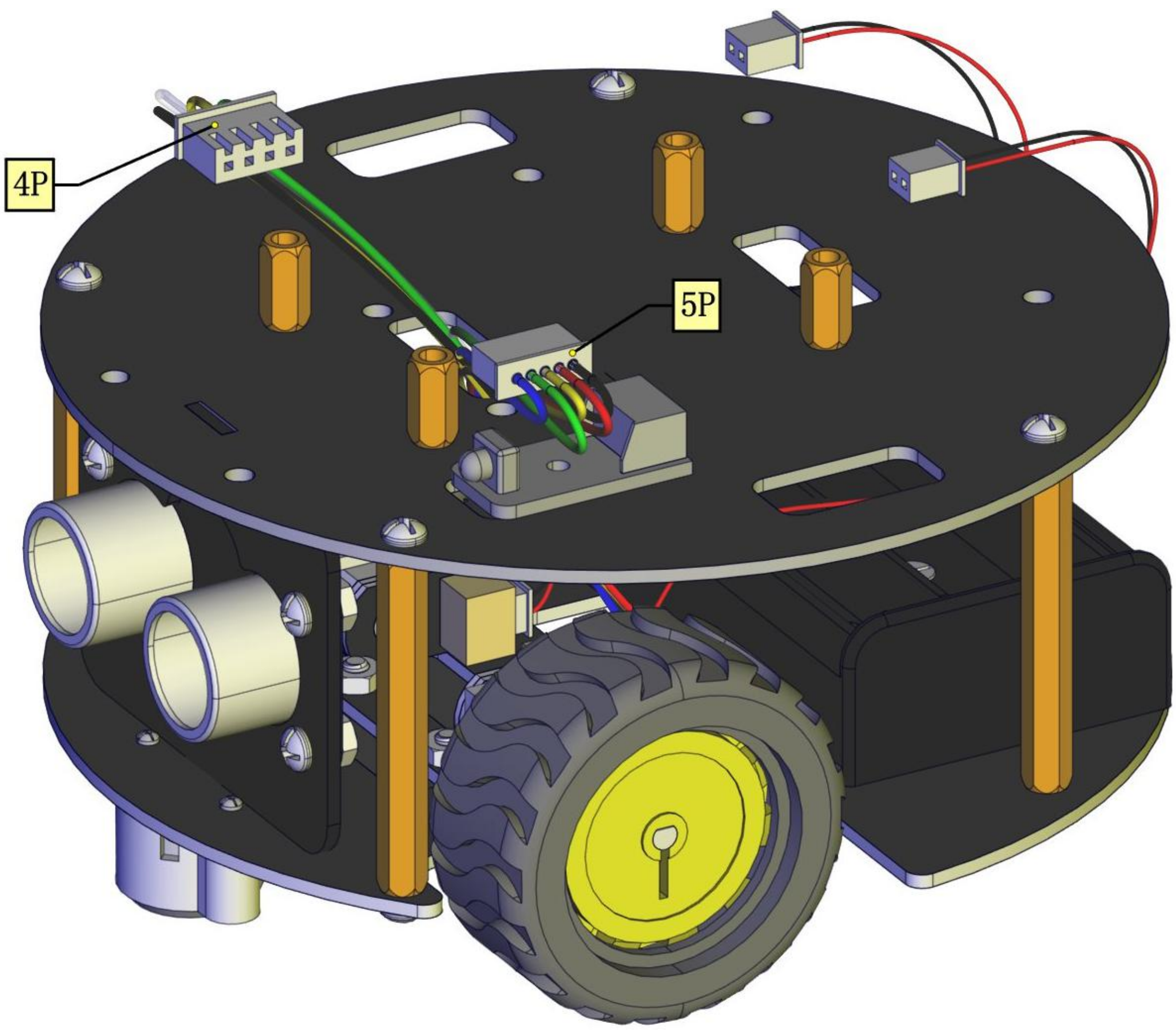
Note: make the side printed “Keyes” upward when installing the middle board.


M3*12MM dual-pass copper pillar
M3 Nickle plating nut
M3*6MM round-head screw

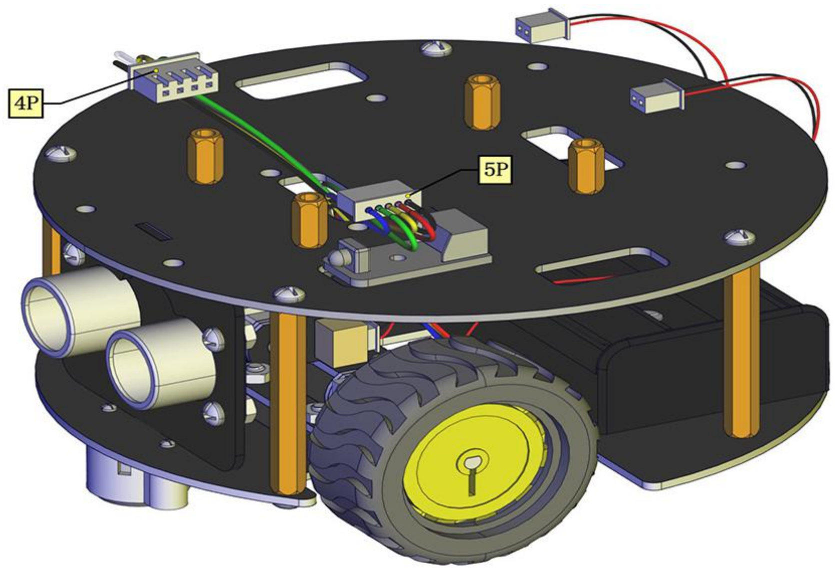


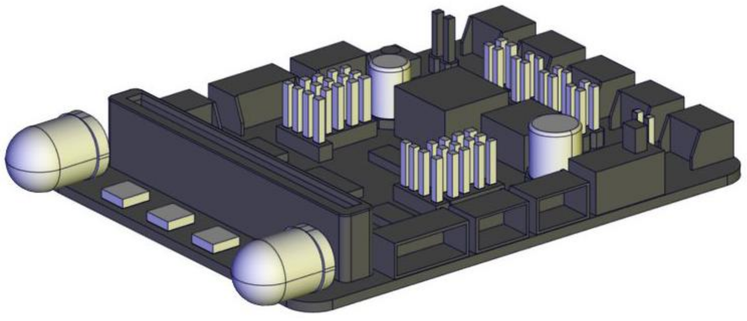

M3*6MM round-head screw
×4

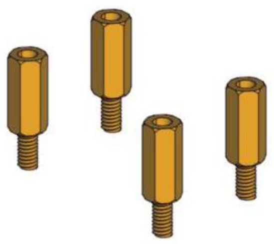

M3*6MM round-head screw



4. Install micro:bit TB6612 Motor Driver Shield





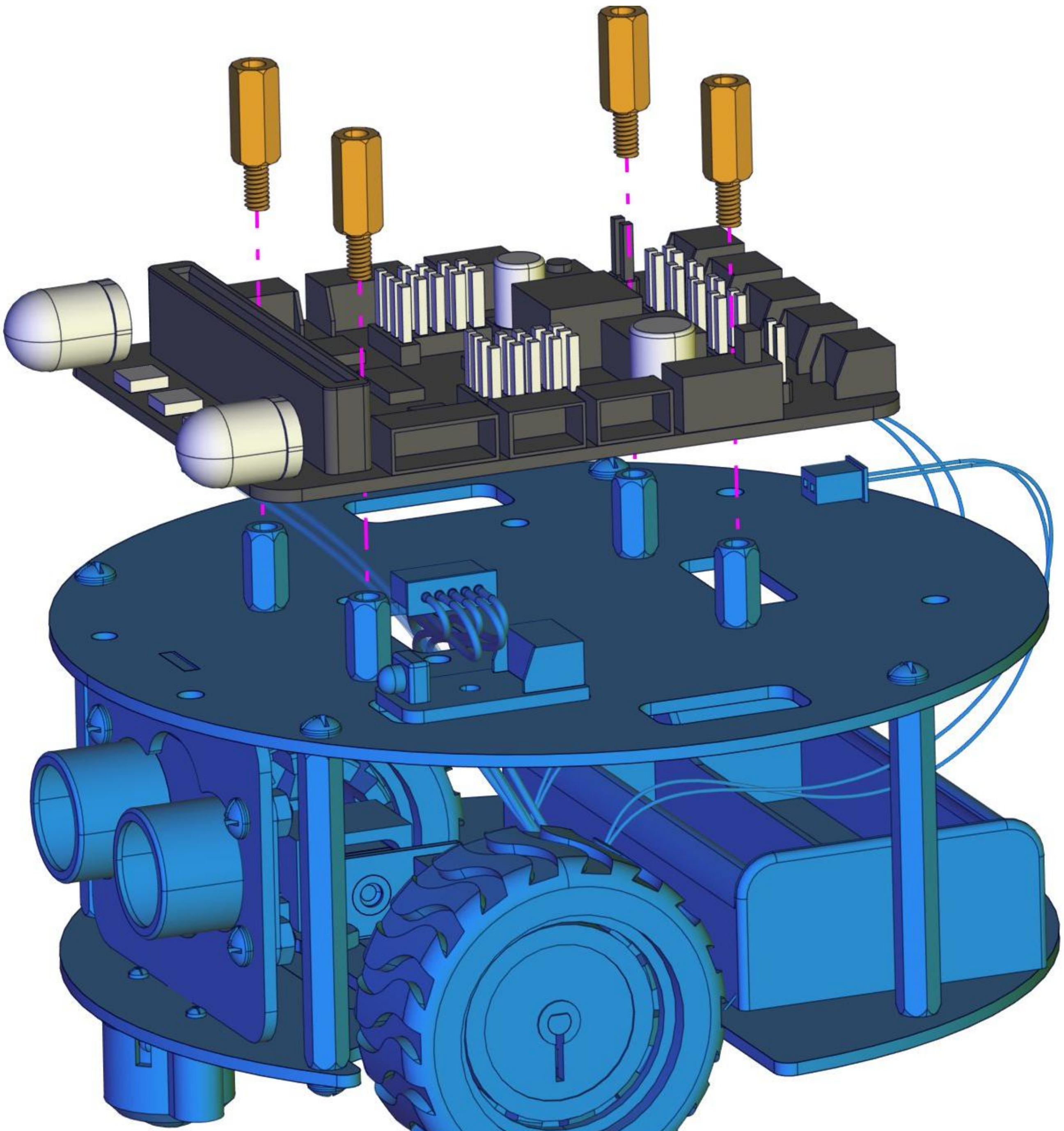


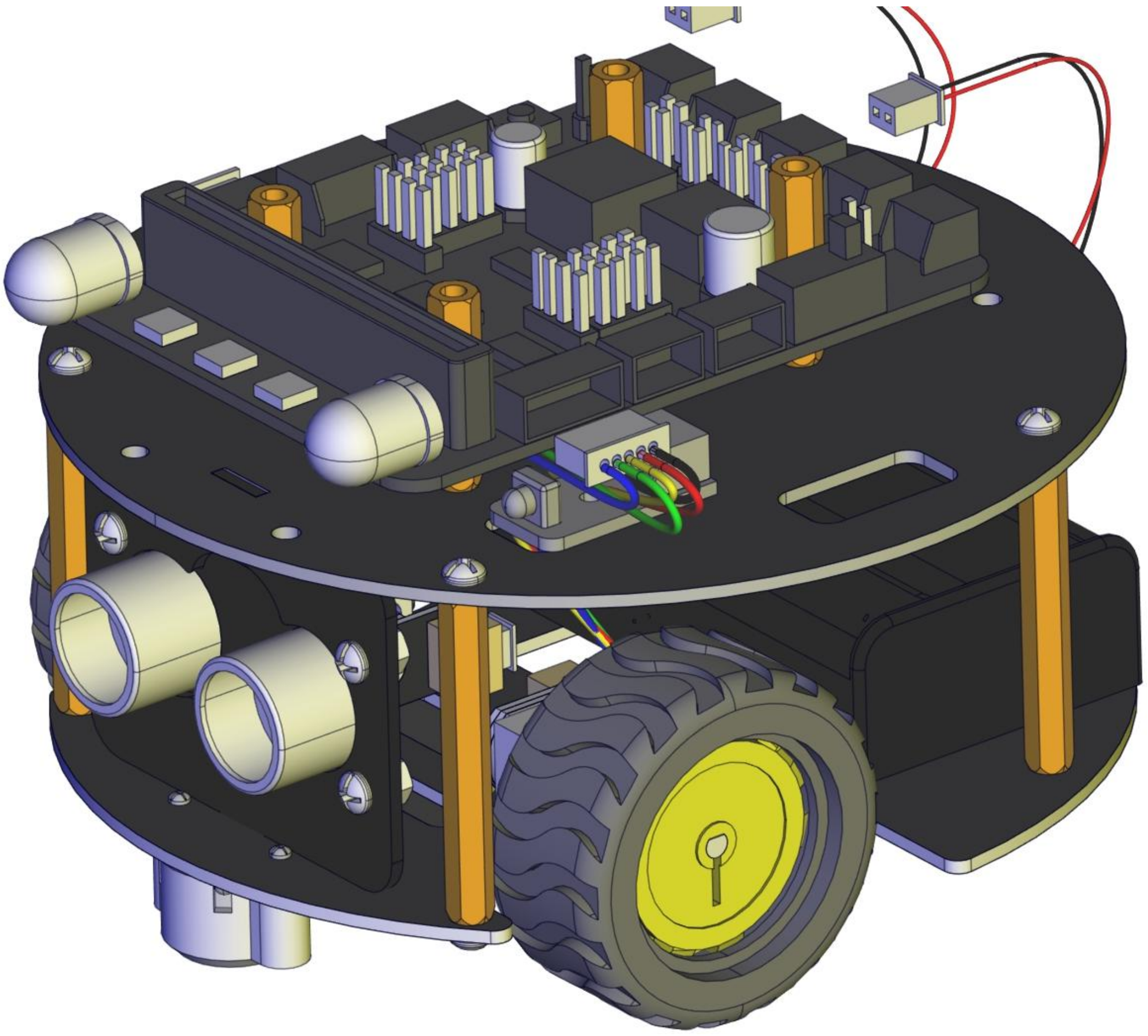
Micro:bit TB6612 Motor Driving Shield

×1

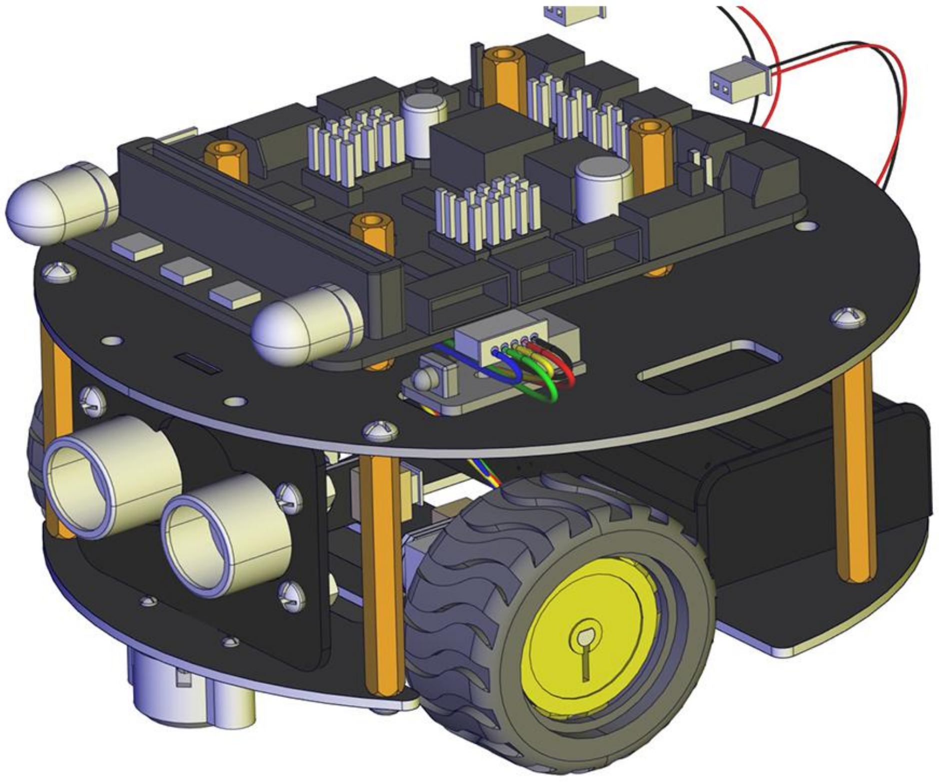
M3*15+6MM hex copper pillar

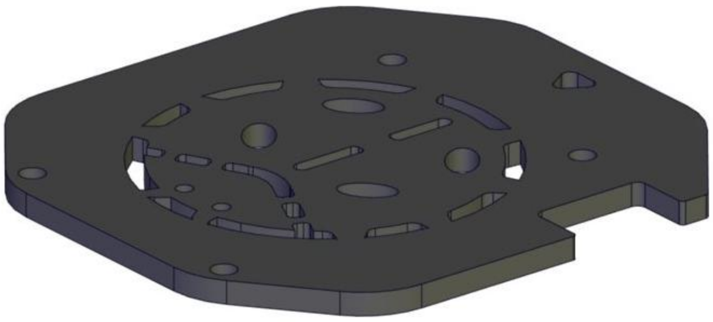
×4





5. Install Top Board



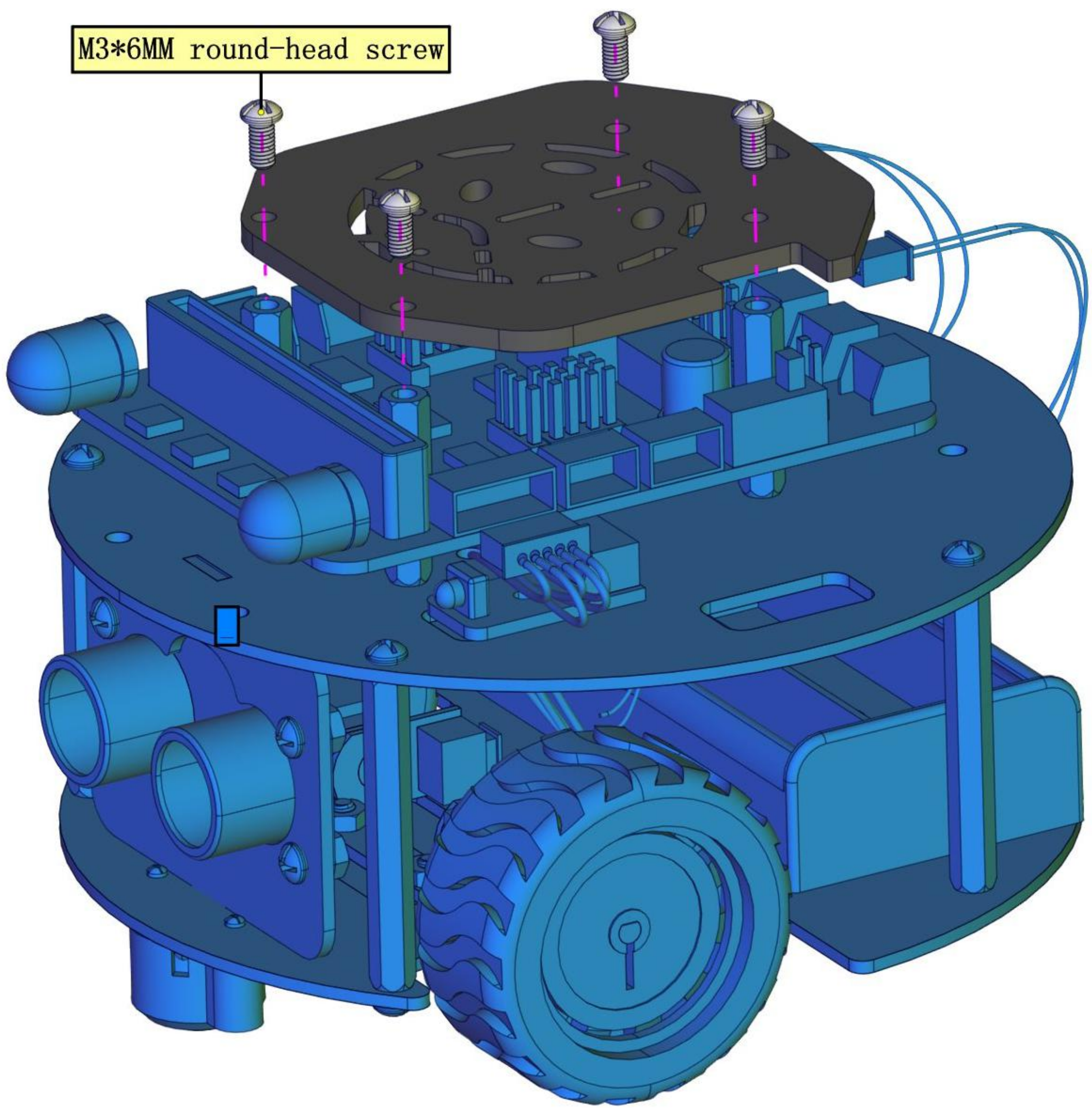


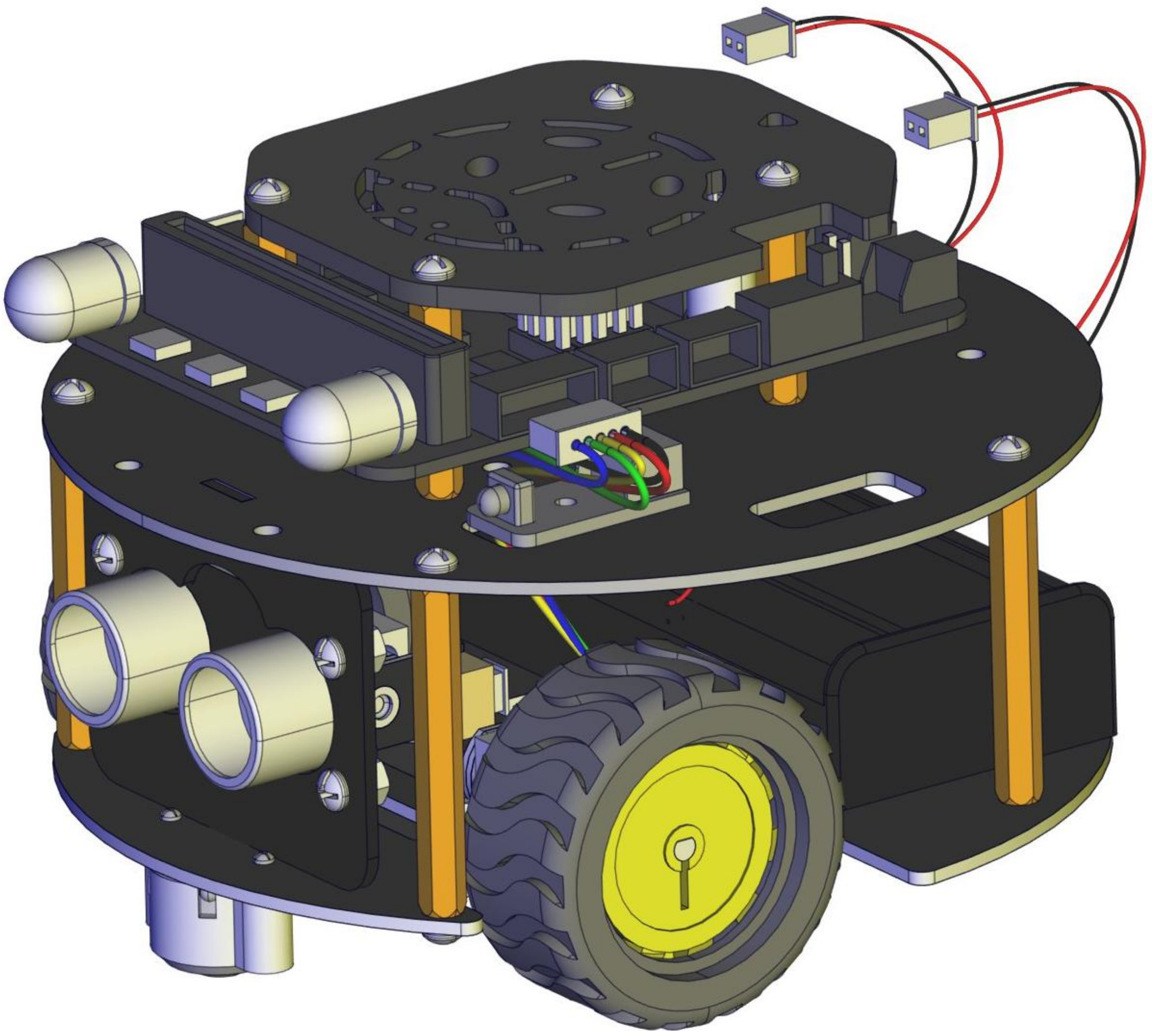
M3*6MM round-head screw

×4

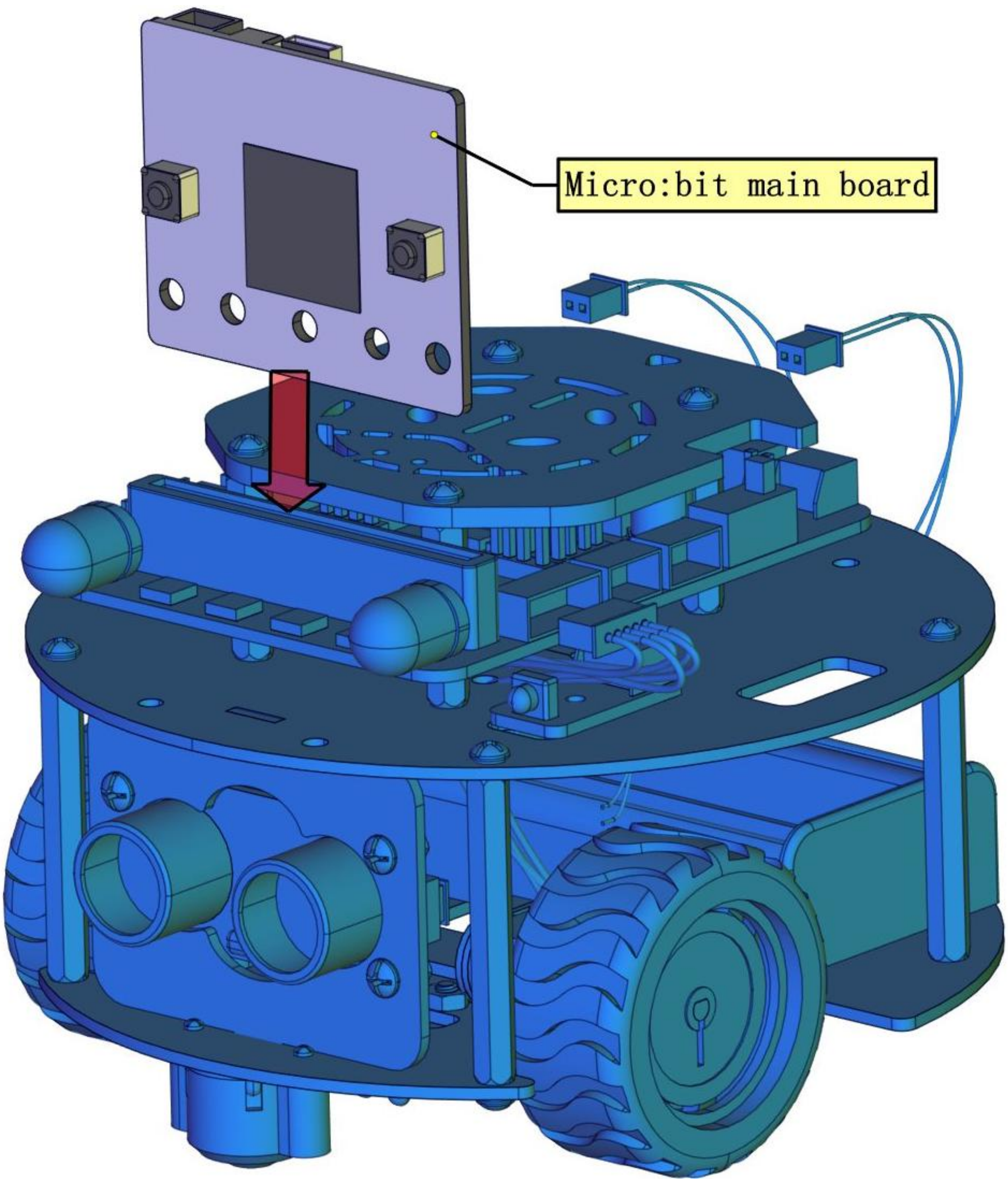
Microbit turtle Top acrylic board

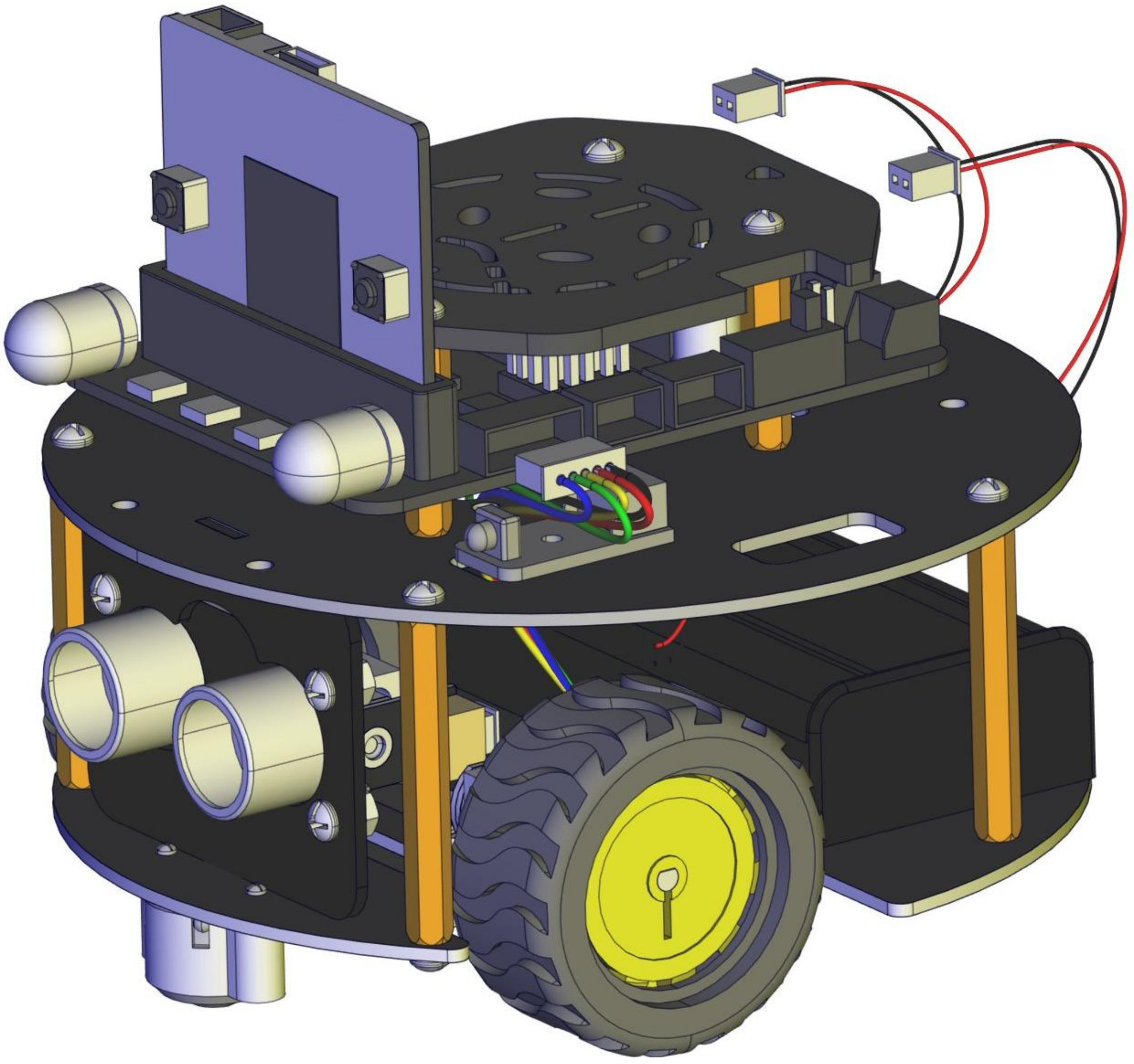
×1


M3*6MM round-head screw



6. Install Micro:bit Board


Micro:bit main board

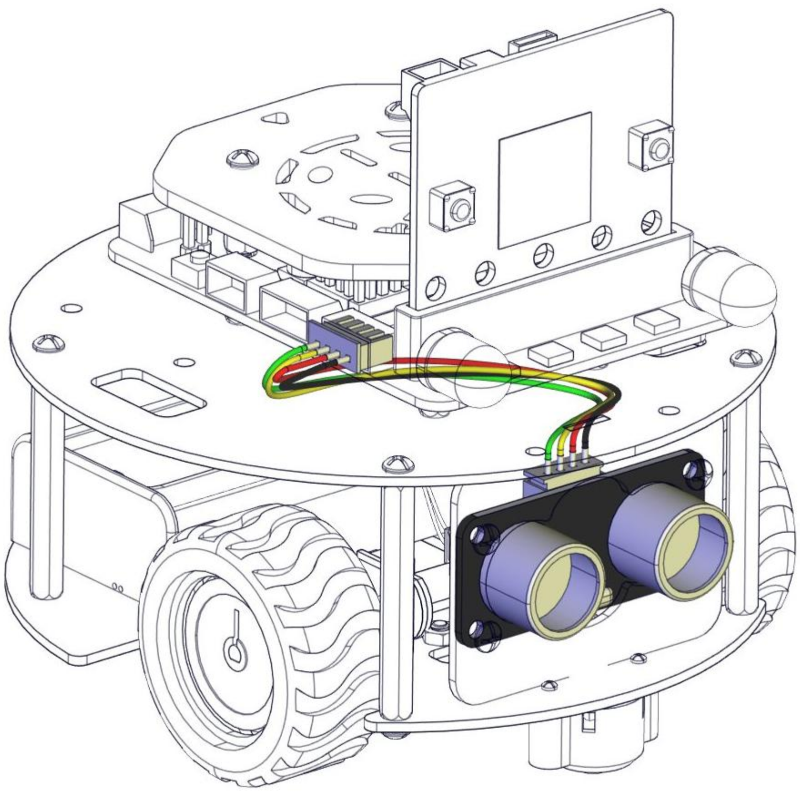


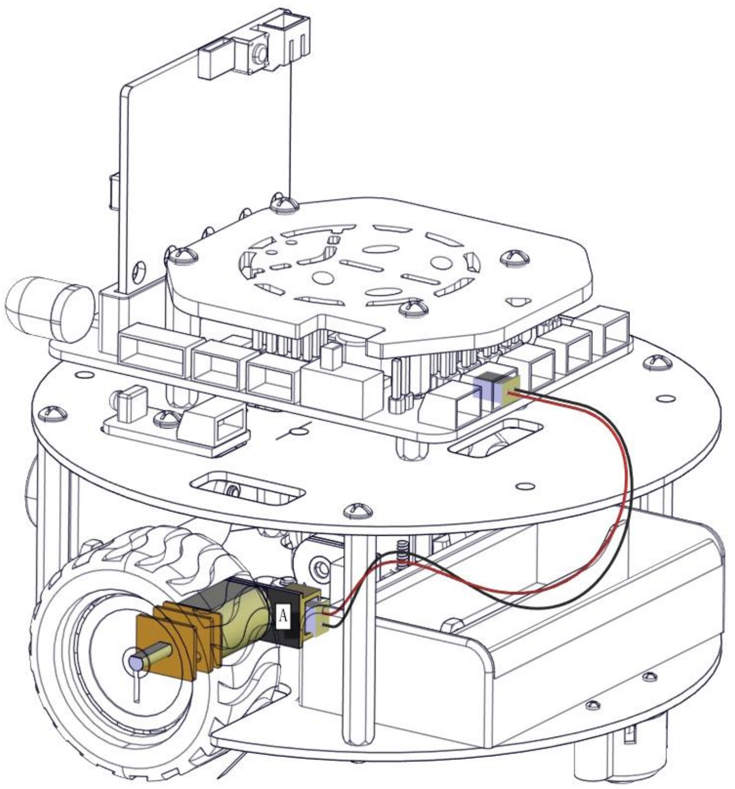
Wiring Up

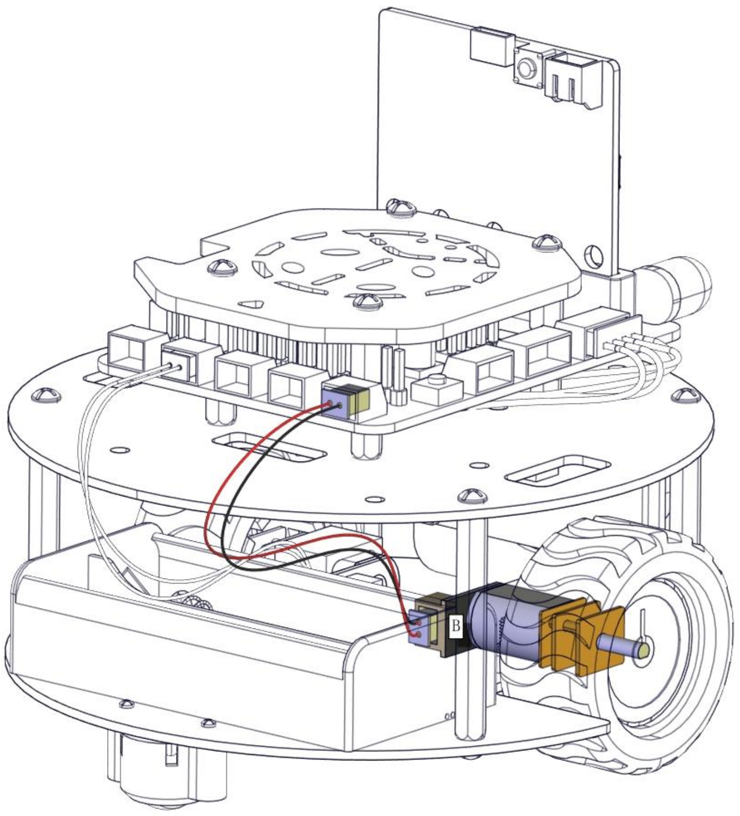
We need an additional 3P wire to connect IR receiver.

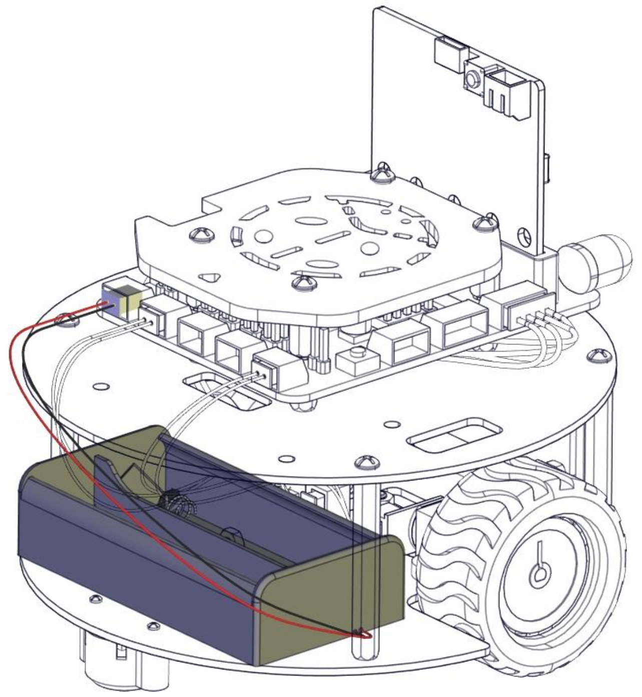
Black line is connected to G (-) , red wire is connected to 5V (+)

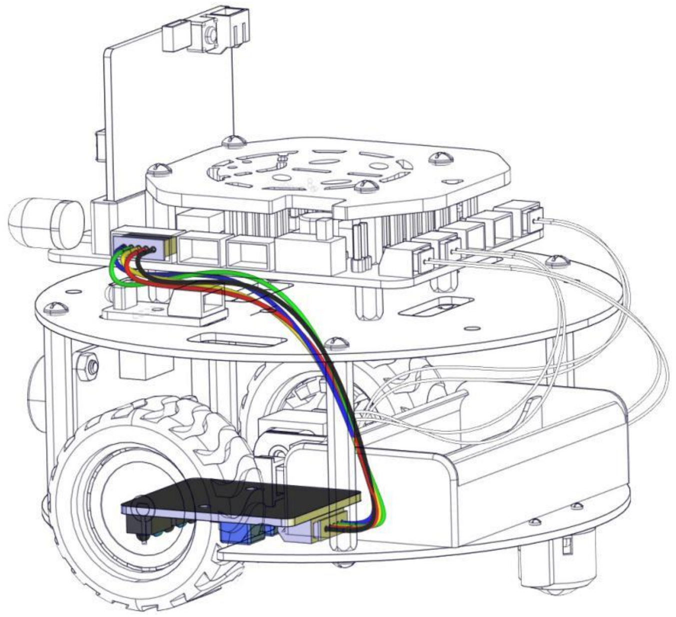
	Battery Holder	Motor A(Left)	Motor B(Right)	Line Tracking Sensor	IR Receiver	Ultrasonic Module
Driver Shield	7-12V IN (+ -)	A1	B1	P16 P15 P14 5V G	P11 5V G	P2 P1 5V G

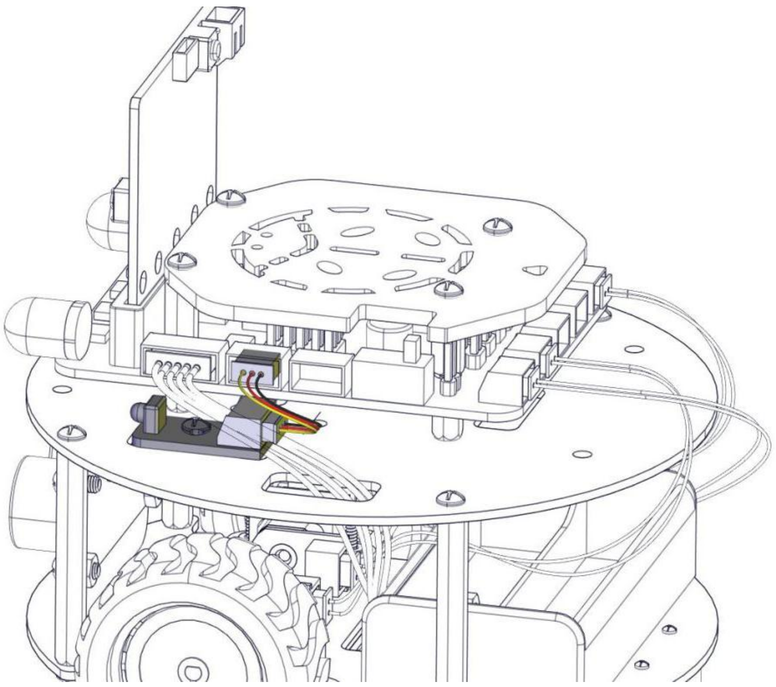


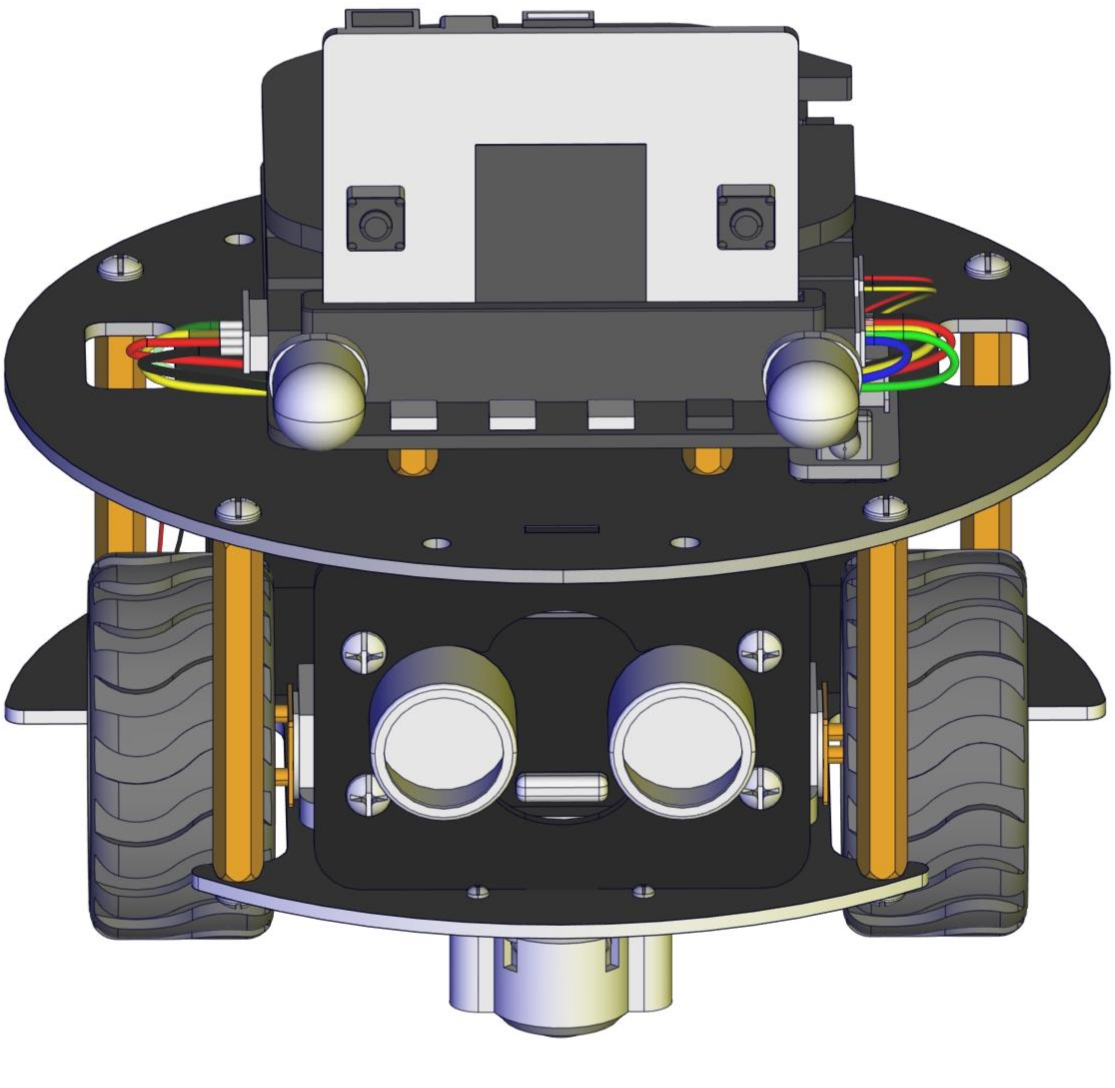

A


B









7. Python

What is MicroPython?

MicroPython is a tiny open source Python programming language interpreter that runs on small embedded development boards. With MicroPython you can write clean and simple Python code to control hardware instead of having to use complex low-level languages like C or C++ (what Arduino uses for programming).

The simplicity of the Python programming language makes MicroPython an excellent choice for beginners who are new to programming and hardware. However MicroPython is also quite full-featured and supports most of Python's syntax so even seasoned Python veterans will find MicroPython familiar and fun to use.

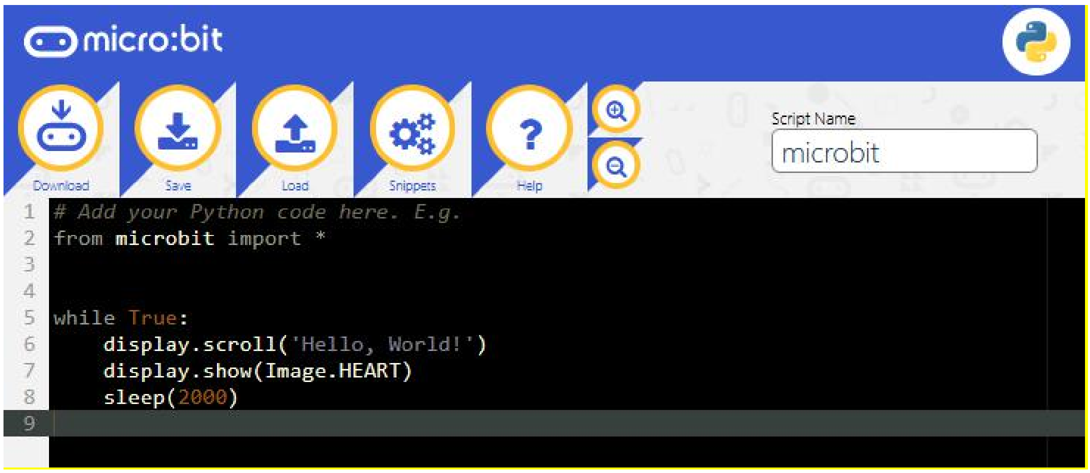
More details please log in official micro:bit website:

https://microbit-micropython.readthedocs.io/en/latest/index.html

https://microbit-micropython.readthedocs.io/en/latest/tutorials/introduction.html

Python has two types of editors（web version and offline version)

1. Web version: https://python.microbit.org/v/1.1



```
# Add your Python code here. E.g.
from microbit import *


while True:
    display.scroll('Hello, World!')
    display.show(Image.HEART)
    sleep(2000)
```

2. The other one is the offline compiler tool -----Mu

(Download Mu：https://codewith.mu/en/download)

Mu

Official Website：https://codewith.mu/

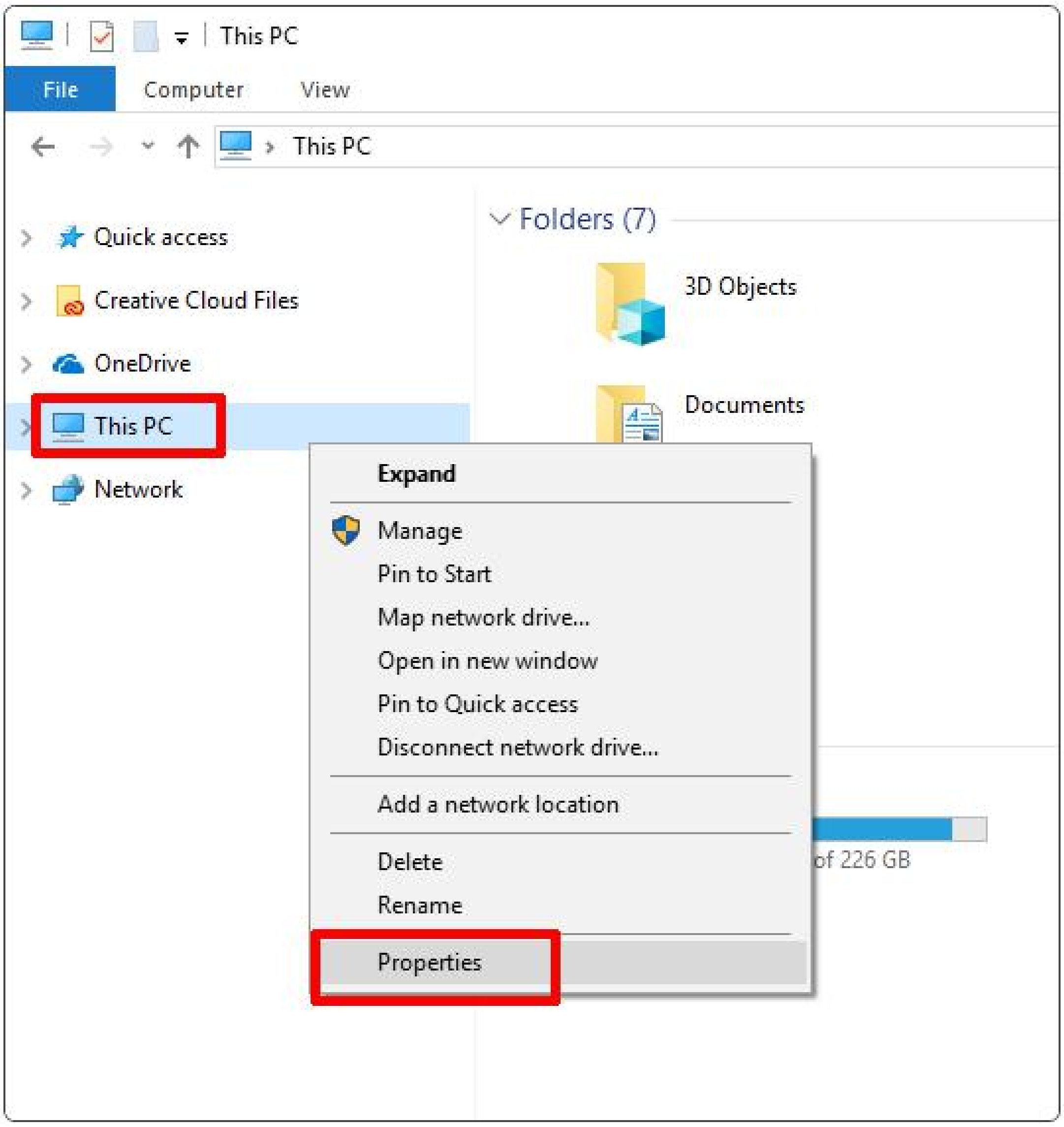
Mu, a Python code editor, is suitable for starters.

Mu program only works on 32-bit and 64-bit Windows7, 8 and 10. Make sure your computer update.

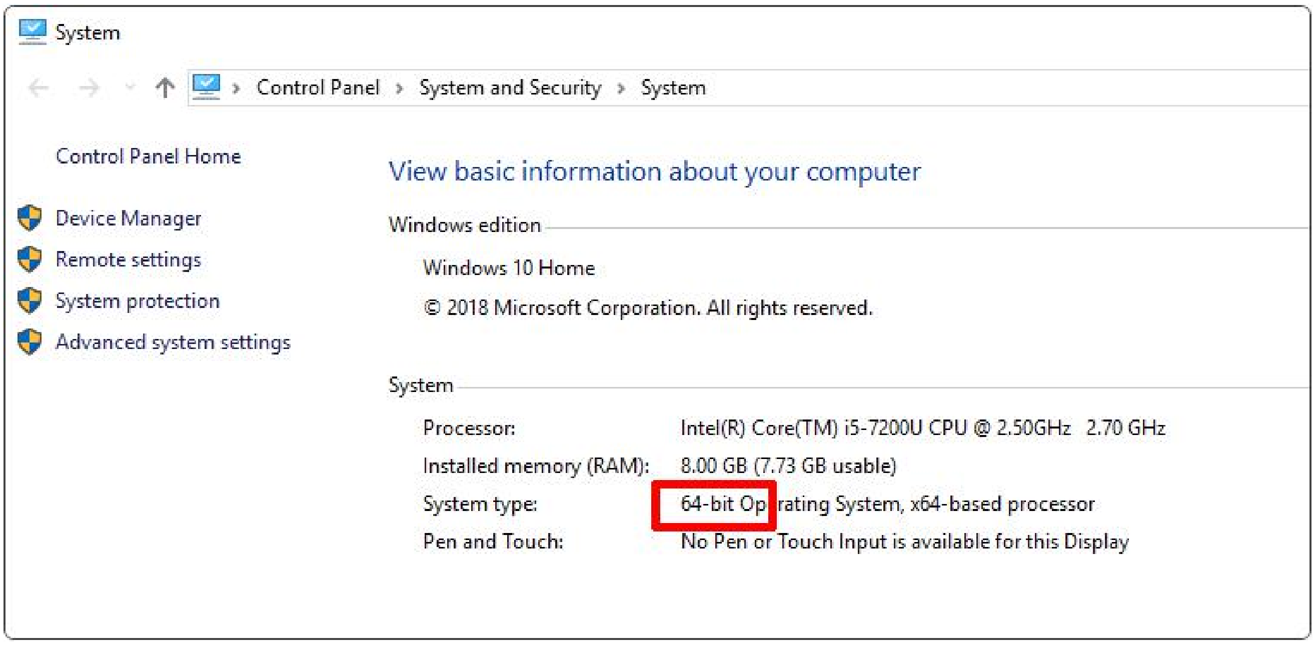
Mu doesn’t support 32-bit Windows. The latest version is Mu 1.1.0-beta 2

1. Download Mu

Click “This PC” and right- click to select Properties to check the version of your computer.



Below is shown system type of your computer.



System

Control Panel › System and Security › System

Control Panel Home

Device Manager
Remote settings
System protection
Advanced system settings

View basic information about your computer

Windows edition

Windows 10 Home

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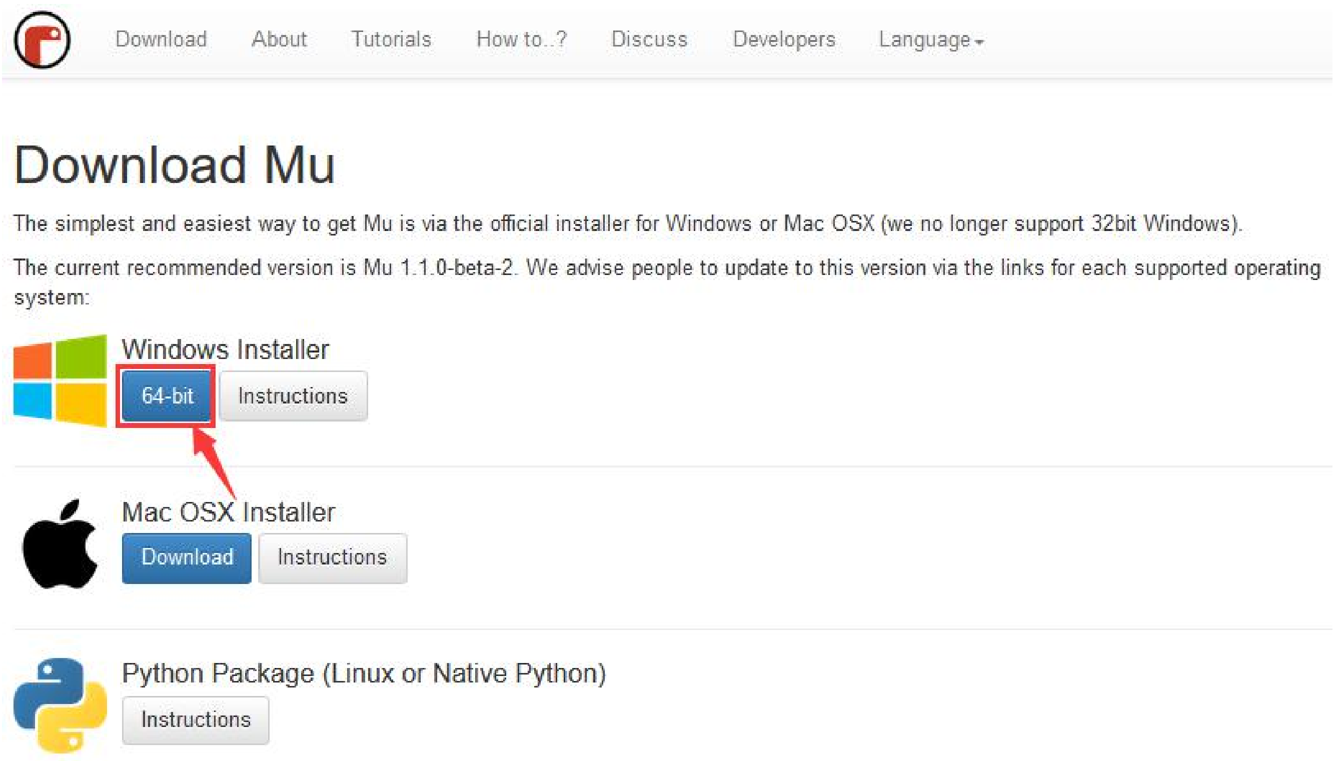
System

Processor:	Intel(R) Core(TM) i5-7200U CPU @ 2.50GHz 2.70 GHz
Installed memory (RAM):	8.00 GB (7.73 GB usable)
System type:	64-bit Operating System, x64-based processor
Pen and Touch:	No Pen or Touch Input is available for this Display

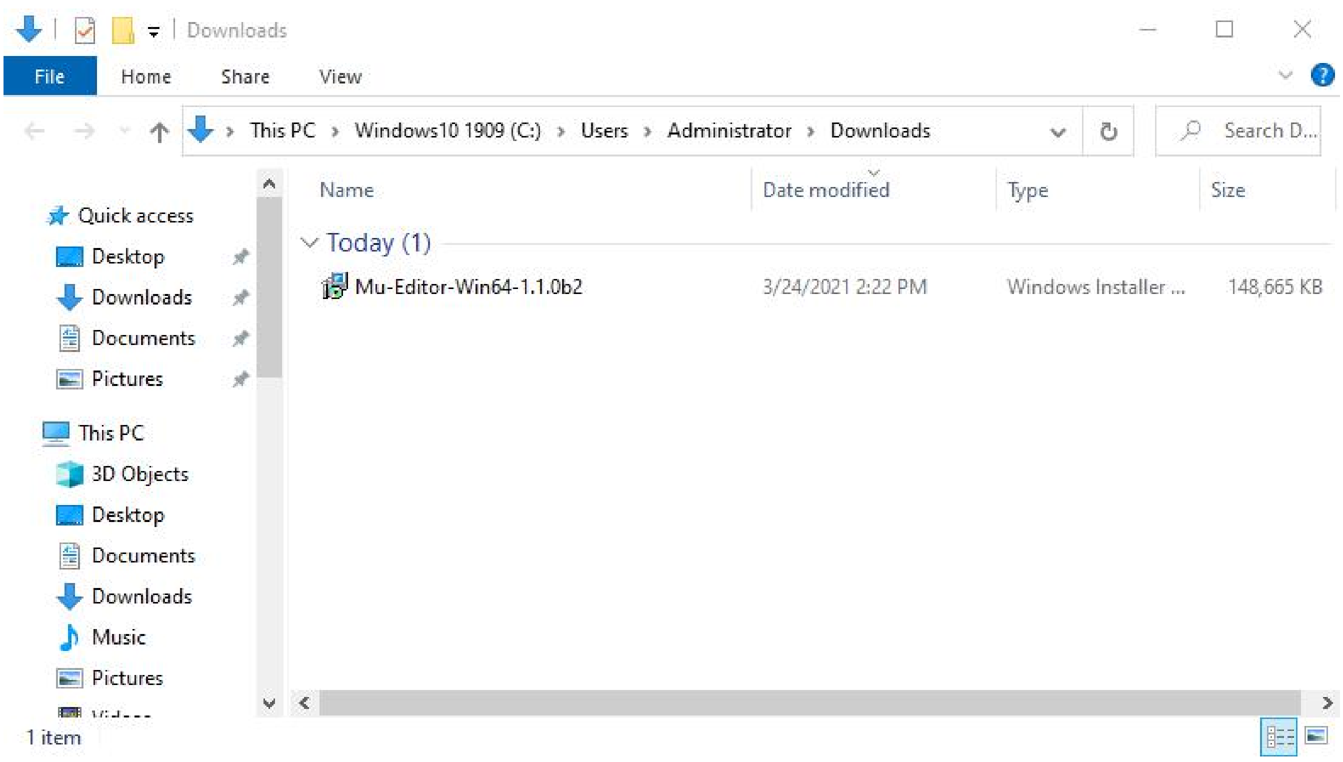


Download Mu

The simplest and easiest way to get Mu is via the official installer for Windows or Mac OSX (we no longer support 32bit Windows).

The current recommended version is Mu 1.1.0-beta-2. We advise people to update to this version via the links for each supported operating system:

Enter link: https://codewith.mu/en/download to download the corresponding version of Mu.

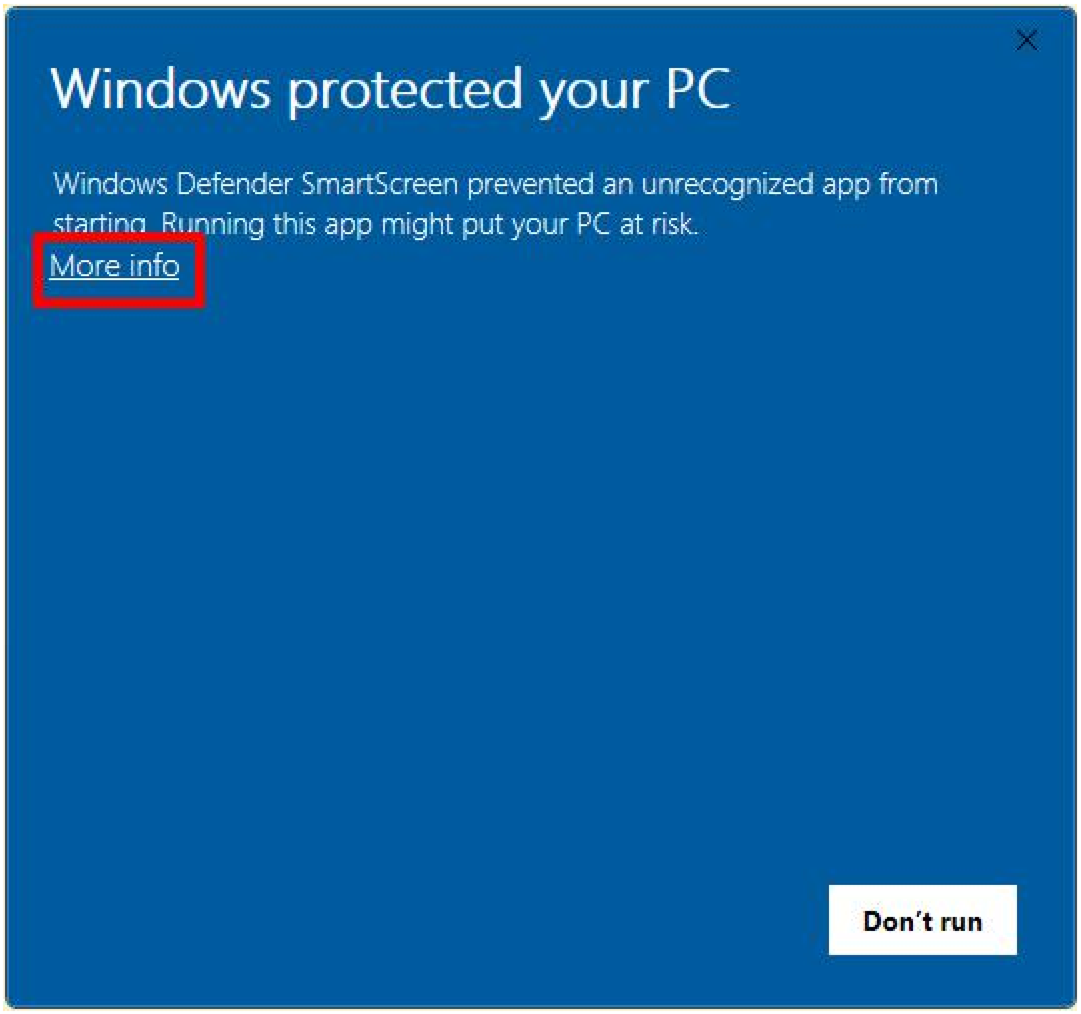


Name | Date modified | Type | Size
Today (1)
Mu-Editor-Win64-1.1.0b2 | 3/24/2021 2:22 PM | Windows Installer ... | 148,665 KB

Mac OSX： https://codewith.mu/en/howto/1.1/install_macos

Windows 10

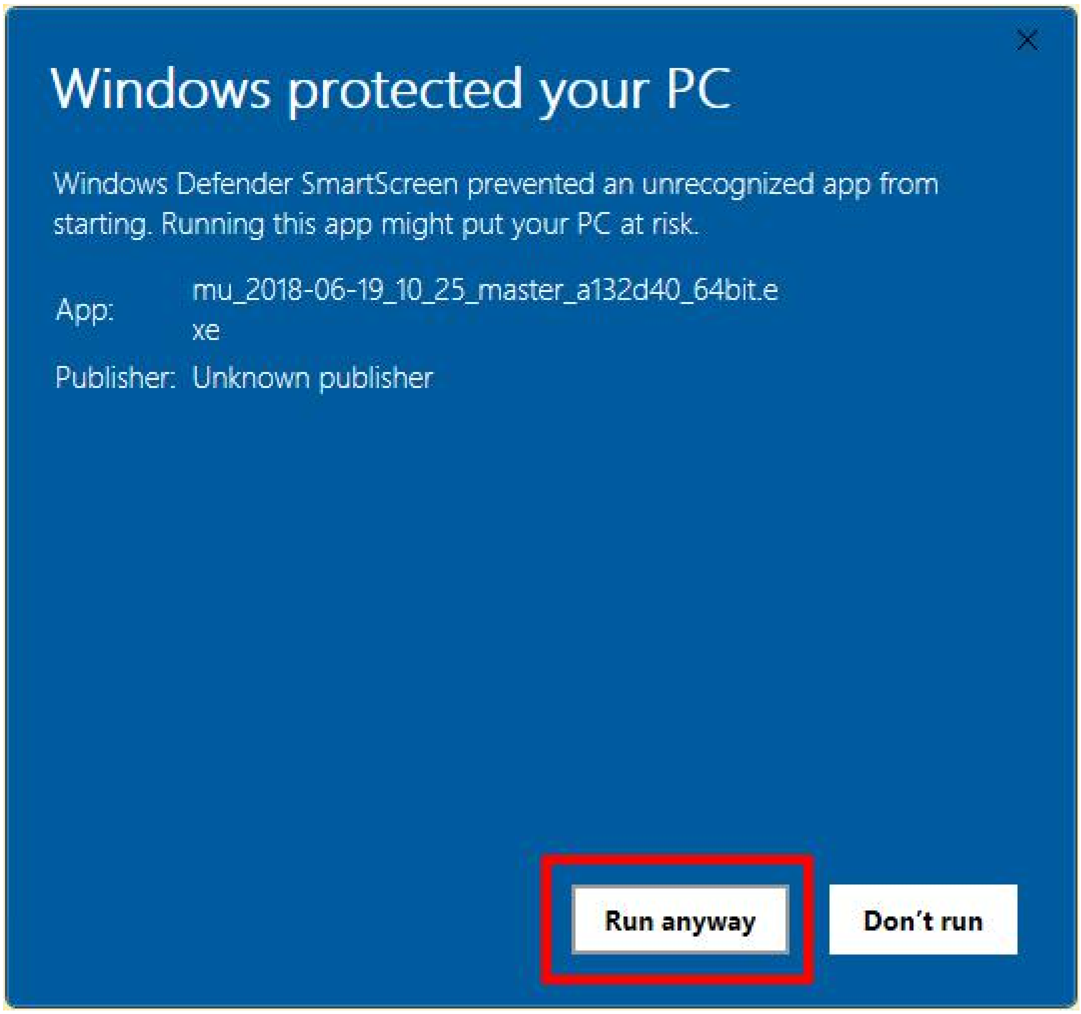
You will view the page pop up, then click More info



Windows protected your PC

Windows Defender SmartScreen prevented an unrecognized app from starting. Running this app might put your PC at risk.

Then click “Run anyway”.

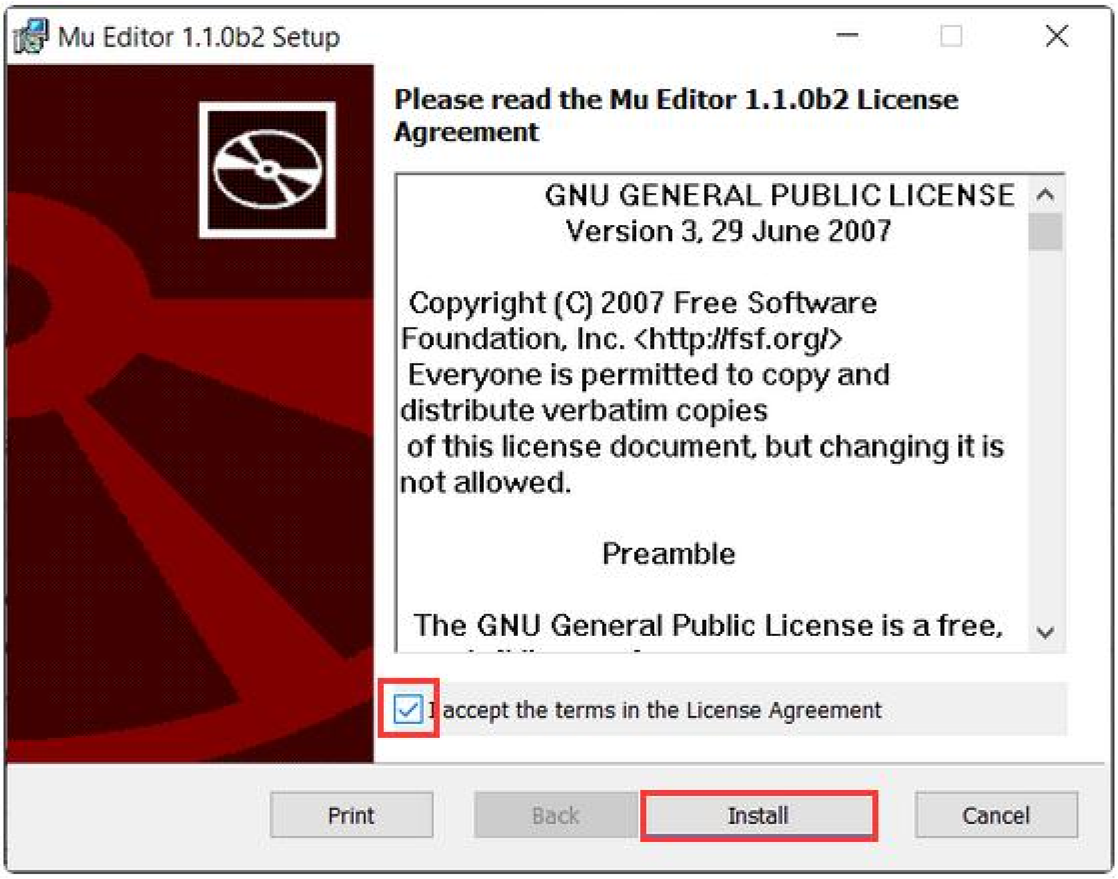


Windows protected your PC

Windows Defender SmartScreen prevented an unrecognized app from starting. Running this app might put your PC at risk.

App: mu_2018-06-19_10_25_master_a132d40_64bit.exe

Publisher: Unknown publisher



Mu Editor 1.1.0b2 Setup

Please read the Mu Editor 1.1.0b2 License Agreement

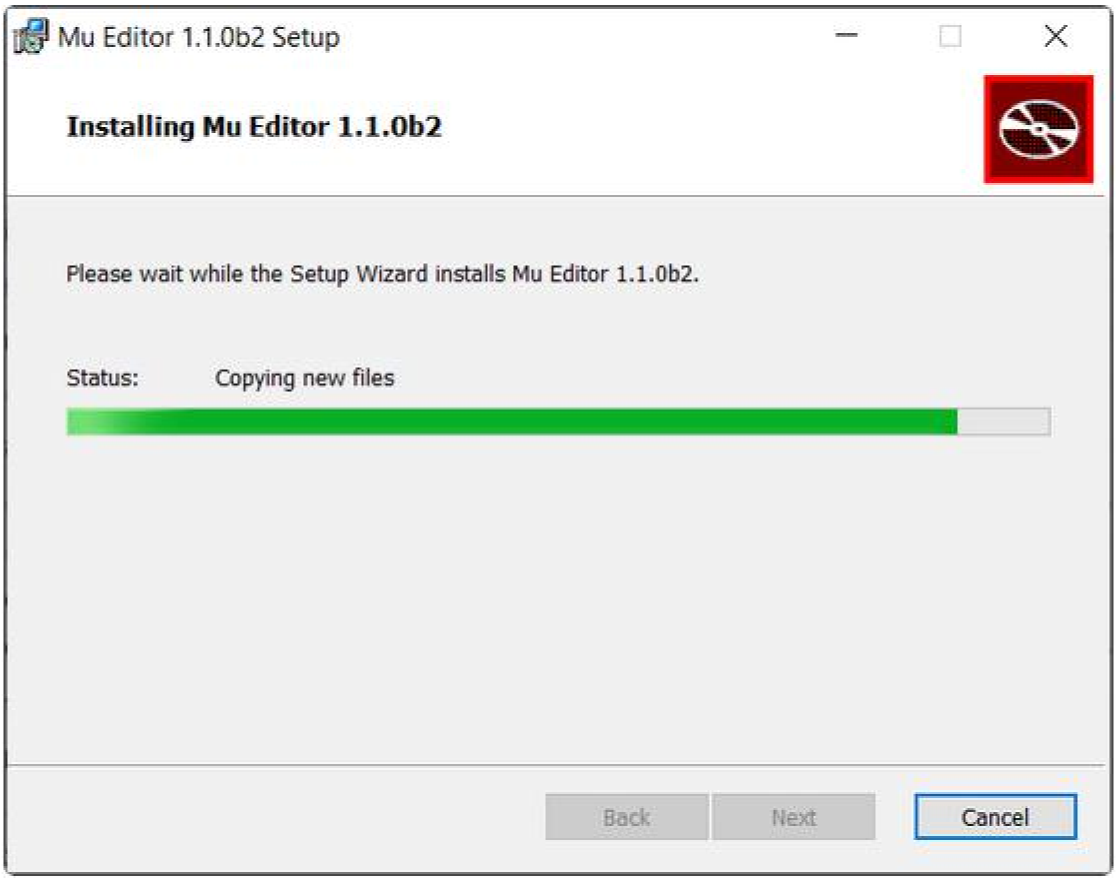
GNU GENERAL PUBLIC LICENSE
Version 3, 29 June 2007

Copyright (C) 2007 Free Software Foundation, Inc. <http://fsf.org/>
Everyone is permitted to copy and distribute verbatim copies
of this license document, but changing it is not allowed.

Preamble

The GNU General Public License is a free,

[✓] I accept the terms in the License Agreement



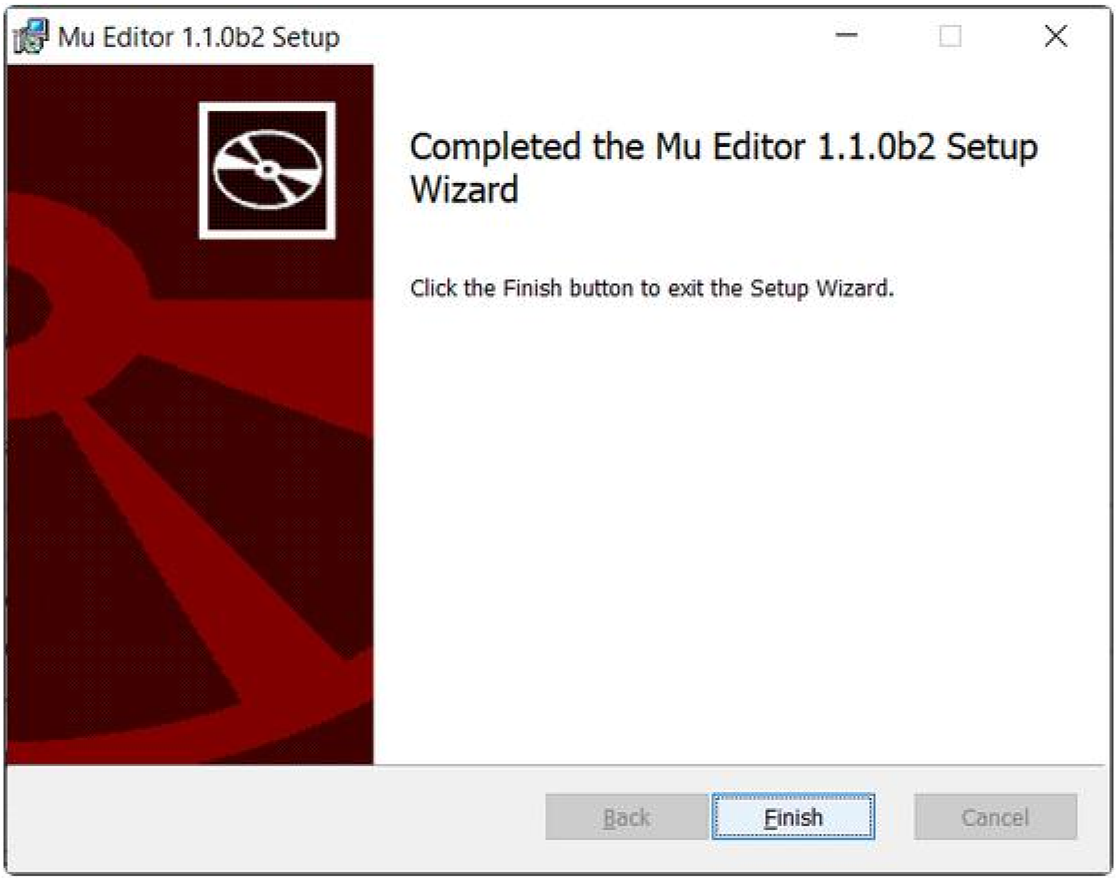
Mu Editor 1.1.0b2 Setup

Installing Mu Editor 1.1.0b2

Please wait while the Setup Wizard installs Mu Editor 1.1.0b2.

Status: Copying new files

After it is installed, click “finish” .

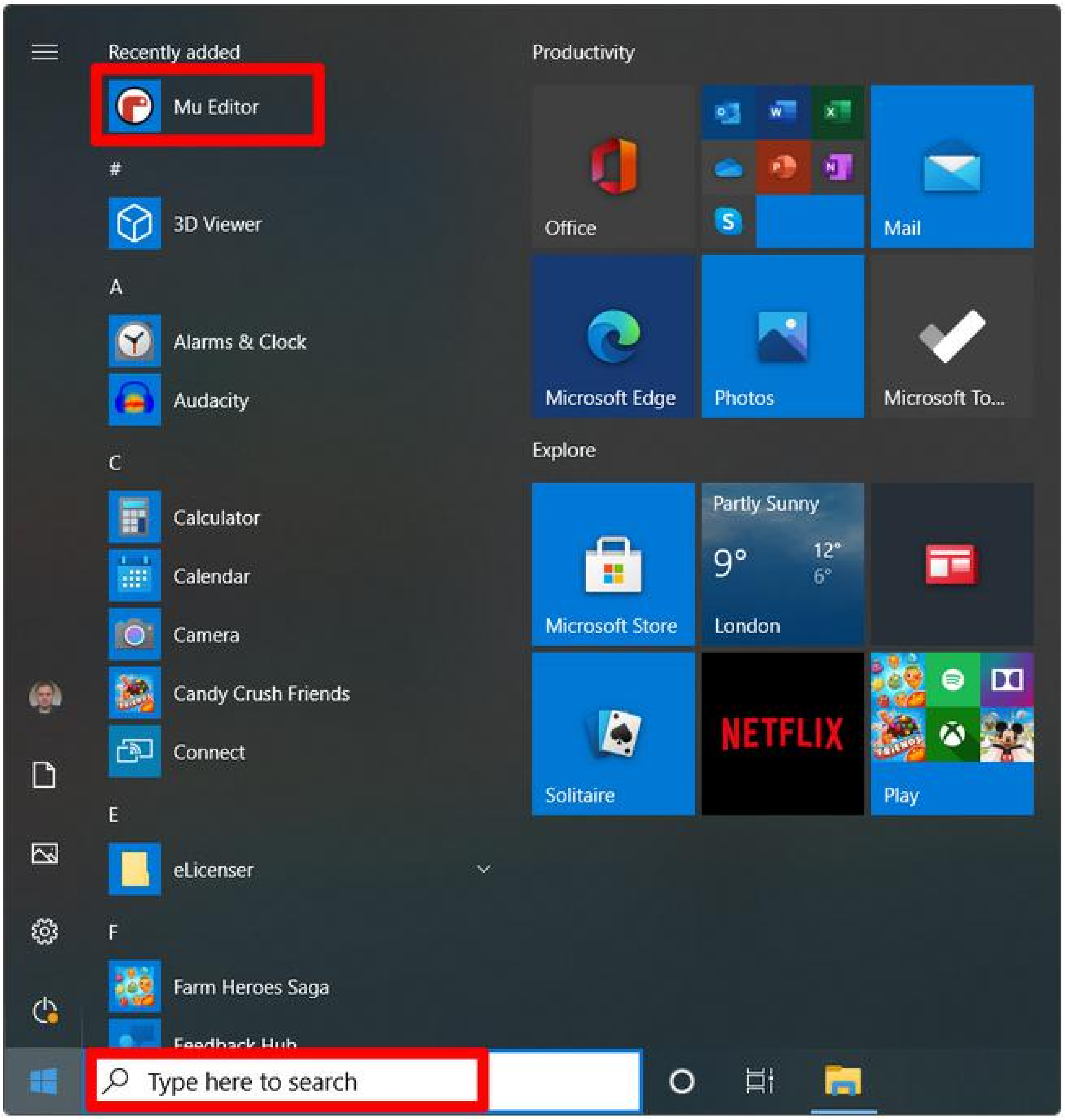

Mu Editor 1.1.0b2 Setup

Completed the Mu Editor 1.1.0b2 Setup Wizard

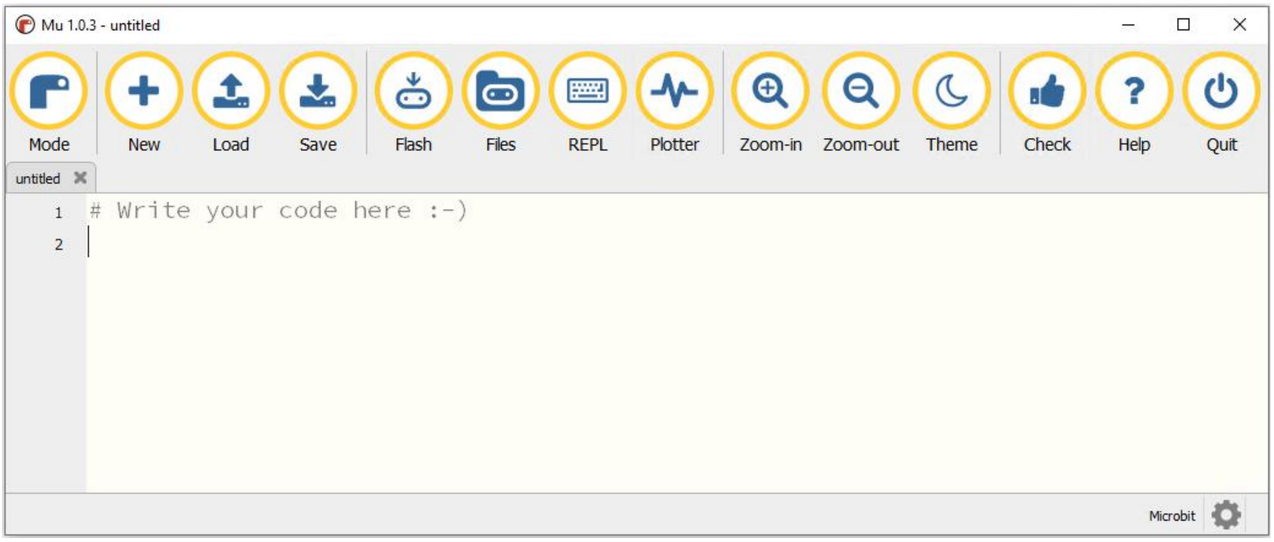
Click the Finish button to exit the Setup Wizard.

Start Mu

Next, find it according to the following picture


Recently added
Mu Editor
#
3D Viewer
A
Alarms & Clock
Audacity
C
Calculator
Calendar
Camera
Candy Crush Friends
Connect
E
eLicenser
F
Farm Heroes Saga
Feedback Hub
Productivity
Office
Mail
Microsoft Edge
Photos
Microsoft To...
Explore
Microsoft Store
Partly Sunny
9°
12°
6°
London
Solitaire
NETFLIX
Play
Type here to search

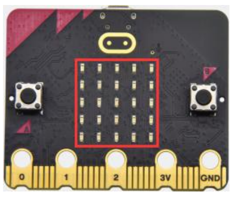
Its main interface is shown as follows:



```
# Write your code here :-)
```

8. Projects

8.1: Heart beat



1. Description:

Prepare a Micro:bit board and USB cable. Next we will conduct a basic experiment that a heartbeat pattern flashes on micro:bit board.

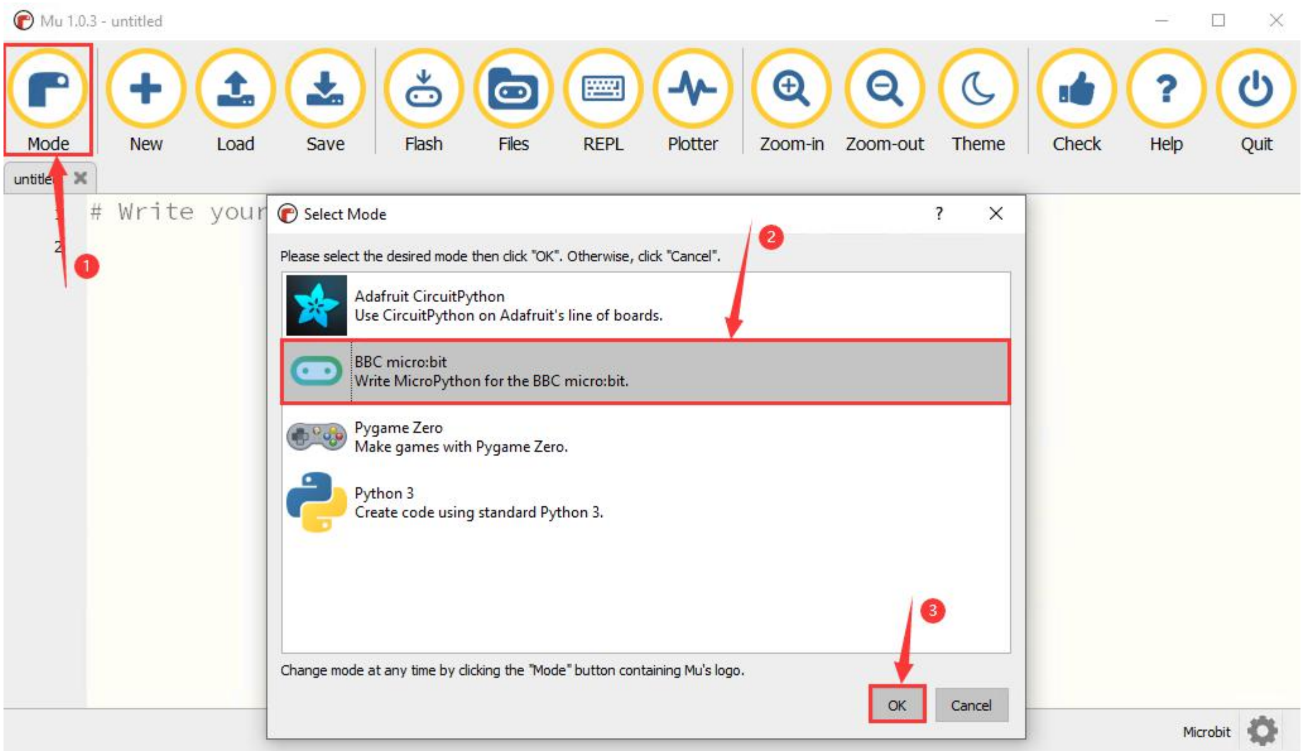
2. Experimental Preparation:

(1) Connect micro:bit to computer with USB cable

(2) Open the offline version of Mu

2. Test Code

Open Mu software, click Mode, then click “BBC micro：bit” and “OK”



Please select the desired mode then click "OK". Otherwise, click "Cancel".

Adafruit CircuitPython
Use CircuitPython on Adafruit's line of boards.

BBC micro:bit
Write MicroPython for the BBC micro:bit.

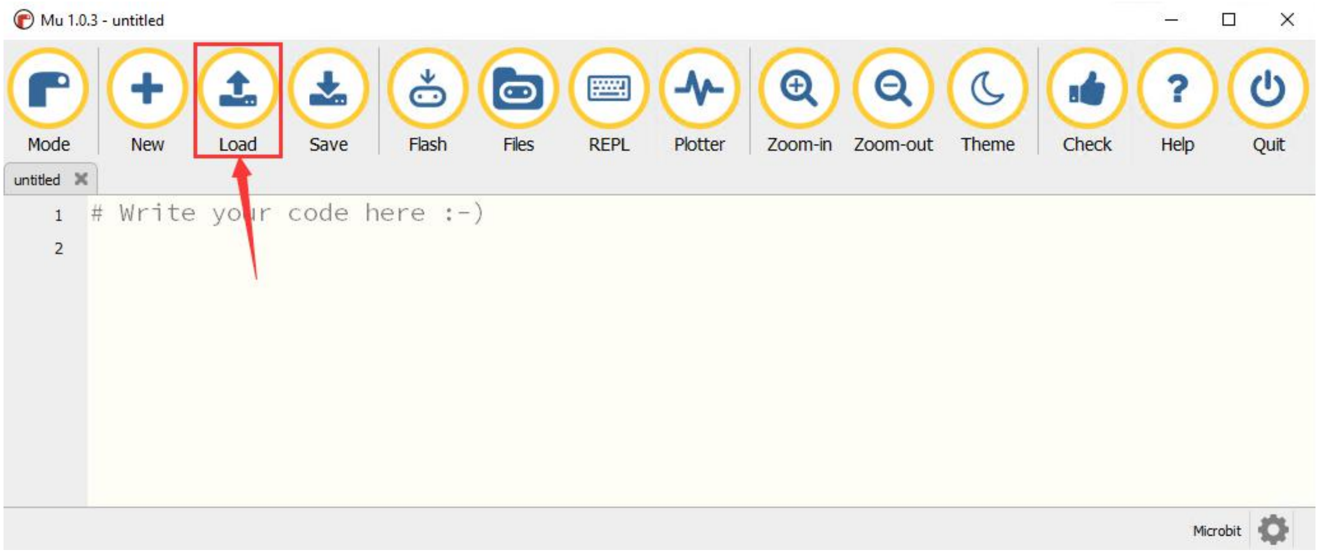
Pygame Zero
Make games with Pygame Zero.

Python 3
Create code using standard Python 3.

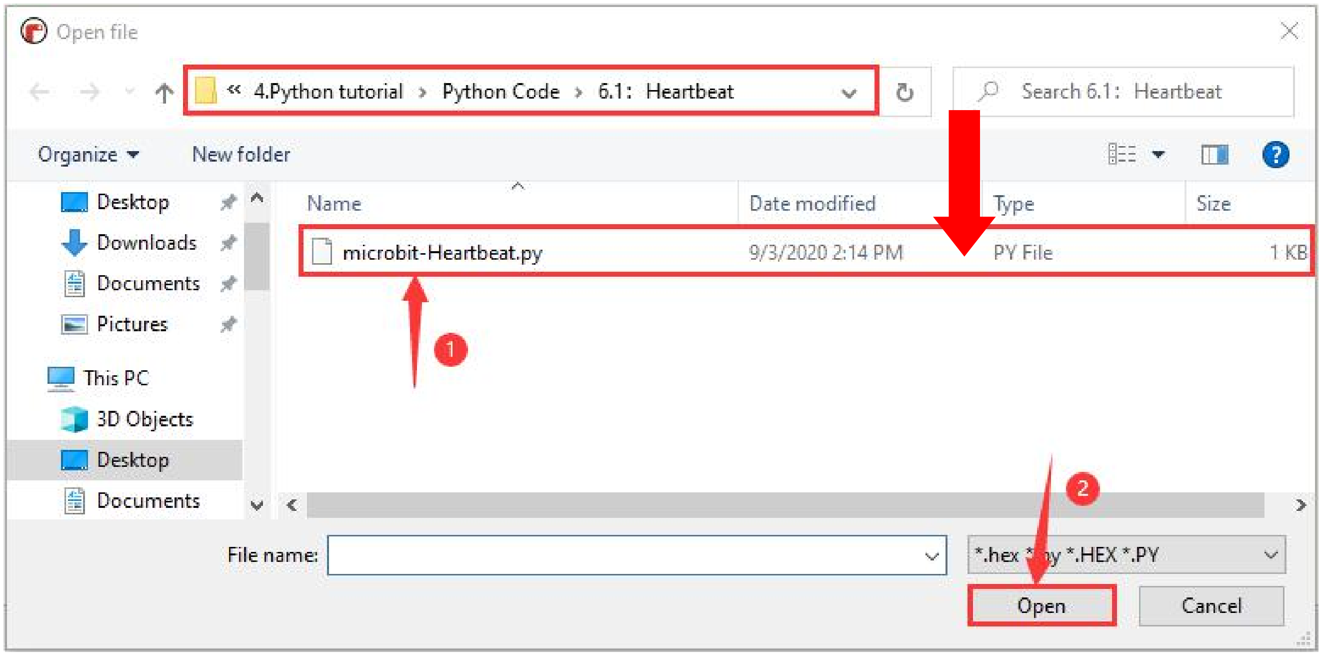
Change mode at any time by clicking the "Mode" button containing Mu's logo.

Tap “Load” , select “microbit-Heartbeat.py” file and click “open”

File Type	Route	File Name
Python file	../Python Code/8.1：Heart beat	microbit-Heart beat.py

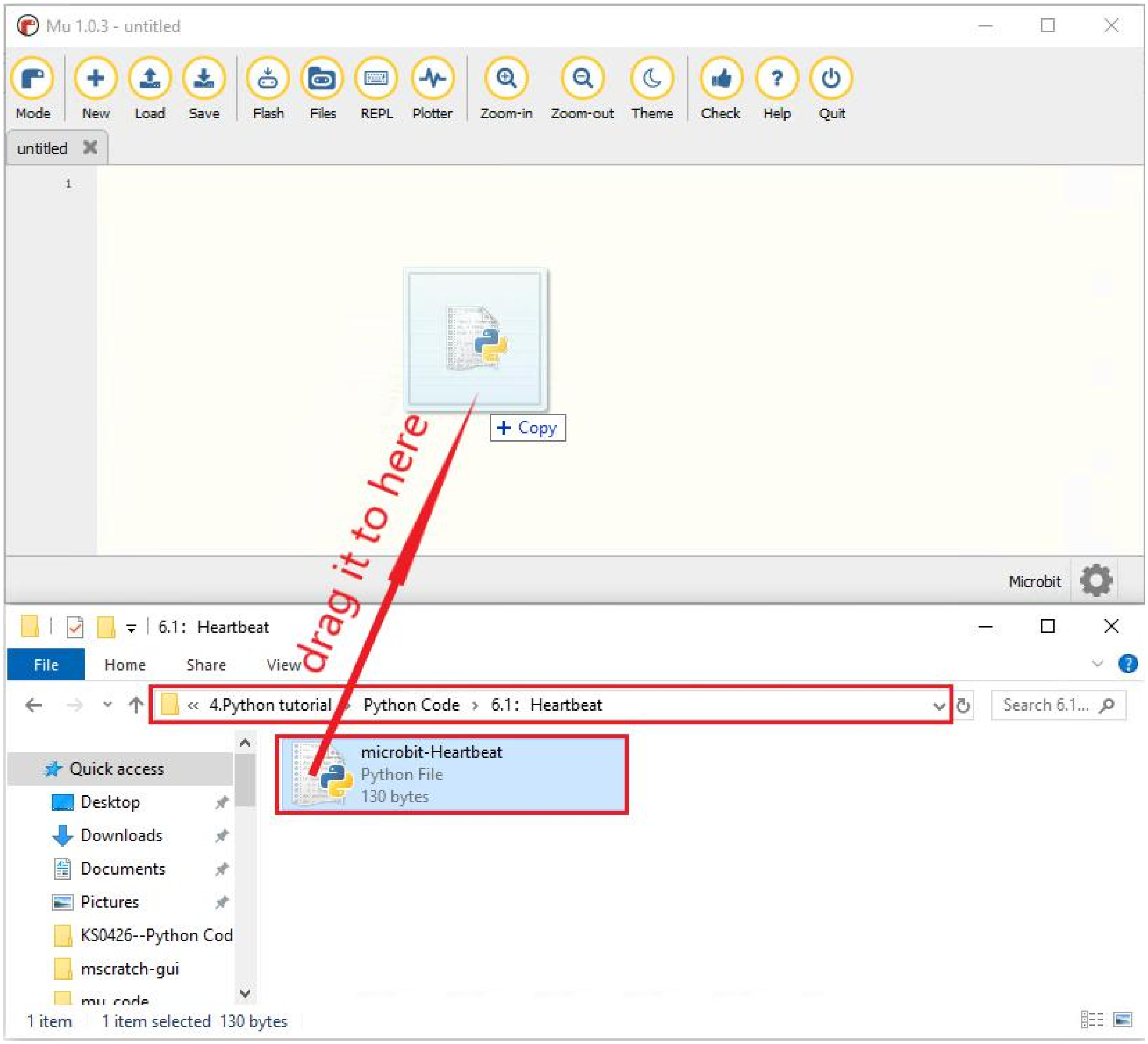


```
# Write your code here :-)
```

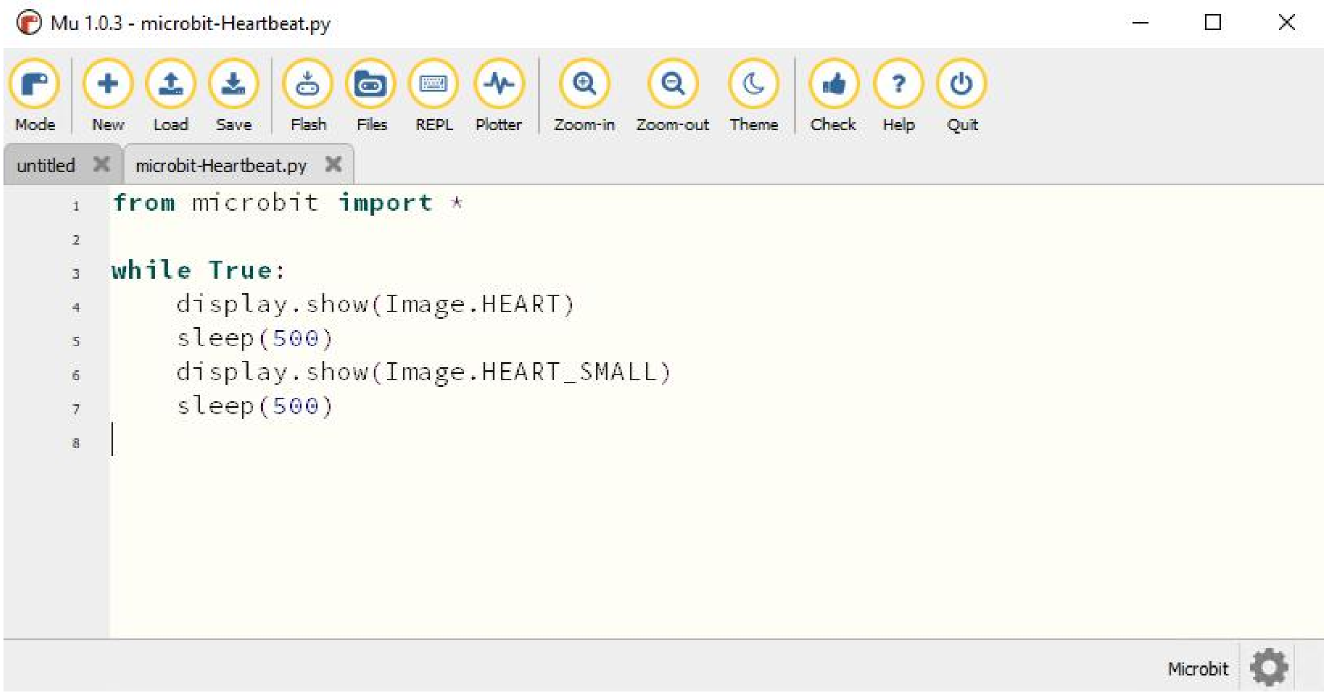


Name	Date modified	Type	Size
microbit-Heartbeat.py	9/3/2020 2:14 PM	PY File	1 KB

There is another way to import code. Open Mu software and drag file "microbit-Heart beat.py" into it.



You can also input code in the edit window yourself. (note:all English words and symbols must be written in English)



```
from microbit import *

while True:
    display.show(Image.HEART)
    sleep(500)
    display.show(Image.HEART_SMALL)
    sleep(500)
```

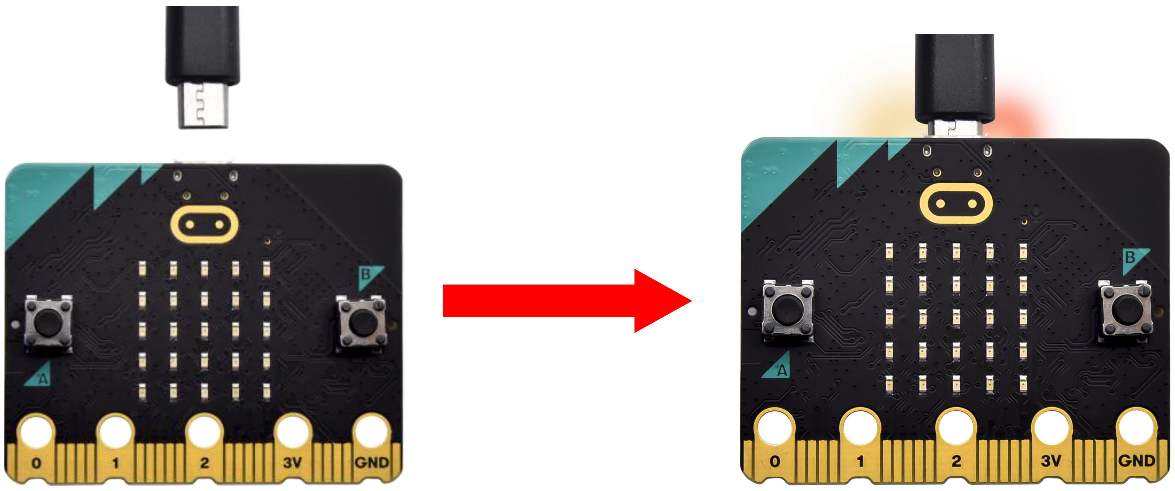
The following is a list of built-in images. If you are interested, you can select one of the following built-in images to replace the "Image.HEART" in the function show () in the figure above.

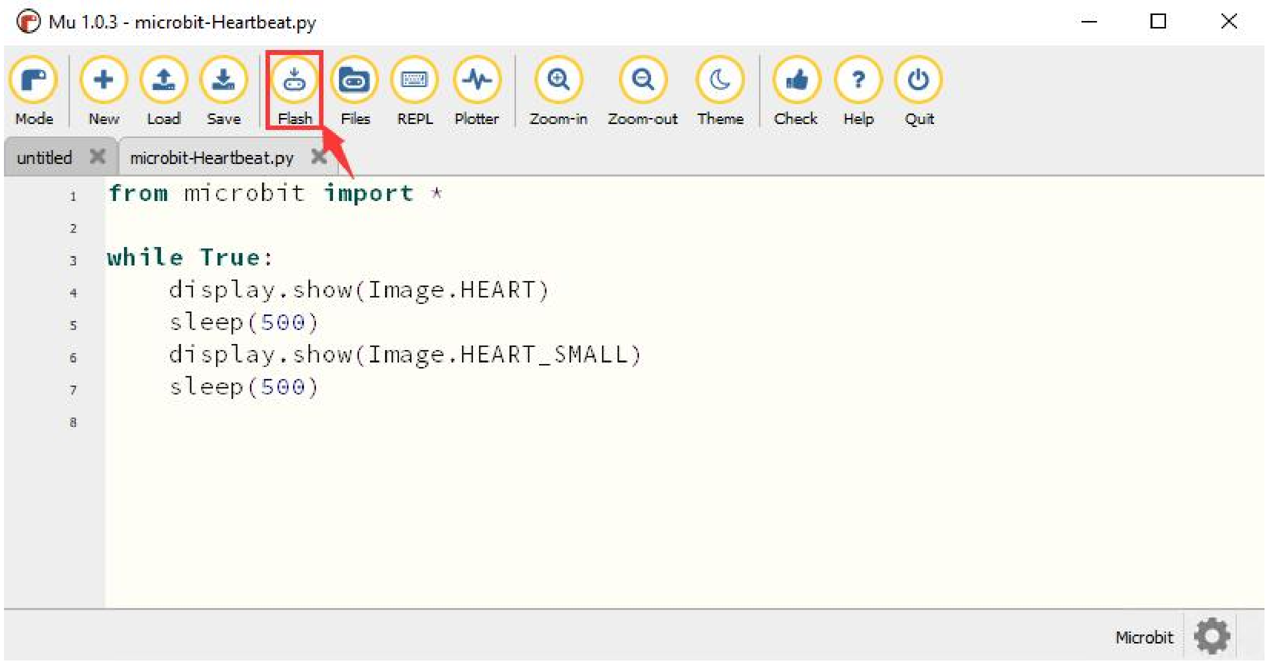
- Image.HEART
- Image.HEART_SMALL
- Image.HAPPY
- Image.SMILE
- Image.SAD
- Image.CONFUSED
- Image.ANGRY
- Image.ASLEEP

- Image.SURPRISED
- Image.SILLY
- Image.FABULOUS
- Image.MEH
- Image.YES
- Image.NO
- Image.CLOCK12, Image.CLOCK11, Image.CLOCK10, Image.CLOCK9,
Image.CLOCK8, Image.CLOCK7, Image.CLOCK6, Image.CLOCK5,
  Image.CLOCK4, Image.CLOCK3, Image.CLOCK2,Image.CLOCK1
- Image.ARROW_N, Image.ARROW_NE, Image.ARROW_E,
  Image.ARROW_SE, Image.ARROW_S, Image.ARROW_SW,
  Image.ARROW_W, Image.ARROW_NW
- Image.TRIANGLE
- Image.TRIANGLE_LEFT
- Image.CHESSBOARD
- Image.DIAMOND
- Image.DIAMOND_SMALL
- Image.SQUARE
- Image.SQUARE_SMALL
- Image.RABBIT
- Image.COW
- Image.MUSIC_CROTCHET

- Image.MUSIC_QUAVER
- Image.MUSIC_QUAVERS
- Image.PITCHFORK
- Image.PACMAN
- Image.TARGET
- Image.TSHIRT
- Image.ROLLERSKATE
- Image.DUCK
- Image.HOUSE
- Image.TORTOISE
- Image.BUTTERFLY
- Image.STICKFIGURE
- Image.GHOST
- Image.SWORD
- Image.GIRAFFE
- Image.SKULL
- Image.UMBRELLA
- Image.SNAKE，Image.ALL_CLOCKS，Image.ALL_ARROWS

Connect micro:bit board to computer with USB cable, click “Flash” to download code to micro:bit board.

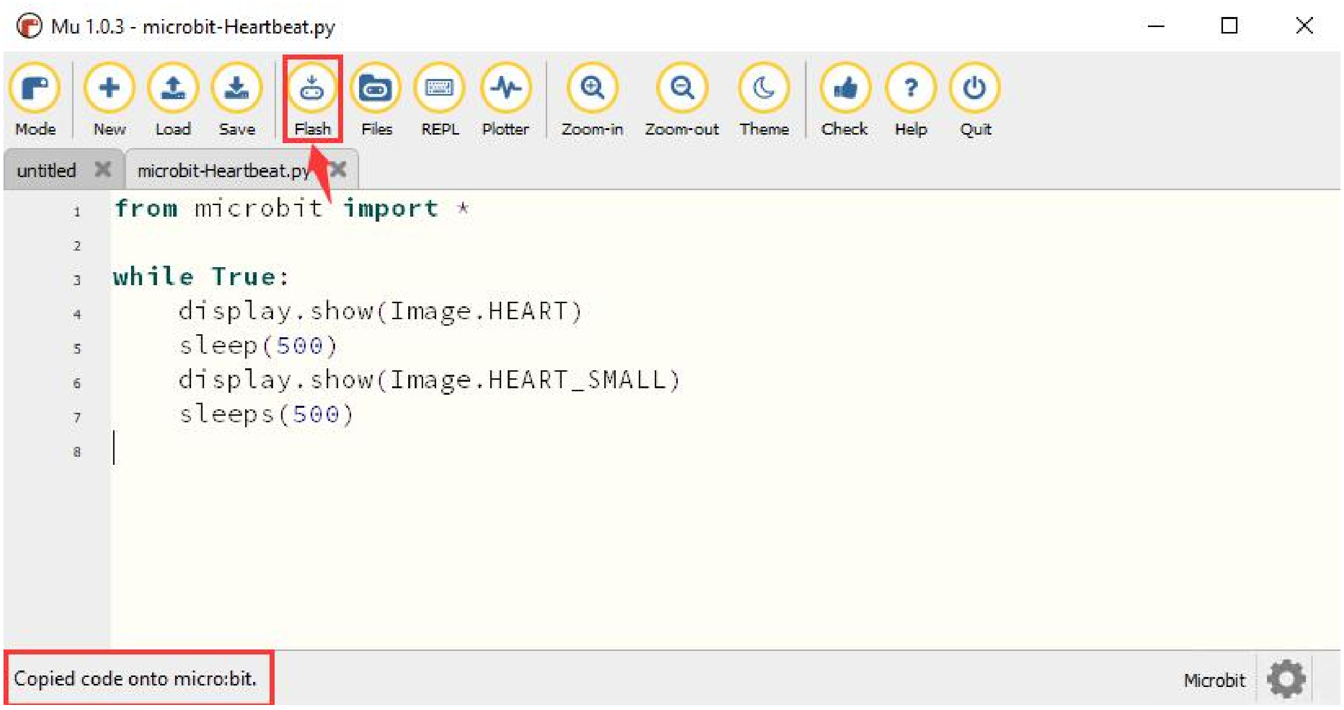




```
from microbit import *

while True:
    display.show(Image.HEART)
    sleep(500)
    display.show(Image.HEART_SMALL)
    sleep(500)
```

The code, even it is wrong, can be downloaded to micro:bit board successfully, yet not working on micro:bit board.

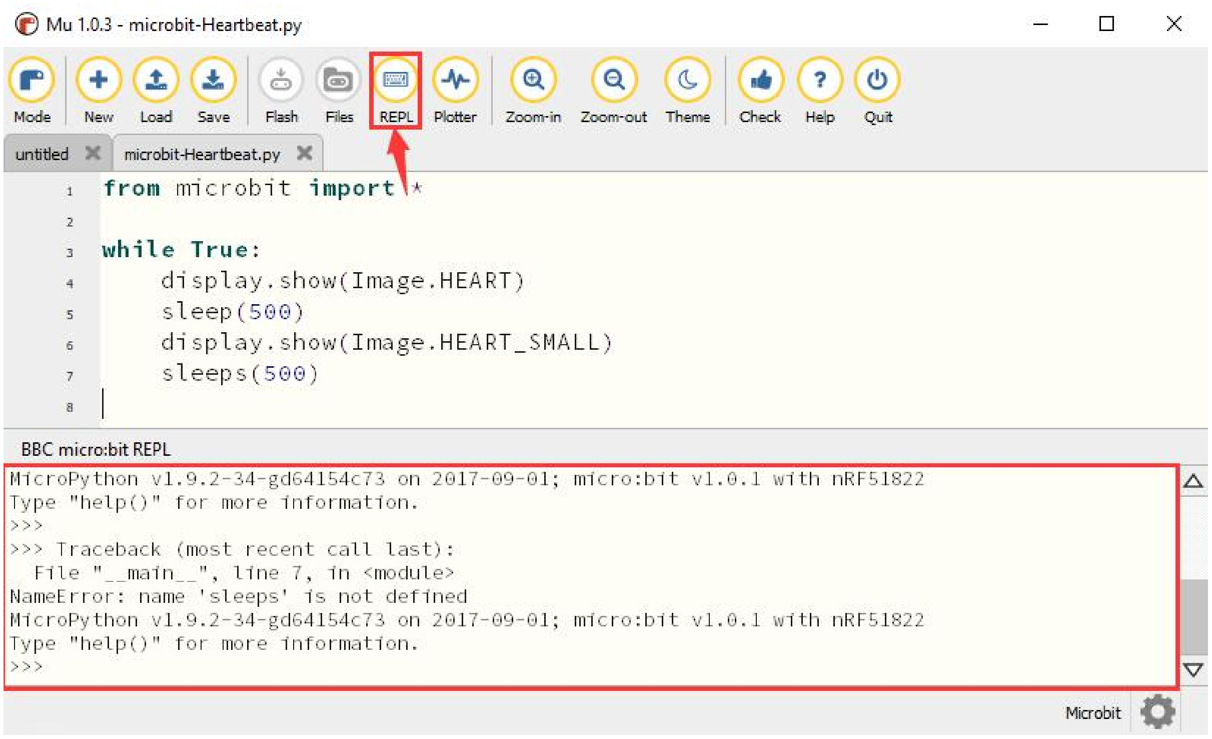
Click “Flash” to download code to micro:bit.



```
from microbit import *

while True:
    display.show(Image.HEART)
    sleep(500)
    display.show(Image.HEART_SMALL)
    sleeps(500)
```

Copied code onto micro:bit.

Click “REPL” and press the reset button on micro:bit, the error information will be displayed on REPL window, as shown below:

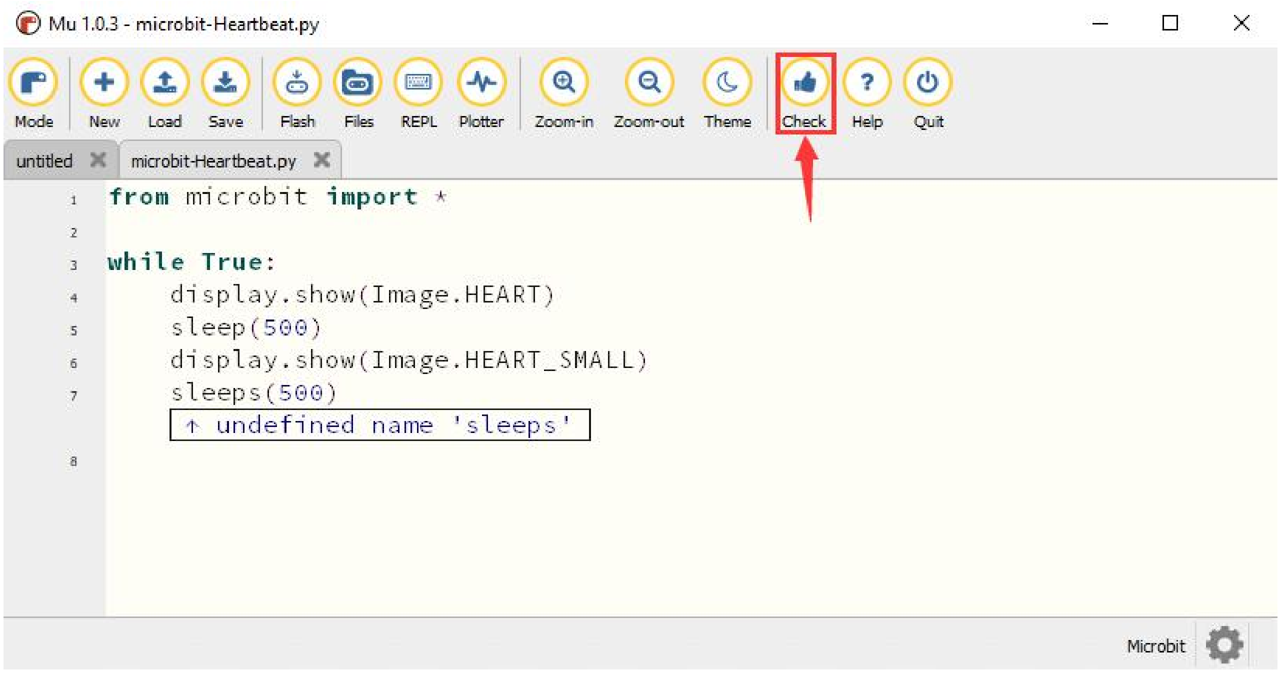


```
from microbit import *

while True:
    display.show(Image.HEART)
    sleep(500)
    display.show(Image.HEART_SMALL)
    sleeps(500)
```

BBC micro:bit REPL

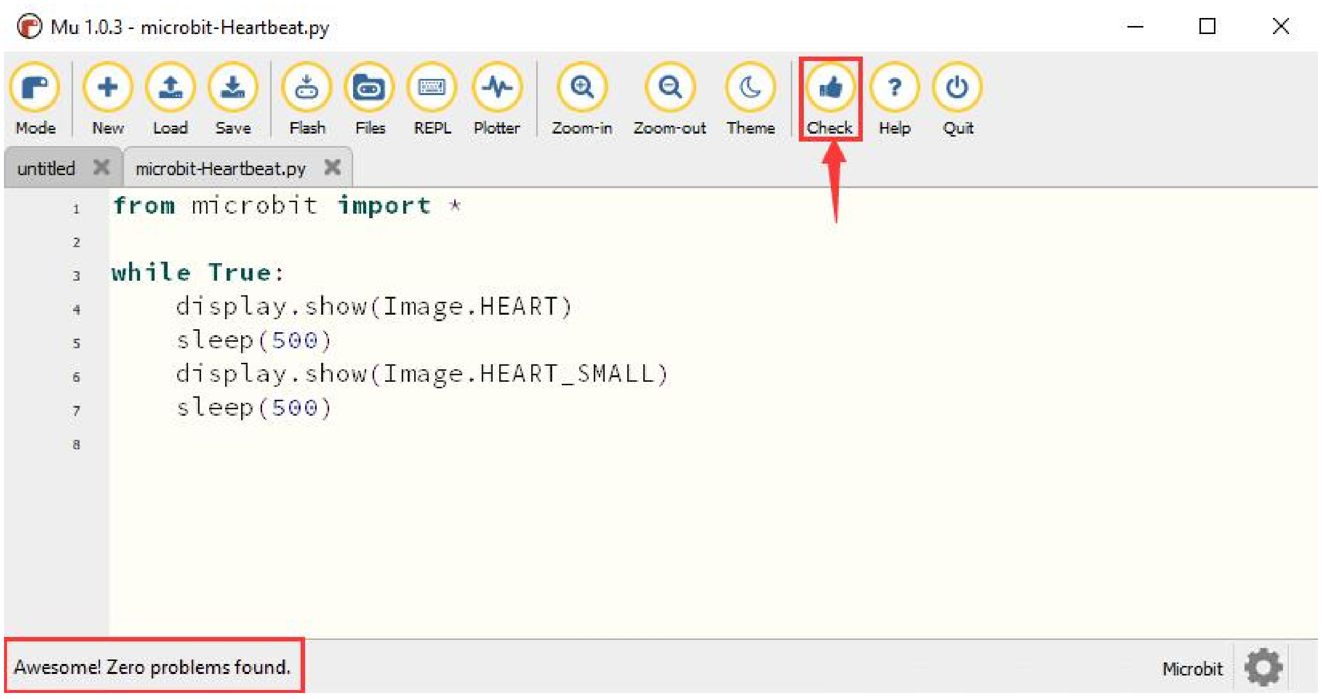
```
MicroPython v1.9.2-34-gd64154c73 on 2017-09-01; micro:bit v1.0.1 with nRF51822
Type "help()" for more information.
>>>
>>> Traceback (most recent call last):
  File "__main__", line 7, in <module>
NameError: name 'sleeps' is not defined
MicroPython v1.9.2-34-gd64154c73 on 2017-09-01; micro:bit v1.0.1 with nRF51822
Type "help()" for more information.
>>>
```

Click “REPL” again to turn off REPL mode, then you could refresh new code. To make sure code correct, you only need to tap “Check” . The errors will be shown on the window.



```
from microbit import *

while True:
    display.show(Image.HEART)
    sleep(500)
    display.show(Image.HEART_SMALL)
    sleeps(500)
    ↑ undefined name 'sleeps'
```

Modify the code according the prompt and click “Check”



```
from microbit import *

while True:
    display.show(Image.HEART)
    sleep(500)
    display.show(Image.HEART_SMALL)
    sleep(500)
```

Awesome! Zero problems found.

More tutorials, log in website please:https://codewith.mu/en/tutorials/

Test Result:

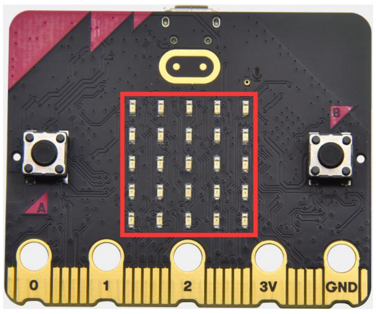
After testing, click “Flash” and download code to micro:bit, plug in power with USB cable. The micro:bit board shows “❤ ” and “▦” in loop way

Code Explanation：

from microbit **import** *	Import the library file of micro：bit
while True:	This is a permanent loop that makes micro:bit execute the code of it.
display.show(Image.HEART)	micro：bit shows “❤ ”

sleep(500)	Delay in 500ms
display.show(Image.HEART_SMALL)	micro：bit displays “▦”

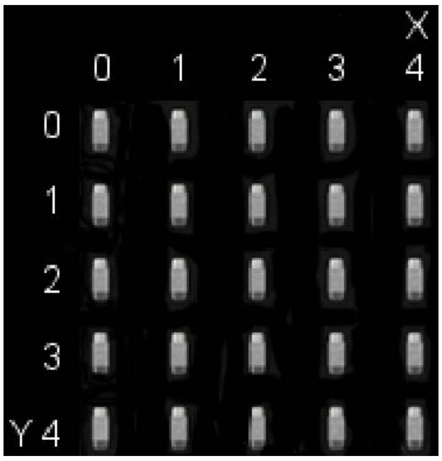
8.2: Light Up a Single LED



1. Description：

Micro:bit motherboard consists of 25 light-emitting diodes, 5 pcs in a group. They correspond to x and y axis. Then the 5*5 matrix is formed. Moreover, every diode locates at the point of x and y axis.

Virtually, we could control an LED by setting coordinate points. For instance, set coordinate point (0, 0) to turn on the LED at row 1 and column 1; light up LED at the row 1 and column 3, we could set （2， 0) and so on.



2. Experimental Preparation:

(1) Link micro:bit board with computer via USB cable.

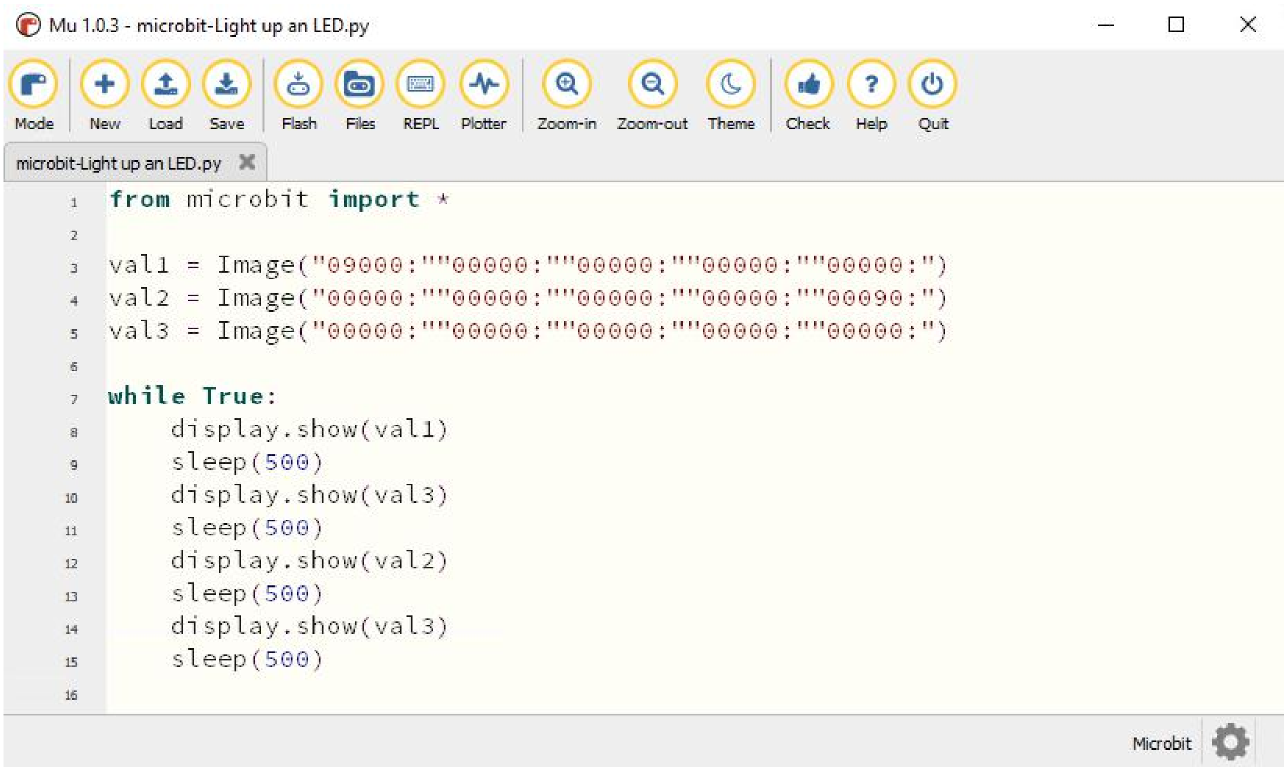
(2) Open the offline version of Mu

3. Test Code

Enter Mu software and open the file "microbit-Light Up a Single LED" to import code: (How to load the project code?)

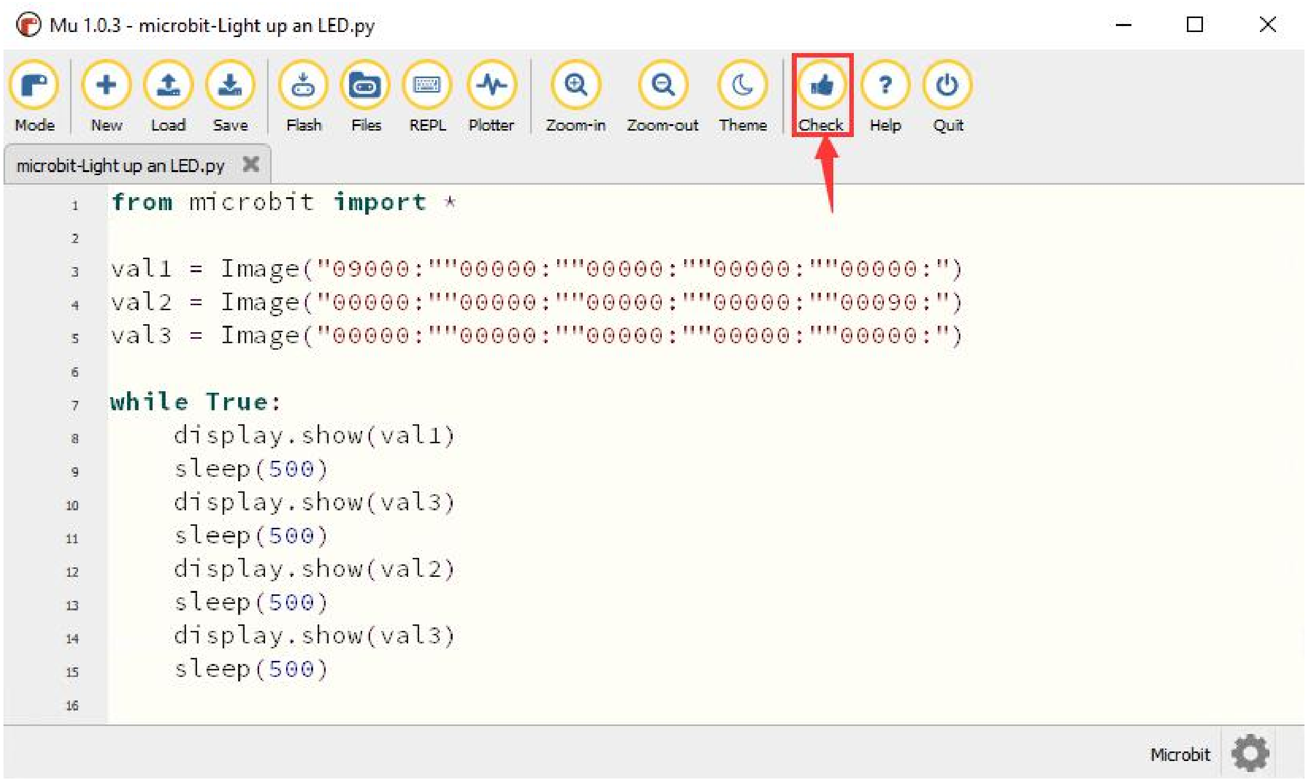
Type	Route	File Name
Python file	../Python Code/6.2: Light Up a Single LED	microbit-Light Up a Single LED.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



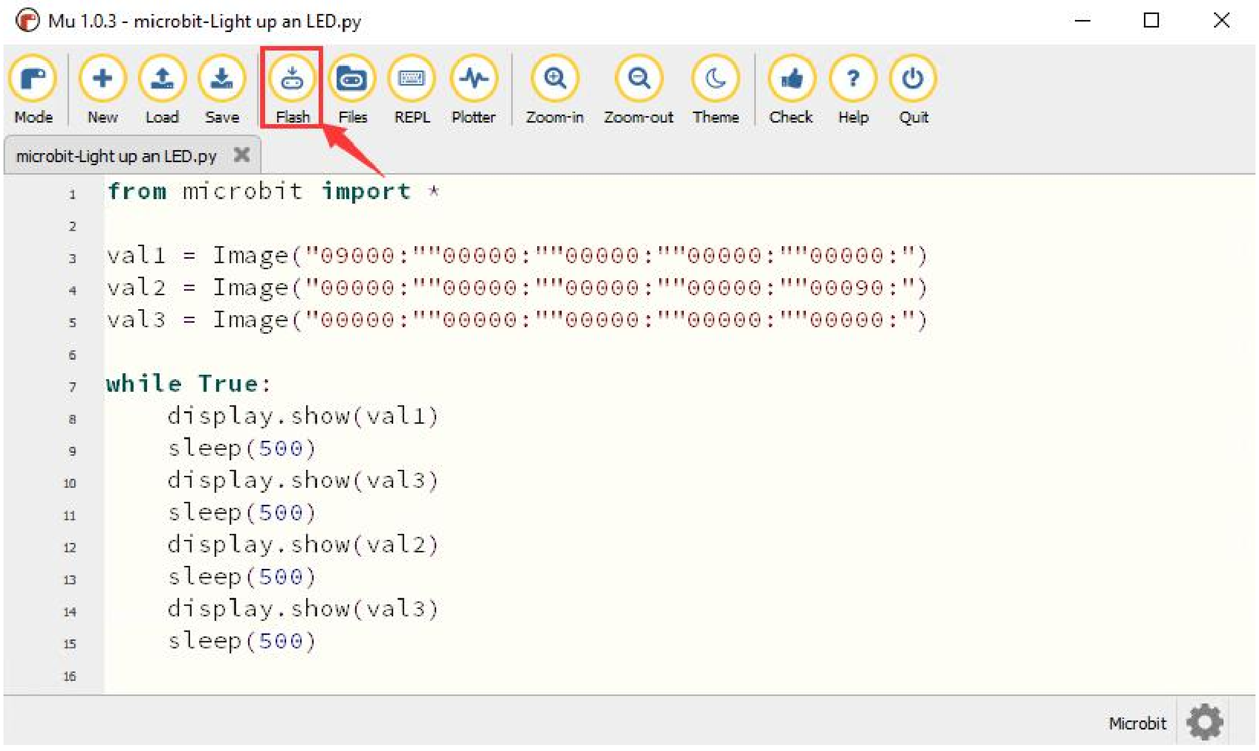
```
from microbit import *

val1 = Image("09000:""00000:""00000:""00000:""00000:")
val2 = Image("00000:""00000:""00000:""00000:""00090:")
val3 = Image("00000:""00000:""00000:""00000:""00000:")

while True:
    display.show(val1)
    sleep(500)
    display.show(val3)
    sleep(500)
    display.show(val2)
    sleep(500)
    display.show(val3)
    sleep(500)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



```
from microbit import *

val1 = Image("09000:""00000:""00000:""00000:""00000:")
val2 = Image("00000:""00000:""00000:""00000:""00090:")
val3 = Image("00000:""00000:""00000:""00000:""00000:")

while True:
    display.show(val1)
    sleep(500)
    display.show(val3)
    sleep(500)
    display.show(val2)
    sleep(500)
    display.show(val3)
    sleep(500)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```
from microbit import *

val1 = Image("09000:""00000:""00000:""00000:""00000:")
val2 = Image("00000:""00000:""00000:""00000:""00090:")
val3 = Image("00000:""00000:""00000:""00000:""00000:")

while True:
    display.show(val1)
    sleep(500)
    display.show(val3)
    sleep(500)
    display.show(val2)
    sleep(500)
    display.show(val3)
    sleep(500)
```

4. Test Result:

After downloading code, plug in power with USB cable, you will see the LED at(1,0) flashes for 0.5s then the LED at (3,4) blinks for 0.5s, in loop way.

5.Code Explanation:

from microbit **import** *	Import the library file of micro: bit
val1 = Image("09000:""00000:""00000:""00000:""00000:")	Set Image() to val1 Set pixel of LED on micro:bit to the value in 0~9

val2 = Image("00000:""00000:""00000:""00000:""00090:") val3 = Image("00000:""00000:""00000:""00000:""00000:")	Pixel of each LED on micro:bit can be set in one of ten values If set pixel to 0 (zero) , which means in close state, literally, 0 is brightness, 9 is best brightness Set Image() to val2 Set Image() to val3
while True:	This is a permanent loop that makes micro:bit execute the code of it.
display.show(val1) sleep(500) display.show(val3) sleep(500)	LED at (1,0) blinks for 0.5s
display.show(val2) sleep(500) display.show(val3) sleep(500)	LED at (3,4) flashes for 0.5s

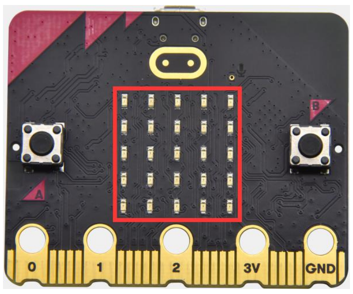
6. Reference

sleep(ms) : delay time

For more details about delay, please refer to:

https://microbit-micropython.readthedocs.io/en/latest/utime.html

8.3: 5 x 5 LED Dot Matrix



1. Description:

Dot matrix gains popularity in our life, such as LED screen, bus station and the mini TV in the lift.

The dot matrix of Micro:bit board consists of 25 light emitting diodes. In previous lesson, we control LED of Micro:bit board to form patterns, numbers and character strings by setting the coordinate points. Moreover, we could adopt another way to complete the display of patterns, numbers and character strings.

2. Experimental Preparation:

(1) Link micro:bit board with computer via USB cable.

(2) Open the offline version of Mu

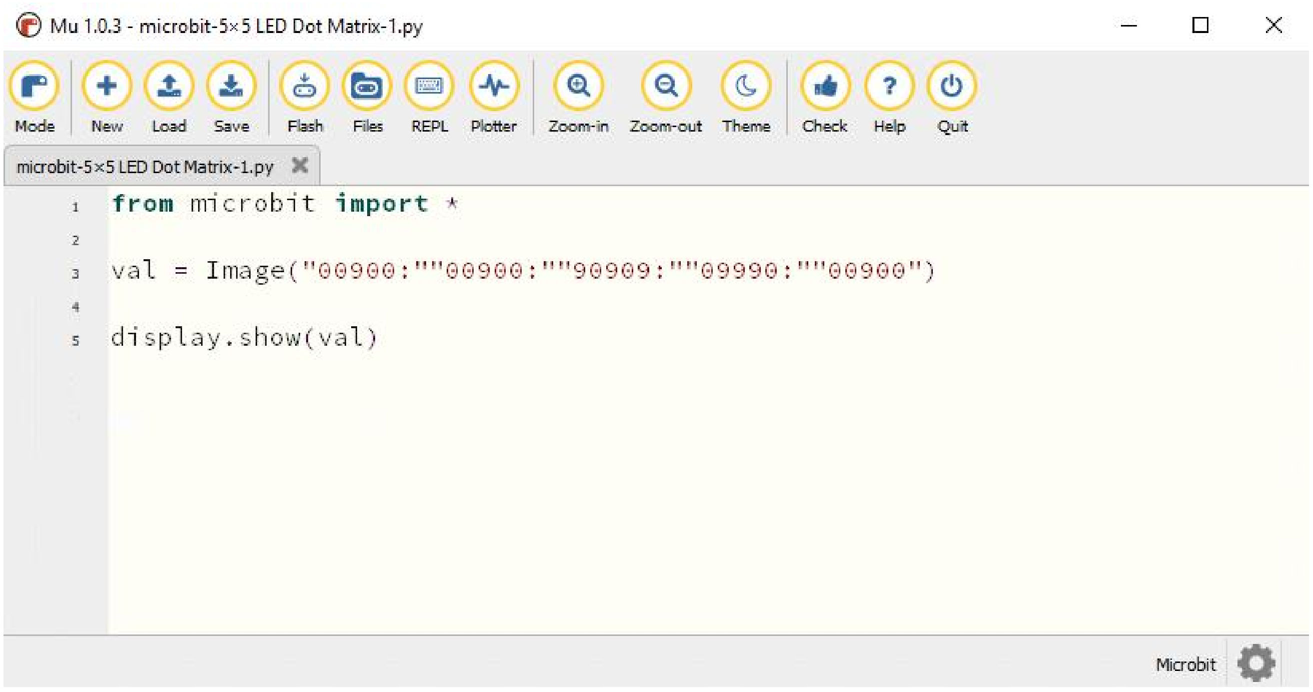
3. Test Code

Code 1:

You could open "Code-1.py" file to Import code (How to load the project code?)

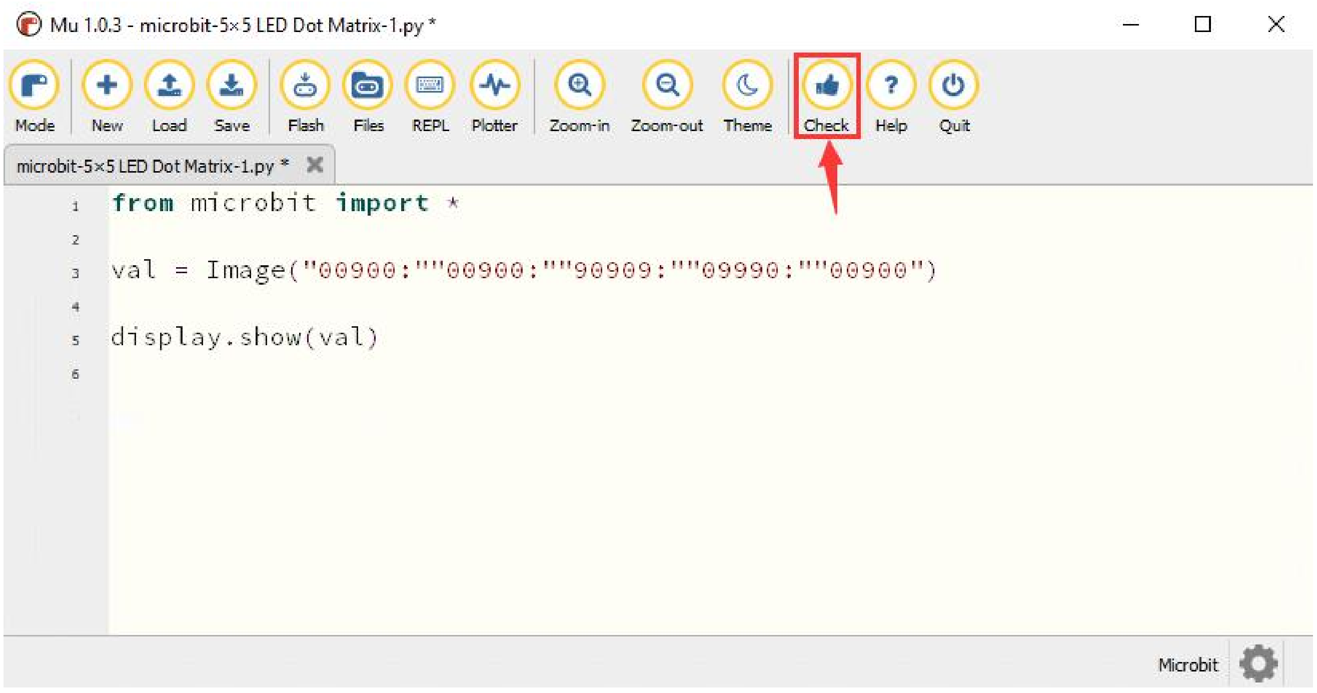
File Type	Route	File Name
Python file	../Python code/8.3: 5×5 LED Dot Matrix	microbit-Code-1.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



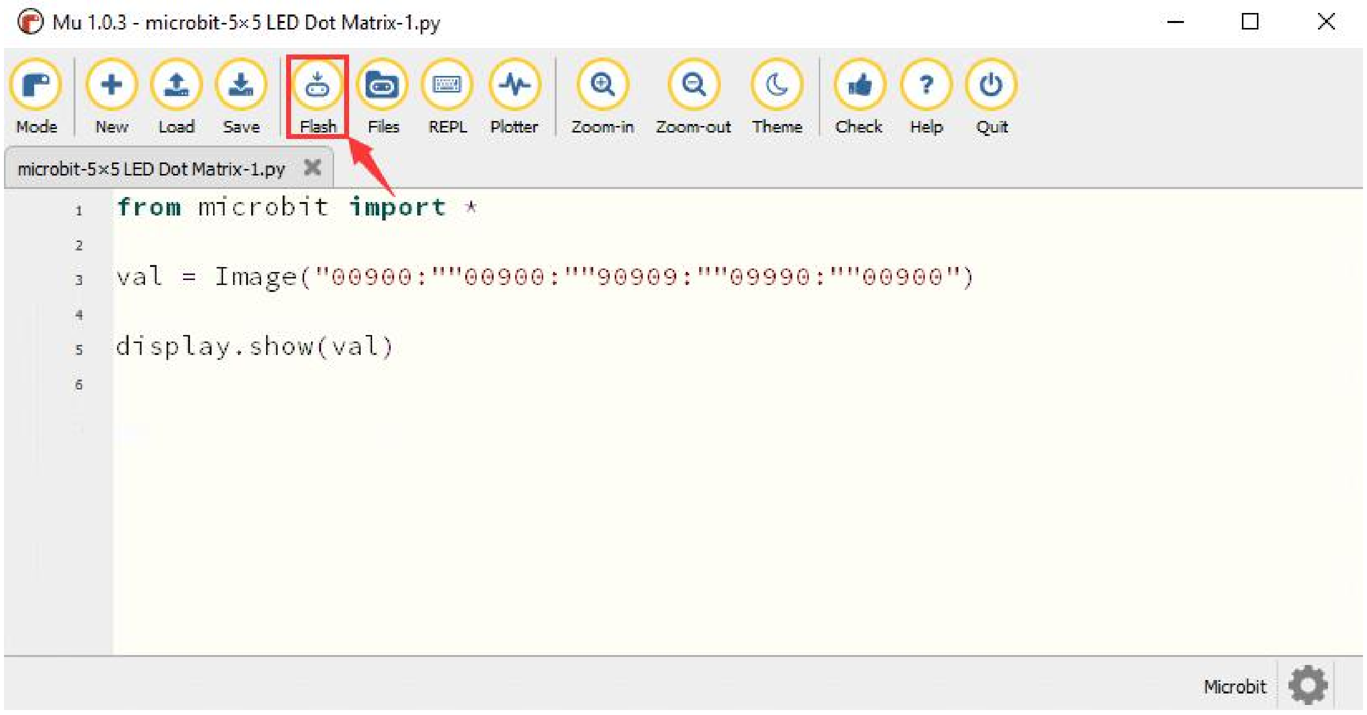
```
from microbit import *

val = Image("00900:""00900:""90909:""09990:""00900")

display.show(val)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-5×5 LED Dot Matrix-1.py *
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-5×5 LED Dot Matrix-1.py *
Microbit

```
from microbit import *

val = Image("00900:""00900:""90909:""09990:""00900")

display.show(val)

```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



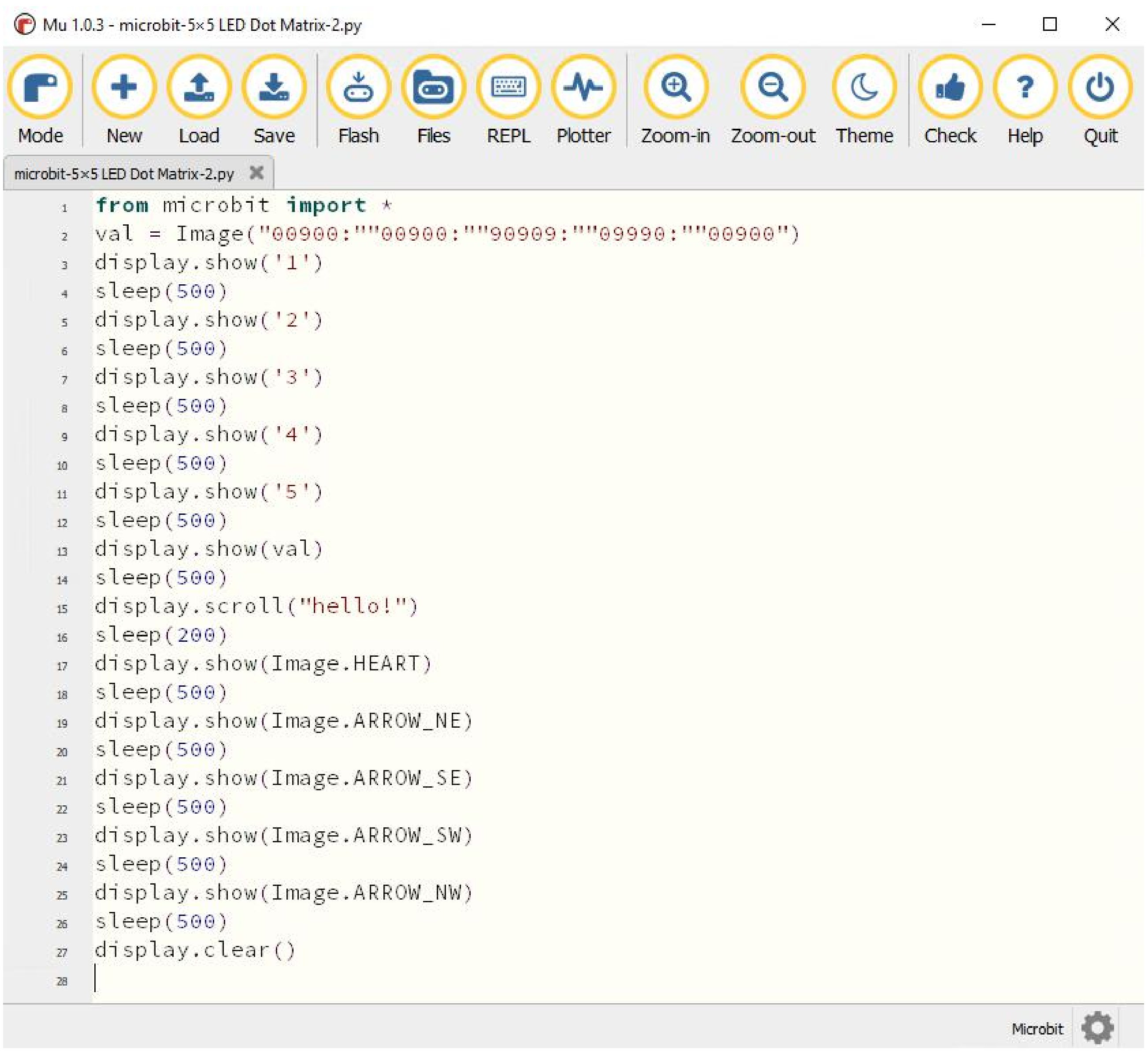
```
from microbit import *

val = Image("00900:""00900:""90909:""09990:""00900")

display.show(val)

```

Code 2：

Enter Mu software and open “Code-2.py “file to import code（How to load the project code?）

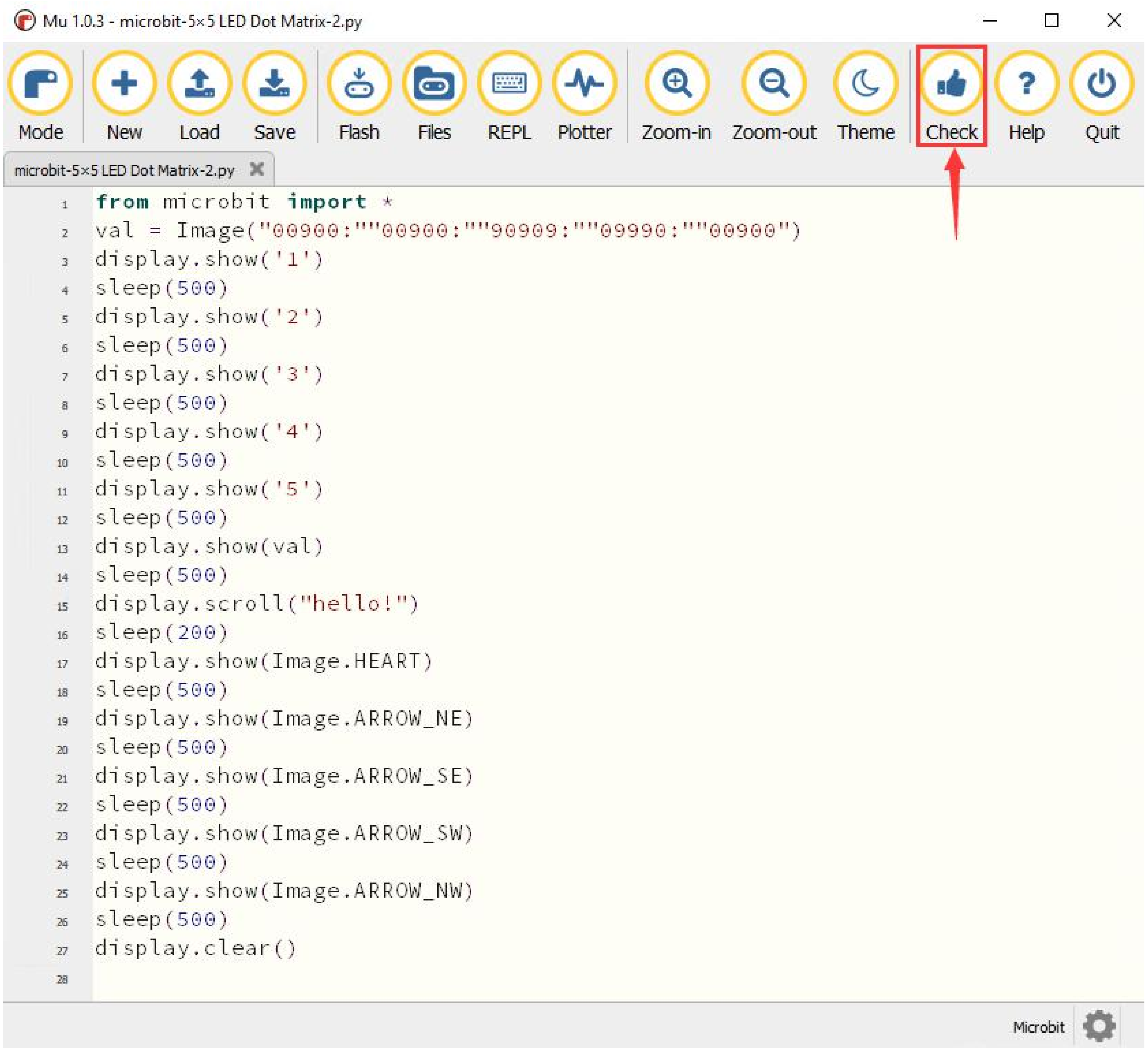
File Type	Route	File Name
Python file	../Python code/8.3： 5×5 LED Dot Matrix	microbit-Code-2.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



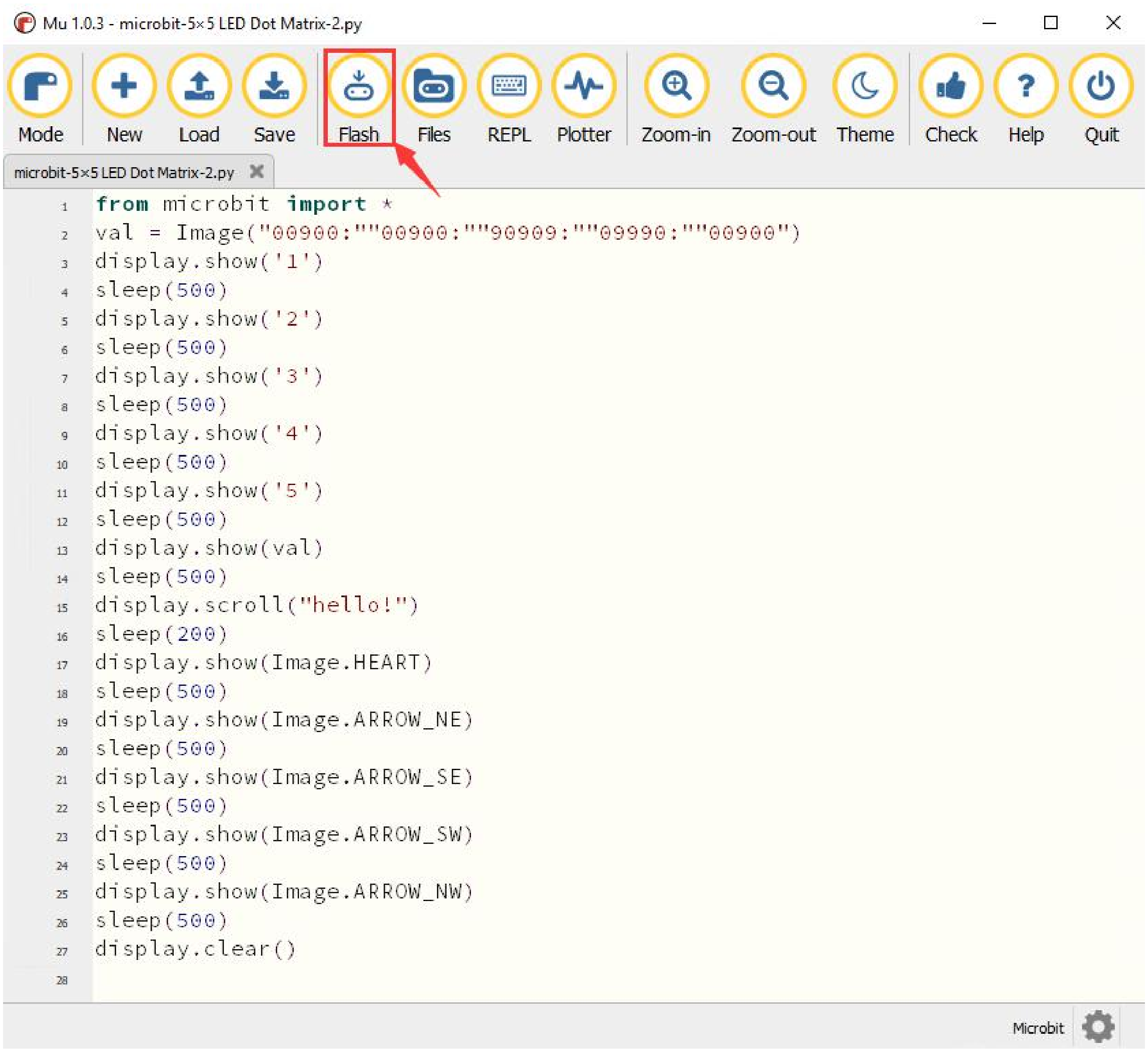
```
from microbit import *
val = Image("00900:""00900:""90909:""09990:""00900")
display.show('1')
sleep(500)
display.show('2')
sleep(500)
display.show('3')
sleep(500)
display.show('4')
sleep(500)
display.show('5')
sleep(500)
display.show(val)
sleep(500)
display.scroll("hello!")
sleep(200)
display.show(Image.HEART)
sleep(500)
display.show(Image.ARROW_NE)
sleep(500)
display.show(Image.ARROW_SE)
sleep(500)
display.show(Image.ARROW_SW)
sleep(500)
display.show(Image.ARROW_NW)
sleep(500)
display.clear()
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



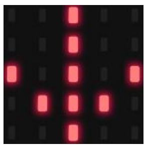
```
from microbit import *
val = Image("00900:""00900:""90909:""09990:""00900")
display.show('1')
sleep(500)
display.show('2')
sleep(500)
display.show('3')
sleep(500)
display.show('4')
sleep(500)
display.show('5')
sleep(500)
display.show(val)
sleep(500)
display.scroll("hello!")
sleep(200)
display.show(Image.HEART)
sleep(500)
display.show(Image.ARROW_NE)
sleep(500)
display.show(Image.ARROW_SE)
sleep(500)
display.show(Image.ARROW_SW)
sleep(500)
display.show(Image.ARROW_NW)
sleep(500)
display.clear()
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.

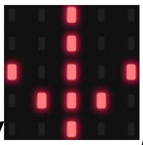
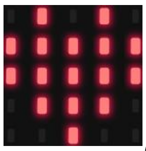
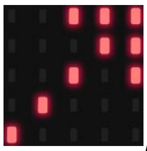
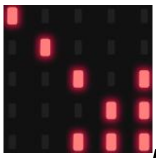
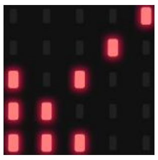


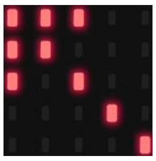
```
from microbit import *
val = Image("00900:""00900:""90909:""09990:""00900")
display.show('1')
sleep(500)
display.show('2')
sleep(500)
display.show('3')
sleep(500)
display.show('4')
sleep(500)
display.show('5')
sleep(500)
display.show(val)
sleep(500)
display.scroll("hello!")
sleep(200)
display.show(Image.HEART)
sleep(500)
display.show(Image.ARROW_NE)
sleep(500)
display.show(Image.ARROW_SE)
sleep(500)
display.show(Image.ARROW_SW)
sleep(500)
display.show(Image.ARROW_NW)
sleep(500)
display.clear()

```

4. Test Result:

Download code 1 to micro:bit and keep USB cable connected , we will see the  icon.

Download code 2. Micro: bit starts showing number 1, 2, 3, 4, and 5, then

cyclically display, “Hello!” , , , , 

and patterns.

5.Code Explanation:

from microbit **import** *	Import the library file of micro：bit
val = Image("09000:""00000:""00000:""00000:""00000:")	Set Image() to variable val
display.show(val)	micro:bit shows “→”
display.show('1')	micro:bit shows “1”
sleep(500)	Delay in 500ms
display.scroll("hello!")	micro:bit scrolls to show “hello!”
display.show(Image.HEART)	micro:bit displays “❤” pattern

display.show(Image.ARROW_NE)
 	
display.show(Image.ARROW_SE)
 	
display.show(Image.ARROW_SW)
 	
display.show(Image.ARROW_NW)
	micro:bit shows “Northeast” arrow
	
	micro:bit displays “Southeast” arrow
	
	micro:bit shows “Southwest” arrow
	
	micro:bit displays “Northwest” arrow

display.clear()	The LED dot matrix of micro:bit clears

6. Reference:

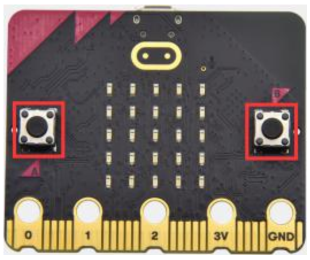
display.scroll() : scroll to display the value on screen. If the value is integer or float, transfer it into character string via str（）.

The display scrolls to show the values, if it is integer or float, we use str（）to transfer into character strings.

More details, please refer to

https://microbit-micropython.readthedocs.io/en/latest/utime.html

8.4: Programmable Buttons



1. Description:

The button can control the on and off of the circuit. The button is attached to the circuit. The circuit is disconnected when the button is not pressed. The circuit is connected as soon as it is pressed, but it is disconnected after being released.

Both ends of button are like two mountains. There is a river in between. The internal metal piece connect the two sides to let the current pass, just like building a bridge to connect the two mountains.

Micro:bit board has three buttons, the reset button on the back and two programmable buttons on the front. By pressing these buttons, the corresponding characters will be displayed on dot matrix.

2. Experimental Preparation:

(1) Link micro:bit board with computer via USB cable.

(2) Open the offline version of Mu

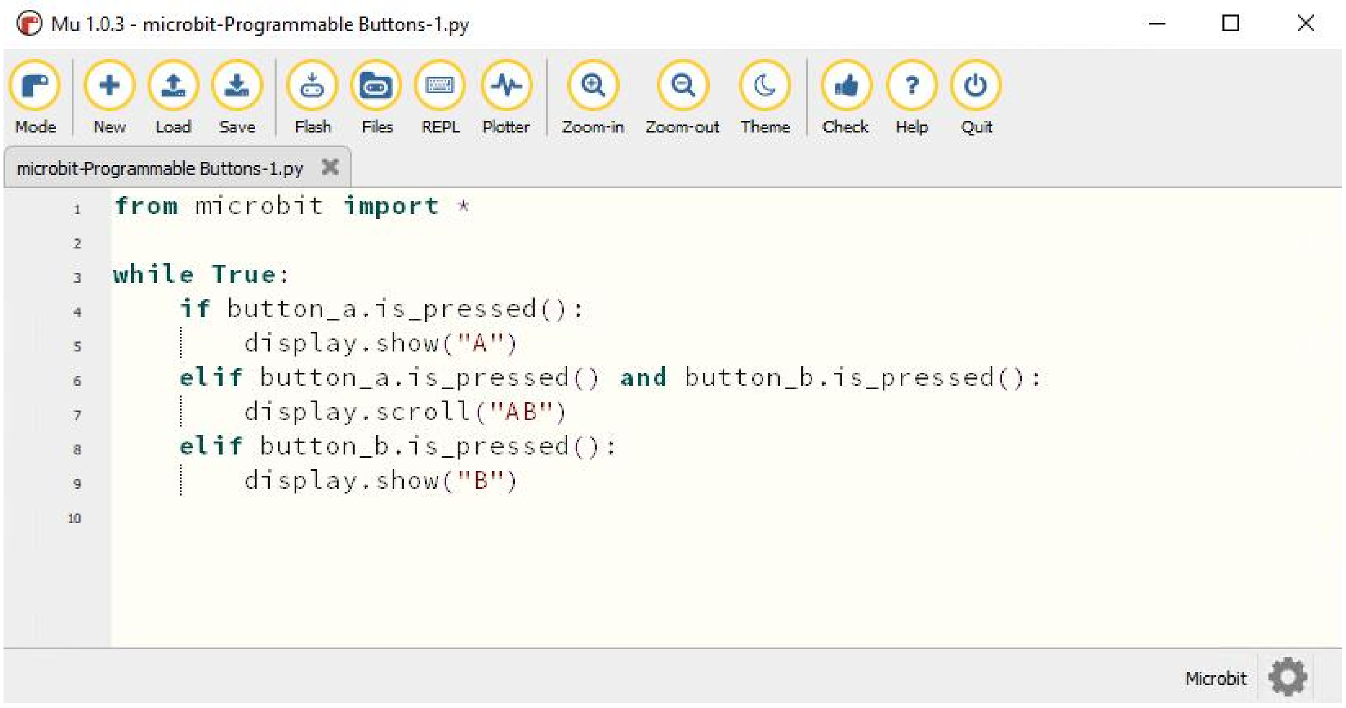
3. Test Code

Code 1:

Open the file“Code 1.py“ in Mu software，(How to load the project code?)

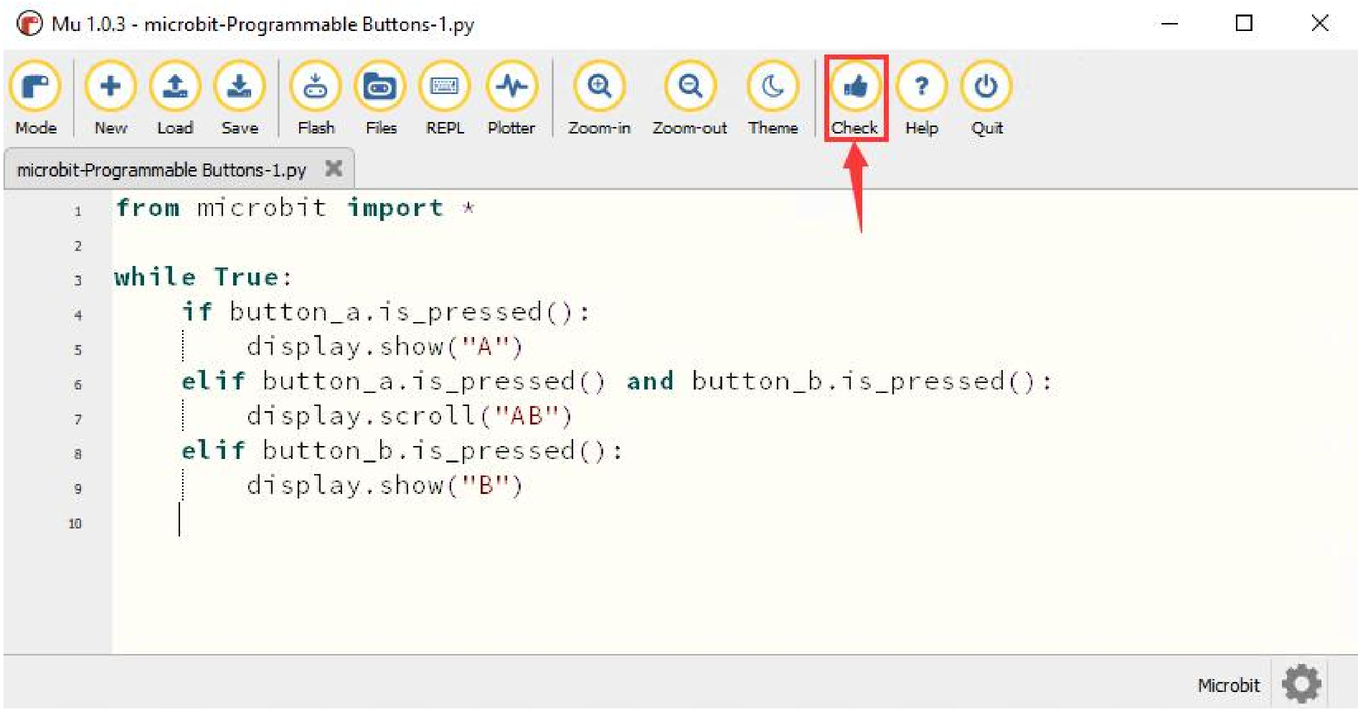
File Type	Route	File Name
Python file	../Python Code/8.4：Programmable Buttons	microbit-Code-1.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit-Programmable Buttons-1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Programmable Buttons-1.py
Microbit

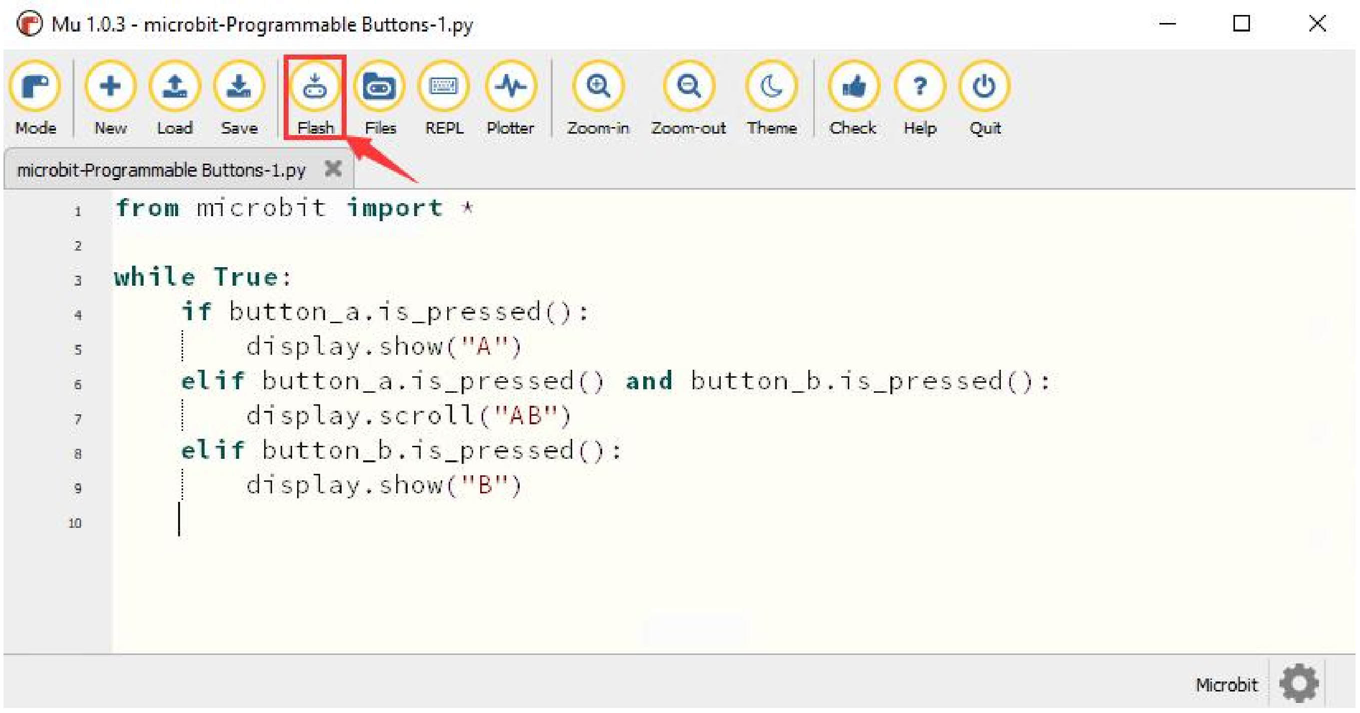
```
from microbit import *

while True:
    if button_a.is_pressed():
        display.show("A")
    elif button_a.is_pressed() and button_b.is_pressed():
        display.scroll("AB")
    elif button_b.is_pressed():
        display.show("B")
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-Programmable Buttons-1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Programmable Buttons-1.py
Microbit

```python
from microbit import *

while True:
    if button_a.is_pressed():
        display.show("A")
    elif button_a.is_pressed() and button_b.is_pressed():
        display.scroll("AB")
    elif button_b.is_pressed():
        display.show("B")
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board


Mu 1.0.3 - microbit-Programmable Buttons-1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Programmable Buttons-1.py
Microbit

```python
from microbit import *

while True:
    if button_a.is_pressed():
        display.show("A")
    elif button_a.is_pressed() and button_b.is_pressed():
        display.scroll("AB")
    elif button_b.is_pressed():
        display.show("B")
```

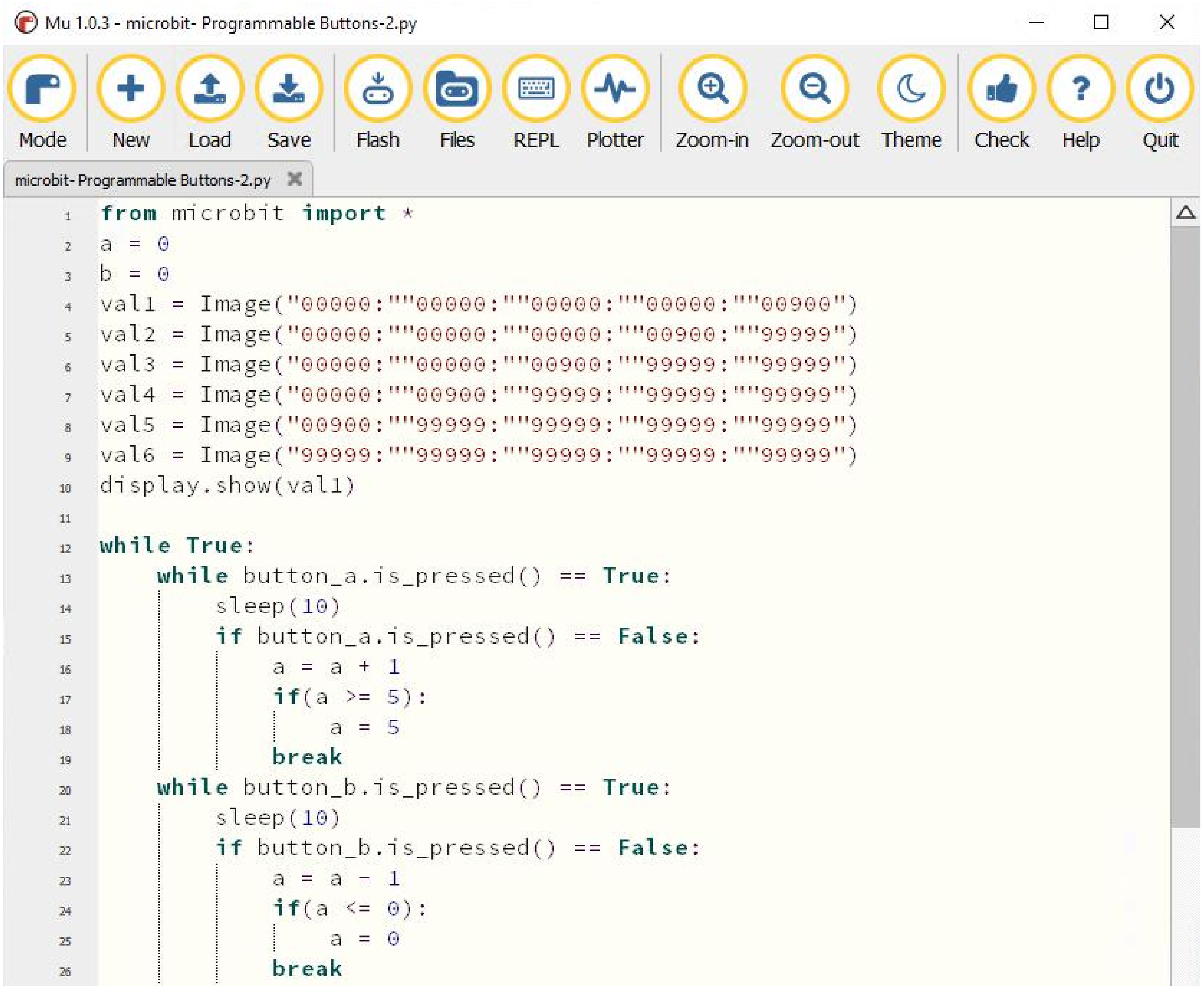
Code 2:

Open the file “Code 2.py” in Mu,

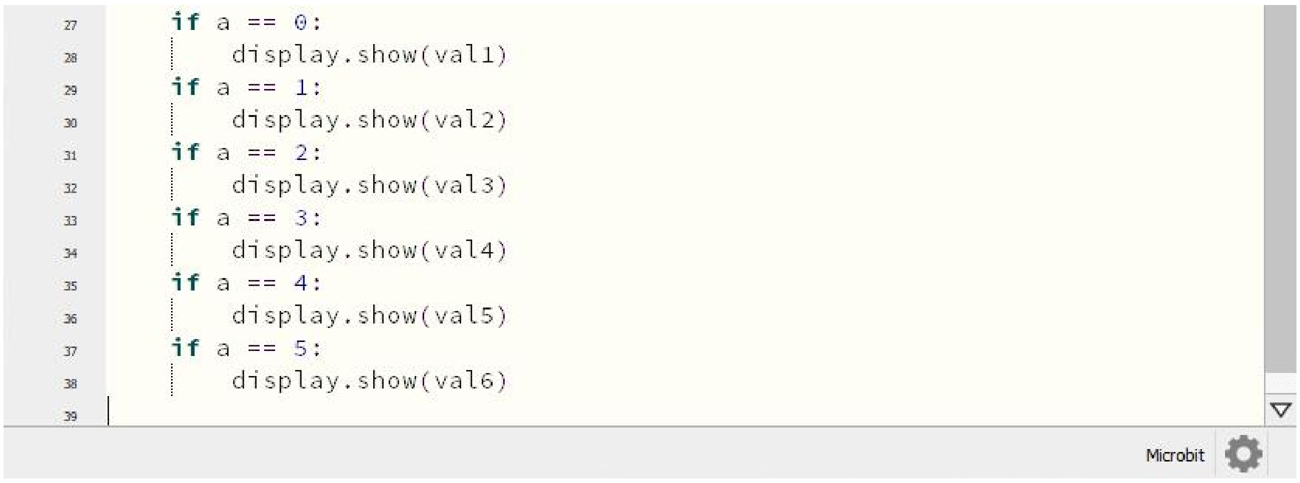
(How to load the project code?)

File Type	Route	File Name
Python file	../Projects/6.4: Programmable Buttons/	Micro:bit- Code-2.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)

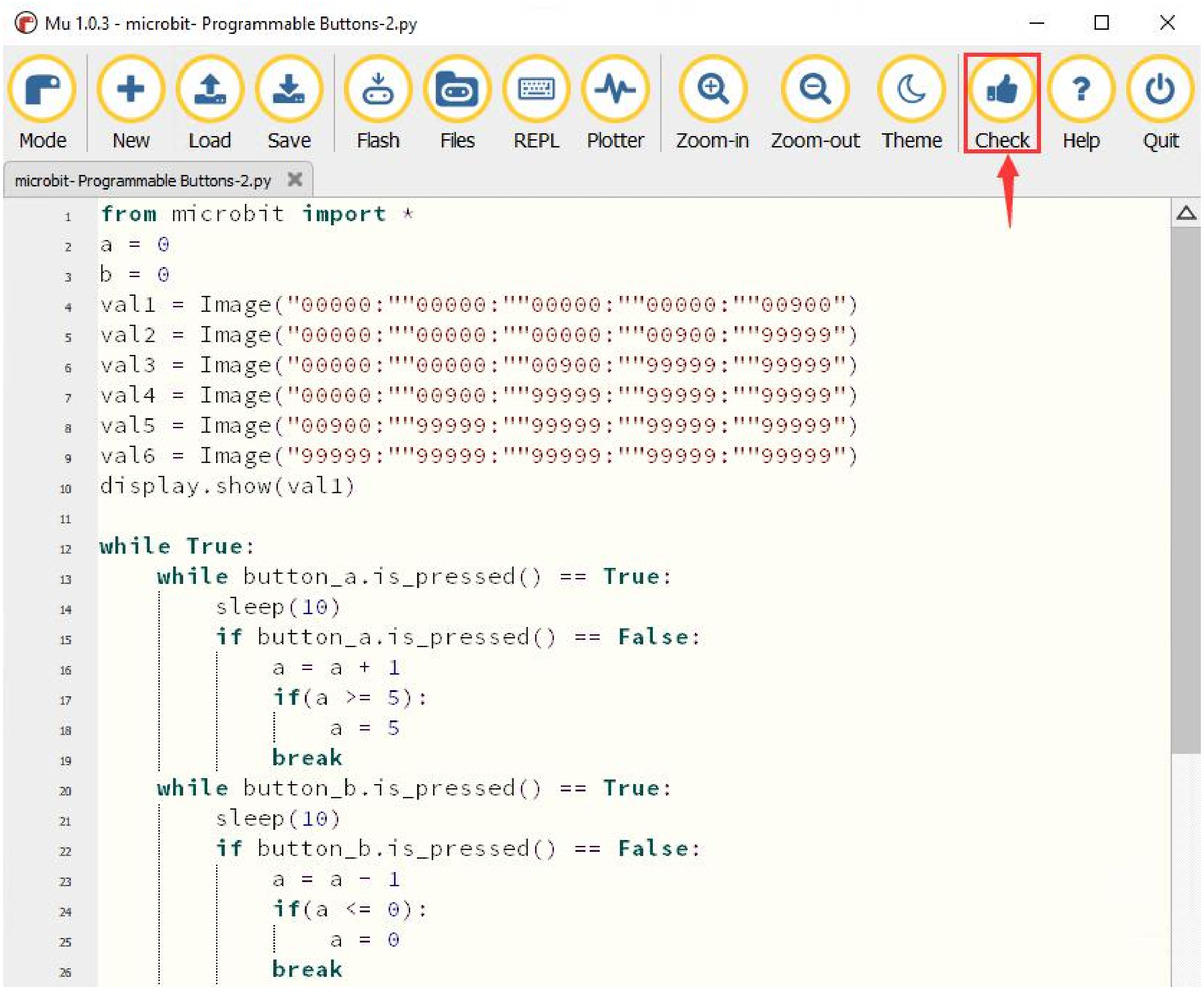

Mu 1.0.3 - microbit- Programmable Buttons-2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit- Programmable Buttons-2.py

```
from microbit import *
a = 0
b = 0
val1 = Image("00000:""00000:""00000:""00000:""00900")
val2 = Image("00000:""00000:""00000:""00900:""99999")
val3 = Image("00000:""00000:""00900:""99999:""99999")
val4 = Image("00000:""00900:""99999:""99999:""99999")
val5 = Image("00900:""99999:""99999:""99999:""99999")
val6 = Image("99999:""99999:""99999:""99999:""99999")
display.show(val1)

while True:
    while button_a.is_pressed() == True:
        sleep(10)
        if button_a.is_pressed() == False:
            a = a + 1
            if(a >= 5):
                a = 5
            break
    while button_b.is_pressed() == True:
        sleep(10)
        if button_b.is_pressed() == False:
            a = a - 1
            if(a <= 0):
                a = 0
            break
```



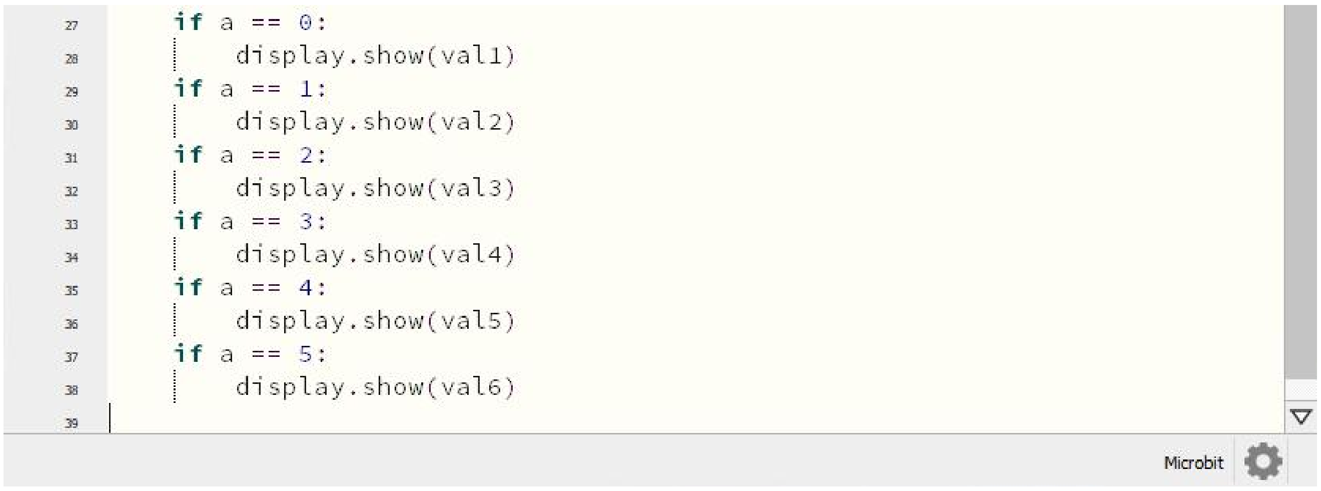
```
    if a == 0:
        display.show(val1)
    if a == 1:
        display.show(val2)
    if a == 2:
        display.show(val3)
    if a == 3:
        display.show(val4)
    if a == 4:
        display.show(val5)
    if a == 5:
        display.show(val6)
```

Click "Check" to examine error in the code. The program proves wrong if underlines and cursors are shown.



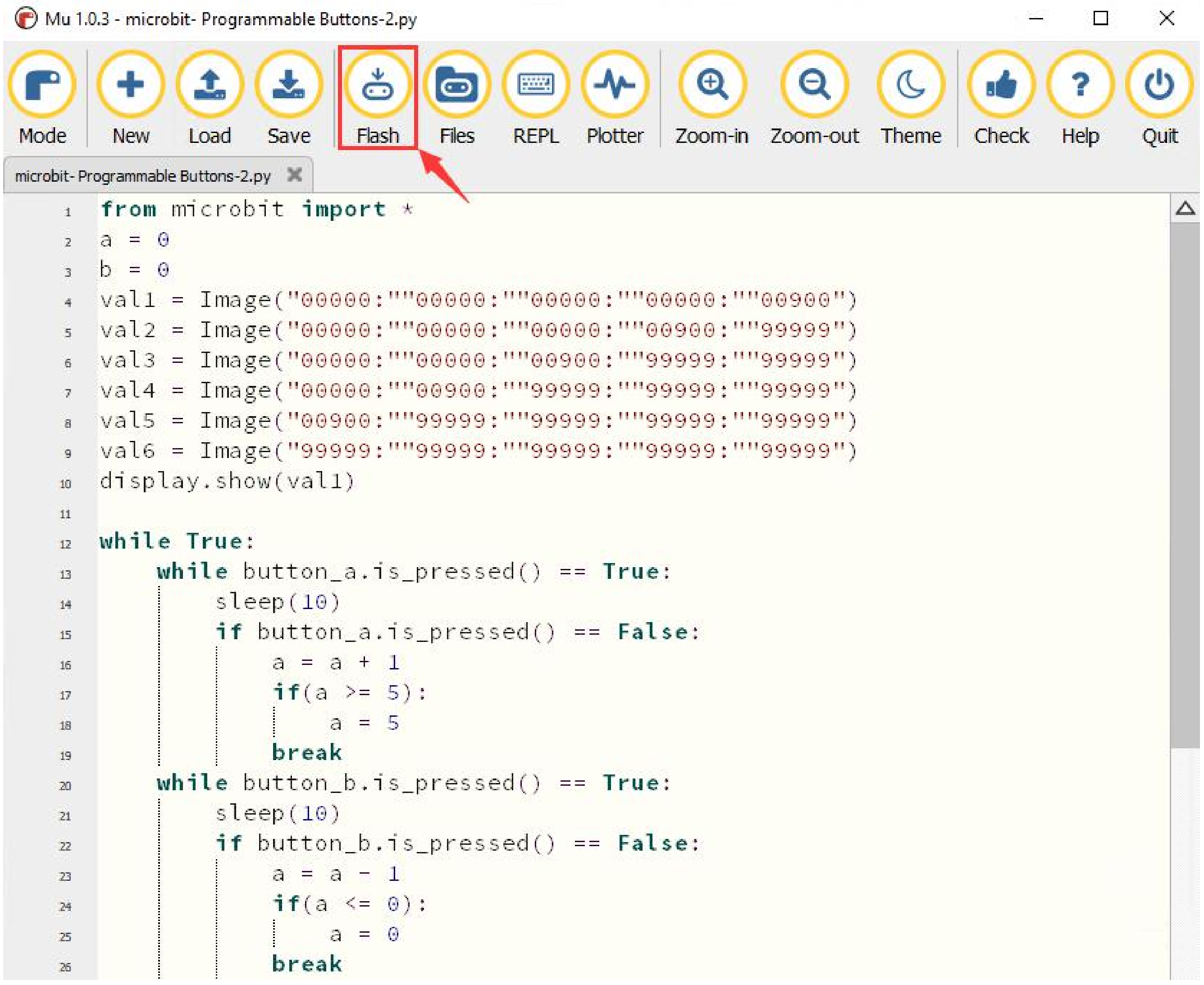
Mu 1.0.3 - microbit- Programmable Buttons-2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit- Programmable Buttons-2.py

```
from microbit import *
a = 0
b = 0
val1 = Image("00000:""00000:""00000:""00000:""00900")
val2 = Image("00000:""00000:""00000:""00900:""99999")
val3 = Image("00000:""00000:""00900:""99999:""99999")
val4 = Image("00000:""00900:""99999:""99999:""99999")
val5 = Image("00900:""99999:""99999:""99999:""99999")
val6 = Image("99999:""99999:""99999:""99999:""99999")
display.show(val1)

while True:
    while button_a.is_pressed() == True:
        sleep(10)
        if button_a.is_pressed() == False:
            a = a + 1
            if(a >= 5):
                a = 5
            break
    while button_b.is_pressed() == True:
        sleep(10)
        if button_b.is_pressed() == False:
            a = a - 1
            if(a <= 0):
                a = 0
            break
```



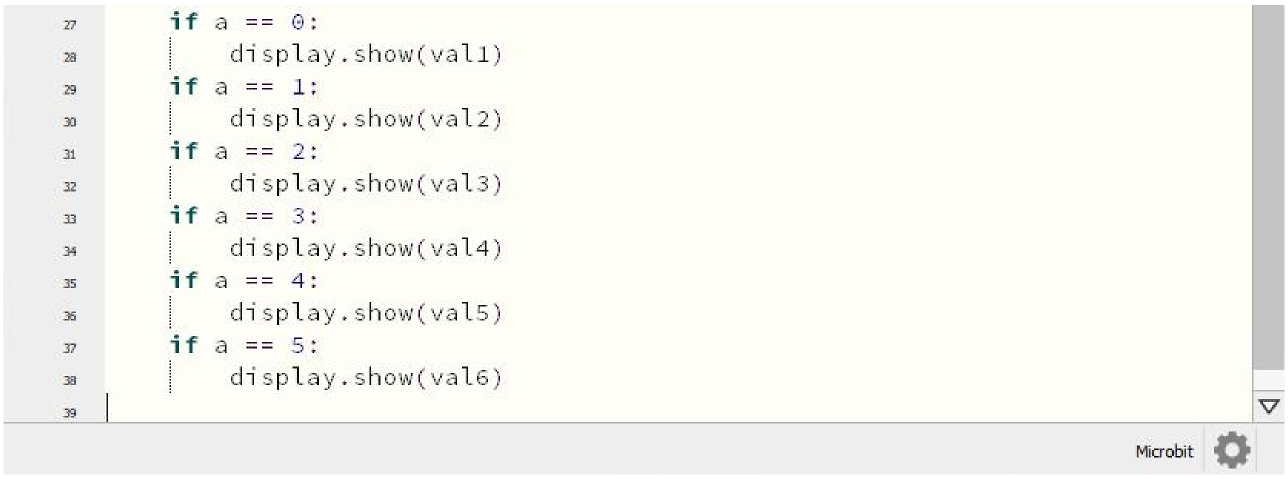
```
    if a == 0:
        display.show(val1)
    if a == 1:
        display.show(val2)
    if a == 2:
        display.show(val3)
    if a == 3:
        display.show(val4)
    if a == 4:
        display.show(val5)
    if a == 5:
        display.show(val6)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



Mu 1.0.3 - microbit- Programmable Buttons-2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit- Programmable Buttons-2.py

```
from microbit import *
a = 0
b = 0
val1 = Image("00000:""00000:""00000:""00000:""00900")
val2 = Image("00000:""00000:""00000:""00900:""99999")
val3 = Image("00000:""00000:""00900:""99999:""99999")
val4 = Image("00000:""00900:""99999:""99999:""99999")
val5 = Image("00900:""99999:""99999:""99999:""99999")
val6 = Image("99999:""99999:""99999:""99999:""99999")
display.show(val1)

while True:
    while button_a.is_pressed() == True:
        sleep(10)
        if button_a.is_pressed() == False:
            a = a + 1
            if(a >= 5):
                a = 5
            break
    while button_b.is_pressed() == True:
        sleep(10)
        if button_b.is_pressed() == False:
            a = a - 1
            if(a <= 0):
                a = 0
            break
```



```
    if a == 0:
        display.show(val1)
    if a == 1:
        display.show(val2)
    if a == 2:
        display.show(val3)
    if a == 3:
        display.show(val4)
    if a == 4:
        display.show(val5)
    if a == 5:
        display.show(val6)
```

4.Test Result:

Upload code 1 and plug in micro:bit via USB cable, press “A” on Micro:bit board, character “A” will be displayed; in case that B is pressed, letter “B” will appear. So will show “AB” if you press A and B buttons simultaneously.

Upload code 2 and plug in board via USB cable. Press button A, a row of luminous LEDs are added, when B is pressed, a row of luminous LEDs are deducted.

1. Code Explanation:

from microbit **import** *	Import the library file of micro: bit
while True:	This is a permanent loop that makes micro:bit execute the code

	of it.

if button_a.is_pressed():
display.show("A")
elif button_a.is_pressed() **and**
button_b.is_pressed():
display.scroll("AB")
elif button_b.is_pressed():
display.show("B")
	If button A is pressed
	micro:bit shows "A"
	If button A and B are pressed at
	same time
	micro:bit displays "AB"
	If button B is pressed
	micro:bit shows "B"

while button_a.is_pressed() == **True**:
sleep(10)
if button_a.is_pressed() == **False**:
a = a + 1
if(a >= 5):
a = 5
break
while button_b.is_pressed() == **True**:
sleep(10)
if button_b.is_pressed() == **False**:
a = a - 1
if(a <= 0):
a = 0
break
	When the button A is pressed
	Delay in 10ms to eliminate the
	shaking of button A
	when button A is released,
	Variable a adds 1
	If variable a≥5
	Variable a=5
	exit the loop
	when button B is pressed
	Delay in 10ms to eliminate the
	shaking of button B
	When the button B is released
	Variable a reduces 1 gradually
	When a≤0

if a == 0:	Variable a=0
display.show(val1)	exit the loop
if a == 1:	When a=0
display.show(val2)	micro:bit shows pattern val1
if a == 2:	When a=1
display.show(val3)	micro:bit displays pattern val2
if a == 3:	When a=2
display.show(val4)	micro:bit shows pattern val3
if a == 4:	If a=3
display.show(val5)	micro:bit displays pattern val4
if a == 5:	If a=4
display.show(val6)	micro:bit shows pattern val5
	If a=5
	micro:bit displays pattern val6

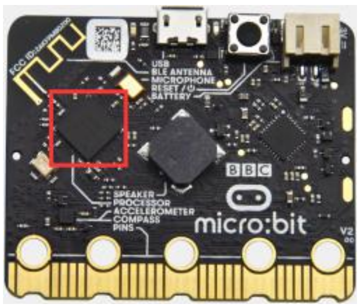
8.5: Temperature Measurement

1.Description:

Micro:bit main board doesn’ t come with temperature sensor actually, but detect temperature through built-in temperature of NFR51822 chip.

Thereby, the detected temperature is more close to chip’ s temperature.

Note: the temperature sensor of Micro:bit main board is shown below:



2. Experimental Preparation：

(1) Link micro:bit board with computer via USB cable.

(2) Open the offline version of Mu

3. Test Code

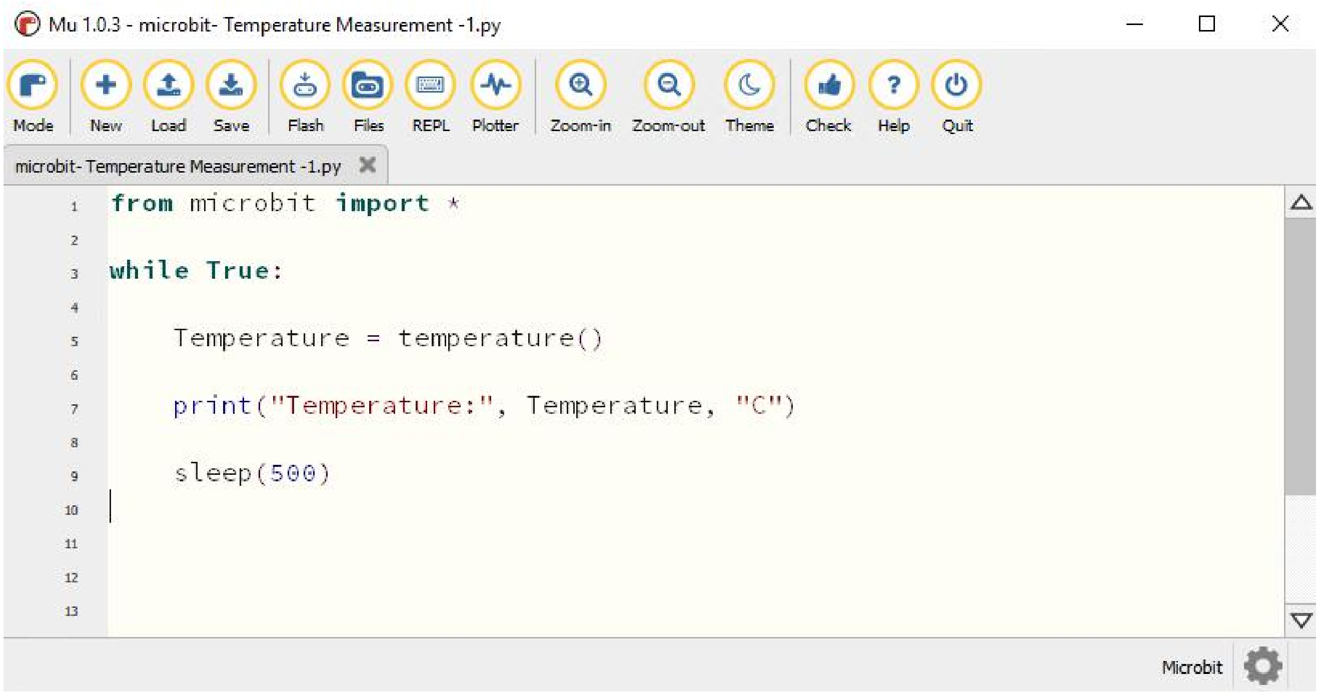
Code 1：

Open “Code 1.py ” file in Mu

(How to load the project code?)

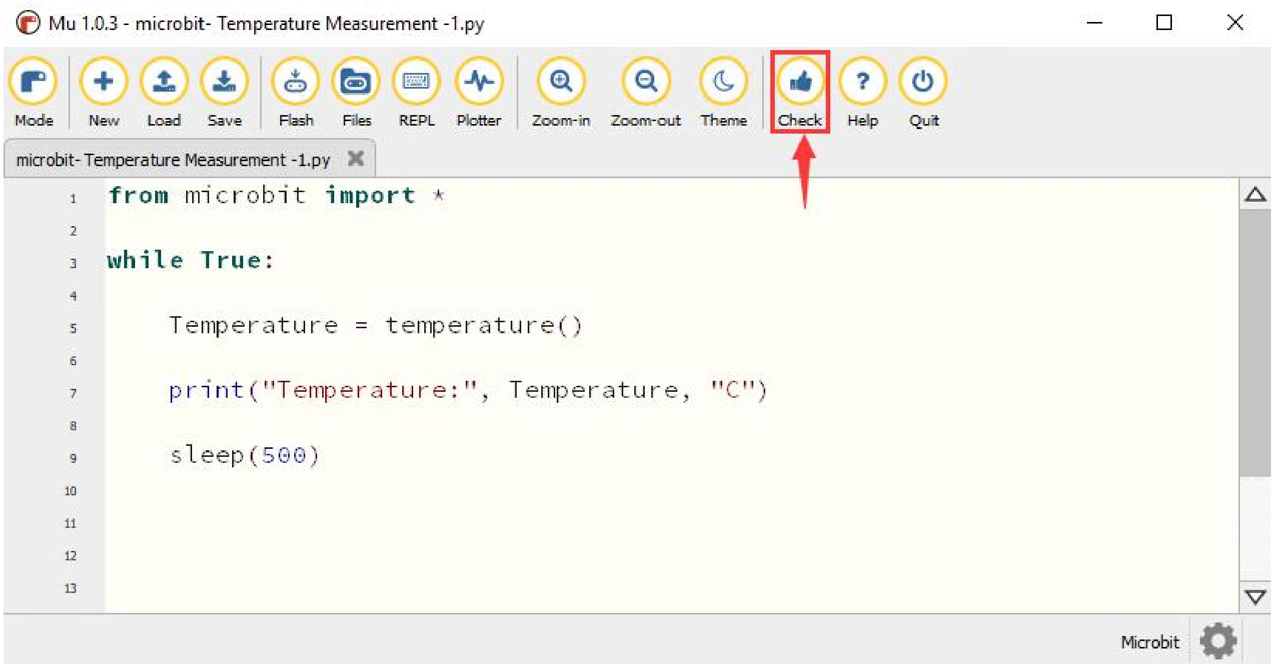
File Type	Route	File Name
Python file	../Python code/8.5：Temperature Measurement	microbit- Code-1.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit- Temperature Measurement -1.py

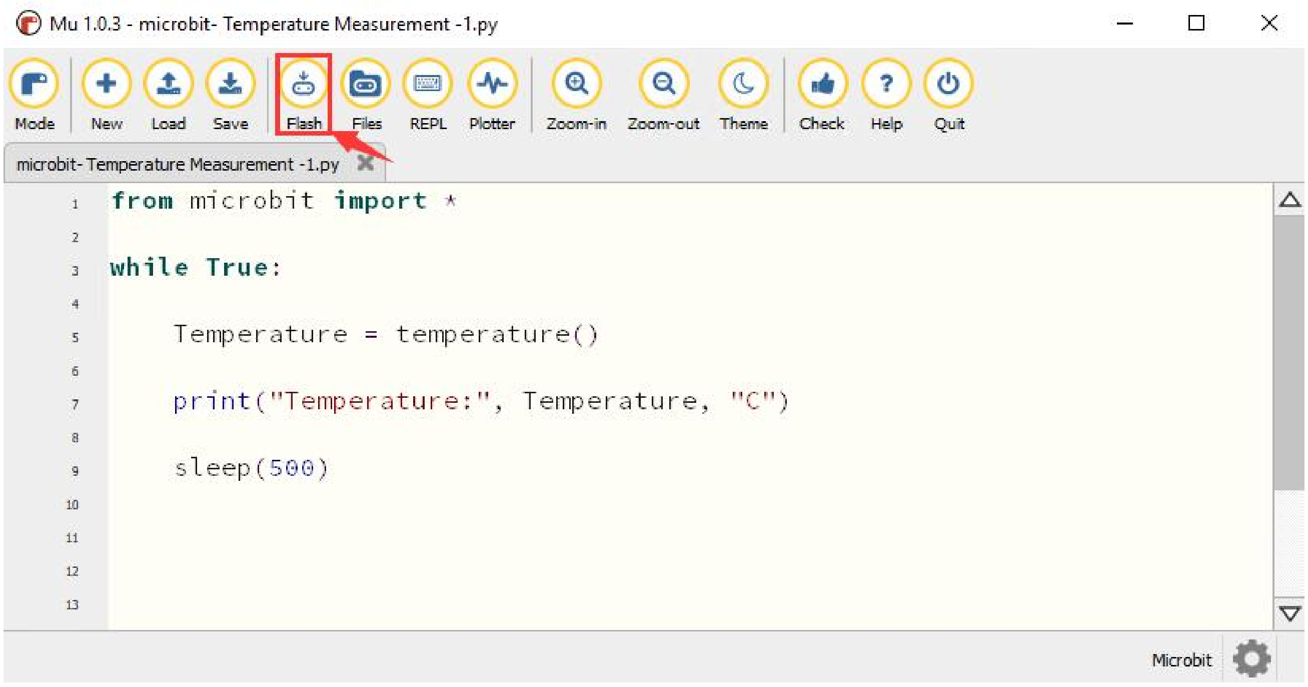
```
from microbit import *

while True:

    Temperature = temperature()

    print("Temperature:", Temperature, "C")

    sleep(500)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit- Temperature Measurement -1.py

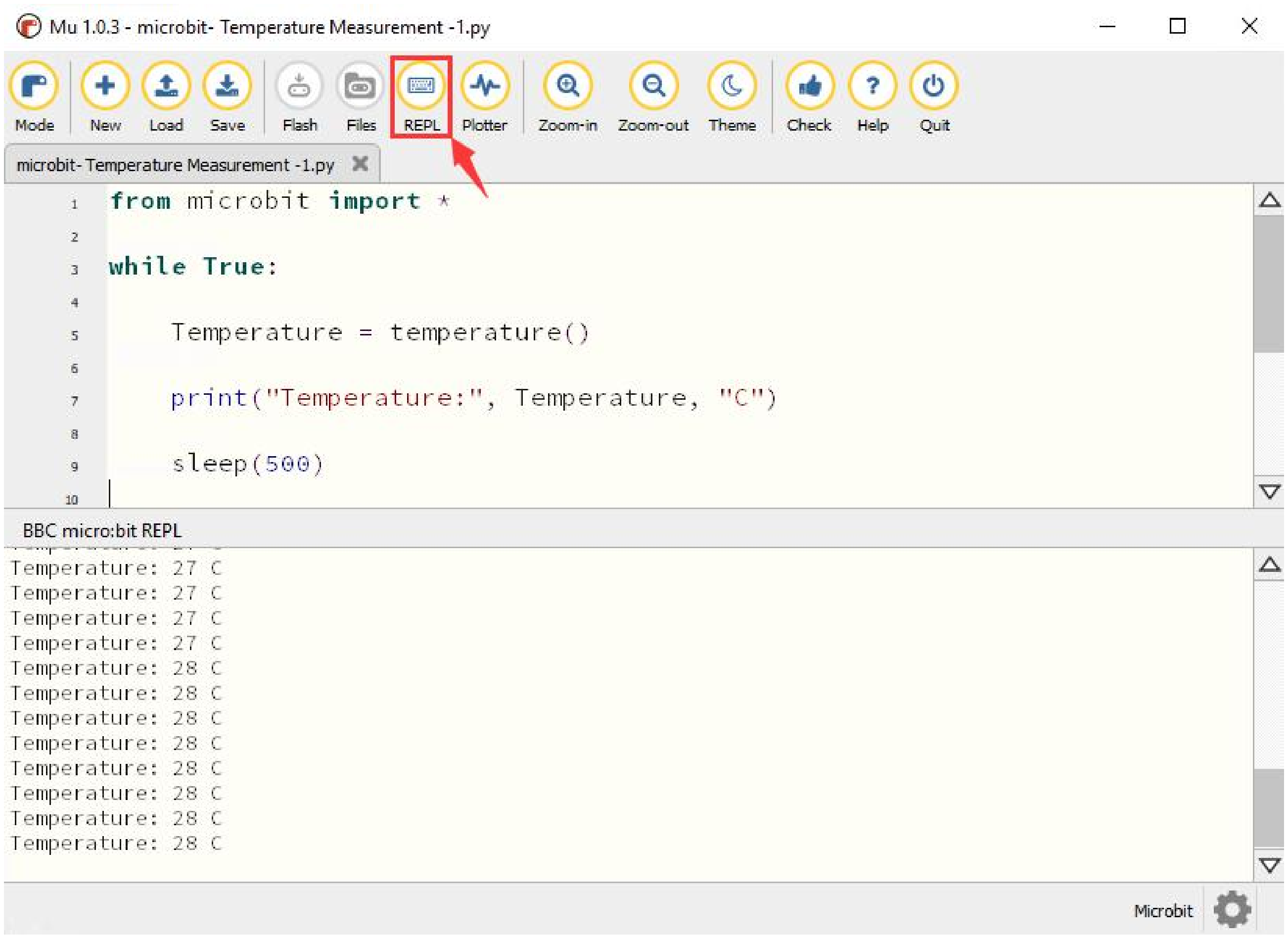
```
from microbit import *

while True:

    Temperature = temperature()

    print("Temperature:", Temperature, "C")

    sleep(500)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.


Mu 1.0.3 - microbit- Temperature Measurement -1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit- Temperature Measurement -1.py
Microbit

```
from microbit import *

while True:

    Temperature = temperature()

    print("Temperature:", Temperature, "C")

    sleep(500)
```

After downloading test code 1 to micro:bit board, keep USB connected and click **"REPL" and press the reset button on micro:bit.** Then REPL window will show the ambient temperature value, as shown below:(C stands for temperature unit)



```
from microbit import *

while True:

    Temperature = temperature()

    print("Temperature:", Temperature, "C")

    sleep(500)
```

```
Temperature: 27 C
Temperature: 27 C
Temperature: 27 C
Temperature: 27 C
Temperature: 28 C
Temperature: 28 C
Temperature: 28 C
Temperature: 28 C
Temperature: 28 C
Temperature: 28 C
Temperature: 28 C
Temperature: 28 C
```

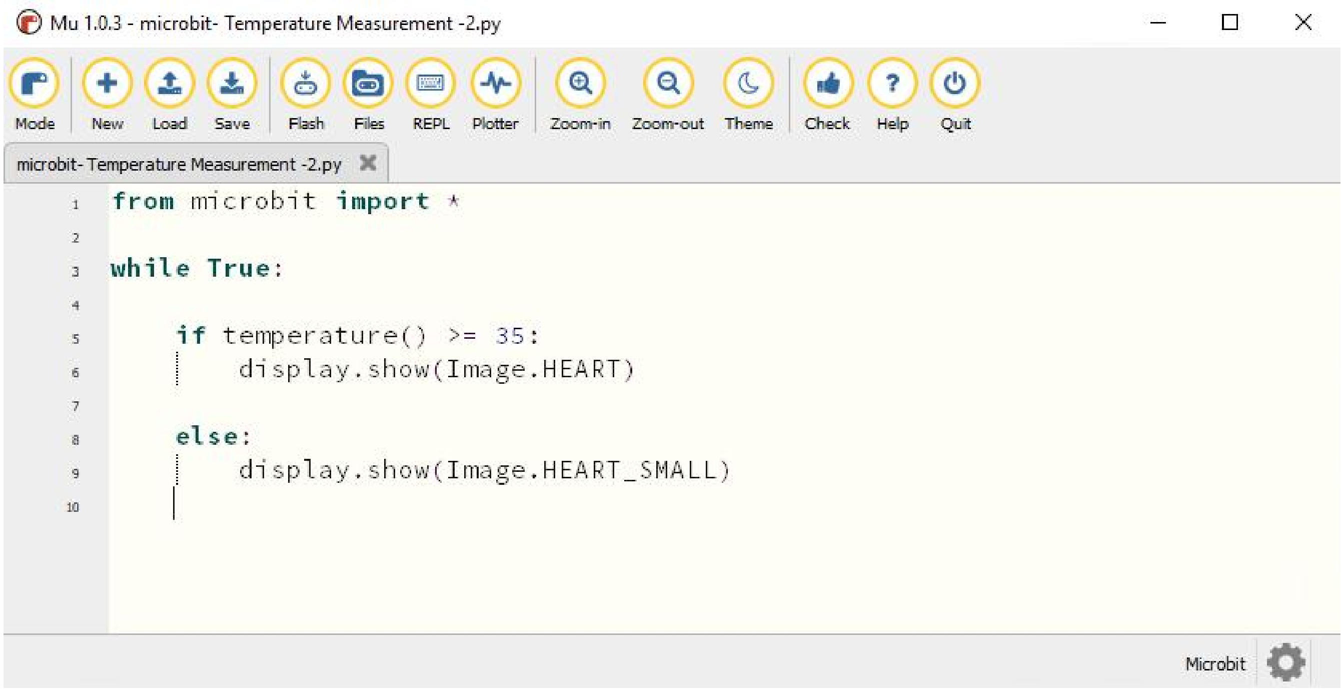
Code 2:

Open “Code 2.py ” in Mu. How to load the project code?)

File Type	Route	File Name
Python file	../Python code/8.5: Temperature Measurement	microbit- Code-2.py

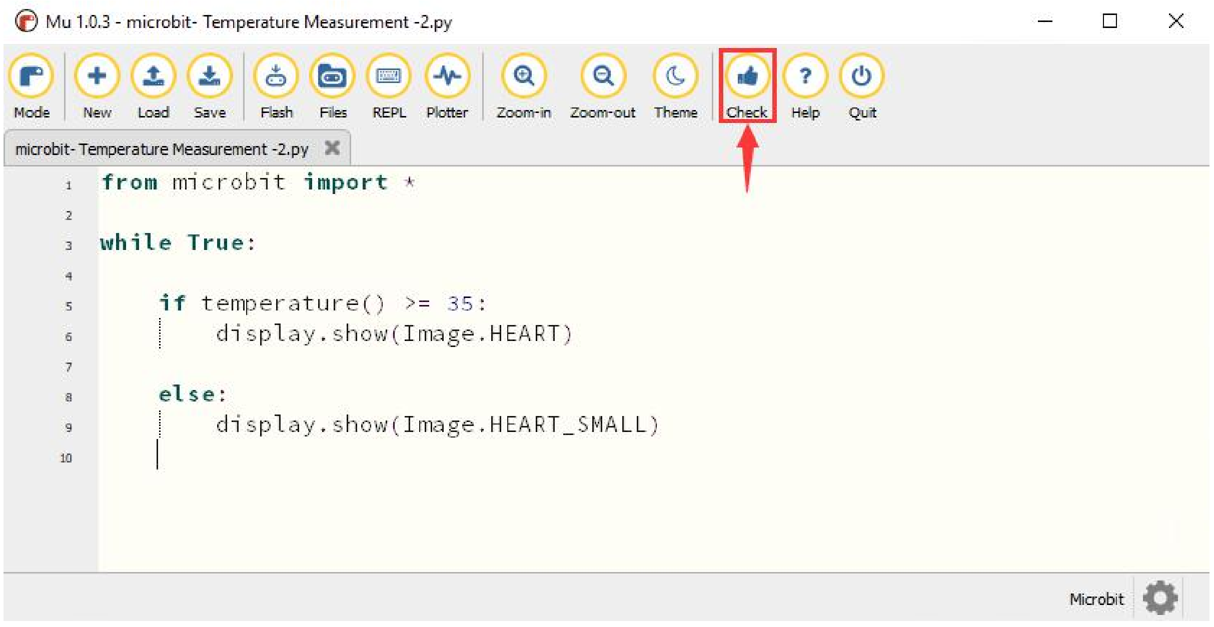
You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)

The temperature value can be set in compliance with the real temperature.


Mu 1.0.3 - microbit- Temperature Measurement -2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit- Temperature Measurement -2.py
Microbit

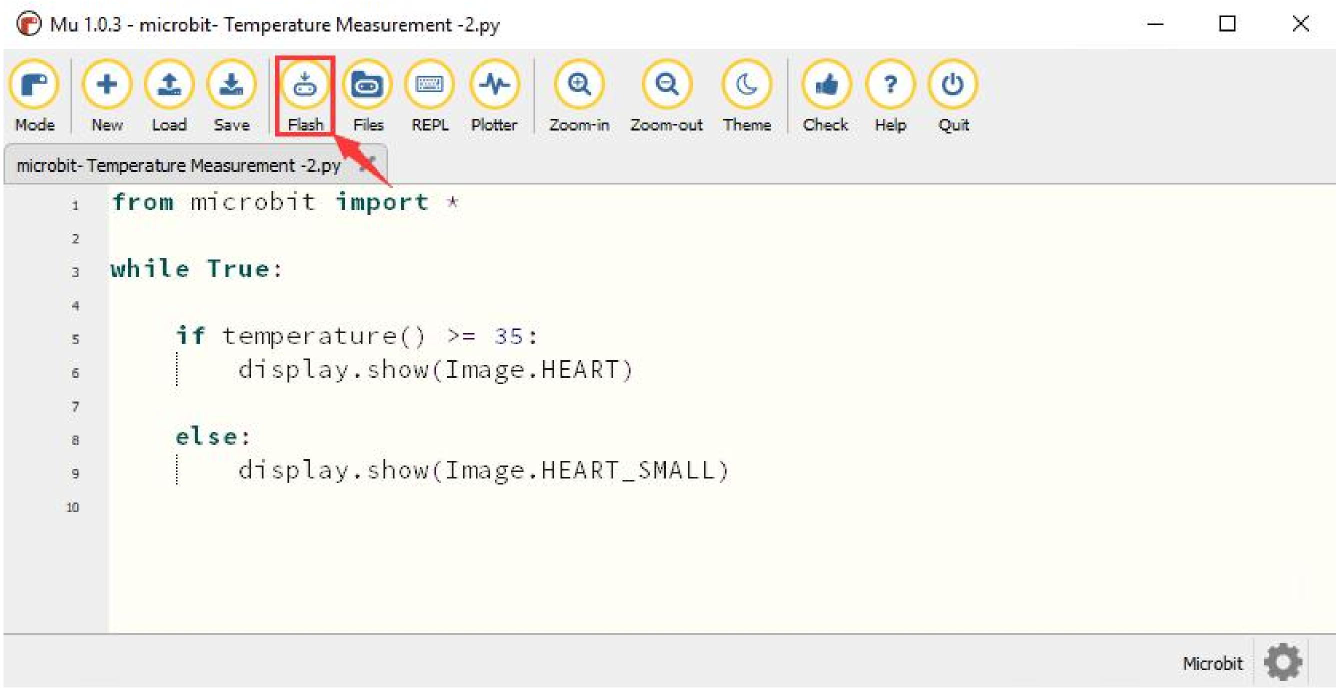
```
from microbit import *

while True:

    if temperature() >= 35:
        display.show(Image.HEART)

    else:
        display.show(Image.HEART_SMALL)

```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit- Temperature Measurement -2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit- Temperature Measurement -2.py
Microbit

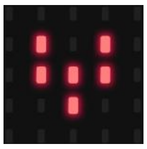
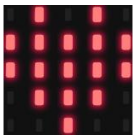
```
from microbit import *

while True:

    if temperature() >= 35:
        display.show(Image.HEART)

    else:
        display.show(Image.HEART_SMALL)

```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.


Mu 1.0.3 - microbit- Temperature Measurement -2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit- Temperature Measurement -2.py
Microbit

```
from microbit import *

while True:

    if temperature() >= 35:
        display.show(Image.HEART)

    else:
        display.show(Image.HEART_SMALL)

```

4.Test Result:

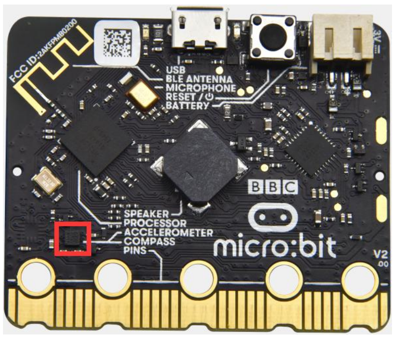
Upload the code 2 plug in micro:bit via USB cable, when the ambient temperature is less than 35 ℃ , 5*5LED will show  . When the temperature is equivalent to or greater than 35℃, the pattern  will appear.

5.Code Explanation:

from microbit **import** *	Import the library file of micro: bit
while True:	This is a permanent loop that makes micro:bit execute the code of it.
Temperature = temperature()	Set temperature() to Temperature
print("Temperature:", Temperature, "C")	BBC micro:bit REPL prints temperature value
sleep(500)	Delay in 500ms

if temperature() >= 35:
display.show(Image.HEART)
else:
display.show(Image.HEART_SMALL)
	If temperature value ≥35℃
	micro:bit shows “♥”
	If temperature value<35℃
	micro:bit displays “▦”

8.6: Micro:bit’ s Compass



1. Description:

This project mainly introduces the use of the Micro:bit’ s compass. In addition to detecting the strength of the magnetic field, it can also be used to determine the direction, an important part of the heading and attitude reference system (AHRS) as well.

It uses FreescaleMAG3110 three-axis magnetometer. Its I2C interface communicates with the outside, the range is ±1000µT, the maximum data update rate is 80Hz. Combined with accelerometer, it can calculate the position. Additionally, it is applied to magnetic detection and compass blocks.

Then we could read the value detected by it to determine the location. We need to calibrate the Micro:bit board when magnetic sensor works.

The correct calibration method is to rotate the Micro:bit board.

In addition, the objects nearby may affect the accuracy of readings and calibration.

2. Experimental Preparation:

(1) Link micro:bit board with computer via USB cable.

(2) Open the offline version of Mu

3. Test Code

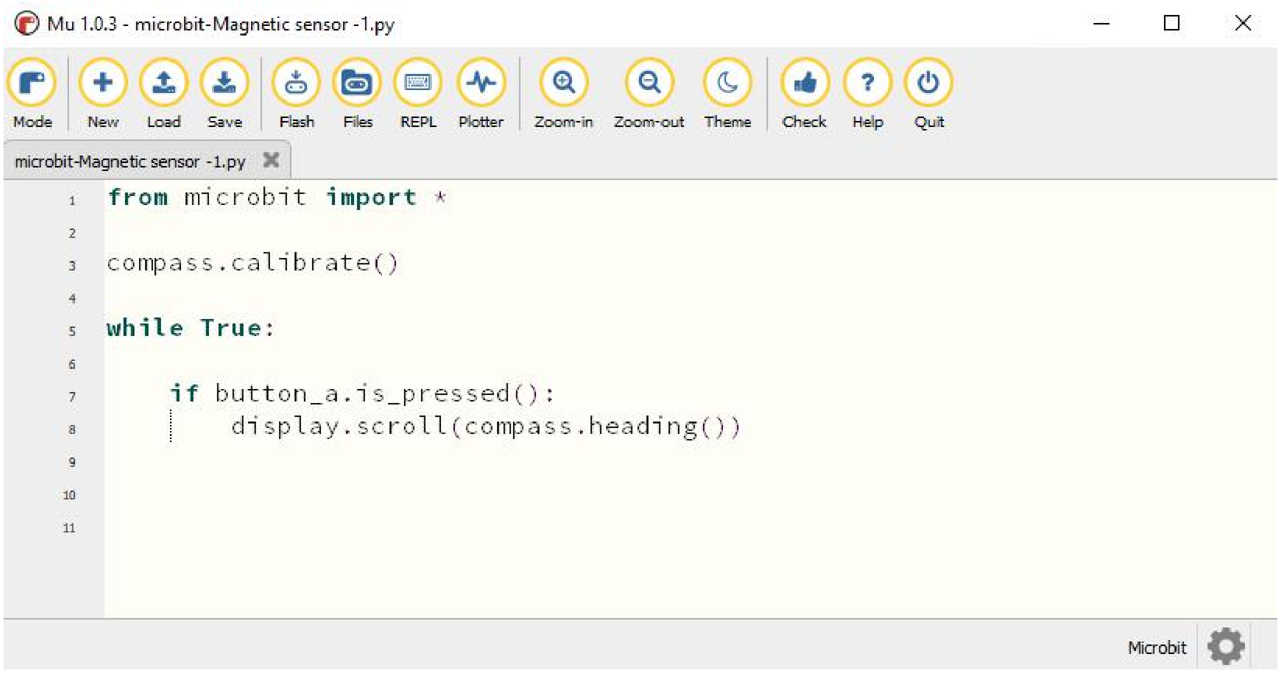
Code 1：

When the button A is pressed, the window displays the value of compass.

Open file “Code 1.py ” in Mu，(How to load the project code?)

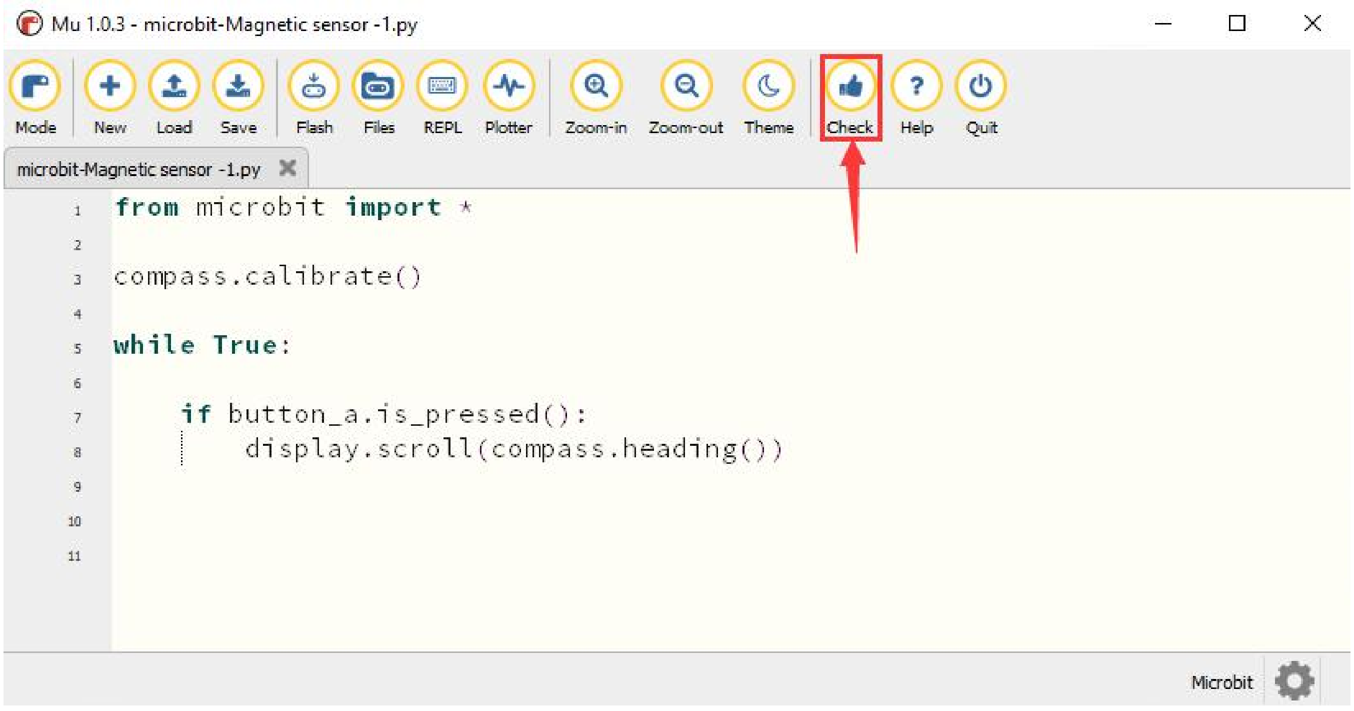
File Type	Route	File Name
Python file	../Python code/8.6：Micro:bit’s Compass	microbit-Code-1.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



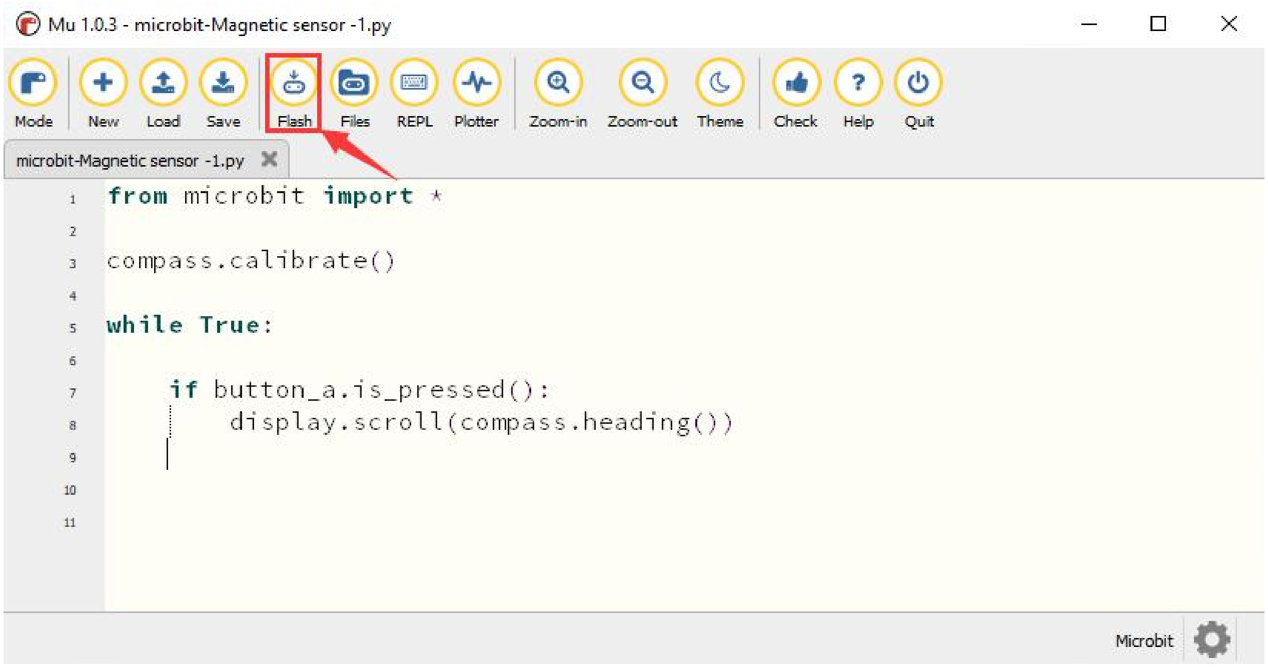
```
from microbit import *

compass.calibrate()

while True:

    if button_a.is_pressed():
        display.scroll(compass.heading())
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



```
from microbit import *

compass.calibrate()

while True:

    if button_a.is_pressed():
        display.scroll(compass.heading())
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.

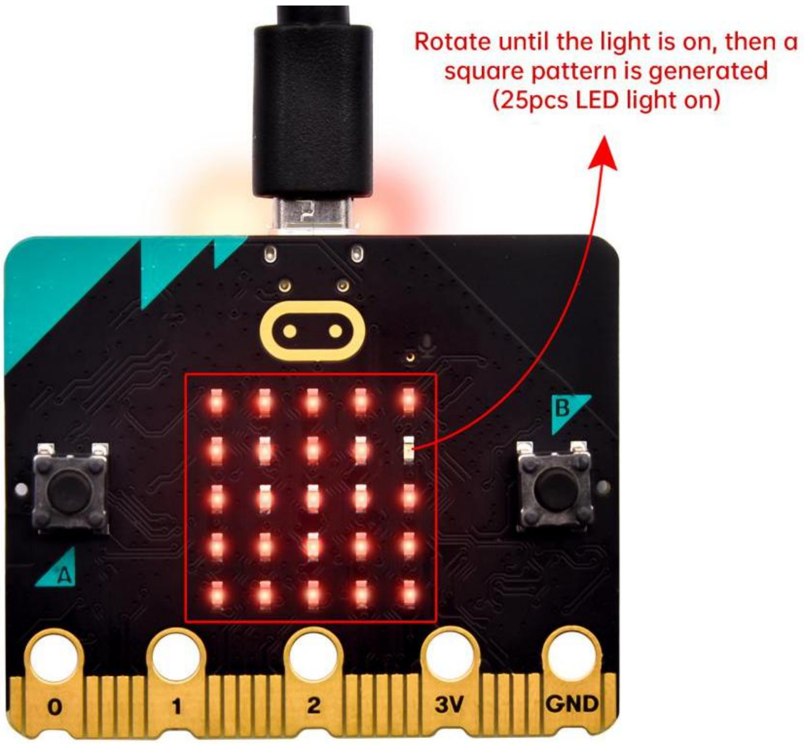


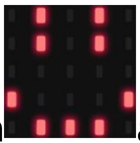
```
from microbit import *

compass.calibrate()

while True:

    if button_a.is_pressed():
        display.scroll(compass.heading())
```

Code Explanation:

We need to calibrate micro： bit due to different magnetic field in different areas. Micro:bit will prompt you to calibrate when you use it first time.

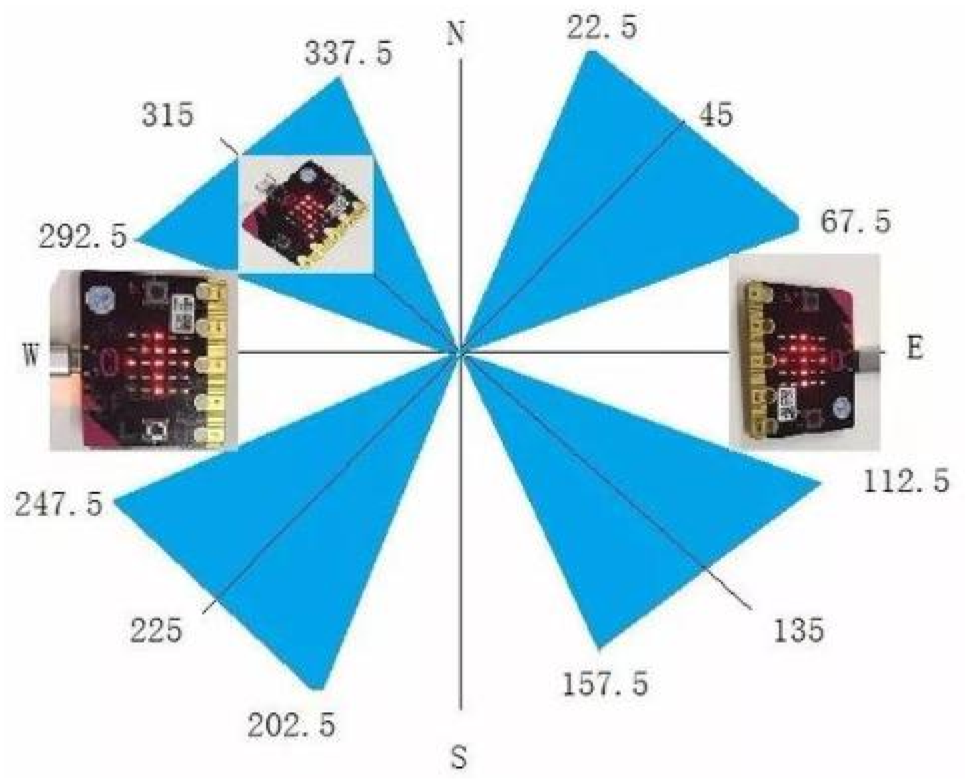
Transfer code 1 to micro:bit, plug in micro:bit via USB cable and press button A. “TILT TO FILL SCREEN” appears on micro:bit. Then enter the calibration interface, the calibration method is to rotate the micro:bit board and display a full square pattern(25 LEDs are on), as shown in the following figure:


Rotate until the light is on, then a square pattern is generated (25pcs LED light on)
0
1
2
3V
GND
A
B

The calibration is finished until you view the smile patternappear. The serial monitor will show 0°, 90°, 180°and 270° when pressing A.

Code 2:

Make micro: bit board point to the north, south, east and west horizontally , LED dot matrix displays the corresponding direction patterns.

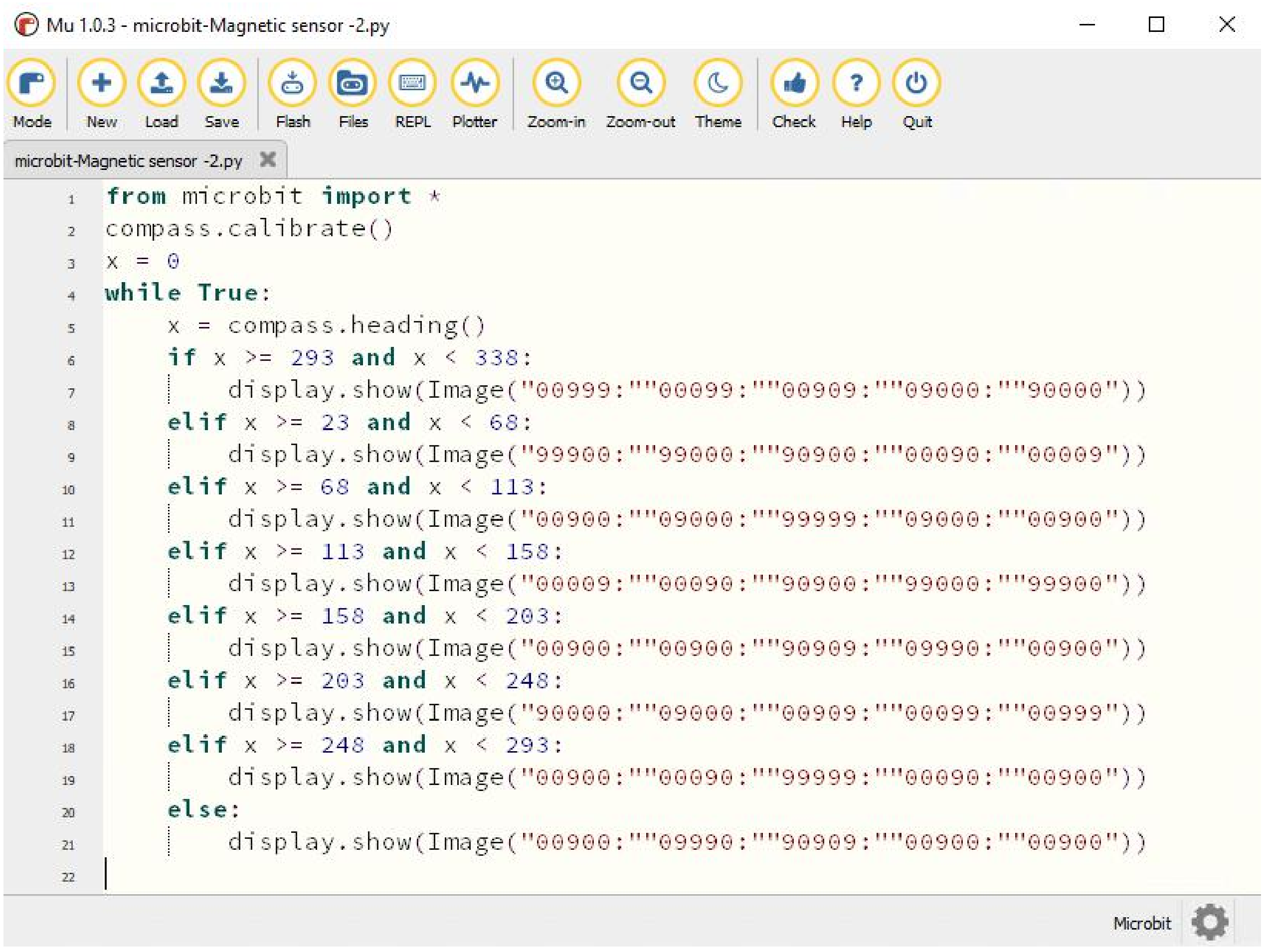


Open “Code 2.py ” file in Mu,

(How to load the project code?)

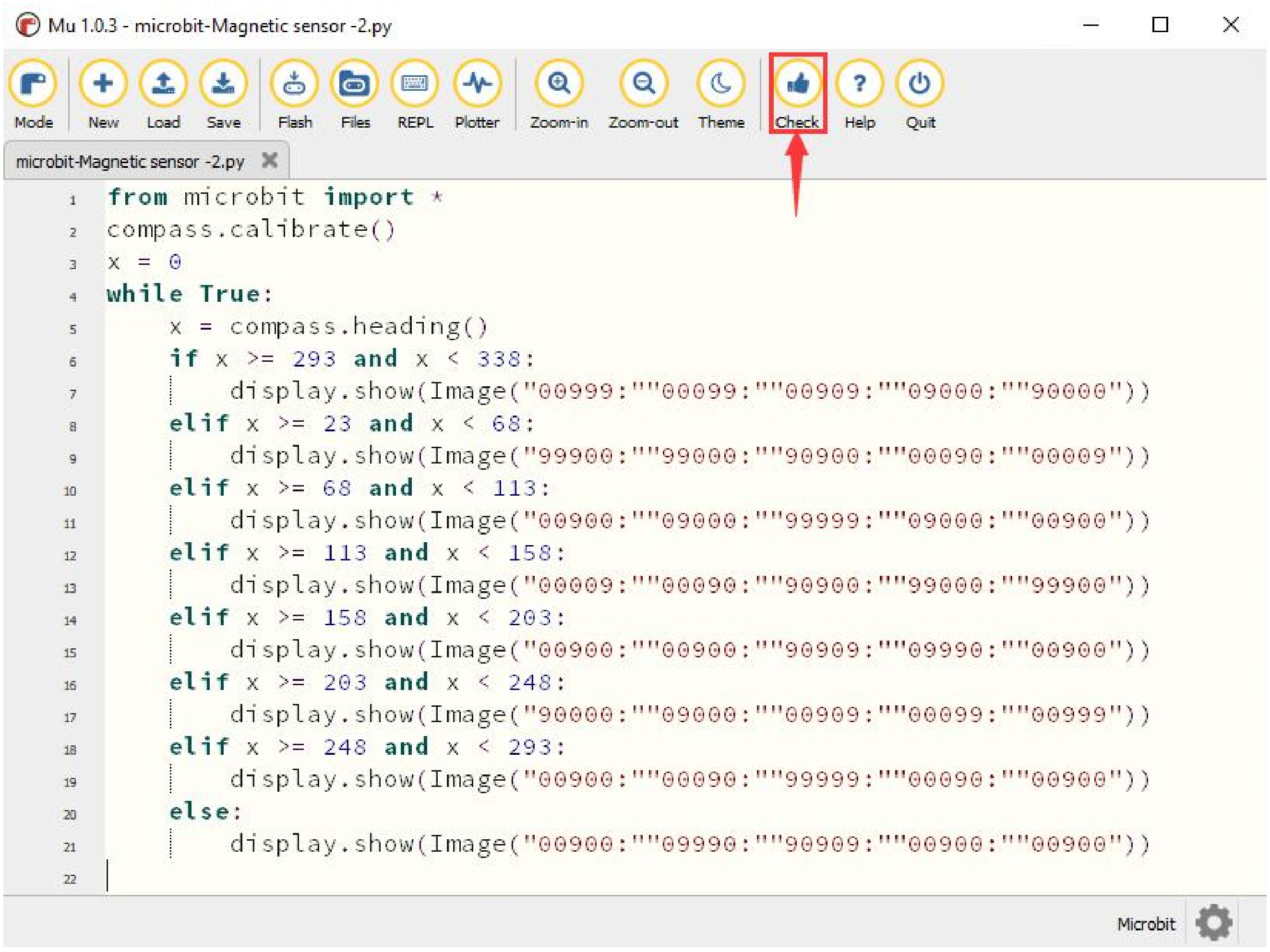
File Type	Route	File Name
Python file	../Python code/8.6：Magnetic sensor	microbit-Code -2.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



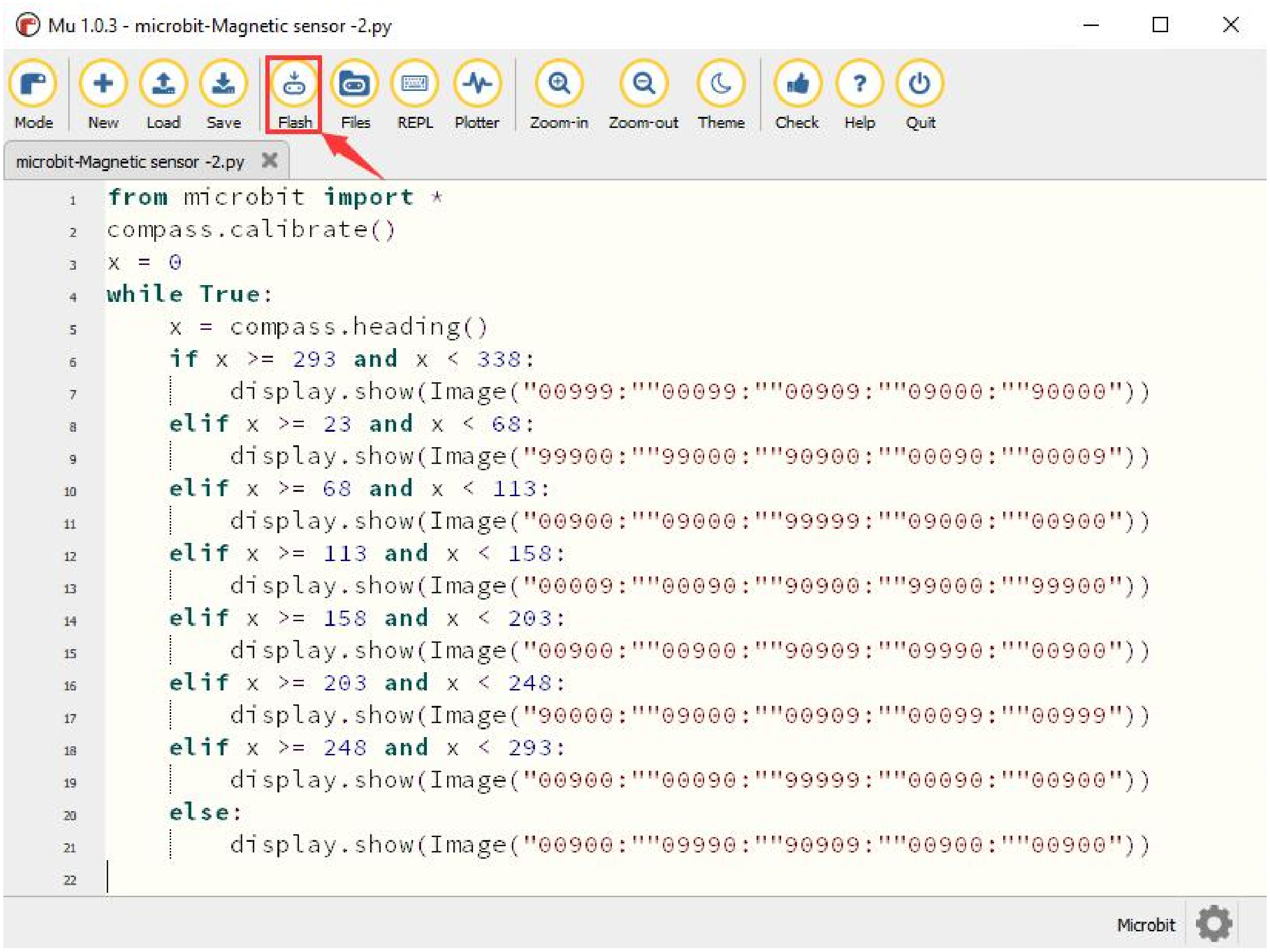
```
from microbit import *
compass.calibrate()
x = 0
while True:
    x = compass.heading()
    if x >= 293 and x < 338:
        display.show(Image("00999:""00099:""00909:""09000:""90000"))
    elif x >= 23 and x < 68:
        display.show(Image("99900:""99000:""90900:""00090:""00009"))
    elif x >= 68 and x < 113:
        display.show(Image("00900:""09000:""99999:""09000:""00900"))
    elif x >= 113 and x < 158:
        display.show(Image("00009:""00090:""90900:""99000:""99900"))
    elif x >= 158 and x < 203:
        display.show(Image("00900:""00900:""90909:""09990:""00900"))
    elif x >= 203 and x < 248:
        display.show(Image("90000:""09000:""00909:""00099:""00999"))
    elif x >= 248 and x < 293:
        display.show(Image("00900:""00090:""99999:""00090:""00900"))
    else:
        display.show(Image("00900:""09990:""90909:""00900:""00900"))
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



```python
from microbit import *
compass.calibrate()
x = 0
while True:
    x = compass.heading()
    if x >= 293 and x < 338:
        display.show(Image("00999:""00099:""00909:""09000:""90000"))
    elif x >= 23 and x < 68:
        display.show(Image("99900:""99000:""90900:""00090:""00009"))
    elif x >= 68 and x < 113:
        display.show(Image("00900:""09000:""99999:""09000:""00900"))
    elif x >= 113 and x < 158:
        display.show(Image("00009:""00090:""90900:""99000:""99900"))
    elif x >= 158 and x < 203:
        display.show(Image("00900:""00900:""90909:""09990:""00900"))
    elif x >= 203 and x < 248:
        display.show(Image("90000:""09000:""00909:""00099:""00999"))
    elif x >= 248 and x < 293:
        display.show(Image("00900:""00090:""99999:""00090:""00900"))
    else:
        display.show(Image("00900:""09990:""90909:""00900:""00900"))
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```python
from microbit import *
compass.calibrate()
x = 0
while True:
    x = compass.heading()
    if x >= 293 and x < 338:
        display.show(Image("00999:""00099:""00909:""09000:""90000"))
    elif x >= 23 and x < 68:
        display.show(Image("99900:""99000:""90900:""00090:""00009"))
    elif x >= 68 and x < 113:
        display.show(Image("00900:""09000:""99999:""09000:""00900"))
    elif x >= 113 and x < 158:
        display.show(Image("00009:""00090:""90900:""99000:""99900"))
    elif x >= 158 and x < 203:
        display.show(Image("00900:""00900:""90909:""09990:""00900"))
    elif x >= 203 and x < 248:
        display.show(Image("90000:""09000:""00909:""00099:""00999"))
    elif x >= 248 and x < 293:
        display.show(Image("00900:""00090:""99999:""00090:""00900"))
    else:
        display.show(Image("00900:""09990:""90909:""00900:""00900"))
```

4.Test Result:

Upload code 2 onto micro:bit board and don’ t plug off USB cable. After calibration, tilt Micro:bit board, the LED dot matrix displays the direction signs.

5. Code Explanation:

from microbit **import** *	Import the library file of micro: bit
compass.calibrate()	Compass calibration
while True:	This is a permanent loop that makes micro:bit execute the code of it.

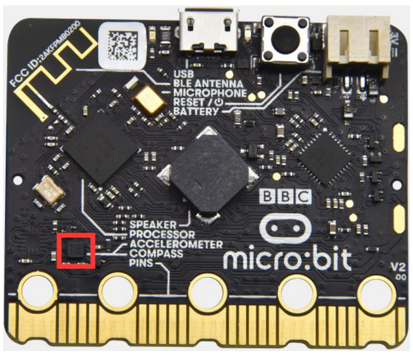
if button_a.is_pressed():
display.scroll(compass.heading())
	When the button A is pressed
	Micro:bit scrolls to show the value of compass

x = 0	Set variable x=0
x = compass.heading()	Set the value of compass to variable x
if…elif…else	Condition judgement statement:if…else if…else

display.show(Image("00999:""00099:""00909:""09000:""90000"))
display.show(Image("99900:""99000:""90900:""00090:""00009"))
display.show(Image("00900:""09000:""99999:""09000:""00900"))
display.show(Image("00009:""00090:""90900:""99000:""99900"))
display.show(Image("00900:""0090
	Micro:bit shows the Northeast arrow sign
	Micro:bit shows the Northwest arrow sign
	Micro:bit shows the west arrow sign
	Micro:bit shows the Southwest arrow sign
	Micro:bit shows the South arrow sign
	Micro:bit shows the South arrow sign

0:""90909:""09990:""00900")) display.show(Image("90000:""0900 0:""00909:""00099:""00999")) display.show(Image("00900:""0009 0:""99999:""00090:""00900")) display.show(Image("00900:""0999 0:""90909:""00900:""00900"))	Micro:bit shows the East arrow sign Micro:bit shows the North arrow sign

8.7: Accelerometer



1. Description:

The Micro:bit board has a built-in Freescale MMA8653FC three-axis acceleration sensor (accelerometer). Its I2C interface works on external communication, the range can be set to ±2g, ±4g, and ±8g, and the maximum data update rate can reach 800Hz.

When the Micro:bit is stationary or moving at a constant speed, the accelerometer only detects the gravitational acceleration; when the

Micro:bit is slightly shaken, the acceleration detected is much smaller than the gravitational acceleration and can be ignored. Therefore, in the process of using Micro:bit, the main purpose is to detect the changes of the gravitational acceleration on the x, y, and z axes when the attitude changes. For this project, we will introduce the detection of several special postures by the accelerometer.

2. Experimental Preparation:

(1) Link micro:bit board with computer via USB cable.

(2) Open the offline version of Mu

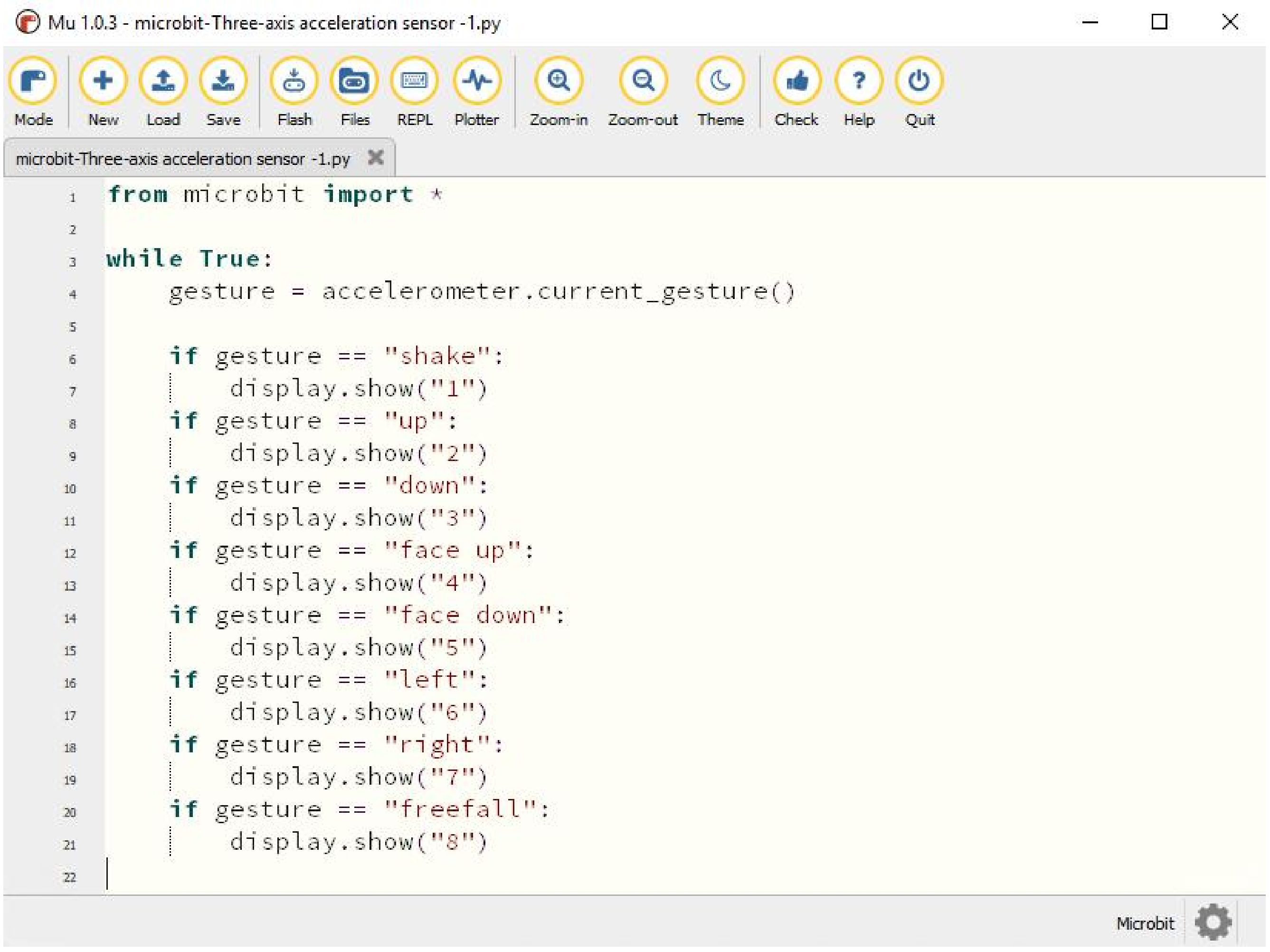
3. Test Code

Code 1:

Open "Code 1.py" file in Mu, (How to load the project code?)

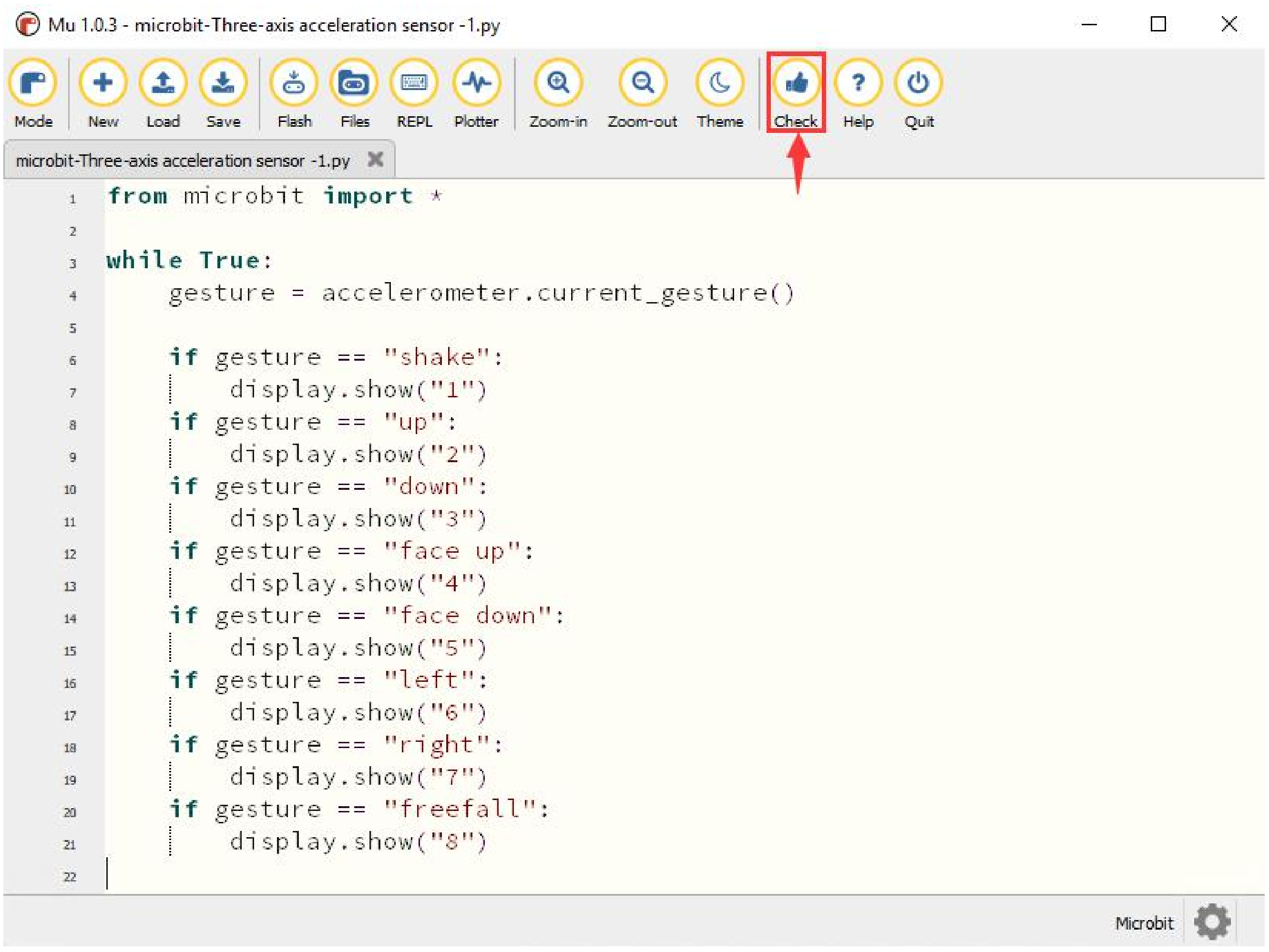
File Type	Route	File Name
Python file	../Python code/8.7：Accelerometer	microbit-Code -1.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit-Three-axis acceleration sensor -1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Three-axis acceleration sensor -1.py
Microbit

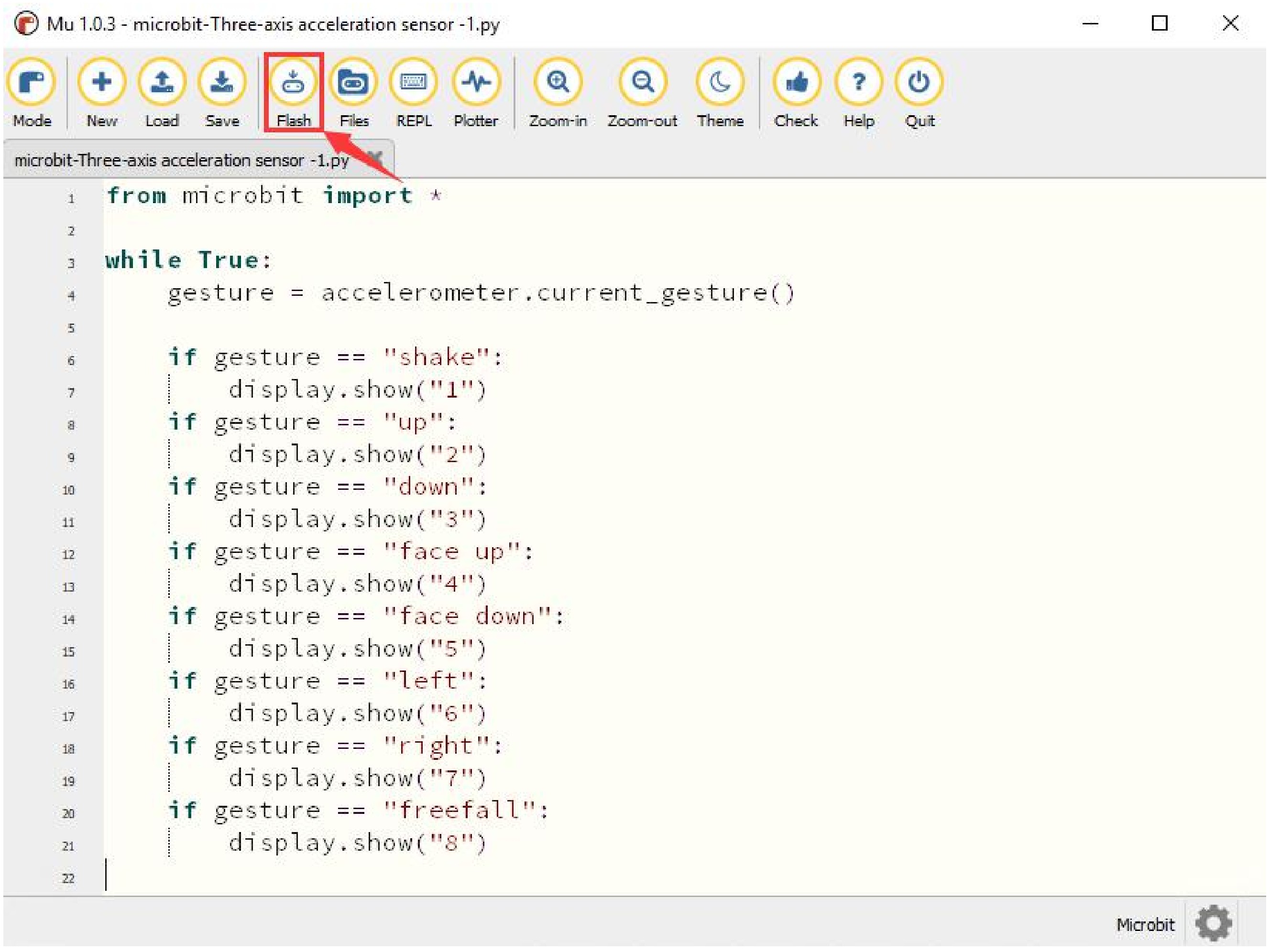
```python
from microbit import *

while True:
    gesture = accelerometer.current_gesture()

    if gesture == "shake":
        display.show("1")
    if gesture == "up":
        display.show("2")
    if gesture == "down":
        display.show("3")
    if gesture == "face up":
        display.show("4")
    if gesture == "face down":
        display.show("5")
    if gesture == "left":
        display.show("6")
    if gesture == "right":
        display.show("7")
    if gesture == "freefall":
        display.show("8")
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-Three-axis acceleration sensor -1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Three-axis acceleration sensor -1.py
Microbit

```python
from microbit import *

while True:
    gesture = accelerometer.current_gesture()

    if gesture == "shake":
        display.show("1")
    if gesture == "up":
        display.show("2")
    if gesture == "down":
        display.show("3")
    if gesture == "face up":
        display.show("4")
    if gesture == "face down":
        display.show("5")
    if gesture == "left":
        display.show("6")
    if gesture == "right":
        display.show("7")
    if gesture == "freefall":
        display.show("8")
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.


Mu 1.0.3 - microbit-Three-axis acceleration sensor -1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Three-axis acceleration sensor -1.py
Microbit

```
from microbit import *

while True:
    gesture = accelerometer.current_gesture()

    if gesture == "shake":
        display.show("1")
    if gesture == "up":
        display.show("2")
    if gesture == "down":
        display.show("3")
    if gesture == "face up":
        display.show("4")
    if gesture == "face down":
        display.show("5")
    if gesture == "left":
        display.show("6")
    if gesture == "right":
        display.show("7")
    if gesture == "freefall":
        display.show("8")

```

Code 2：

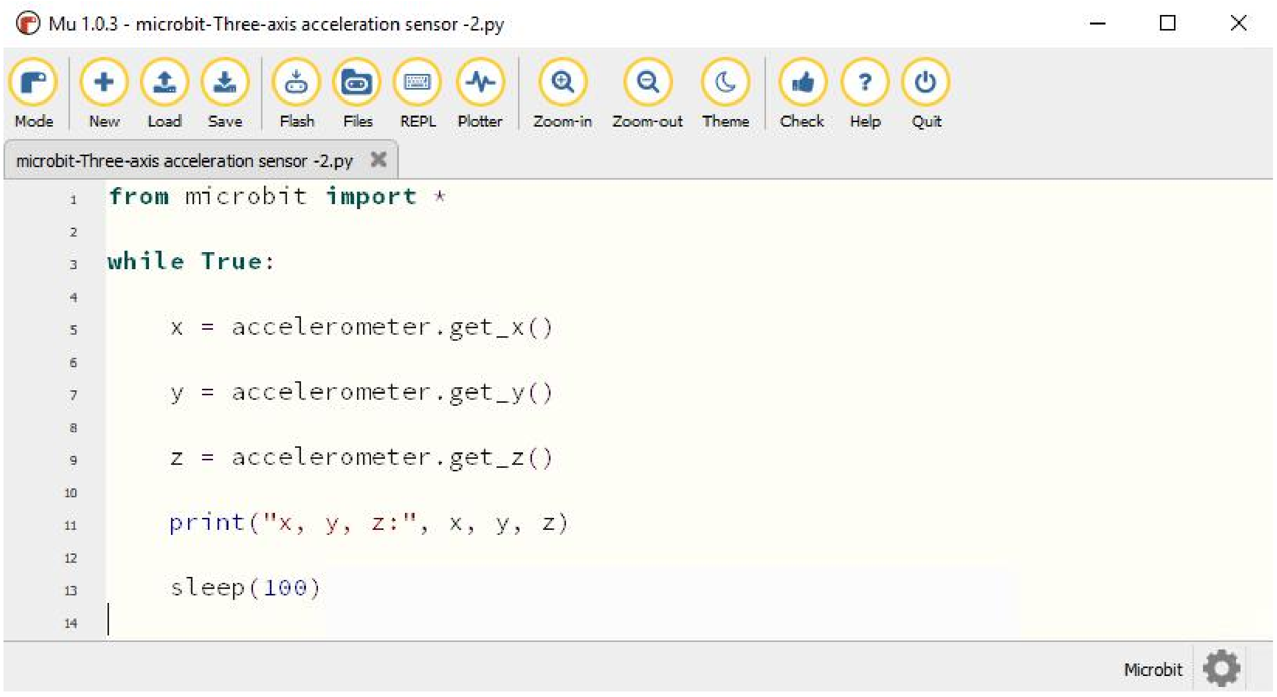
Detect different acceleration values on X, Y and Z axis.

Open file “Code 2.py” in Mu.

（How to load the project code?）

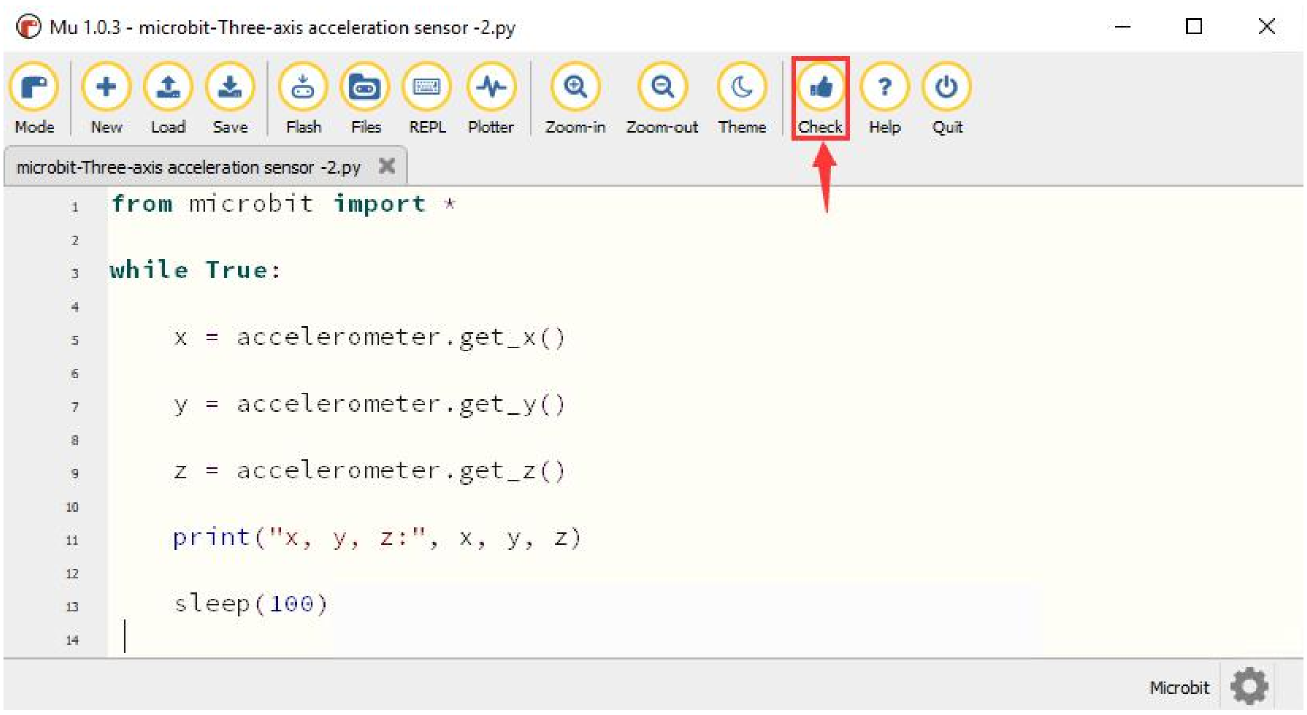
File Type	Route	File Name
Python file	../Python code/8.7：Accelerometer	Code 2.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit-Three-axis acceleration sensor -2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Three-axis acceleration sensor -2.py
Microbit

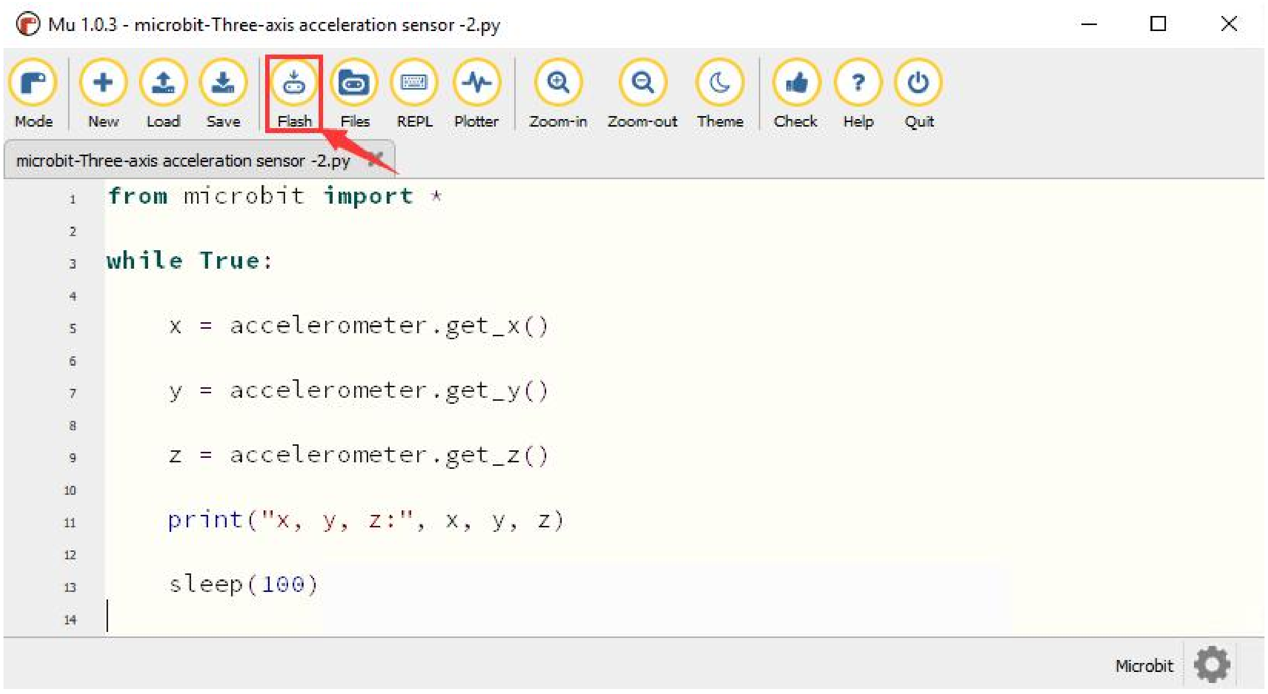
```
from microbit import *

while True:

    x = accelerometer.get_x()

    y = accelerometer.get_y()

    z = accelerometer.get_z()

    print("x, y, z:", x, y, z)

    sleep(100)

```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-Three-axis acceleration sensor -2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Three-axis acceleration sensor -2.py
Microbit

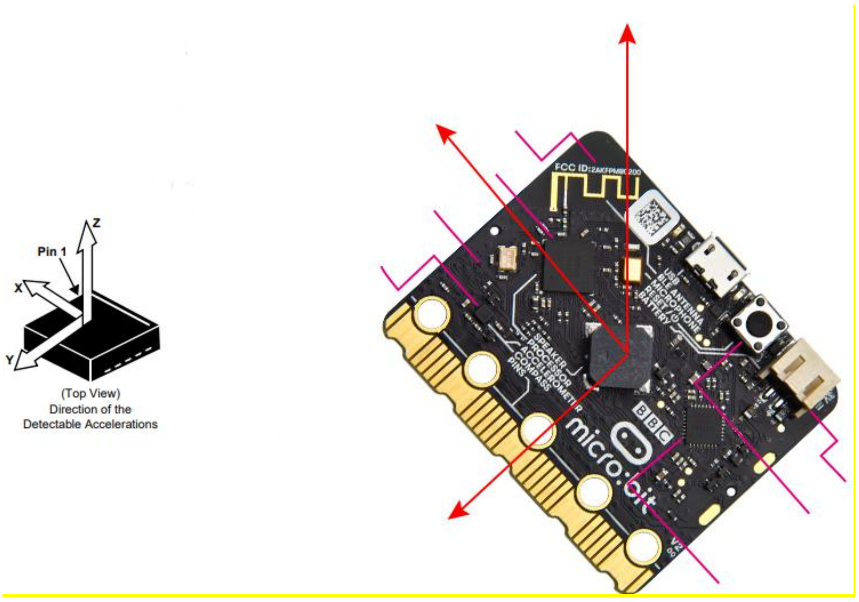
```
from microbit import *

while True:

    x = accelerometer.get_x()

    y = accelerometer.get_y()

    z = accelerometer.get_z()

    print("x, y, z:", x, y, z)

    sleep(100)

```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.


Mu 1.0.3 - microbit-Three-axis acceleration sensor -2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Three-axis acceleration sensor -2.py
Microbit

```
from microbit import *

while True:

    x = accelerometer.get_x()

    y = accelerometer.get_y()

    z = accelerometer.get_z()

    print("x, y, z:", x, y, z)

    sleep(100)

```

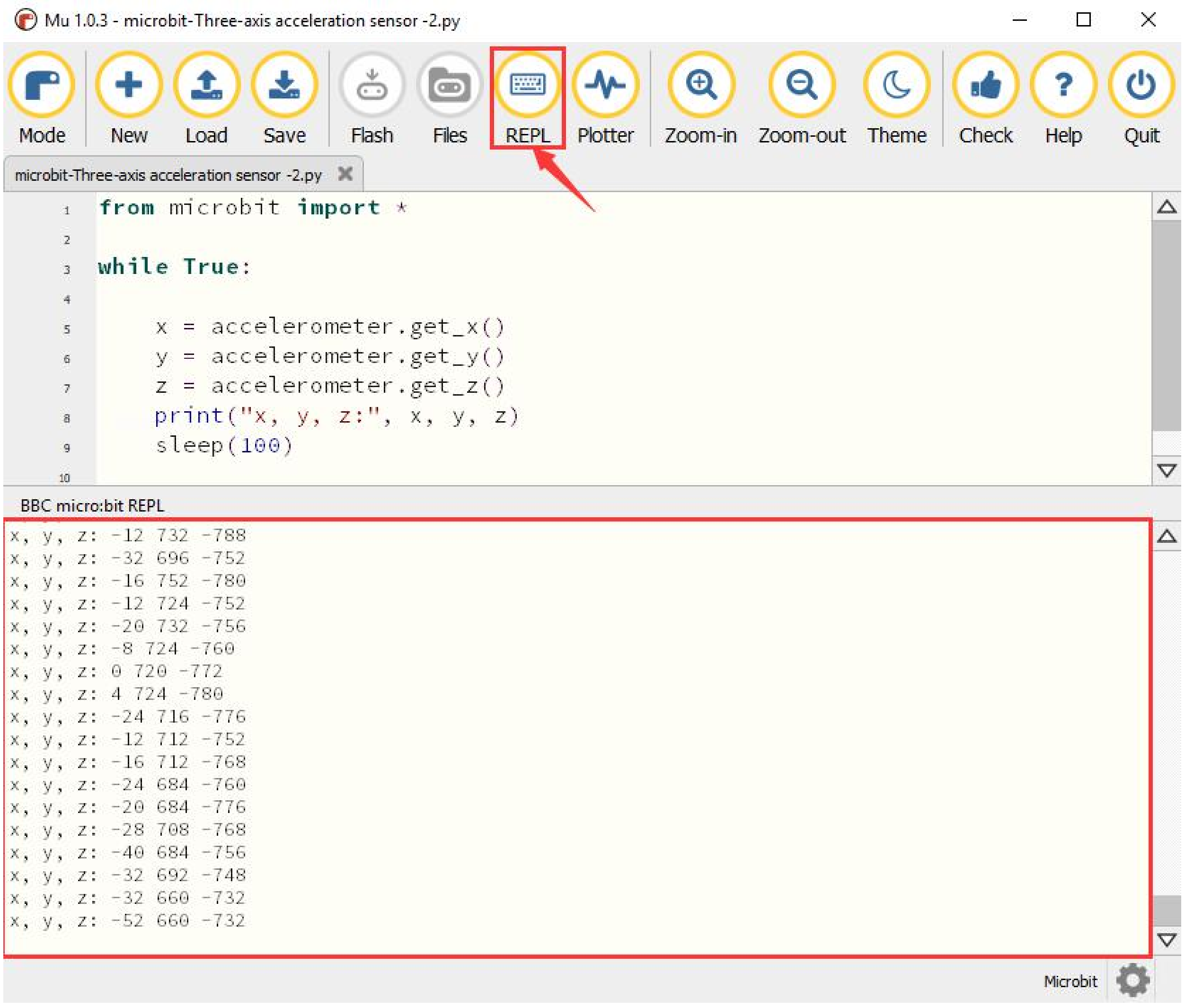
The coordinates of the micro:bit accelerometer are shown in the following figure:



The value of acceleration on the X-axis, Y-axis, and Z-axis, as well as the synthesis of acceleration (the synthesis of gravitational acceleration and other external forces). Then flip the micro:bit board, the data is shown below:

Download code 2 onto micro:bit board, and don’ t pull off the USB cable.

Click “REPL” and press the reset button. The value of acceleration on X axis, Y axis and Z axis are shown below


Mu 1.0.3 - microbit-Three-axis acceleration sensor -2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Three-axis acceleration sensor -2.py
BBC micro:bit REPL
Microbit

```
from microbit import *

while True:

    x = accelerometer.get_x()
    y = accelerometer.get_y()
    z = accelerometer.get_z()
    print("x, y, z:", x, y, z)
    sleep(100)
```

```
x, y, z: -12 732 -788
x, y, z: -32 696 -752
x, y, z: -16 752 -780
x, y, z: -12 724 -752
x, y, z: -20 732 -756
x, y, z: -8 724 -760
x, y, z: 0 720 -772
x, y, z: 4 724 -780
x, y, z: -24 716 -776
x, y, z: -12 712 -752
x, y, z: -16 712 -768
x, y, z: -24 684 -760
x, y, z: -20 684 -776
x, y, z: -28 708 -768
x, y, z: -40 684 -756
x, y, z: -32 692 -748
x, y, z: -32 660 -732
x, y, z: -52 660 -732
```

4.Test Result:

Download code 1 to micro:bit board and plug in power with USB cable shake the Micro:bit board then the number 1 appears.

Place micro:bit vertically(logo up), then the number 2 is displayed:

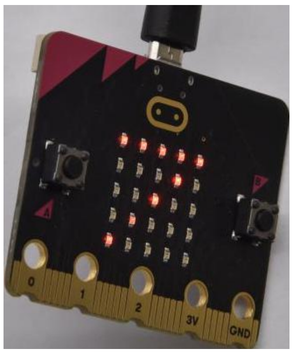
Place micro:bit vertically(logo down), then the number 3 is displayed:

Place micro:bit horizontally (facing up), then the number 4 is displayed:

On the contrary, place micro:bit horizontally (facing down), then the number 5 is displayed:

When Micro:bit board is tilt to the left, number 6 is shown.

When Micro:bit board is inclined to the right, number 7 is displayed.



When it is free fall(accidentally making it fall), number 8 appears on dot matrix. (Note: we don’t recommend you to make it free fall, it will make board damage)

5.Code Explanation:

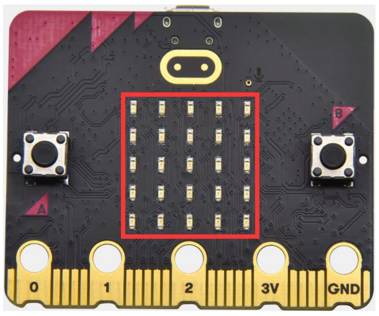
from microbit **import** *	Import the library file of micro: bit
gesture = accelerometer.current_gesture()	Set accelerometer.current_gesture() to gesture
while True:	This is a permanent loop that makes micro:bit execute the code of it.
if gesture == "shake": display.show("1") **if** gesture == "up": display.show("2")	Shaking micro:bit board, number 1 will appear When log points to the North, number 2 will show up.

if gesture == "down":
display.show("3")
if gesture == "face up":
display.show("4")
if gesture == "face down":
display.show("5")
if gesture == "left":
display.show("6")
if gesture == "right":
display.show("7")
if gesture == "freefall":
display.show("8")
	When log points to the South, number 3 will be shown
	When the LED dot matrix is upward, the number 4 is shown.
	the number 5 is displayed when the LED dot matrix is downward.
	When Micro:bit board is tilt to the left, number 6 is shown.
	When micro:bit is tilt to the right
	When Micro:bit board is inclined to the right, number 7 is displayed.
	When it is free fall(accidentally making it fall), number 8 appears on dot matrix.

x = accelerometer.get_x()
y = accelerometer.get_y()
z = accelerometer.get_z()
	Read the acceleration value on x axis， the return value is integer, and set x= the read value on x axis
	Read the acceleration value on y axis， the return value is integer, and set y= the read value on y axis
	Read the acceleration value on z axis， the return value is integer, and

	set z= the read value on z axis
print("x, y, z:", x, y, z)	The value of acceleration will be shown
sleep(100)	Delay in 100ms

8.8: Detect Light Intensity by micro:bit



1. Description:

This project will introduce how Micro:bit detects the external light intensity. Since Micro:bit doesn’ t come with photosensitive sensor, the detection of light intensity is completed through the LED matrix. When the light irradiates the LED matrix, the voltage change will be produced. Therefore, we could determine the light intensity by voltage change.

2. Experimental Preparation:

(1) Link micro:bit board with computer via USB cable.

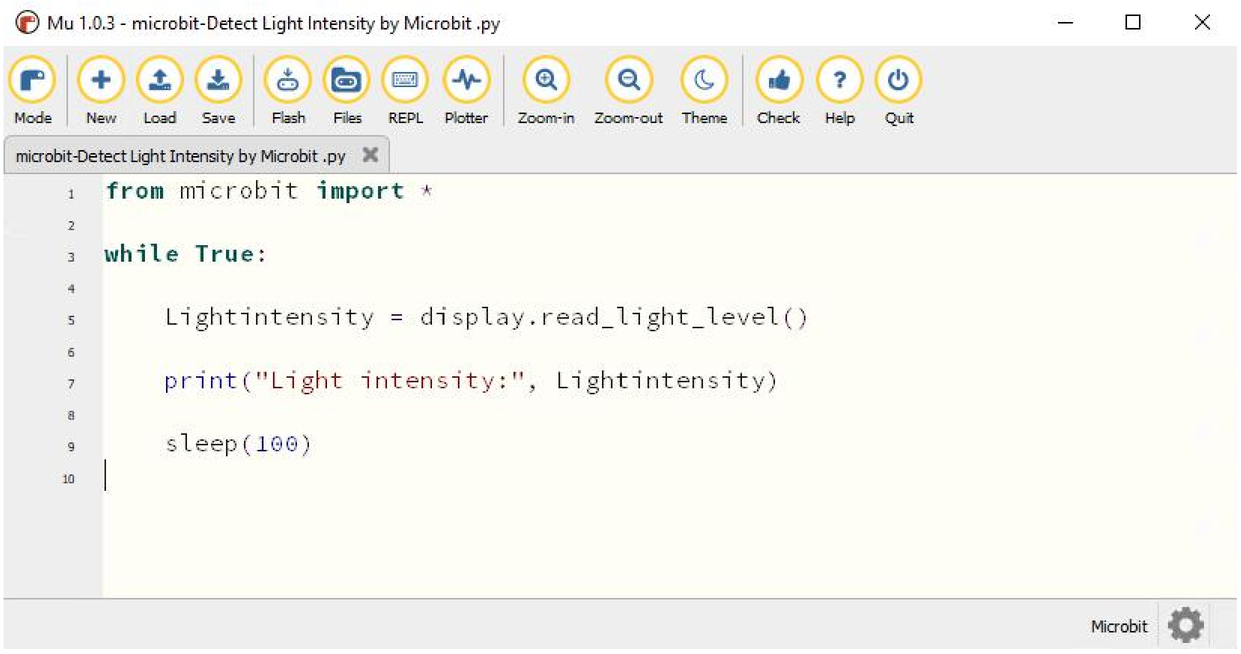
(2) Open the offline version of Mu

3. Test Code

Open“microbit-Detect Light Intensity by Micro:bit .py” file in Mu software，（How to load the project code?)

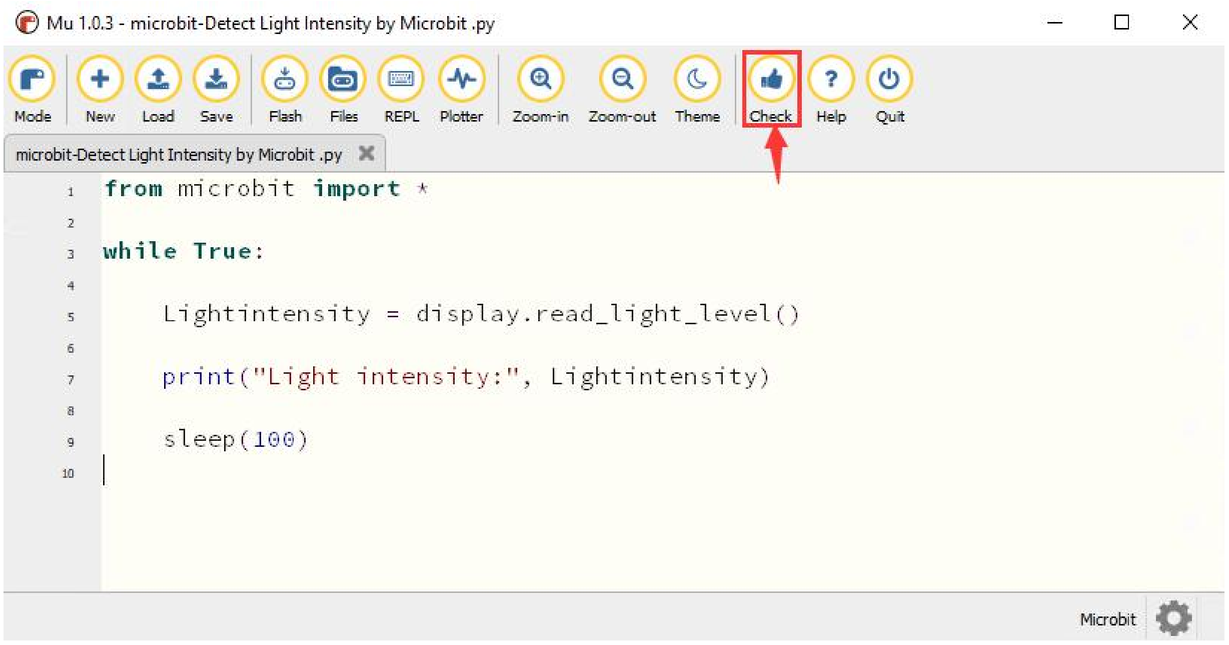
File Type	Route	File Name
Python file	../Python code/8.8：Detect Light Intensity by Micro:bit	microbit-Detect Light Intensity by Micro:bit .py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit-Detect Light Intensity by Microbit .py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Detect Light Intensity by Microbit .py
Microbit

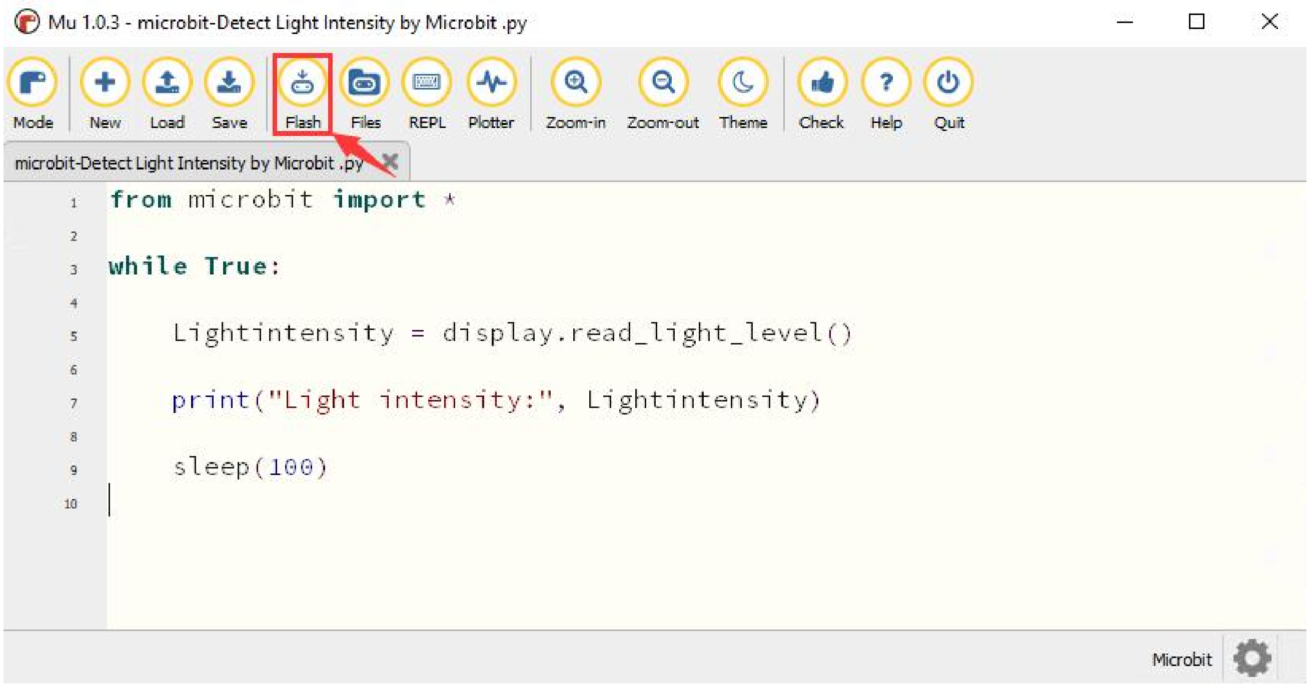
```
from microbit import *

while True:

    Lightintensity = display.read_light_level()

    print("Light intensity:", Lightintensity)

    sleep(100)

```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-Detect Light Intensity by Microbit .py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Detect Light Intensity by Microbit .py
Microbit

```
from microbit import *

while True:

    Lightintensity = display.read_light_level()

    print("Light intensity:", Lightintensity)

    sleep(100)

```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.

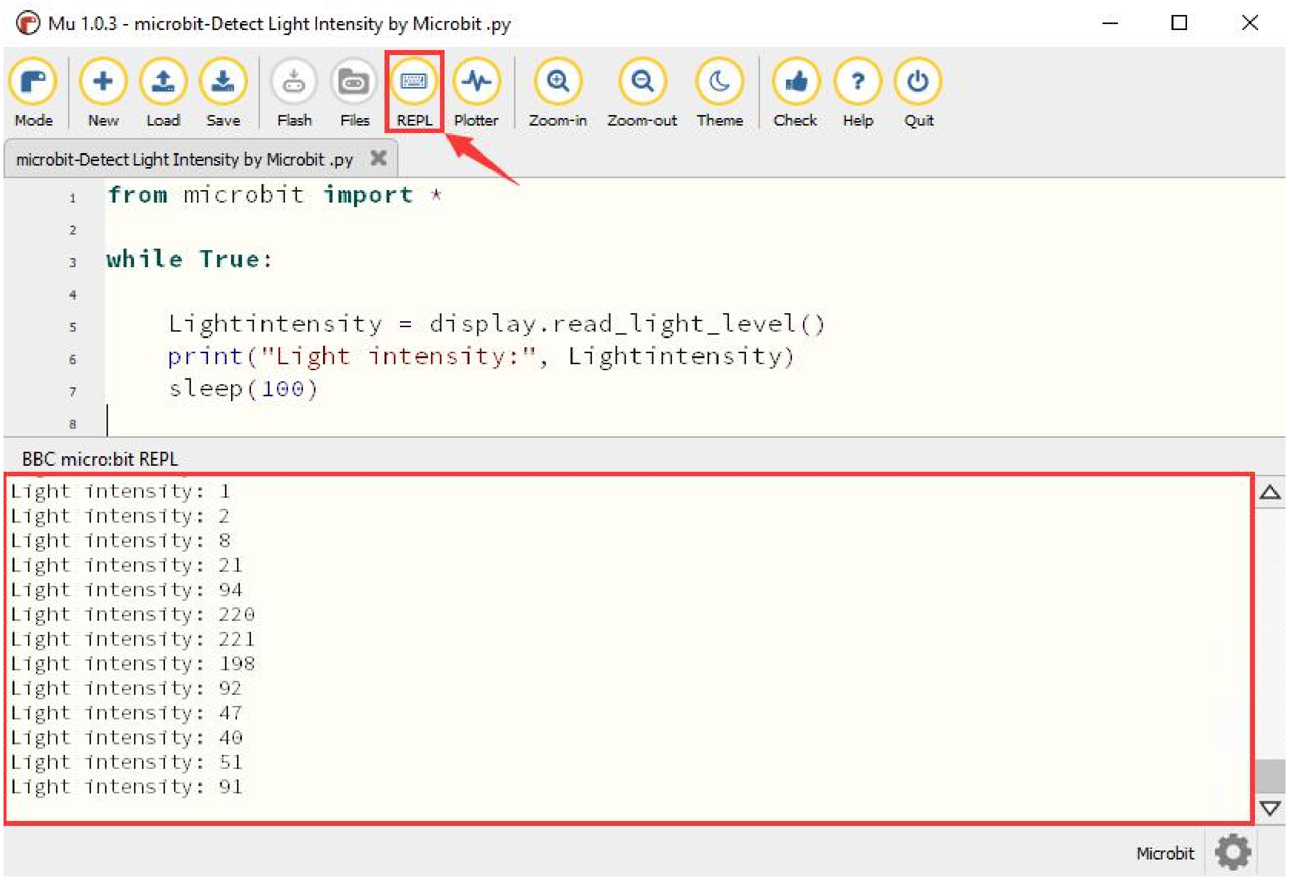

Mu 1.0.3 - microbit-Detect Light Intensity by Microbit .py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Detect Light Intensity by Microbit .py
Microbit

```
from microbit import *

while True:

    Lightintensity = display.read_light_level()

    print("Light intensity:", Lightintensity)

    sleep(100)

```

4. Test Result:

Download code onto micro:bit board, don’t plug off USB cable. Click “REPL” and press the reset buttons, the light intensity value will be displayed, as shown below.

Covering the LED dot matrix, the intensity value is 0; on the contrary, the intensity value increases when placing micro:bit board under the sun.


Mu 1.0.3 - microbit-Detect Light Intensity by Microbit .py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Detect Light Intensity by Microbit .py
BBC micro:bit REPL
Microbit

```
from microbit import *

while True:

    Lightintensity = display.read_light_level()
    print("Light intensity:", Lightintensity)
    sleep(100)

```

```
Light intensity: 1
Light intensity: 2
Light intensity: 8
Light intensity: 21
Light intensity: 94
Light intensity: 220
Light intensity: 221
Light intensity: 198
Light intensity: 92
Light intensity: 47
Light intensity: 40
Light intensity: 51
Light intensity: 91
```

5.Code Explanation:

from microbit **import** *	Import the library file of micro: bit
gesture = accelerometer.current_gesture()	Set accelerometer.current_gesture() to gesture
while True:	This is a permanent loop that makes

	micro:bit execute the code of it.
Lightintensity = display.read_light_level()	Set display.read_light_level() to Lightintensity
print("Light intensity:", Lightintensity)	BBC microbit REPL prints the detected light intensity value
sleep(100)	Delay in 100ms

8.9: Speaker

1. Description:

The Micro: Bit main board V2 has an built-in speaker, which makes adding sound to the programs easier. We can program the speaker to air all kinds of tones ,such as playing the song "Ode to Joy" .

2. Preparation:

Connect micro:bit to computer with USB cable

Open offline Mu editor

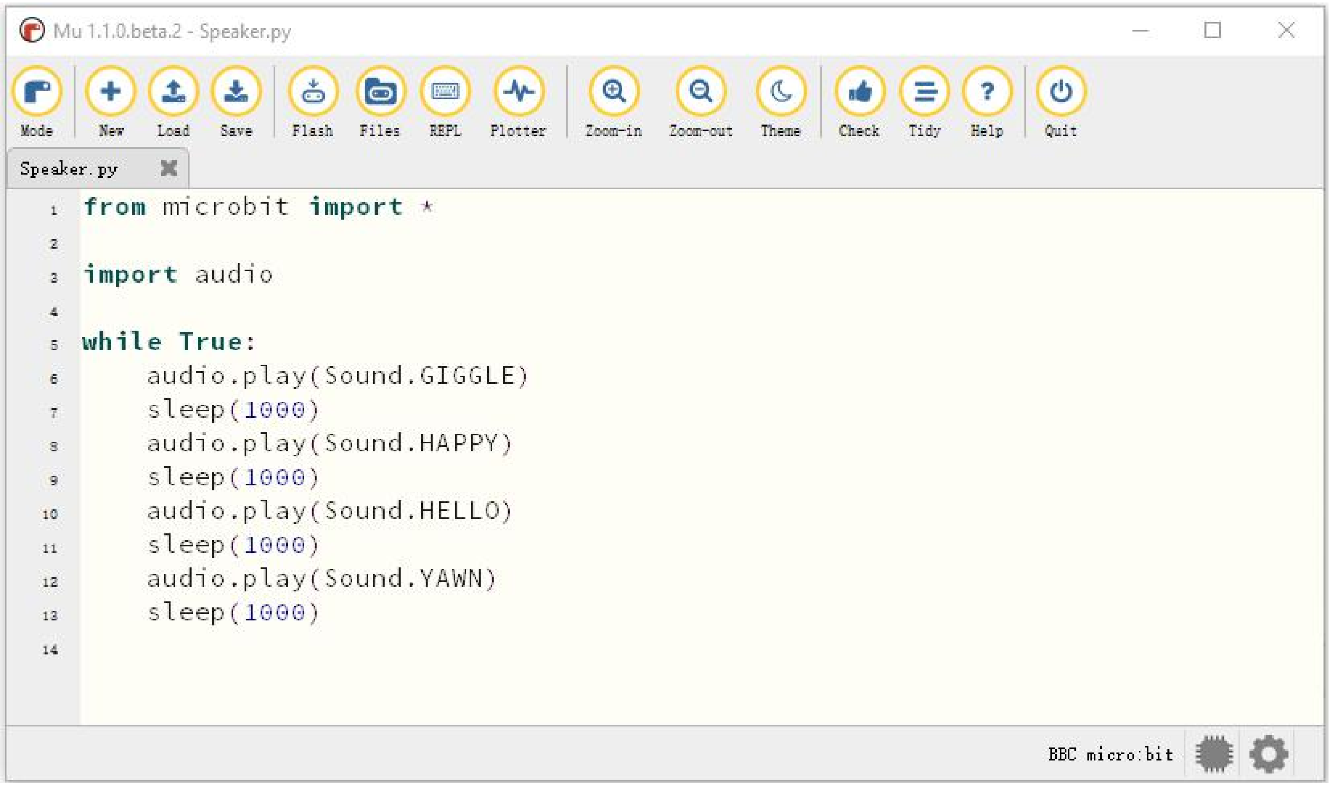
3.Test Result:

Open "microbit-Speaker .py in Mu software

(How to load the project code?)

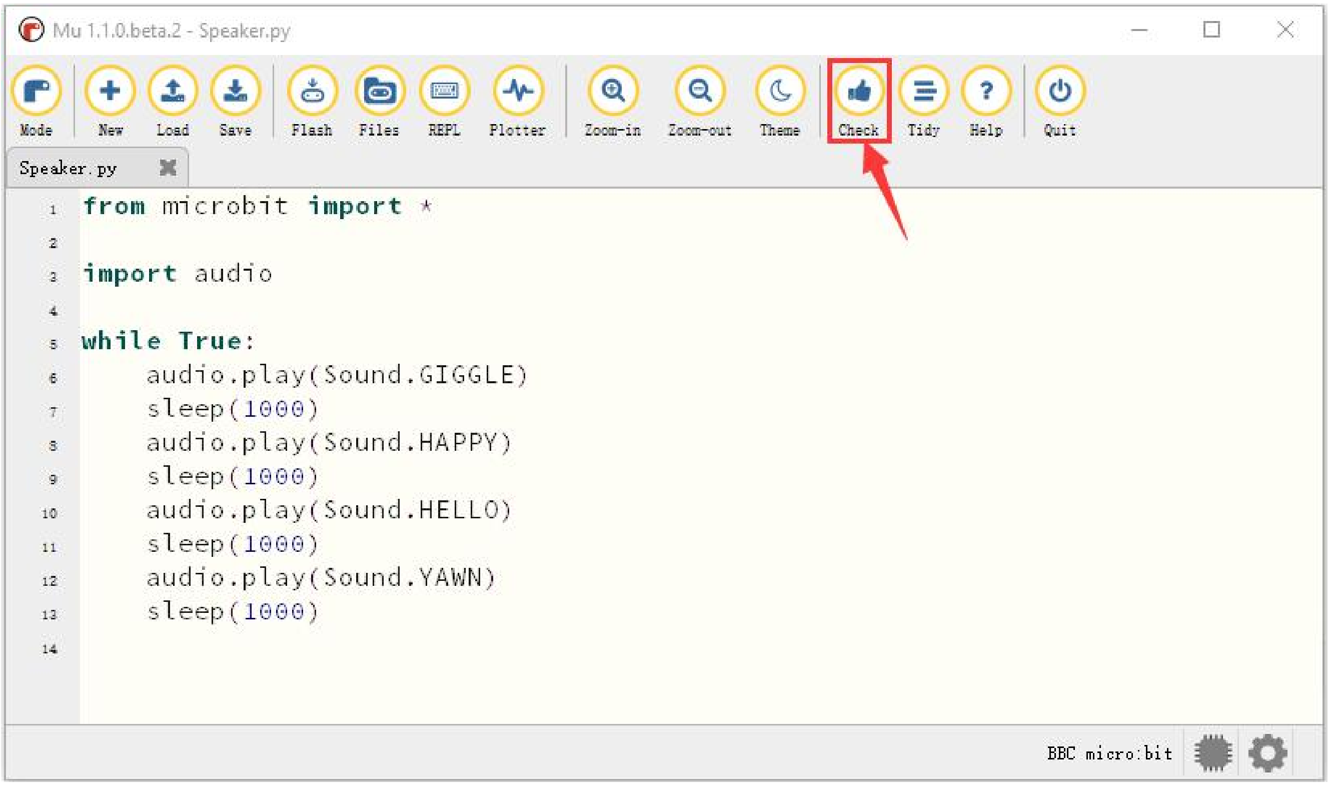
File Type	Route	File Name
Python file	../Python code/ 8.9: Speaker	microbit-Speaker.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



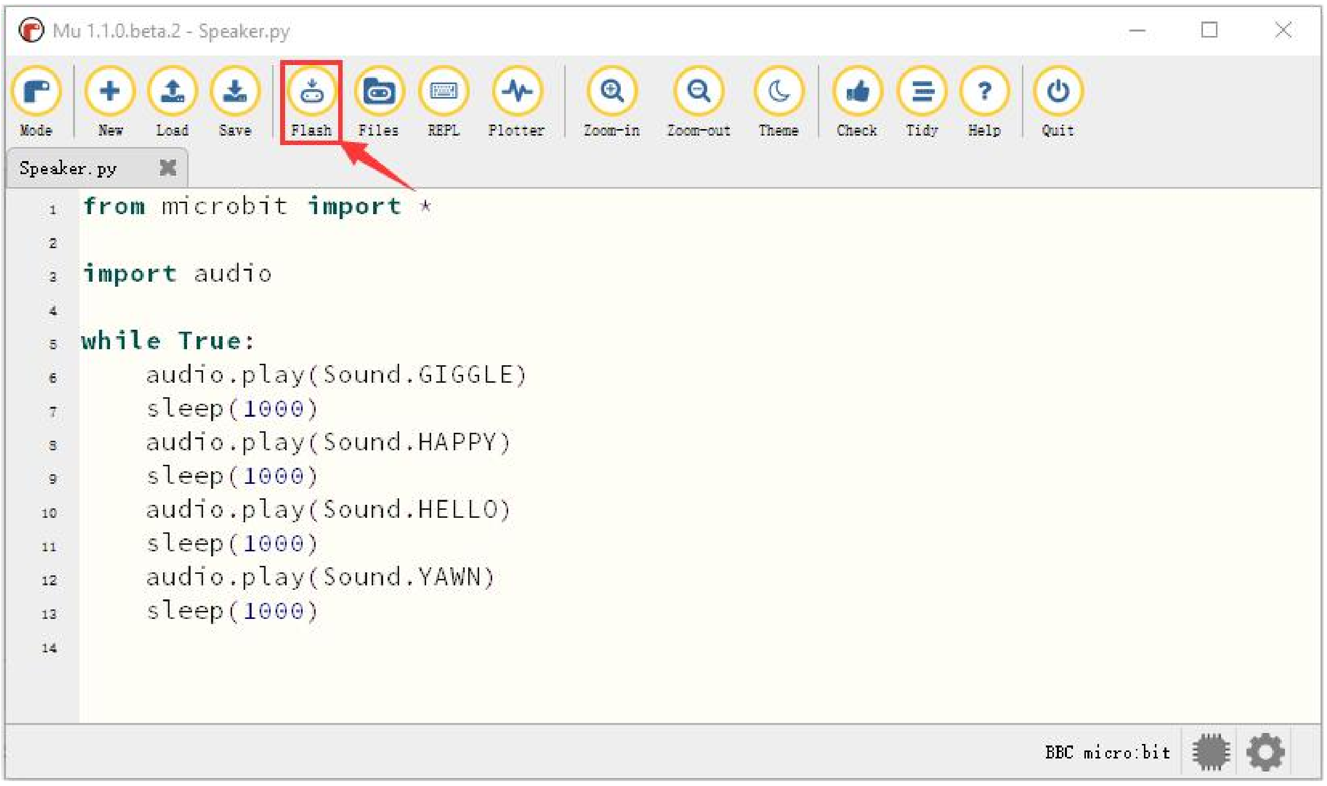
```
from microbit import *

import audio

while True:
    audio.play(Sound.GIGGLE)
    sleep(1000)
    audio.play(Sound.HAPPY)
    sleep(1000)
    audio.play(Sound.HELLO)
    sleep(1000)
    audio.play(Sound.YAWN)
    sleep(1000)
```

Click “Check” to examine error in the code. The underlines and cursors signal that the program is wrong.



```
from microbit import *

import audio

while True:
    audio.play(Sound.GIGGLE)
    sleep(1000)
    audio.play(Sound.HAPPY)
    sleep(1000)
    audio.play(Sound.HELLO)
    sleep(1000)
    audio.play(Sound.YAWN)
    sleep(1000)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```
from microbit import *

import audio

while True:
    audio.play(Sound.GIGGLE)
    sleep(1000)
    audio.play(Sound.HAPPY)
    sleep(1000)
    audio.play(Sound.HELLO)
    sleep(1000)
    audio.play(Sound.YAWN)
    sleep(1000)

```

4.Test Result:

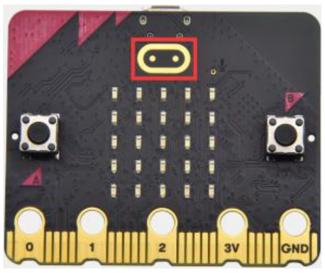
Download code to the micro:bit, and keep USB cable connected. The micro:bit emits the sound and displays the music sign.

5.Code Explanation:

from microbit **import** *	Import the library of micro: bit
import audio	Audio library
while True:	This is a permanent loop that makes micro:bit execute the code of it.
audio.play(Sound.GIGGLE)	Emit the “giggle” sound

sleep(1000)	delay in 1000ms

8.10: Touch-sensitive Logo



1. Description:

The Micro: Bit main board V2 is equipped with a golden touch-sensitive logo, which can act as an input component and function like an extra button.

It contains a capacitive touch sensor that senses small changes in the electric field when pressed (or touched), just like your phone or tablet screen do.When you press it , you can activate the program.

2. Preparation:

Connect micro:bit to computer with USB cable

Open offline Mu editor

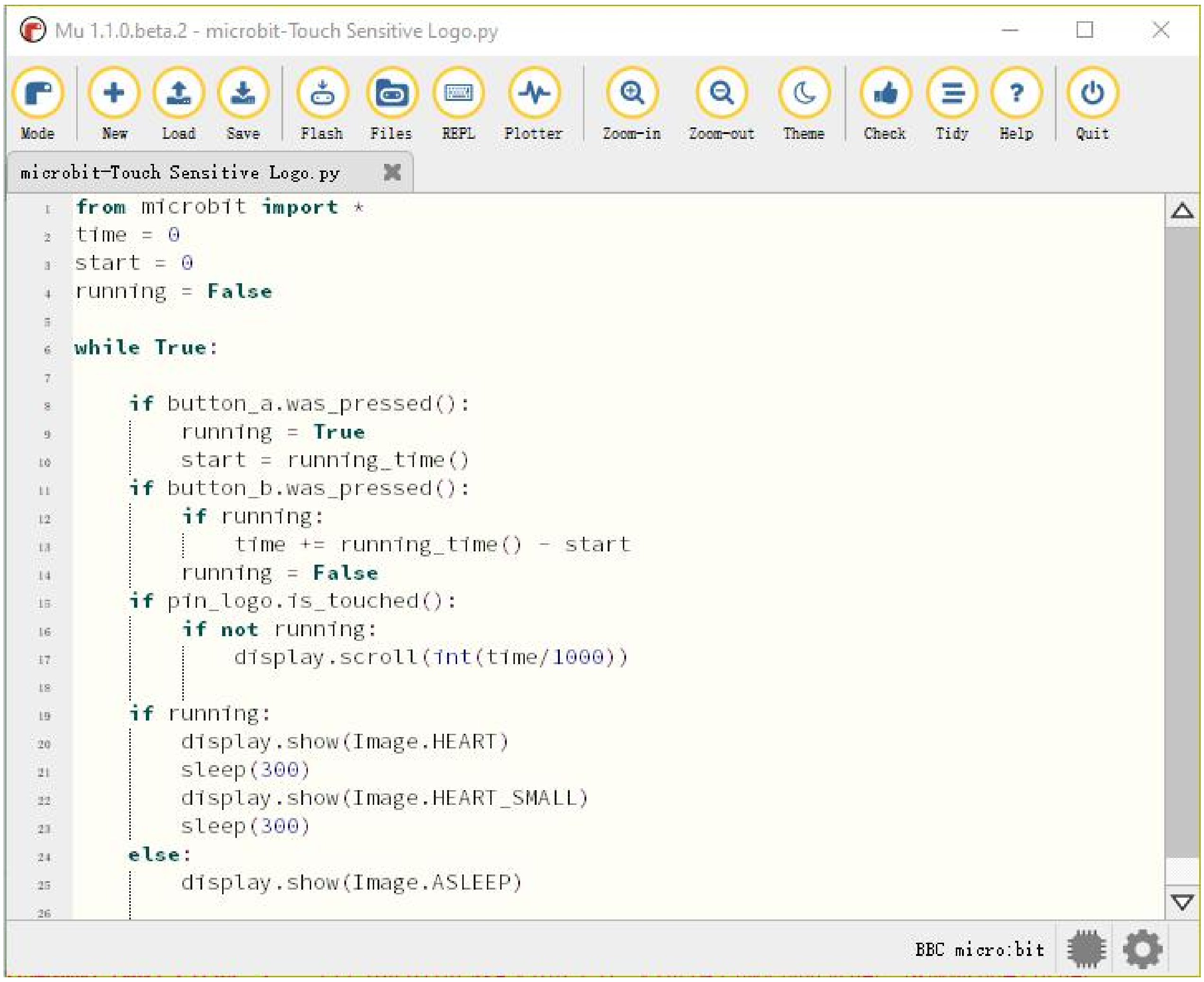
3.Test Result:

Open “microbit-Touch Sensitive Logo .py ” in Mu software

(How to load the project code?)

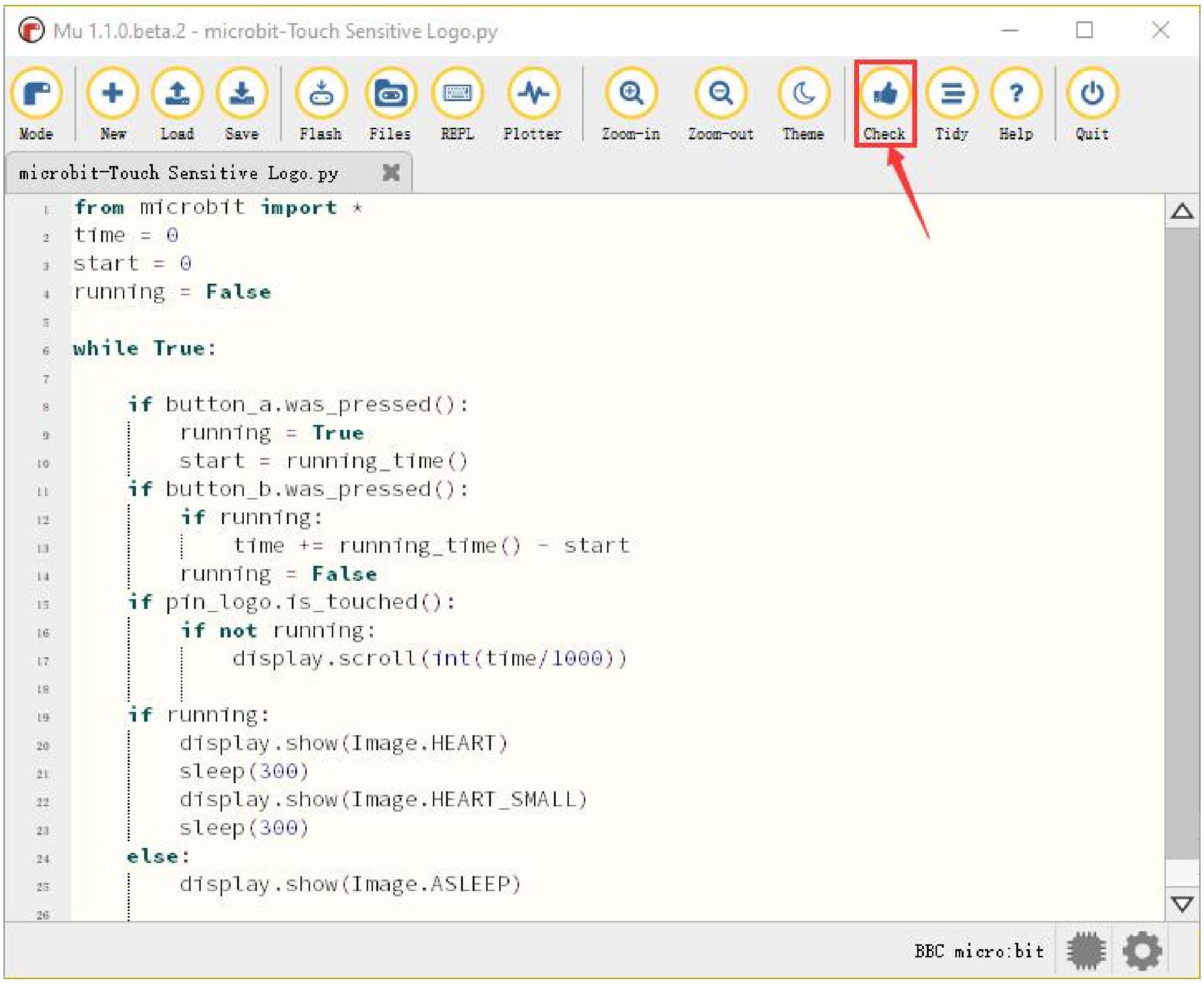
File Type	Route	File Name
Python file	../Python code/8.10: Touch Sensitive Logo	microbit-Touch Sensitive Logo.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



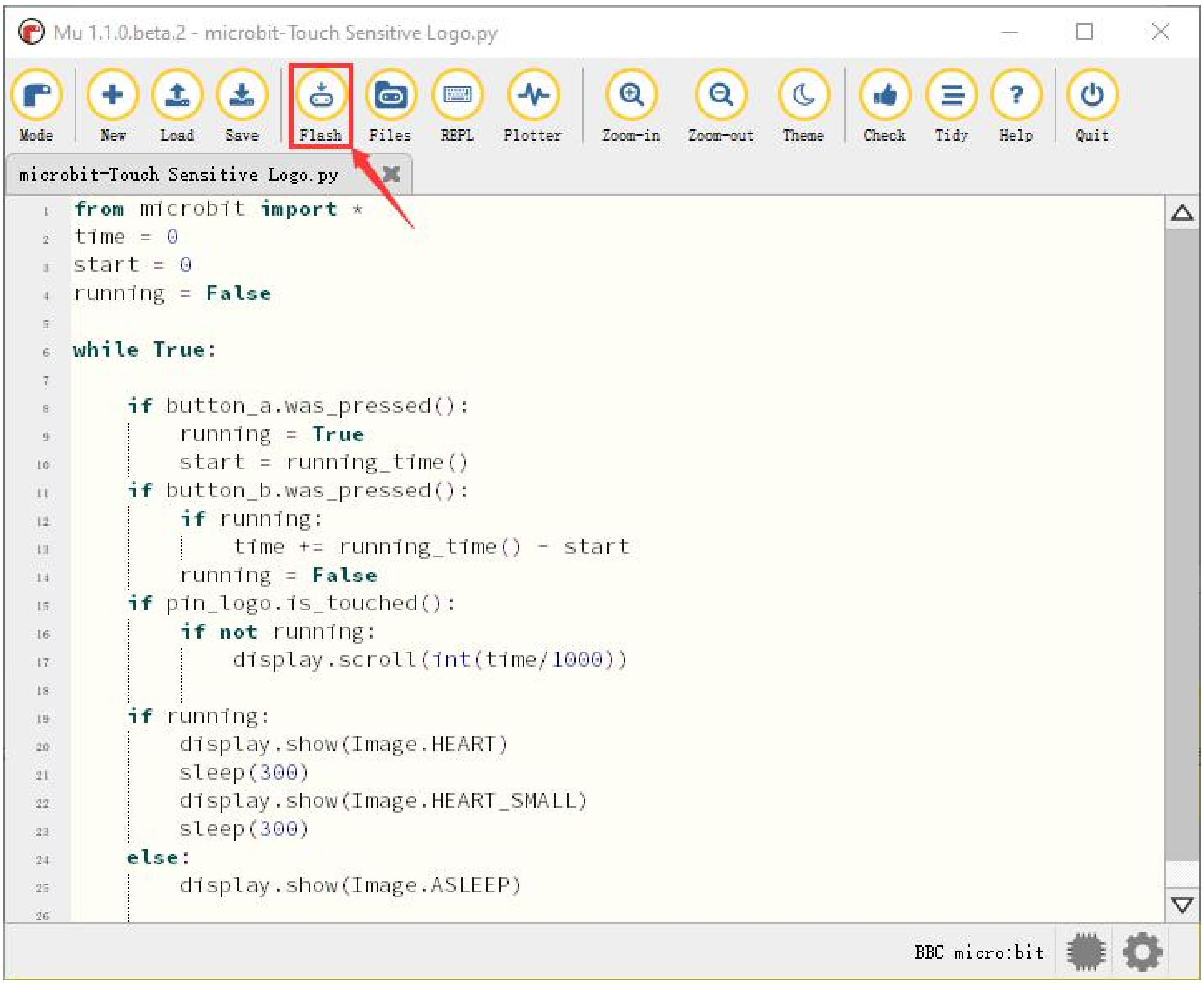
```
from microbit import *
time = 0
start = 0
running = False

while True:

    if button_a.was_pressed():
        running = True
        start = running_time()
    if button_b.was_pressed():
        if running:
            time += running_time() - start
        running = False
    if pin_logo.is_touched():
        if not running:
            display.scroll(int(time/1000))

    if running:
        display.show(Image.HEART)
        sleep(300)
        display.show(Image.HEART_SMALL)
        sleep(300)
    else:
        display.show(Image.ASLEEP)
```

Click "Check" to examine error in the code. The underlines and cursors signal that the program is wrong.



```
from microbit import *
time = 0
start = 0
running = False

while True:

    if button_a.was_pressed():
        running = True
        start = running_time()
    if button_b.was_pressed():
        if running:
            time += running_time() - start
        running = False
    if pin_logo.is_touched():
        if not running:
            display.scroll(int(time/1000))

    if running:
        display.show(Image.HEART)
        sleep(300)
        display.show(Image.HEART_SMALL)
        sleep(300)
    else:
        display.show(Image.ASLEEP)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.

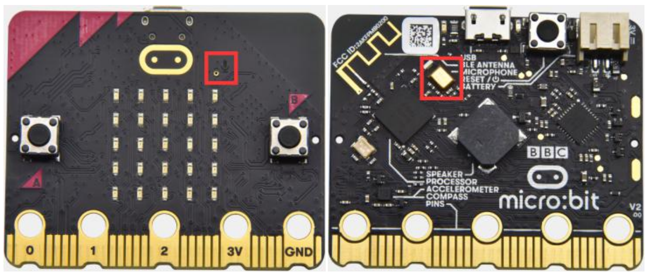


```
from microbit import *
time = 0
start = 0
running = False

while True:

    if button_a.was_pressed():
        running = True
        start = running_time()
    if button_b.was_pressed():
        if running:
            time += running_time() - start
        running = False
    if pin_logo.is_touched():
        if not running:
            display.scroll(int(time/1000))

    if running:
        display.show(Image.HEART)
        sleep(300)
        display.show(Image.HEART_SMALL)
        sleep(300)
    else:
        display.show(Image.ASLEEP)
```

4.Test Result:

When you press button A, LED will show heart beat icon; and the button B is used to stop showing the image. In addition, touch logo then the micro:bit will count time as a stopwatch; press the reset button to restart counting time.

8.11: Microphone



1.Description:

The Micro: Bit main board V2 is built with a microphone which can test the volume of ambient environment. When you clap, the microphone LED indicator will turn on. Since it can measure the intensity of sound, you can make a noise scale or disco lighting changing with music. The microphone is placed on the opposite side of the microphone LED indicator and in proximity with holes that lets sound pass.When the board detects sound, the LED indicator lights up.

2.Preparation:

Connect micro:bit to computer with USB cable

Open the offline Mu editor

3.Test Result:

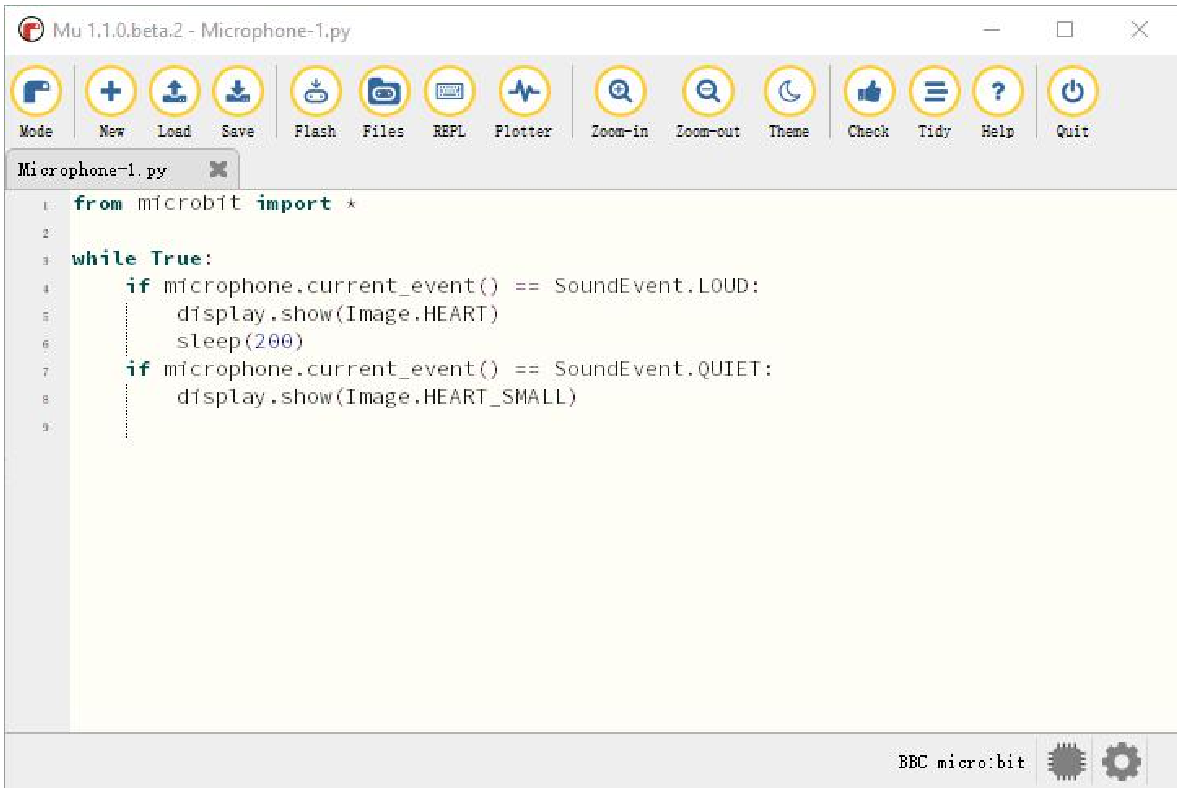
Code 1:

Open the "microbit-Microphone.py " file in the Mu software.

(How to load the project code?)

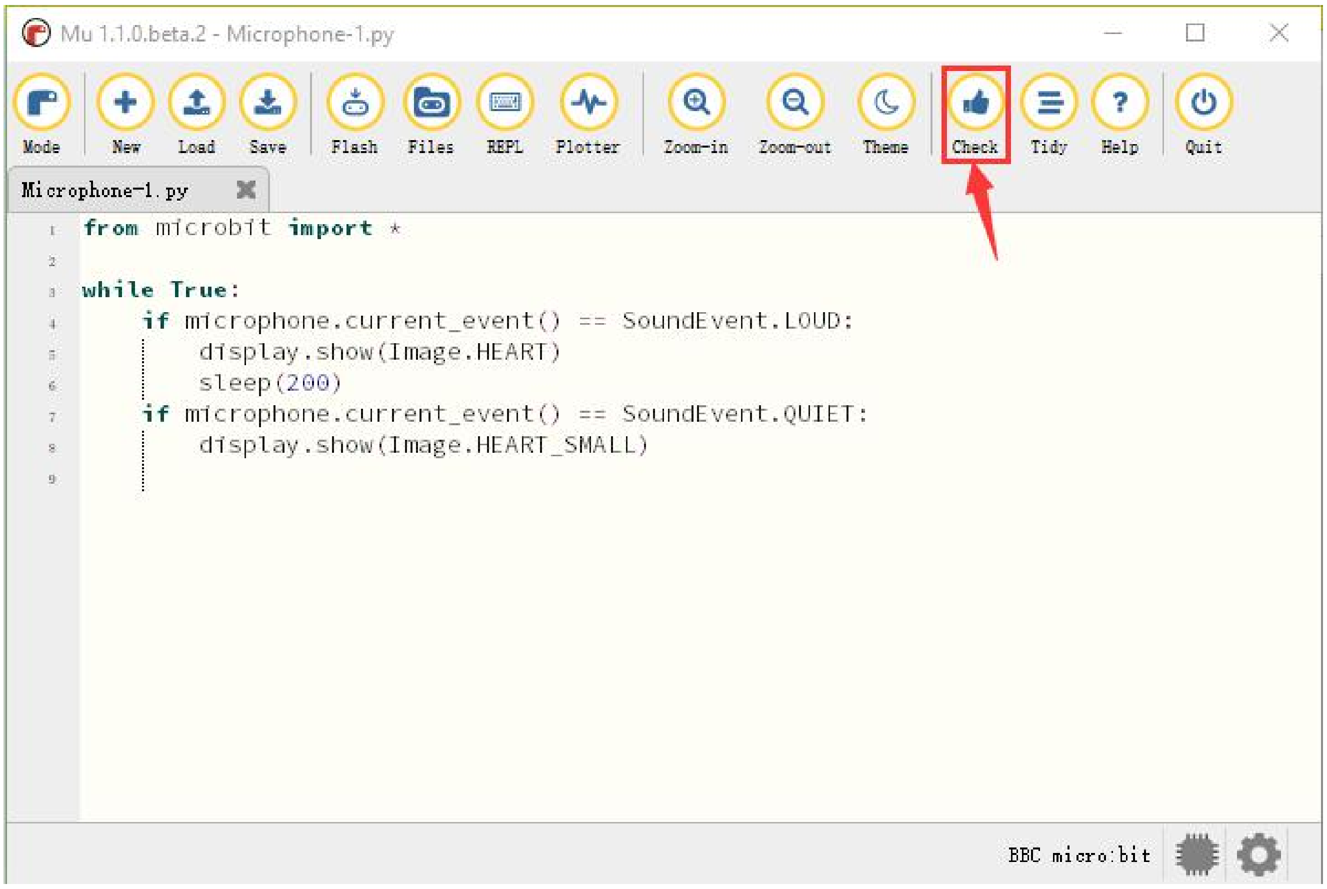
File Type	Route	File Name
Python file	../Python code/8.11：Microphone	microbit-Microphone-1.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



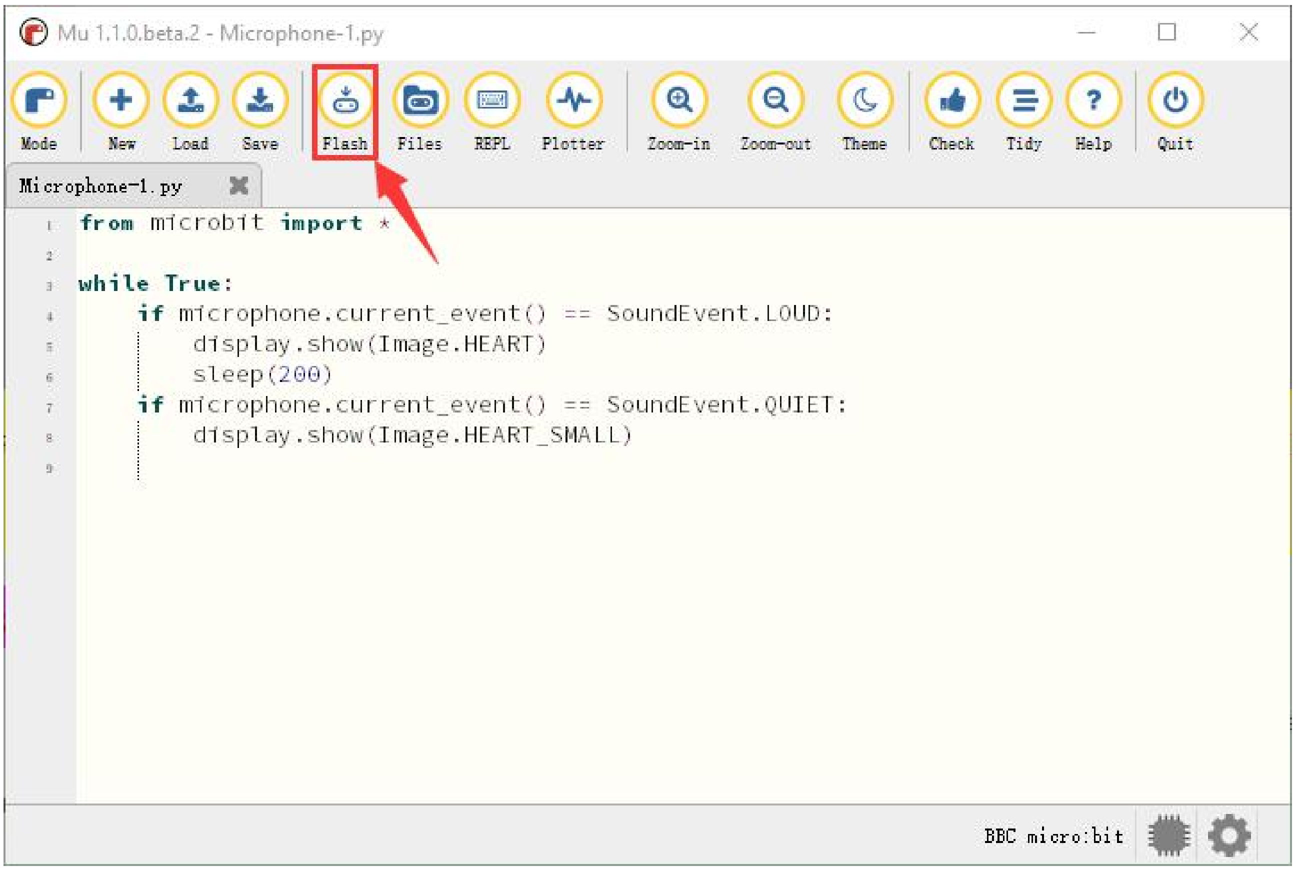
```
from microbit import *

while True:
    if microphone.current_event() == SoundEvent.LOUD:
        display.show(Image.HEART)
        sleep(200)
    if microphone.current_event() == SoundEvent.QUIET:
        display.show(Image.HEART_SMALL)
```

Click “Check” to examine error in the code. The underlines and cursors signal that the program is wrong.

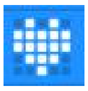


```
from microbit import *

while True:
    if microphone.current_event() == SoundEvent.LOUD:
        display.show(Image.HEART)
        sleep(200)
    if microphone.current_event() == SoundEvent.QUIET:
        display.show(Image.HEART_SMALL)

```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```
from microbit import *

while True:
    if microphone.current_event() == SoundEvent.LOUD:
        display.show(Image.HEART)
        sleep(200)
    if microphone.current_event() == SoundEvent.QUIET:
        display.show(Image.HEART_SMALL)
```

The LED light will display "" when you clap your hands and will appear when the environment is quiet.

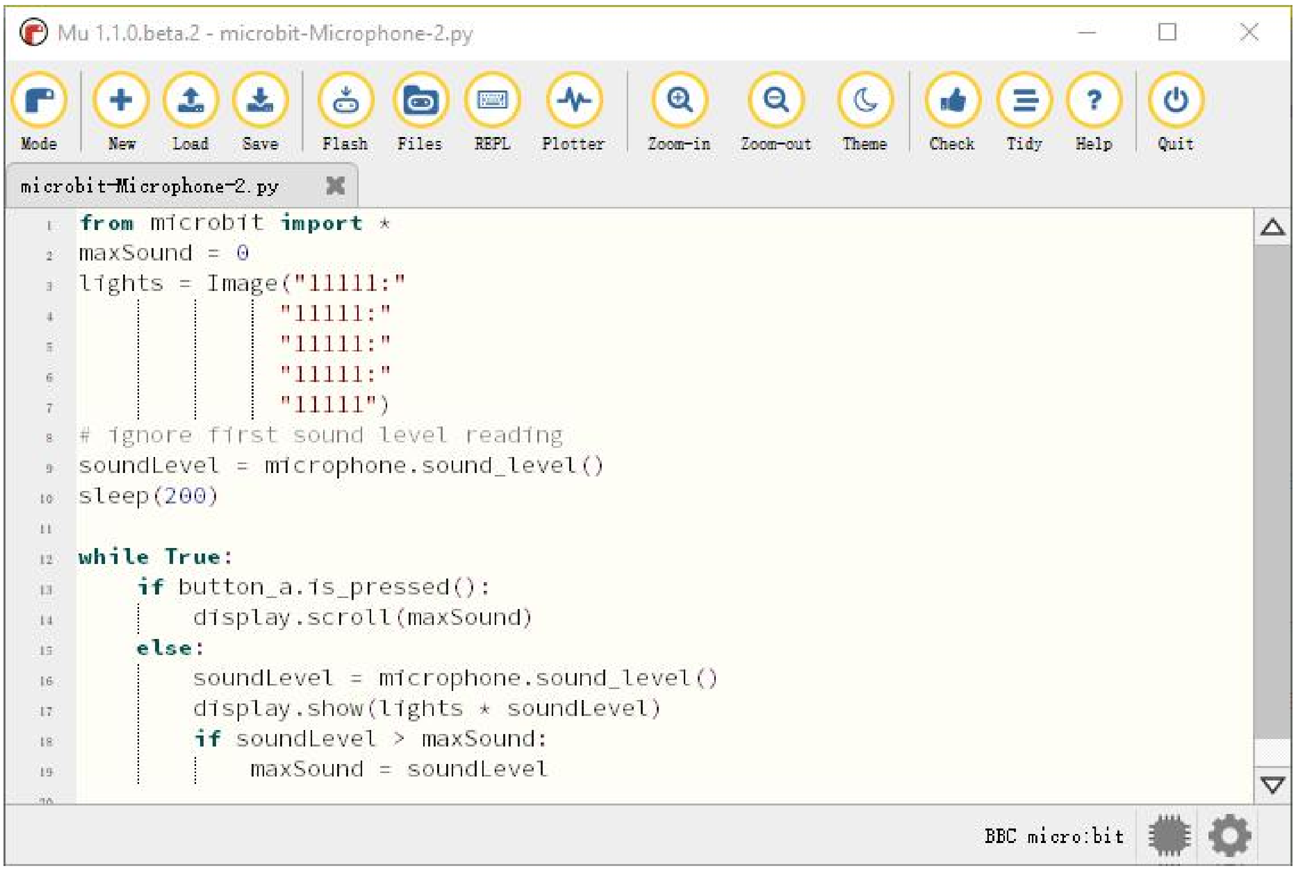
Code 2:

Open "microbit- Microphone -2.py "file in Mu software

(How to load the project code?)

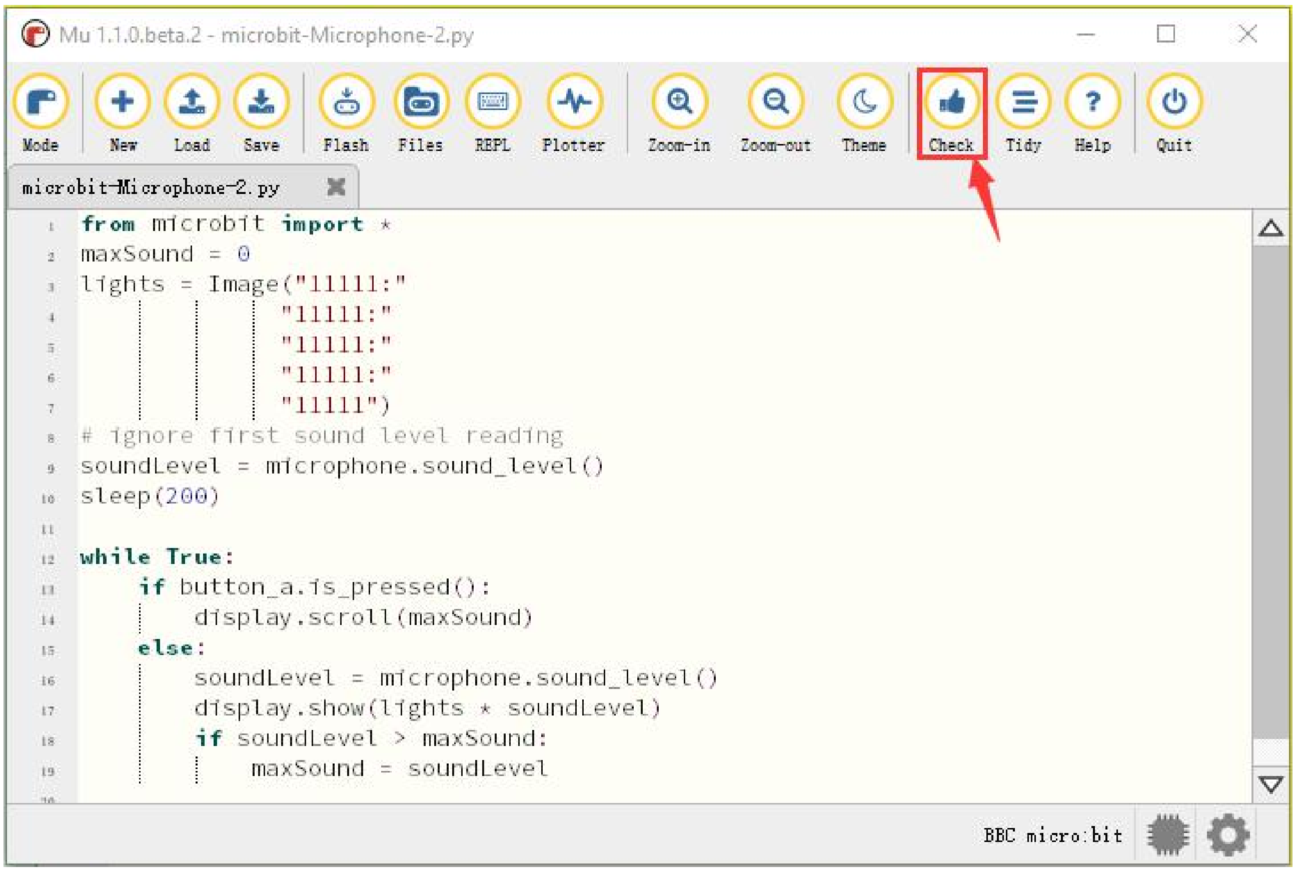
File Type	Route	File Name
Python file	../Python code/8.11： Microphone	microbit- Microphone -2.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



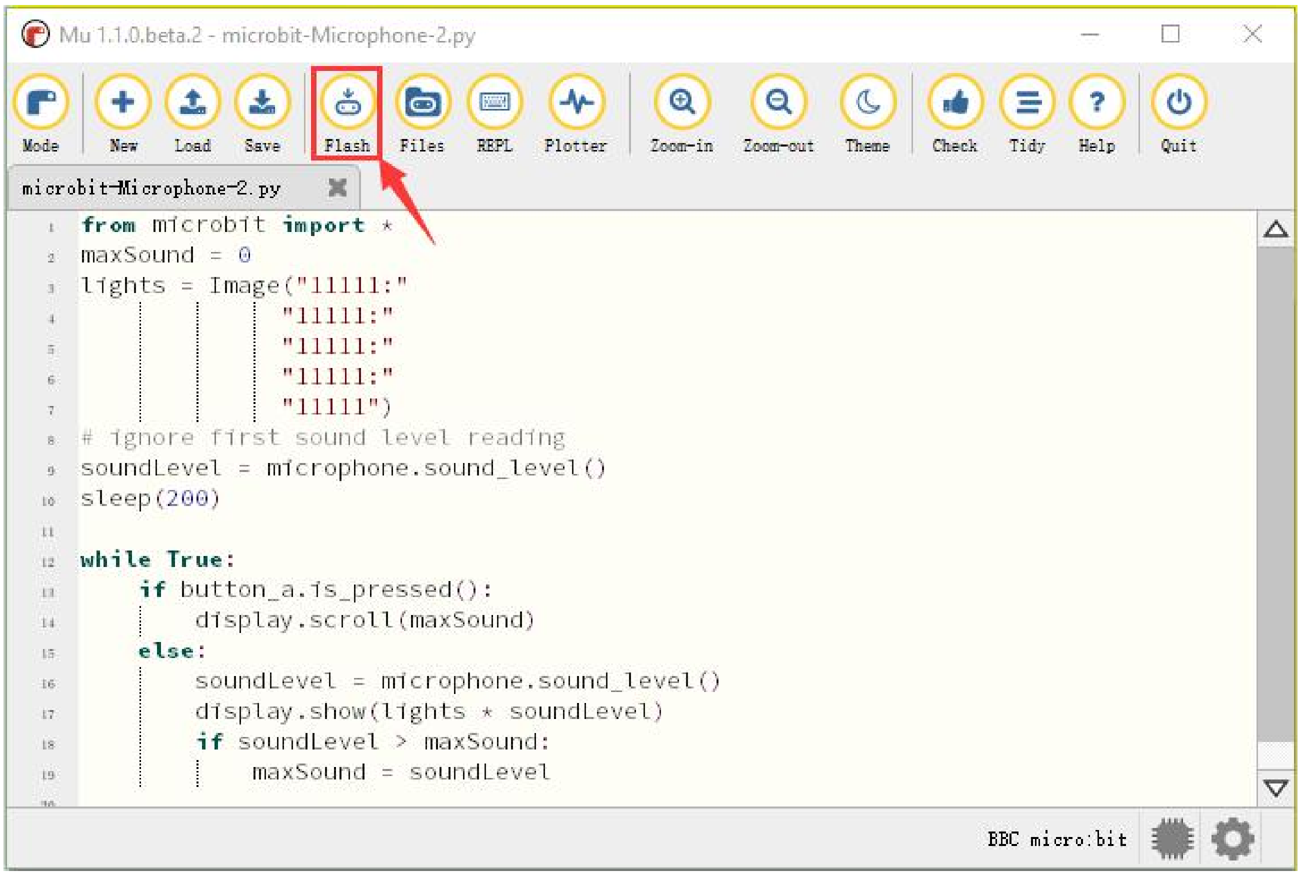
```
from microbit import *
maxSound = 0
lights = Image("11111:"
               "11111:"
               "11111:"
               "11111:"
               "11111")
# ignore first sound level reading
soundLevel = microphone.sound_level()
sleep(200)

while True:
    if button_a.is_pressed():
        display.scroll(maxSound)
    else:
        soundLevel = microphone.sound_level()
        display.show(lights * soundLevel)
        if soundLevel > maxSound:
            maxSound = soundLevel
```

Click “Check” to examine error in the code. The underlines and cursors signal that the program is wrong.



```
from microbit import *
maxSound = 0
lights = Image("11111:"
               "11111:"
               "11111:"
               "11111:"
               "11111")
# ignore first sound level reading
soundLevel = microphone.sound_level()
sleep(200)

while True:
    if button_a.is_pressed():
        display.scroll(maxSound)
    else:
        soundLevel = microphone.sound_level()
        display.show(lights * soundLevel)
        if soundLevel > maxSound:
            maxSound = soundLevel
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```
from microbit import *
maxSound = 0
lights = Image("11111:"
               "11111:"
               "11111:"
               "11111:"
               "11111")
# ignore first sound level reading
soundLevel = microphone.sound_level()
sleep(200)

while True:
    if button_a.is_pressed():
        display.scroll(maxSound)
    else:
        soundLevel = microphone.sound_level()
        display.show(lights * soundLevel)
        if soundLevel > maxSound:
            maxSound = soundLevel
```

4.Test Result:

When you press the button A, the micro:bit will show the detected maximum value(press the reset button to get the maximum value)

The micro:bit will get brighter if the detected sound value gets larger.

5.Code Explanation:

from microbit **import** *	Import the library of micro: bit
while True:	This is a permanent loop that makes micro:bit execute the code of it.

if microphone.current_event() == SoundEvent.LOUD:
display.show(Image.HEART)
sleep(200)
if microphone.current_event() == SoundEvent.QUIET:
display.show(Image.HEART_SMALL)
	If there is a sound
	LED shows ❤
	Delay in 200ms
	if no sound is detected
	LED lights show▦

print("Light intensity:", Lightintensity)	BBC microbit REPL prints the detected light intensity value
maxSound = 0	The initial value of maxSound is 0
lights = Image("11111:""11111:""11111:""11111:""11111")	Assign Image() to variable lights
soundLevel = microphone.sound_level()	Assign microphone.sound_level() to the variable soundLevel

if button_a.is_pressed():
display.scroll(maxSound)
else:
	if the button A is pressed
	LED lights show the sound value
	If not

soundLevel = microphone.sound_level()
display.show(lights * soundLevel)
if soundLevel > maxSound:
maxSound = soundLevel
	Assign microphone.sound_level() to the variable soundLevel
	As the sound changes，the micro:bit will display the breathing light effect
	If the sound value is higher than its maximum value
	the maximum sound value is equal to sound level value

8.12: Bluetooth Wireless Communication

Micro:bit board comes with NRF51822 processor, Bluetooth and 2.4GHz RF antenna, which work with Bluetooth and 2.4G wireless communication.

In this project, we connect cellphone to Micro:bit motherboard to complete the wireless connection.

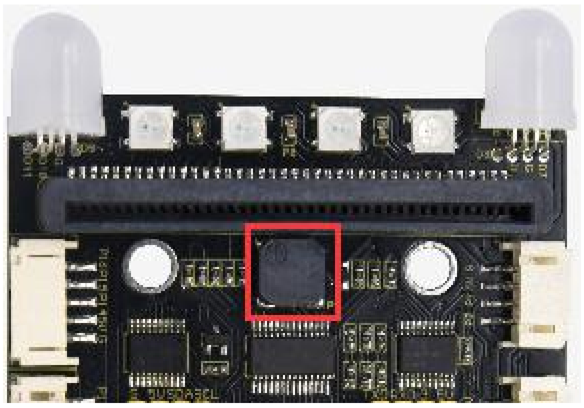
With 16k RAM, micro:bit owns a low-consumption Bluetooth module and support Bluetooth communication. However, BLE heap stack occupies 12K RAM, which implies that there is no enough space to run microPython.

At present, microPython doesn’t support Bluetooth.

https://microbit-micropython.readthedocs.io/en/latest/ble.html

In the further lessons, we will conduct experiments with micro:bit and other sensors or modules.

8.13: Passive Sensor



1. Description:

We can use Micro:bit board to make many interactive works of which the most commonly used is acoustic-optic display. The previous lessons are related to LED. However, we will elaborate the Sound in this lesson.

Buzzer is inclusive of active buzzer and passive buzzer.

The passive buzzer doesn’ t carry with vibrator inside, so it need external sine or square wave to drive. It can produce slight sound when connecting directly to power supply. It features controlling sound frequency and producing the sound of "do re mi fa so la si".

A diode should be connected in reverse when driving by the square wave signal source, which will hinder the high-voltage generated to damage other components or service life when the power breaks down.

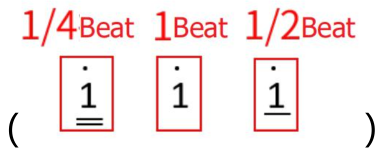
Frequency is made of a series of pitch names in English letters and Numbers. You can choose different frequencies, that is, tone. The frequency of sound is called pitch.

It involves music knowledge. In music lesson, our teacher taught "1（Do）, 2（Re）, 3(Mi), 4(Fa) , 5(Sol), 6(La), 7(Si)"

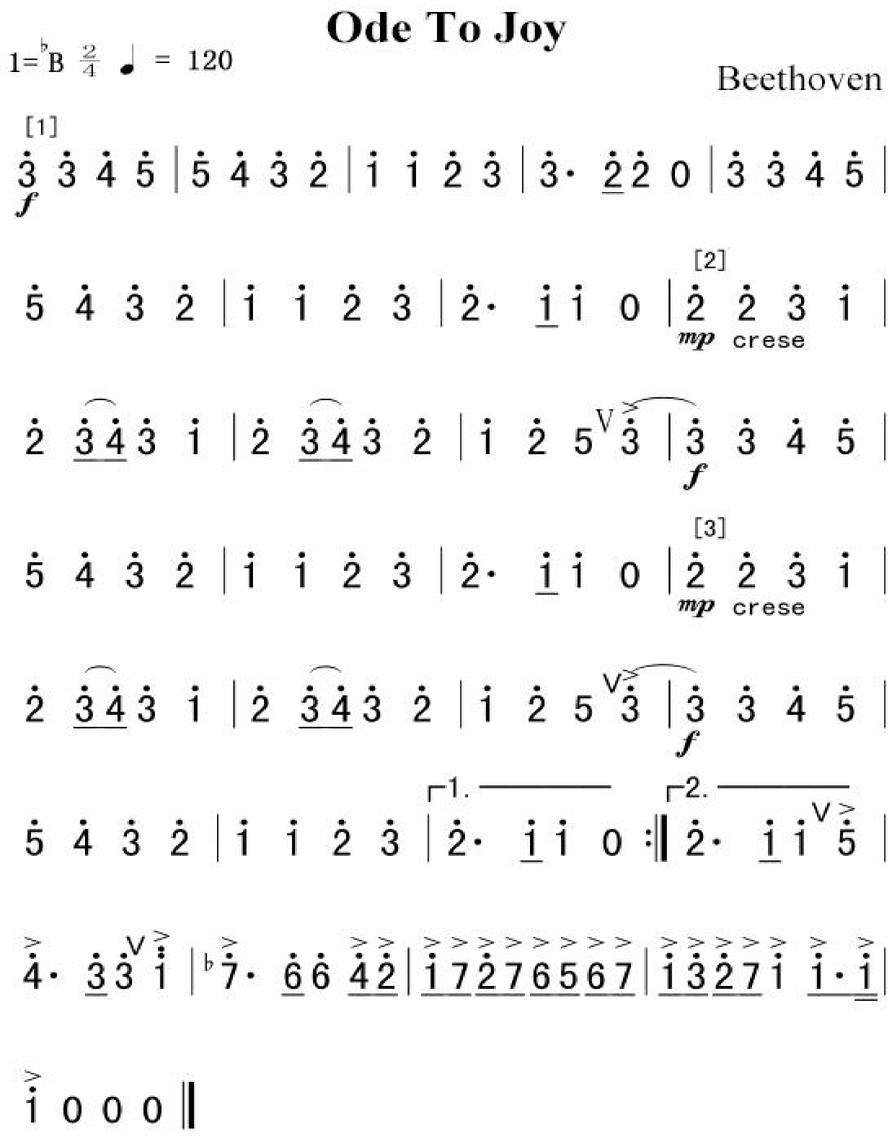
1 (Do)	2（Re)	3(Mi)	4(Fa)	5(Sol)	6(La)	7(Si)
C	D	E	F	G	A	B

The number depends on high or low tone. The larger the number, the higher the tone. When the number is same, the frequency (tone) is getting higher and higher from C to _B.

Beats are the time delay for each note. The larger the number, the longer the delay time. A note without a line in the spectrum is a beat, with a delay of 1000 milliseconds. while a beat with an underline is 1/2 of a beat without a line, and a beat with two underlines is 1/4 of a beat without a line.



Here is the notation of Ode to Joy.



2. Experimental Preparation:

(1) Insert micro:bit board into slot of V2 shield..

(2) Place batteries into battery holder.

(3) Dial POWER switch to ON end

(4) Link micro:bit board with computer via USB cable.

(5) Open the offline version of Mu

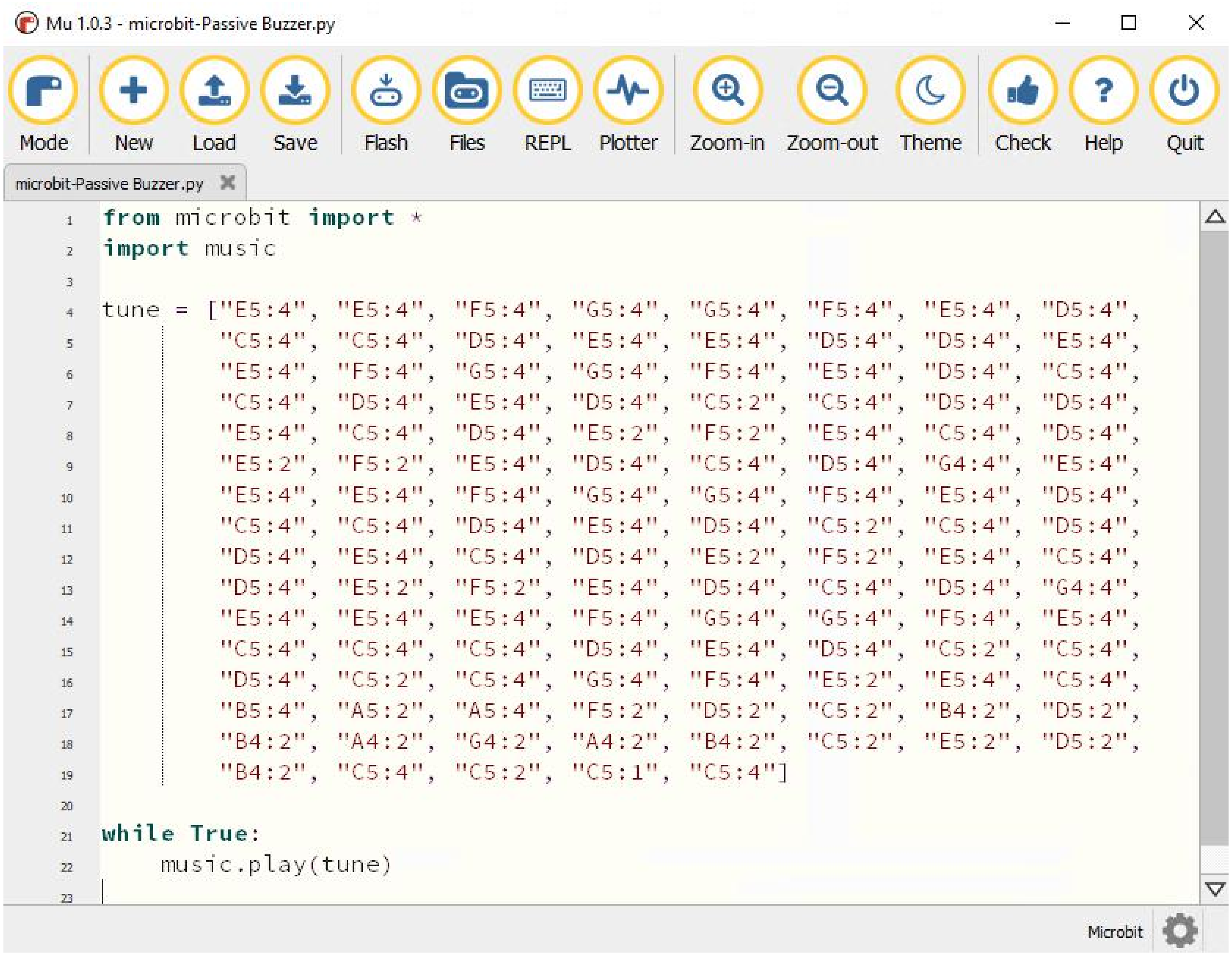
3. Test Code

Open “microbit-Passive Buzzer.py” file in Mu software，

（How to load the project code?)

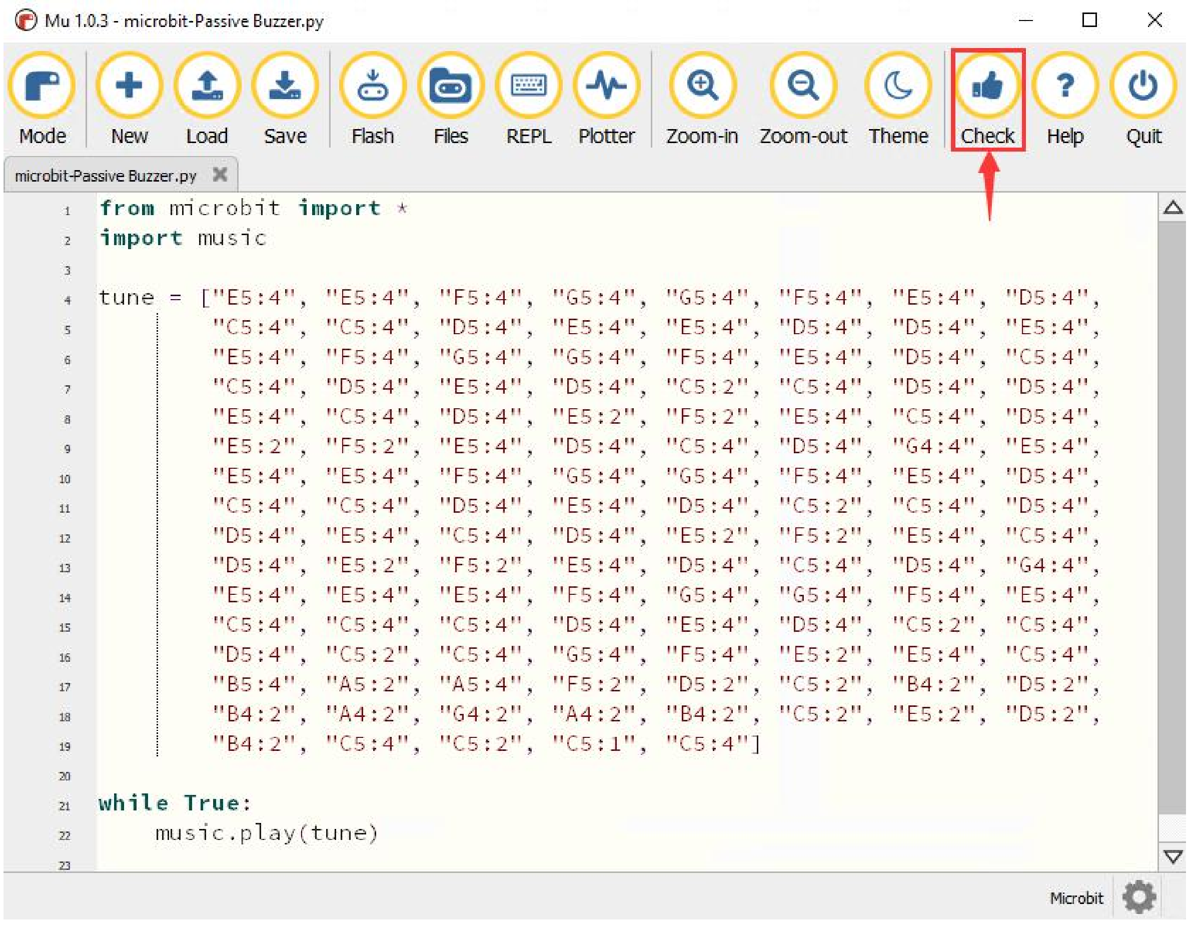
File Type	Route	File Name
Python file	../Python code/8.13：Passive Buzzer	microbit-Passive Buzzer.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



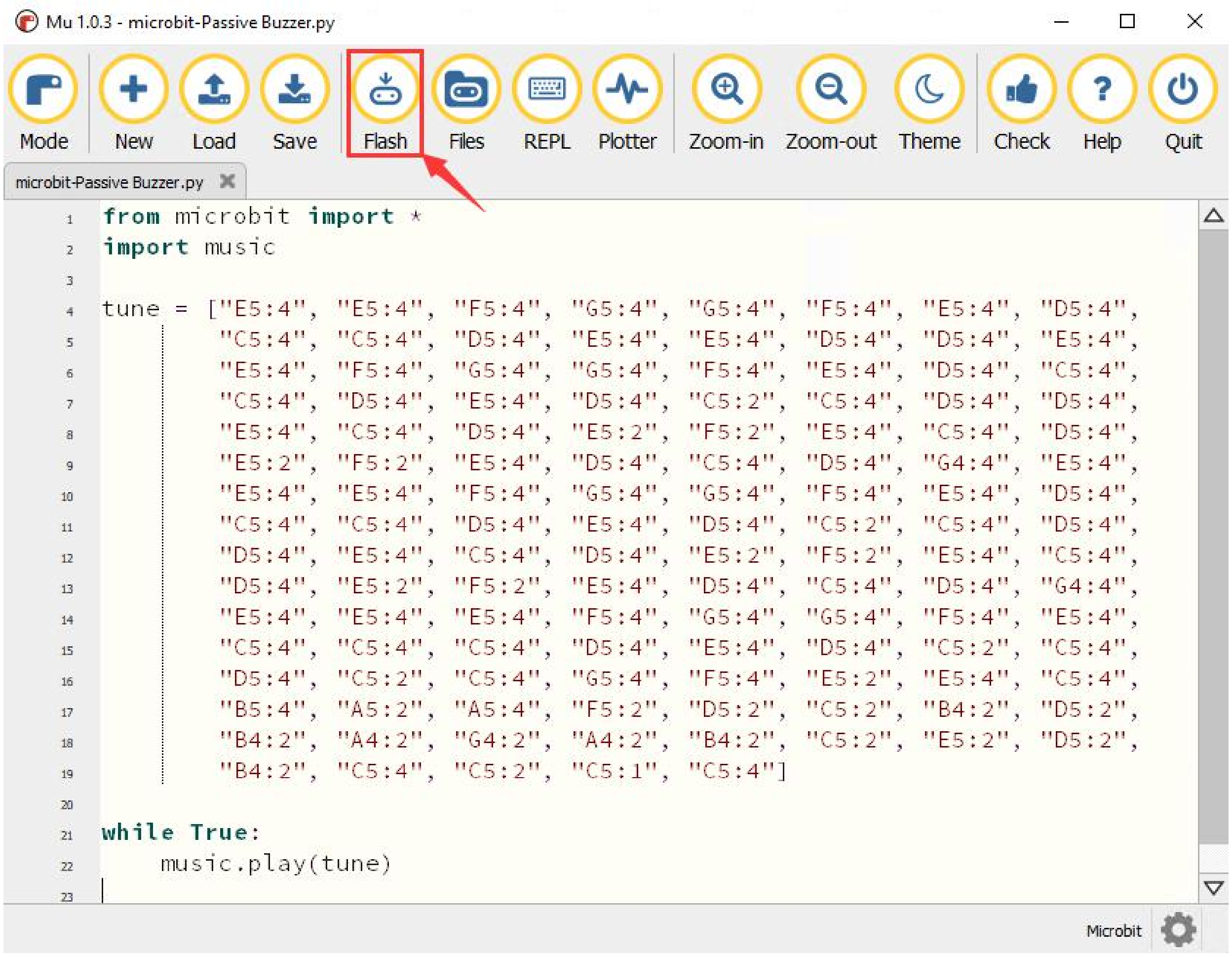
```
from microbit import *
import music

tune = ["E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4",
        "C5:4", "C5:4", "D5:4", "E5:4", "E5:4", "D5:4", "D5:4", "E5:4",
        "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4", "C5:4",
        "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4", "D5:4", "D5:4",
        "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "C5:4", "D5:4",
        "E5:2", "F5:2", "E5:4", "D5:4", "C5:4", "D5:4", "G4:4", "E5:4",
        "E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4",
        "C5:4", "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4", "D5:4",
        "D5:4", "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "C5:4",
        "D5:4", "E5:2", "F5:2", "E5:4", "D5:4", "C5:4", "D5:4", "G4:4",
        "E5:4", "E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4",
        "C5:4", "C5:4", "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4",
        "D5:4", "C5:2", "C5:4", "G5:4", "F5:4", "E5:2", "E5:4", "C5:4",
        "B5:4", "A5:2", "A5:4", "F5:2", "D5:2", "C5:2", "B4:2", "D5:2",
        "B4:2", "A4:2", "G4:2", "A4:2", "B4:2", "C5:2", "E5:2", "D5:2",
        "B4:2", "C5:4", "C5:2", "C5:1", "C5:4"]

while True:
    music.play(tune)

```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



```
from microbit import *
import music

tune = ["E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4",
        "C5:4", "C5:4", "D5:4", "E5:4", "E5:4", "D5:4", "D5:4", "E5:4",
        "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4", "C5:4",
        "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4", "D5:4", "D5:4",
        "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "C5:4", "D5:4",
        "E5:2", "F5:2", "E5:4", "D5:4", "C5:4", "D5:4", "G4:4", "E5:4",
        "E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4",
        "C5:4", "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4", "D5:4",
        "D5:4", "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "C5:4",
        "D5:4", "E5:2", "F5:2", "E5:4", "D5:4", "C5:4", "D5:4", "G4:4",
        "E5:4", "E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4",
        "C5:4", "C5:4", "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4",
        "D5:4", "C5:2", "C5:4", "G5:4", "F5:4", "E5:2", "E5:4", "C5:4",
        "B5:4", "A5:2", "A5:4", "F5:2", "D5:2", "C5:2", "B4:2", "D5:2",
        "B4:2", "A4:2", "G4:2", "A4:2", "B4:2", "C5:2", "E5:2", "D5:2",
        "B4:2", "C5:4", "C5:2", "C5:1", "C5:4"]

while True:
    music.play(tune)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```
from microbit import *
import music

tune = ["E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4",
        "C5:4", "C5:4", "D5:4", "E5:4", "E5:4", "D5:4", "D5:4", "E5:4",
        "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4", "C5:4",
        "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4", "D5:4", "D5:4",
        "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "C5:4", "D5:4",
        "E5:2", "F5:2", "E5:4", "D5:4", "C5:4", "D5:4", "G4:4", "E5:4",
        "E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4",
        "C5:4", "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4", "D5:4",
        "D5:4", "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "C5:4",
        "D5:4", "E5:2", "F5:2", "E5:4", "D5:4", "C5:4", "D5:4", "G4:4",
        "E5:4", "E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4",
        "C5:4", "C5:4", "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4",
        "D5:4", "C5:2", "C5:4", "G5:4", "F5:4", "E5:2", "E5:4", "C5:4",
        "B5:4", "A5:2", "A5:4", "F5:2", "D5:2", "C5:2", "B4:2", "D5:2",
        "B4:2", "A4:2", "G4:2", "A4:2", "B4:2", "C5:2", "E5:2", "D5:2",
        "B4:2", "C5:4", "C5:2", "C5:1", "C5:4"]

while True:
    music.play(tune)
```

4. Test Result:

Download code onto micro:bit board, and dial POWER to ON end; "Ode to joy" song will be played in loop way.

5. Code Explanation:

from microbit **import** *	Import the library file of micro: bit
import music	import music files containing the control of sound

tune = ["E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4", "C5:4", "C5:4", "D5:4", "E5:4", "E5:4", "D5:4", "D5:4", "E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4", "C5:4", "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4", "D5:4", "D5:4", "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "D5:4", "C5:4", "D5:4", "G4:4", "E5:4", "E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "D5:4", "C5:4", "C5:4", "D5:4", "E5:4", "D5:4", "C5:2",	Create variable tune

"C5:4", "D5:4", "D5:4", "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "C5:4", "D5:4", "E5:2", "F5:2", "E5:4", "D5:4", "C5:4", "D5:4", "G4:4", "E5:4", "E5:4", "E5:4", "F5:4", "G5:4", "G5:4", "F5:4", "E5:4", "C5:4", "C5:4", "C5:4", "D5:4", "E5:4", "D5:4", "C5:2", "C5:4", "D5:4", "C5:2", "C5:4", "G5:4", "F5:4", "E5:2", "E5:4", "C5:4", "B5:4", "A5:2", "A5:4", "F5:2", "D5:2", "C5:2", "B4:2", "D5:2", "B4:2", "A4:2", "G4:2", "A4:2", "B4:2", "C5:2", "E5:2", "D5:2", "B4:2", "C5:4", "C5:2", "C5:1", "C5:4"]	

while True:	This is a permanent loop that makes micro:bit execute the code of it.
music.play(tune)	Call the function play ( ) to save the notes in variable tune

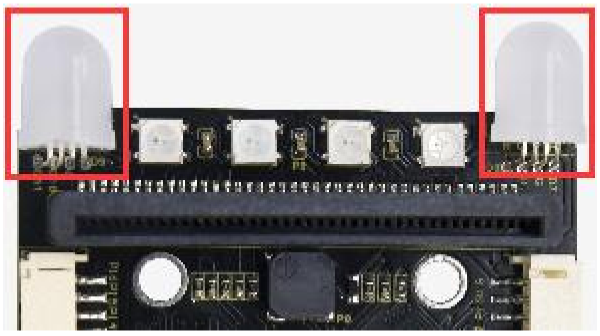
6. References:

music.play(): used to play music and MicroPython has abundant **music melody.**

More info, please the below link:

https://microbit-micropython.readthedocs.io/en/latest/tutorials/music.html

8.14: RGB Experiments



1. Description:

The RGB color mode is a color standard in the industry. It obtains various colors by changing the three color channels of red (R), green (G), and blue (B) and integrating them. RGB denotes the three colors of red, green and blue.

The monitors mostly adopt the RGB color standard, and all the colors on the computer screen are composed of the three colors of red, green and blue mixed in different proportions. A group of red, green and blue is the smallest display unit. Any color on the screen can be recorded and expressed by a set of RGB values.

Each of the three color channels of red, green, and blue is divided into 256 levels of brightness. At 0, the "light" is the weakest-it is turned off, and at 255, the "light" is the brightest. When the three-color gray values are the same, the gray tones with different gray values are produced, that is, when the three-color gray is 0, the darkest black is generated; when the three-color gray is 255, it is the brightest white tone .

Color	RGB value (R,G,B)	Color code	Color	RGB value (R,G,B)	Color code
Black	0,0,0	#000000	Red	255,0,0	#FF0000
Green	0,255,0	#00FF00	Blue	0,0,255	#0000FF
indigo	0,255,255	#00FFFF	Dark red	255,0,255	#FF00FF
Yellow	255,255,0	#FFFF00	White	255,255,255	#FFFFFF

……	…….	……	……	……	……
Adjust the numbers to get gradient colors					

RGB colors are called additive colors since the adding of R, G, and B together (that is, all light reflect back to the eye) produces white color. Additive colors are used for lighting, television and computer displays. For example, displays produce color by emitting red, green, and blue rays. Most visible spectra can be expressed as a mixture of red, green and blue (RGB) light in different proportions and intensities. If these colors overlap, they produce cyan, magenta and yellow.

We will make two experiments, one is that two RGB LEDs light up red, green, blue, indigo, dark red, yellow and white color, another one is that RGB lights display color in gradient way.

2. Experimental Preparation：

(1) Insert micro:bit board into slot of V2 shield.

(2) Put batteries into battery holder

(3) Dial POWER to ON end

(4) Link micro:bit board with computer via USB cable.

(5) Open the offline version of Mu

3. Test Code

Code 1

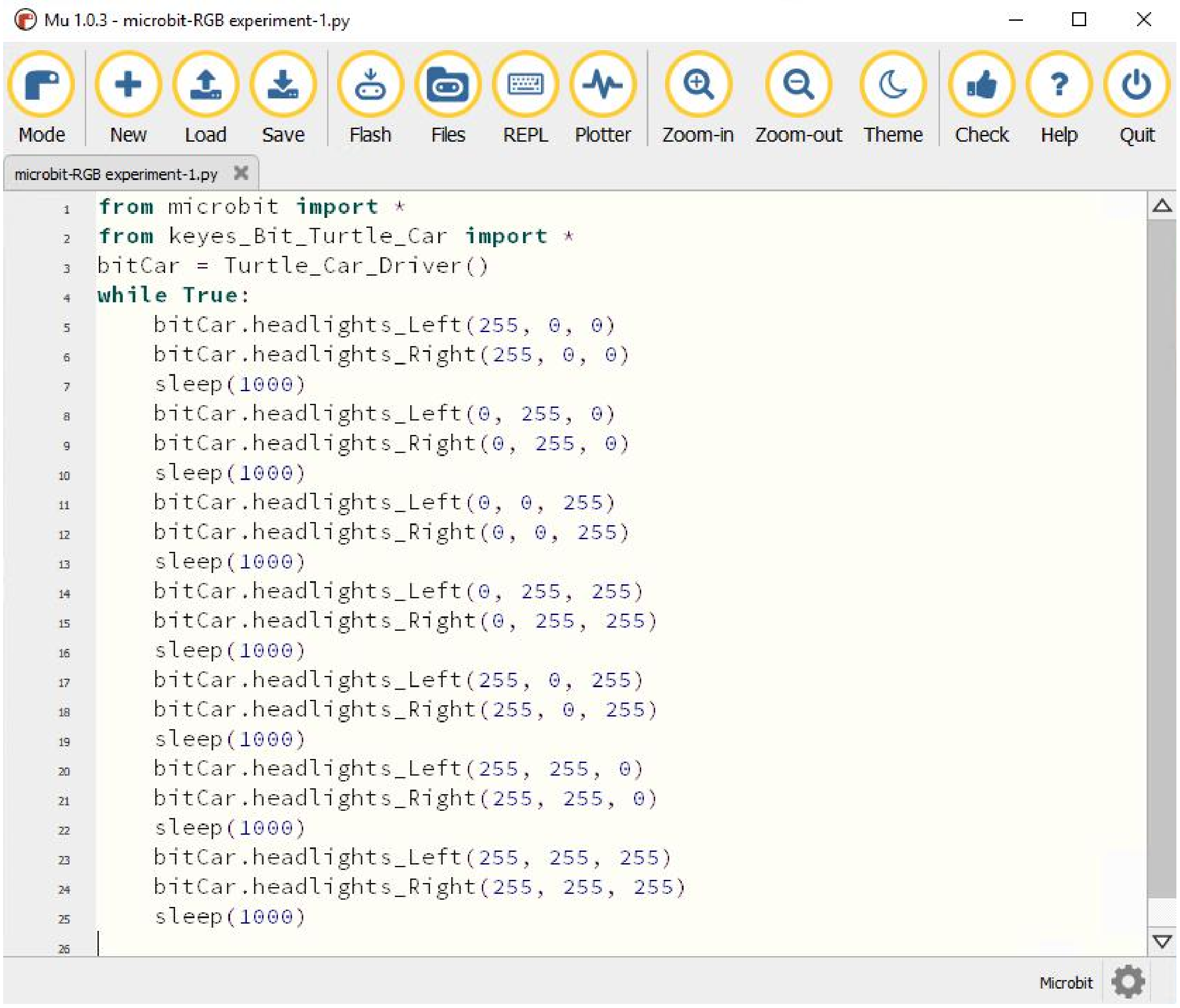
RGB shows seven colors in loop way.

Open “Code 1.py” file in Mu

（How to load the project code?）

File Type	Route	File Name
Python file	../Python code/8.14：RGB experiment	microbit-Code-1.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



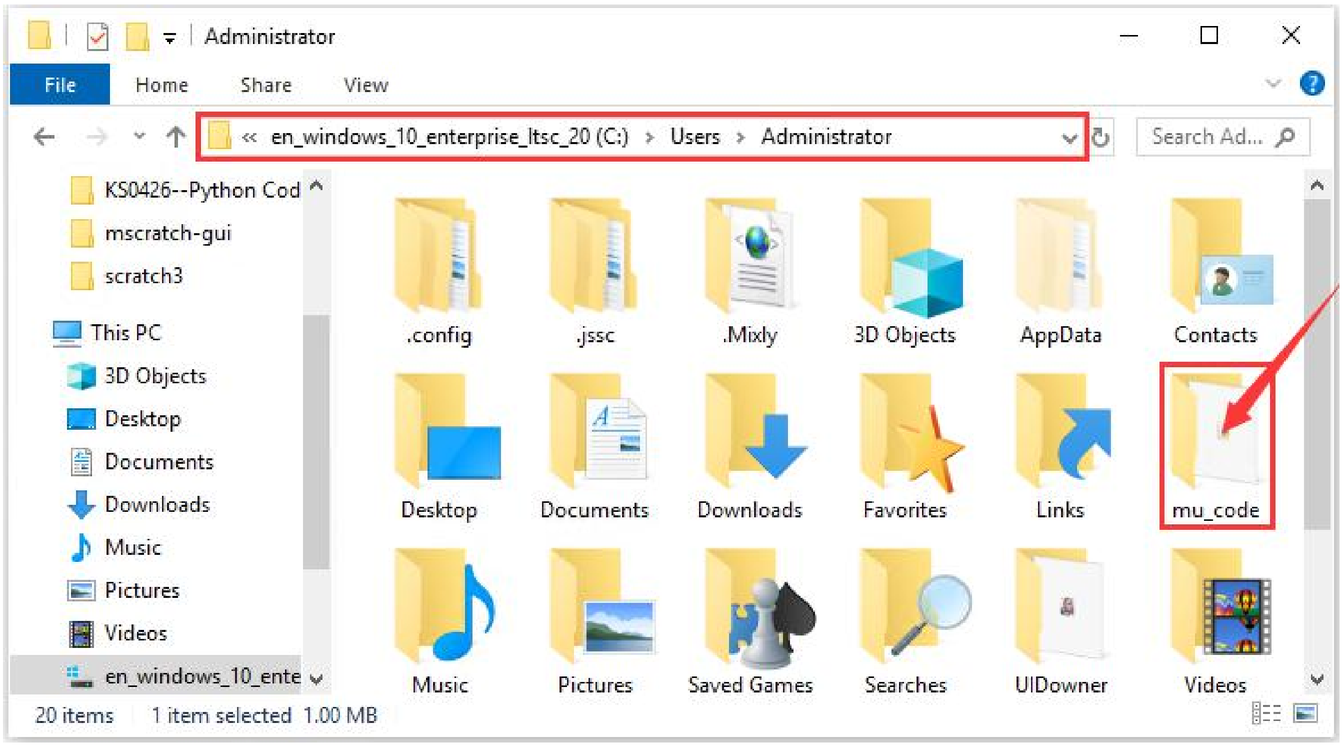
```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
while True:
    bitCar.headlights_Left(255, 0, 0)
    bitCar.headlights_Right(255, 0, 0)
    sleep(1000)
    bitCar.headlights_Left(0, 255, 0)
    bitCar.headlights_Right(0, 255, 0)
    sleep(1000)
    bitCar.headlights_Left(0, 0, 255)
    bitCar.headlights_Right(0, 0, 255)
    sleep(1000)
    bitCar.headlights_Left(0, 255, 255)
    bitCar.headlights_Right(0, 255, 255)
    sleep(1000)
    bitCar.headlights_Left(255, 0, 255)
    bitCar.headlights_Right(255, 0, 255)
    sleep(1000)
    bitCar.headlights_Left(255, 255, 0)
    bitCar.headlights_Right(255, 255, 0)
    sleep(1000)
    bitCar.headlights_Left(255, 255, 255)
    bitCar.headlights_Right(255, 255, 255)
    sleep(1000)
```

Import “keyes_Bit_Turtle_Car.py” File

Don’ t click “Flash” immediately, you need to firstly import “ keyes_Bit_Turtle_Car.py” file which includes the control method of micro:bit smart robot car, making Python code control robot car easily.

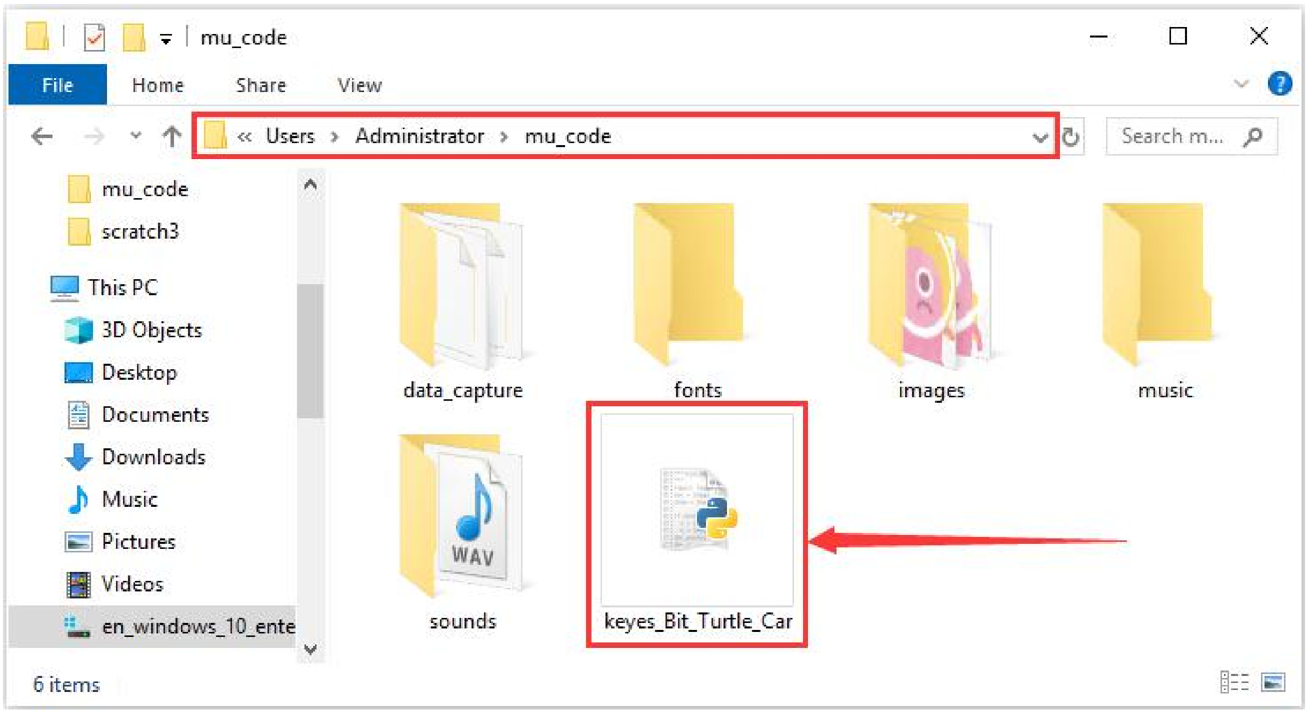
Files are mostly stored in the mu_code directory in your home directory. Mu’ s default directory is “Mu_code” .

Refer to the link: https://codewith.mu/en/tutorials/1.0/files

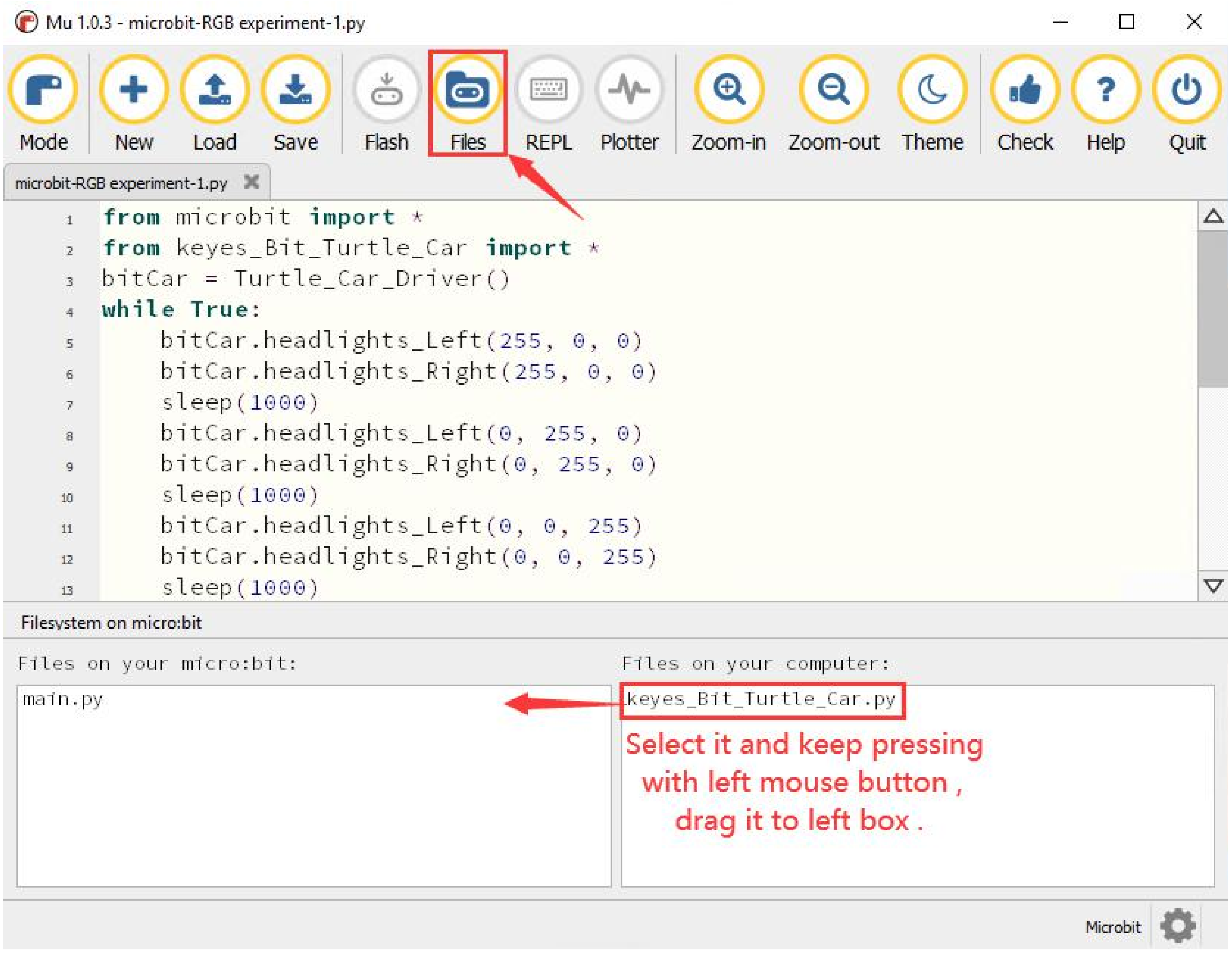


Copy “keyes_Bit_Turtle_Car.py” library to “mu_code” folder

File type	Path	File name
Python file	.. /Python Code/ Libraries	keyes_Bit_Turtle_Car.py

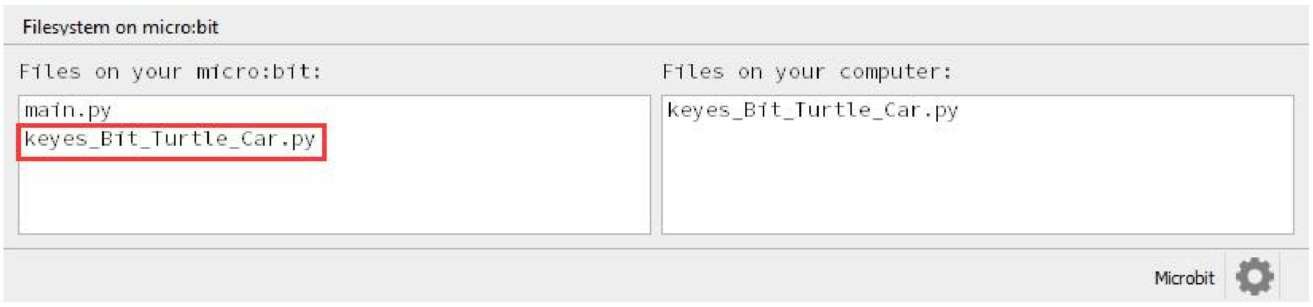


Open Mu, connect micro:bit to computer, click “Files” and drag “keyes_Bit_Turtle_Car.py” library file to micro:bit.

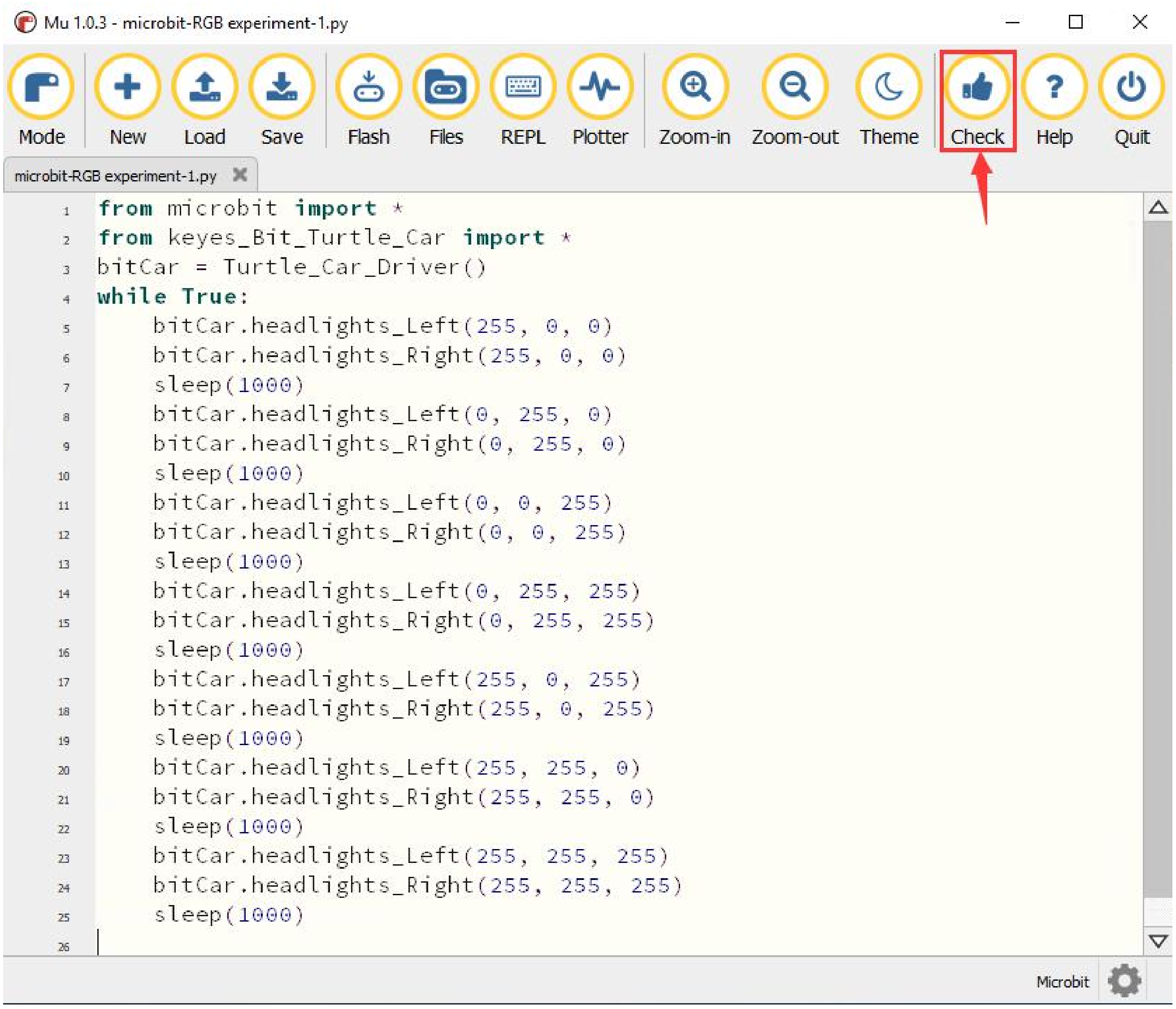


```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
while True:
    bitCar.headlights_Left(255, 0, 0)
    bitCar.headlights_Right(255, 0, 0)
    sleep(1000)
    bitCar.headlights_Left(0, 255, 0)
    bitCar.headlights_Right(0, 255, 0)
    sleep(1000)
    bitCar.headlights_Left(0, 0, 255)
    bitCar.headlights_Right(0, 0, 255)
    sleep(1000)
```

You could view it in the left column, after importing "keyes_Bit_Turtle_Car.py" file.



Tap "Check" button to confirm if the code has errors. The program proves wrong if there are underlines and cursors



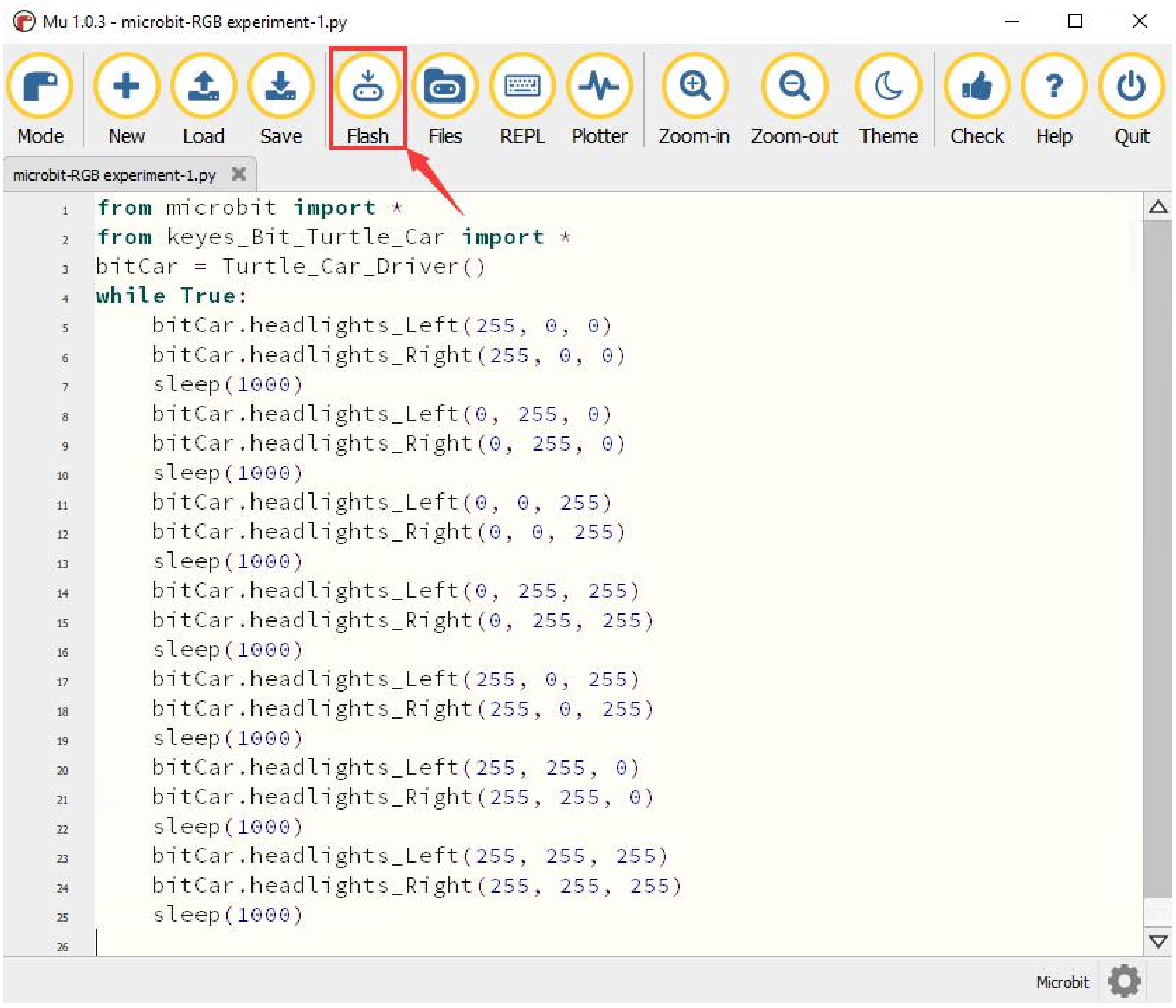
```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
while True:
    bitCar.headlights_Left(255, 0, 0)
    bitCar.headlights_Right(255, 0, 0)
    sleep(1000)
    bitCar.headlights_Left(0, 255, 0)
    bitCar.headlights_Right(0, 255, 0)
    sleep(1000)
    bitCar.headlights_Left(0, 0, 255)
    bitCar.headlights_Right(0, 0, 255)
    sleep(1000)
    bitCar.headlights_Left(0, 255, 255)
    bitCar.headlights_Right(0, 255, 255)
    sleep(1000)
    bitCar.headlights_Left(255, 0, 255)
    bitCar.headlights_Right(255, 0, 255)
    sleep(1000)
    bitCar.headlights_Left(255, 255, 0)
    bitCar.headlights_Right(255, 255, 0)
    sleep(1000)
    bitCar.headlights_Left(255, 255, 255)
    bitCar.headlights_Right(255, 255, 255)
    sleep(1000)
```

Besides, the prompt signs will appear. The prompt is a warning sign which doesn’ t indicate wrong code.

```
↑ 'from keyes_Bit_Car_Driver import *' used; unable to detect undefined names
```

```
↑ 'Bit_Car_Driver' may be undefined, or defined from star imports: keyes_Bit_Car_Driver
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
while True:
    bitCar.headlights_Left(255, 0, 0)
    bitCar.headlights_Right(255, 0, 0)
    sleep(1000)
    bitCar.headlights_Left(0, 255, 0)
    bitCar.headlights_Right(0, 255, 0)
    sleep(1000)
    bitCar.headlights_Left(0, 0, 255)
    bitCar.headlights_Right(0, 0, 255)
    sleep(1000)
    bitCar.headlights_Left(0, 255, 255)
    bitCar.headlights_Right(0, 255, 255)
    sleep(1000)
    bitCar.headlights_Left(255, 0, 255)
    bitCar.headlights_Right(255, 0, 255)
    sleep(1000)
    bitCar.headlights_Left(255, 255, 0)
    bitCar.headlights_Right(255, 255, 0)
    sleep(1000)
    bitCar.headlights_Left(255, 255, 255)
    bitCar.headlights_Right(255, 255, 255)
    sleep(1000)
```

Click " Flash " and appear errors, you need to confirm if you import "keyes_Bit_Turtle_Car.py" library.

Note: You need to import "keyes_Bit_Turtle_Car.py" file to micro:bit.

If you program with different micro:bit, the library file "keyes_Bit_Turtle_Car.py" needs to be imported again to a new micro:bit.

Code 2:

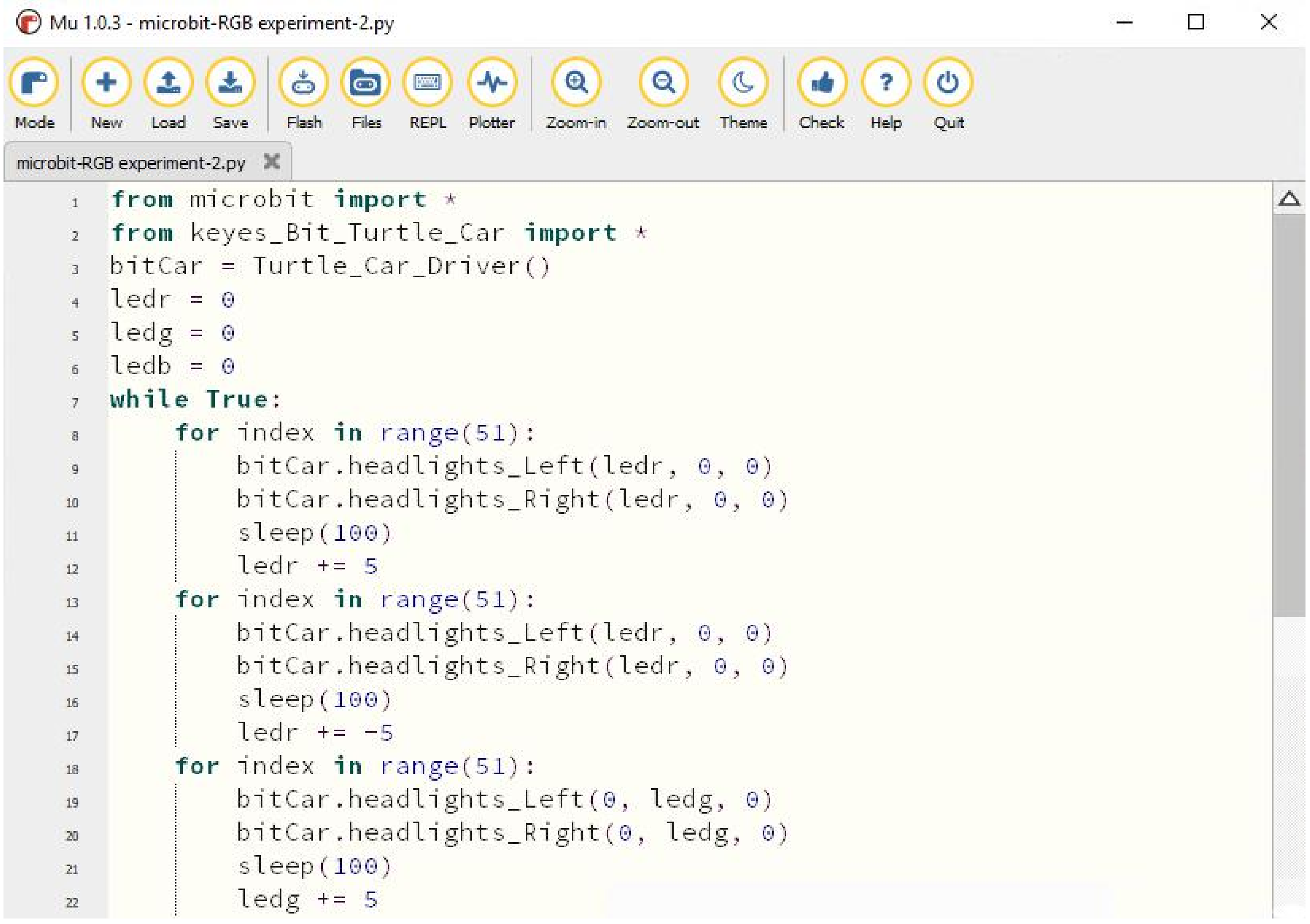
Display different colors

Open file “microbit- Code 2.py ” in Mu,

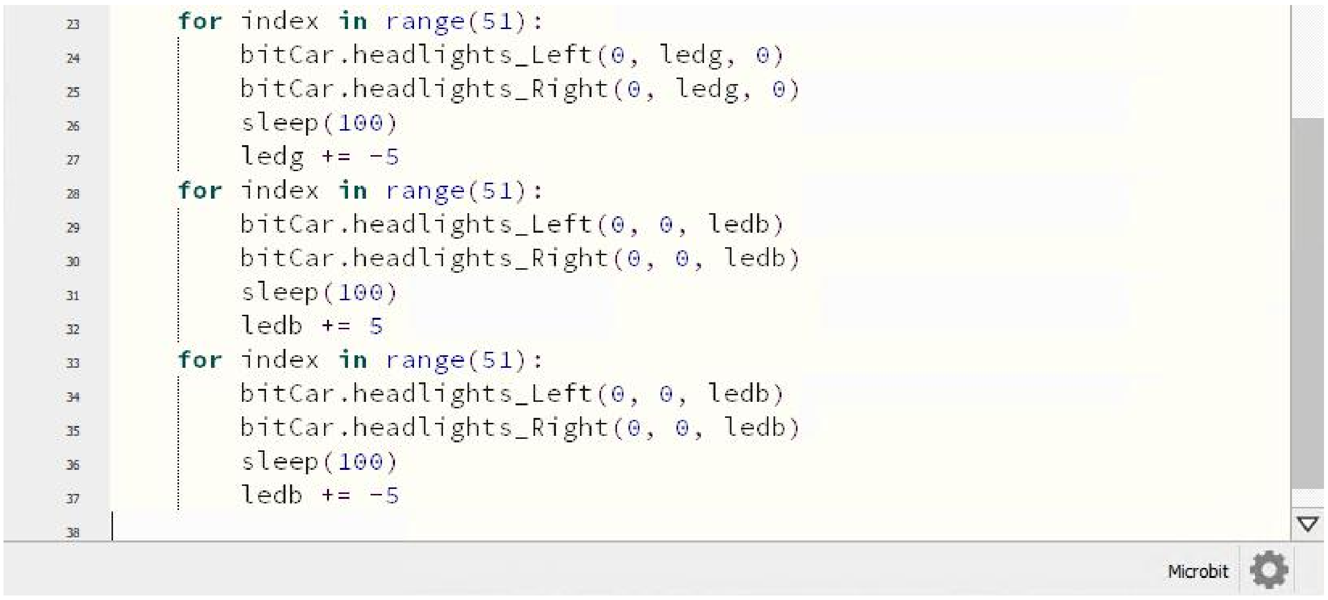
(How to load the project code?)

File Type	Route	File Name
Python file	../Python code/8.14: RGB Experiments	microbit-Code-2.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)

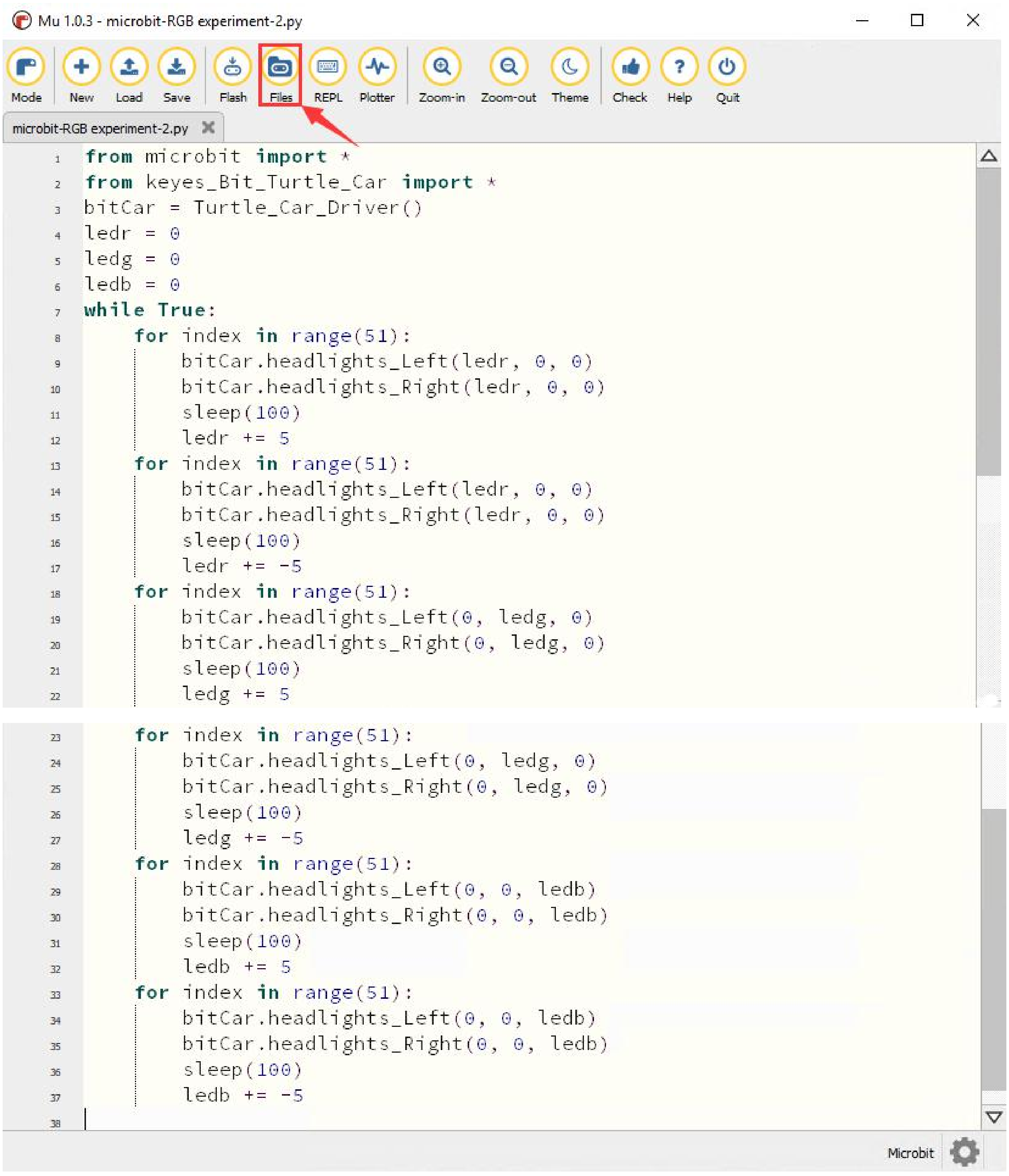


```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
ledr = 0
ledg = 0
ledb = 0
while True:
    for index in range(51):
        bitCar.headlights_Left(ledr, 0, 0)
        bitCar.headlights_Right(ledr, 0, 0)
        sleep(100)
        ledr += 5
    for index in range(51):
        bitCar.headlights_Left(ledr, 0, 0)
        bitCar.headlights_Right(ledr, 0, 0)
        sleep(100)
        ledr += -5
    for index in range(51):
        bitCar.headlights_Left(0, ledg, 0)
        bitCar.headlights_Right(0, ledg, 0)
        sleep(100)
        ledg += 5
```



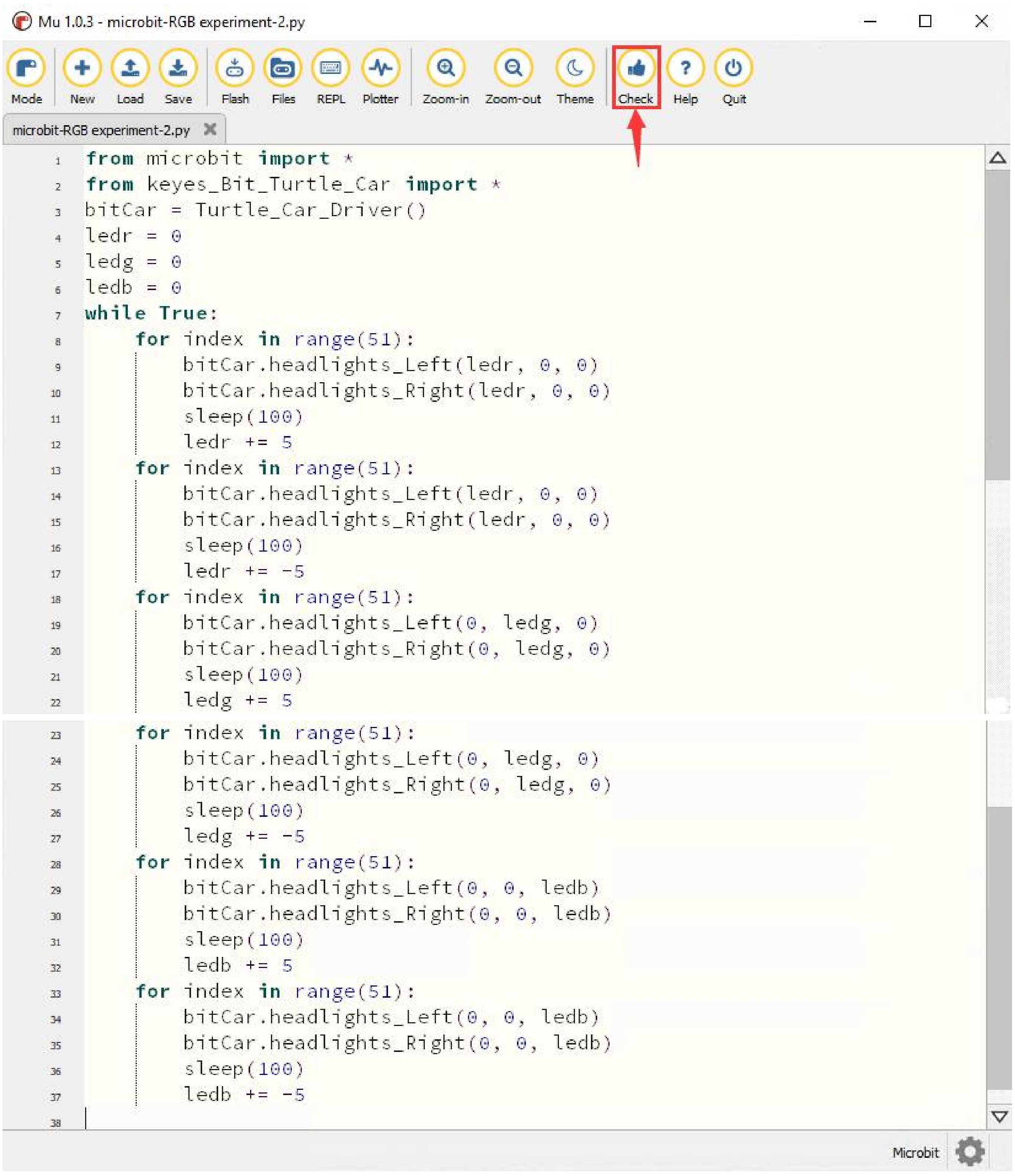
```
    for index in range(51):
        bitCar.headlights_Left(0, ledg, 0)
        bitCar.headlights_Right(0, ledg, 0)
        sleep(100)
        ledg += -5
    for index in range(51):
        bitCar.headlights_Left(0, 0, ledb)
        bitCar.headlights_Right(0, 0, ledb)
        sleep(100)
        ledb += 5
    for index in range(51):
        bitCar.headlights_Left(0, 0, ledb)
        bitCar.headlights_Right(0, 0, ledb)
        sleep(100)
        ledb += -5
```

Click “Files” to import “keyes_Bit_Turtle_Car.py” library file to micro:bit (How to import files?) . If micro:bit has library inside, you don’ t need add one.



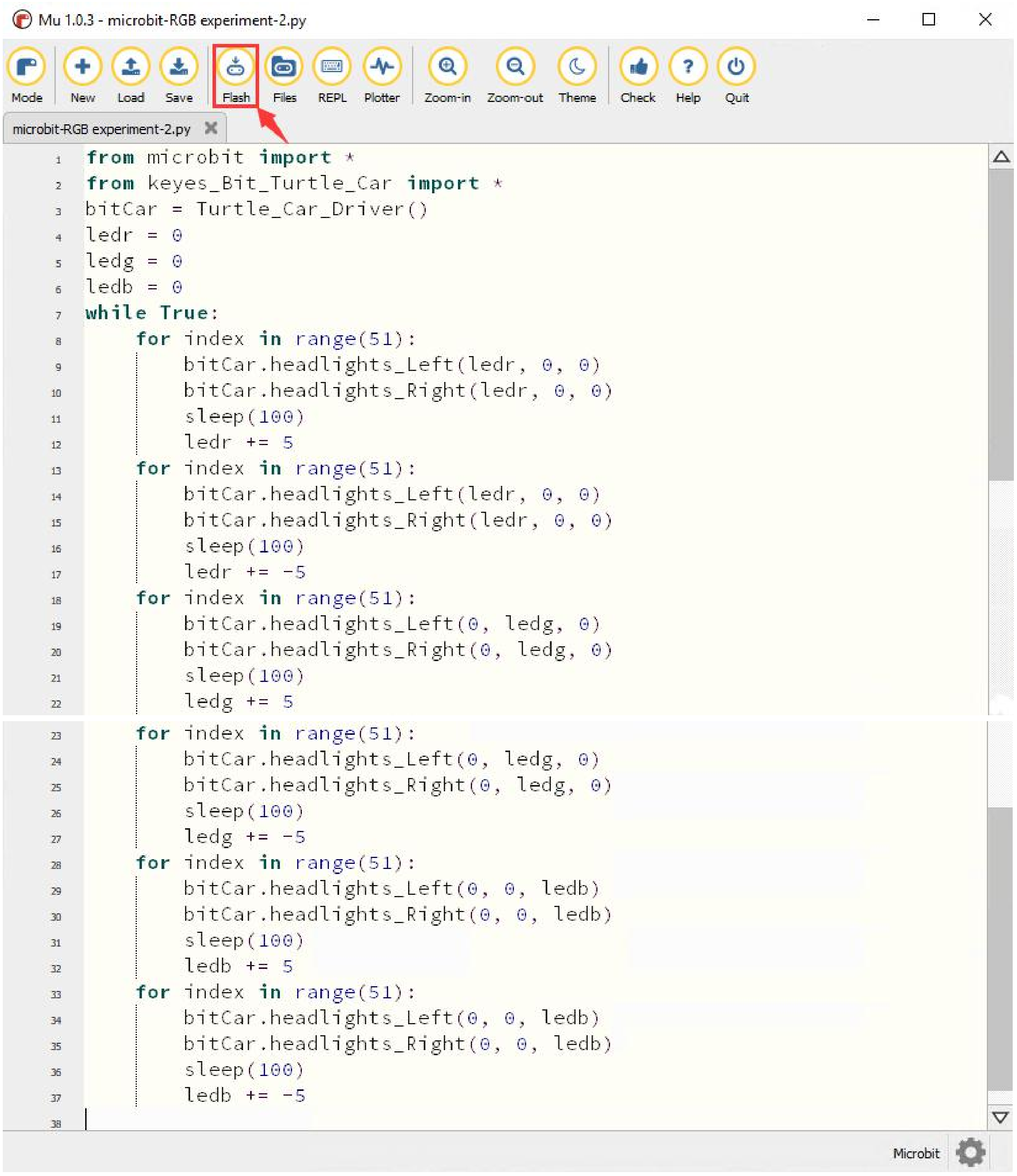
```python
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
ledr = 0
ledg = 0
ledb = 0
while True:
    for index in range(51):
        bitCar.headlights_Left(ledr, 0, 0)
        bitCar.headlights_Right(ledr, 0, 0)
        sleep(100)
        ledr += 5
    for index in range(51):
        bitCar.headlights_Left(ledr, 0, 0)
        bitCar.headlights_Right(ledr, 0, 0)
        sleep(100)
        ledr += -5
    for index in range(51):
        bitCar.headlights_Left(0, ledg, 0)
        bitCar.headlights_Right(0, ledg, 0)
        sleep(100)
        ledg += 5
    for index in range(51):
        bitCar.headlights_Left(0, ledg, 0)
        bitCar.headlights_Right(0, ledg, 0)
        sleep(100)
        ledg += -5
    for index in range(51):
        bitCar.headlights_Left(0, 0, ledb)
        bitCar.headlights_Right(0, 0, ledb)
        sleep(100)
        ledb += 5
    for index in range(51):
        bitCar.headlights_Left(0, 0, ledb)
        bitCar.headlights_Right(0, 0, ledb)
        sleep(100)
        ledb += -5
```

Click "Check" to examine error in the code. The program proves wrong if underlines and cursors are shown.



```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
ledr = 0
ledg = 0
ledb = 0
while True:
    for index in range(51):
        bitCar.headlights_Left(ledr, 0, 0)
        bitCar.headlights_Right(ledr, 0, 0)
        sleep(100)
        ledr += 5
    for index in range(51):
        bitCar.headlights_Left(ledr, 0, 0)
        bitCar.headlights_Right(ledr, 0, 0)
        sleep(100)
        ledr += -5
    for index in range(51):
        bitCar.headlights_Left(0, ledg, 0)
        bitCar.headlights_Right(0, ledg, 0)
        sleep(100)
        ledg += 5
    for index in range(51):
        bitCar.headlights_Left(0, ledg, 0)
        bitCar.headlights_Right(0, ledg, 0)
        sleep(100)
        ledg += -5
    for index in range(51):
        bitCar.headlights_Left(0, 0, ledb)
        bitCar.headlights_Right(0, 0, ledb)
        sleep(100)
        ledb += 5
    for index in range(51):
        bitCar.headlights_Left(0, 0, ledb)
        bitCar.headlights_Right(0, 0, ledb)
        sleep(100)
        ledb += -5
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```python
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
ledr = 0
ledg = 0
ledb = 0
while True:
    for index in range(51):
        bitCar.headlights_Left(ledr, 0, 0)
        bitCar.headlights_Right(ledr, 0, 0)
        sleep(100)
        ledr += 5
    for index in range(51):
        bitCar.headlights_Left(ledr, 0, 0)
        bitCar.headlights_Right(ledr, 0, 0)
        sleep(100)
        ledr += -5
    for index in range(51):
        bitCar.headlights_Left(0, ledg, 0)
        bitCar.headlights_Right(0, ledg, 0)
        sleep(100)
        ledg += 5
    for index in range(51):
        bitCar.headlights_Left(0, ledg, 0)
        bitCar.headlights_Right(0, ledg, 0)
        sleep(100)
        ledg += -5
    for index in range(51):
        bitCar.headlights_Left(0, 0, ledb)
        bitCar.headlights_Right(0, 0, ledb)
        sleep(100)
        ledb += 5
    for index in range(51):
        bitCar.headlights_Left(0, 0, ledb)
        bitCar.headlights_Right(0, 0, ledb)
        sleep(100)
        ledb += -5
```

4. Test Result:

Download code 1 to micro:bit board and turn on the switch at the back of micro:bit car, 2 RGB lights of smart car emit red, green, blue, indigo, dark red, yellow and white color cyclically.

Download code 2 to micro:bit board and turn on the switch at the back of micro:bit car, 2 RGB lights show different color in loop way.

5. Code Explanation:

from microbit **import** *	Import the library file of micro: bit
from keyes_Bit_Turtle_Car **import ***	Import the library of keyes_Bit_Turtle_Car
while True:	This is a permanent loop that makes micro:bit execute the code of it.

bitCar.headlights_Left(255, 0, 0)
bitCar.headlights_Right(255, 0, 0)
sleep(1000)
bitCar.headlights_Left(0, 255, 0)
bitCar.headlights_Right(0, 255, 0)
sleep(1000)
bitCar.headlights_Left(0, 0, 255)
bitCar.headlights_Right(0, 0, 255)
sleep(1000)
bitCar.headlights_Left(0, 255, 255)
bitCar.headlights_Right(0, 255, 255)
sleep(1000)
bitCar.headlights_Left(255, 0, 255)
bitCar.headlights_Right(255, 0, 255)
sleep(1000)
bitCar.headlights_Left(255, 255, 0)
bitCar.headlights_Right(255, 255, 0)
sleep(1000)
bitCar.headlights_Left(255, 255, 255)
bitCar.headlights_Right(255, 255, 255)
sleep(1000)
	2 RGB LEDs light up red color
	Delay 1000ms
	2 RGB LEDs light up green color
	Delay 1000ms
	2 RGB LEDs light up blue color
	Delay 1000ms
	2 RGB LEDs light up indigo color
	Delay 1000ms
	2 RGB LEDs light up dark red color
	Delay 1000ms
	2 RGB LEDs light up yellow color
	Delay 1000ms
	Left RGB lights up white color
	2 RGB LEDs light up white color
	Delay 1000ms

ledr = 0	Set the initial value of ledr to 0

ledg = 0	Set the initial value of ledg to 0
ledb = 0	Set the initial value of ledb to 0
for index **in** range(51):	Repeat 51 times

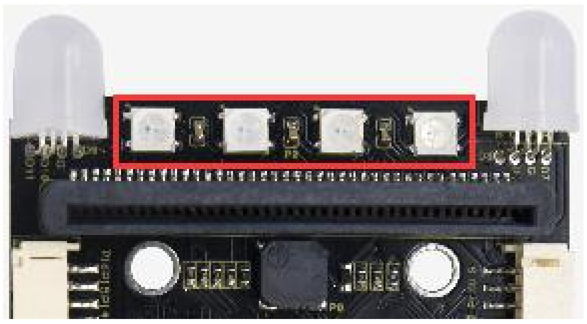
bitCar.headlights_Left(ledr, 0, 0)
bitCar.headlights_Right(ledr, 0, 0)
	Set RGB lights of car: R： led-r G： 0 B： 0

bitCar.headlights_Left(0, ledg, 0)
bitCar.headlights_Right(0, ledg, 0)
	Set RGB lights of car: R： 0 G： ledg B： 0

bitCar.headlights_Left(0, 0, ledb)
bitCar.headlights_Right(0, 0, ledb)
	Set 2 RGB lights R： 0 G: 0 B： ledb

ledr += 5
ledr += -5
ledg += 5
ledg += -5
ledb += 5
ledb += -5
	Change the value of led-r by 5
	Change the value of led-r by -5
	Change the value of ledg by 5
	Change the value of ledg by -5
	Change the value of ledb by 5
	Change the value of ledb by -5

8.15: WS2812 RGB LEDs



1. Description:

The driver shield cooperates 4 pcs WS2812 RGB LEDs, compatible with micro:bit board and controlled by P8. In this lesson, we will make RGB LEDs display different colors by P8

2. Experimental Preparation:

(1) Insert micro:bit board into slot of V2 shield.

(2) Put batteries into battery holder

(3) Dial POWER to ON end on driver shield

(4) Link micro:bit board with computer via USB cable.

(5) Open the offline version of Mu

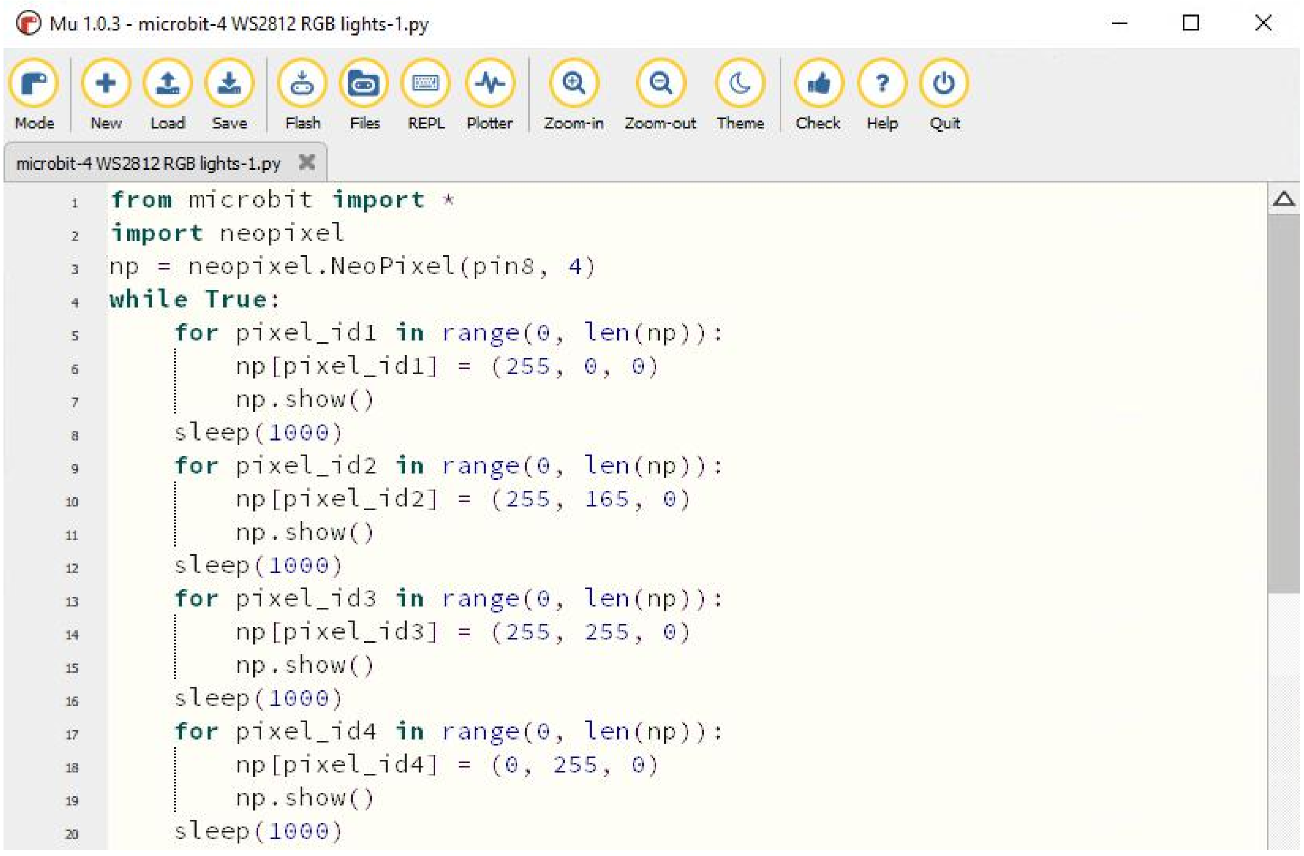
3. Test Code

Code 1:

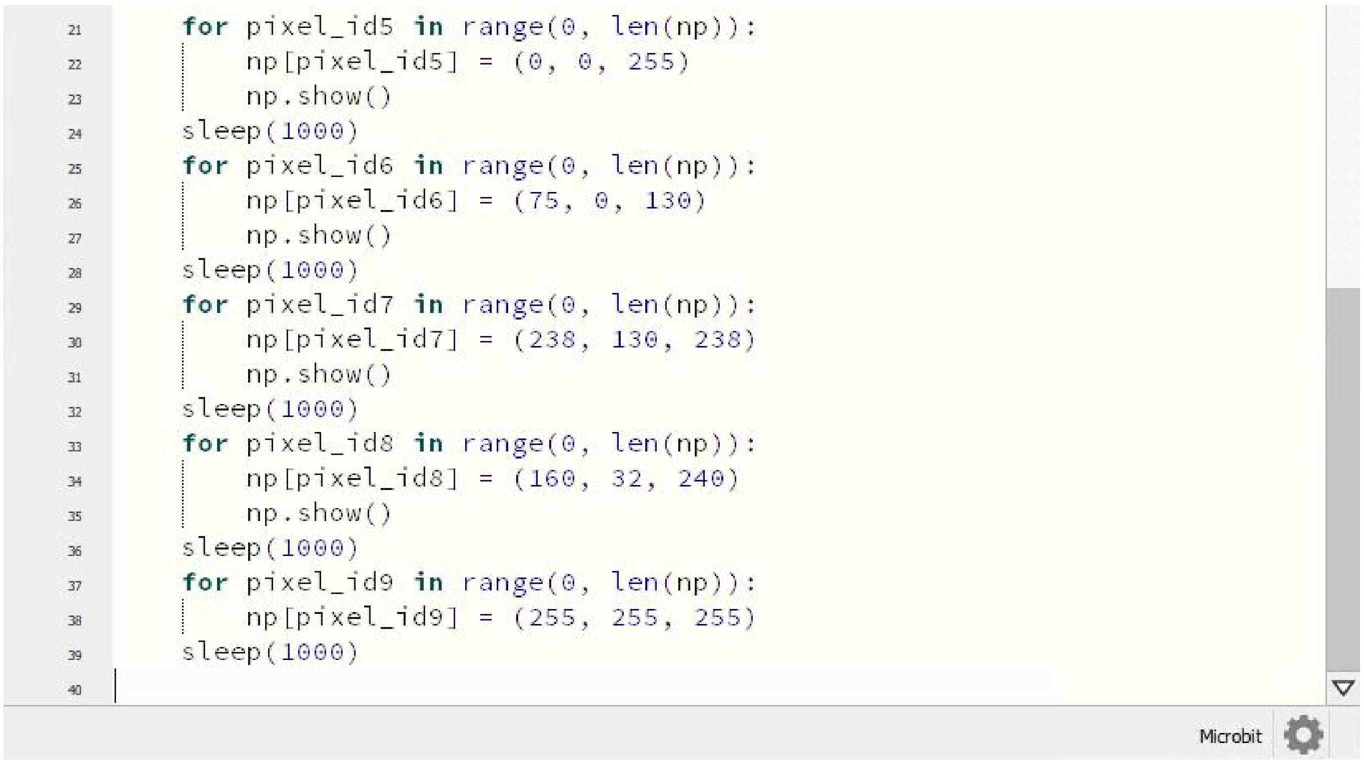
Open “microbit-Code-1.py” in Mu, (How to load the project code?)

File Type	Route	File Name
Python file	../Python code/8.15: WS2812 RGB LEDs	microbit-Code-1.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)

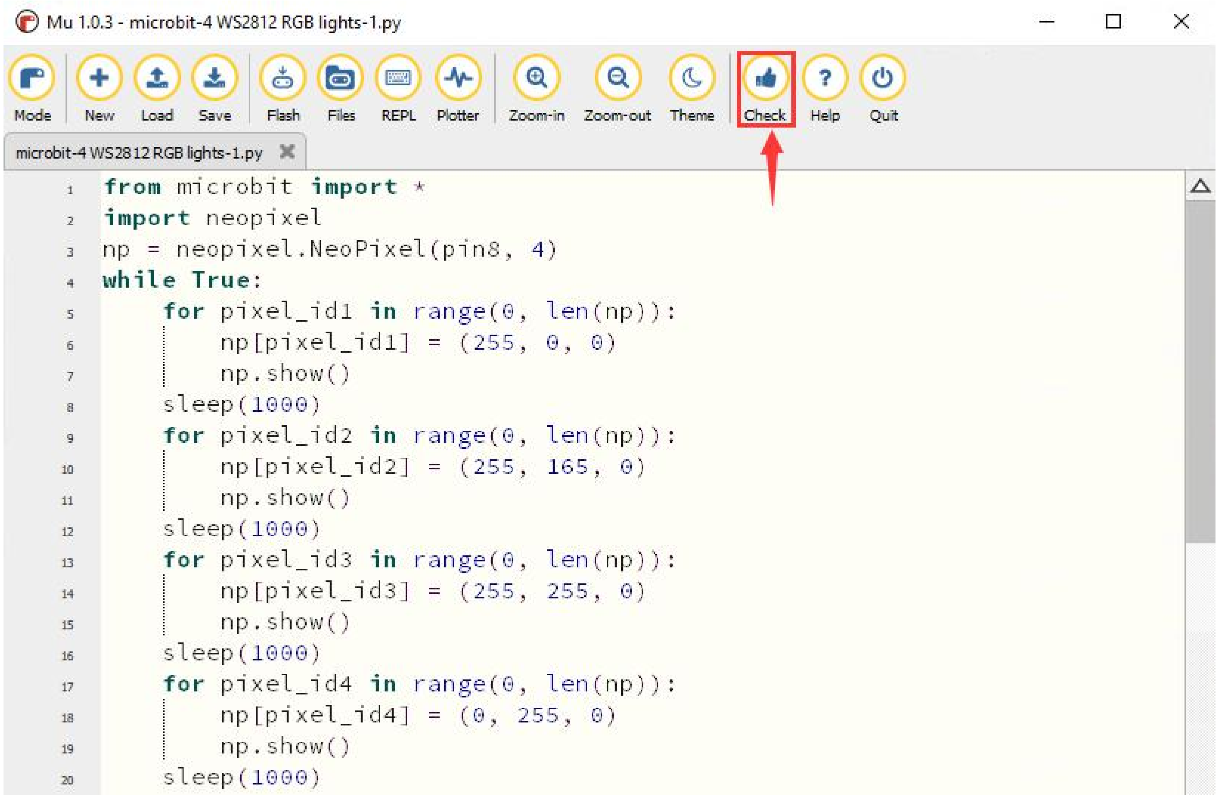

Mu 1.0.3 - microbit-4 WS2812 RGB lights-1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-4 WS2812 RGB lights-1.py

```
from microbit import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
while True:
    for pixel_id1 in range(0, len(np)):
        np[pixel_id1] = (255, 0, 0)
        np.show()
    sleep(1000)
    for pixel_id2 in range(0, len(np)):
        np[pixel_id2] = (255, 165, 0)
        np.show()
    sleep(1000)
    for pixel_id3 in range(0, len(np)):
        np[pixel_id3] = (255, 255, 0)
        np.show()
    sleep(1000)
    for pixel_id4 in range(0, len(np)):
        np[pixel_id4] = (0, 255, 0)
        np.show()
    sleep(1000)
```



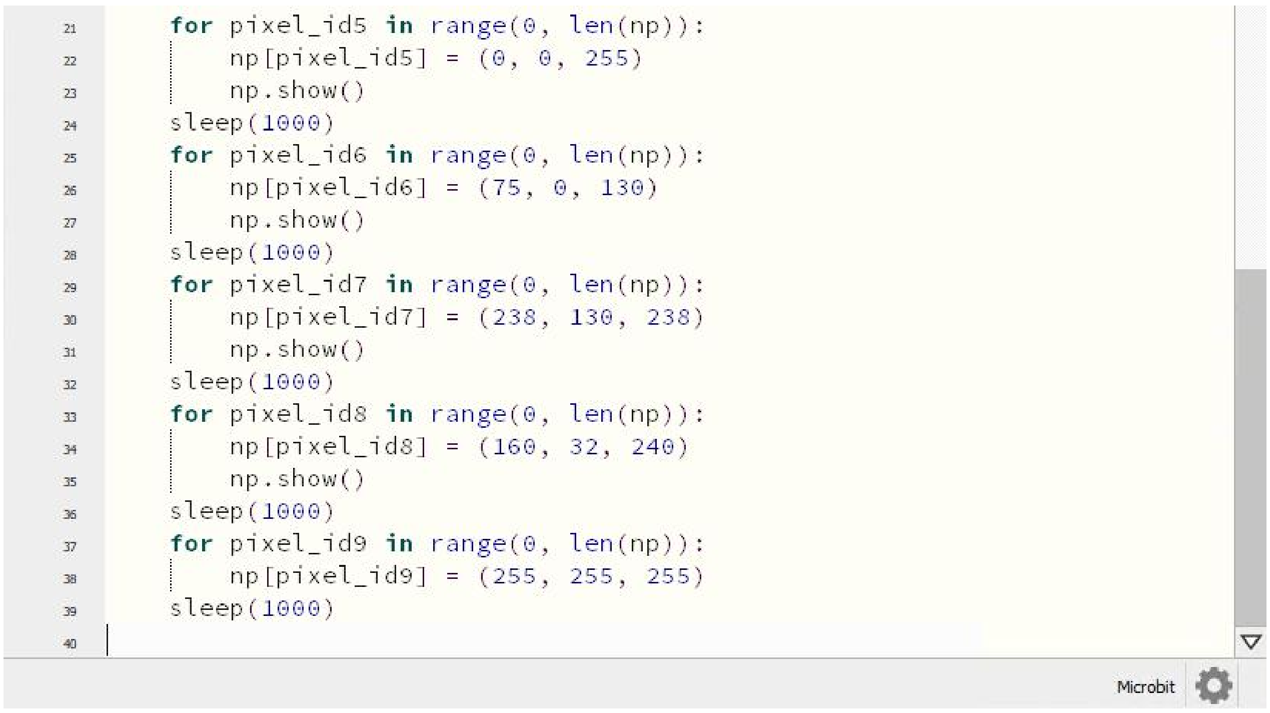
```
    for pixel_id5 in range(0, len(np)):
        np[pixel_id5] = (0, 0, 255)
        np.show()
    sleep(1000)
    for pixel_id6 in range(0, len(np)):
        np[pixel_id6] = (75, 0, 130)
        np.show()
    sleep(1000)
    for pixel_id7 in range(0, len(np)):
        np[pixel_id7] = (238, 130, 238)
        np.show()
    sleep(1000)
    for pixel_id8 in range(0, len(np)):
        np[pixel_id8] = (160, 32, 240)
        np.show()
    sleep(1000)
    for pixel_id9 in range(0, len(np)):
        np[pixel_id9] = (255, 255, 255)
    sleep(1000)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



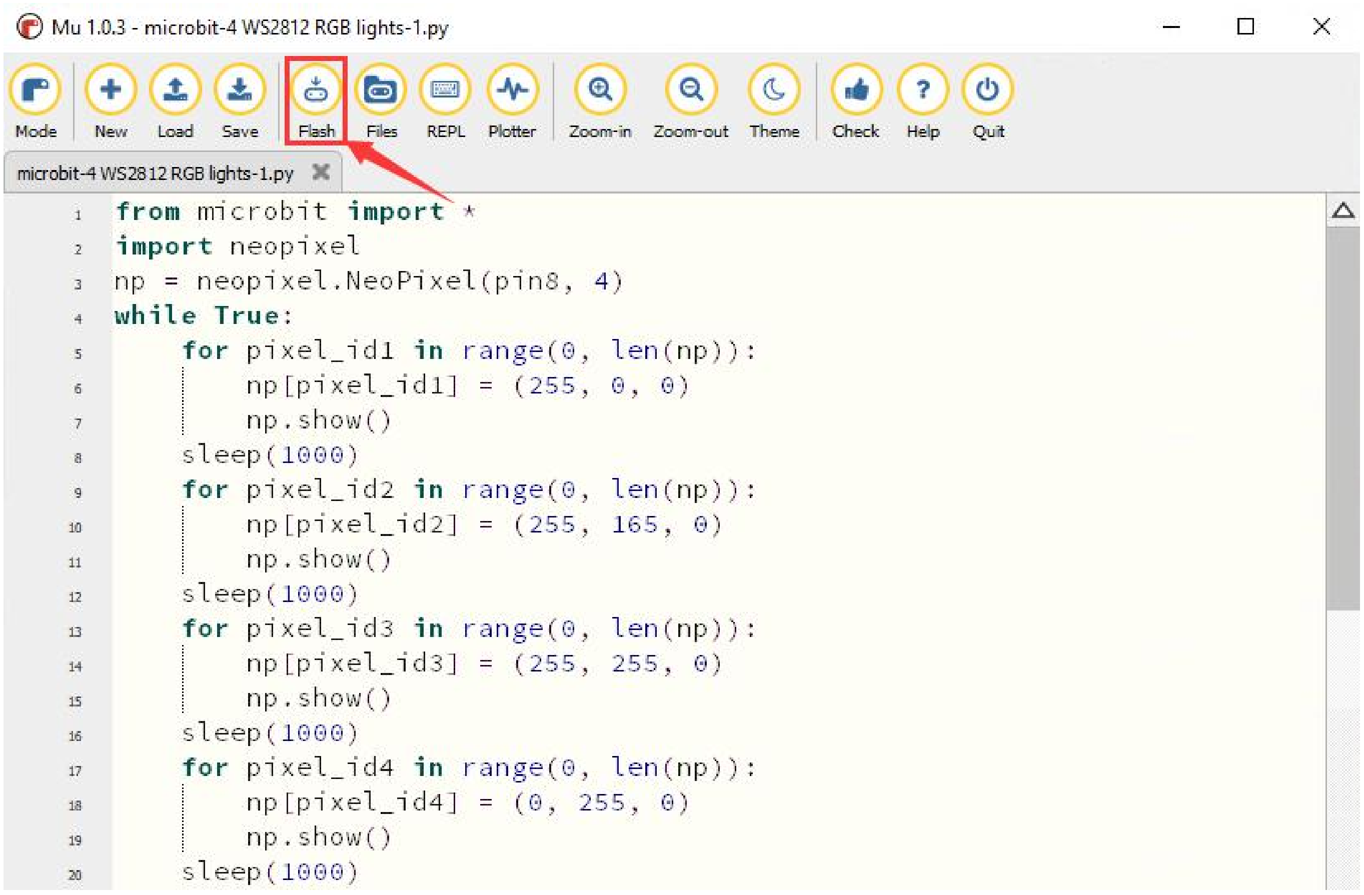
Mu 1.0.3 - microbit-4 WS2812 RGB lights-1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-4 WS2812 RGB lights-1.py

```
from microbit import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
while True:
    for pixel_id1 in range(0, len(np)):
        np[pixel_id1] = (255, 0, 0)
        np.show()
    sleep(1000)
    for pixel_id2 in range(0, len(np)):
        np[pixel_id2] = (255, 165, 0)
        np.show()
    sleep(1000)
    for pixel_id3 in range(0, len(np)):
        np[pixel_id3] = (255, 255, 0)
        np.show()
    sleep(1000)
    for pixel_id4 in range(0, len(np)):
        np[pixel_id4] = (0, 255, 0)
        np.show()
    sleep(1000)
```



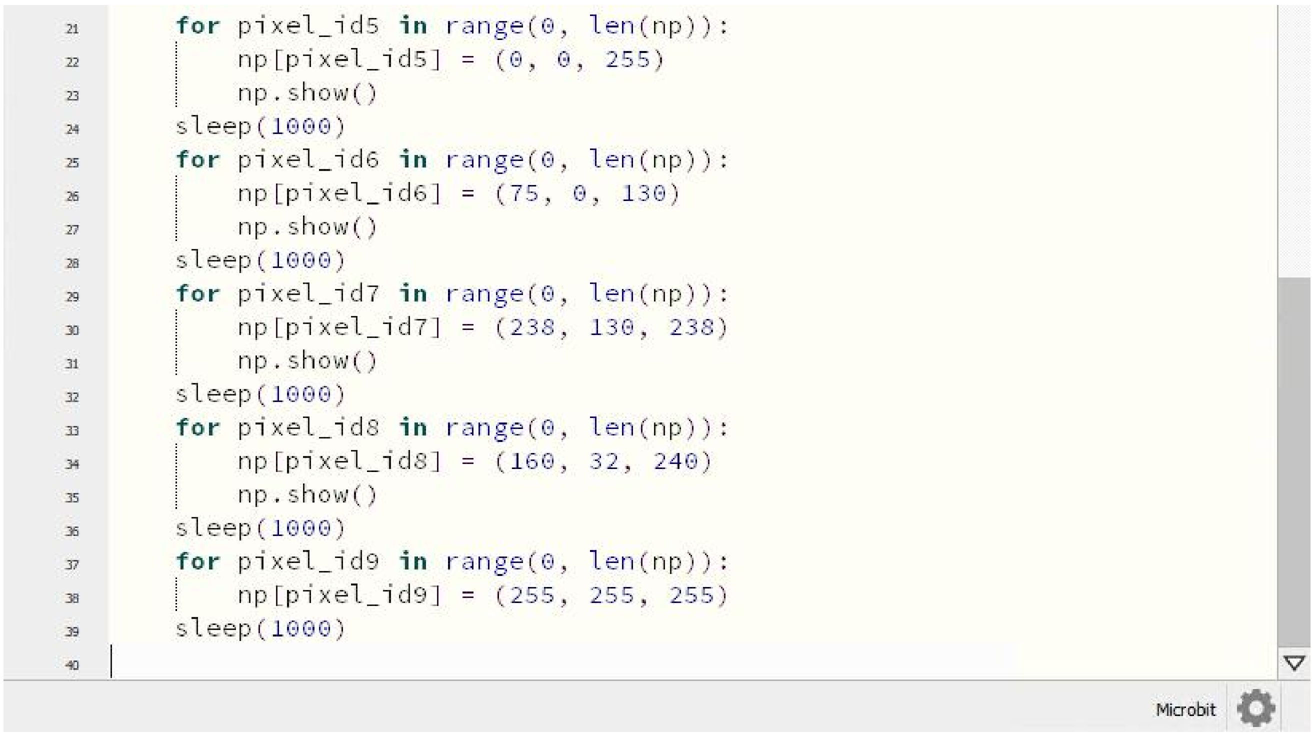
```
    for pixel_id5 in range(0, len(np)):
        np[pixel_id5] = (0, 0, 255)
        np.show()
    sleep(1000)
    for pixel_id6 in range(0, len(np)):
        np[pixel_id6] = (75, 0, 130)
        np.show()
    sleep(1000)
    for pixel_id7 in range(0, len(np)):
        np[pixel_id7] = (238, 130, 238)
        np.show()
    sleep(1000)
    for pixel_id8 in range(0, len(np)):
        np[pixel_id8] = (160, 32, 240)
        np.show()
    sleep(1000)
    for pixel_id9 in range(0, len(np)):
        np[pixel_id9] = (255, 255, 255)
    sleep(1000)
```

If the code is correct, connect micro:bit to computer and click "Flash" to download code to micro:bit board.



Mu 1.0.3 - microbit-4 WS2812 RGB lights-1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-4 WS2812 RGB lights-1.py

```
from microbit import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
while True:
    for pixel_id1 in range(0, len(np)):
        np[pixel_id1] = (255, 0, 0)
        np.show()
    sleep(1000)
    for pixel_id2 in range(0, len(np)):
        np[pixel_id2] = (255, 165, 0)
        np.show()
    sleep(1000)
    for pixel_id3 in range(0, len(np)):
        np[pixel_id3] = (255, 255, 0)
        np.show()
    sleep(1000)
    for pixel_id4 in range(0, len(np)):
        np[pixel_id4] = (0, 255, 0)
        np.show()
    sleep(1000)
```



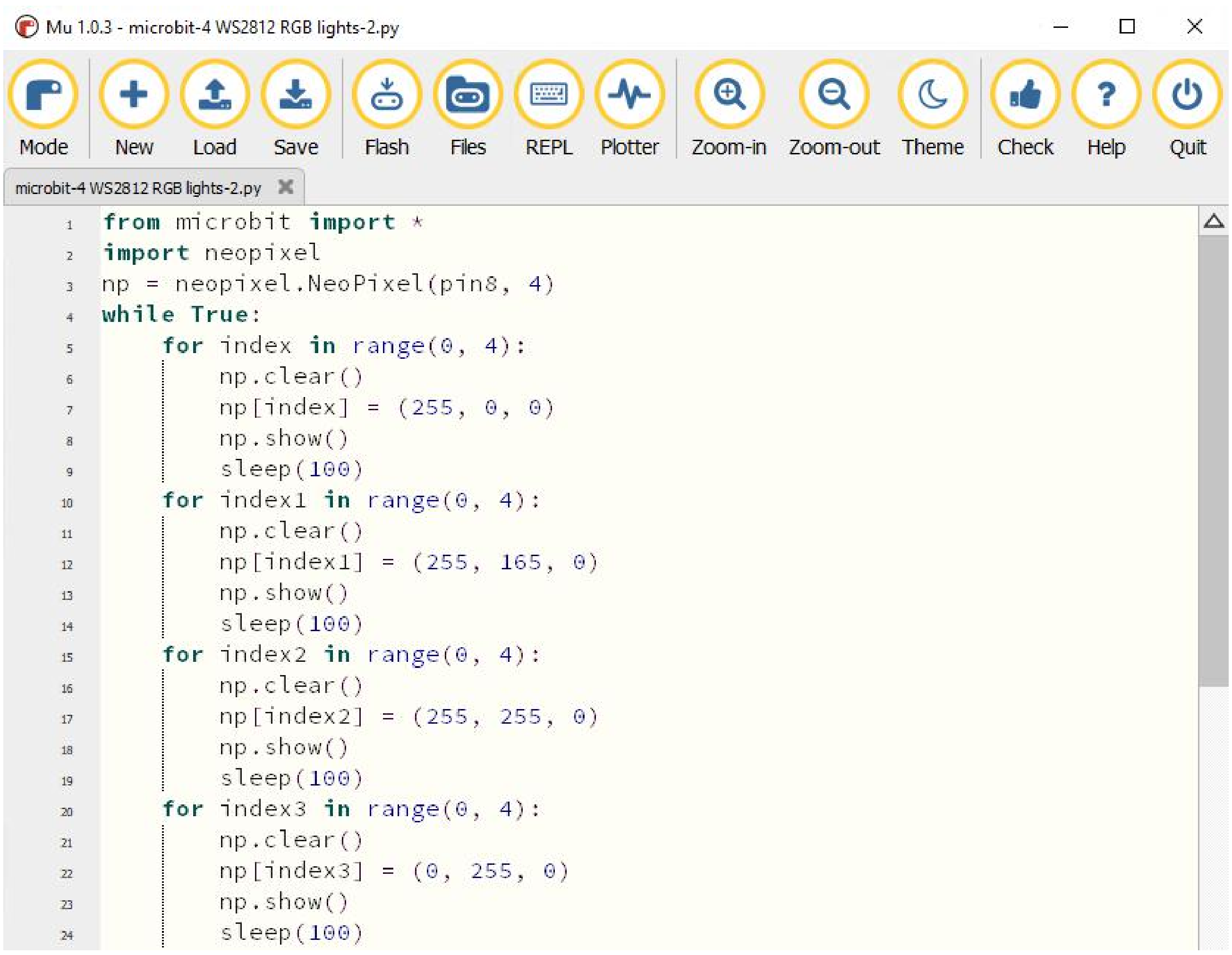
```
    for pixel_id5 in range(0, len(np)):
        np[pixel_id5] = (0, 0, 255)
        np.show()
    sleep(1000)
    for pixel_id6 in range(0, len(np)):
        np[pixel_id6] = (75, 0, 130)
        np.show()
    sleep(1000)
    for pixel_id7 in range(0, len(np)):
        np[pixel_id7] = (238, 130, 238)
        np.show()
    sleep(1000)
    for pixel_id8 in range(0, len(np)):
        np[pixel_id8] = (160, 32, 240)
        np.show()
    sleep(1000)
    for pixel_id9 in range(0, len(np)):
        np[pixel_id9] = (255, 255, 255)
    sleep(1000)
```

Code 2:

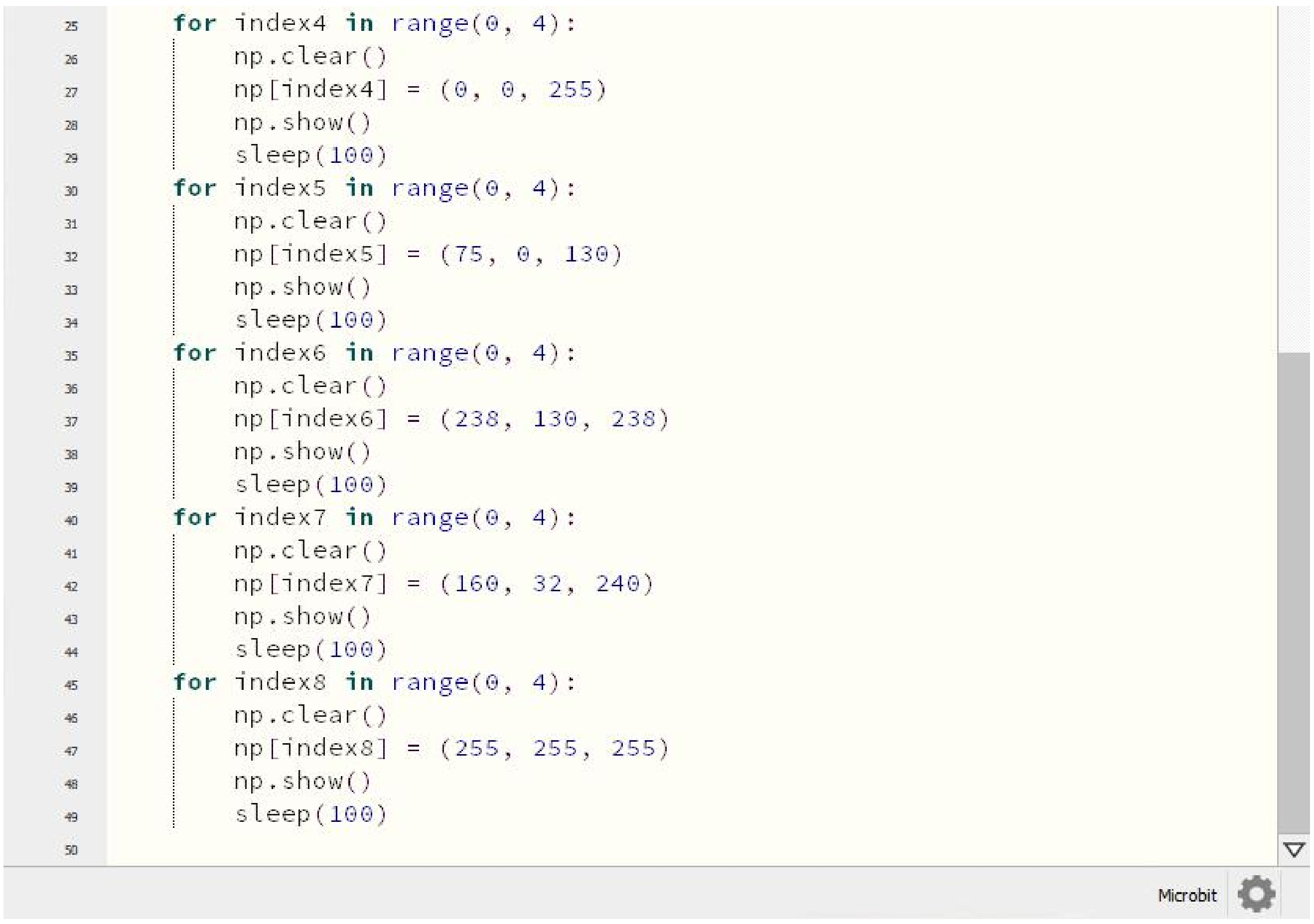
Open “microbit-Code-2.py” in Mu (How to load the project code?)

File Type	Route	File Name
Python file	../Python Code/8.15: WS2812 RGB LEDs	microbit-Code-2.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)

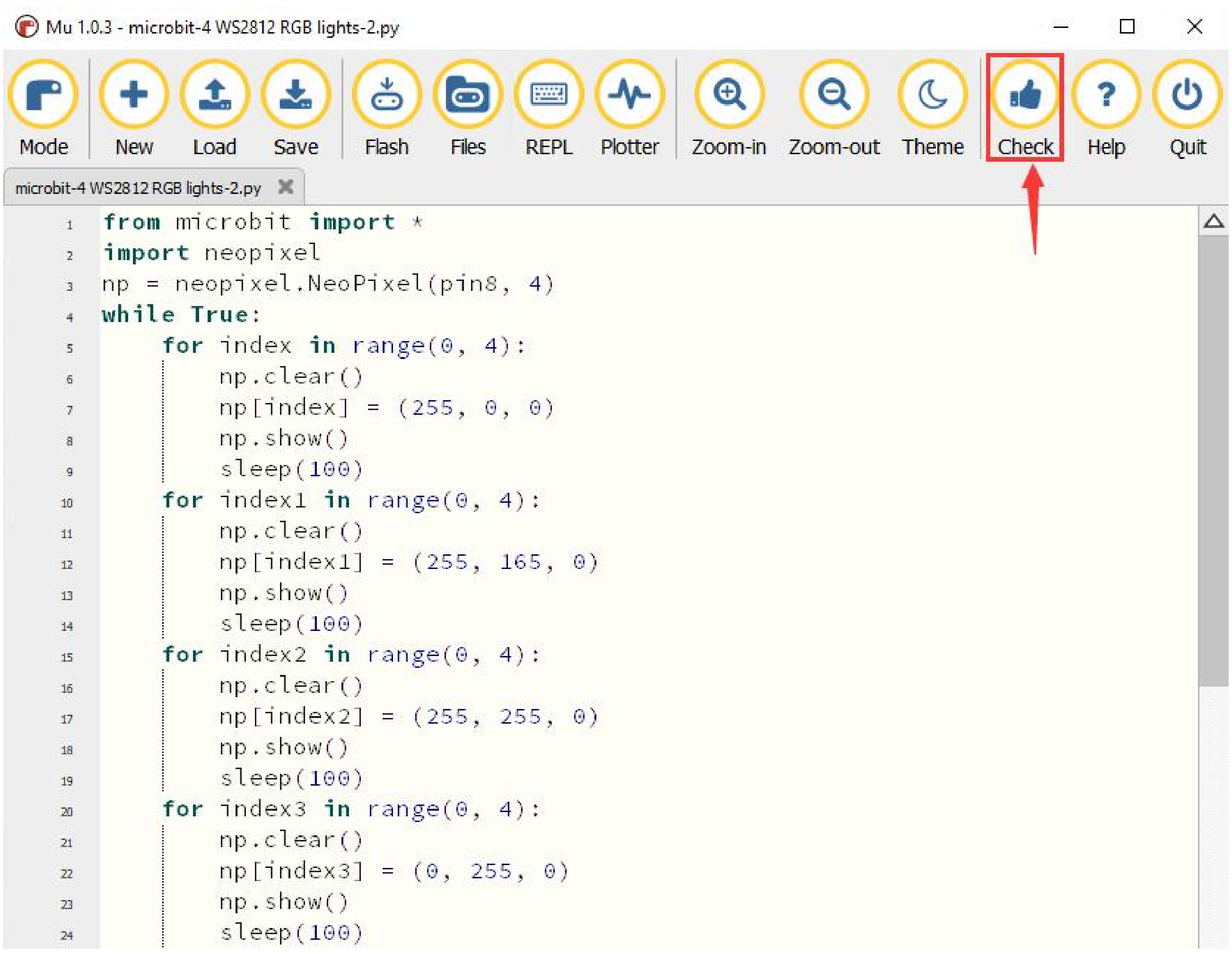

Mu 1.0.3 - microbit-4 WS2812 RGB lights-2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-4 WS2812 RGB lights-2.py

```
from microbit import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
while True:
    for index in range(0, 4):
        np.clear()
        np[index] = (255, 0, 0)
        np.show()
        sleep(100)
    for index1 in range(0, 4):
        np.clear()
        np[index1] = (255, 165, 0)
        np.show()
        sleep(100)
    for index2 in range(0, 4):
        np.clear()
        np[index2] = (255, 255, 0)
        np.show()
        sleep(100)
    for index3 in range(0, 4):
        np.clear()
        np[index3] = (0, 255, 0)
        np.show()
        sleep(100)
```

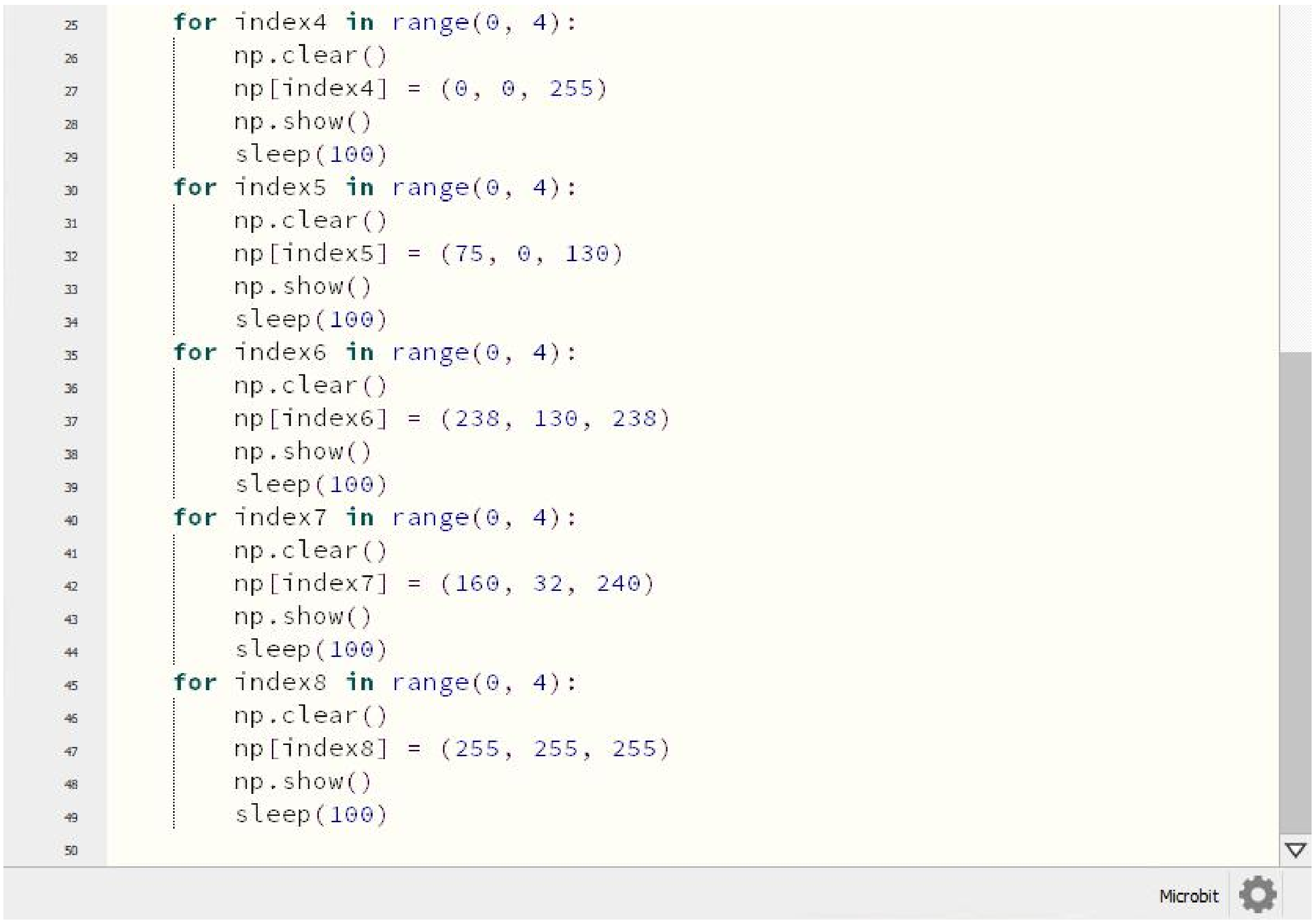


```
    for index4 in range(0, 4):
        np.clear()
        np[index4] = (0, 0, 255)
        np.show()
        sleep(100)
    for index5 in range(0, 4):
        np.clear()
        np[index5] = (75, 0, 130)
        np.show()
        sleep(100)
    for index6 in range(0, 4):
        np.clear()
        np[index6] = (238, 130, 238)
        np.show()
        sleep(100)
    for index7 in range(0, 4):
        np.clear()
        np[index7] = (160, 32, 240)
        np.show()
        sleep(100)
    for index8 in range(0, 4):
        np.clear()
        np[index8] = (255, 255, 255)
        np.show()
        sleep(100)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.

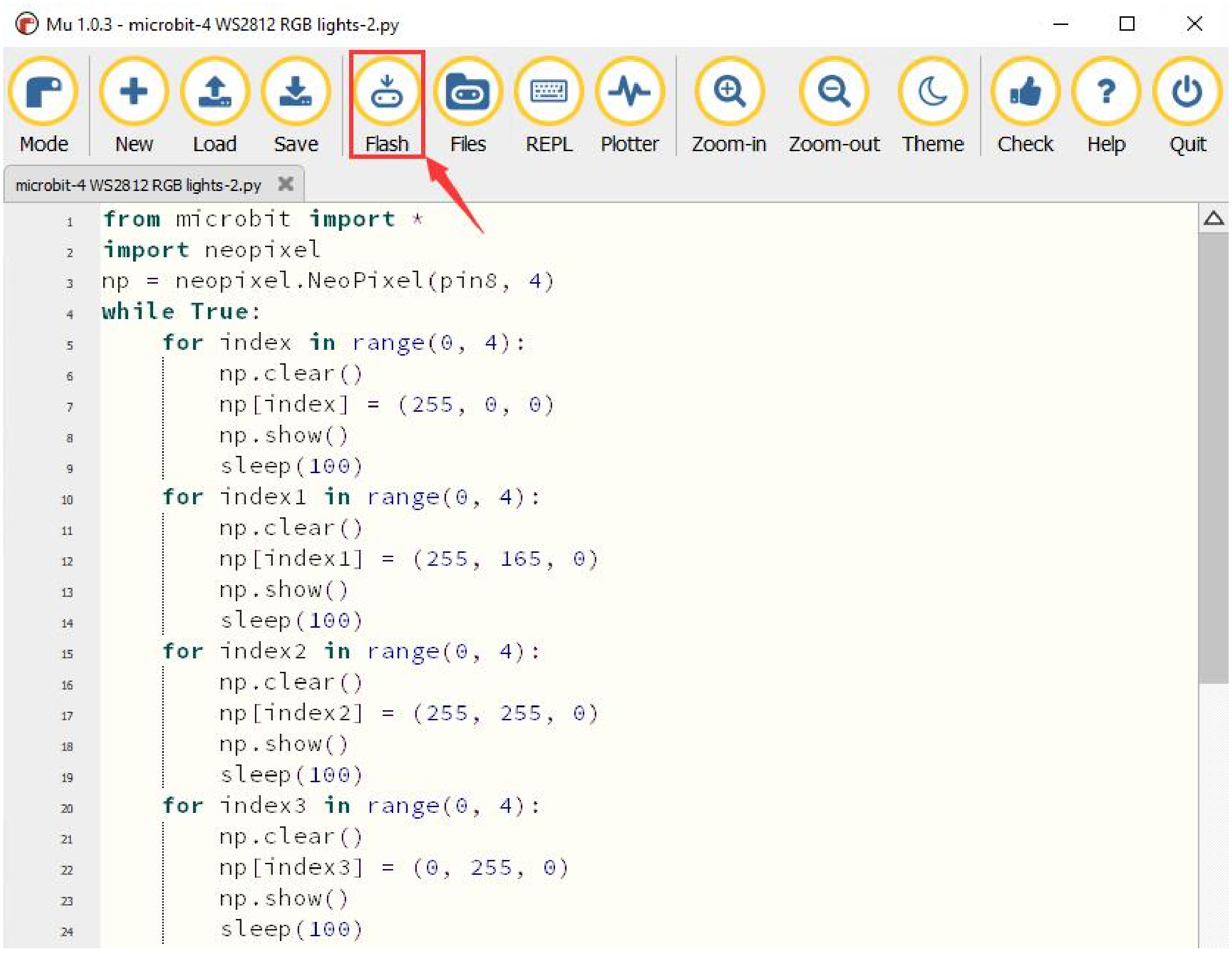

Mu 1.0.3 - microbit-4 WS2812 RGB lights-2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-4 WS2812 RGB lights-2.py

```
from microbit import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
while True:
    for index in range(0, 4):
        np.clear()
        np[index] = (255, 0, 0)
        np.show()
        sleep(100)
    for index1 in range(0, 4):
        np.clear()
        np[index1] = (255, 165, 0)
        np.show()
        sleep(100)
    for index2 in range(0, 4):
        np.clear()
        np[index2] = (255, 255, 0)
        np.show()
        sleep(100)
    for index3 in range(0, 4):
        np.clear()
        np[index3] = (0, 255, 0)
        np.show()
        sleep(100)
```

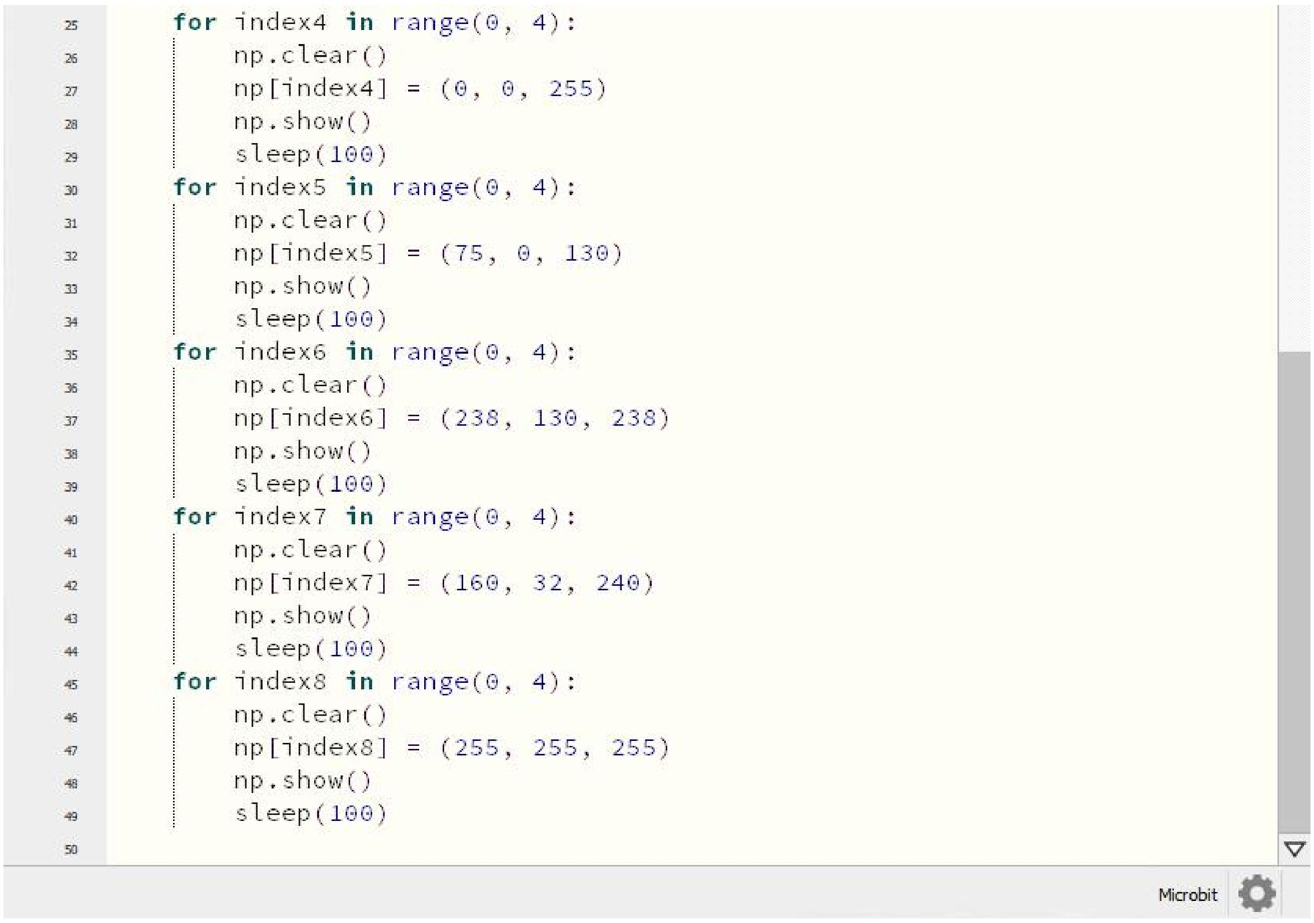


```
    for index4 in range(0, 4):
        np.clear()
        np[index4] = (0, 0, 255)
        np.show()
        sleep(100)
    for index5 in range(0, 4):
        np.clear()
        np[index5] = (75, 0, 130)
        np.show()
        sleep(100)
    for index6 in range(0, 4):
        np.clear()
        np[index6] = (238, 130, 238)
        np.show()
        sleep(100)
    for index7 in range(0, 4):
        np.clear()
        np[index7] = (160, 32, 240)
        np.show()
        sleep(100)
    for index8 in range(0, 4):
        np.clear()
        np[index8] = (255, 255, 255)
        np.show()
        sleep(100)

```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.


Mu 1.0.3 - microbit-4 WS2812 RGB lights-2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-4 WS2812 RGB lights-2.py

```
from microbit import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
while True:
    for index in range(0, 4):
        np.clear()
        np[index] = (255, 0, 0)
        np.show()
        sleep(100)
    for index1 in range(0, 4):
        np.clear()
        np[index1] = (255, 165, 0)
        np.show()
        sleep(100)
    for index2 in range(0, 4):
        np.clear()
        np[index2] = (255, 255, 0)
        np.show()
        sleep(100)
    for index3 in range(0, 4):
        np.clear()
        np[index3] = (0, 255, 0)
        np.show()
        sleep(100)
```



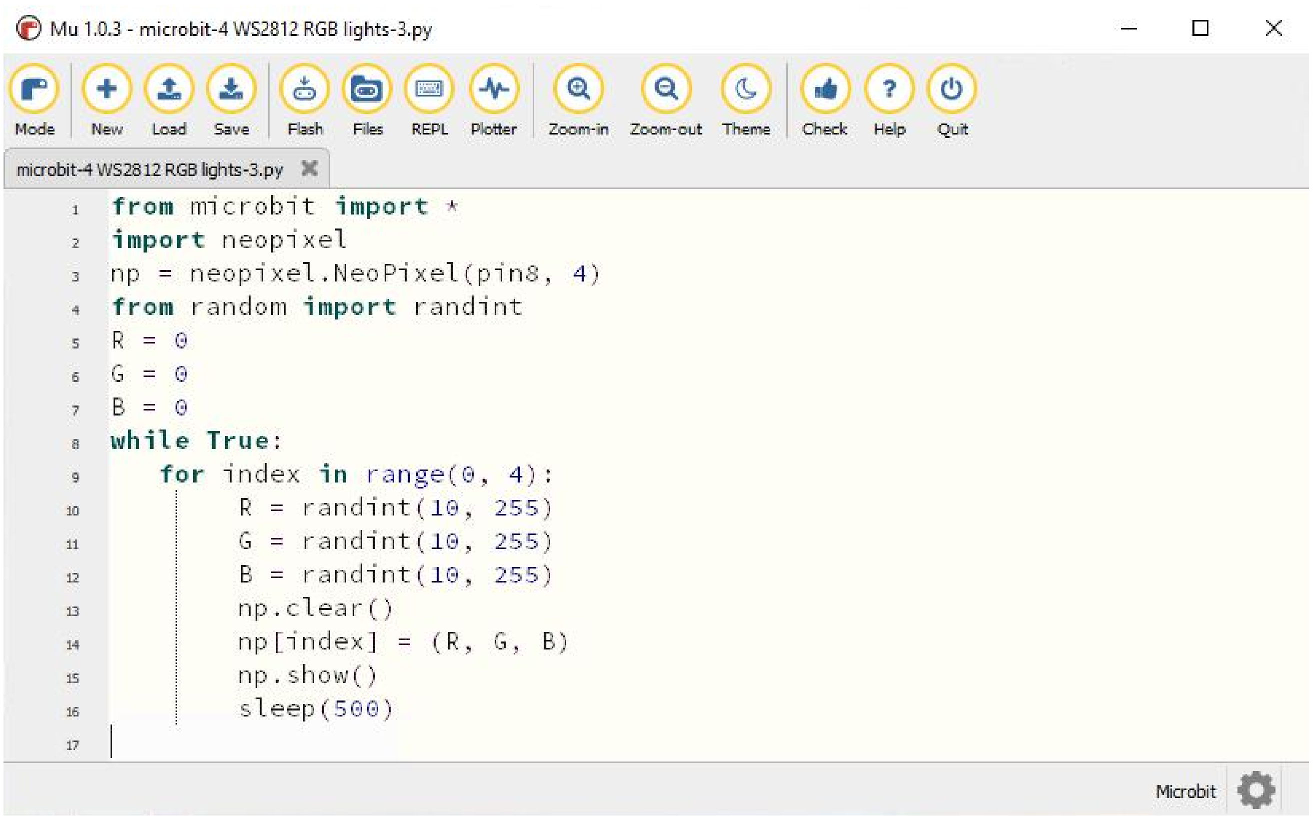
```
    for index4 in range(0, 4):
        np.clear()
        np[index4] = (0, 0, 255)
        np.show()
        sleep(100)
    for index5 in range(0, 4):
        np.clear()
        np[index5] = (75, 0, 130)
        np.show()
        sleep(100)
    for index6 in range(0, 4):
        np.clear()
        np[index6] = (238, 130, 238)
        np.show()
        sleep(100)
    for index7 in range(0, 4):
        np.clear()
        np[index7] = (160, 32, 240)
        np.show()
        sleep(100)
    for index8 in range(0, 4):
        np.clear()
        np[index8] = (255, 255, 255)
        np.show()
        sleep(100)
```

Code 3:

Open “microbit-Code-3.py” in Mu. (How to load the project code?)

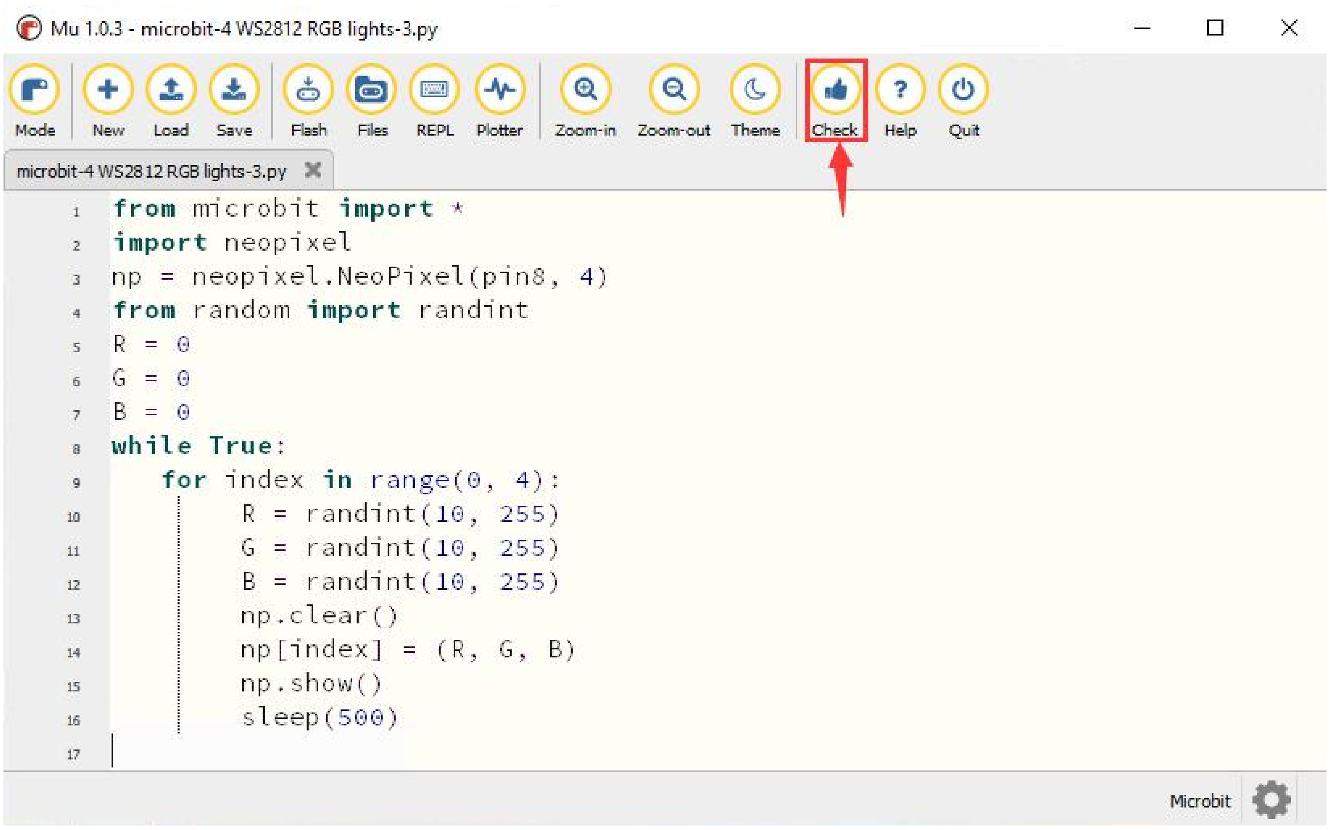
File Type	Route	File Name
Python file	../Python Code/8.15: WS2812 RGB LEDs	microbit-Code-3.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit-4 WS2812 RGB lights-3.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-4 WS2812 RGB lights-3.py
Microbit

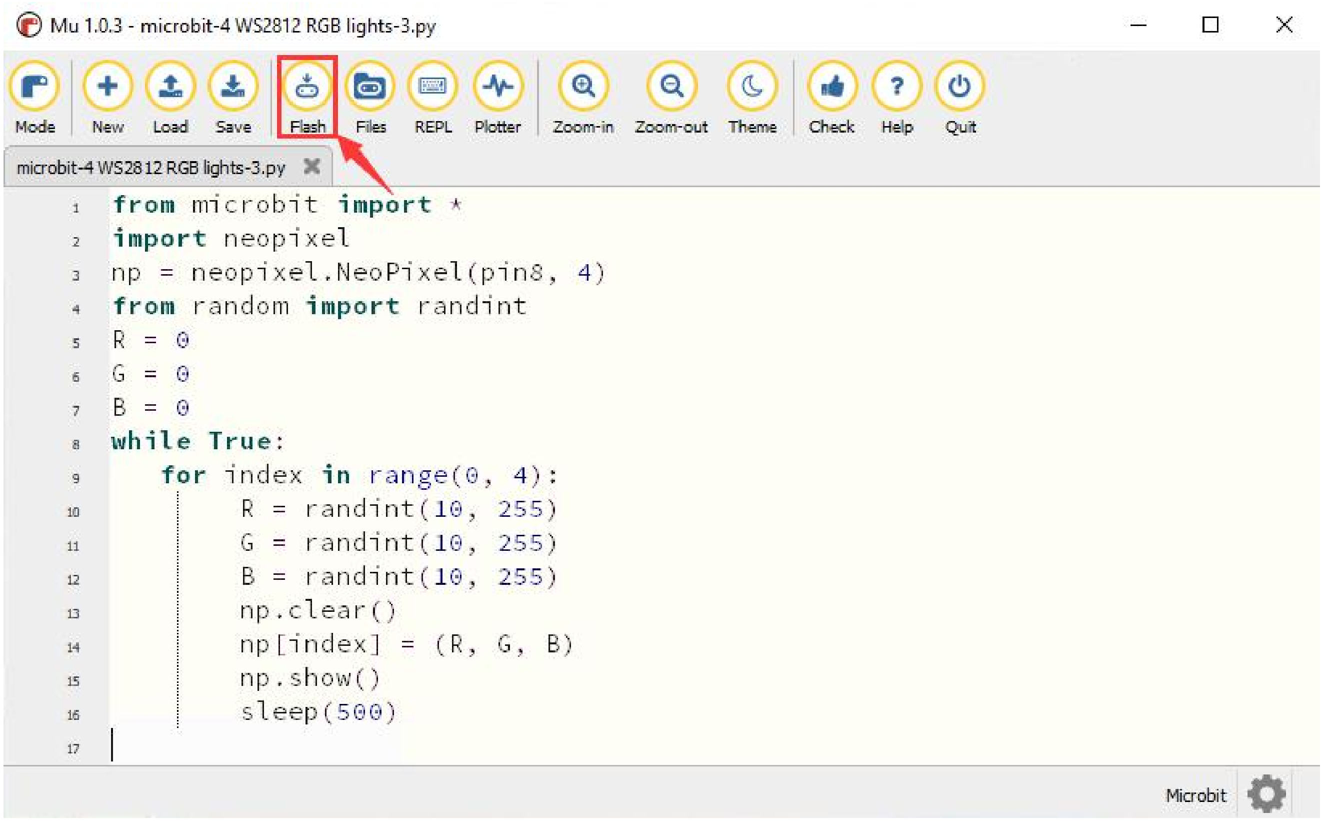
```
from microbit import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
from random import randint
R = 0
G = 0
B = 0
while True:
    for index in range(0, 4):
        R = randint(10, 255)
        G = randint(10, 255)
        B = randint(10, 255)
        np.clear()
        np[index] = (R, G, B)
        np.show()
        sleep(500)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-4 WS2812 RGB lights-3.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-4 WS2812 RGB lights-3.py
Microbit

```
from microbit import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
from random import randint
R = 0
G = 0
B = 0
while True:
    for index in range(0, 4):
        R = randint(10, 255)
        G = randint(10, 255)
        B = randint(10, 255)
        np.clear()
        np[index] = (R, G, B)
        np.show()
        sleep(500)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.


Mu 1.0.3 - microbit-4 WS2812 RGB lights-3.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-4 WS2812 RGB lights-3.py
Microbit

```python
from microbit import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
from random import randint
R = 0
G = 0
B = 0
while True:
    for index in range(0, 4):
        R = randint(10, 255)
        G = randint(10, 255)
        B = randint(10, 255)
        np.clear()
        np[index] = (R, G, B)
        np.show()
        sleep(500)

```

4. Test Result:

Download code 1 to micro: bit, and dial POWER to ON end. WS2812RGB LEDs light up different colors cyclically.

Download code 2 to micro: bit, WS2812RGB LEDs display like flow light.

Download code 3 to micro: bit, every WS2812RGB light shows random color one by one.

(How to download?　How to quick download?)

5.Code Explanation:

from　microbit　**import** *	Import the library file of micro：bit
import　neopixel	Import the library file of neopixel
np.clear()	RGB on Neopixel are all off
while True:	This is a permanent loop that makes micro:bit execute the code of it.
for pixel_id1 **in** range(0, len(np)):	Set pixel of RGB in　(0，len（np））to pixel_id1
for index **in** range(0, 4):	Set pixel of RGB in (0,4) to index
np.show()	Display current pixel on Neopixel

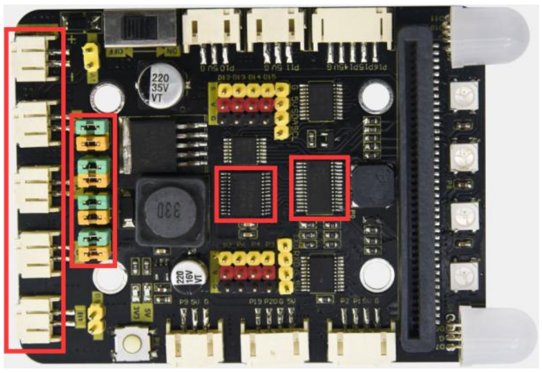
np[pixel_id1] = (255, 0, 0)
np[pixel_id2] = (255, 165, 0)
np[pixel_id3] = (255, 255, 0)
np[pixel_id4] = (0, 255, 0)
np[pixel_id5] = (0, 0, 255)
np[pixel_id6] = (75, 0, 130)
np[pixel_id7] = (238, 130, 238)
np[pixel_id8] = (160, 32, 240)
	Set pixel_id1　to display red color
	Set pixel_id2　to display orange color
	Set pixel_id3　to display yellow color
	Set pixel_id4　to display green color
	Set pixel_id5　to display blue　color
	Set pixel_id6　to display indigo color
	Set pixel_id7　to display violet color

np[pixel_id9] = (255, 255, 255)	Set pixel_id8 to display purple color Set pixel_id9 to display white color
from random **import** randint	Import randint from random variables
np[pixel_id] = (R, G, B)	Set pixel_id to display rainbow color

R = 0
 	
G = 0
 	
B = 0
	Set the initial value of R to 0
	
	Set the initial value of G to 0
	
	Set the initial value of B to 0

R = randint(10, 255)
 	
G = randint(10, 255)
 	
B = randint(10, 255)
	Set R=randint(10, 255)
	
	Set G=randint(10, 255)
	
	Set B=randint(10, 255)

8.16: Motor Driving

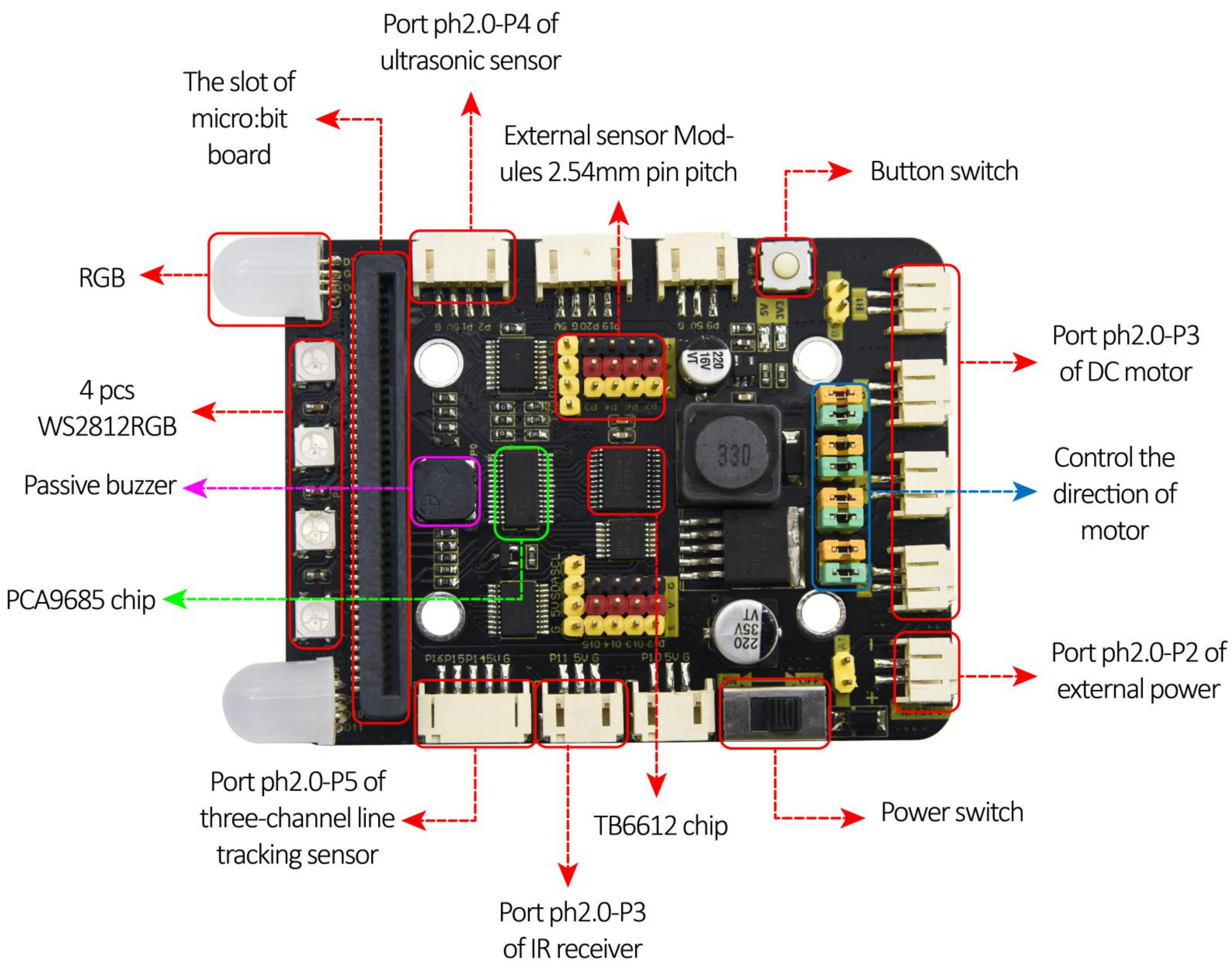


1. Description:

Keyestudio micro： bit smart car is equipped with two DC geared motors which are added a gearbox based on regular DC motors.

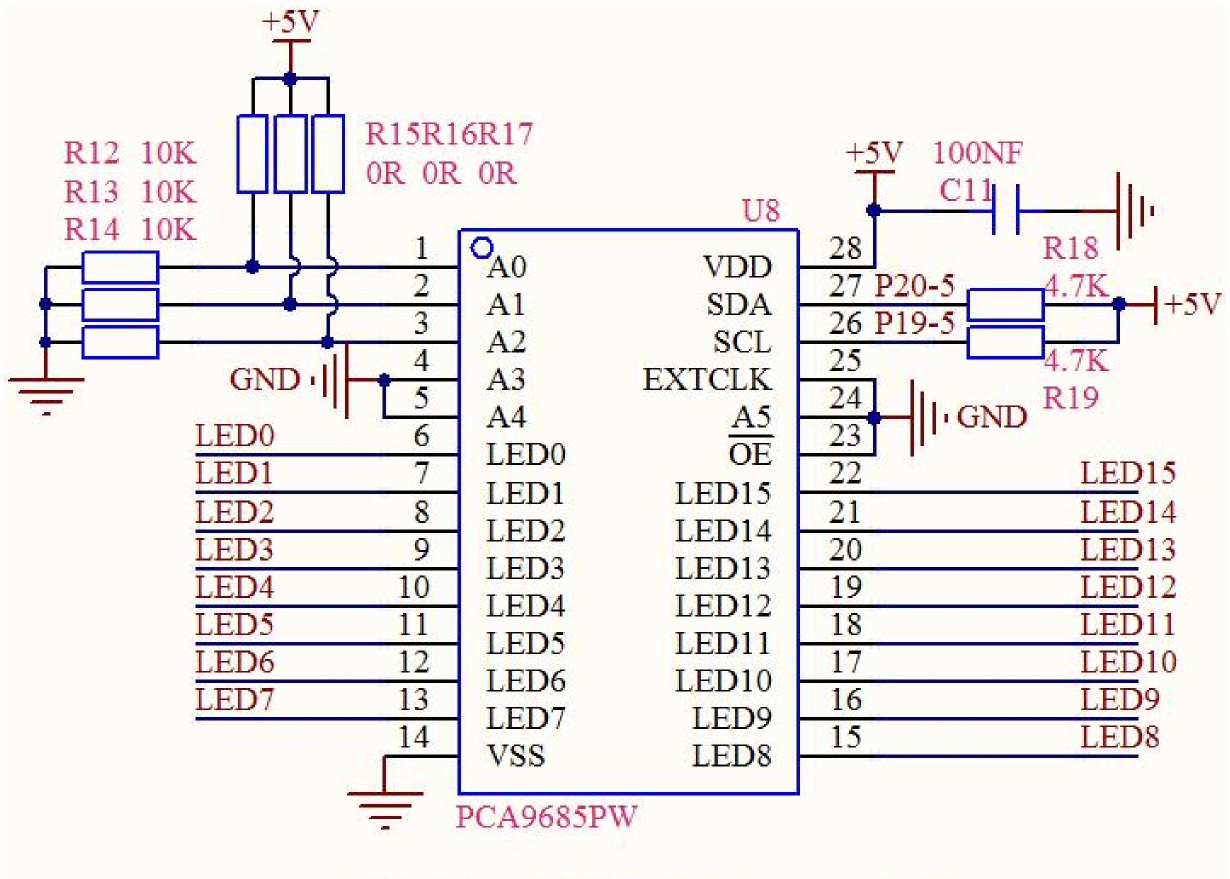
Gear motor is the integration of gearmotor and motor, which is applied widely in steel and machine industry

Micro:bit motor driver shield comes with PCA9685PW and TB6612FNG chip， to save the IO port resource， we control the rotation direction and speed of two DC gear motors with TB6612FNG chip.


Port ph2.0-P4 of ultrasonic sensor
The slot of micro:bit board
External sensor Modules 2.54mm pin pitch
Button switch
RGB
Port ph2.0-P3 of DC motor
4 pcs WS2812RGB
Control the direction of motor
Passive buzzer
PCA9685 chip
Port ph2.0-P2 of external power
Port ph2.0-P5 of three-channel line tracking sensor
TB6612 chip
Power switch
Port ph2.0-P3 of IR receiver

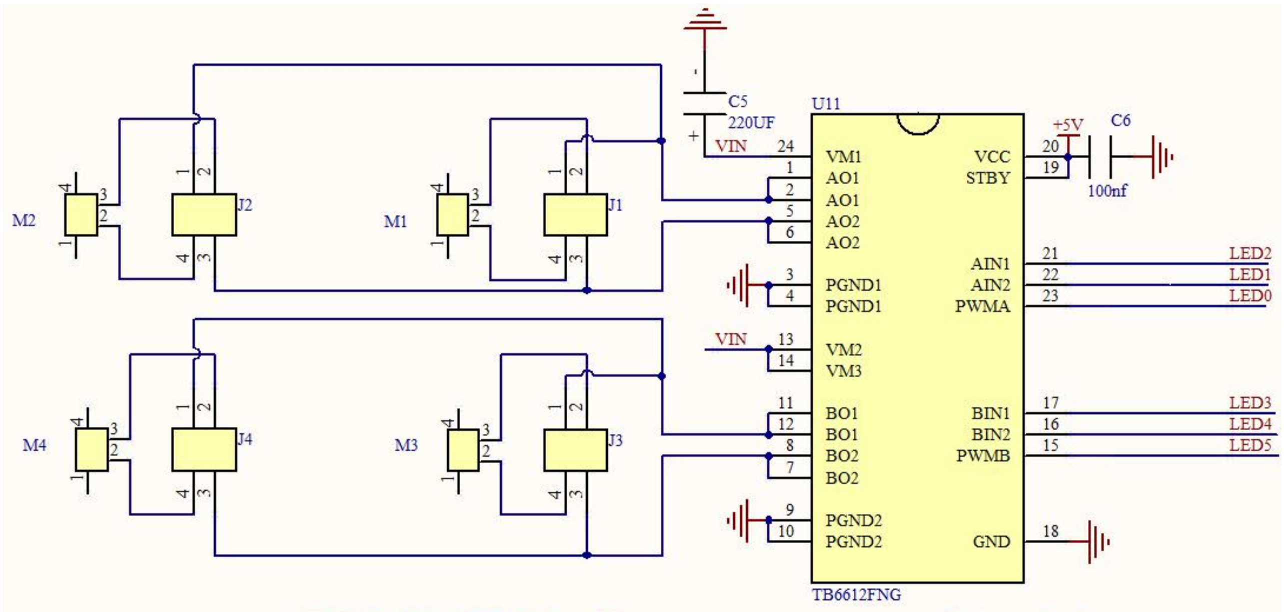
PCA9685 chip is controlled by IIC port of micro:bit board and used to be output port and expand the IO ports of micro:bit board.

TB6612 chip is controlled by LEDx pin of PCA9685 chip(pin LED1 and LED2 control the direction of left motor, speed is LED0 pin; LED3 and LED4 pin control direction of right motor, speed is LED5



+5V
R12 10K
R13 10K
R14 10K
R15R16R17
0R 0R 0R
U8
+5V 100NF
C11
R18
4.7K
4.7K
R19
P20-5
P19-5
GND
A0 A1 A2 A3 A4 LED0 LED1 LED2 LED3 LED4 LED5 LED6 LED7 VSS
VDD SDA SCL EXTCLK A5 OE LED15 LED14 LED13 LED12 LED11 LED10 LED9 LED8
PCA9685PW

PCA9685PW IC

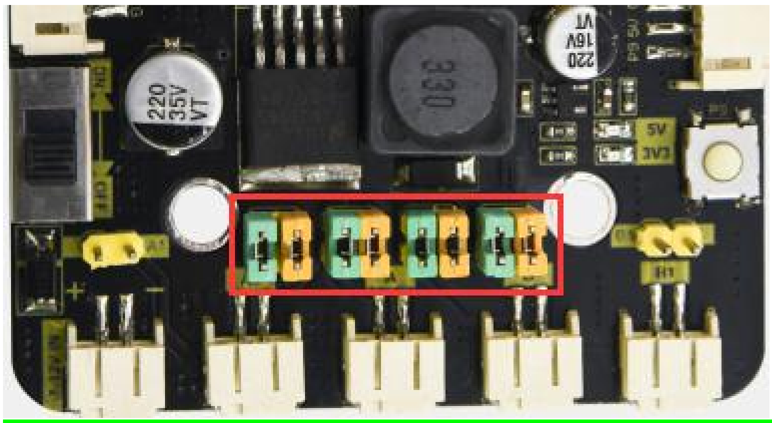


C5
220UF
VIN
U11
M1 M2 M3 M4
J1 J2 J3 J4
VM1 AO1 AO1 AO2 AO2 PGND1 PGND1 VM2 VM3 BO1 BO1 BO2 BO2 PGND2 PGND2
VCC STBY AIN1 AIN2 PWMA BIN1 BIN2 PWMB GND
+5V C6 100nf
LED2 LED1 LED0 LED3 LED4 LED5
TB6612FNG

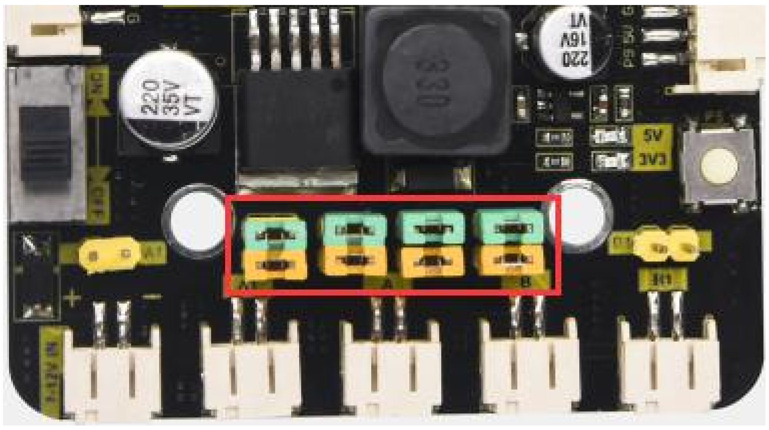
TB6612FNG Motor control chip

Note:please follow the direction of eight jumper caps inserted.

In this way, the rotation direction is as same as the set rotation orientation in the code



The picture below is wrong inserted direction of jumper caps



2. Experimental Preparation:

(1) Insert micro:bit board into slot of V2 shield.

(2) Put batteries into battery holder

(3) Dial POWER to ON end on shield

(4) Link micro:bit board with computer via USB cable.

(5) Open the offline version of Mu

3. Test Code

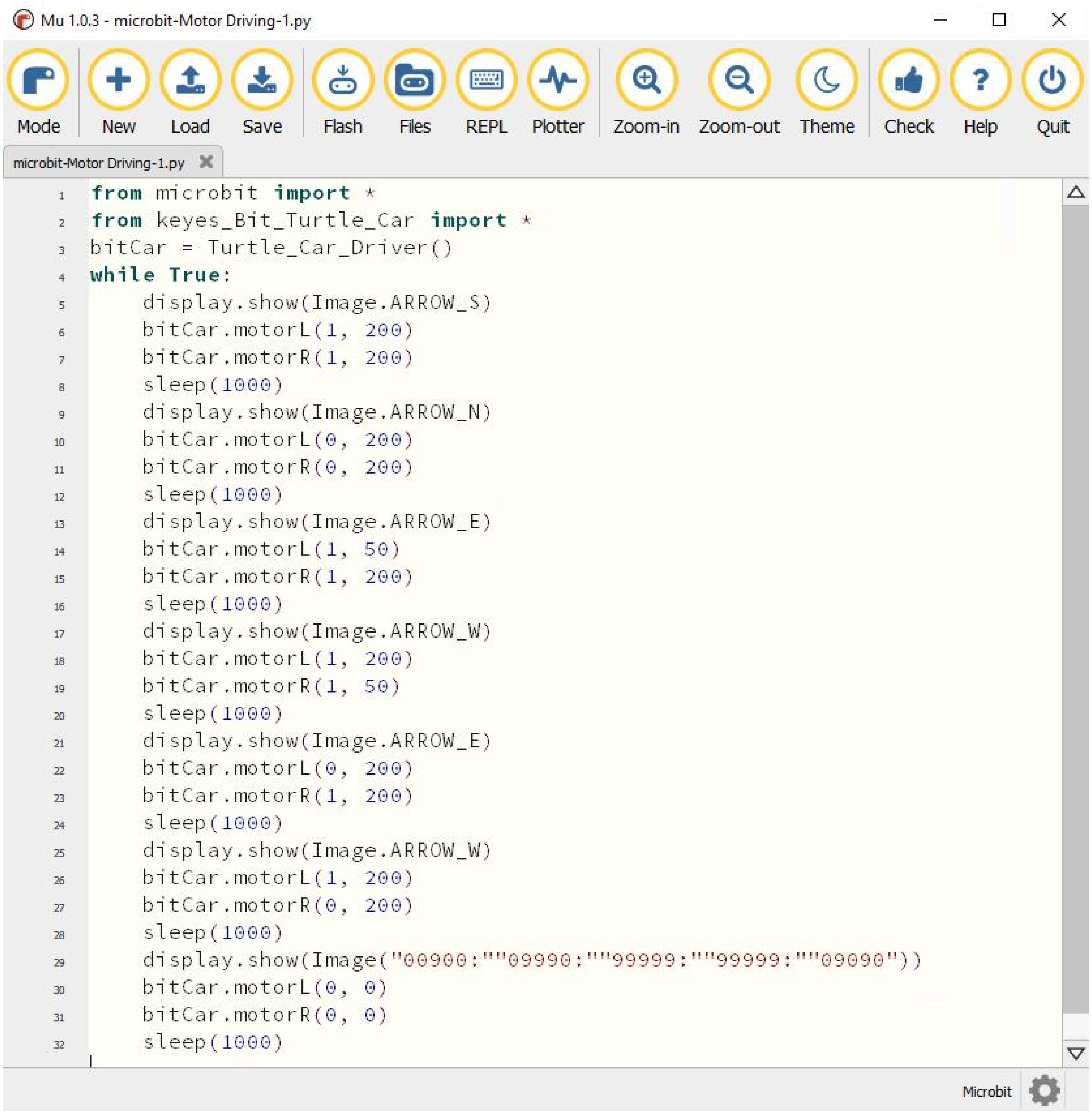
Code 1:

Open "microbit-Code 1.py" file in Mu,

(How to load the project code?)

File Type	Route	File Name
Python file	../Python code/8.16: Motor Driving	microbit-Code-1.py

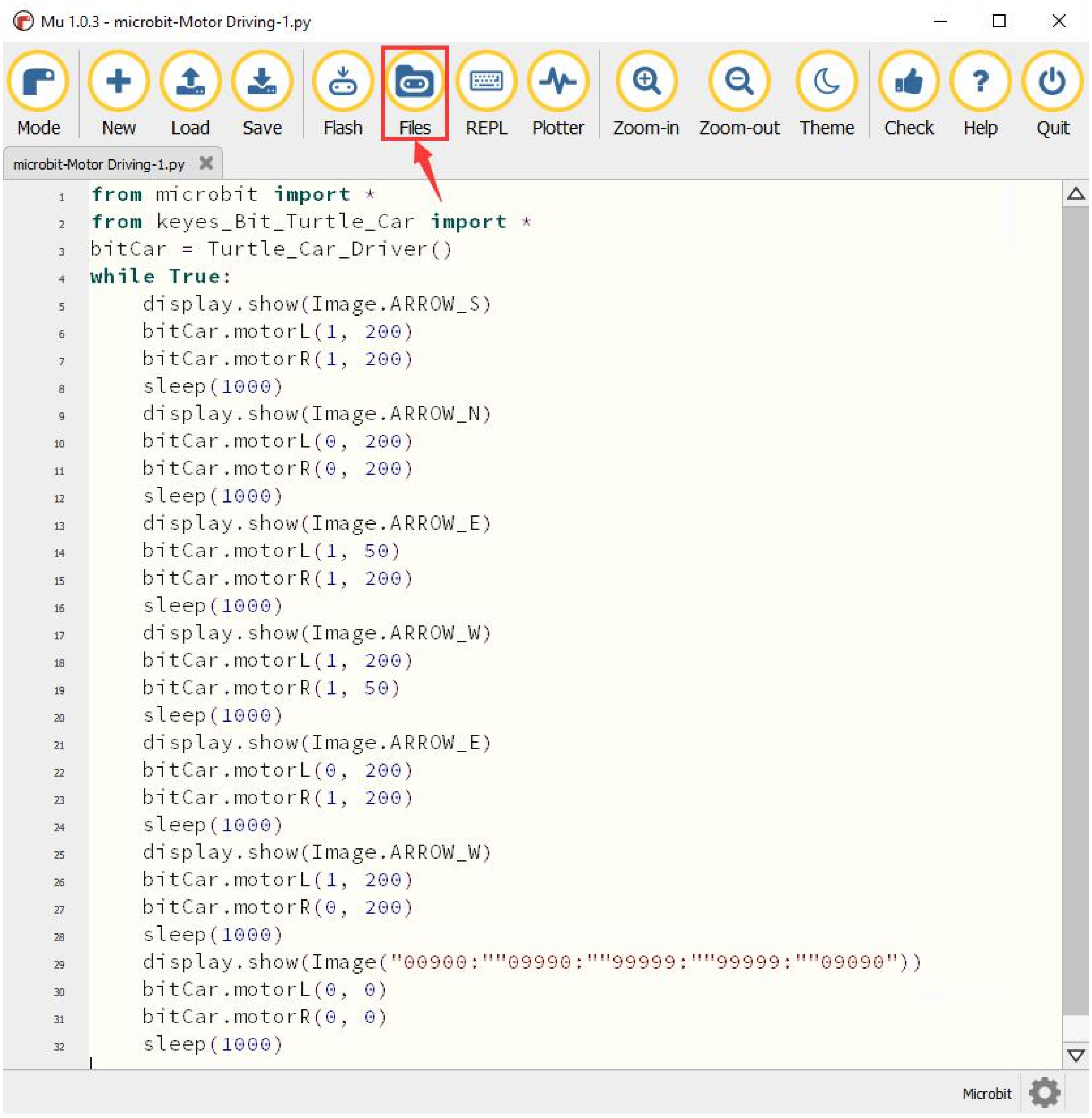
You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



```python
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
while True:
    display.show(Image.ARROW_S)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_N)
    bitCar.motorL(0, 200)
    bitCar.motorR(0, 200)
    sleep(1000)
    display.show(Image.ARROW_E)
    bitCar.motorL(1, 50)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_W)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 50)
    sleep(1000)
    display.show(Image.ARROW_E)
    bitCar.motorL(0, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_W)
    bitCar.motorL(1, 200)
    bitCar.motorR(0, 200)
    sleep(1000)
    display.show(Image("00900:""09990:""99999:""99999:""09090"))
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    sleep(1000)
```

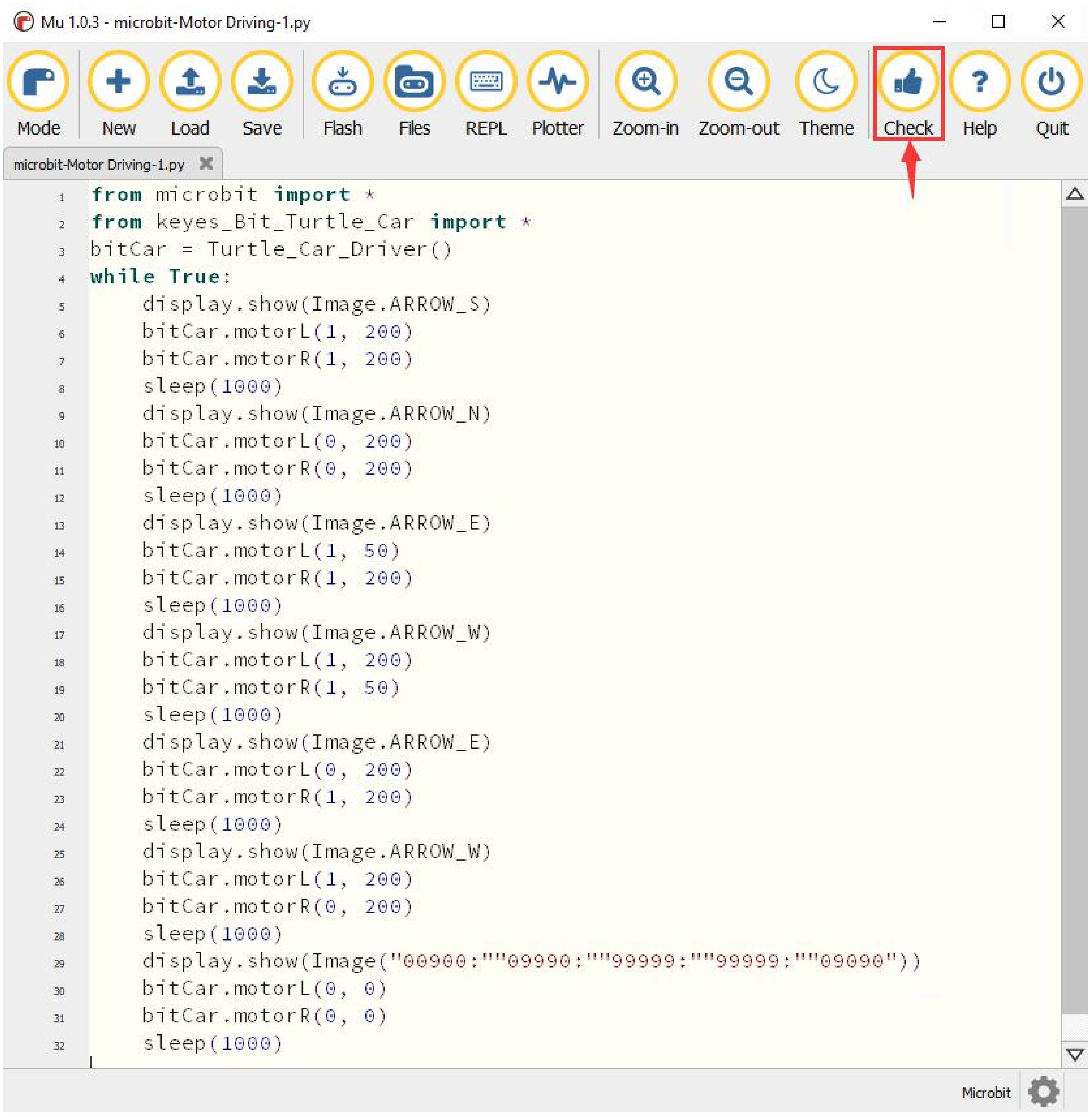
Click “Files” to import the library file of “keyes_Bit_Turtle_Car.py” to micro:bit (How to import files?)

If micro:bit has library, you don’t need to add one.



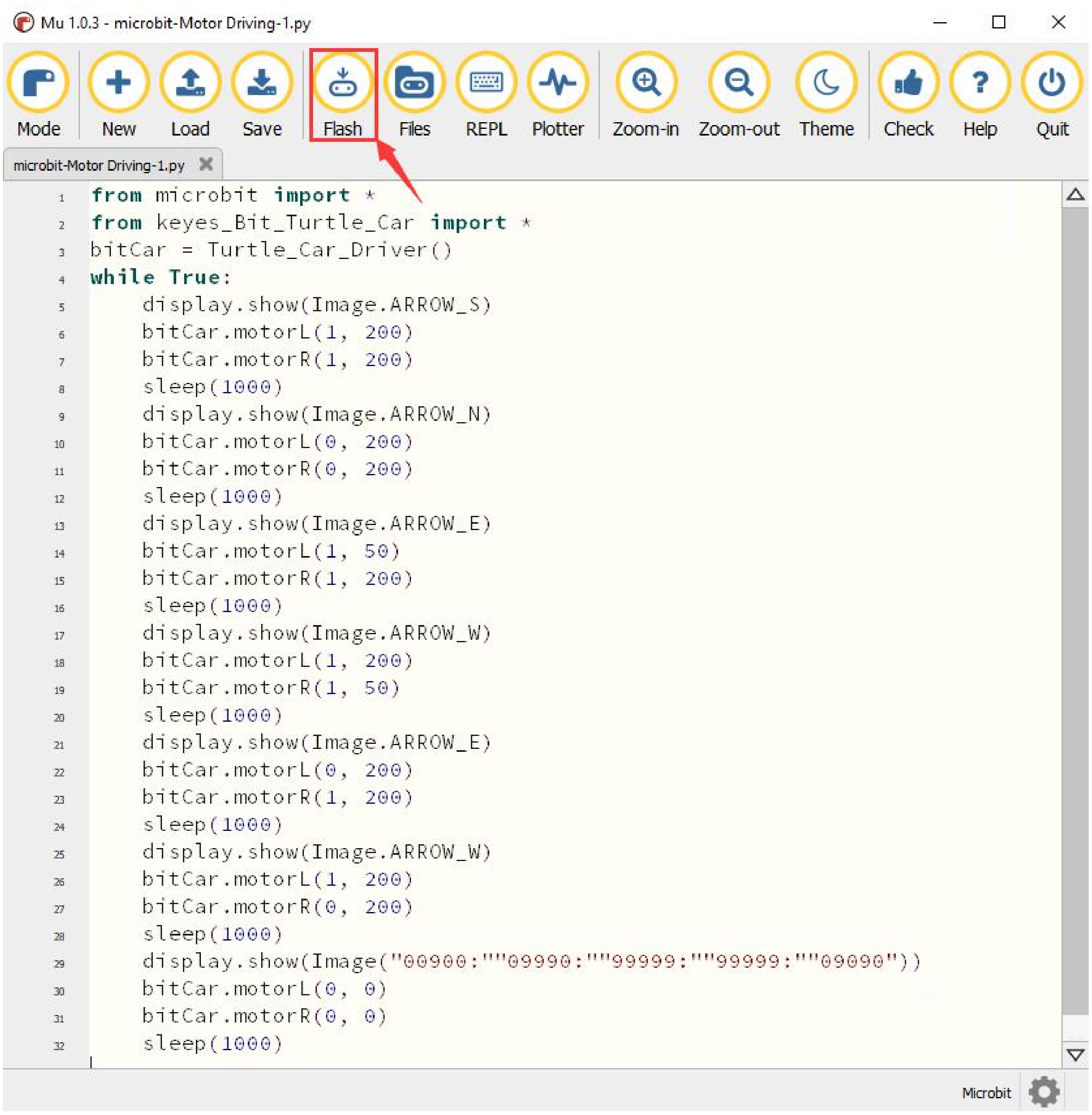
```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
while True:
    display.show(Image.ARROW_S)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_N)
    bitCar.motorL(0, 200)
    bitCar.motorR(0, 200)
    sleep(1000)
    display.show(Image.ARROW_E)
    bitCar.motorL(1, 50)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_W)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 50)
    sleep(1000)
    display.show(Image.ARROW_E)
    bitCar.motorL(0, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_W)
    bitCar.motorL(1, 200)
    bitCar.motorR(0, 200)
    sleep(1000)
    display.show(Image("00900:""09990:""99999:""99999:""09090"))
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    sleep(1000)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
while True:
    display.show(Image.ARROW_S)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_N)
    bitCar.motorL(0, 200)
    bitCar.motorR(0, 200)
    sleep(1000)
    display.show(Image.ARROW_E)
    bitCar.motorL(1, 50)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_W)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 50)
    sleep(1000)
    display.show(Image.ARROW_E)
    bitCar.motorL(0, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_W)
    bitCar.motorL(1, 200)
    bitCar.motorR(0, 200)
    sleep(1000)
    display.show(Image("00900:""09990:""99999:""99999:""09090"))
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    sleep(1000)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
while True:
    display.show(Image.ARROW_S)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_N)
    bitCar.motorL(0, 200)
    bitCar.motorR(0, 200)
    sleep(1000)
    display.show(Image.ARROW_E)
    bitCar.motorL(1, 50)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_W)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 50)
    sleep(1000)
    display.show(Image.ARROW_E)
    bitCar.motorL(0, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    display.show(Image.ARROW_W)
    bitCar.motorL(1, 200)
    bitCar.motorR(0, 200)
    sleep(1000)
    display.show(Image("00900:""09990:""99999:""99999:""09090"))
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    sleep(1000)
```

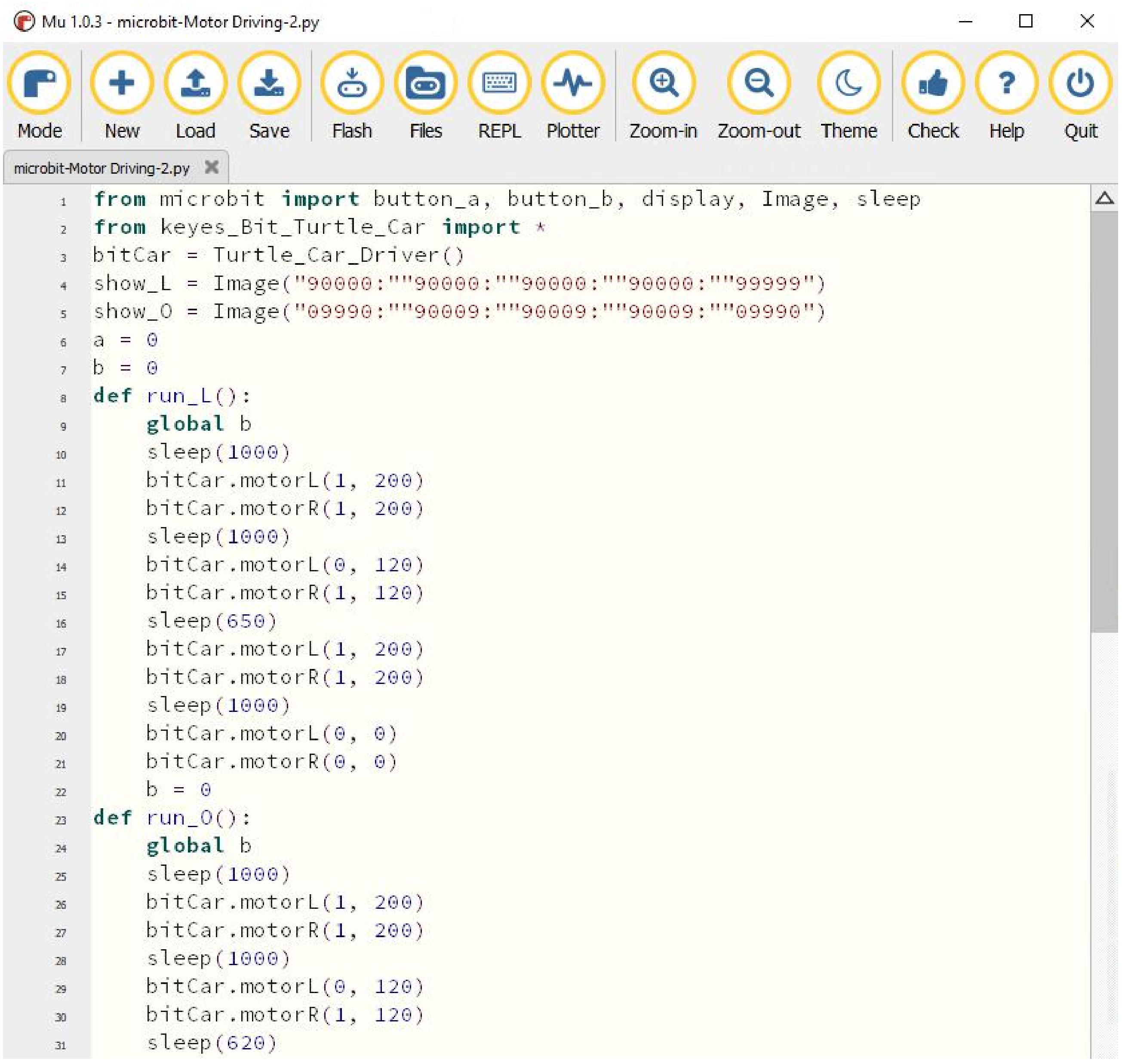
Code 2:

Open “microbit-Code 2.py” file in Mu.

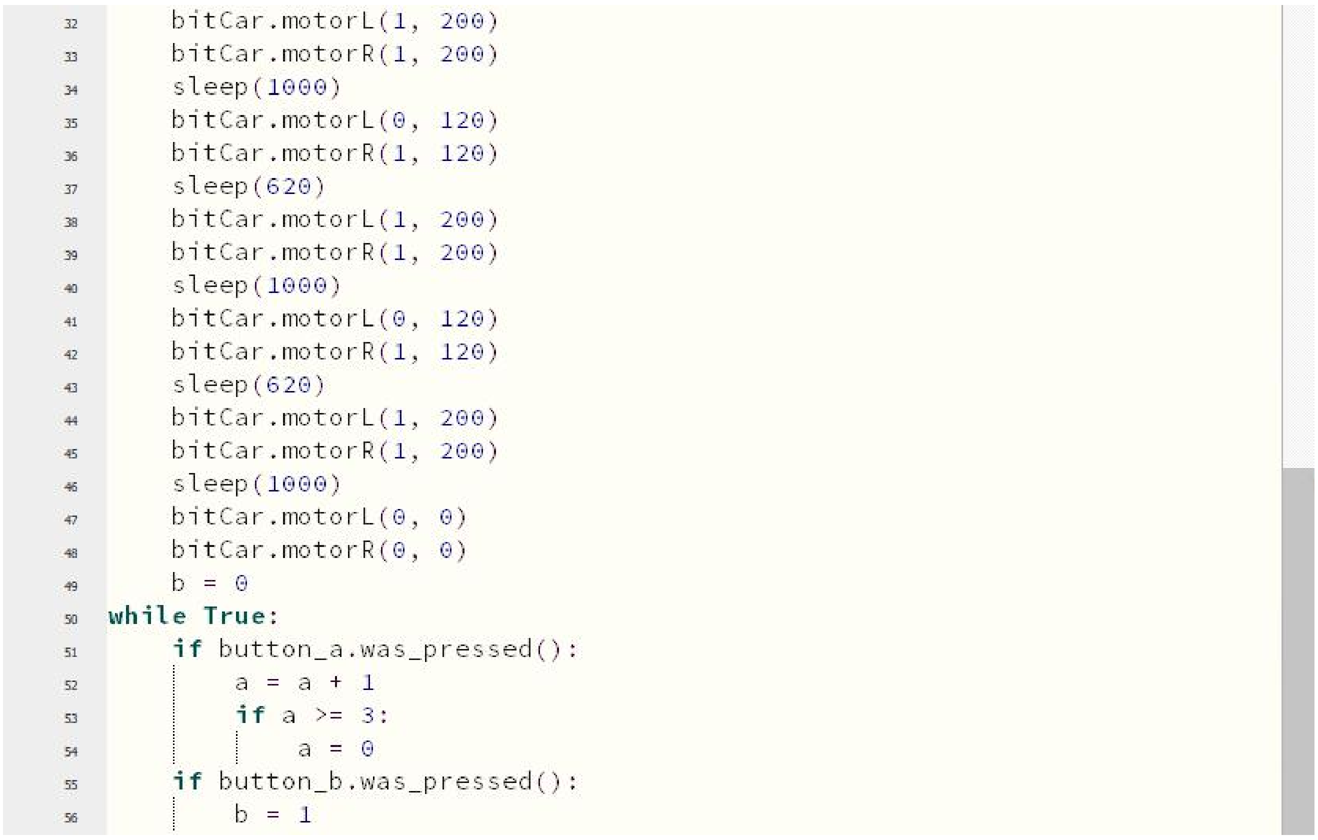
(How to load the project code?)

File Type	Route	File Name
Python file	../Python Code/8.16：Motor Driving	microbit-Code-2.py

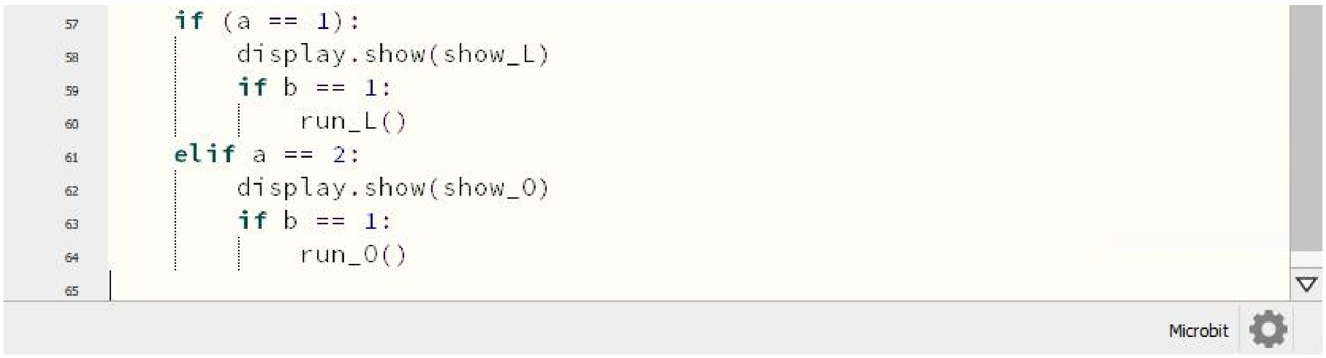
You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



```
from microbit import button_a, button_b, display, Image, sleep
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
show_L = Image("90000:""90000:""90000:""90000:""99999")
show_O = Image("09990:""90009:""90009:""90009:""09990")
a = 0
b = 0
def run_L():
    global b
    sleep(1000)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(650)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    b = 0
def run_O():
    global b
    sleep(1000)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
```



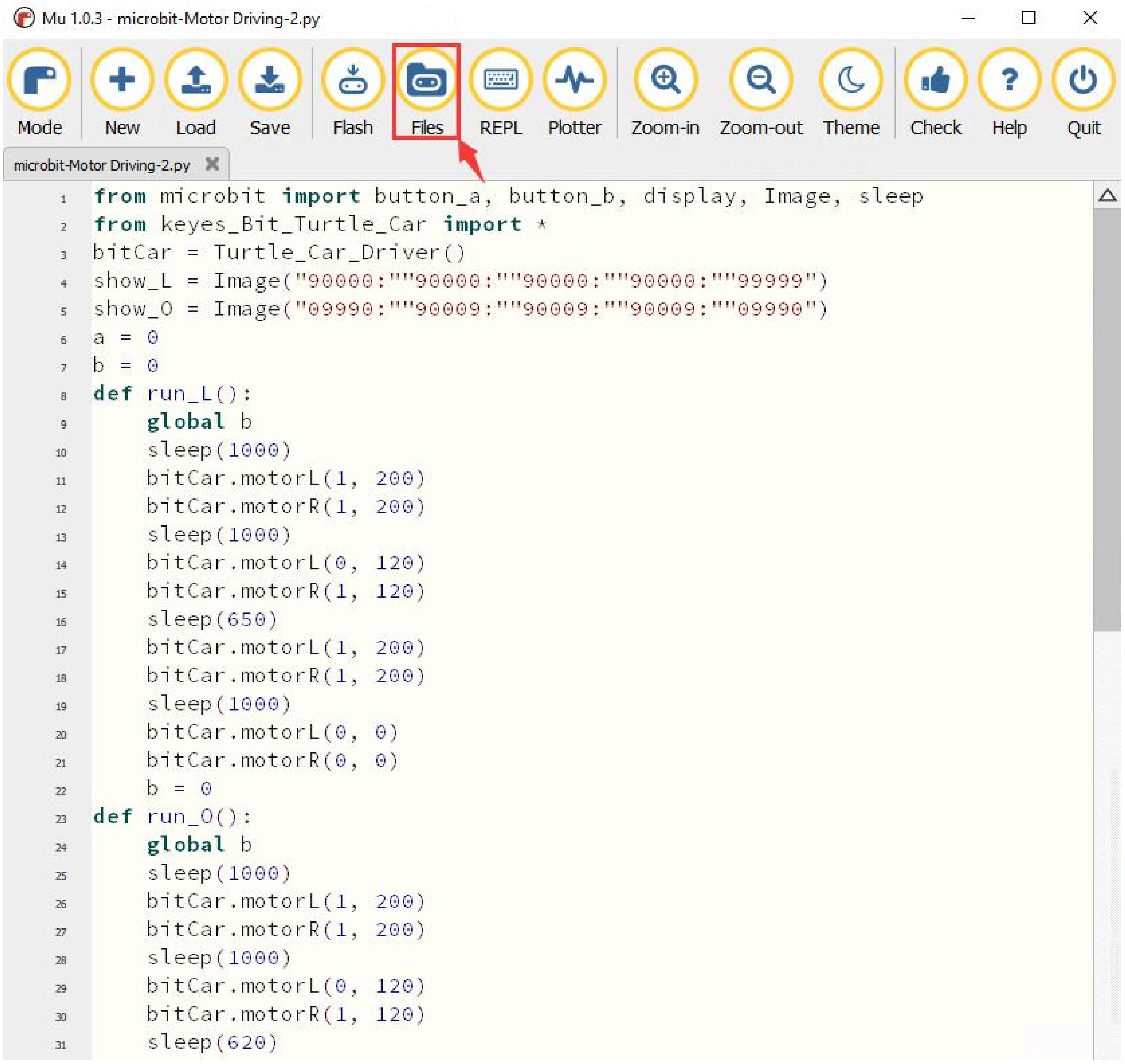
```
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    b = 0
while True:
    if button_a.was_pressed():
        a = a + 1
        if a >= 3:
            a = 0
    if button_b.was_pressed():
        b = 1
```



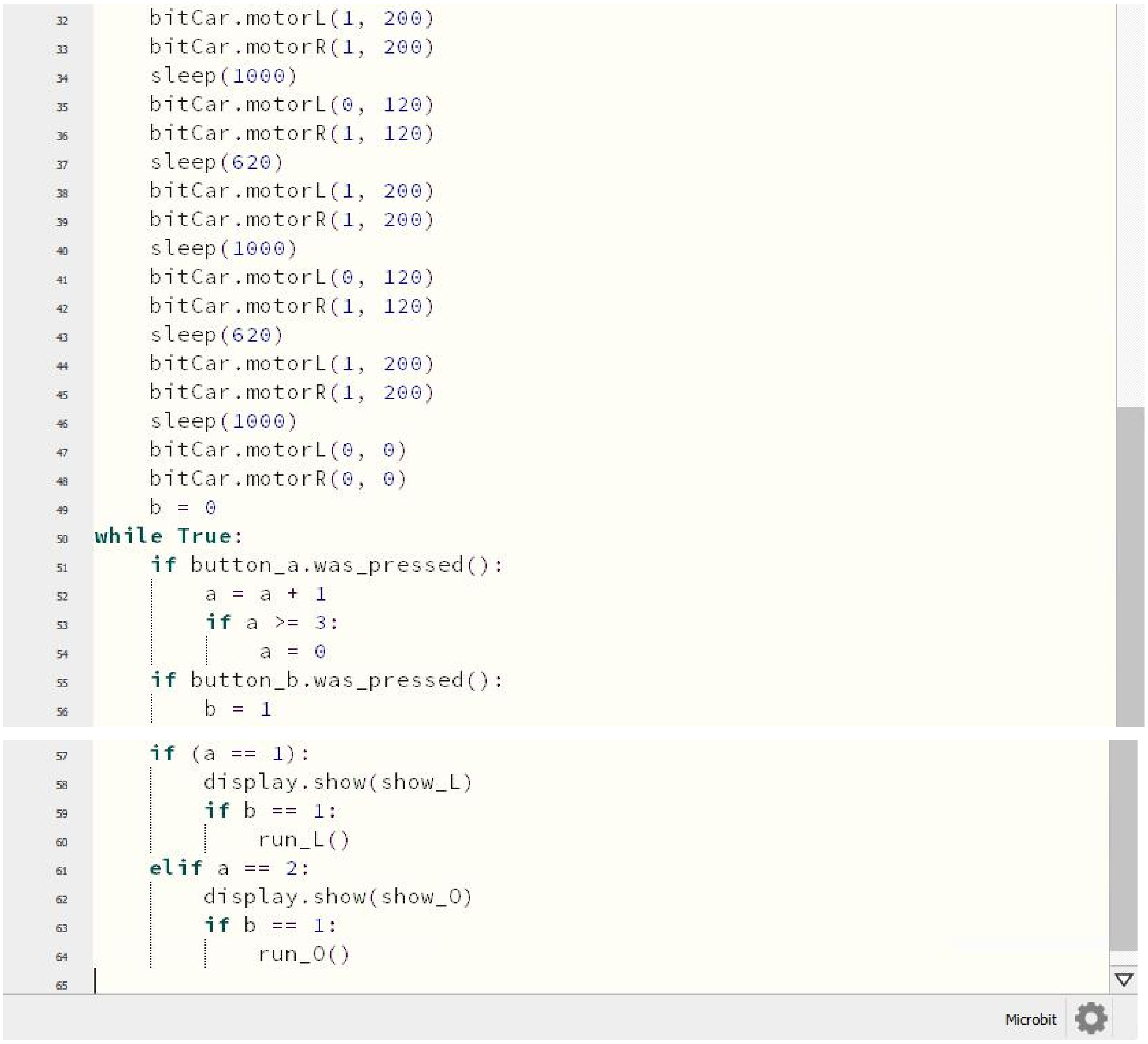
```
    if (a == 1):
        display.show(show_L)
        if b == 1:
            run_L()
    elif a == 2:
        display.show(show_O)
        if b == 1:
            run_O()

```

Click “Files” to import the library of “keyes_Bit_Turtle_Car.py” to micro:bit.

(How to import files?)

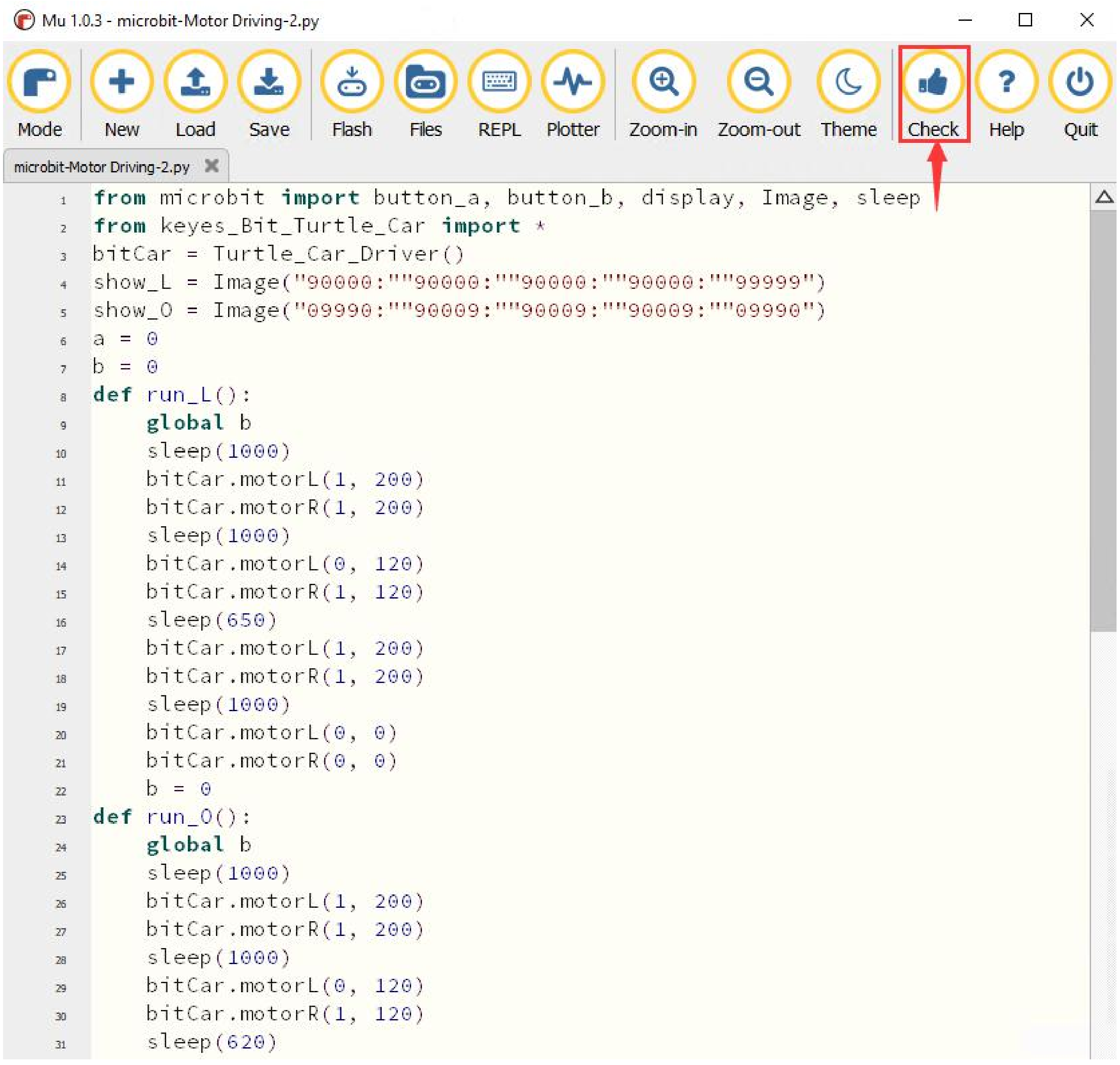


```
from microbit import button_a, button_b, display, Image, sleep
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
show_L = Image("90000:""90000:""90000:""90000:""99999")
show_O = Image("09990:""90009:""90009:""90009:""09990")
a = 0
b = 0
def run_L():
    global b
    sleep(1000)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(650)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    b = 0
def run_O():
    global b
    sleep(1000)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
```

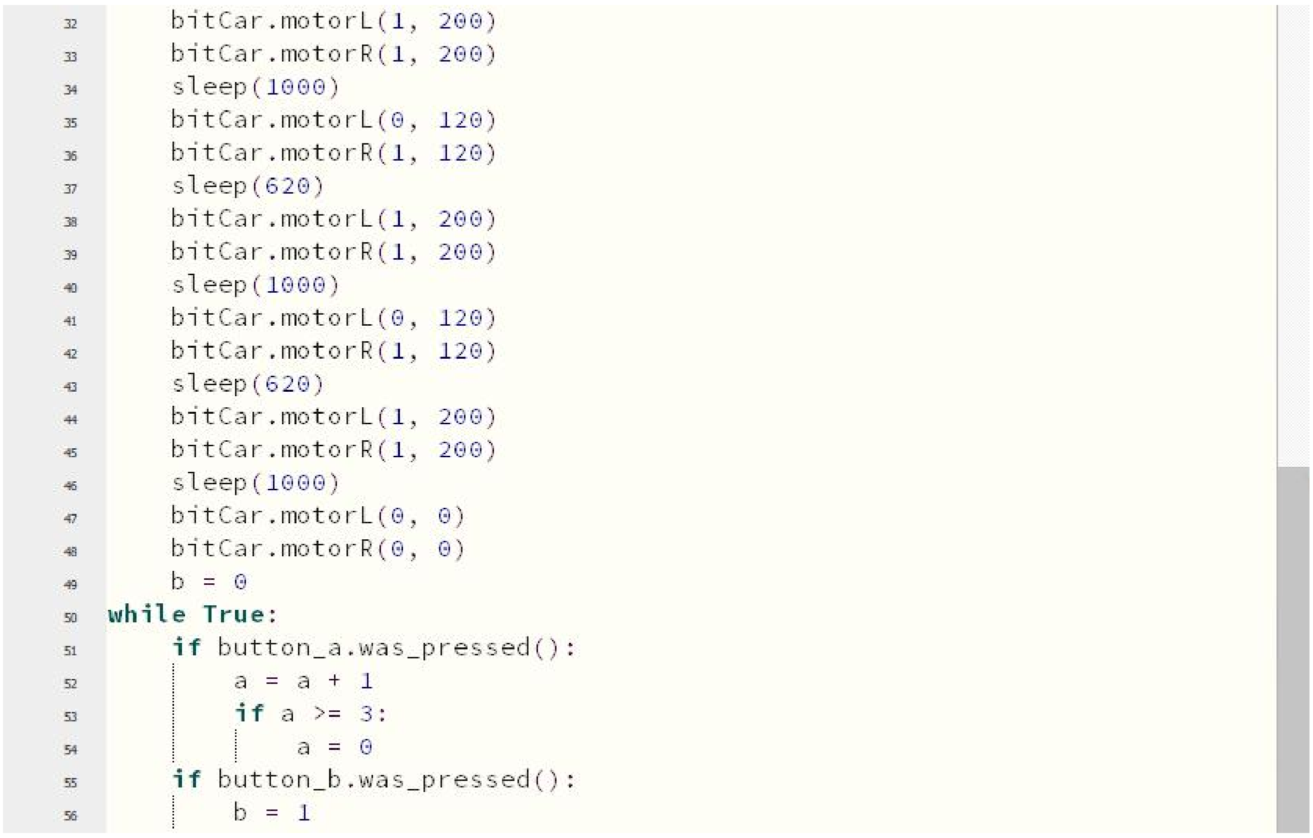


```
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    b = 0
while True:
    if button_a.was_pressed():
        a = a + 1
        if a >= 3:
            a = 0
    if button_b.was_pressed():
        b = 1
    if (a == 1):
        display.show(show_L)
        if b == 1:
            run_L()
    elif a == 2:
        display.show(show_O)
        if b == 1:
            run_O()

```

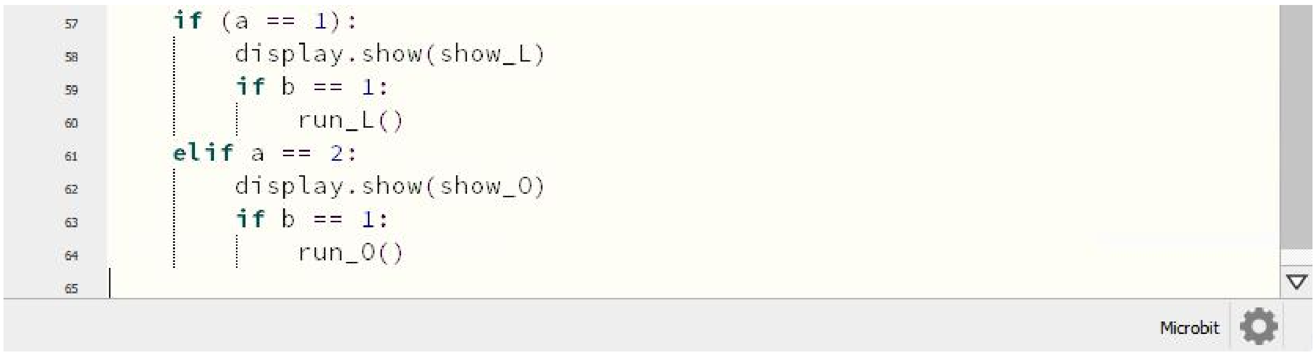
Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



```python
from microbit import button_a, button_b, display, Image, sleep
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
show_L = Image("90000:""90000:""90000:""90000:""99999")
show_O = Image("09990:""90009:""90009:""90009:""09990")
a = 0
b = 0
def run_L():
    global b
    sleep(1000)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(650)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    b = 0
def run_O():
    global b
    sleep(1000)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
```

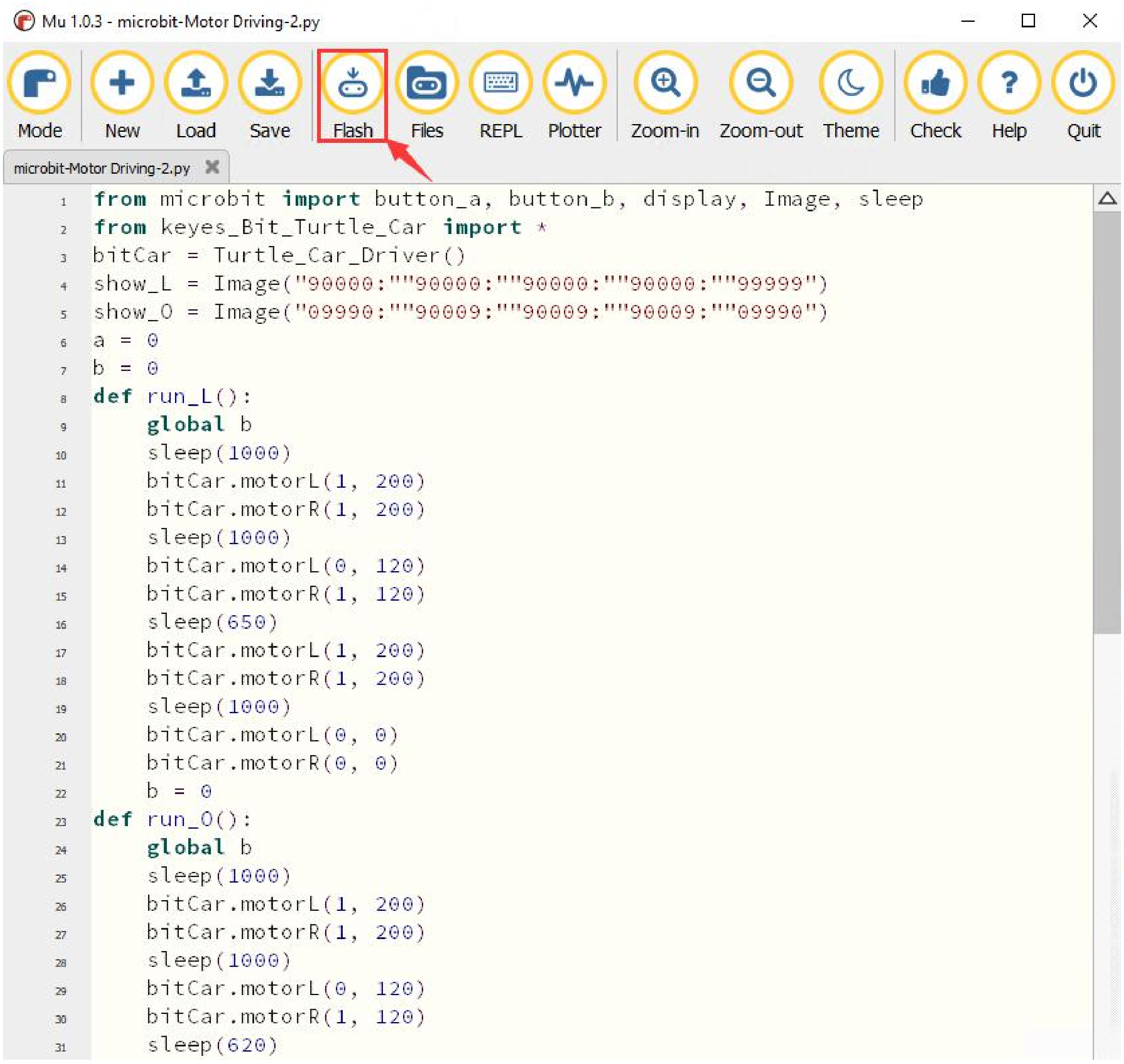


```
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    b = 0
while True:
    if button_a.was_pressed():
        a = a + 1
        if a >= 3:
            a = 0
    if button_b.was_pressed():
        b = 1
```

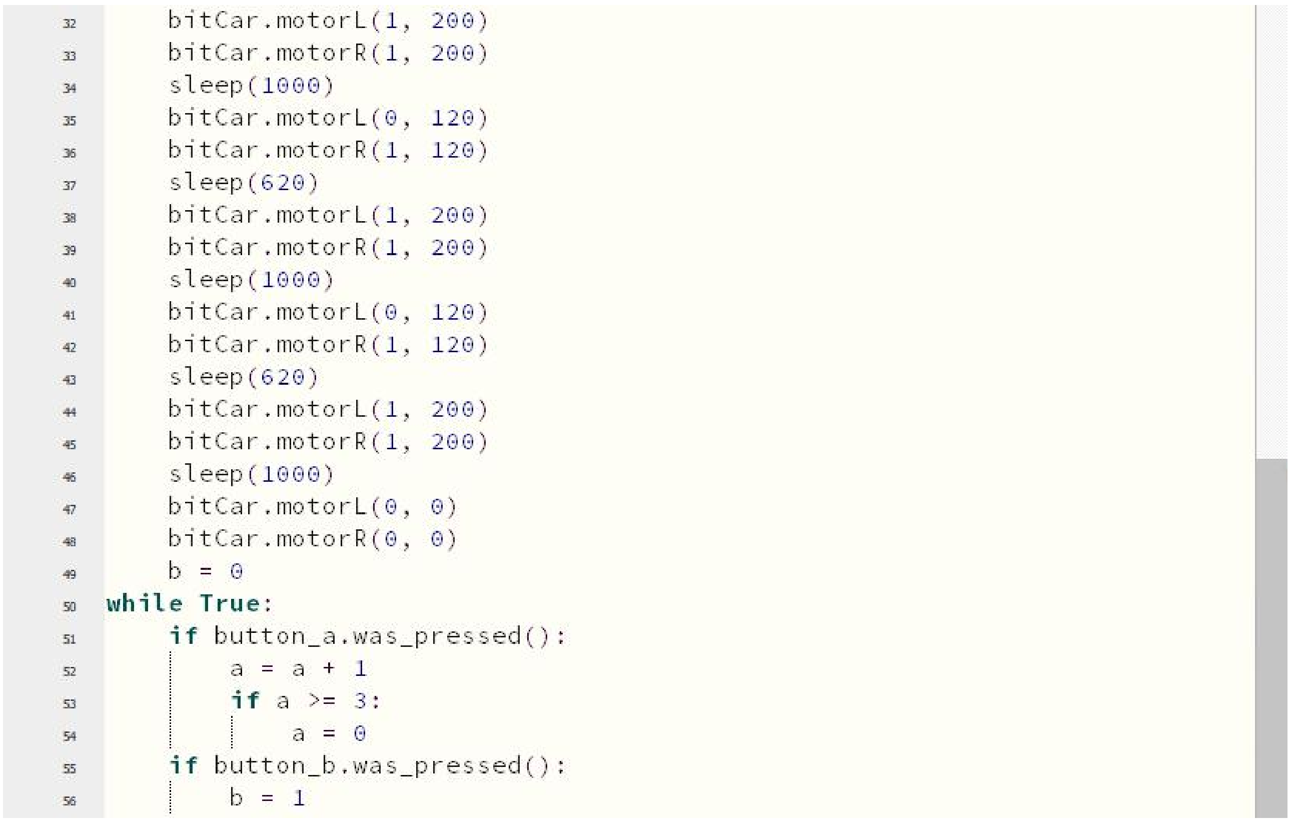


```
    if (a == 1):
        display.show(show_L)
        if b == 1:
            run_L()
    elif a == 2:
        display.show(show_O)
        if b == 1:
            run_O()

```

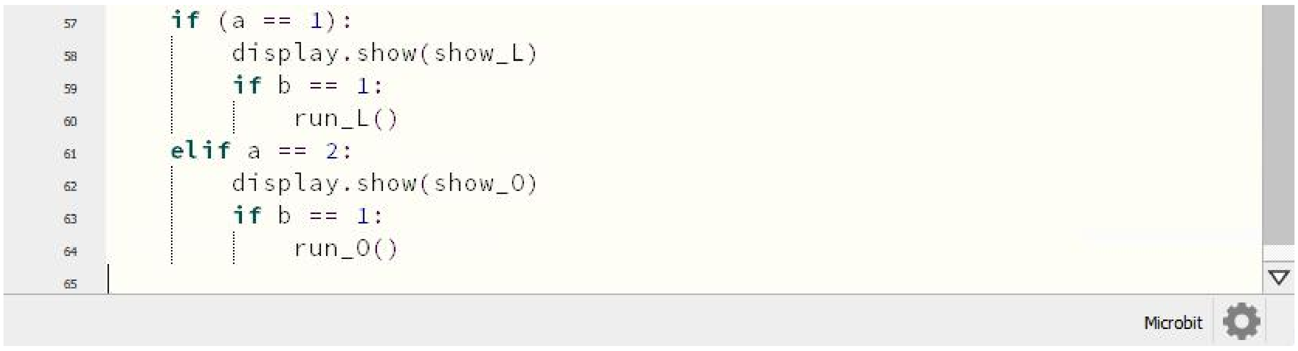
If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```
from microbit import button_a, button_b, display, Image, sleep
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
show_L = Image("90000:""90000:""90000:""90000:""99999")
show_O = Image("09990:""90009:""90009:""90009:""09990")
a = 0
b = 0
def run_L():
    global b
    sleep(1000)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(650)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    b = 0
def run_O():
    global b
    sleep(1000)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
```



```
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 120)
    bitCar.motorR(1, 120)
    sleep(620)
    bitCar.motorL(1, 200)
    bitCar.motorR(1, 200)
    sleep(1000)
    bitCar.motorL(0, 0)
    bitCar.motorR(0, 0)
    b = 0
while True:
    if button_a.was_pressed():
        a = a + 1
        if a >= 3:
            a = 0
    if button_b.was_pressed():
        b = 1
```



```
    if (a == 1):
        display.show(show_L)
        if b == 1:
            run_L()
    elif a == 2:
        display.show(show_O)
        if b == 1:
            run_O()

```

4.Test Result:

Download code 1 to micro:bit, and turn on the switch on robot car. The robot car will go forward for 1s, back for 1s, turn left for 1s, right for 1s, turn anticlockwise for 1s, clockwise for 1 and stop 1s. Matrix also displays the patterns.

Note: Download code 2 to micro:bit, and turn on the switch of micro:bit. (Note: the control pin of right obstacle avoidance sensor and B button are P11. To prevent the obstacle avoidance sensor from interfering button B, we could screw the potentiometer RP9 clockwise to turn off the right obstacle sensor.

When the button A and B are firstly pressed, micro" bit will show "L" , the route of car is "L" . When they are pressed again,"口"is shown on micro:bit, and route of car is "口" .

5.Code Explanation:

from microbit **import** button_a, button_b, display, Image, sleep	RAM is not big enough, import button_a, button_b, display, Image, sleep
from keyes_Bit_Turtle_Car **import** *	Import the library of keyes_Bit_Turtle_Car
bitCar =Turtle_Car_Driver()	instantiate
while True:	This is a permanent loop that makes micro:bit execute the code of it.

display.show(Image.ARROW_S)
display.show(Image.ARROW_N)
display.show(Image.ARROW_E)
display.show(Image.ARROW_W)
display.show(Image("00900:""09990:""99999:""99999:""09090"))
	micro:bit shows arrow pointing to South
	micro:bit shows arrow pointing to North
	micro:bit shows arrow pointing to East
	micro:bit shows arrow pointing to West
	micro:bit displays “❤”

bitCar.motorL(1, 200)
bitCar.motorR(1, 200)
	The left motor of car rotates clockwise at the speed of PWM200
	（1: clockwise，0: anticlockwise；PWM100 means speed（0~255））
	The right motor of car rotates clockwise at the speed of PWM200

bitCar.motorL(0, 200)
bitCar.motorR(0, 200)
	The left motor of car rotates anticlockwise at the speed of PWM200
	The right motor of car rotates anticlockwise at the speed of PWM200

sleep(1000)	Delay in 1000ms

a = 0
b = 0
	Set the initial value of a to 0
	Set the initial value of b to 0

def run_L():
def run_O():
	Define run_L()
	Define run_O()

show_L = Image("90000:""90000:""90000:""90000:""99999")	Set Image() to show_L

if button_a.was_pressed():
a = a + 1
if a >= 3:
a = 0
if button_b.was_pressed():
b = 1
if (a == 1):
display.show(show_L)
if b == 1:
run_L()
elif a == 2:
display.show(show_O)
if b == 1:
run_O()
	If button A is pressed,
	a = a + 1
	If a⩾3
	a=0
	If button B is pressed,
	b=1
	If a=1
	micro:bit shows “L” pattern
	If b=1
	The track of car is route L
	If a=2
	micro:bit shows “O” image
	If b=1
	The track of car is route O

8.17: Line Tracking Car

8.17.1: Detect Line Tracking Sensor

1.Description:

The V2 expansion board of keyestudio micro： bit mini smart robot car comes with two line tracking sensors which adopt TCRT5000 IR tubes.

TCRT5000 IR tube has an IR emitting tube and a receiving tube.

Low level(0) is output when IR transmitting tube emits IR signals to receiving tube; high level(1) will be output when smart car runs along black line.

When smart car drives on the white ground, TCRT5000 IR tube will emit IR signals which will be reflected by white ground and received by receiving tube, consequently output low level(0); on the contrary, when driving on the black surface, the high level is output.

The left and right line tracking sensors are respectively controlled by P12 and P13.

Put a paper under the bottom of car, adjust the potentiometers on shield to adjust sensitivity. When D2 and D6 are on, then pull up the universal wheels for 0.5cm off the paper. The sensitivity is set well if D2 and D6 are off

2. Experimental Preparation:

(1) Insert micro:bit board into slot of V2 shield.

(2) Put batteries into battery holder

(3) Dial POWER to ON end on driver shield

(4) Link micro:bit board with computer via USB cable.

(5) Open the offline version of Mu

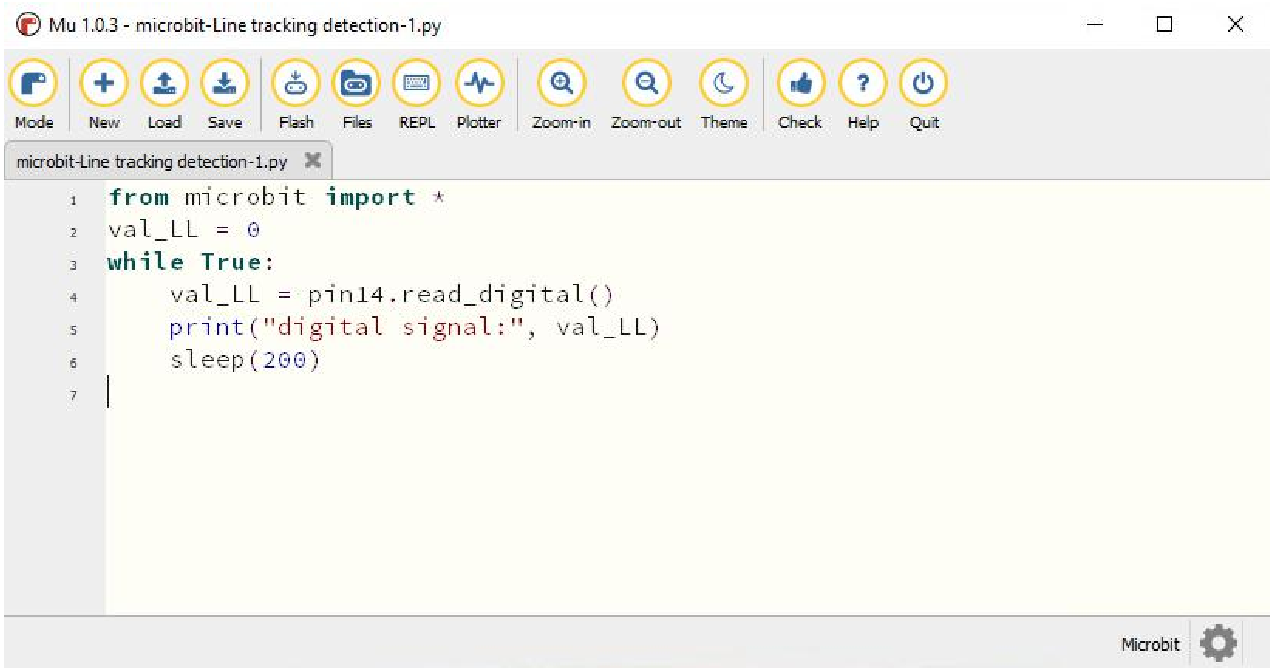
3. Test Code

Code 1:

Open the file "Code-1.py" in Mu (How to load the project code?)

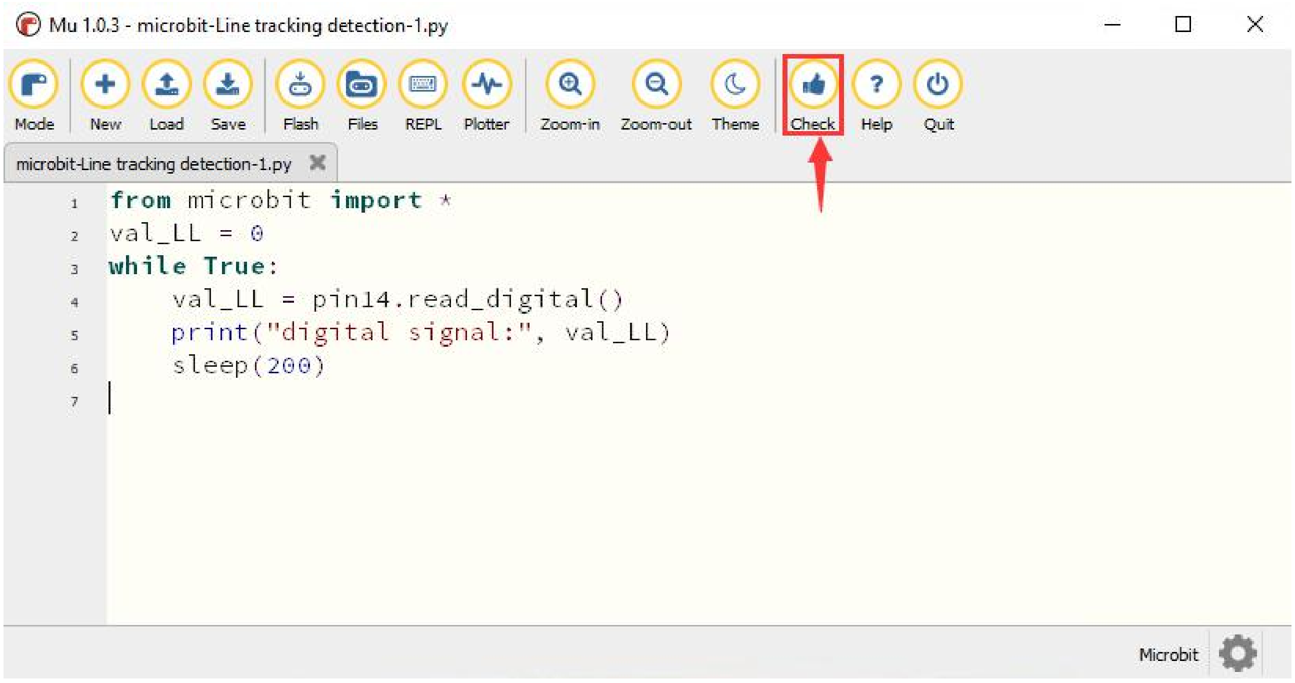
File Type	Route	File Name
Python file	../Python code/ 8.17: Line tracking car/8.17.1	microbit-Code-1.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit-Line tracking detection-1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Line tracking detection-1.py
Microbit

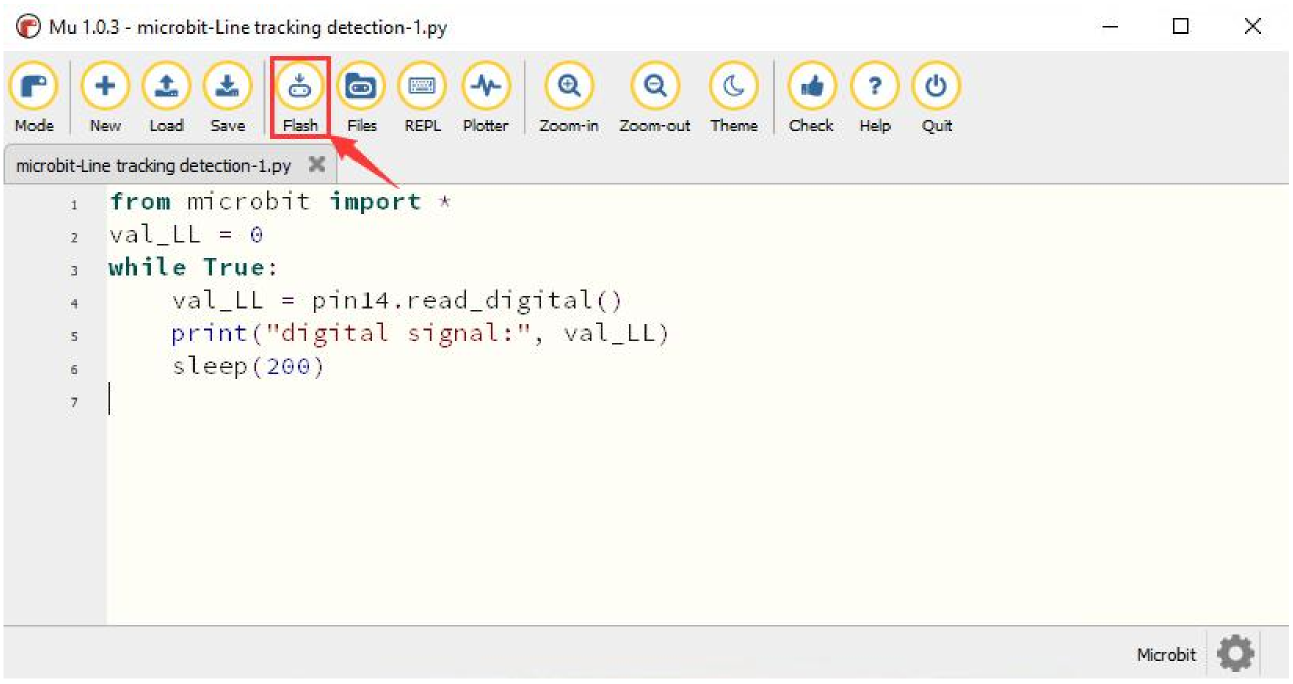
```
from microbit import *
val_LL = 0
while True:
    val_LL = pin14.read_digital()
    print("digital signal:", val_LL)
    sleep(200)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-Line tracking detection-1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Line tracking detection-1.py
Microbit

```
from microbit import *
val_LL = 0
while True:
    val_LL = pin14.read_digital()
    print("digital signal:", val_LL)
    sleep(200)
```

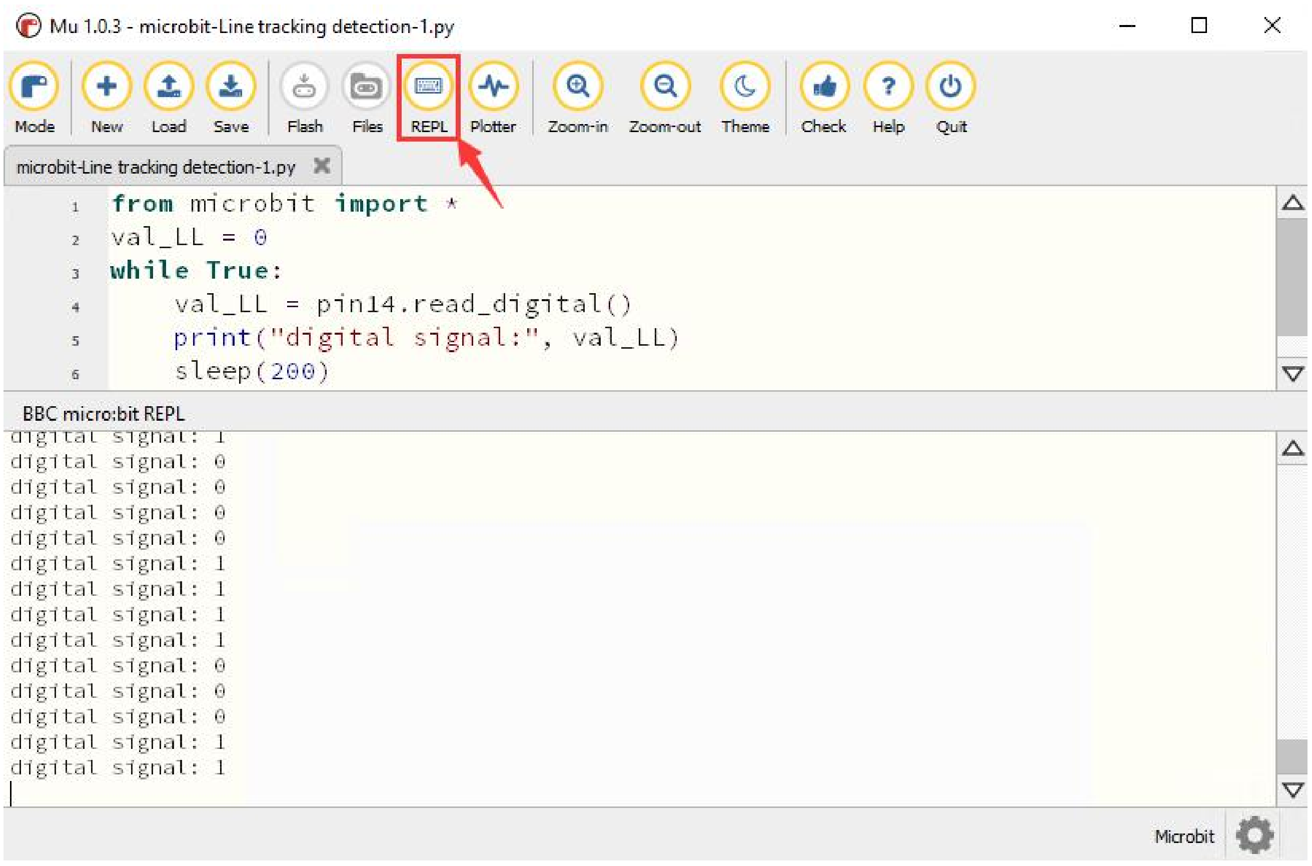
If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.


Mu 1.0.3 - microbit-Line tracking detection-1.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Line tracking detection-1.py
Microbit

```
from microbit import *
val_LL = 0
while True:
    val_LL = pin14.read_digital()
    print("digital signal:", val_LL)
    sleep(200)
```

Download code 1 onto micro:bit board, don’t plug off USB cable. Click “REPL” and press the reset buttons, the readings detected by left TCRT5000 IR tube are displayed on monitor.

When the left TCRT5000 IR tube detects white object, 0 will be shown and left indicator will be on; when no white objects and only black object are detected, 1 will be displayed and indicator will be off, as shown below.



```
from microbit import *
val_LL = 0
while True:
    val_LL = pin14.read_digital()
    print("digital signal:", val_LL)
    sleep(200)
```

```
digital signal: 1
digital signal: 0
digital signal: 0
digital signal: 0
digital signal: 0
digital signal: 1
digital signal: 1
digital signal: 1
digital signal: 1
digital signal: 0
digital signal: 0
digital signal: 0
digital signal: 1
digital signal: 1
```

Code 2:

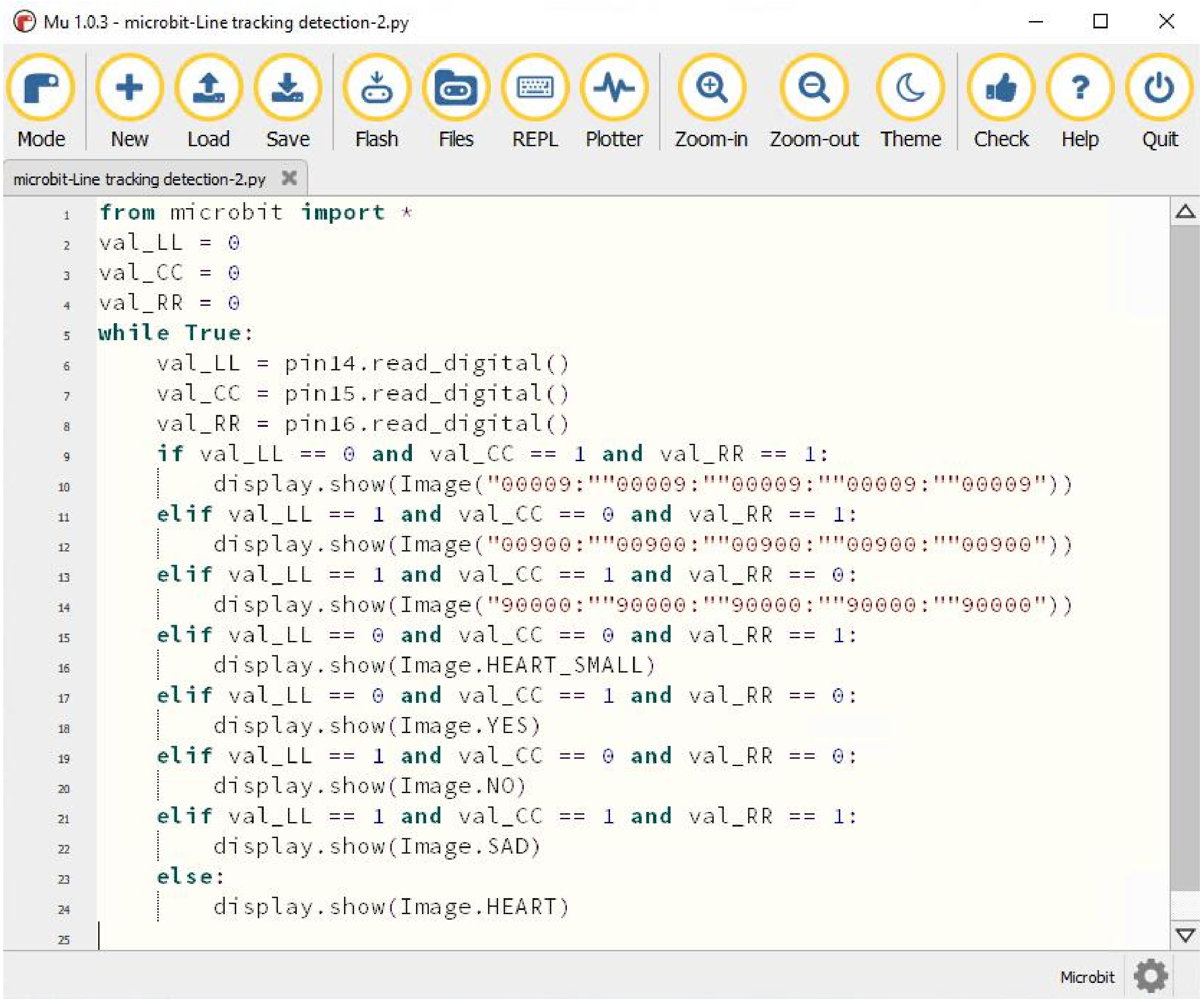
Level of left, middle and right TCRT5000 IR Tube			Binary
Low（0）	Low（0）	High（1）	001
Low（0）	High（1）	Low（0）	010
Low（0）	High（1）	High（1）	011

High（1）	Low（0）	Low（0）	100
High（1）	Low（0）	High（1）	101
High（1）	High（1）	Low（0）	110
High（1）	High（1）	High（1）	111
Low（0）	Low（0）	Low（0）	000

Open “microbit-Code-2.py” in Mu（How to load the project code?)

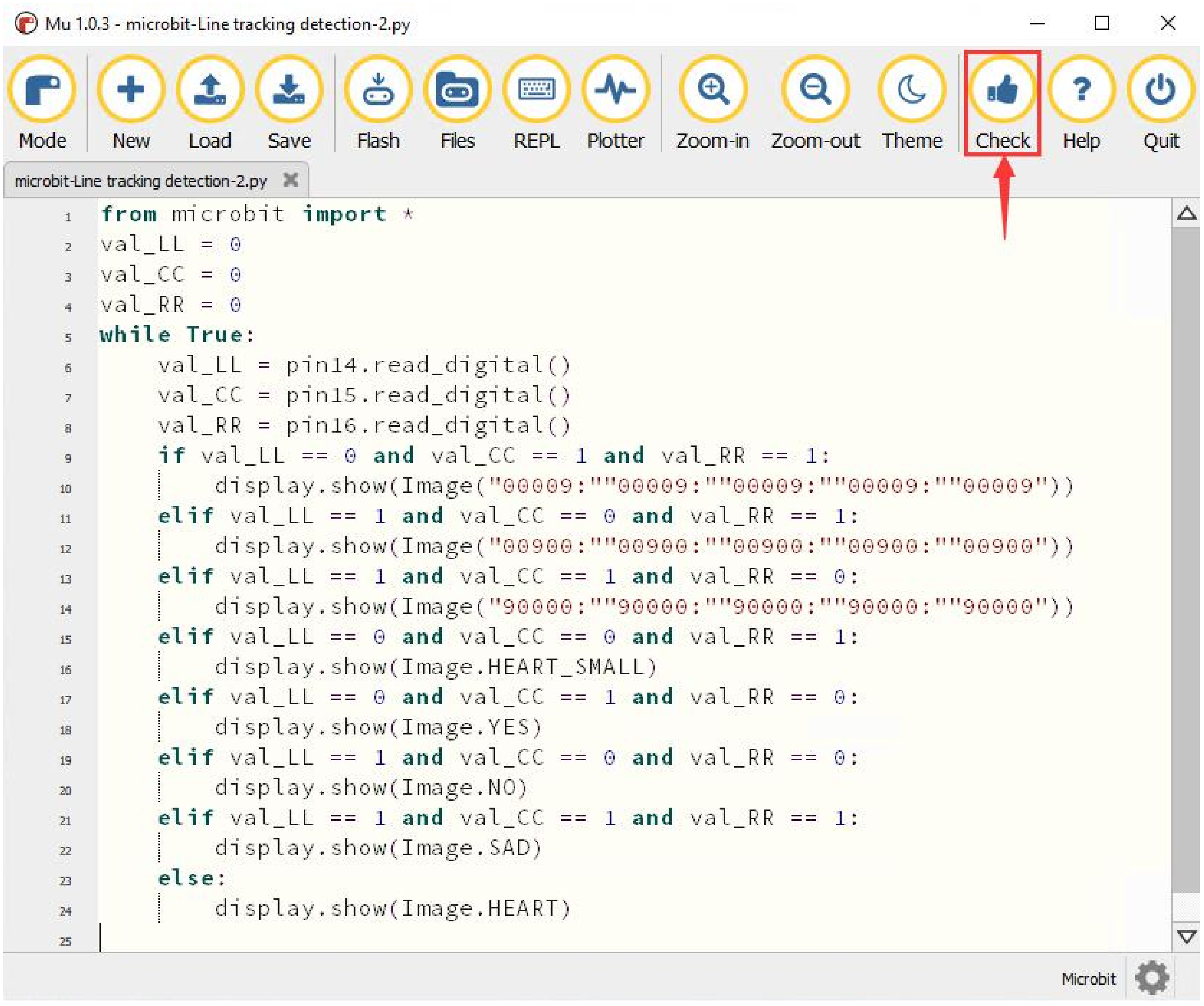
File Type	Route	File Name
Python file	../Python code/8.17：Line tracking car/8.17.1	microbit-Code-2.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit-Line tracking detection-2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Line tracking detection-2.py
Microbit

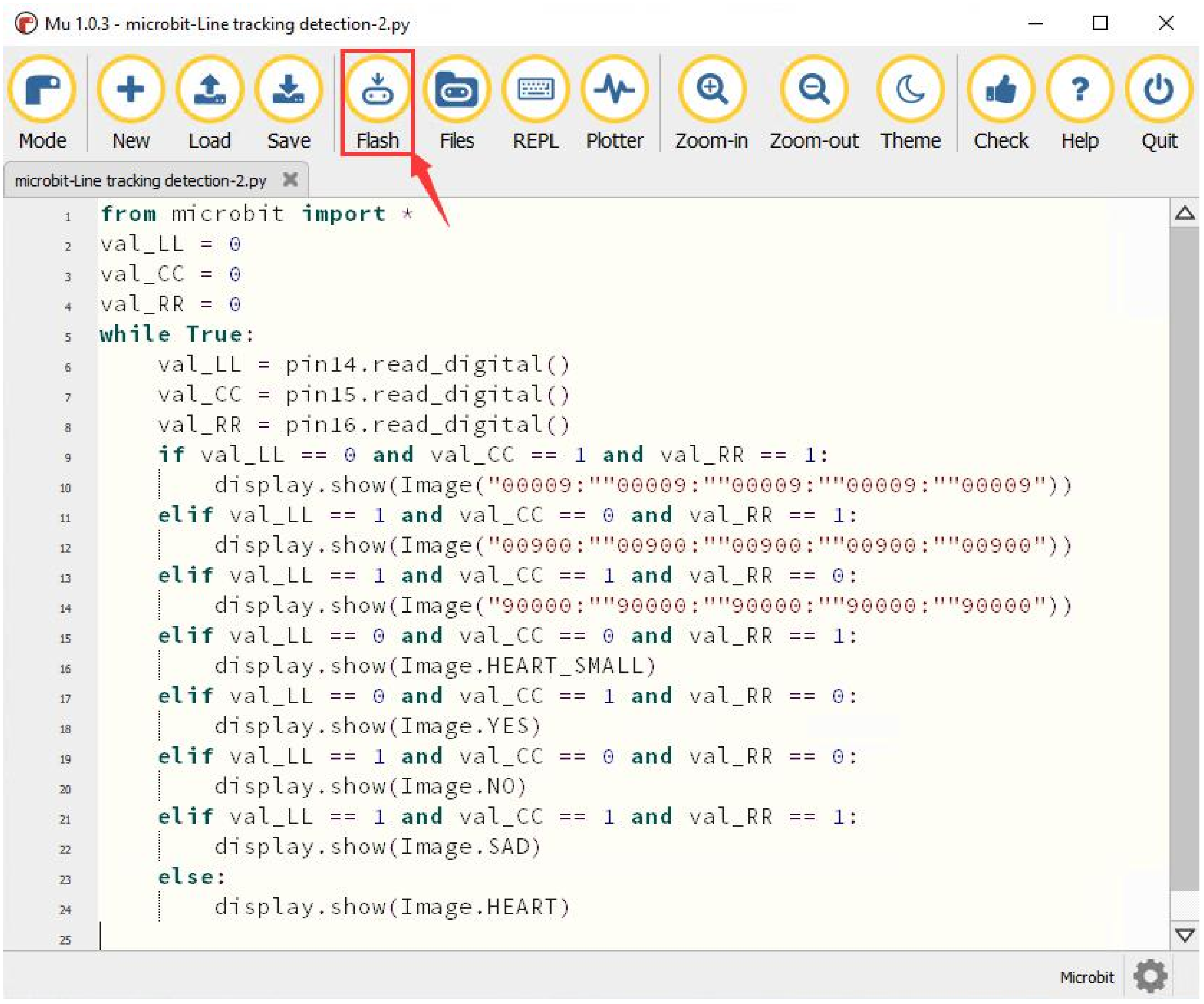
```
from microbit import *
val_LL = 0
val_CC = 0
val_RR = 0
while True:
    val_LL = pin14.read_digital()
    val_CC = pin15.read_digital()
    val_RR = pin16.read_digital()
    if val_LL == 0 and val_CC == 1 and val_RR == 1:
        display.show(Image("00009:""00009:""00009:""00009:""00009"))
    elif val_LL == 1 and val_CC == 0 and val_RR == 1:
        display.show(Image("00900:""00900:""00900:""00900:""00900"))
    elif val_LL == 1 and val_CC == 1 and val_RR == 0:
        display.show(Image("90000:""90000:""90000:""90000:""90000"))
    elif val_LL == 0 and val_CC == 0 and val_RR == 1:
        display.show(Image.HEART_SMALL)
    elif val_LL == 0 and val_CC == 1 and val_RR == 0:
        display.show(Image.YES)
    elif val_LL == 1 and val_CC == 0 and val_RR == 0:
        display.show(Image.NO)
    elif val_LL == 1 and val_CC == 1 and val_RR == 1:
        display.show(Image.SAD)
    else:
        display.show(Image.HEART)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-Line tracking detection-2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Line tracking detection-2.py
Microbit

```python
from microbit import *
val_LL = 0
val_CC = 0
val_RR = 0
while True:
    val_LL = pin14.read_digital()
    val_CC = pin15.read_digital()
    val_RR = pin16.read_digital()
    if val_LL == 0 and val_CC == 1 and val_RR == 1:
        display.show(Image("00009:""00009:""00009:""00009:""00009"))
    elif val_LL == 1 and val_CC == 0 and val_RR == 1:
        display.show(Image("00900:""00900:""00900:""00900:""00900"))
    elif val_LL == 1 and val_CC == 1 and val_RR == 0:
        display.show(Image("90000:""90000:""90000:""90000:""90000"))
    elif val_LL == 0 and val_CC == 0 and val_RR == 1:
        display.show(Image.HEART_SMALL)
    elif val_LL == 0 and val_CC == 1 and val_RR == 0:
        display.show(Image.YES)
    elif val_LL == 1 and val_CC == 0 and val_RR == 0:
        display.show(Image.NO)
    elif val_LL == 1 and val_CC == 1 and val_RR == 1:
        display.show(Image.SAD)
    else:
        display.show(Image.HEART)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.


Mu 1.0.3 - microbit-Line tracking detection-2.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Line tracking detection-2.py
Microbit

```
from microbit import *
val_LL = 0
val_CC = 0
val_RR = 0
while True:
    val_LL = pin14.read_digital()
    val_CC = pin15.read_digital()
    val_RR = pin16.read_digital()
    if val_LL == 0 and val_CC == 1 and val_RR == 1:
        display.show(Image("00009:""00009:""00009:""00009:""00009"))
    elif val_LL == 1 and val_CC == 0 and val_RR == 1:
        display.show(Image("00900:""00900:""00900:""00900:""00900"))
    elif val_LL == 1 and val_CC == 1 and val_RR == 0:
        display.show(Image("90000:""90000:""90000:""90000:""90000"))
    elif val_LL == 0 and val_CC == 0 and val_RR == 1:
        display.show(Image.HEART_SMALL)
    elif val_LL == 0 and val_CC == 1 and val_RR == 0:
        display.show(Image.YES)
    elif val_LL == 1 and val_CC == 0 and val_RR == 0:
        display.show(Image.NO)
    elif val_LL == 1 and val_CC == 1 and val_RR == 1:
        display.show(Image.SAD)
    else:
        display.show(Image.HEART)
```

4.Test Result:

Download code 2 to micro:bit board, “I” will be shown at left and indicator will be on when only left TCRT5000 IR tube on line tracking sensor detects white objects.

“I” will be shown in the middle and indicator will be on when only middle TCRT5000 IR tube on line tracking sensor detects white objects.

“I” will be shown at right and indicator will be on when only right TCRT5000 IR tube on line tracking sensor detects white objects.

As only left and middle TCRT5000 IR tubes detect white objects, micro:bit shows “▦” and indicators at left and middle are on.

Micro:bit shows “▦” and indicators at left and right are on when only left and right TCRT5000 IR tubes detect white objects.

Micro:bit shows “▦” and indicators at right and middle are on when only middle and right TCRT5000 IR tubes detect white objects.

Micro:bit displays “▦” and none of indicator is on when both of them detect black objects or no object is detected.

Both of them detect white objects, micro:bit shows “❤” and indicators are on.

5. Code Explanation:

from microbit **import** *	import the library file of micro:bit
val_LL = 0	Set the initial value of val_LL to 0
val_CC = 0	Set the initial of val_CC to 0

val_RR = 0	Set the initial value of val_RR
while True:	This is a permanent loop that makes micro:bit execute the code of it.
val_LL = pin14.read_digital()	Set the digital signal read by TCRT5000 IR tube connected to P14 to val_LL
val_CC = pin15.read_digital()	Set the digital signal read by TCRT5000 IR tube connected to P15 to val_CC
val_RR = pin16.read_digital()	Set the digital signal read by TCRT5000 IR tube connected to P16 to val_RR
print("Light intensity:", Lightintensity)	REPL monitor prints the digital signal read by TCRT5000 IR tube connected to P14
sleep(100)	Delay in 100ms

if val_LL == 0 **and** val_CC == 1 **and** val_RR == 1:
display.show(Image("00009:""00009:""00009:""00009:""00009"))
elif val_LL == 1 **and** val_CC == 0 **and** val_RR == 1:
display.show(Image("00900:""00900:""00900:""00900:""00900"))
elif val_LL == 1 **and** val_CC == 1
	If val_LL =0, val_CC = 1 and val_RR = 1 micro:bit shows "1" on the left
	If val_LL =1, val_CC = 0 and val_RR = 1 micro:bit shows "1" in the middle
	If val_LL =1, val_CC = 1and val_RR = 0 micro:bit shows "1" on the left
	If val_LL =0 , val_CC = 0 and val_RR = 1 micro:bit displays "▦"
	If val_LL =0, val_CC = 1and val_RR = 0

and val_RR ==0:
display.show(Image("90000:""90000:""90000:""90000:""90000"))
elif val_LL == 0 **and** val_CC == 0 **and** val_RR == 1:
display.show(Image.HEART_SMALL)
elif val_LL == 0 **and** val_CC == 1 **and** val_RR == 0:
display.show(Image.YES)
elif val_LL == 1 **and** val_CC == 0 **and** val_RR == 0:
display.show(Image.NO)
elif val_LL == 1 **and** val_CC == 1 **and** val_RR == 1:
display.show(Image.SAD)
else:
display.show(Image.HEART)
	micro:bit displays “▦”
	If val_LL =1 , val_CC = 0 and val_RR = 0
	micro:bit displays “▦”
	If val_LL =1, val_CC = 1and val_RR = 1
	micro:bit shows “▦”
	Otherwise, the above condition is not met
	micro:bit shows “❤” .

8.17.2: Line Tracking Car

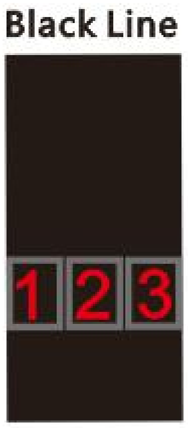
1. Description:

In this lesson we will combine line tracking sensors with a motor to make a line tracking smart car.

The micro:bit board will analyze the signals and control smart car to show line tracking function.

Left/Middle/Right TCRT5000 IR Tunes（Level）			binary	
LOW（0）	LOW（0）	HIGH（1）	001	Turn right
LOW（0）	HIGH（1）	LOW（0）	010	Go forward
LOW（0）	HIGH（1）	HIGH（1）	011	Go forward
HIGH（1）	LOW（0）	LOW（0）	100	Turn left
HIGH（1）	LOW（0）	HIGH（1）	101	Go forward
HIGH（1）	HIGH（1）	LOW（0）	110	Go forward

HIGH (1)	HIGH (1)	HIGH (1)	111	Go forward
LOW (0)	LOW (0)	LOW (0)	000	Stop



The three-channel line tracking sensor is connected to integrated pin(G,5V P14, P15, P16) and controlled by P14, P15 and P16.

2. Experimental Preparation:

(1) Insert micro:bit board into slot of V2 shield.

(2) Put batteries into battery holder

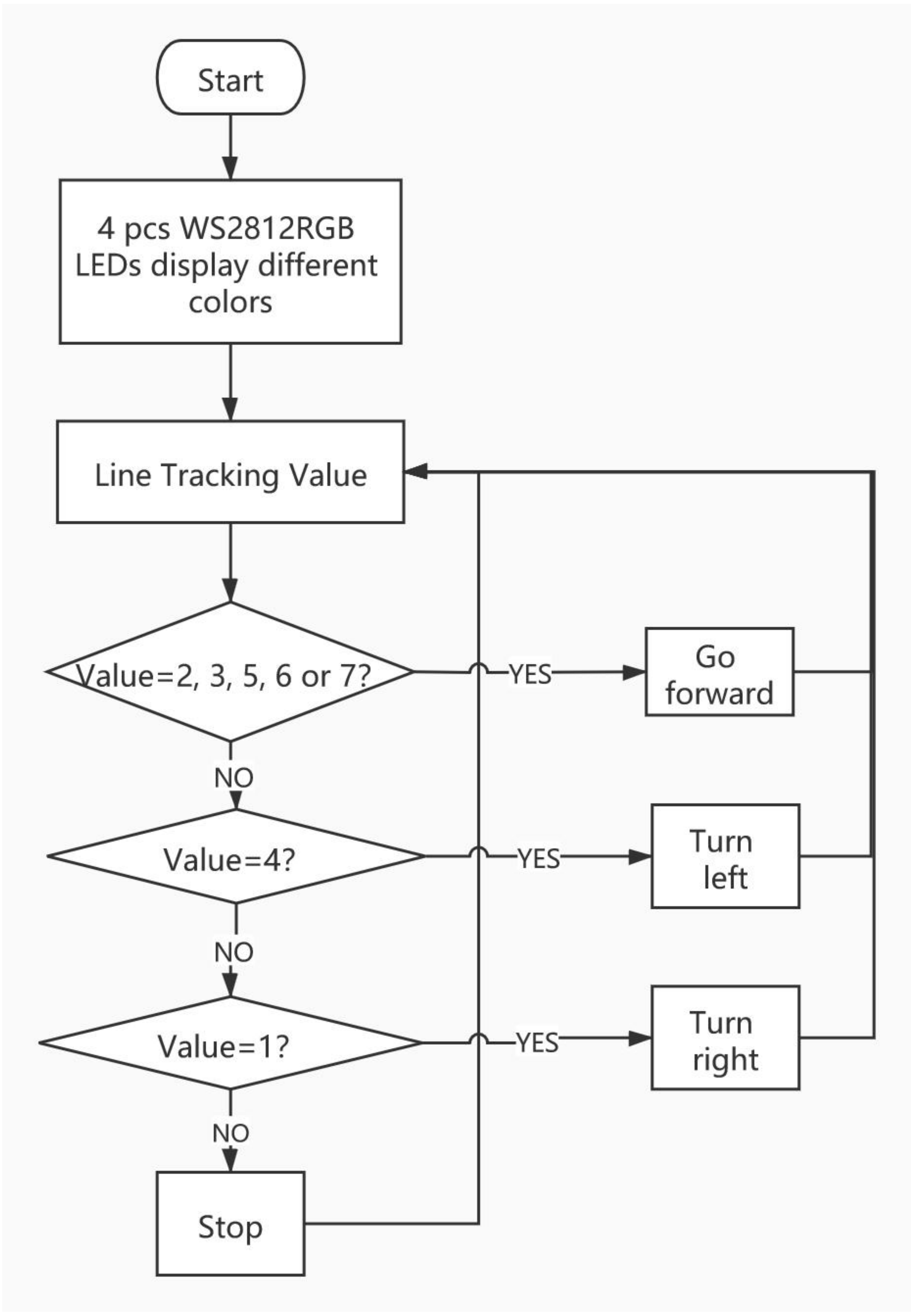
(3) Dial POWER switch to ON end on shield

(4) Link micro:bit board with computer via USB cable.

(5) Open the offline version of Mu

Warning: the line tracking sensor can't work normally under strong light because there is a mountain of invisible light including IR and ultraviolet rays.

3. Flow Chart


Start
4 pcs WS2812RGB LEDs display different colors
Line Tracking Value
Value=2, 3, 5, 6 or 7?
YES
Go forward
NO
Value=4?
YES
Turn left
NO
Value=1?
YES
Turn right
NO
Stop

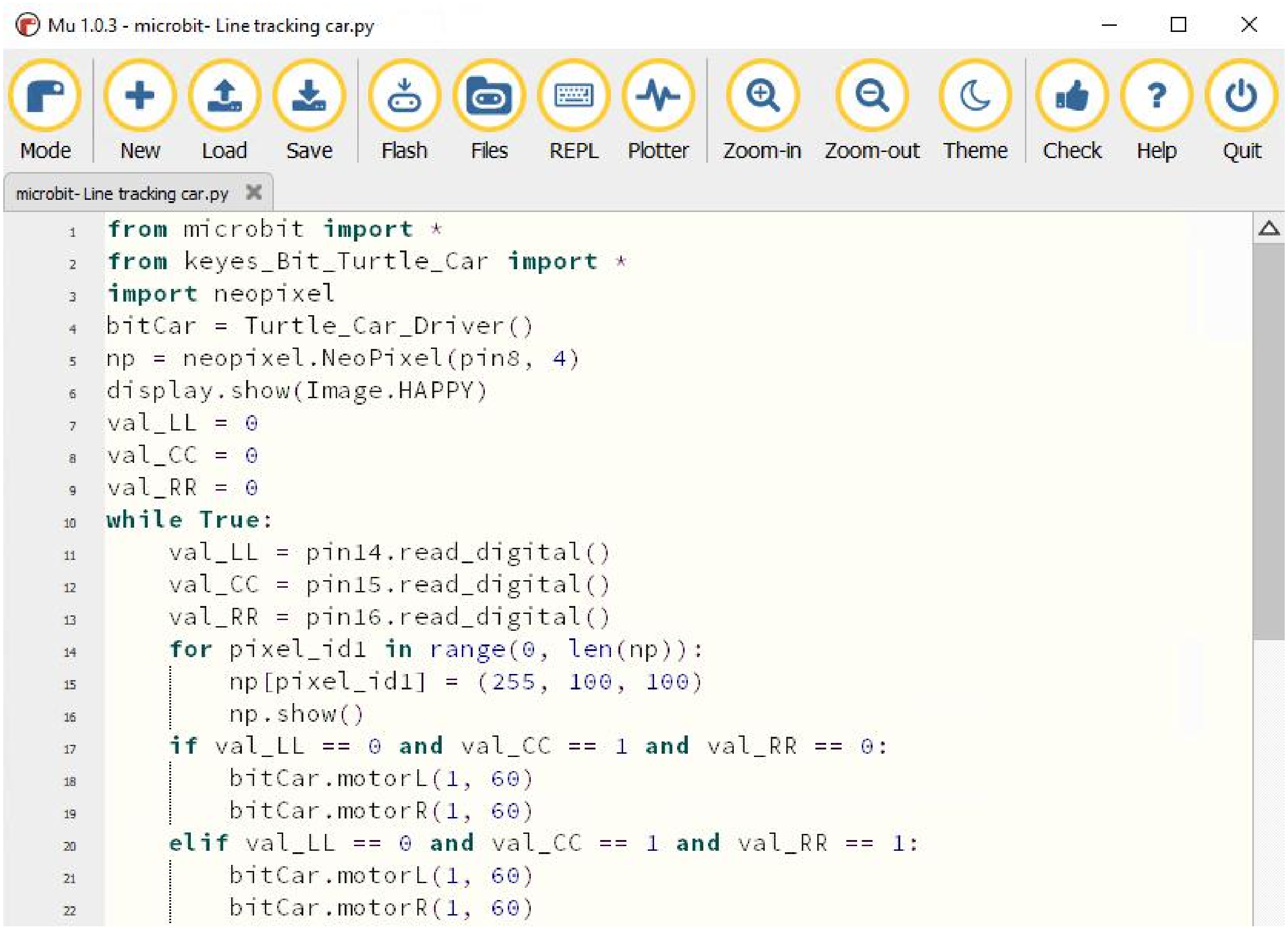
4. Test Code

Open “microbit- Code.py ” in Mu:

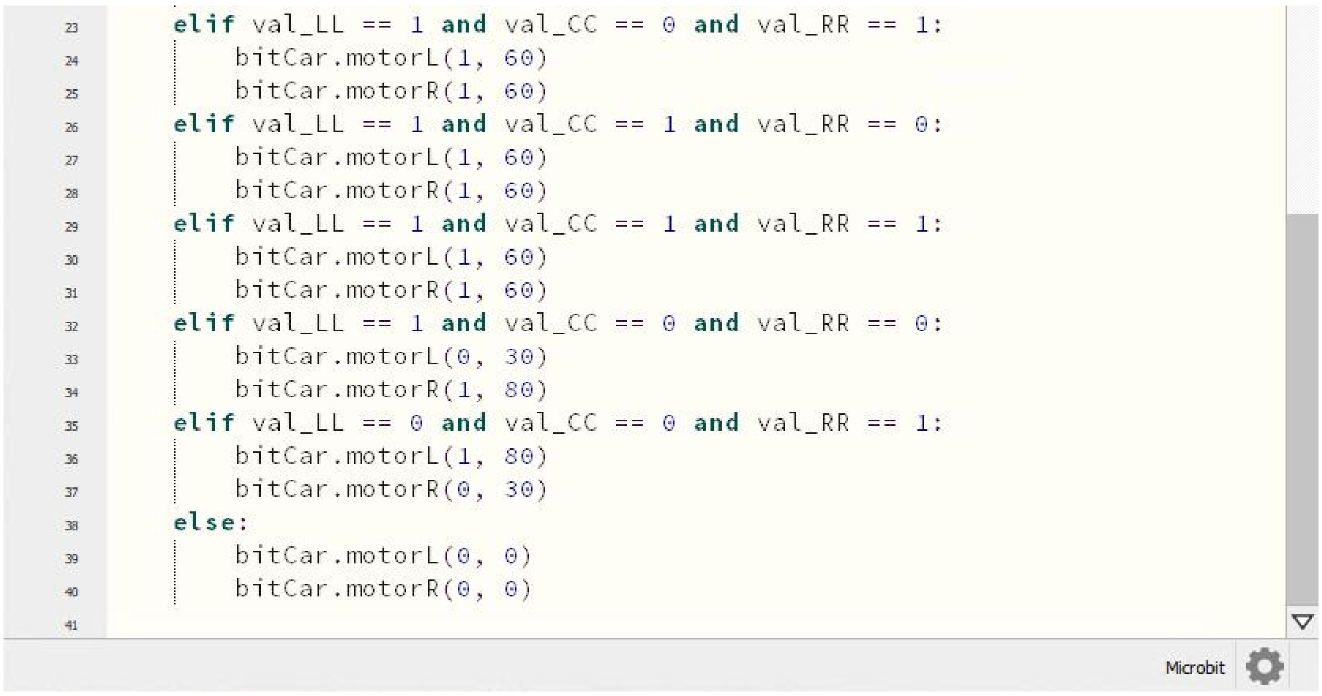
(How to load the project code?)

File Type	Route	File Name
Python file	../Python Code/8.17：Line tracking car/8.17.2	microbit-Code.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit- Line tracking car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit- Line tracking car.py

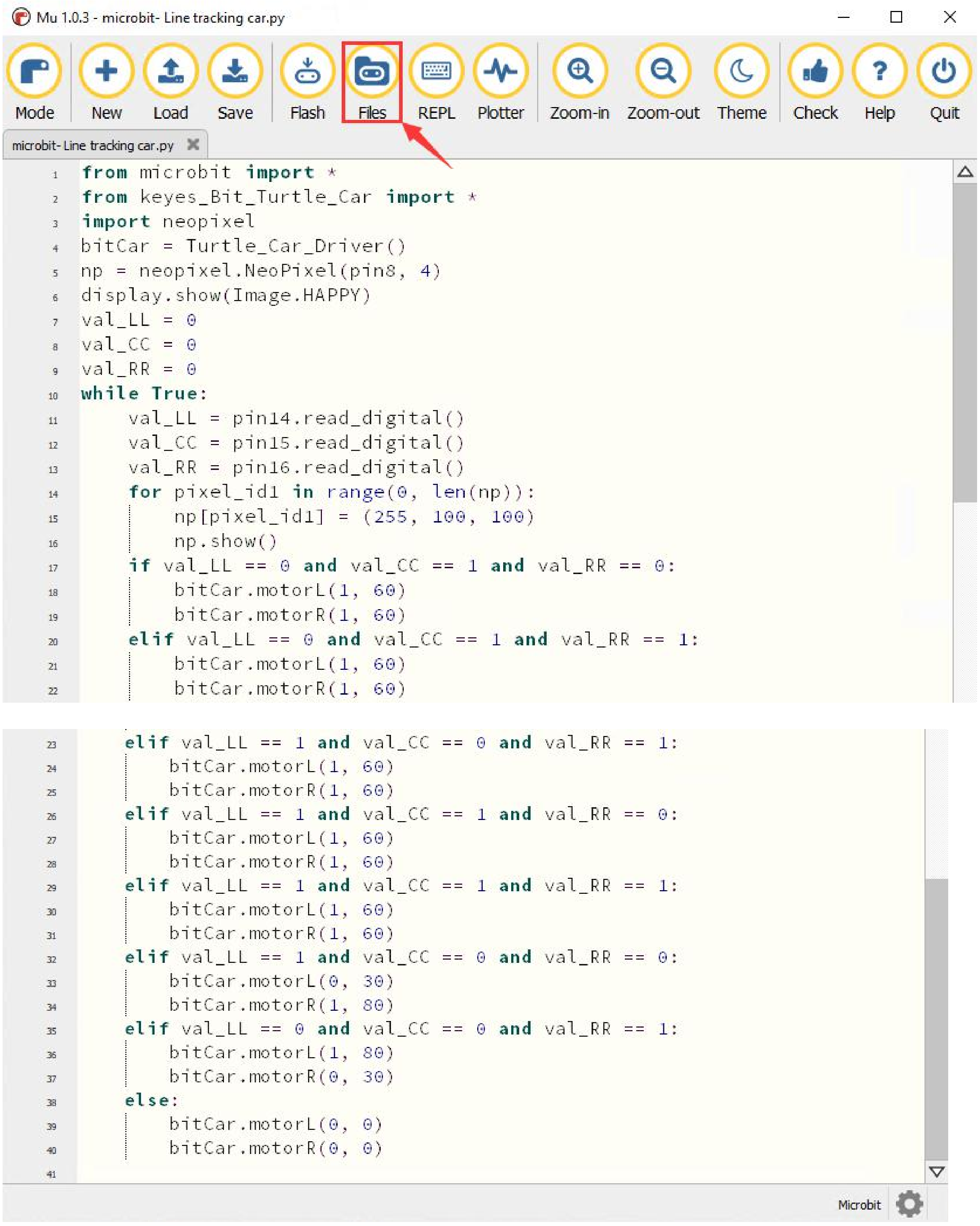
```
from microbit import *
from keyes_Bit_Turtle_Car import *
import neopixel
bitCar = Turtle_Car_Driver()
np = neopixel.NeoPixel(pin8, 4)
display.show(Image.HAPPY)
val_LL = 0
val_CC = 0
val_RR = 0
while True:
    val_LL = pin14.read_digital()
    val_CC = pin15.read_digital()
    val_RR = pin16.read_digital()
    for pixel_id1 in range(0, len(np)):
        np[pixel_id1] = (255, 100, 100)
        np.show()
    if val_LL == 0 and val_CC == 1 and val_RR == 0:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 0 and val_CC == 1 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
```



```
    elif val_LL == 1 and val_CC == 0 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 1 and val_RR == 0:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 1 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 0 and val_RR == 0:
        bitCar.motorL(0, 30)
        bitCar.motorR(1, 80)
    elif val_LL == 0 and val_CC == 0 and val_RR == 1:
        bitCar.motorL(1, 80)
        bitCar.motorR(0, 30)
    else:
        bitCar.motorL(0, 0)
        bitCar.motorR(0, 0)
```

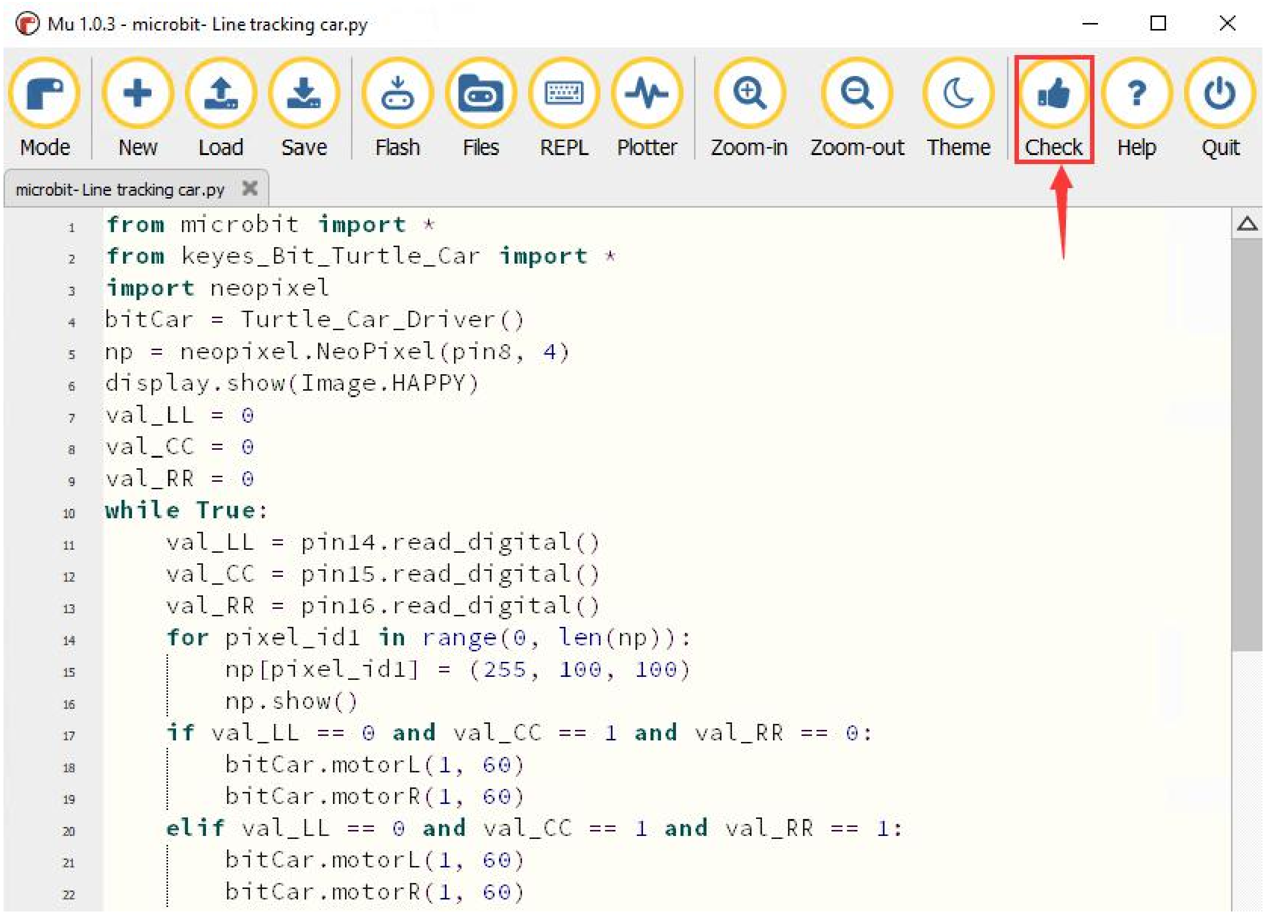
Click " Files " to import the library file of "keyes_Bit_Turtle_Car.py" to micro:bit (How to import files?)

If micro:bit has library, you don' t need to add one.

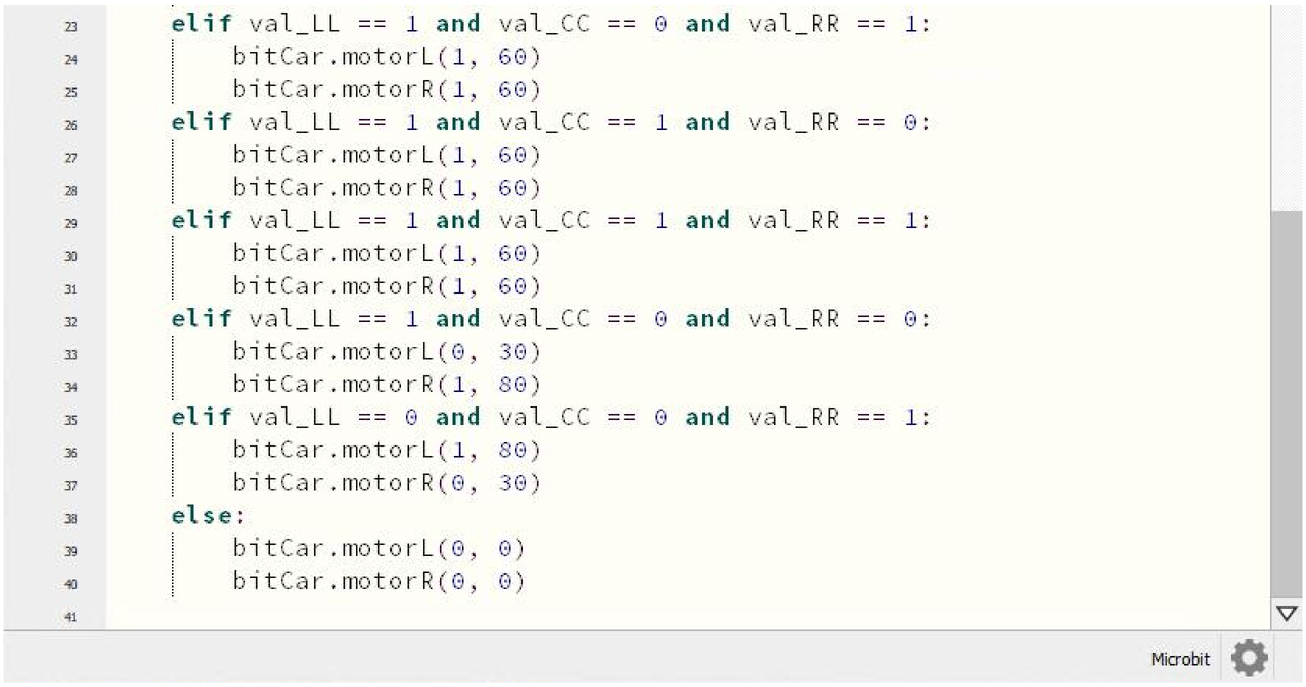


```
from microbit import *
from keyes_Bit_Turtle_Car import *
import neopixel
bitCar = Turtle_Car_Driver()
np = neopixel.NeoPixel(pin8, 4)
display.show(Image.HAPPY)
val_LL = 0
val_CC = 0
val_RR = 0
while True:
    val_LL = pin14.read_digital()
    val_CC = pin15.read_digital()
    val_RR = pin16.read_digital()
    for pixel_id1 in range(0, len(np)):
        np[pixel_id1] = (255, 100, 100)
        np.show()
    if val_LL == 0 and val_CC == 1 and val_RR == 0:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 0 and val_CC == 1 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 0 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 1 and val_RR == 0:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 1 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 0 and val_RR == 0:
        bitCar.motorL(0, 30)
        bitCar.motorR(1, 80)
    elif val_LL == 0 and val_CC == 0 and val_RR == 1:
        bitCar.motorL(1, 80)
        bitCar.motorR(0, 30)
    else:
        bitCar.motorL(0, 0)
        bitCar.motorR(0, 0)
```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.

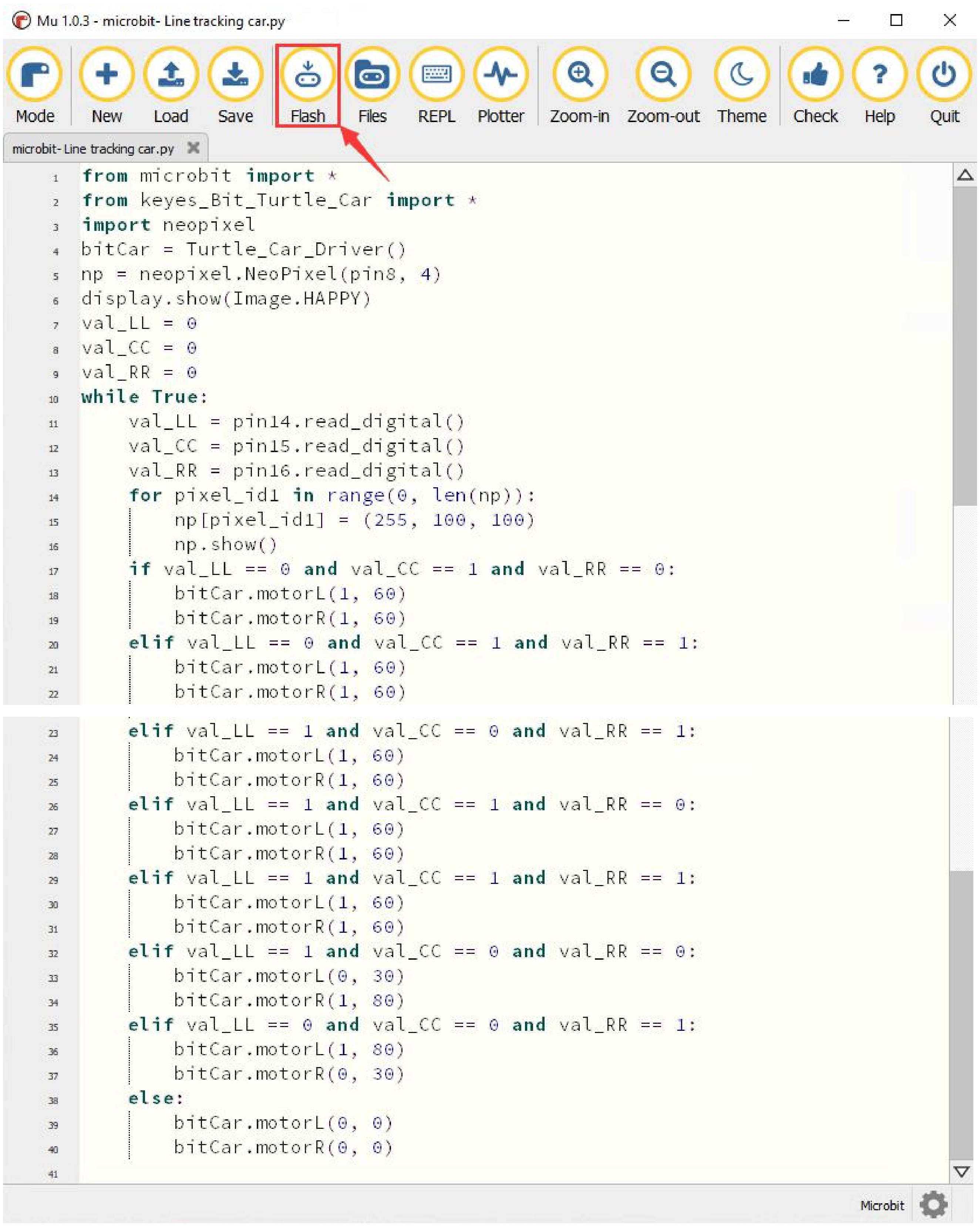

Mu 1.0.3 - microbit- Line tracking car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit- Line tracking car.py

```
from microbit import *
from keyes_Bit_Turtle_Car import *
import neopixel
bitCar = Turtle_Car_Driver()
np = neopixel.NeoPixel(pin8, 4)
display.show(Image.HAPPY)
val_LL = 0
val_CC = 0
val_RR = 0
while True:
    val_LL = pin14.read_digital()
    val_CC = pin15.read_digital()
    val_RR = pin16.read_digital()
    for pixel_id1 in range(0, len(np)):
        np[pixel_id1] = (255, 100, 100)
        np.show()
    if val_LL == 0 and val_CC == 1 and val_RR == 0:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 0 and val_CC == 1 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
```



```
    elif val_LL == 1 and val_CC == 0 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 1 and val_RR == 0:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 1 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 0 and val_RR == 0:
        bitCar.motorL(0, 30)
        bitCar.motorR(1, 80)
    elif val_LL == 0 and val_CC == 0 and val_RR == 1:
        bitCar.motorL(1, 80)
        bitCar.motorR(0, 30)
    else:
        bitCar.motorL(0, 0)
        bitCar.motorR(0, 0)
```

If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



```python
from microbit import *
from keyes_Bit_Turtle_Car import *
import neopixel
bitCar = Turtle_Car_Driver()
np = neopixel.NeoPixel(pin8, 4)
display.show(Image.HAPPY)
val_LL = 0
val_CC = 0
val_RR = 0
while True:
    val_LL = pin14.read_digital()
    val_CC = pin15.read_digital()
    val_RR = pin16.read_digital()
    for pixel_id1 in range(0, len(np)):
        np[pixel_id1] = (255, 100, 100)
        np.show()
    if val_LL == 0 and val_CC == 1 and val_RR == 0:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 0 and val_CC == 1 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 0 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 1 and val_RR == 0:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 1 and val_RR == 1:
        bitCar.motorL(1, 60)
        bitCar.motorR(1, 60)
    elif val_LL == 1 and val_CC == 0 and val_RR == 0:
        bitCar.motorL(0, 30)
        bitCar.motorR(1, 80)
    elif val_LL == 0 and val_CC == 0 and val_RR == 1:
        bitCar.motorL(1, 80)
        bitCar.motorR(0, 30)
    else:
        bitCar.motorL(0, 0)
        bitCar.motorR(0, 0)
```

4. Test Result:

Download code to micro:bit and dial POWER to ON end. The car can follow black traces and 4 pcs WS2812 RGB light up.

Note: (1) the width of black trace should be wider than the width of line tracking sensor.

Avoid to test smart car under the strong light.

5. Code Explanation:

from microbit **import ***	Import the library of micro:bit
from keyes_Bit_Car_Driver **import ***	Import the library of micro:bit
import neopixel	Import the library of neopixel
display.show(Image.HAPPY)	micro:bit shows "smile" pattern
while True:	This is a permanent loop that makes micro:bit execute the code of it.
val_LL = pin14.read_digital()	Set the digital signal read by line TCRT5000 IR tube connected to P14, to val_LL

val_CC = pin15.read_digital()	Set the digital signal read by line TCRT5000 IR tube connected to P15, to val_CC
val_RR = pin16.read_digital()	Set the digital signal read by line TCRT5000 IR tube connected to P16, to val_RR

for pixel_id1 in range(0, len(np)):
np[pixel_id1] = (255, 100, 100)
np.show()
	Set the pixel of RGB to pixel_id1 in the range of (0，len（np）)
	Set the pixel of RGB on Neopixel strip to pixel_id1 on (255, 100, 100)
	Display pixel on Neopixel strip

if val_LL == 0 **and** val_CC == 1 **and** val_RR == 0:
bitCar.motorL(1, 60)
bitCar.motorR(1, 60)
elif val_LL == 0 **and** val_CC == 1 **and** val_RR == 1:
bitCar.motorL(1, 60)
bitCar.motorR(1, 60)
elif val_LL == 1 **and** val_CC == 0 **and** val_RR == 1:
bitCar.motorL(1, 60)
bitCar.motorR(1, 60)
elif val_LL == 1 **and** val_CC == 1 **and** val_RR == 0:
bitCar.motorL(1, 60)
bitCar.motorR(1, 60)
elif val_LL == 1 **and** val_CC == 1 **and** val_RR == 1:
bitCar.motorL(1, 60)
bitCar.motorR(1, 60)
elif val_LL == 1 **and** val_CC == 0 **and** val_RR == 0:
	If val_LL = 0, val_CC =1 and val_RR =0
	Left motor rotates clockwise at the speed of PWM 60（1: clockwise，0: anticlockwise；speed: PWM 60（0~255））
	Right motor rotates clockwise at the speed of PWM 60
	If val_LL = 0 , val_CC =1 and val_RR =1
	Left motor rotates clockwise at the speed of PWM 60
	Right motor rotates clockwise at the speed of PWM 60
	When val_LL = 1, val_CC = 0 and val_RR = 1
	Left motor rotates clockwise at the speed of PWM 60
	Right motor rotates clockwise at the speed of PWM 60
	When val_LL = 1, val_CC = 1 and val_RR = 0

bitCar.motorL(0, 30)
bitCar.motorR(1, 80)
elif val_LL == 0 **and** val_CC == 0 **and** val_RR == 1:
bitCar.motorL(1, 80)
bitCar.motorR(0, 30)
else:
bitCar.motorL(0, 0)
bitCar.motorR(0, 0)
	Left motor rotates clockwise at the speed of PWM 60
	Right motor rotates clockwise at the speed of PWM 60
	
	When val_LL = 1, val_CC = 1 and val_RR = 1
	Left motor rotates clockwise at the speed of PWM 60
	Right motor rotates clockwise at the speed of PWM 60
	If val_LL = 1, val_CC = 0 and val_RR = 0
	Left motor rotates anticlockwise at the speed of PWM 30
	Right motor rotates clockwise at the speed of PWM 60
	If val_LL = 0, val_CC = 0 and val_RR = 1
	Left motor rotates clockwise at the speed of PWM 80
	Right motor rotates anticlockwise

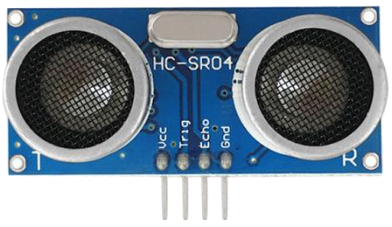
	at the speed of PWM 30 Otherwise, the above condition is not met Left motor doesn’t rotate Right motor doesn’t rotate

8.18: Ultrasonic Follow Smart Car

8.18.1: Ultrasonic Ranging

The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. It comes complete with ultrasonic transmitter and receiver modules.

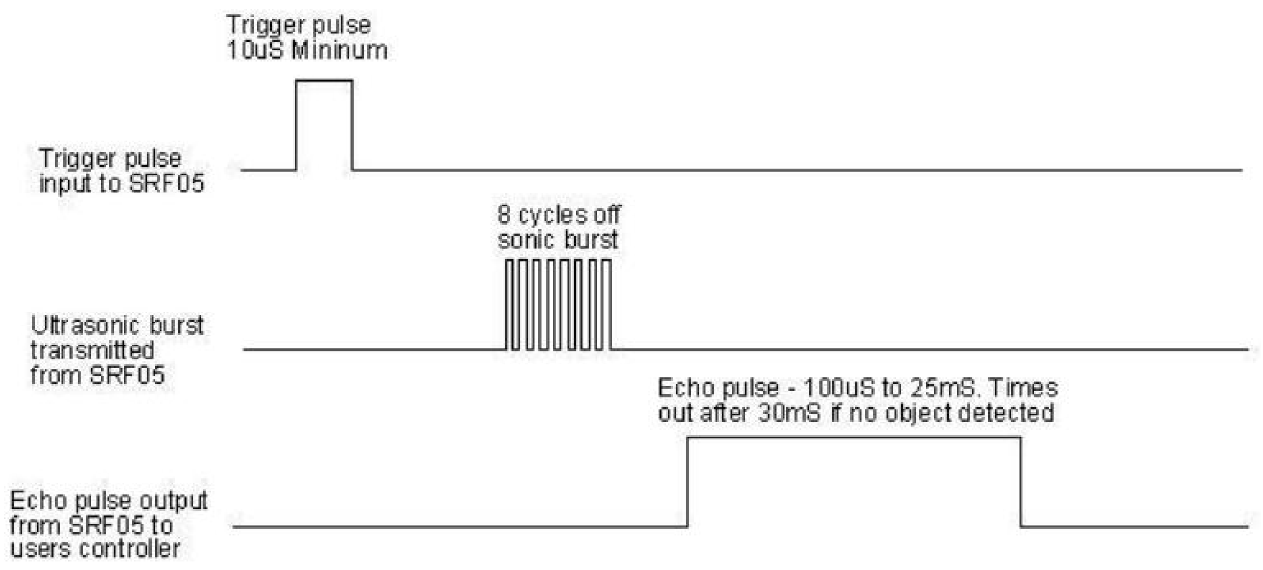
The HC-SR04 or the ultrasonic sensor is being used in a wide range of electronics projects for creating obstacle detection and distance measuring application as well as various other applications.



As the above picture shown, it is like two eyes. One is transmitting end, the other is receiving end.

The ultrasonic module will emit the ultrasonic waves after trigger signal. When the ultrasonic waves encounter the object and are reflected back, the module outputs an echo signal, so it can determine the distance of object from the time difference between trigger signal and echo signal.

Working principle:


Trigger pulse
10uS Mininum
Trigger pulse input to SRF05
8 cycles off sonic burst
Ultrasonic burst transmitted from SRF05
Echo pulse - 100uS to 25mS. Times out after 30mS if no object detected
Echo pulse output from SRF05 to users controller

1. Pull down TRIG then trigger high level signals with least 10us

2. After triggering, the module will automatically send eight 40KHz ultrasonic pulses and detect whether there is a signal return.

3. The propagation speed of sound in the air is about 343m/s, therefore, distance = speed * time, because the ultrasonic wave emits and comes back, which is 2 times of distance, so it needs to be divided by 2, the distance measured by ultrasonic wave = (speed * time)/2

3. Specification：

- Working voltage：3-5.5V（DC）
- Power Supply :+5V DC
- Working Current: 15mA
- Working frequency: 40khz
- Maximum Ranging Distance : around 3m

- Minimum Ranging Distance: 2-3cm
- Resolution : 0.3 cm
- Measuring Angle: ≤15 degree
- Trigger Input Pulse width: 10uS
- Accuracy: up to 0.2cm
- Output echo signal : output TTL level signal(high), which is proportion to range.

4. Experimental Preparation:

(1) Insert micro:bit board into slot of V2 shield.

(2) Put batteries into battery holder

(3) Dial POWER to ON end on driver shield

(4) Link micro:bit board with computer via USB cable.

(5) Open the offline version of Mu

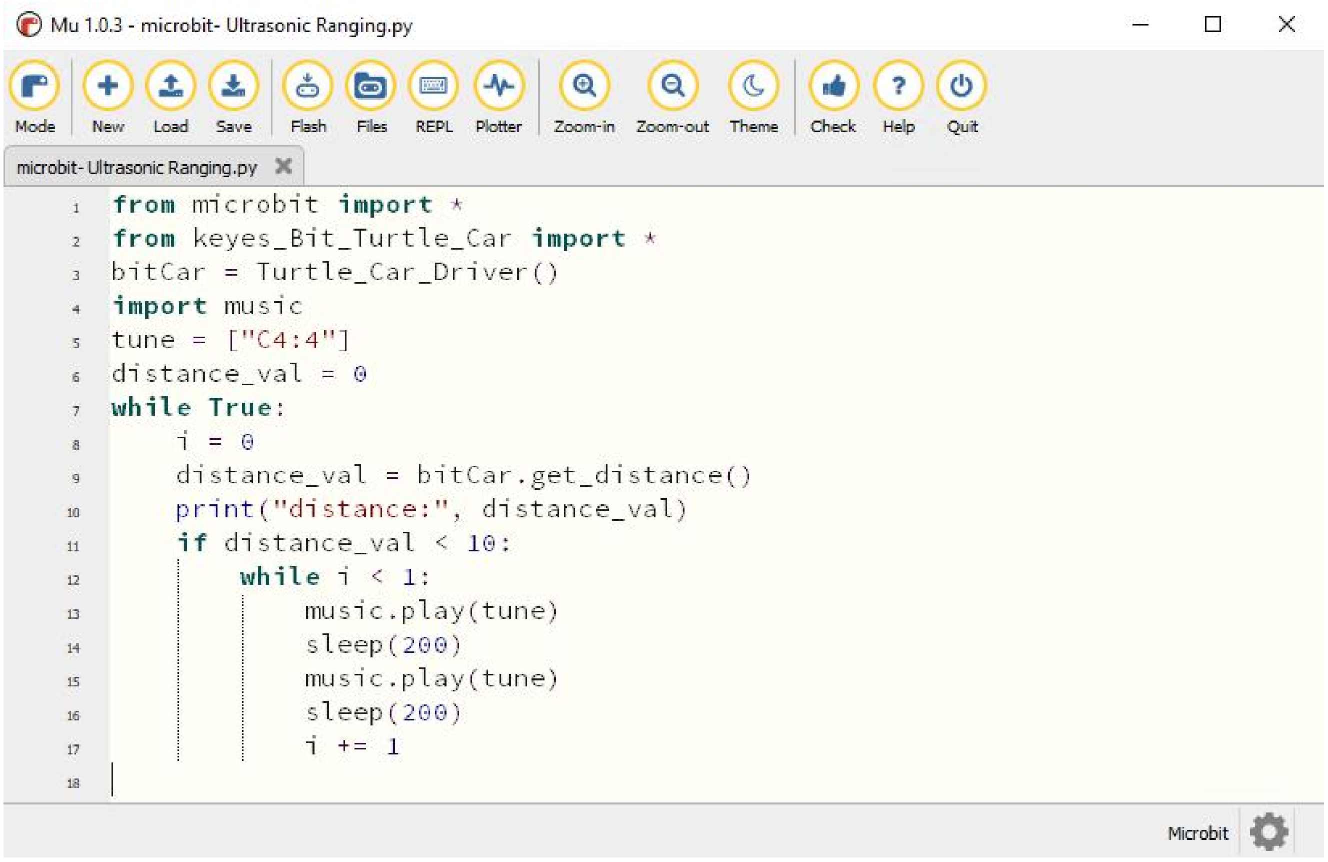
5. Test Code

Open "microbit- Ultrasonic Ranging.py" file in Mu software

(How to load the project code?)

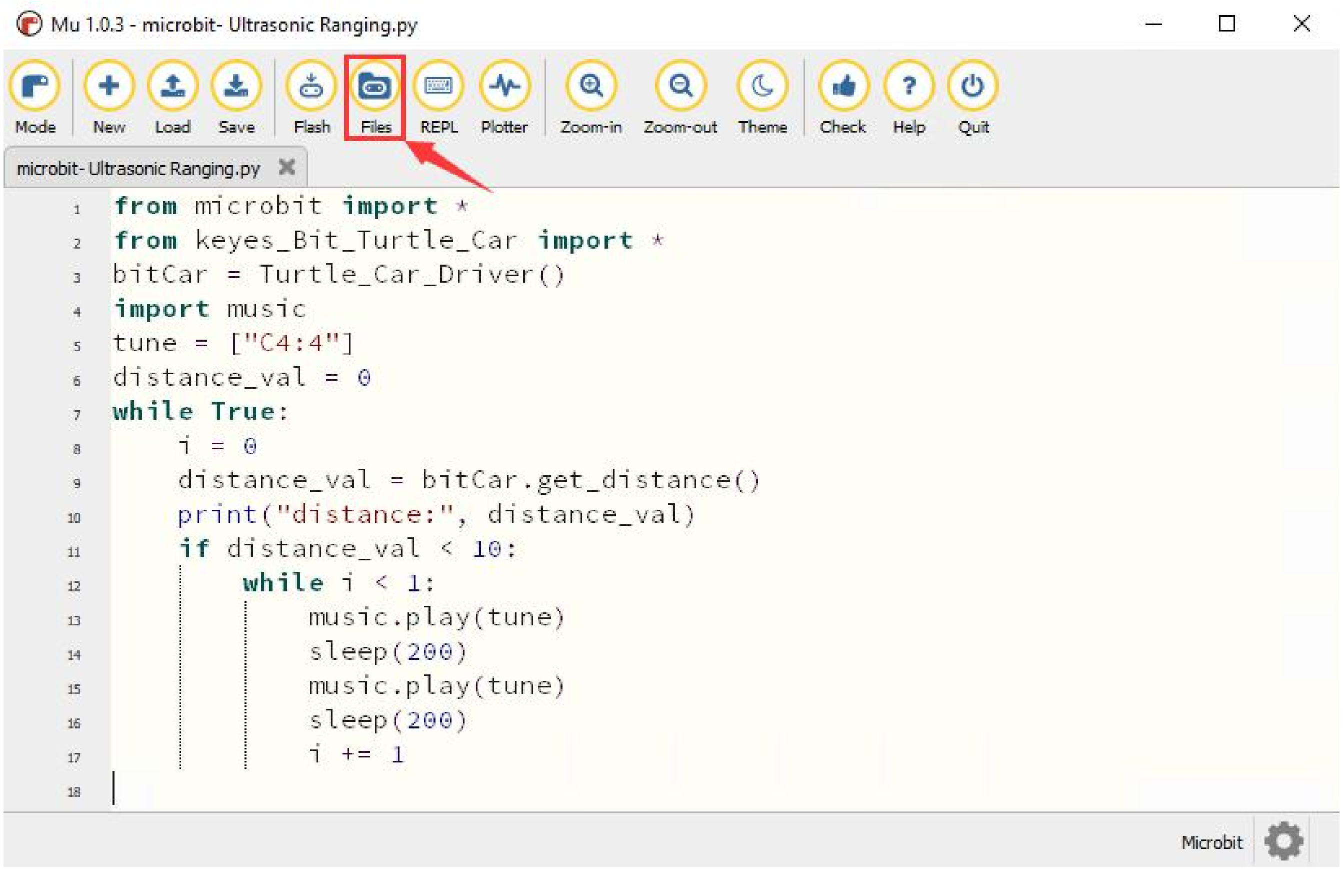
File Type	Route	File Name
Python file	../Python code/8.18：Ultrasonic Robot car/8.18.1：Ultrasonic Ranging	microbit-Ultrasonic Ranging.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



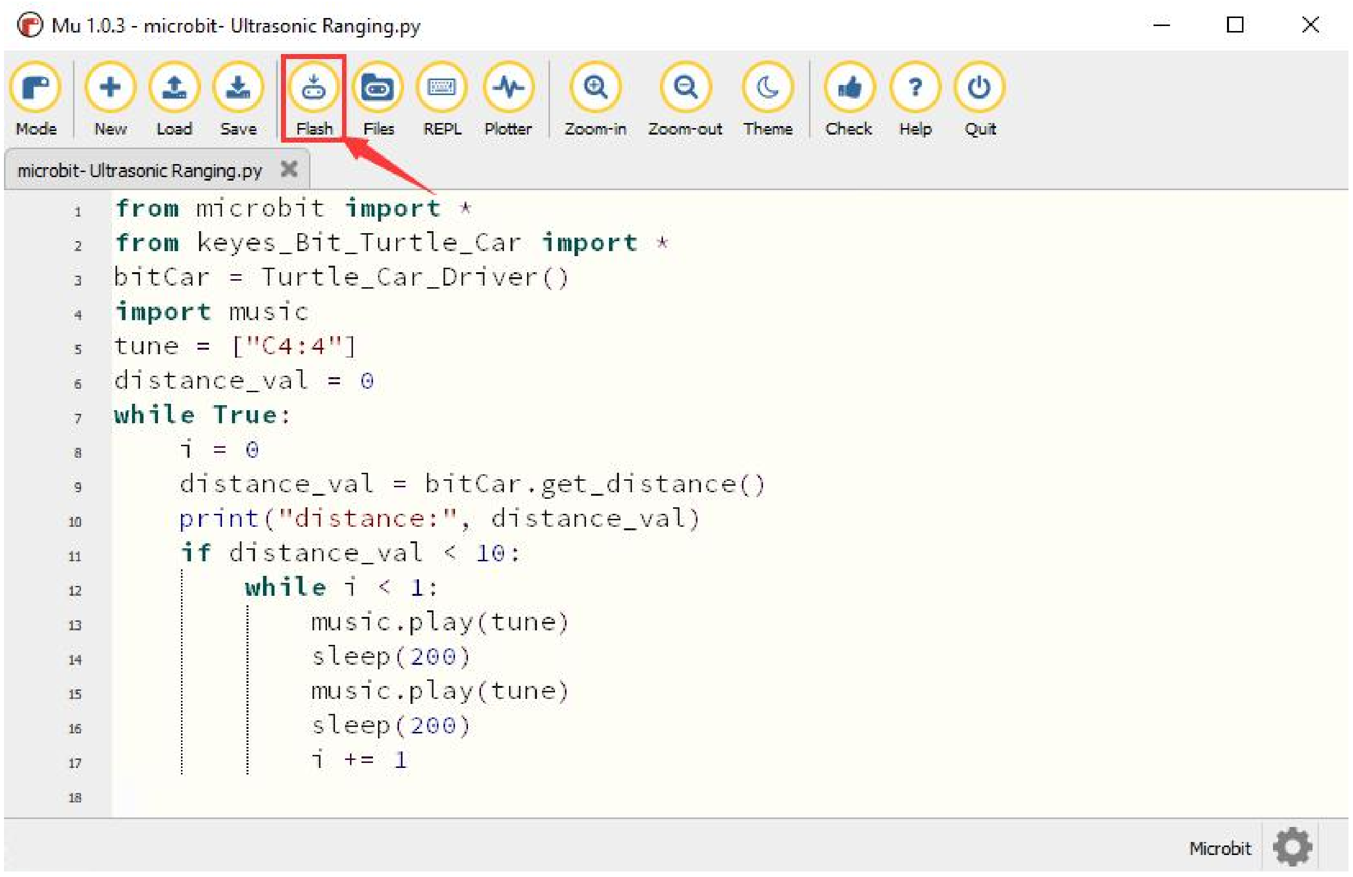
```python
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
import music
tune = ["C4:4"]
distance_val = 0
while True:
    i = 0
    distance_val = bitCar.get_distance()
    print("distance:", distance_val)
    if distance_val < 10:
        while i < 1:
            music.play(tune)
            sleep(200)
            music.play(tune)
            sleep(200)
            i += 1
```

Click “Files” to import the library file of “keyes_Bit_Turtle_Car.py ” to micro:bit (How to import files?) (How to import files?) 。



```python
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
import music
tune = ["C4:4"]
distance_val = 0
while True:
    i = 0
    distance_val = bitCar.get_distance()
    print("distance:", distance_val)
    if distance_val < 10:
        while i < 1:
            music.play(tune)
            sleep(200)
            music.play(tune)
            sleep(200)
            i += 1

```

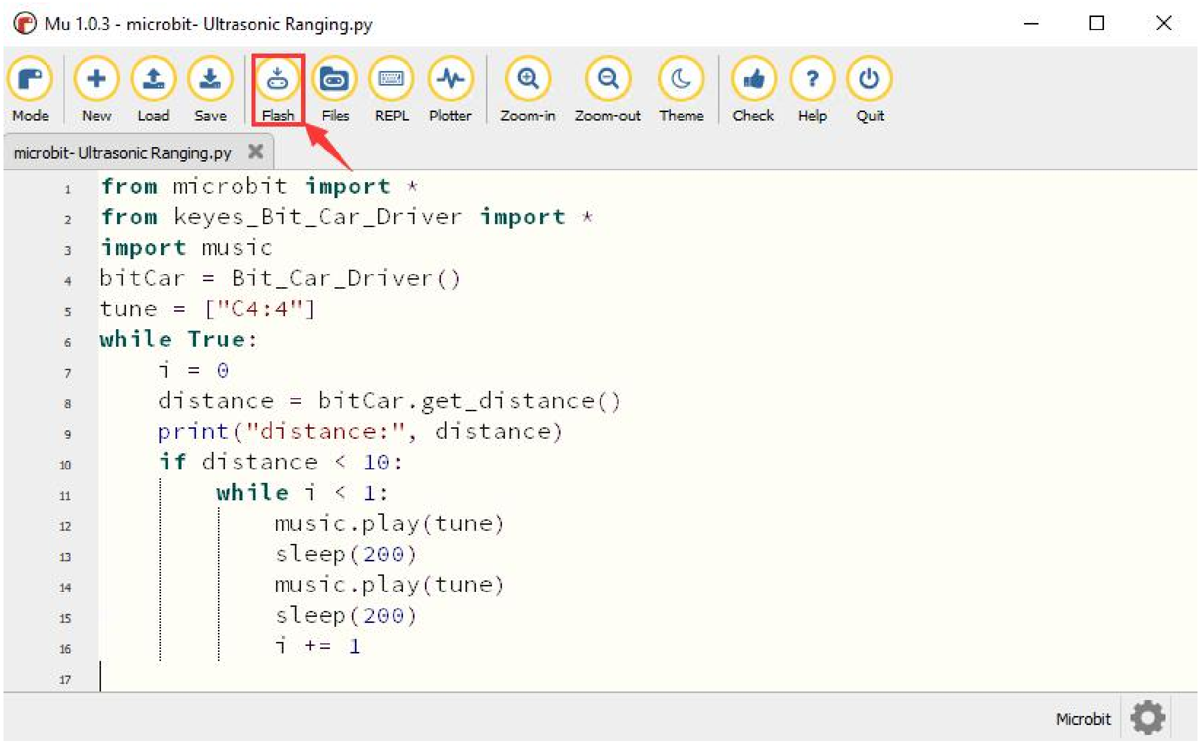
Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



```python
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
import music
tune = ["C4:4"]
distance_val = 0
while True:
    i = 0
    distance_val = bitCar.get_distance()
    print("distance:", distance_val)
    if distance_val < 10:
        while i < 1:
            music.play(tune)
            sleep(200)
            music.play(tune)
            sleep(200)
            i += 1

```

Click “Files” to import the library file of “keyes_Bit_Car_Driver.py to micro:bit (How to import files?)

If micro:bit has library, you don’ t need to add one.

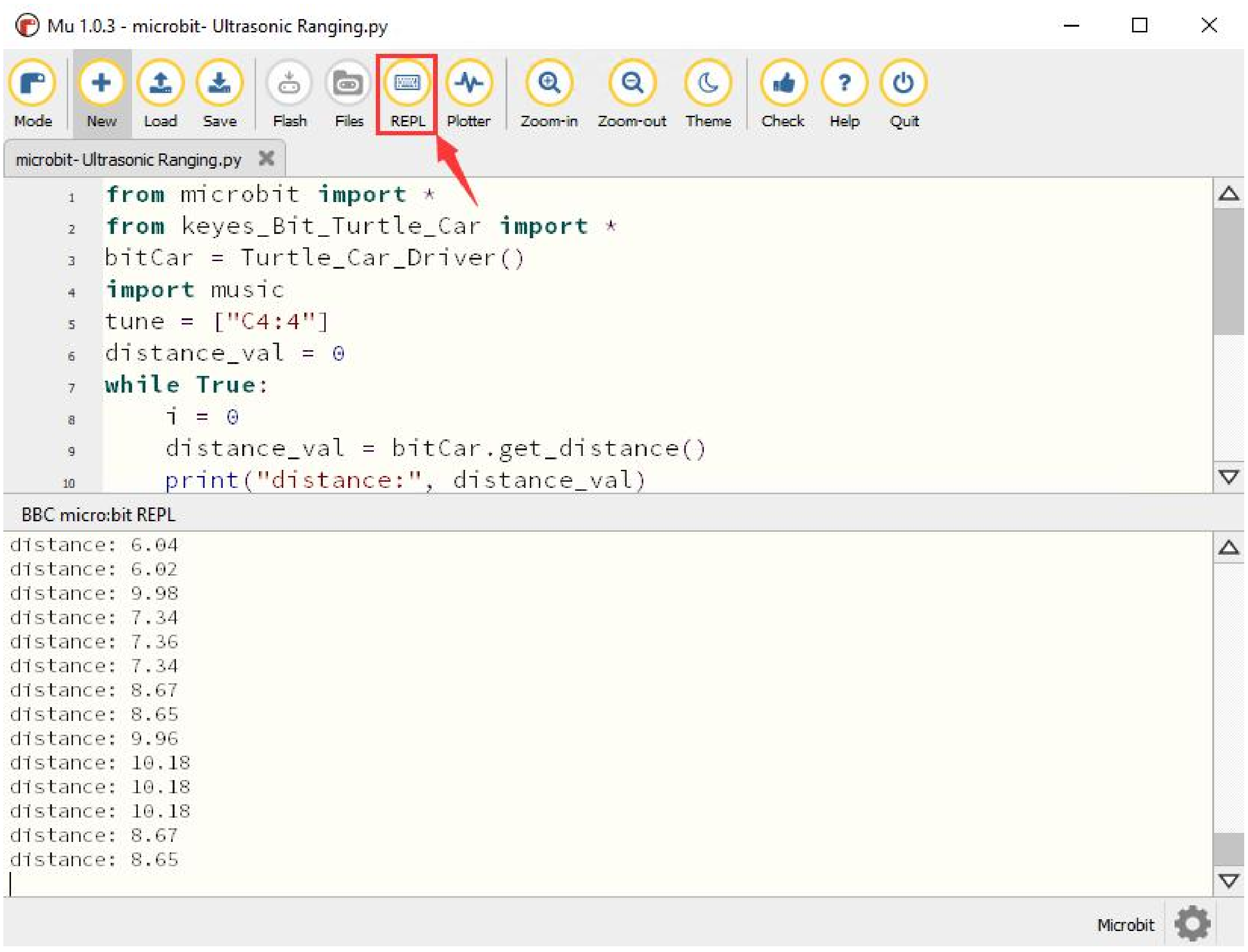


```python
from microbit import *
from keyes_Bit_Car_Driver import *
import music
bitCar = Bit_Car_Driver()
tune = ["C4:4"]
while True:
    i = 0
    distance = bitCar.get_distance()
    print("distance:", distance)
    if distance < 10:
        while i < 1:
            music.play(tune)
            sleep(200)
            music.play(tune)
            sleep(200)
            i += 1

```

6. Test Result:

Download code onto micro:bit board, don’ t plug off USB cable. Click “REPL” and press the reset buttons, the distance value of obstacle will be displayed, as shown below.

When the distance is less than 10cm, the passive buzzer of smart car emits sound.



```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
import music
tune = ["C4:4"]
distance_val = 0
while True:
    i = 0
    distance_val = bitCar.get_distance()
    print("distance:", distance_val)
```

```
distance: 6.04
distance: 6.02
distance: 9.98
distance: 7.34
distance: 7.36
distance: 7.34
distance: 8.67
distance: 8.65
distance: 9.96
distance: 10.18
distance: 10.18
distance: 10.18
distance: 8.67
distance: 8.65
```

7. Code Explanation:

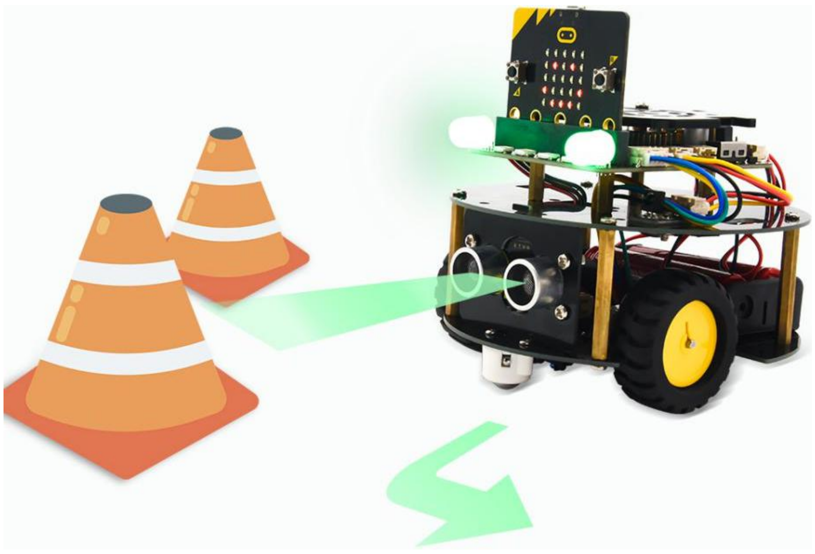
from microbit **import** *	Import the library of micro:bit
from keyes_Bit_Turtle_Car **import** *	Import the library of keyes_Bit_Turtle_Car
bitCar = Turtle_Car_Driver()	instantiate ()为 bitCar
import music	Import the library of music
tune = ["C4:4"]	Create tune to save
while True:	This is a permanent loop that makes micro:bit execute the code of it.

i = 0	Set variable i=0
distance_val = bitCar.get_distance()	Set bitCar.get_distance() to distance
print("distance:", distance_val)	BBC microbit REPL window shows the distance value between the ultrasonic sensor and the obstacle
if distance < 10:	**if** distance < 10
while i < 1:	When i < 1

music.play(tune)
sleep(200)
music.play(tune)
sleep(200)
	Passive buzzer emits sound

i += 1	Variable i adds 1 gradually

8.18.2: Ultrasonic Avoidance Car



1. Description:

We’ ve learned the knowledge of obstacle avoidance sensor. In this project, we will integrate ultrasonic sensor, and car expansion board to make an ultrasonic avoidance car.

Its principle is to detect the distance between the car and obstacle by ultrasonic sensor and control the motion of smart car.

2. Experimental Preparation:

(1) Insert micro:bit board into slot of V2 shield.

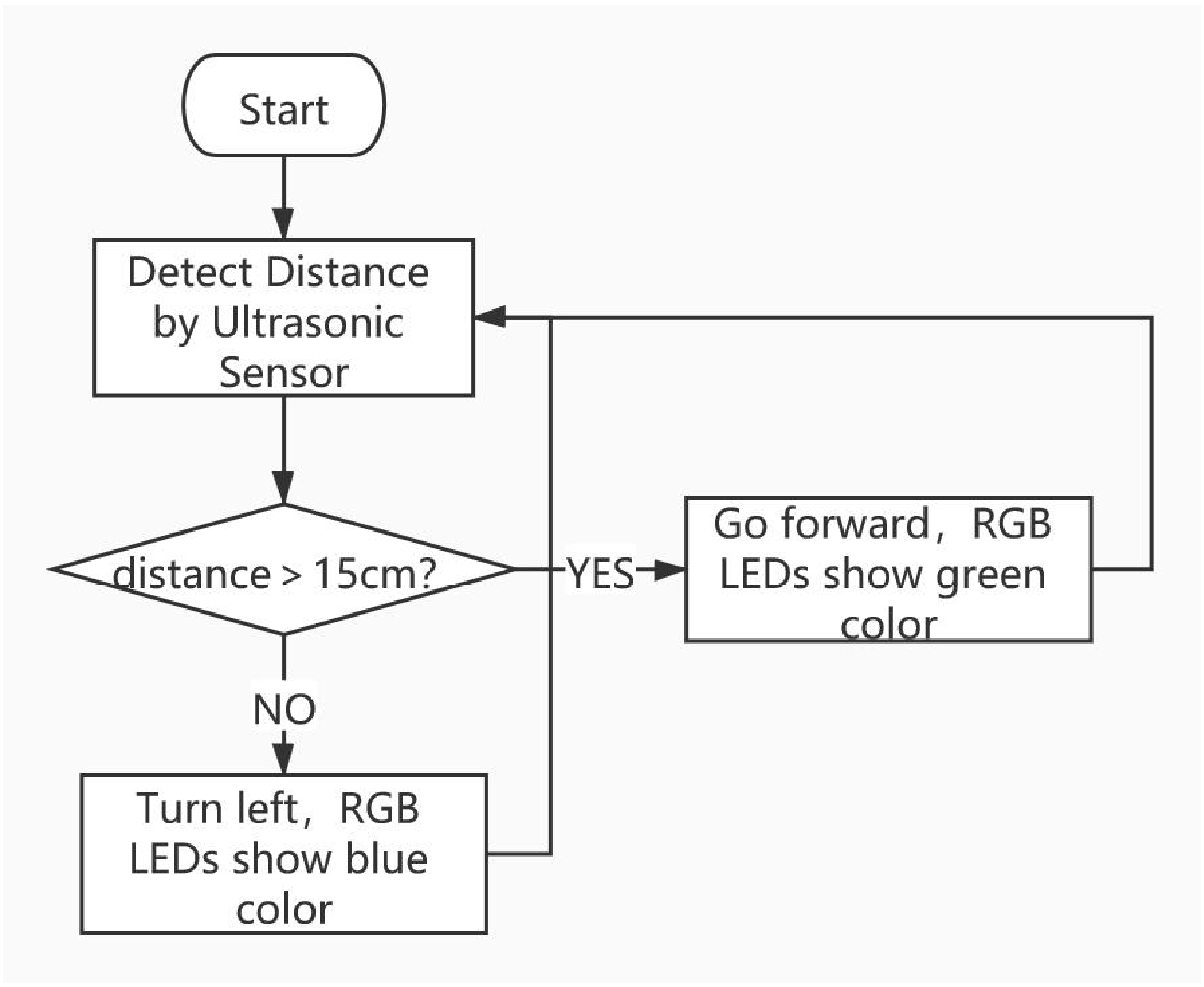
(2) Put batteries into battery holder

(3) Dial POWER switch to ON end on shield.

(4) Link micro:bit board with computer via USB cable.

(5) Open the offline version of Mu

3. Flow Chart

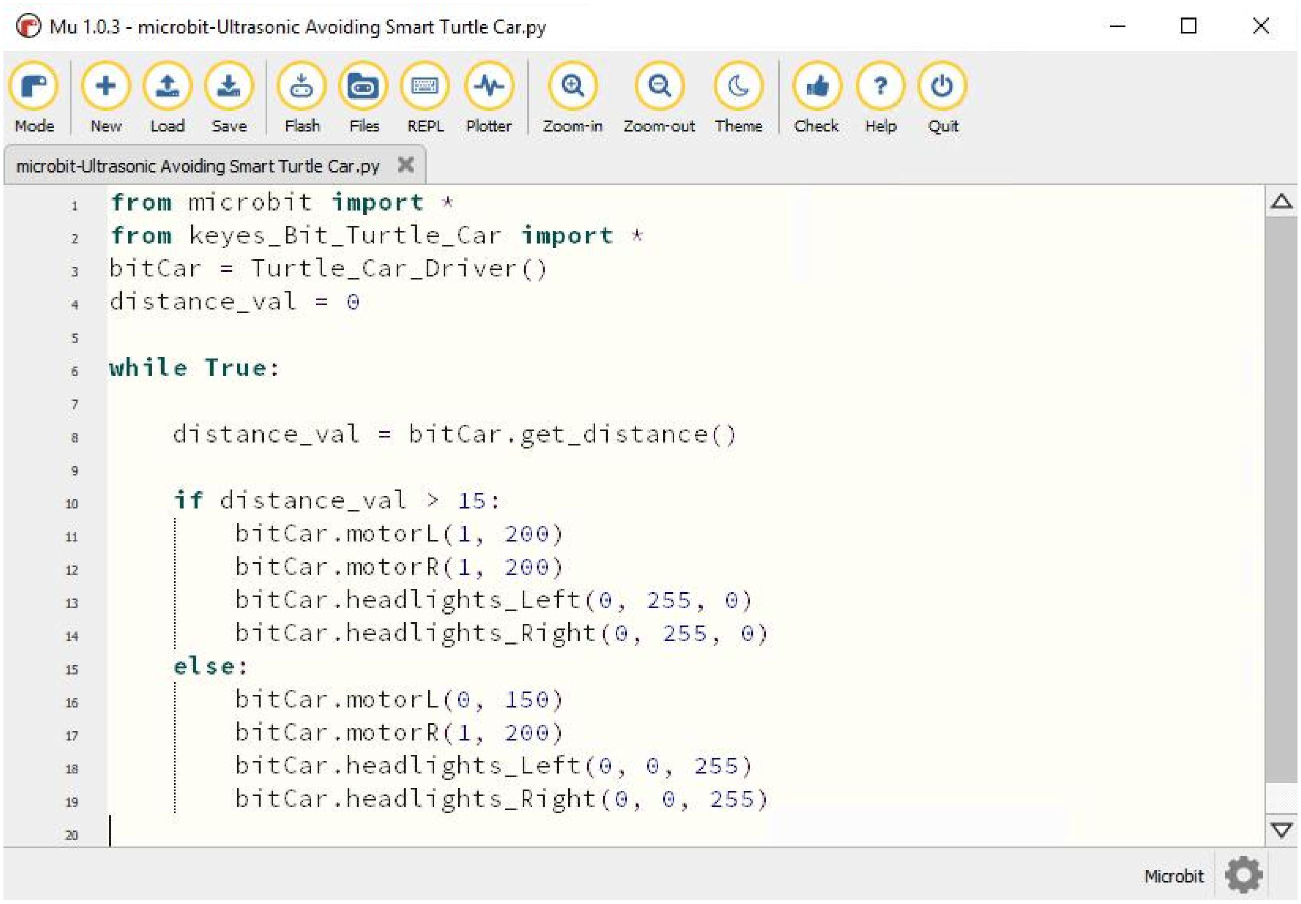

Start
Detect Distance by Ultrasonic Sensor
distance > 15cm?
YES
Go forward， RGB LEDs show green color
NO
Turn left， RGB LEDs show blue color

4. Test Code

Open “microbit-Code.py ” in Mu. (How to load the project code?)

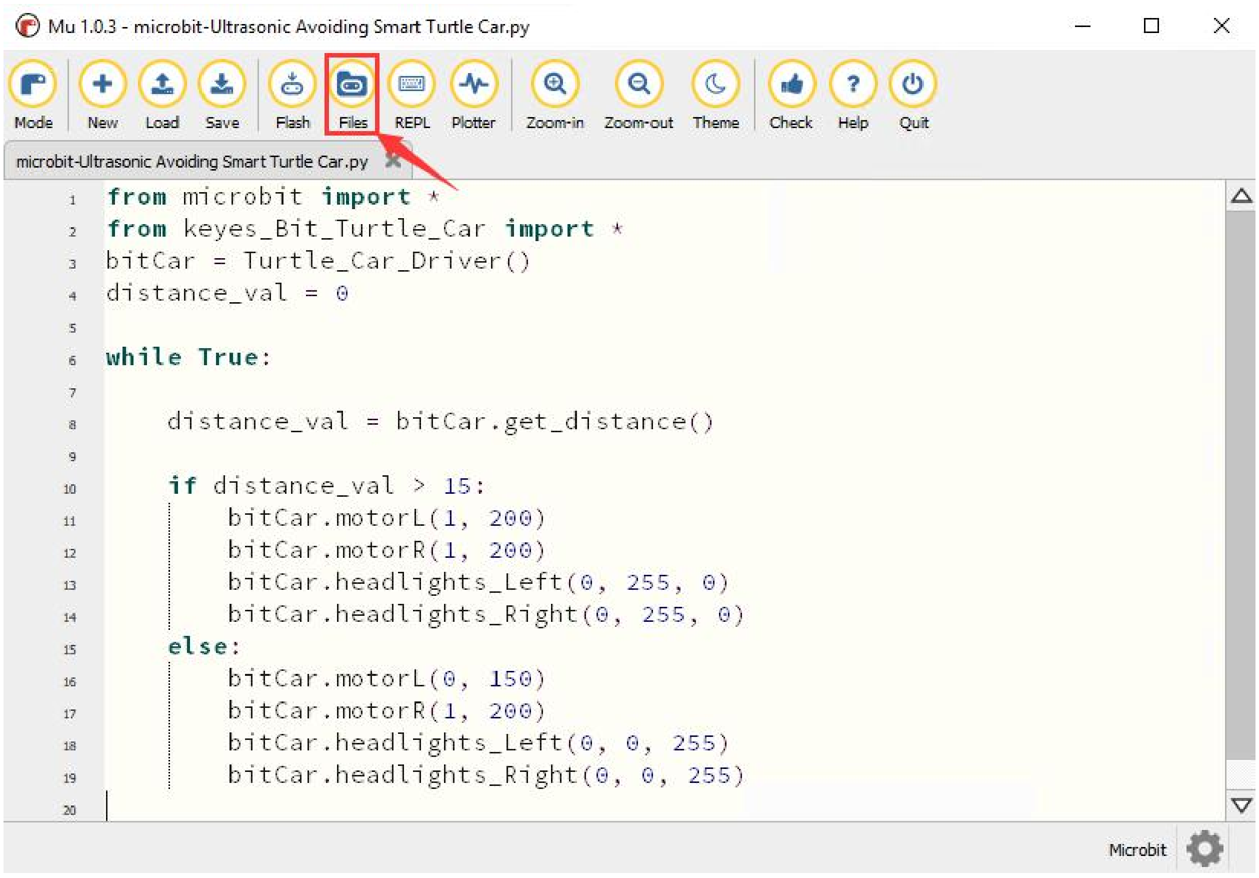
File Type	Route	File Name
Python file	../Python Code/8.18: Ultrasonic Follow Smart Turtle Car/8.18.2: Ultrasonic Avoidance Car	microbit-Code.py

You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit-Ultrasonic Avoiding Smart Turtle Car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Ultrasonic Avoiding Smart Turtle Car.py
Microbit

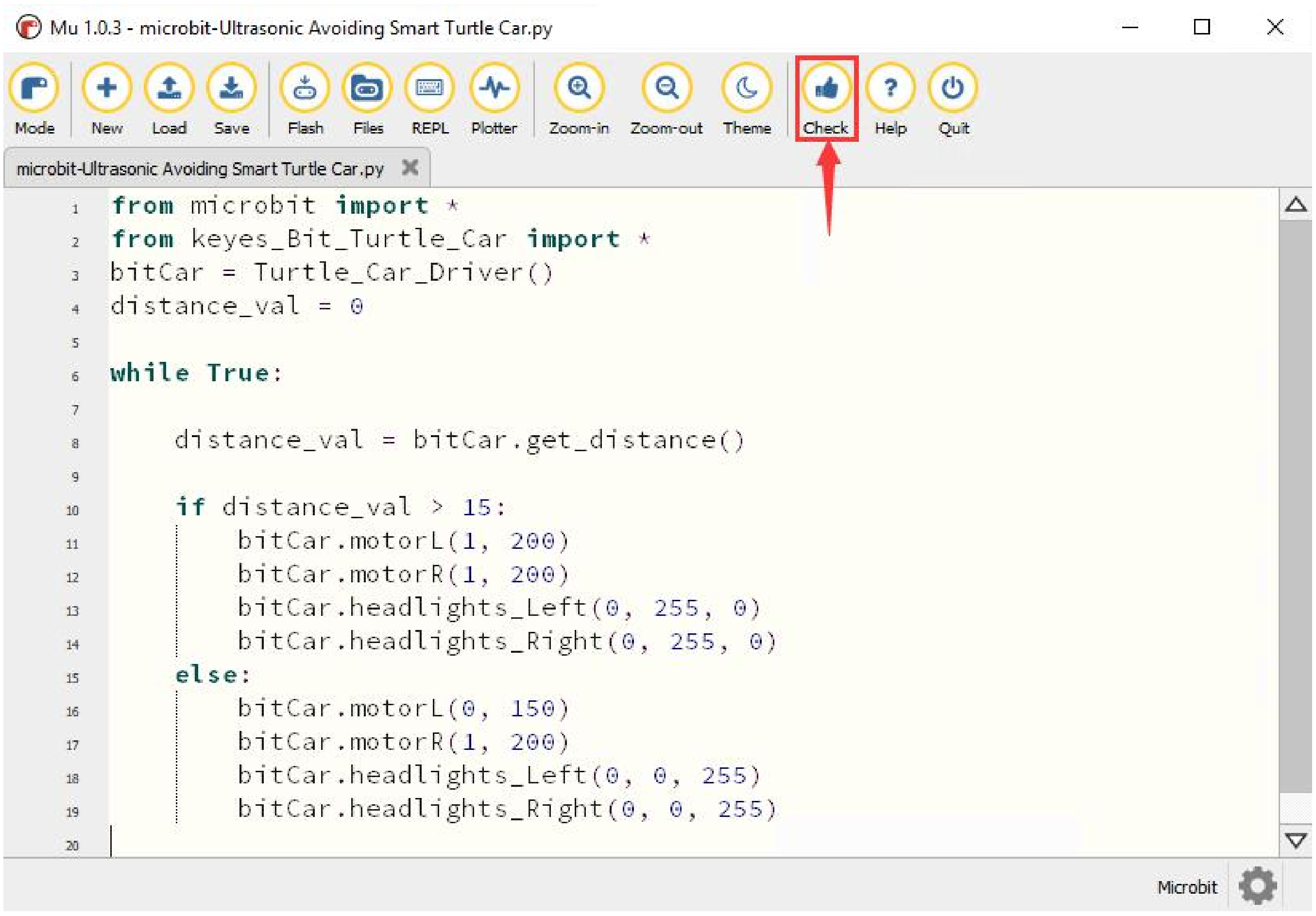
```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
distance_val = 0

while True:

    distance_val = bitCar.get_distance()

    if distance_val > 15:
        bitCar.motorL(1, 200)
        bitCar.motorR(1, 200)
        bitCar.headlights_Left(0, 255, 0)
        bitCar.headlights_Right(0, 255, 0)
    else:
        bitCar.motorL(0, 150)
        bitCar.motorR(1, 200)
        bitCar.headlights_Left(0, 0, 255)
        bitCar.headlights_Right(0, 0, 255)
```

Click "Files" to import the library file of "keyes_Bit_Turtle_Car.py " to micro:bit (How to import files?) (How to import files?)


Mu 1.0.3 - microbit-Ultrasonic Avoiding Smart Turtle Car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Ultrasonic Avoiding Smart Turtle Car.py
Microbit

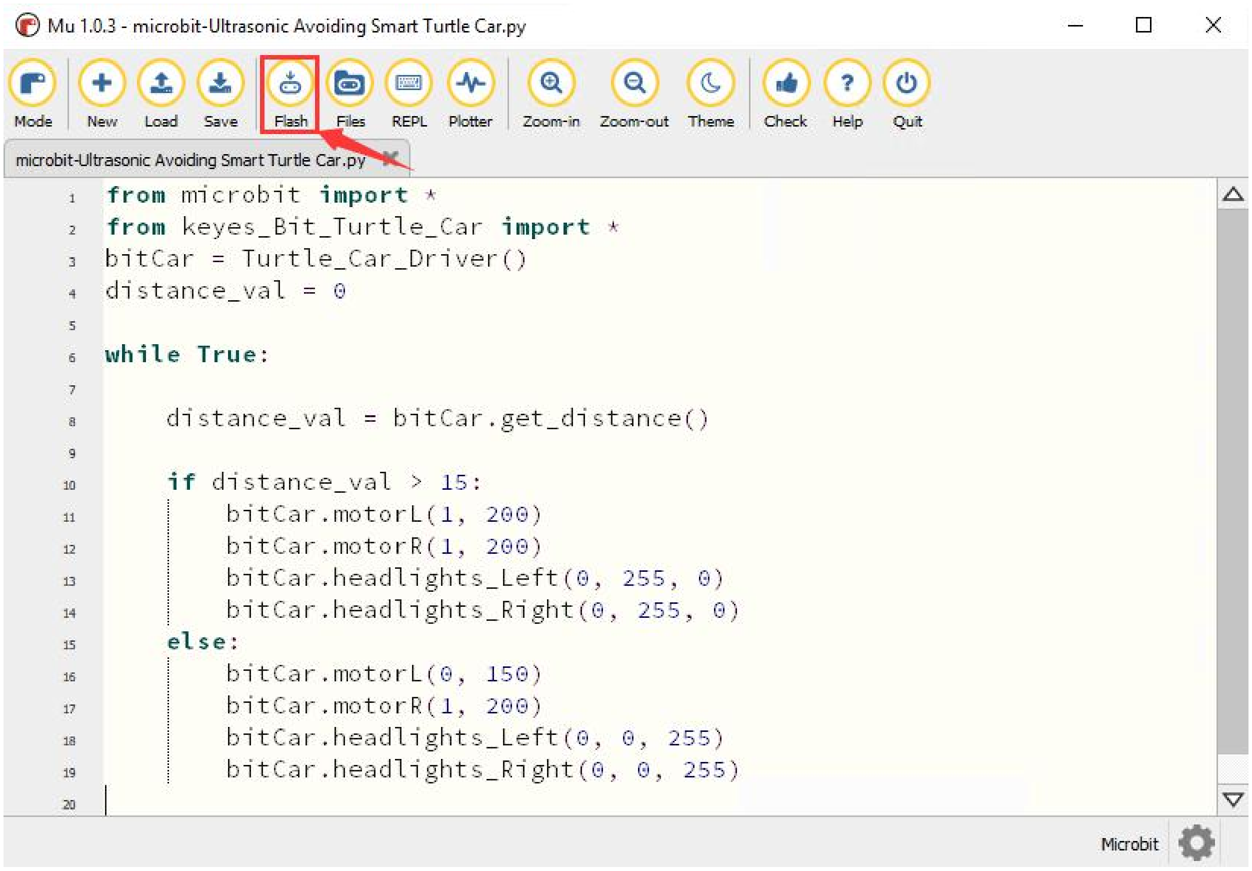
```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
distance_val = 0

while True:

    distance_val = bitCar.get_distance()

    if distance_val > 15:
        bitCar.motorL(1, 200)
        bitCar.motorR(1, 200)
        bitCar.headlights_Left(0, 255, 0)
        bitCar.headlights_Right(0, 255, 0)
    else:
        bitCar.motorL(0, 150)
        bitCar.motorR(1, 200)
        bitCar.headlights_Left(0, 0, 255)
        bitCar.headlights_Right(0, 0, 255)

```

Click "Check" to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-Ultrasonic Avoiding Smart Turtle Car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Ultrasonic Avoiding Smart Turtle Car.py
Microbit

```python
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
distance_val = 0

while True:

    distance_val = bitCar.get_distance()

    if distance_val > 15:
        bitCar.motorL(1, 200)
        bitCar.motorR(1, 200)
        bitCar.headlights_Left(0, 255, 0)
        bitCar.headlights_Right(0, 255, 0)
    else:
        bitCar.motorL(0, 150)
        bitCar.motorR(1, 200)
        bitCar.headlights_Left(0, 0, 255)
        bitCar.headlights_Right(0, 0, 255)

```

Make sure code correct, connect micro:bit to computer via USB cable, turn on the switch of keyestudio Micro:bit robot car and click "Flash" to download code to micro:bit.


Mu 1.0.3 - microbit-Ultrasonic Avoiding Smart Turtle Car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Ultrasonic Avoiding Smart Turtle Car.py
Microbit

```
from microbit import *
from keyes_Bit_Turtle_Car import *
bitCar = Turtle_Car_Driver()
distance_val = 0

while True:

    distance_val = bitCar.get_distance()

    if distance_val > 15:
        bitCar.motorL(1, 200)
        bitCar.motorR(1, 200)
        bitCar.headlights_Left(0, 255, 0)
        bitCar.headlights_Right(0, 255, 0)
    else:
        bitCar.motorL(0, 150)
        bitCar.motorR(1, 200)
        bitCar.headlights_Left(0, 0, 255)
        bitCar.headlights_Right(0, 0, 255)
```

5. Test Result:

Download code to micro:bit, dial to ON end, and dial POWER to ON end. When the obstacle distance is greater than 15cm, turtle car goes forward and 2 RGB lights show green color; on the contrary, smart car turns left and 2 RGB lights show blue color.

6.Code Explanation:

from microbit **import** *	Import the library of micro:bit
from keyes_Bit_Turtle_Car **import** *	Import the library of keyes_Bit_Turtle_Car

bitCar = Turtle_Car_Driver()	instantiate ()为 bitCar
distance_val = 0	Set the initial value of distance_val to 0
while True:	This is a permanent loop that makes micro:bit execute the code of it.
distance_val = bitCar.get_distance()	Set bitCar.get_distance() to distance_val

if distance_val >= 15:
bitCar.motorL(1, 200)
bitCar.motorR(1, 200)
bitCar.headlights_Left(0, 255, 0)
bitCar.headlights_Right(0, 255, 0)
else:
bitCar.motorL(0, 150)
bitCar.motorR(1, 150)
bitCar.headlights_Left(0, 0, 255)
bitCar.headlights_Right(0, 0, 255)
	If distance_val ≥15
	Left motors of turtle car rotate clockwise at the speed of PWM100
	Right motors of turtle car rotate clockwise at the speed of PWM100
	RGB lights show green color
	If the above condition is not met
	Left motors of turtle car rotate anticlockwise at the speed of PWM150
	Right motors of turtle car rotate clockwise at the speed of PWM150
	One RGB shows indigo color
	One RGB shows blue color

8.18.3: Ultrasonic Follow Smart Car

1. Description:

In previous lesson, we' ve learned the basic principle of line tracking sensor. Next, we will combine ultrasonic sensor with car shield to make an ultrasonic follow car.

The ultrasonic sensor detects the obstacle distance and control the motion status of car.

2. Experimental Preparation:

(1) Insert micro:bit board into slot of V2 shield.

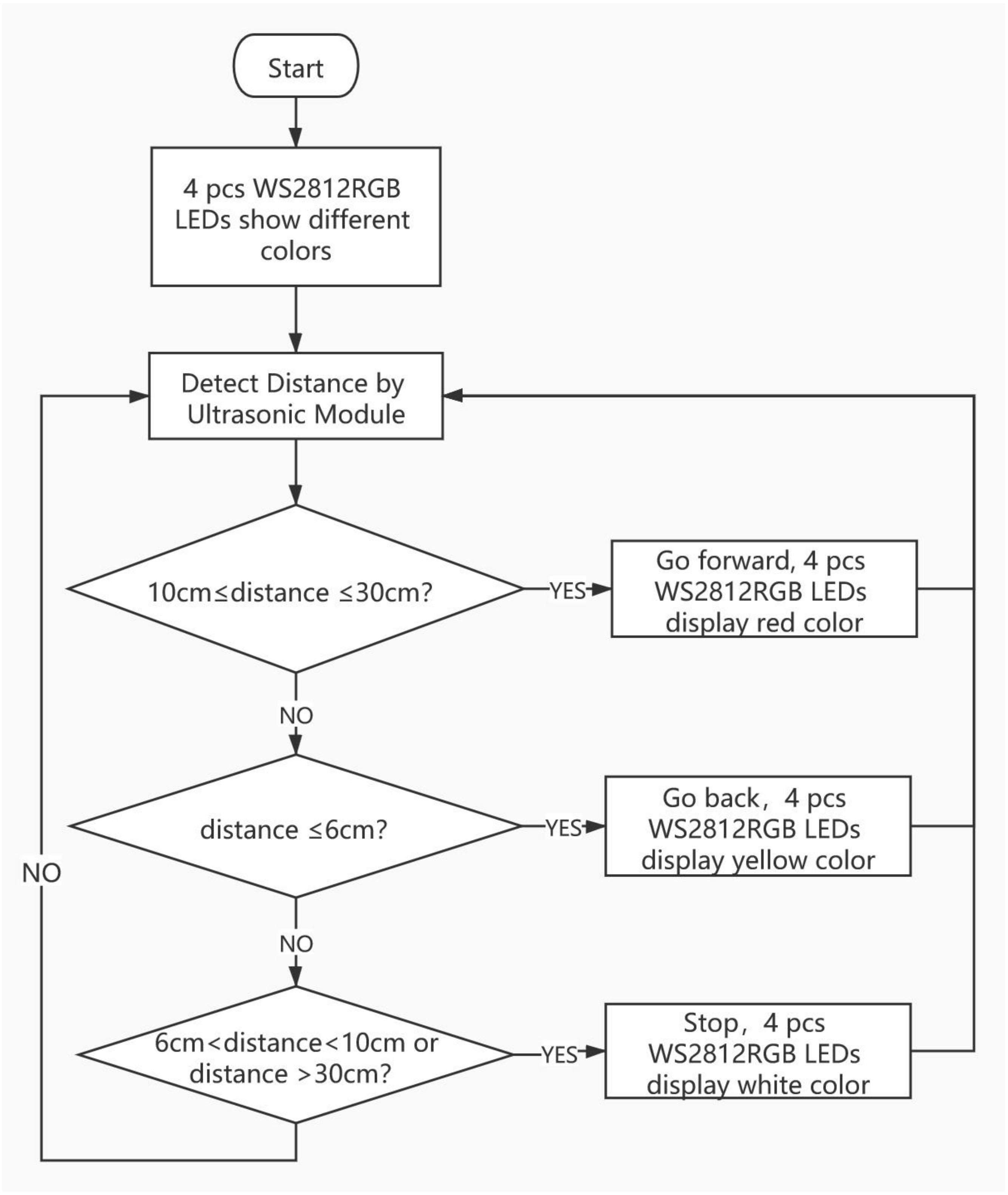
(2) Put batteries into battery holder

(3) Dial POWER switch to ON end on shield.

(4) Link micro:bit board with computer via USB cable.

(5) Open the offline version of Mu

3. Flow Chart

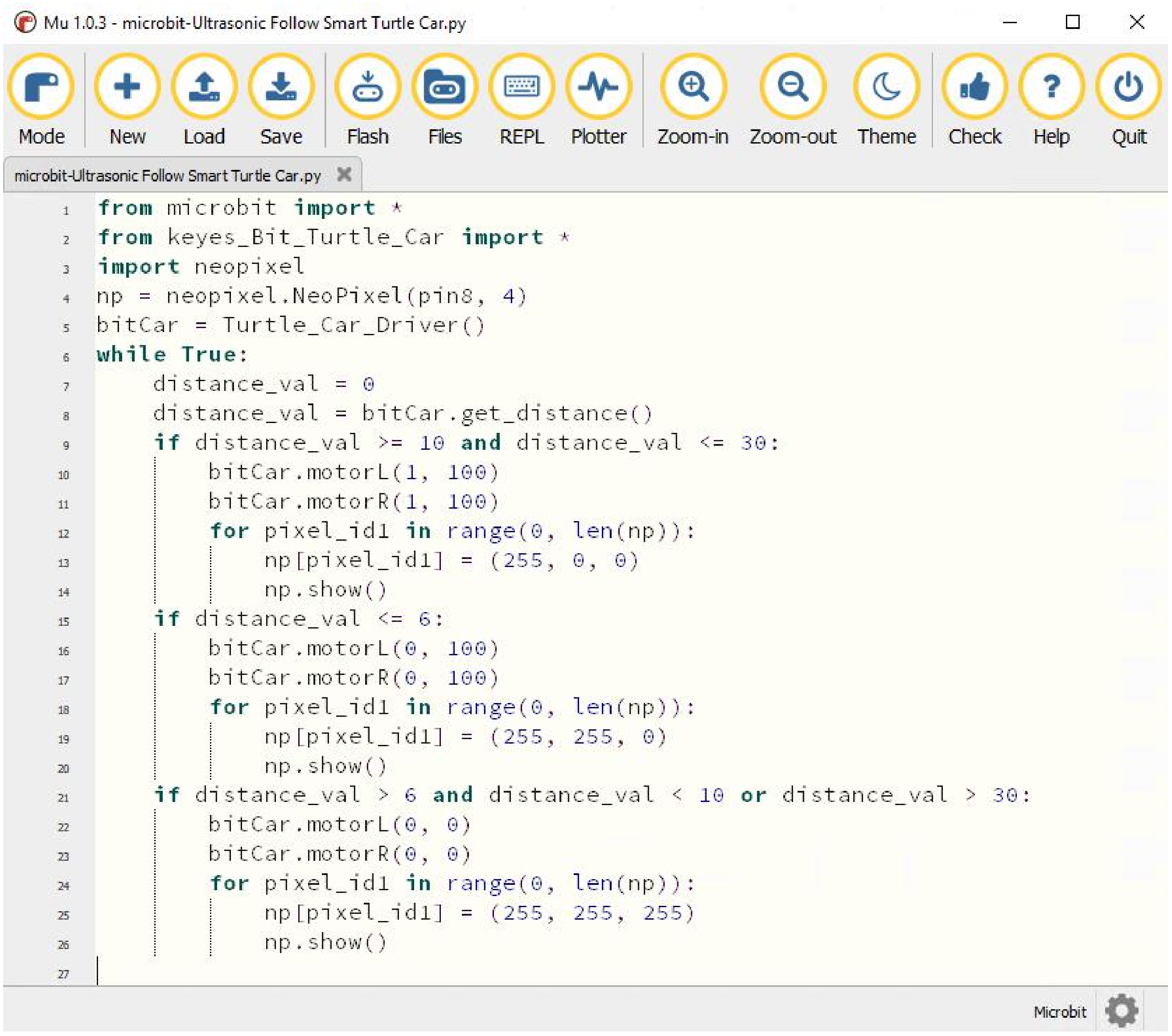

Start
4 pcs WS2812RGB LEDs show different colors
Detect Distance by Ultrasonic Module
10cm≤distance ≤30cm?
YES
Go forward, 4 pcs WS2812RGB LEDs display red color
NO
distance ≤6cm?
YES
Go back，4 pcs WS2812RGB LEDs display yellow color
NO
NO
6cm<distance<10cm or distance >30cm?
YES
Stop，4 pcs WS2812RGB LEDs display white color

4. Test Code

Open “microbit-Code.py” file in Mu, (How to load the project code?)

File Type	Route	File Name
Python file	../Python Code/8.18：Ultrasonic following car/8.18.3：Ultrasonic Follow Smart Car	microbit-Code.py

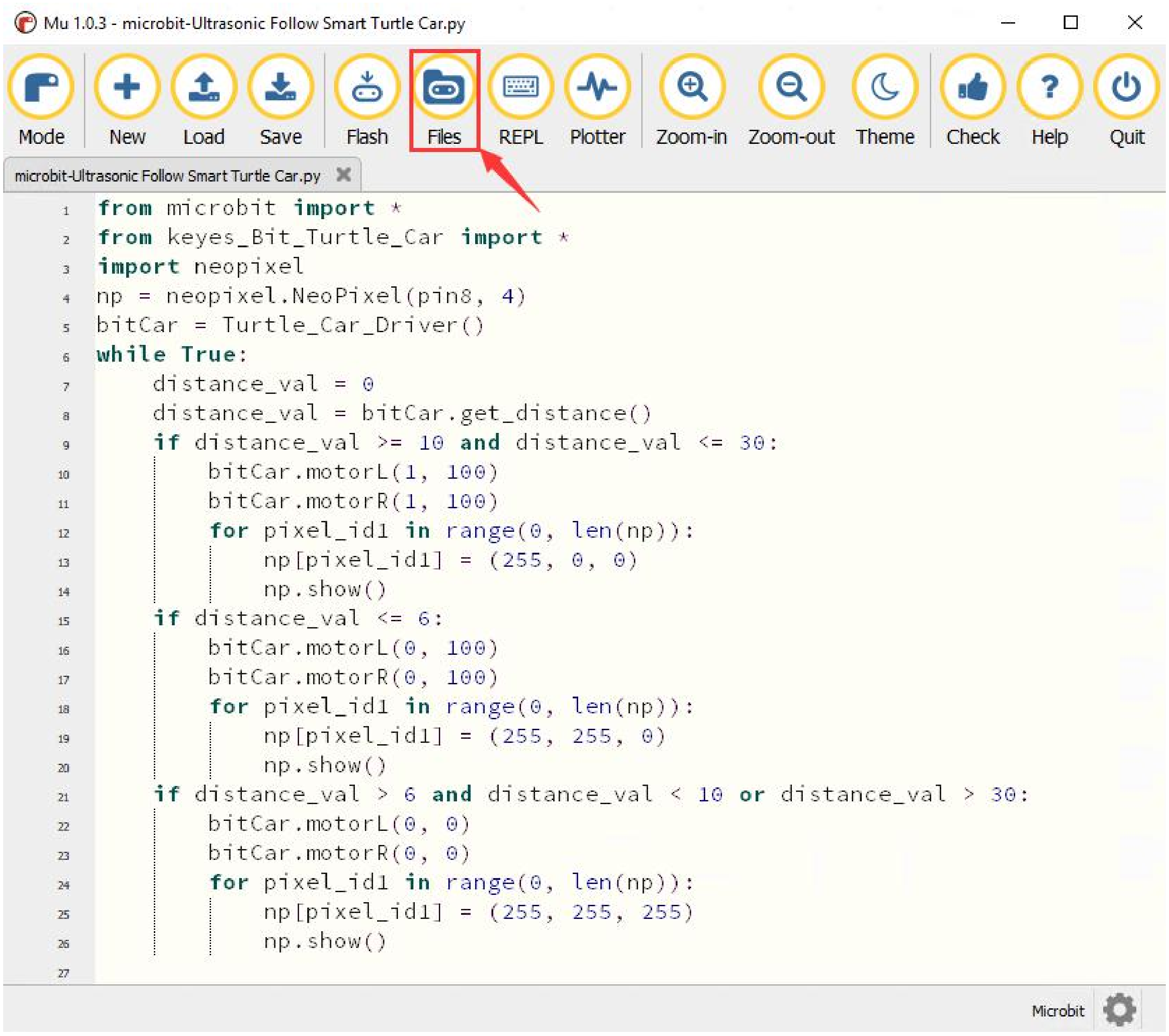
You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)


Mu 1.0.3 - microbit-Ultrasonic Follow Smart Turtle Car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Ultrasonic Follow Smart Turtle Car.py
Microbit

```python
from microbit import *
from keyes_Bit_Turtle_Car import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
bitCar = Turtle_Car_Driver()
while True:
    distance_val = 0
    distance_val = bitCar.get_distance()
    if distance_val >= 10 and distance_val <= 30:
        bitCar.motorL(1, 100)
        bitCar.motorR(1, 100)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 0, 0)
            np.show()
    if distance_val <= 6:
        bitCar.motorL(0, 100)
        bitCar.motorR(0, 100)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 0)
            np.show()
    if distance_val > 6 and distance_val < 10 or distance_val > 30:
        bitCar.motorL(0, 0)
        bitCar.motorR(0, 0)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 255)
            np.show()

```

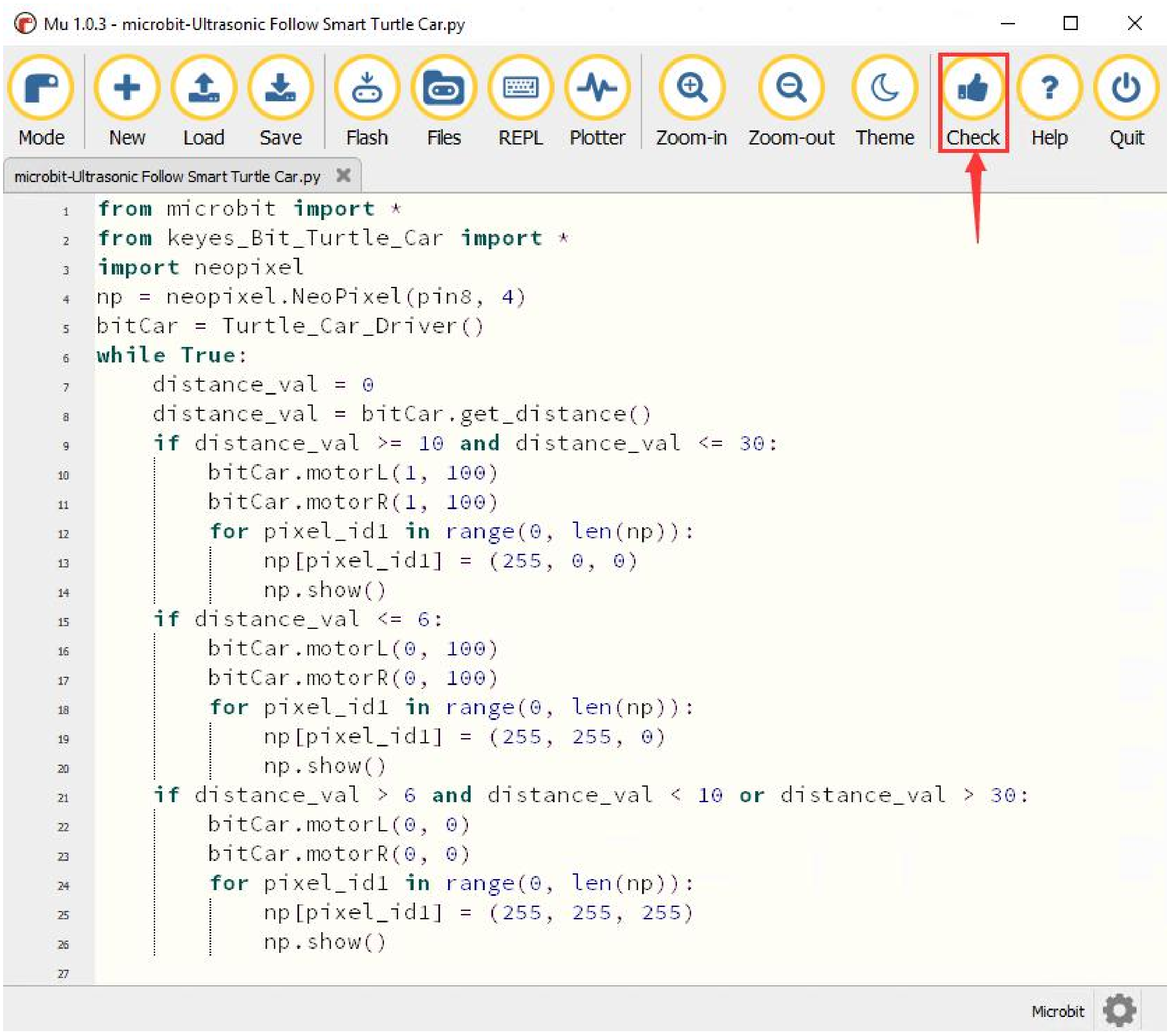
Click “Files” to import the library file of “keyes_Bit_Turtle_Car.py” to micro:bit (How to import files?)

If micro:bit has library, you don’ t need to add one.


Mu 1.0.3 - microbit-Ultrasonic Follow Smart Turtle Car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Ultrasonic Follow Smart Turtle Car.py
Microbit

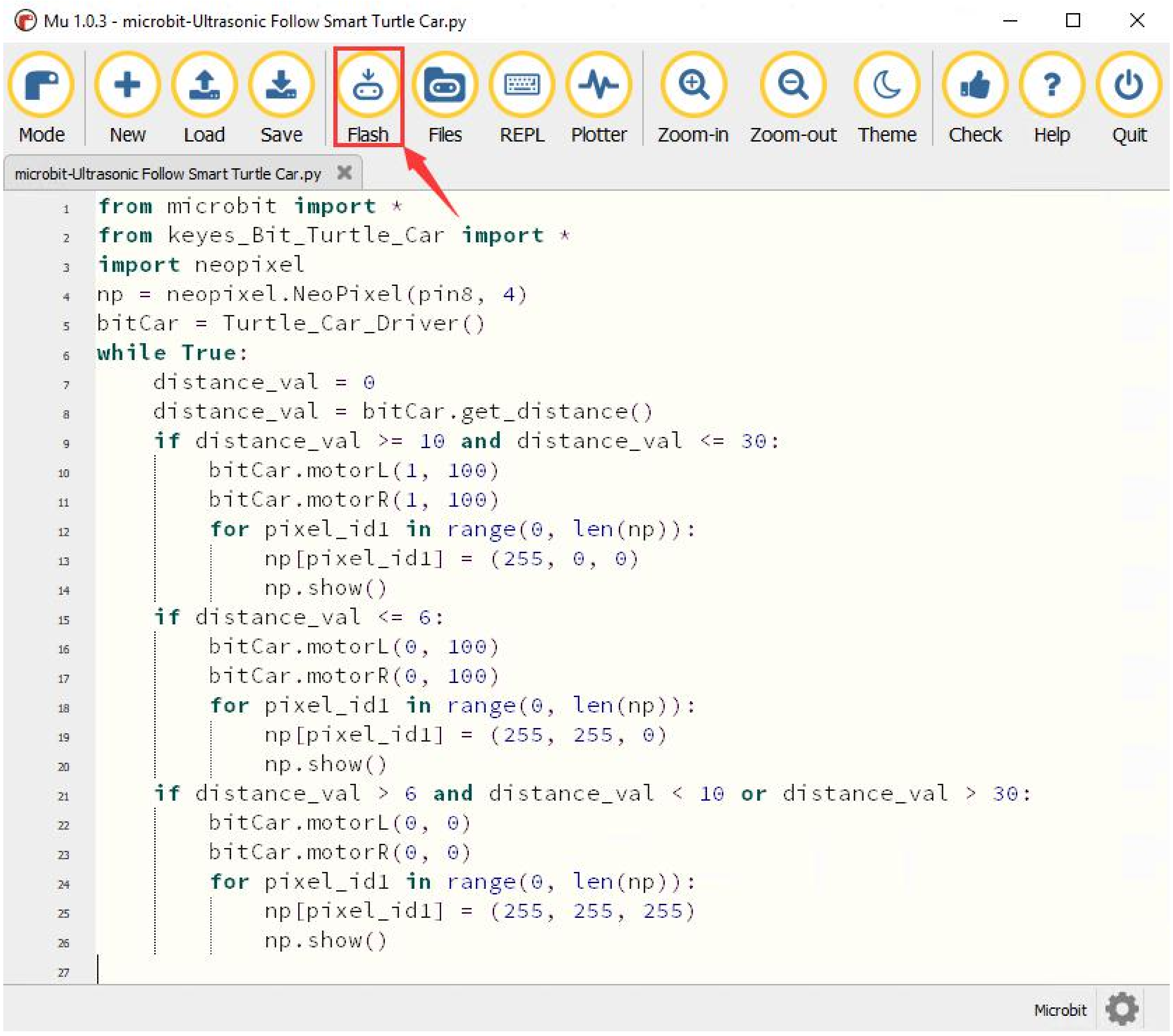
```
from microbit import *
from keyes_Bit_Turtle_Car import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
bitCar = Turtle_Car_Driver()
while True:
    distance_val = 0
    distance_val = bitCar.get_distance()
    if distance_val >= 10 and distance_val <= 30:
        bitCar.motorL(1, 100)
        bitCar.motorR(1, 100)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 0, 0)
            np.show()
    if distance_val <= 6:
        bitCar.motorL(0, 100)
        bitCar.motorR(0, 100)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 0)
            np.show()
    if distance_val > 6 and distance_val < 10 or distance_val > 30:
        bitCar.motorL(0, 0)
        bitCar.motorR(0, 0)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 255)
            np.show()

```

Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.


Mu 1.0.3 - microbit-Ultrasonic Follow Smart Turtle Car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Ultrasonic Follow Smart Turtle Car.py
Microbit

```
from microbit import *
from keyes_Bit_Turtle_Car import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
bitCar = Turtle_Car_Driver()
while True:
    distance_val = 0
    distance_val = bitCar.get_distance()
    if distance_val >= 10 and distance_val <= 30:
        bitCar.motorL(1, 100)
        bitCar.motorR(1, 100)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 0, 0)
            np.show()
    if distance_val <= 6:
        bitCar.motorL(0, 100)
        bitCar.motorR(0, 100)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 0)
            np.show()
    if distance_val > 6 and distance_val < 10 or distance_val > 30:
        bitCar.motorL(0, 0)
        bitCar.motorR(0, 0)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 255)
            np.show()
```

Make sure code correct, connect micro:bit to computer via USB cable, turn on the switch of keyestudio Micro:bit robot car and click “Flash” to download code to micro:bit board.


Mu 1.0.3 - microbit-Ultrasonic Follow Smart Turtle Car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Help
Quit
microbit-Ultrasonic Follow Smart Turtle Car.py
Microbit

```python
from microbit import *
from keyes_Bit_Turtle_Car import *
import neopixel
np = neopixel.NeoPixel(pin8, 4)
bitCar = Turtle_Car_Driver()
while True:
    distance_val = 0
    distance_val = bitCar.get_distance()
    if distance_val >= 10 and distance_val <= 30:
        bitCar.motorL(1, 100)
        bitCar.motorR(1, 100)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 0, 0)
            np.show()
    if distance_val <= 6:
        bitCar.motorL(0, 100)
        bitCar.motorR(0, 100)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 0)
            np.show()
    if distance_val > 6 and distance_val < 10 or distance_val > 30:
        bitCar.motorL(0, 0)
        bitCar.motorR(0, 0)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 255)
            np.show()
```

5. Test Result:

After downloading code, dial POWER switch to ON end, as a result, the car will follow the obstacle to move and WS2812 RGB lights will display different colors.

Note: the obstacle only moves in front of smart car, not turning around

6. Code Explanation:

from microbit **import** *	Import the library of micro:bit
from keyes_Bit_Turtle_Car **import** *	Import the library of keyes_Bit_Turtle_Car
bitCar = Turtle_Car_Driver()	instantiate
import neopixel	Import the library of neopixel
while True:	This is a permanent loop that makes micro:bit execute the code of it.
distance_val = 0	Set the initial value of distance_val to 0
distance_val = bitCar.get_distance()	Set bitCar.get_distance() to distance_val

if distance_val >= 10 **and** distance_val <= 30:
bitCar.motorL(1, 100)
bitCar.motorR(1, 100)
for pixel_id1 **in** range(0, len(np)):
np[pixel_id1] = (255, 0, 0)
np.show()
if distance_val <= 6:
	If distance_val ≥10 and distance_val ≤ 30
	Left motors of turtle car rotate clockwise at the speed of PWM100
	Right motors of turtle car rotate clockwise at the speed of PWM100
	
	RGB pixel is pixel_id1 in the range of

bitCar.motorL(0, 100)
bitCar.motorR(0, 100)
for pixel_id1 **in** range(0, len(np)):
np[pixel_id1] = (255, 255, 0)
np.show()
if distance_val > 6 **and** distance_val < 10 **or** distance_val > 30:
bitCar.motorL(0, 0)
bitCar.motorR(0, 0)
for pixel_id1 **in** range(0, len(np)):
np[pixel_id1] = (255, 255, 255)
np.show()
	（0，len（np））
	Set pixel_id1 to show red color
	Display pixel on Neopixel stripIf distance_val ≤6
	Left motors of turtle car rotate anticlockwise at the speed of PWM100
	Right motors of turtle car rotate anticlockwise at the speed of PWM100
	RGB pixel is pixel_id1 in the range of （0，len（np））
	Set pixel_id1 to show yellow color
	Display pixel on Neopixel strip
	If distance_val > 6,distance_val < 10 or distance_val > 30
	left motor doesn’t rotate
	right motor doesn’t rotate
	RGB pixel is pixel_id1 in the range of （0，len（np））
	Set pixel_id1 to light up white color
	Display pixel on Neopixel strip

7. Resource

1. BBC microbit MicroPython：

https://microbit-micropython.readthedocs.io/en/latest/tutorials/introduction.html

2.MicroPython：

https://docs.openmv.io/reference/index.html

3.ustruct library：

https://docs.openmv.io/library/ustruct.html

4.math library：

https://docs.openmv.io/library/math.html

5.utime(sleep_us,tick_us) library：

https://docs.openmv.io/library/utime.html#