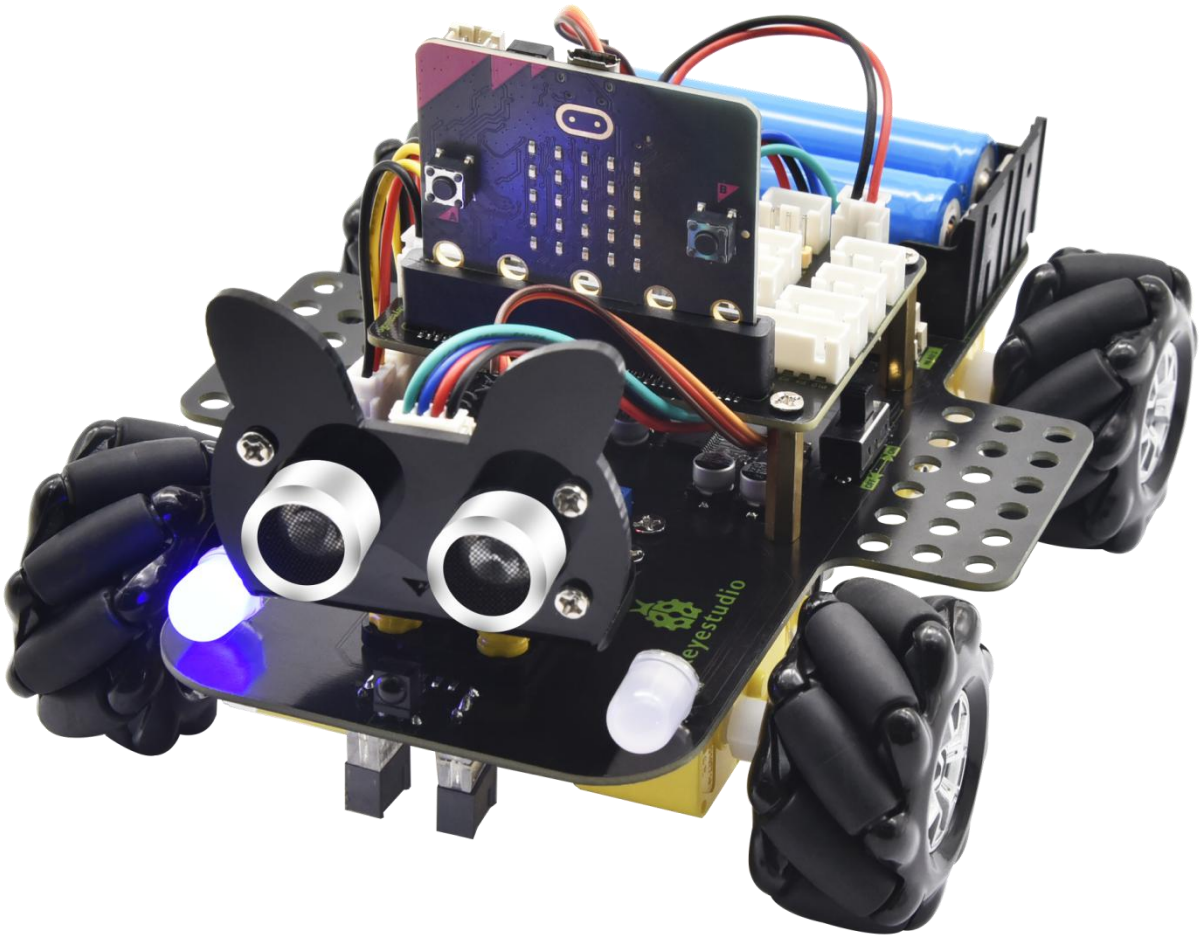
Keyestudio 4WD Mecanum Robot Car

(Python)



Contents

1. Introduction

Have you wondered to learn programming or have your own programming robot? Nowadays, programming has developed to a lower age group, and it will be a trend for everyone to be able to program thanks to the spread of simple graphical programming platforms, from micro:bit to Arduino and Raspberry Pi. Maybe you haven't heard of them before. It doesn't matter because with the help of this product and tutorial, you can easily install a multi-functional programming car and experience the fun of being a maker.

Micro:bit is a highly integrated microcontroller of powerful functions and small size. It is very suitable to be applied in STEAM education for it functions to make robots, wearable devices and electronic interactive games via the combination of code programming and graphical programming.

This Keyestudio 4WD Mecanum Robot Car is a smart DIY car specially designed for micro:bit. The smart car kit consists of a car body with extended functions, a PCB base plate with integrated motor drive sensors, 4 decelerating DC motors, Mecanum wheels, various modules and sensors

and acrylic boards. Therefore, you can easily assemble a cool Mecanum wheel 4WD smart car by yourself.

This tutorial programs in MicroPython language which is the Micro:bit version of Python language. It will guide you to use software Mu to write MicroPython language for Micro:bit main board to control the smart home system. In this process, not only can you enhance your ability to make stuffs but also learn the skills of programming.

Python is one of the most popular programming language especially in machine learning for its availability and accessibility have brought huge convenience to this field. However, MicroPython is a lean and efficient implementation of the Python programming language for microcontrollers and embedded systems.

and then use Microsoft's online graphical programming platform Make Code to program the micro:bit control board to control the car. In the process, you can not only experience the fun of creation but enhance hands-on ability and learn programming skills as well.

This tutorial is a Python tutorial for 4WD Mecanum Robot Car. If you

haven't learned the basic tutorial (Makecode version of Tutorial), we strongly recommend you to learn it first. Because the basic one is programmed using graphical blocks, which is easier to understand and start.

For your convenience, source code written in Python has been provided in every project, as well as code programming steps and code explanation in details. Hope you can better understand them.

2. Description

This product is a smart car based on Micro:bit. It boasts multiply functions including ultrasonic sound following, line tracking, infrared control and Bluetooth control. It comes with a passive buzzer which is able to play music, 4 WS2812RGB LEDs to display different colors, 2 colorful lights to make direction lights for the car. This product uses two 18650 lithium batteries for power supply.

When installing and disassembling the battery, please pay attention to the positive and negative poles of the battery, and be sure not to reverse the them. By the way, the motor speed of this product is adjustable.

In order to provide you with better experience, corresponding documents about installation and test code are also provided.

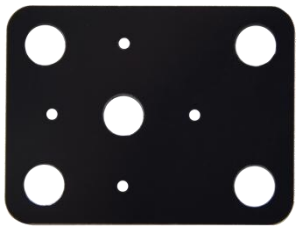
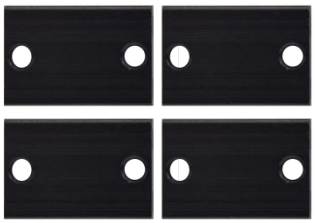
3.Parameters

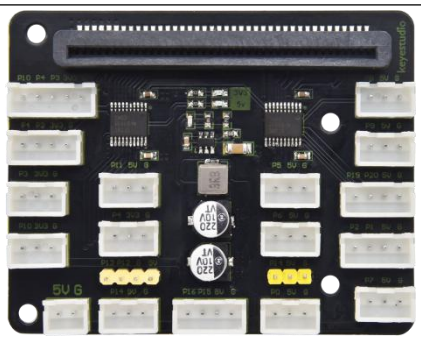
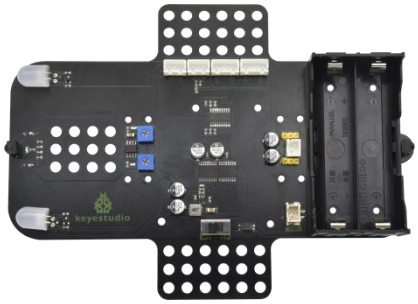
- Connector port input: DC 6V---9V
- Operating voltage of drive board system: 5V
- Standard operating power consumption: about 2.2W
- Maximum power: Maximum output power is 12W
- Motor speed: 200RPM/1min
- Working temperature range: 0-50℃
- Size: 120*120*120mm
- Environmental protection attributes: ROHS

Note: working voltage of micro:bit is 3.3V, driver shield integrates 3.3V/5V communication conversion circuit.

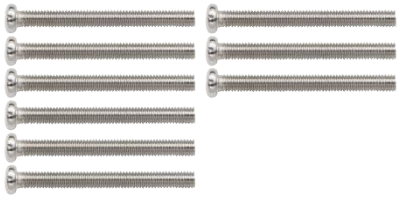
4.Kit List

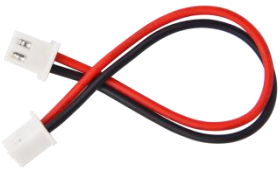
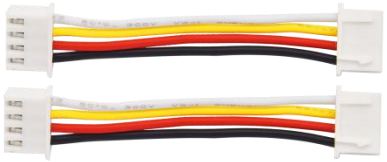
#	Picture	Components	Quanti ty

1		KS0511 Acrylic Board T=3mm	1
2		Acrylic Board with Lego Holes T=3mm	1
3		4.5V Motor	4
4		23*15*5MM Fixing Board	4
5		Servo	1

6		Mecanum Wheels	4
7		Keyestudio Micro:bit IO Port Expansion Sensor Shield With Level Conversion	1
8		Micro:bit Main Board V2.0 with Package for KS4031	1
		Micro:bit Main Board V2.0 with Package for KS4032	0
9		Keyestudio Driver Board	1

10		M3*20MM Dual-pass Copper Pillar	4
11		4265c Lego Part	4
12		43093 Lego Part	4
13		Acrylic Gasket Six in One Pack	1
14		M3*6MM Round Head Screw	18

15		Keyestudio Ultrasonic Module	1
16		M3 Nickle-plated Nut	14
17		M3*30MM Round Head Screw	9
18		M2 Nickle-plated Nut	3
19		M2*8MM Round Head Screw	3
20		M3*8MM Round Head Screw	5
21		Remote Control (without batteries)	1
22		Plastic String 3*100mm	5

23		USB Cable	1
24		HX-2.54 2P DuPont Wire 100mm	1
25		HX-2.54 4P DuPont Wire 50mm	2
26		XH2.54 4P DuPont Wire 160mm	1
27		XH2.54 3P DuPont Wire 50mm	2
28		3*40mm Screwdriver	1
29		M1.2*5mm Round Head Self-tapping Screw	6

5.Preparations:

5.1Background Information about Micro:bit

(1)What is Micro:bit?

Micro:bit is an open source hardware platform based on the ARM architecture launched by British Broadcasting Corporation (BBC) together with ARM, Barclays, element14, Microsoft and other institutions. The core device is a 32-bit Arm Cortex-M4 with FPU micro-processing.

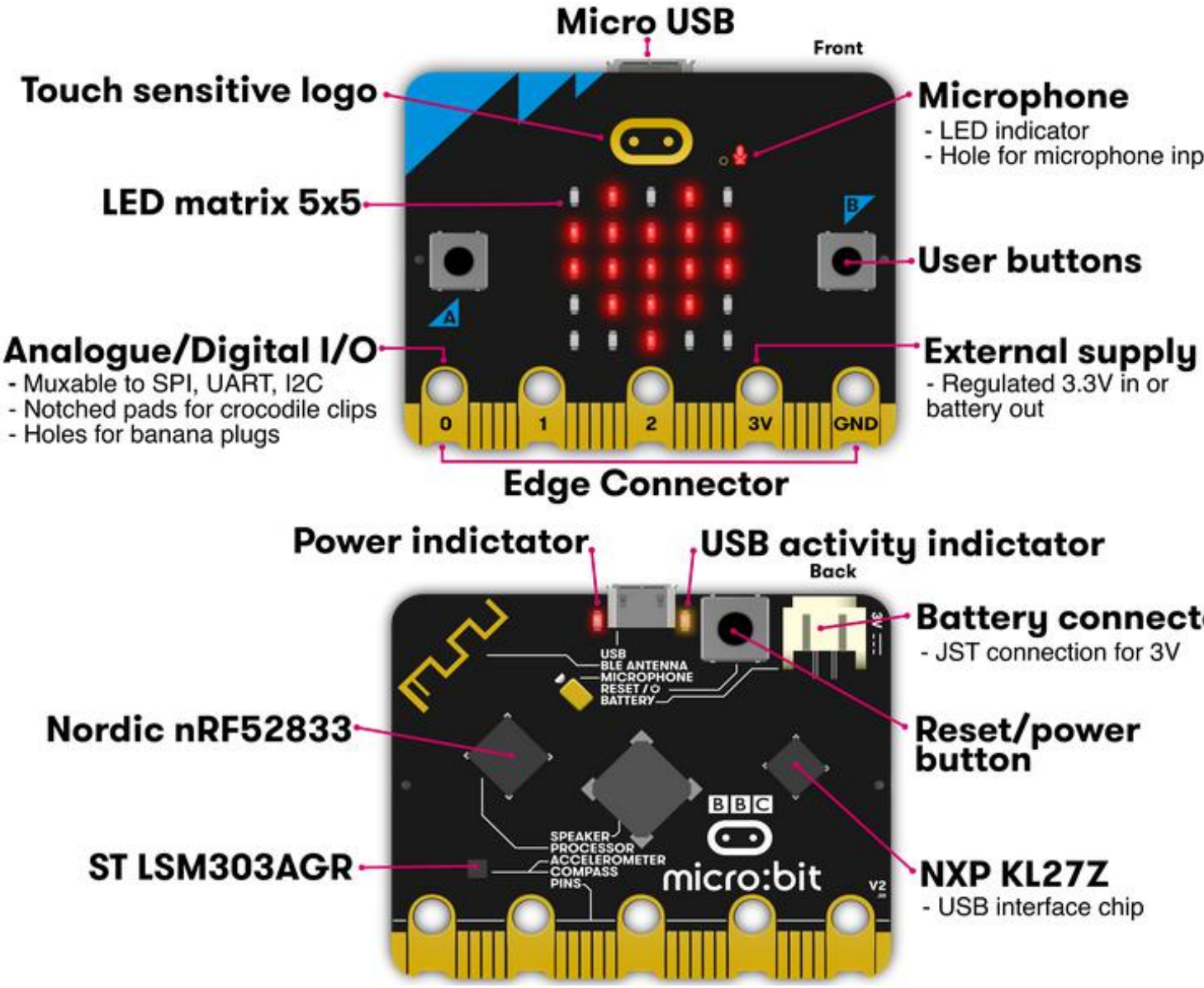
Though it is just the size of a credit card, the Micro:bit main board is equipped with loads of components,including a 5*5 LED dot matrix, 2 programmable buttons, an accelerometer, a compass, a thermometer, a touch-sensitive logo and a MEMS microphone, a Bluetooth module of low energy, and a buzzer and others. Thus, it also boasts multiple functions.

The buzzer built in the other side of the board makes playing all kinds of sound possible without any external equipment. The golden fingers and gears added provide a better fixing of crocodile clips. Moreover, this board has a sleeping mode to lower power consumption of batteries and it can be entered if users long press the Reset & Power button on the back of it. It is capable of reading the data of sensors, controlling servos and RGB lights and attaching with a shield so as to connect with various sensors. It also supports a variety of codes and graphical programming platforms, and is compatible with almost all PCs and mobile devices. It has no need to install drivers. It is of high integration of electronic modules, and has a serial port

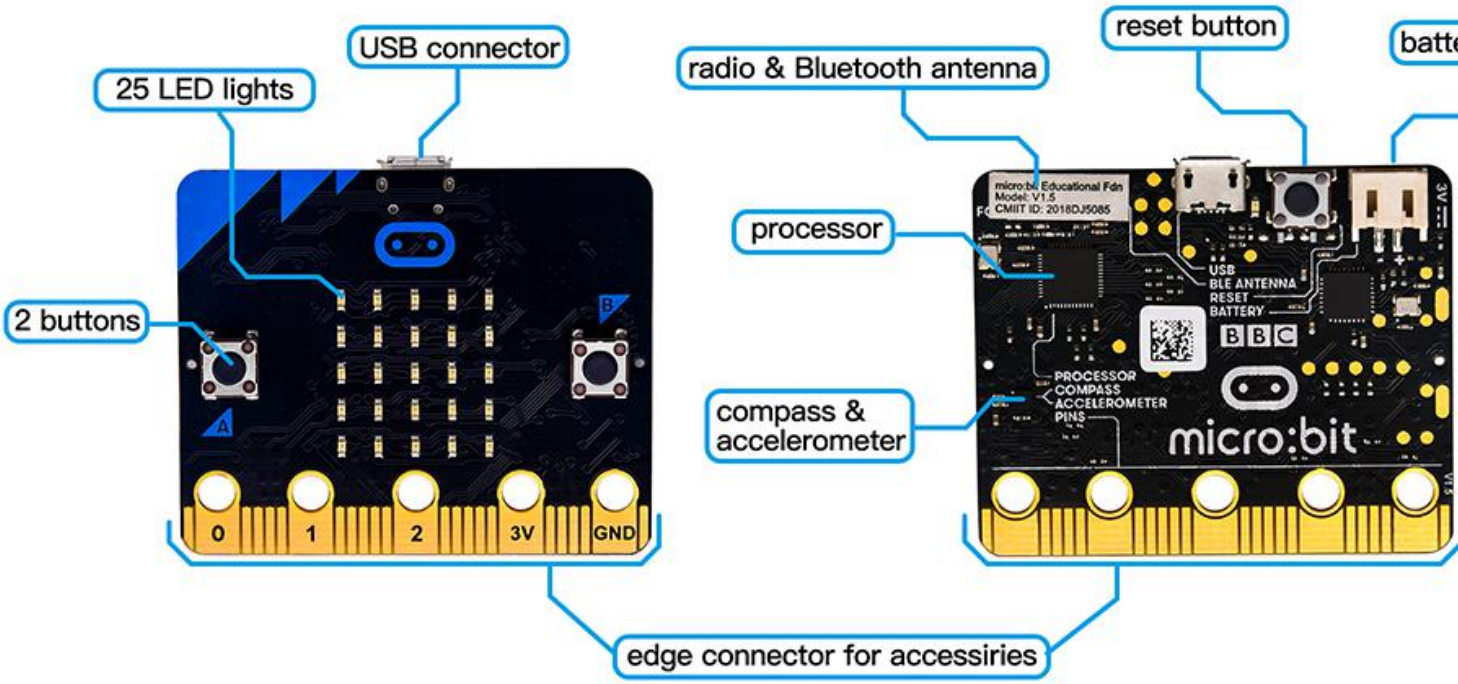
monitoring function for easy debugging.

The board has found wide applications. It can be applied in programming video games, making interactions between light and sound, controlling a robot, conducting scientific experiments, developing wearable devices and make some cool inventions like robots and musical instruments, basically everything imaginable.

(2)Layout


Micro USB
Front
Touch sensitive logo
Microphone
- LED indicator
- Hole for microphone inp
LED matrix 5x5
User buttons
Analogue/Digital I/O
- Muxable to SPI, UART, I2C
- Notched pads for crocodile clips
- Holes for banana plugs
External supply
- Regulated 3.3V in or battery out
0
1
2
3V
GND
Edge Connector
Power indictator
USB activity indictator
Back
Battery connect
- JST connection for 3V
USB
BLE ANTENNA
MICROPHONE
RESET / O
BATTERY
Nordic nRF52833
Reset/power button
SPEAKER
PROCESSOR
ACCELEROMETER
COMPASS
PINS
ST LSM303AGR
micro:bit
V2
NXP KL27Z
- USB interface chip

Micro:bit V2



Micro:bit V1.5

(2) Comparison between V2.0 & V1.5

	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 flickers into darkness,

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:

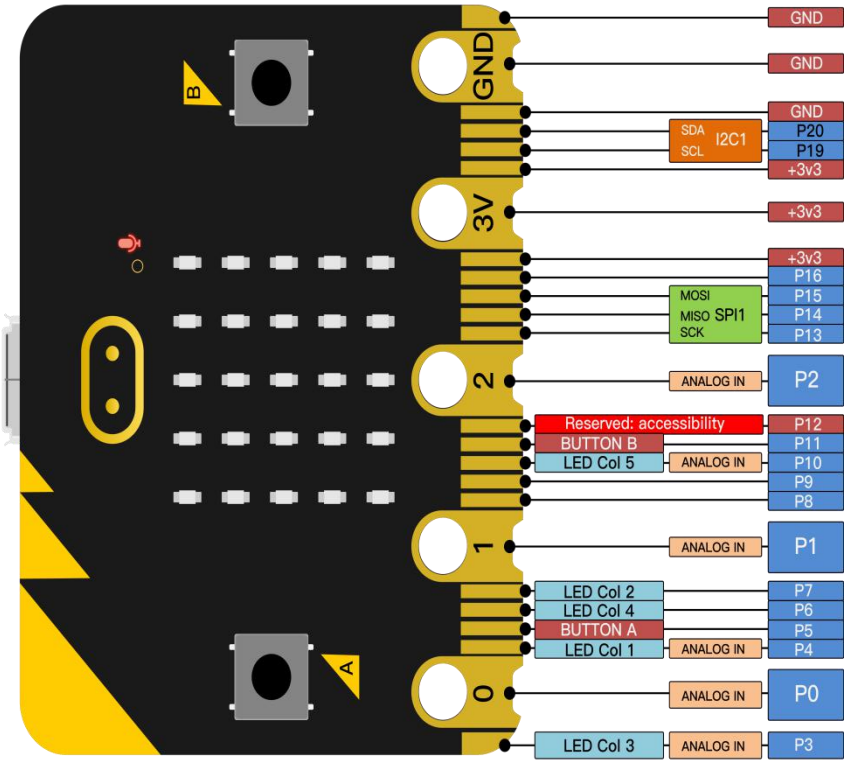
https://tech.microbit.org/hardware/

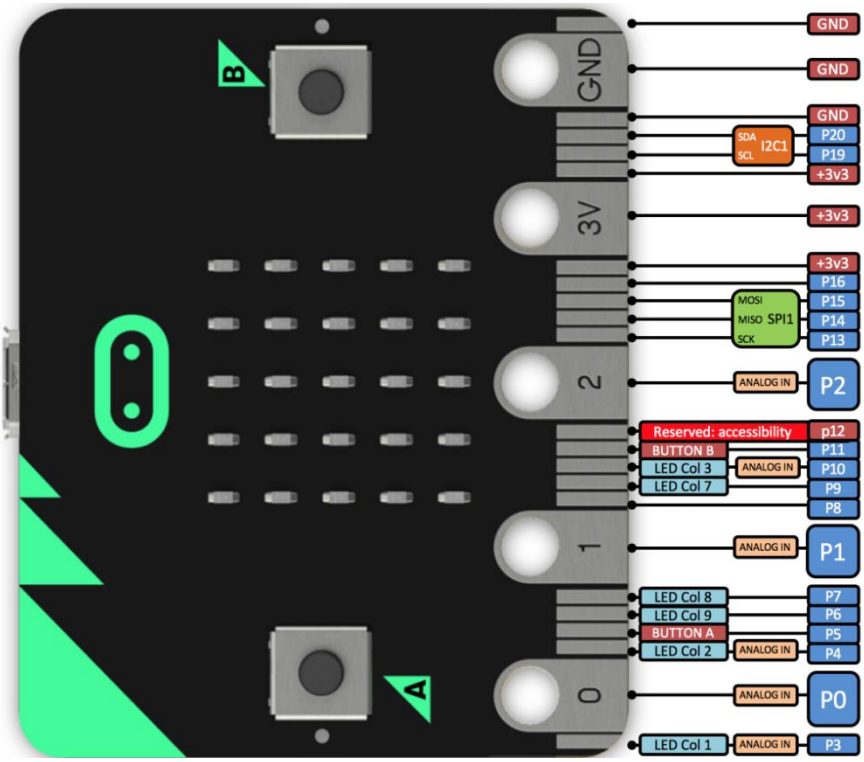
https://microbit.org/new-microbit/

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

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

(3) Pinout





The functions of pins:

GPIO	P0，P1，P2，P3，P4，P5，P6，P7，P8，P9，P10，P11，P12，P13，P14，P15，P16，P19，P20
ADC/DAC	P0，P1，P2，P3，P4，P10
IIC	P19（SCL），P20（SDA）
SPI	P13（SCK），P14（MISO），P15（MOSI）
PWM（used frequently）	P0，P1，P2，P3，P4，P10
PWM（not frequently used）	P5、P6、P7、P8、P9、P11、P12、P13、P14、P15、P16、P19、P20
Occupied	P3(LED Col3)，P4(LED Col1)，P5(Button A)，P6(LED Col4)，

	P7(LED Col2)，P10(LED Col5)，P11(Button B)

Browse the official website for more details:

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

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

(4)Notes for the application of Micro:bit main board

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 and P10)shared with the LED dot matrix, blocking them from the matrix or the LEDs may display randomly and the data about sensors connected maybe wrong.

e. Pin 19 and 20 can not be used as IO ports though the Makecode shows they can. They can only be used as I2C communication.

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

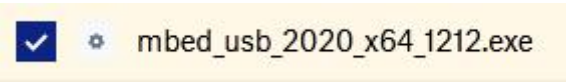
g. Forbid to operate it on metal products to avoid short circuit.

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

5.2.Install Micro:bit driver

Micro:bit is free of driver installation. However, in case your computer fail to recognize the main board, you can install the diver too.

Just enter the link https://fs.keyestudio.com/KS4031-4032

to download the driver file 

of micro:bit in file folder 

6.keyestudio 4WD Mecanum Robot Car

This chapter will introduce the function and structure of keyestudio 4WD Mecanum Robot Car. It is a programmable car based on BBC micro:bit. Driven by motors, it boasts a line tracking sensor and an infrared receiver integrated into the bottom plate, an ultrasonic sensor, servos ,2 colorful lights, 4 WS2812 RGB lights. The wiring is not complicated and it has Lego jacks to facilitate connection with other peripheral devices. Abundant hardware resources will enable you to master more knowledge and skills, so that you can use your imagination to create more technological inventions.

6.1.Basic Information about Keyestudio 4WD Mecanum Robot Car

This car can help you to better learn to use Micro:bit and obtain electronic knowledge.

Components:an ultrasonic sensor, servos ,2 colorful lights, 4 WS2812 RGB lights 4 decelerating DC motors, Mecanum wheels,

Sensor	Colorful light	Decelerating DC motor	Servo	Ultrasonic sensor	Line Tracking Sensor	Infrared Receiver	WS2812 RGB light	Power switch
#	2	4	1	1	1	1	4	1

Note: the line tracking sensor, WS2812 RGB lights and infrared receiver servo are integrated in the base.

Pins:

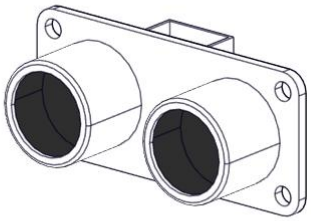
Pin on Micro:bit	Sensors of the keyestudio 4WD Mecanum Robot Car
P1 P2	Line Tracking Sensor
P14	Servo
P8	4个WS2812RGB Lights
P9	Infrared Receiver
P15P16	Ultrasonic Sensor

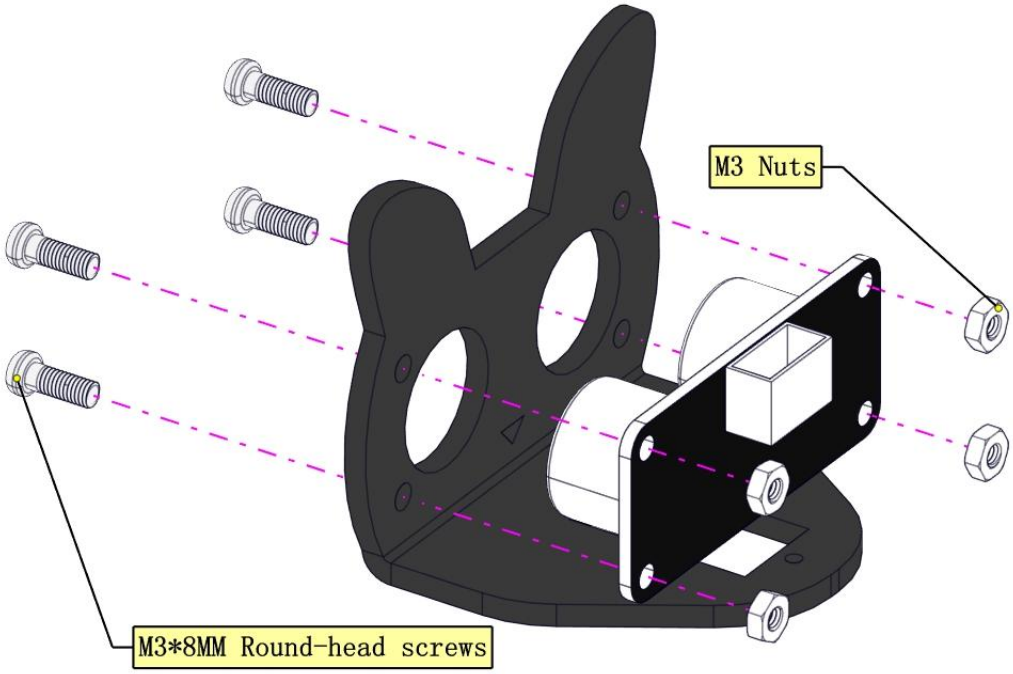
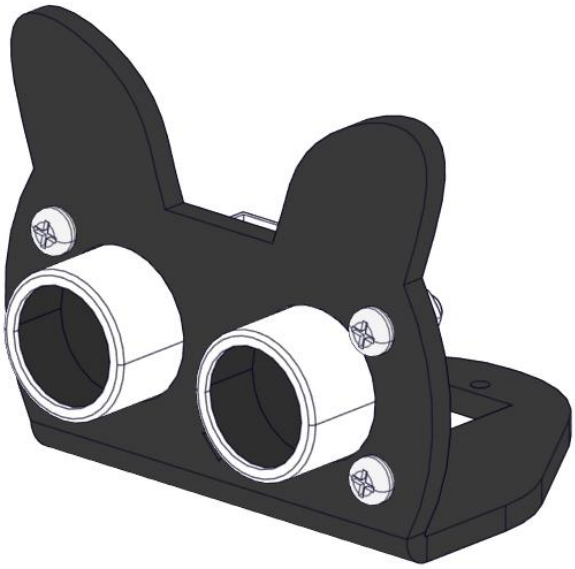
Power supply and Battery

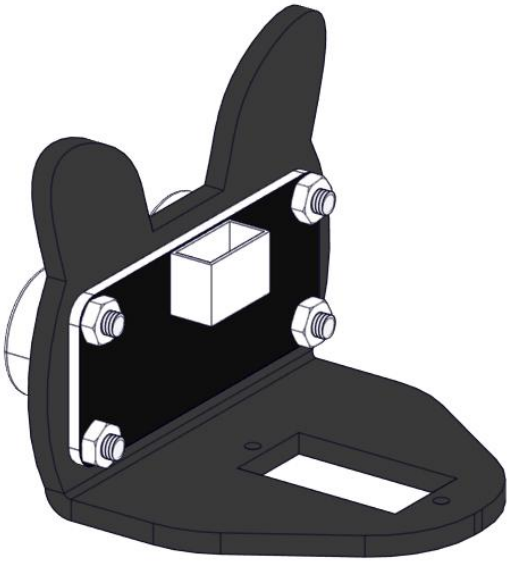
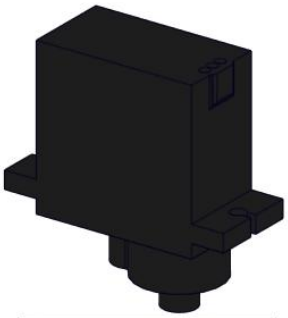
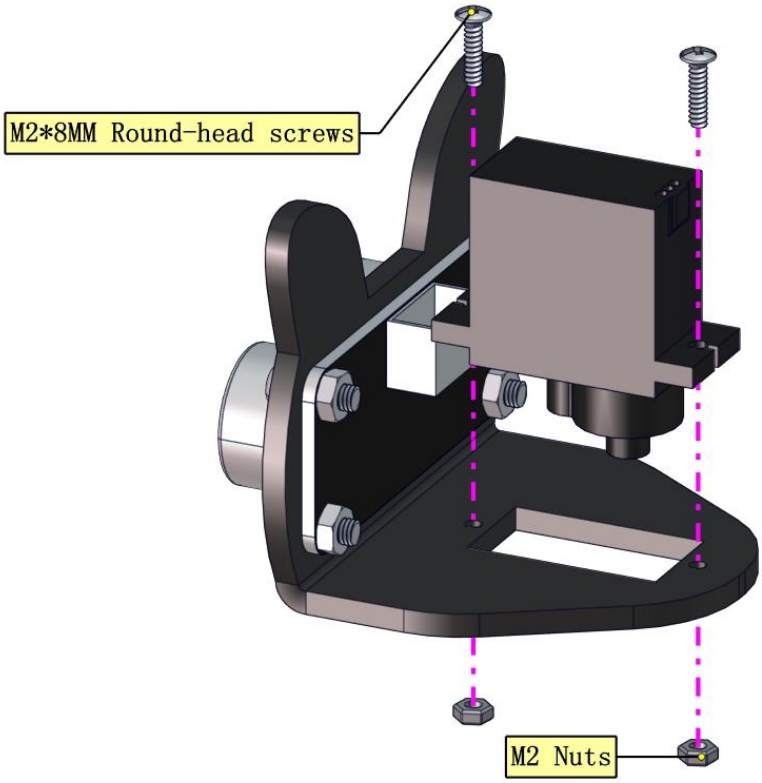
The keyestudio 4WD Mecanum Robot Car is powered by two 18650 batteries. The battery holder of the car is compatible with any type of 18650 lithium battery (rechargeable). You can use a universal battery charger to charge the 18650 lithium battery.

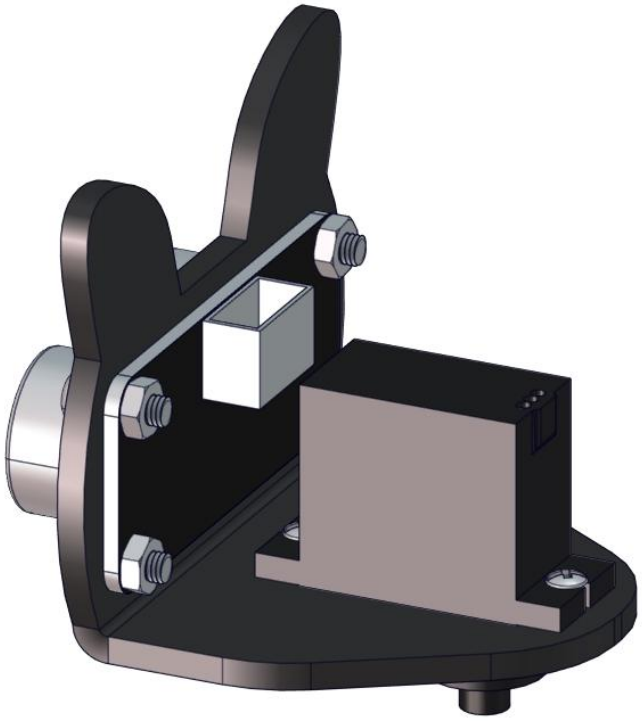
Please note: This product does not contain batteries.

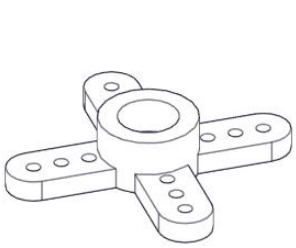
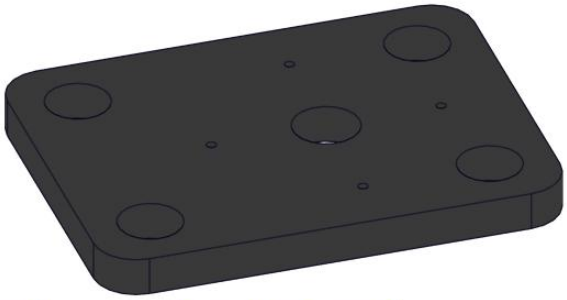
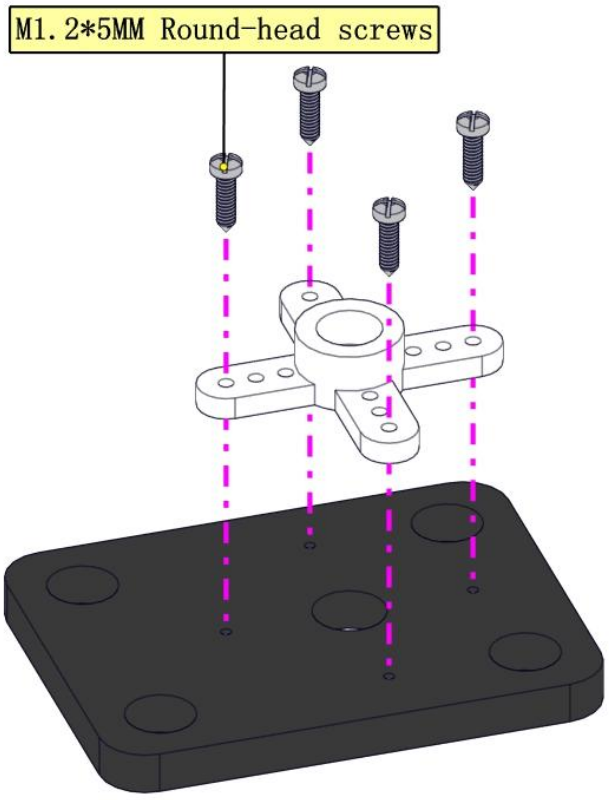
6.2. The Installation of Keyestudio 4WD Mecanum Robot Car

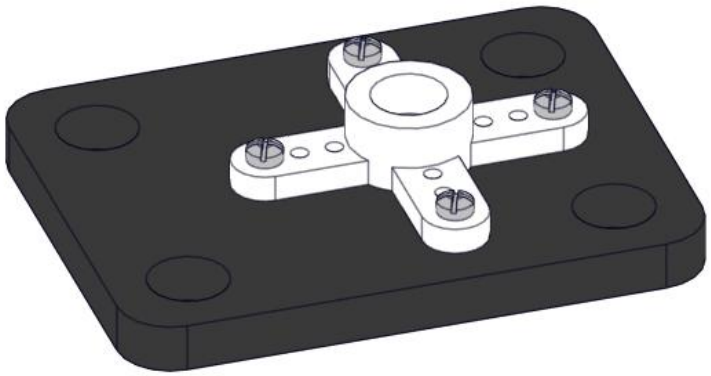
Part 1	
Components Needed	 Acrylic Boards ×1  Ultrasonic Sensor ×1  M3*8MM Round-head screws ×4  M3 Nuts ×4

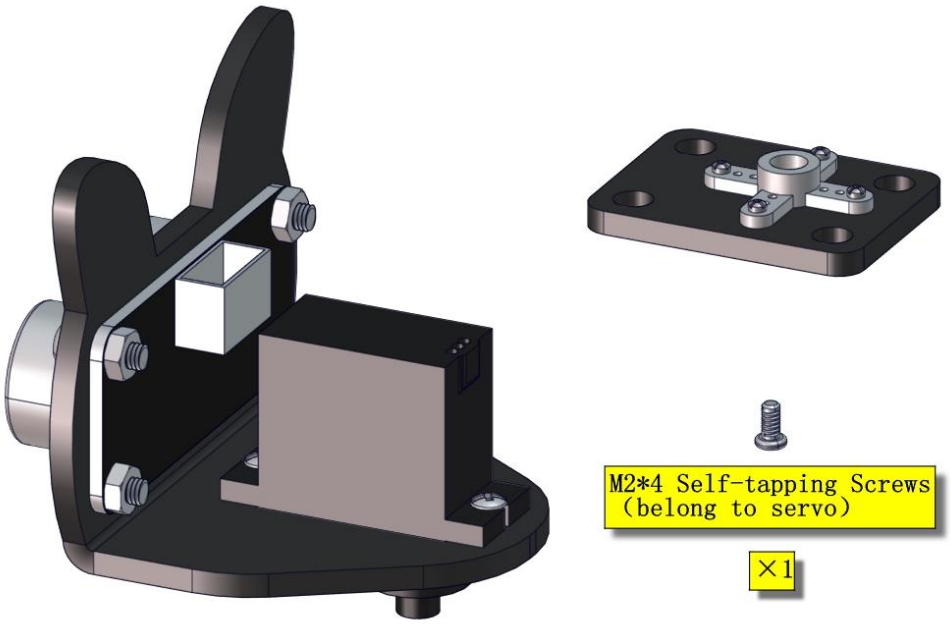
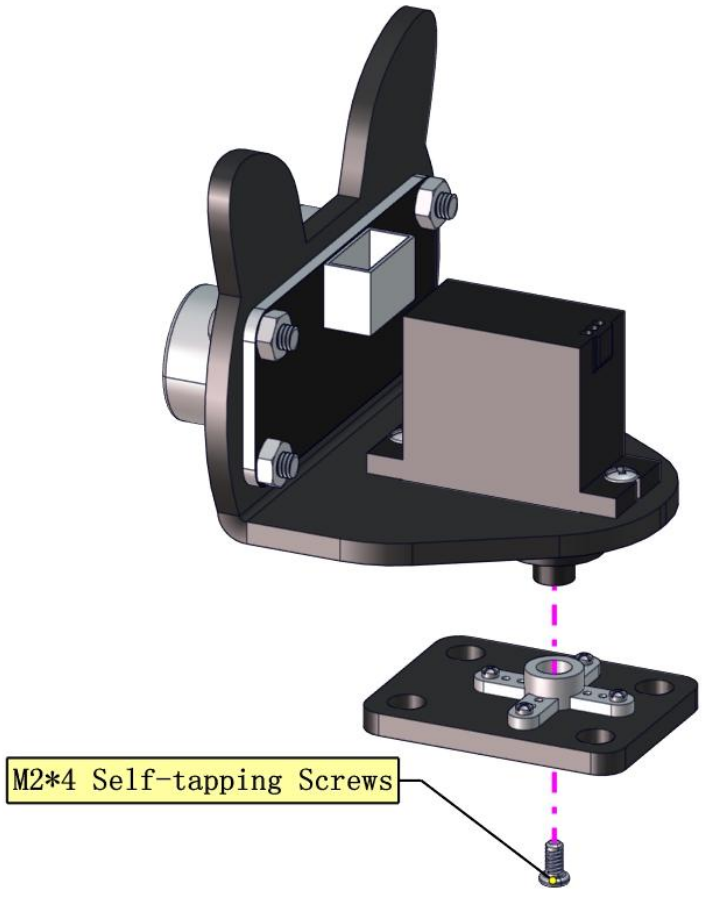
Installation Diagram	
Prototype	
Part 2	

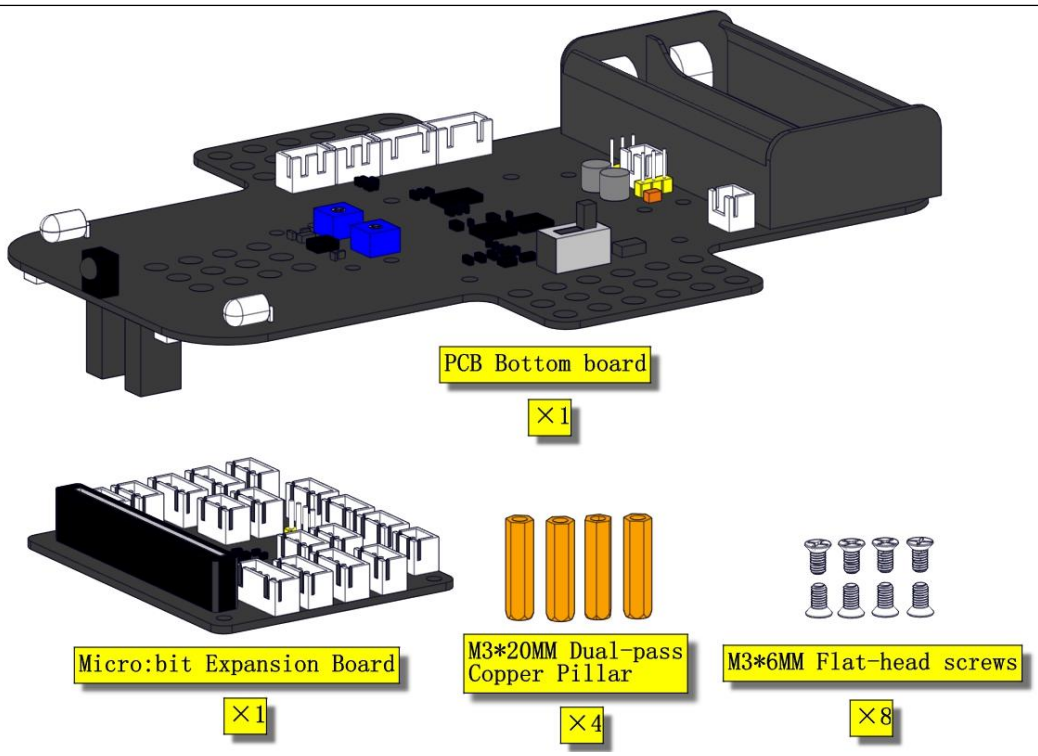
Components Needed	  Keyestudio Servo ×1  M2*8MM Round-head screws ×2  M2 Nuts ×2
Installation Diagram	 M2*8MM Round-head screws M2 Nuts

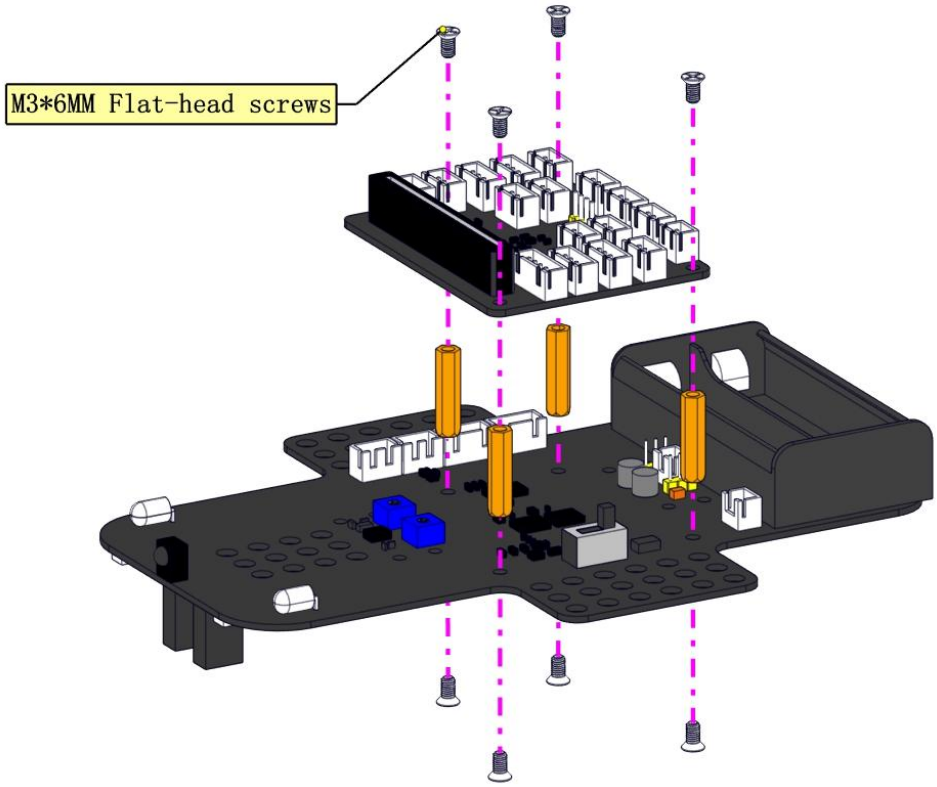
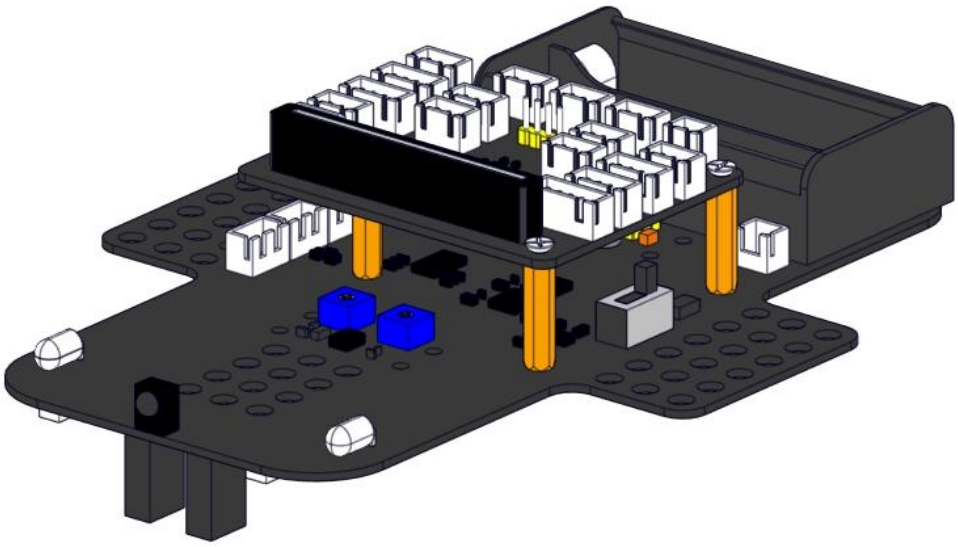
Prototype	
Part 3	

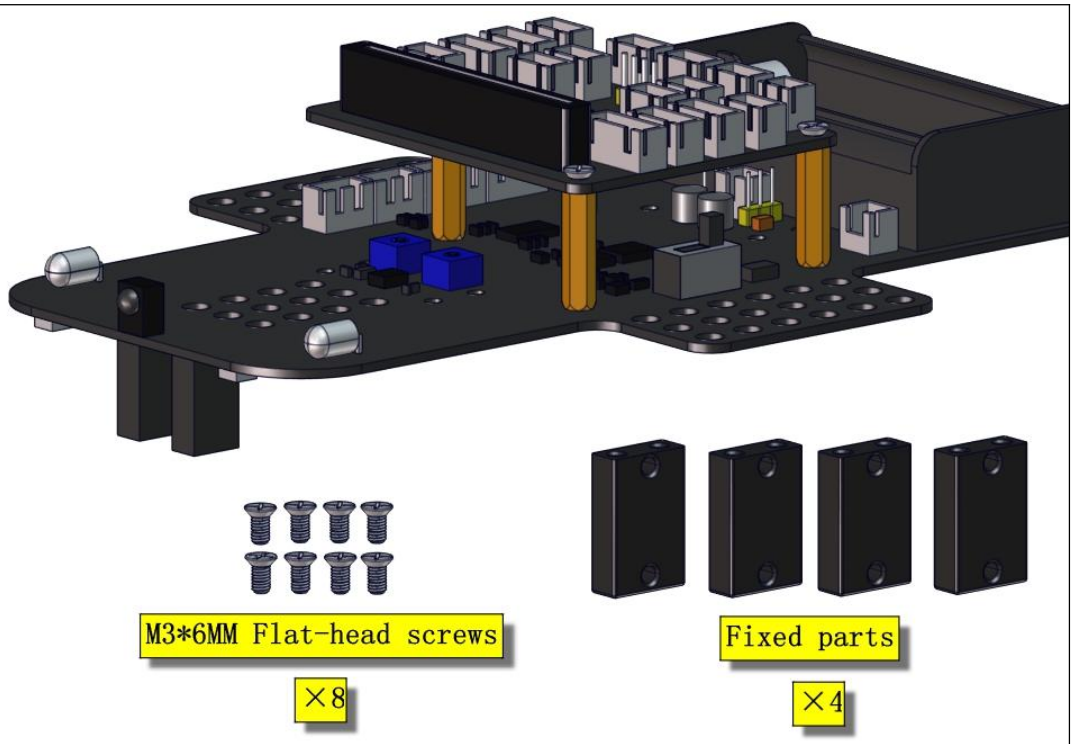
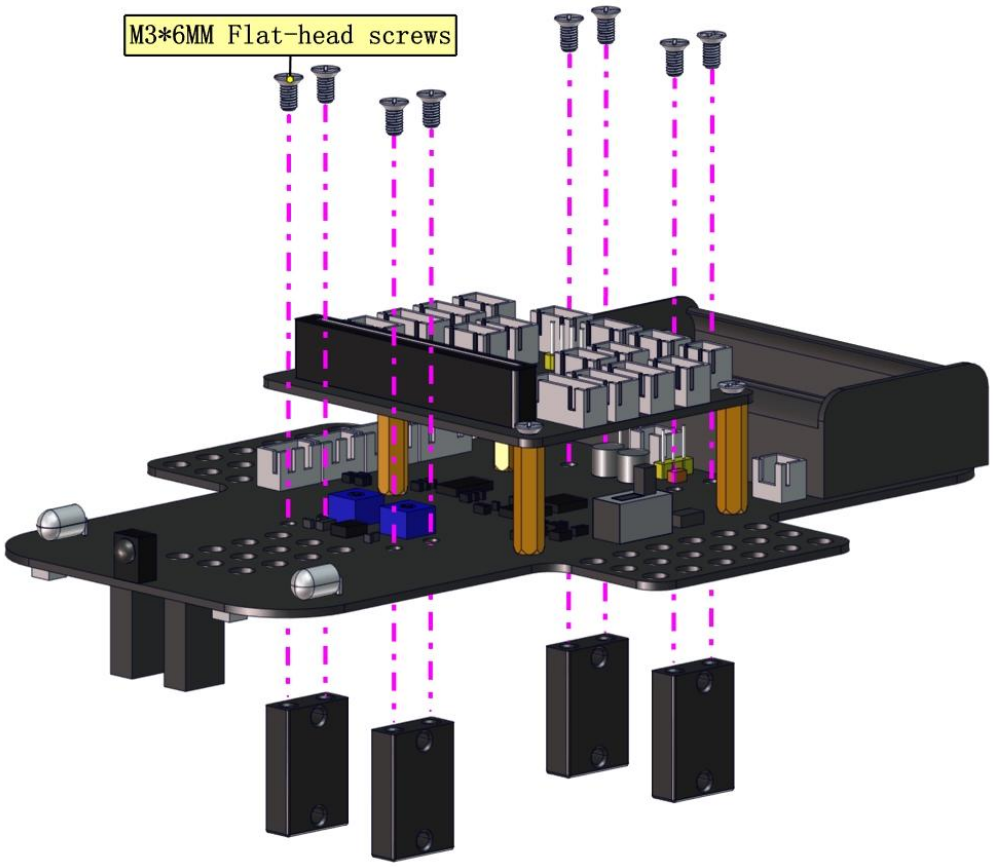
Components Needed	  Control horn(belong to servo) ×1 Acrylic Boards ×1  M1.2*5MM Round-head screws ×4
Installation Diagram	

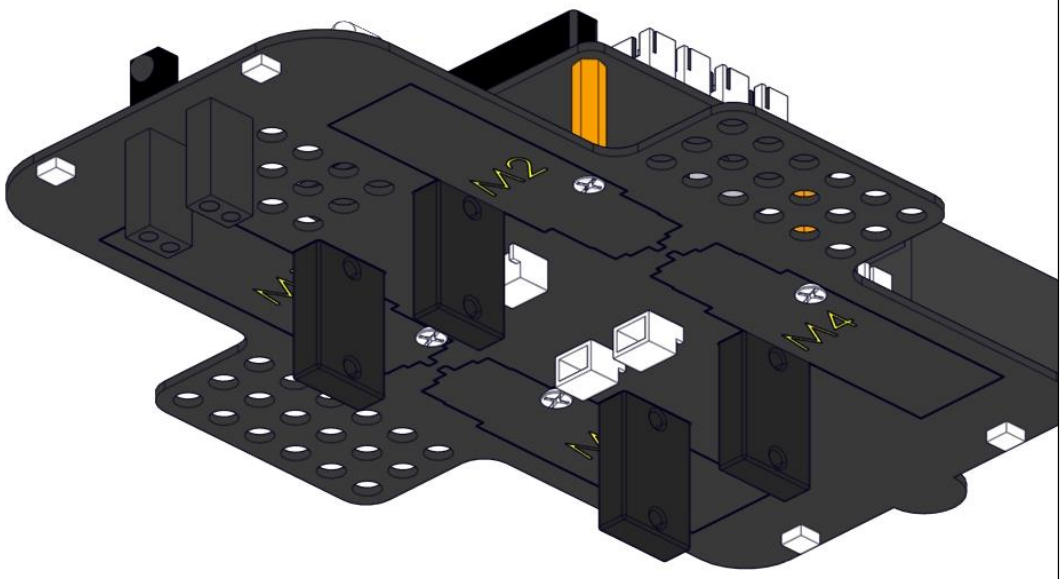
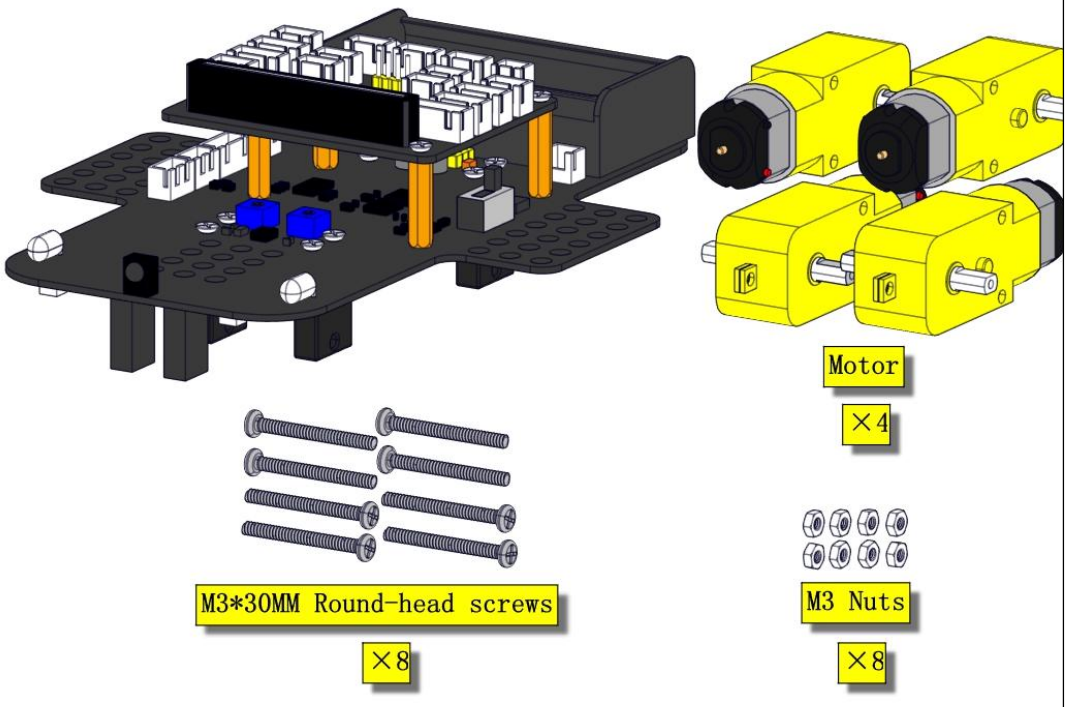
Prototype	
Part 4 (adjust the angle of the servo first)	
Adjust the angle of the servo to 90 degrees according to the test code in project 8.15.	

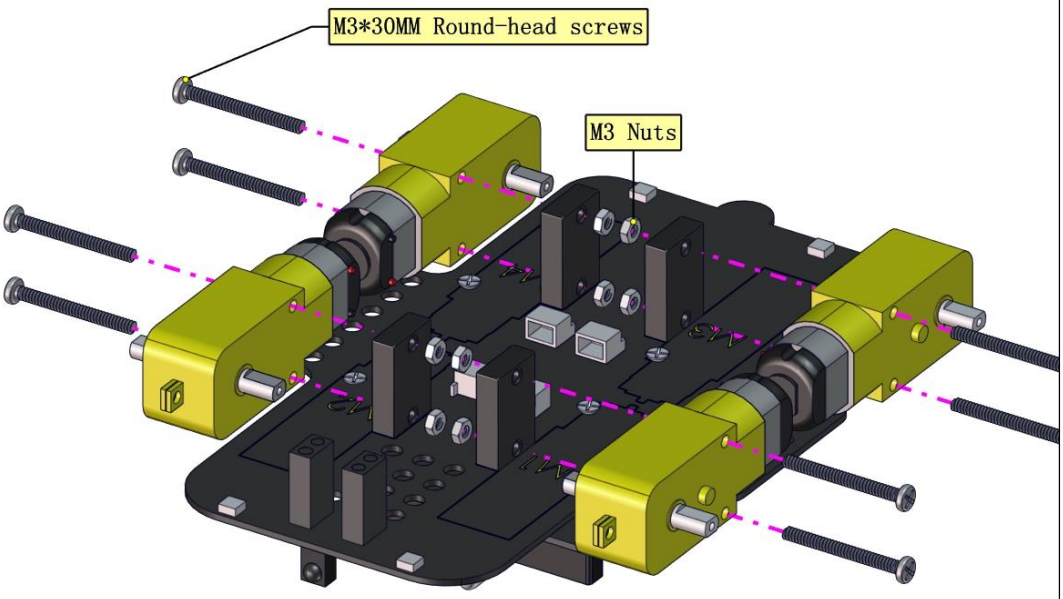
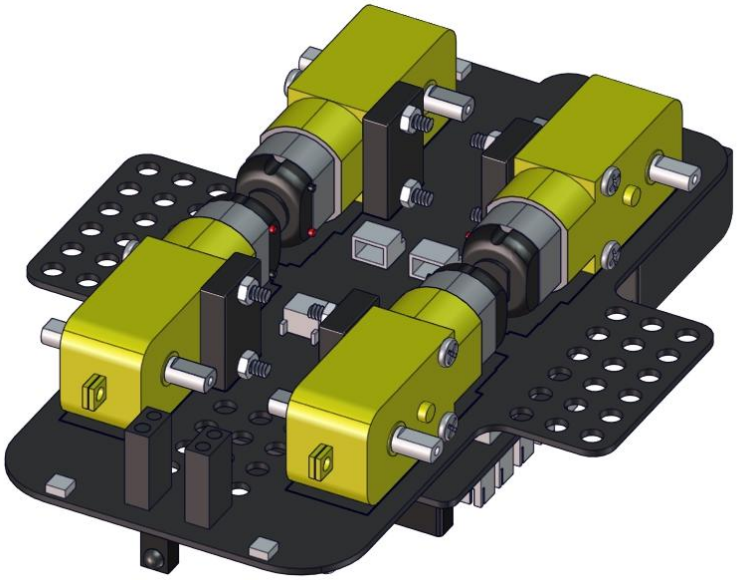
Components Needed	
Installation Diagram (mind the installation direction)	

Prototype	
Part 5	
Components Needed	

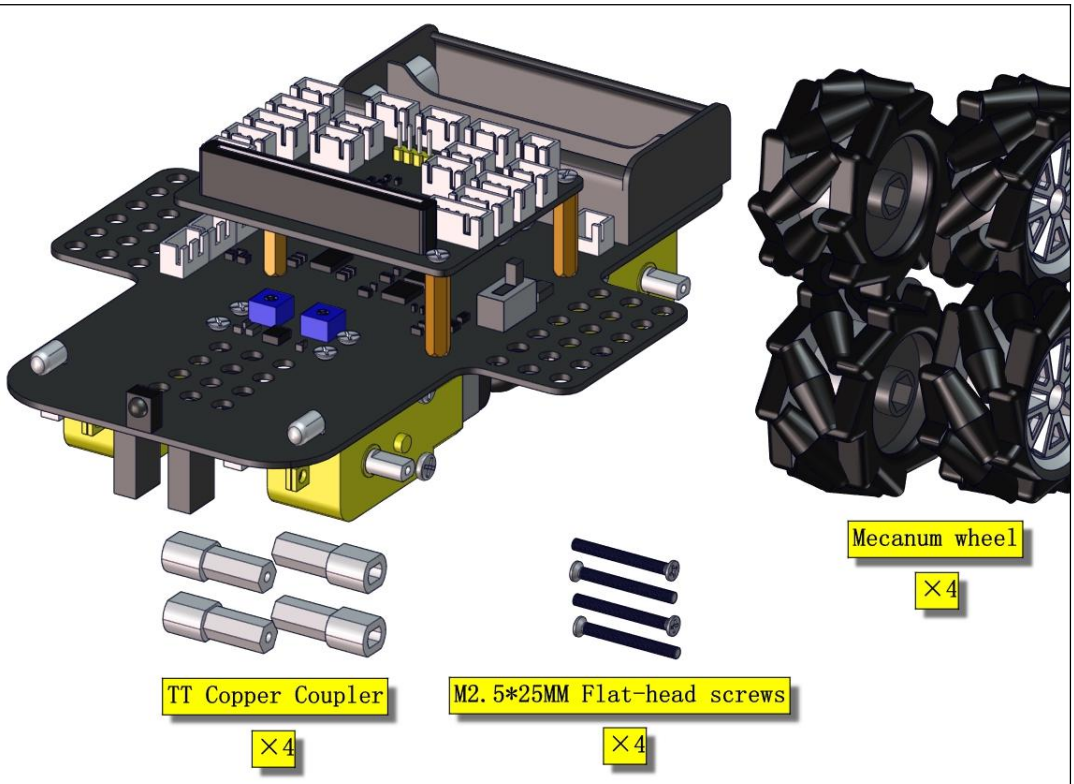
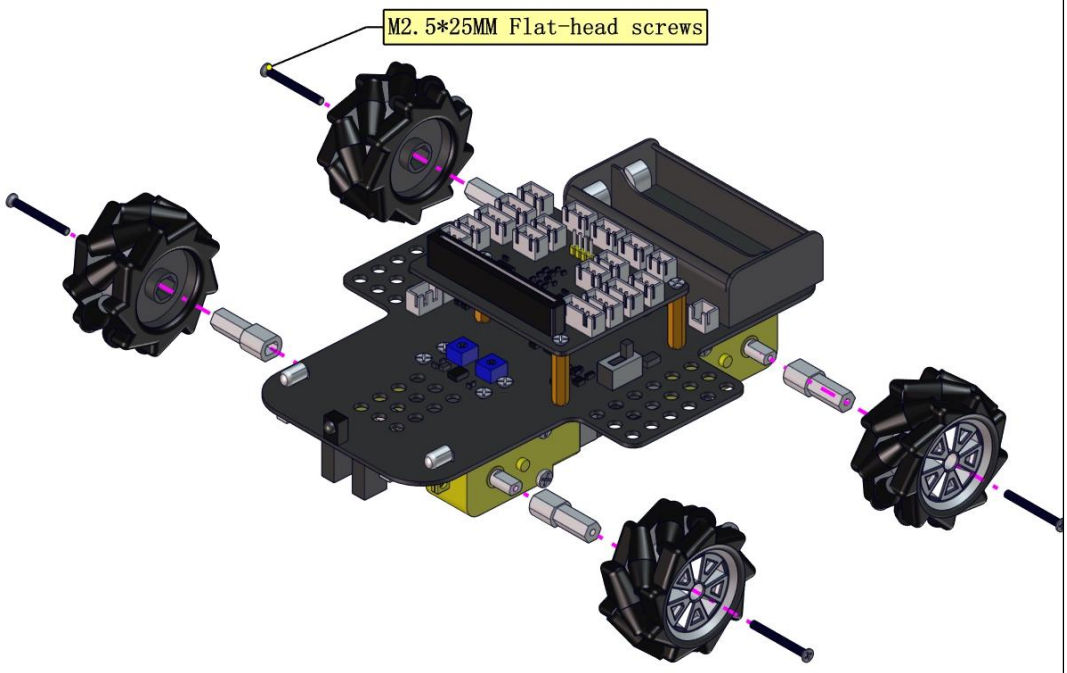
Installation Diagram	
Prototype	
Part 6	

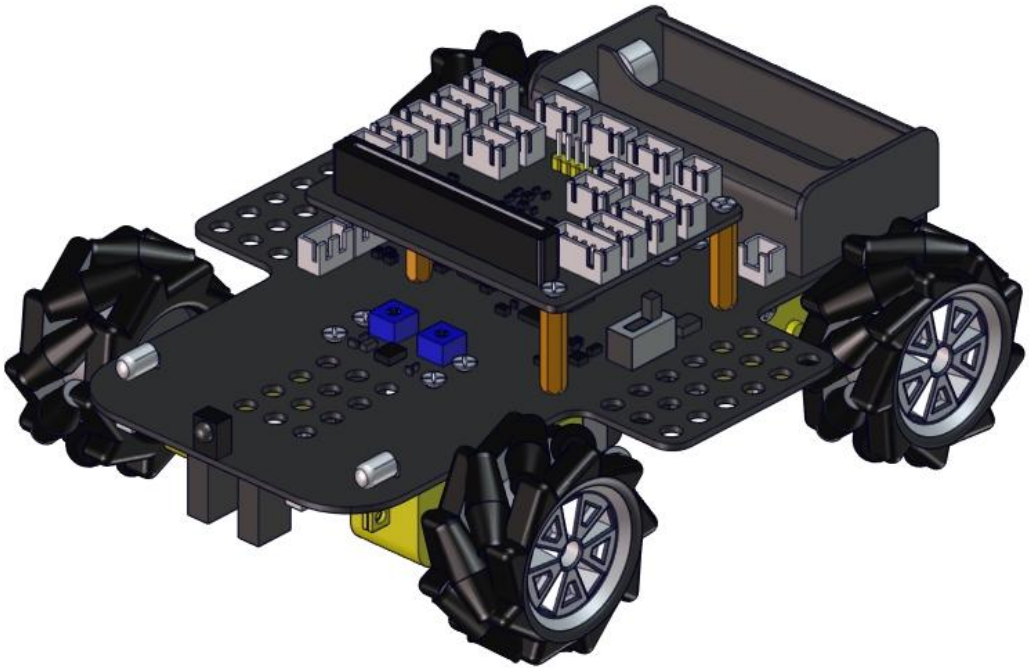
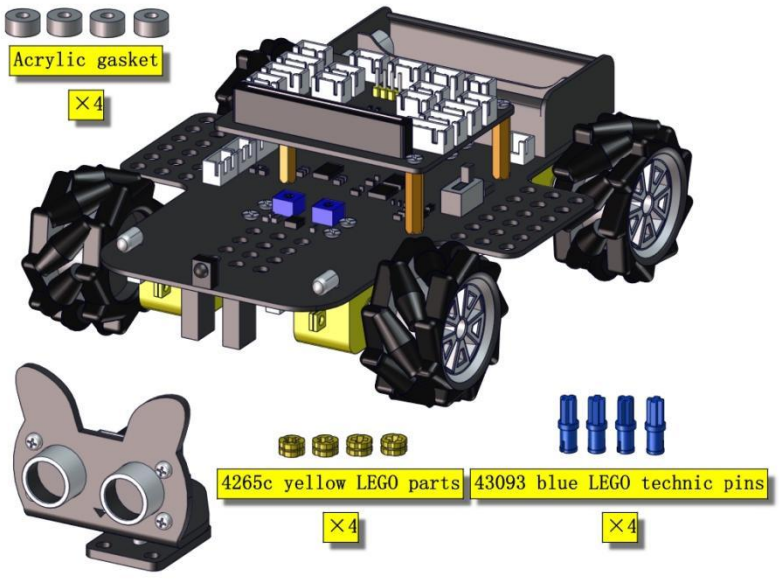
Components Needed	
Installation Diagram	

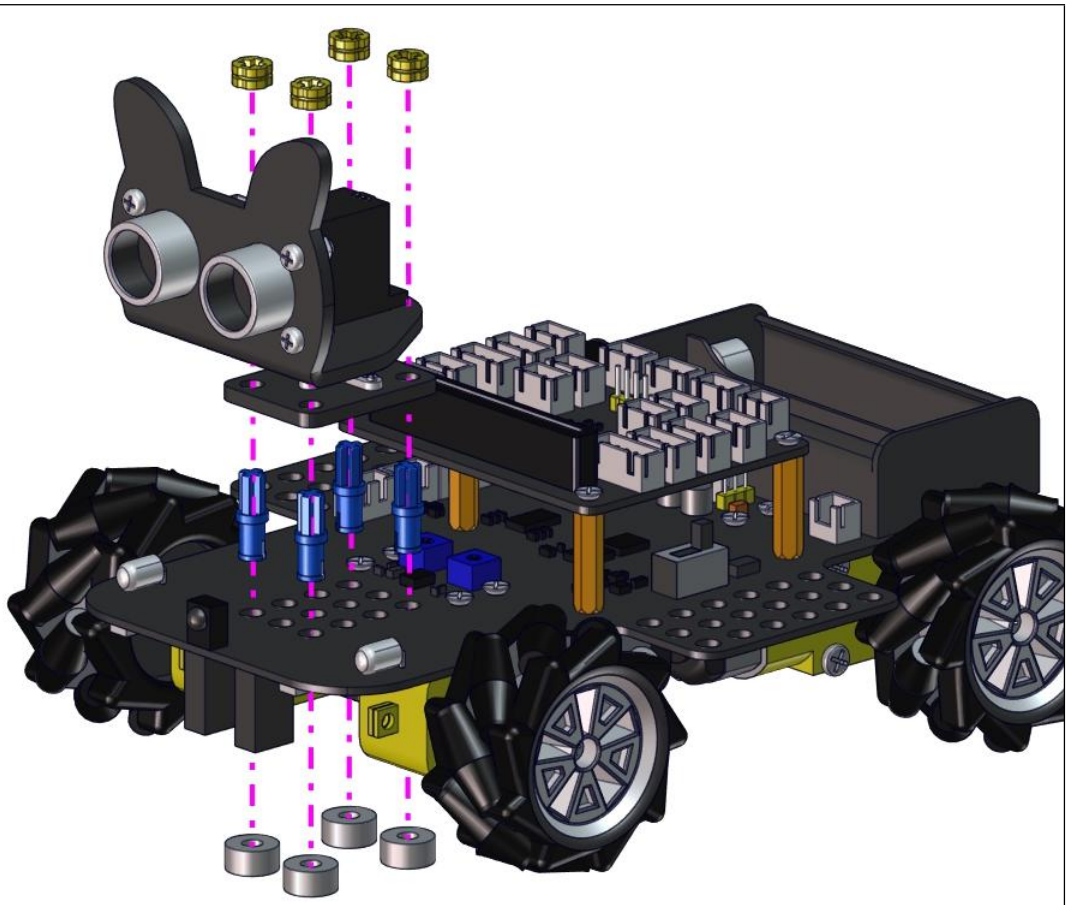
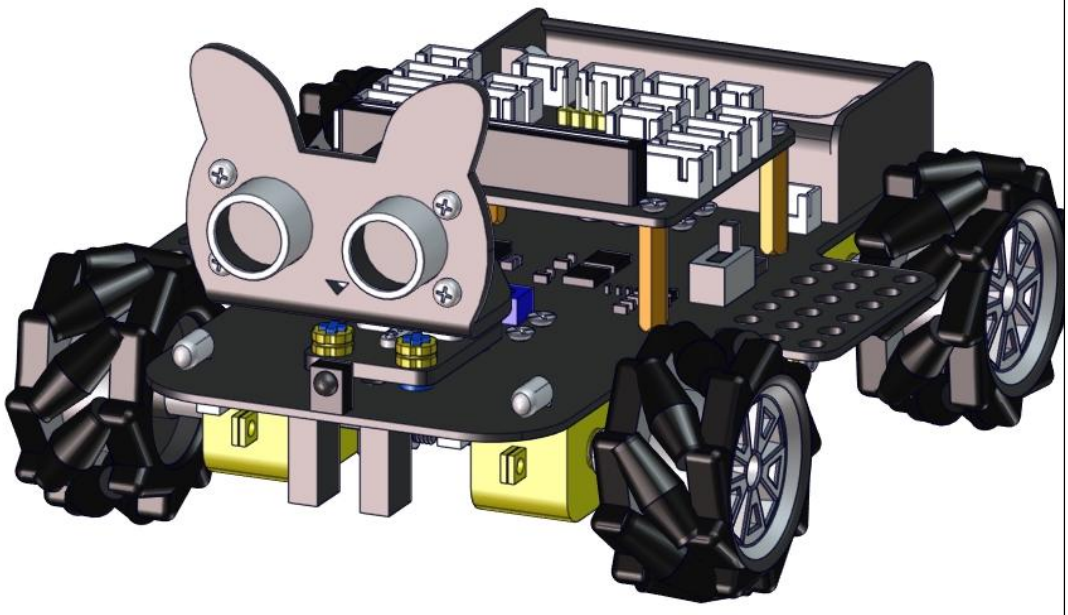
Prototype	
Part 7	
Components Needed	

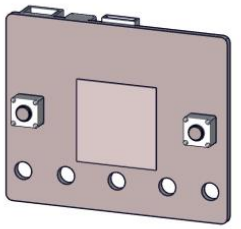
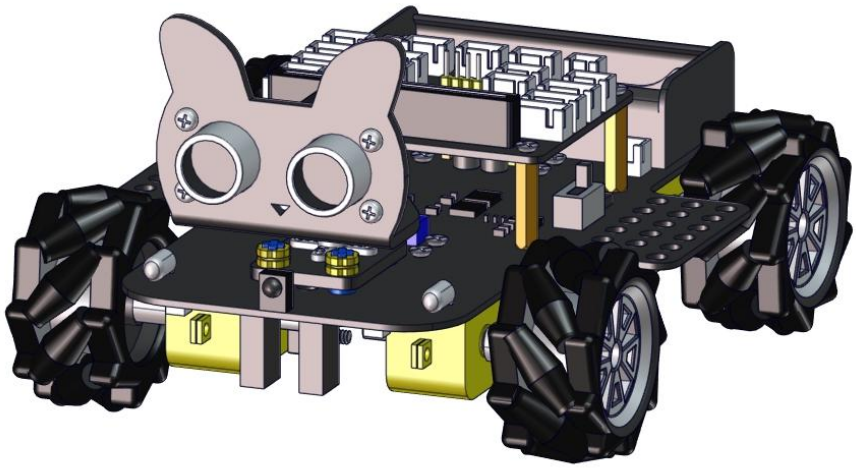
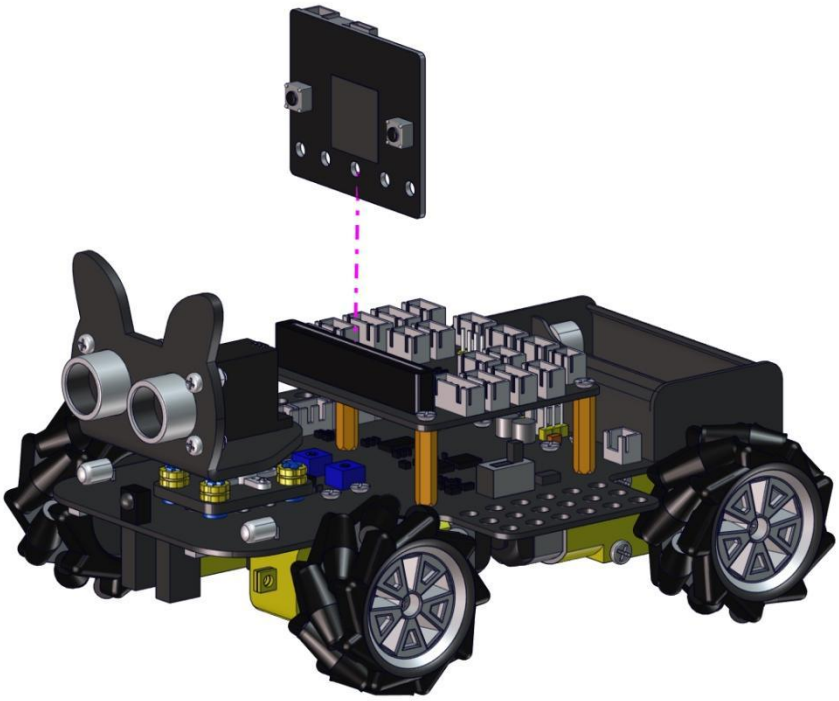
Installation Diagram (mind the direction of the motor)	
Prototype	

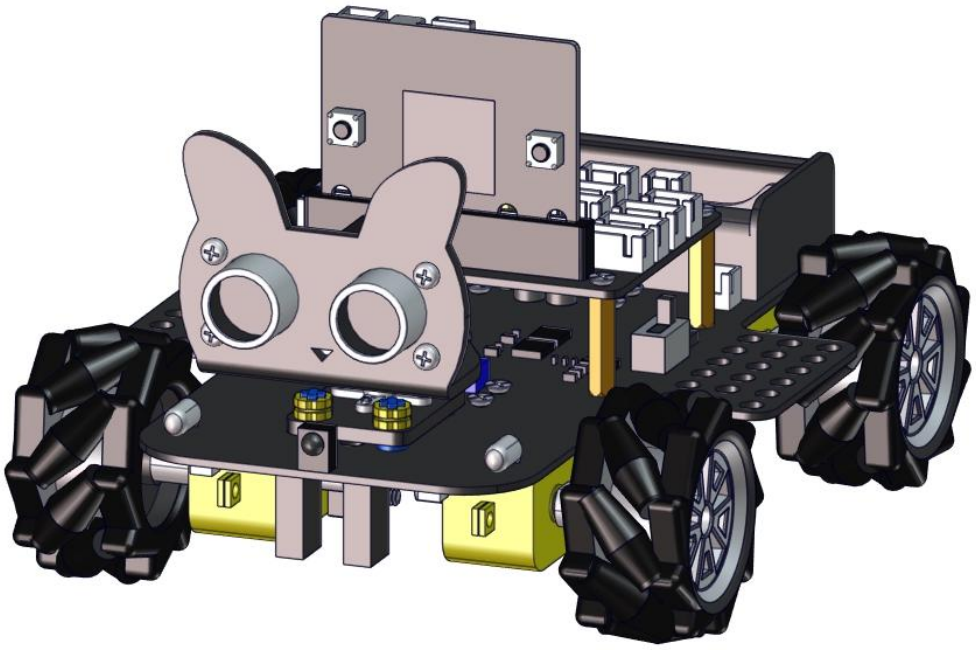
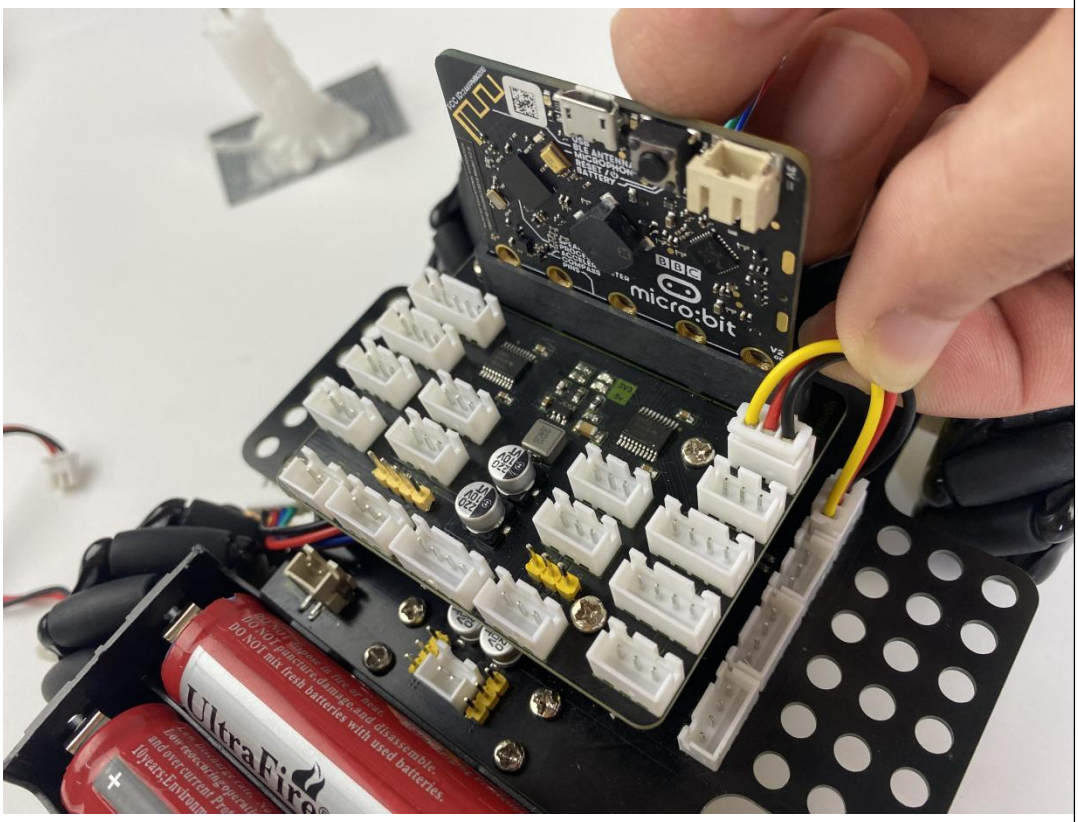
Part 8

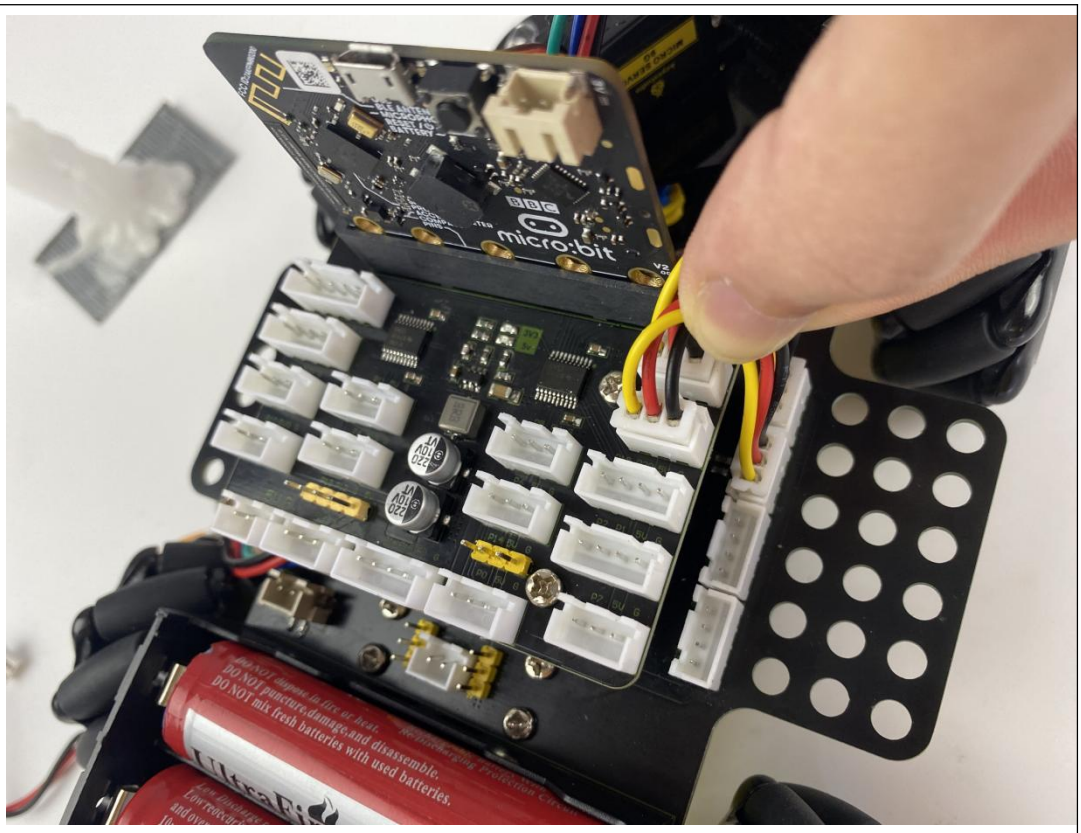
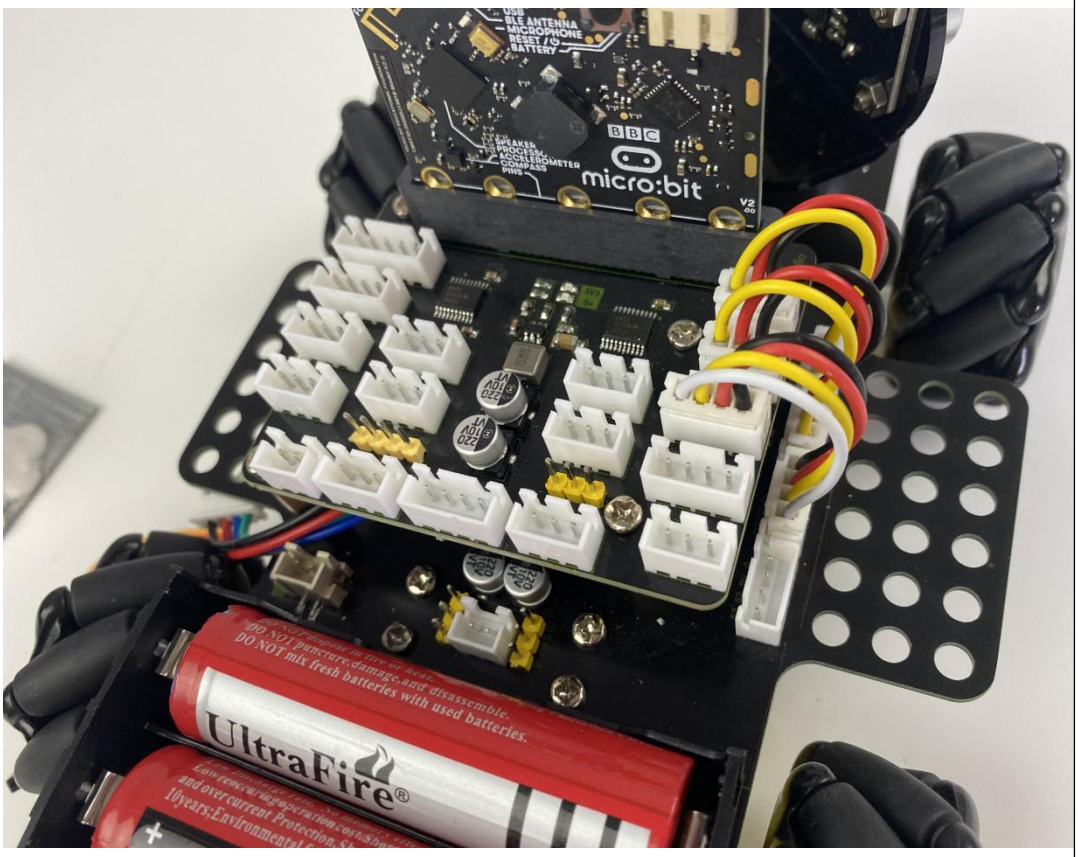
Components Needed	
Installation Diagram (Pay attention to the installation direction of the mecanum wheel)	

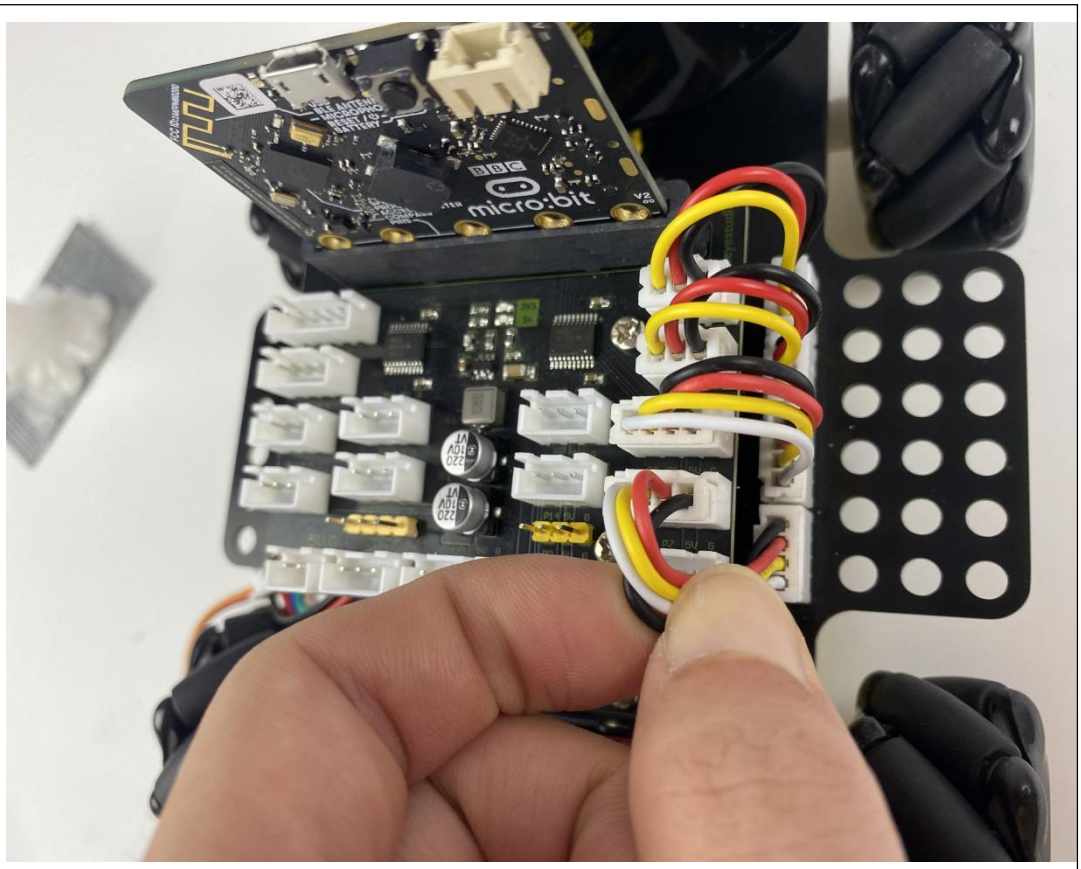
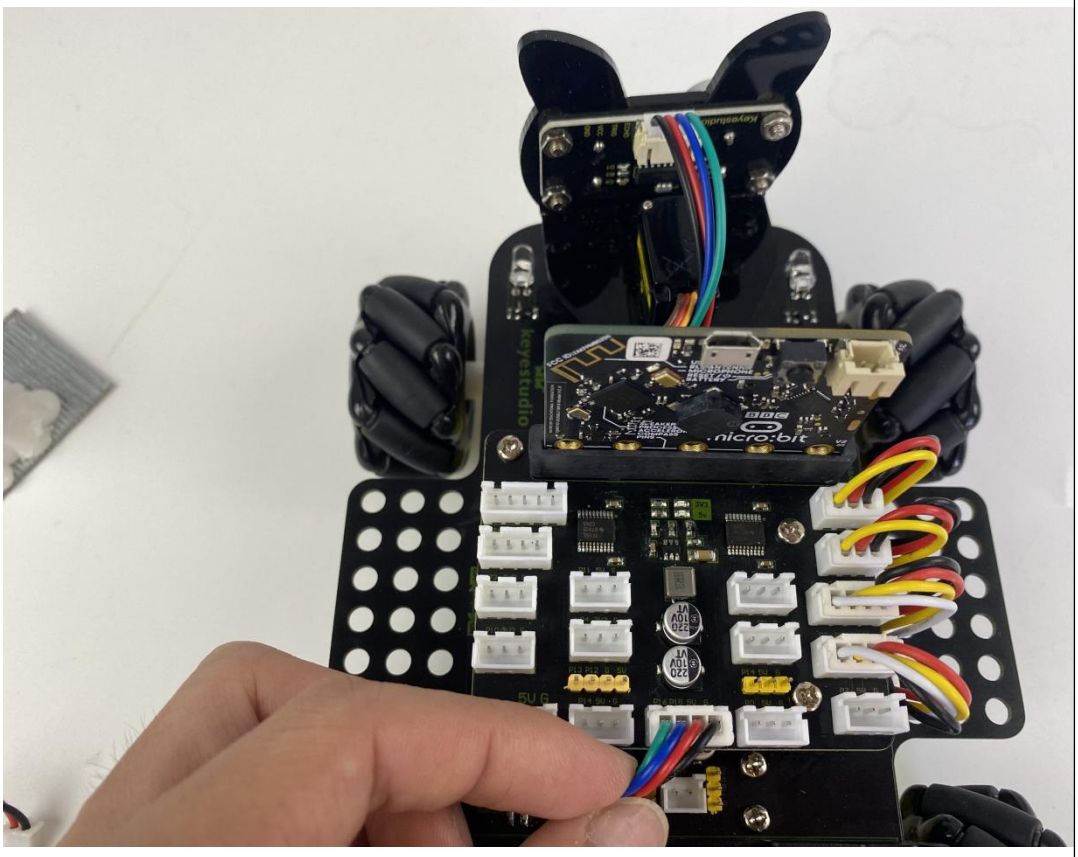
Prototype	
Part 9	
Components Needed	

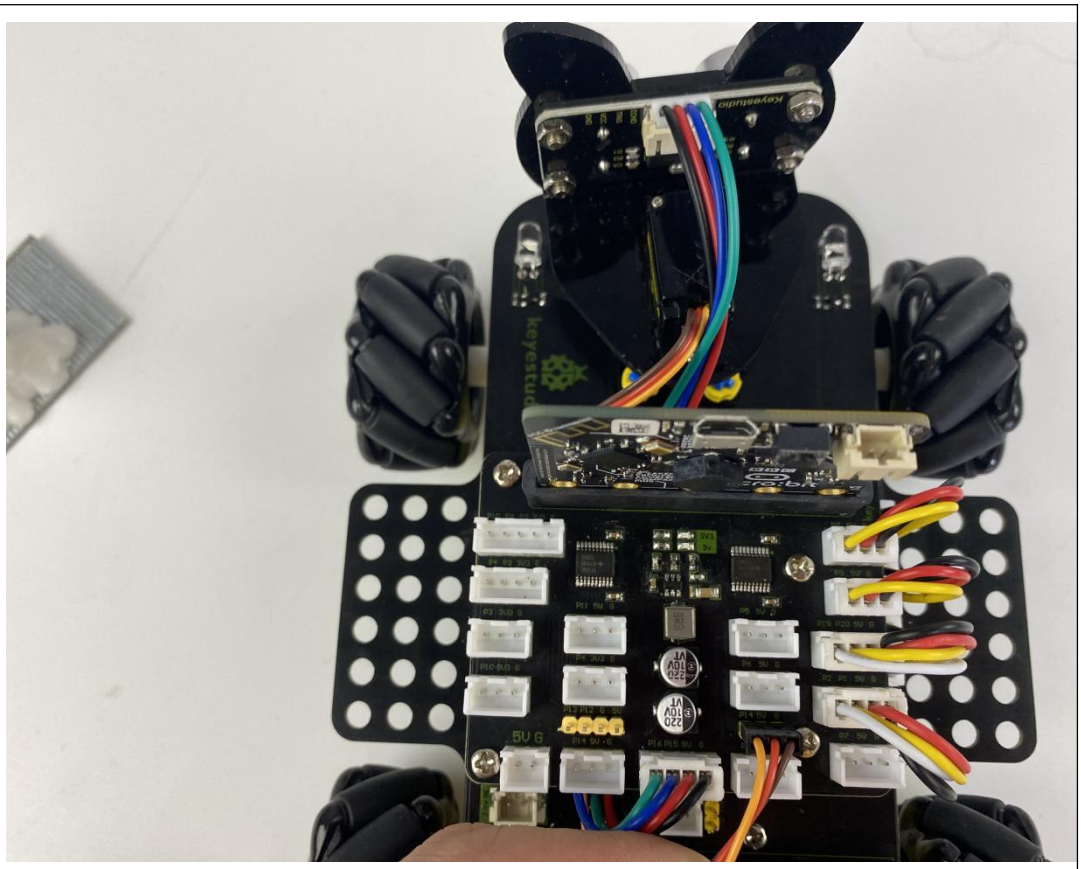
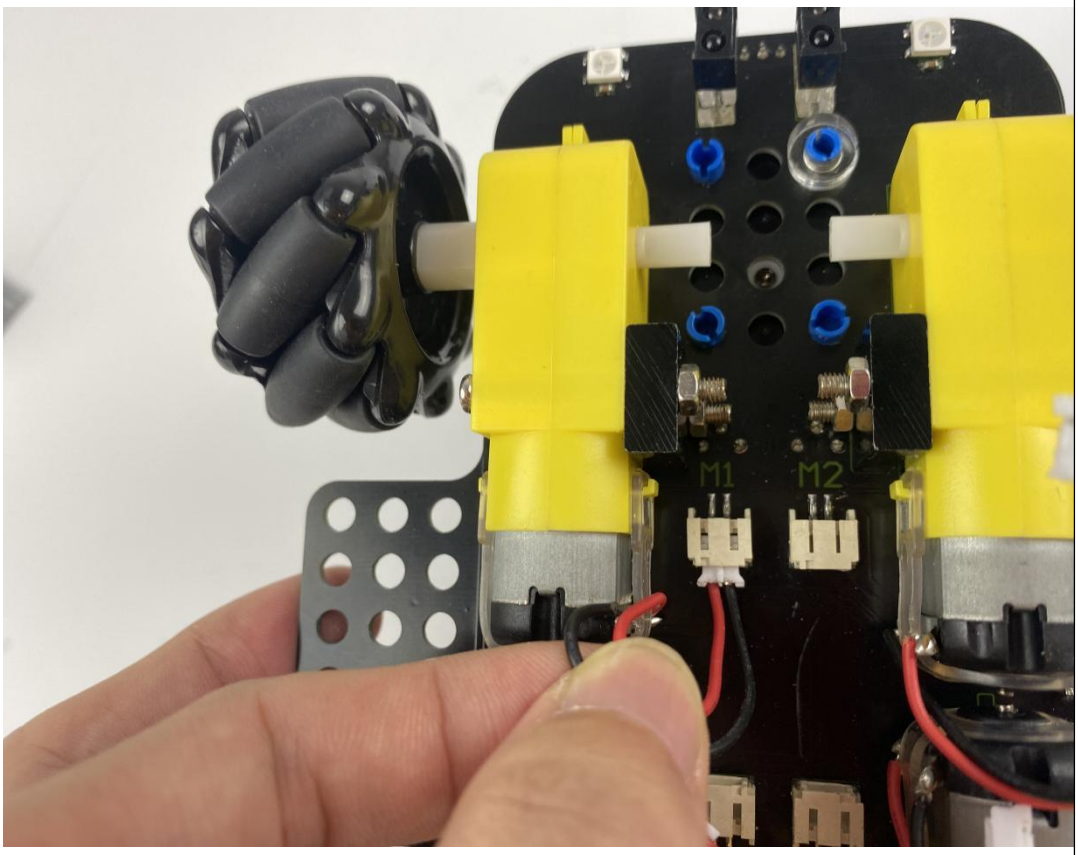
Installation Diagram	
Prototype	
Part 10	

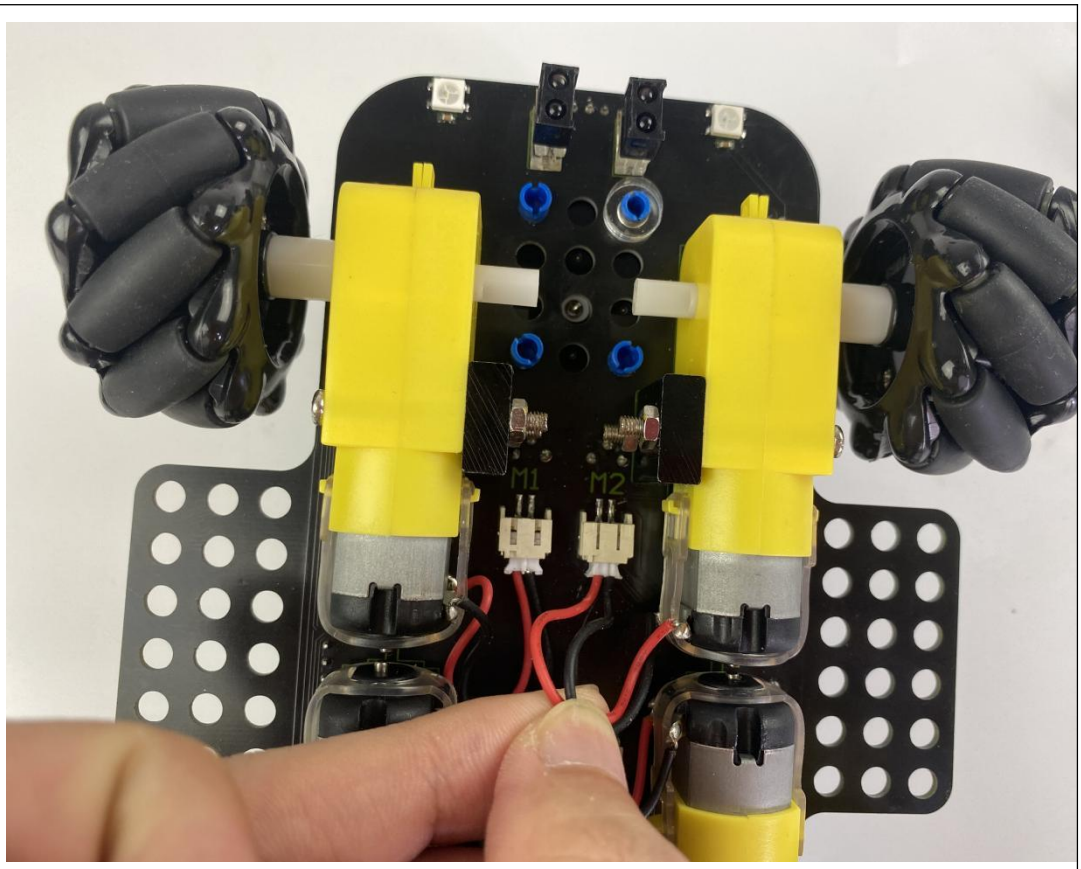
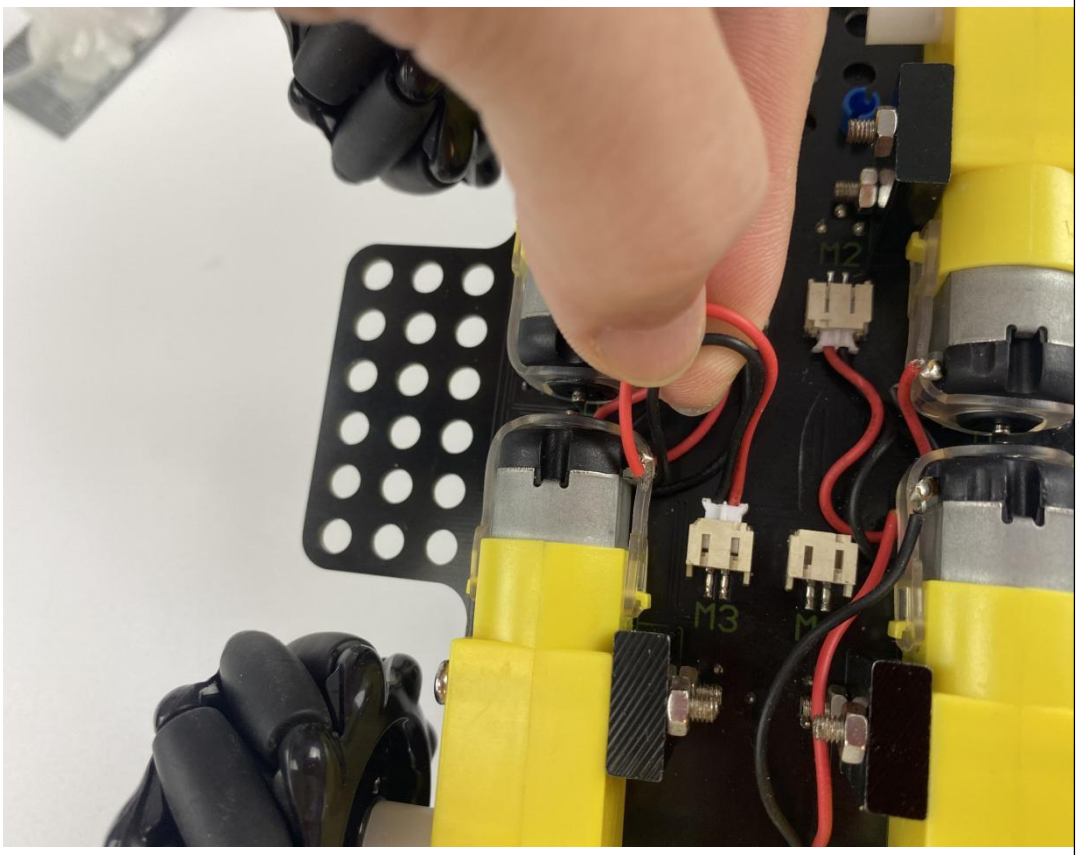
Components Needed	 
Installation Diagram	

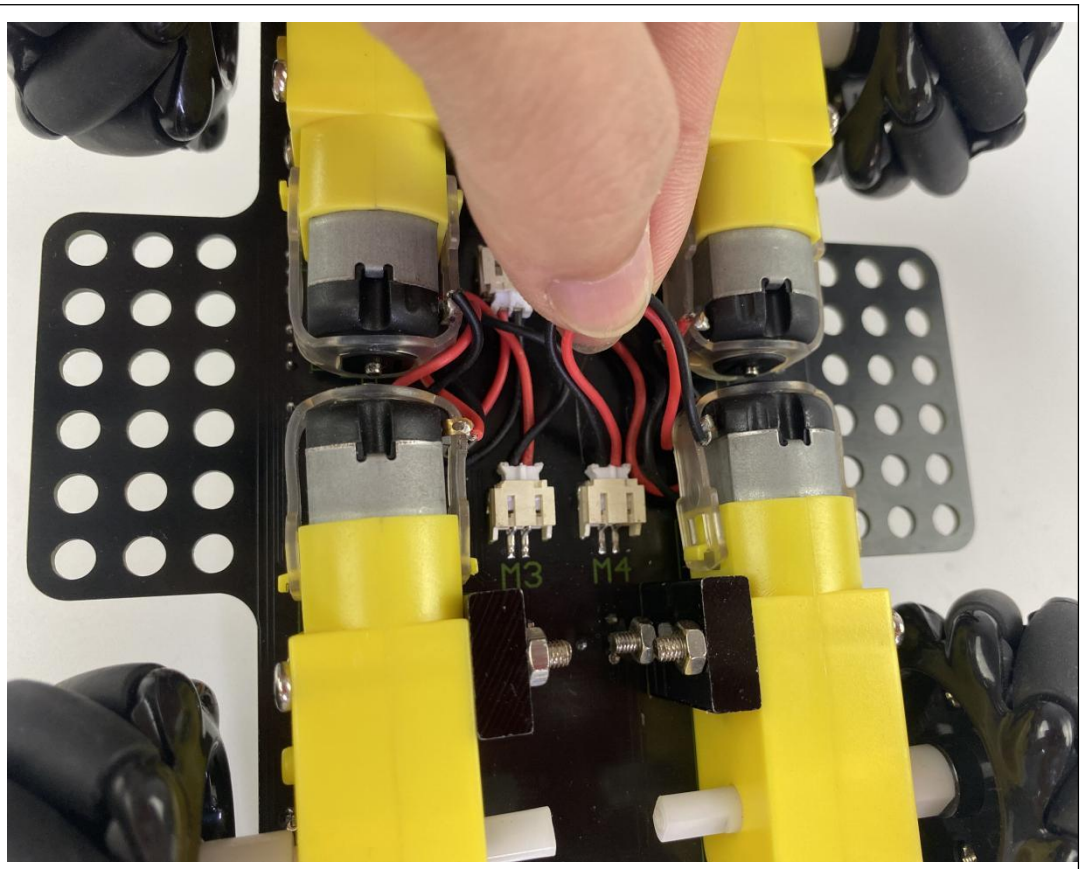
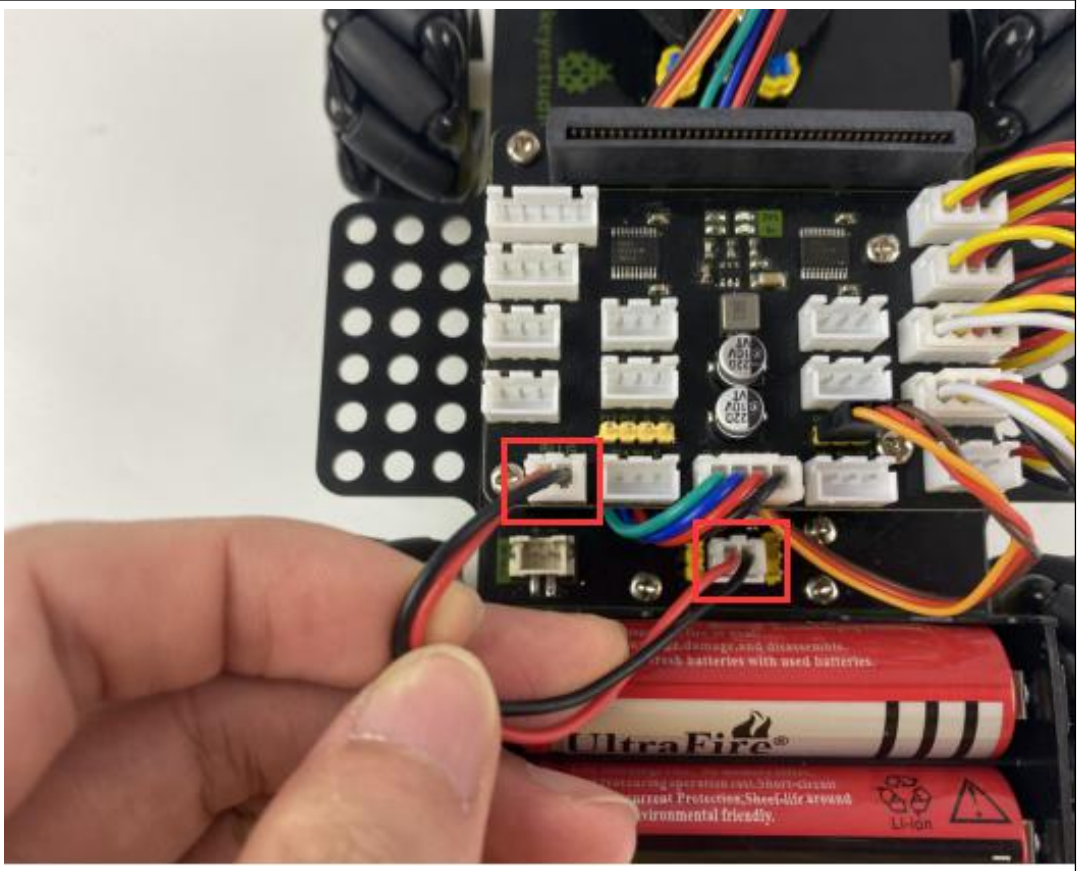
Prototype	
Start Wiring	
The wiring of the RGB lights	

The wiring of the infrared receiver module	
The wiring of the motor and colorful lights	

The wiring of the line-tracking sensor	
The wiring of the ultrasonic sensor	

The wiring of the servo	
The wiring of the M1 motor	

The wiring of the M2 motor	
The wiring of the M3 motor	

The wiring of the M4 motor	
The wiring of the power supply (the 5V is connected to the shield)	

7. Python

This tutorial is written for Python language. If you want to use graphical code programming, please refer to the manual "Makecode Tutorial.pdf". In the root directory of the resource you downloaded, there is a folder named "Python tutorial", which stores all the Python code of Micro:bit 4WD Mecanum Robot Car. The Python code file is a file ending with ".py".

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.

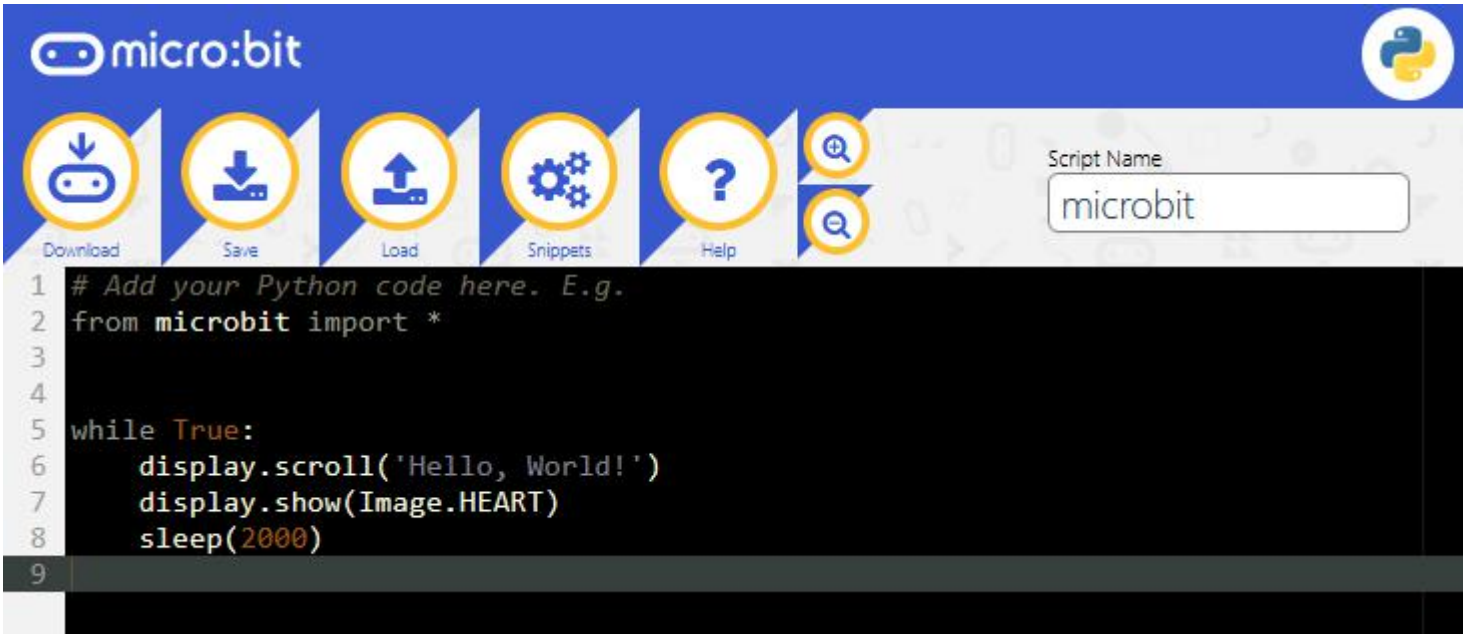
More details please log in official micro:bit website:

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



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

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

Mu

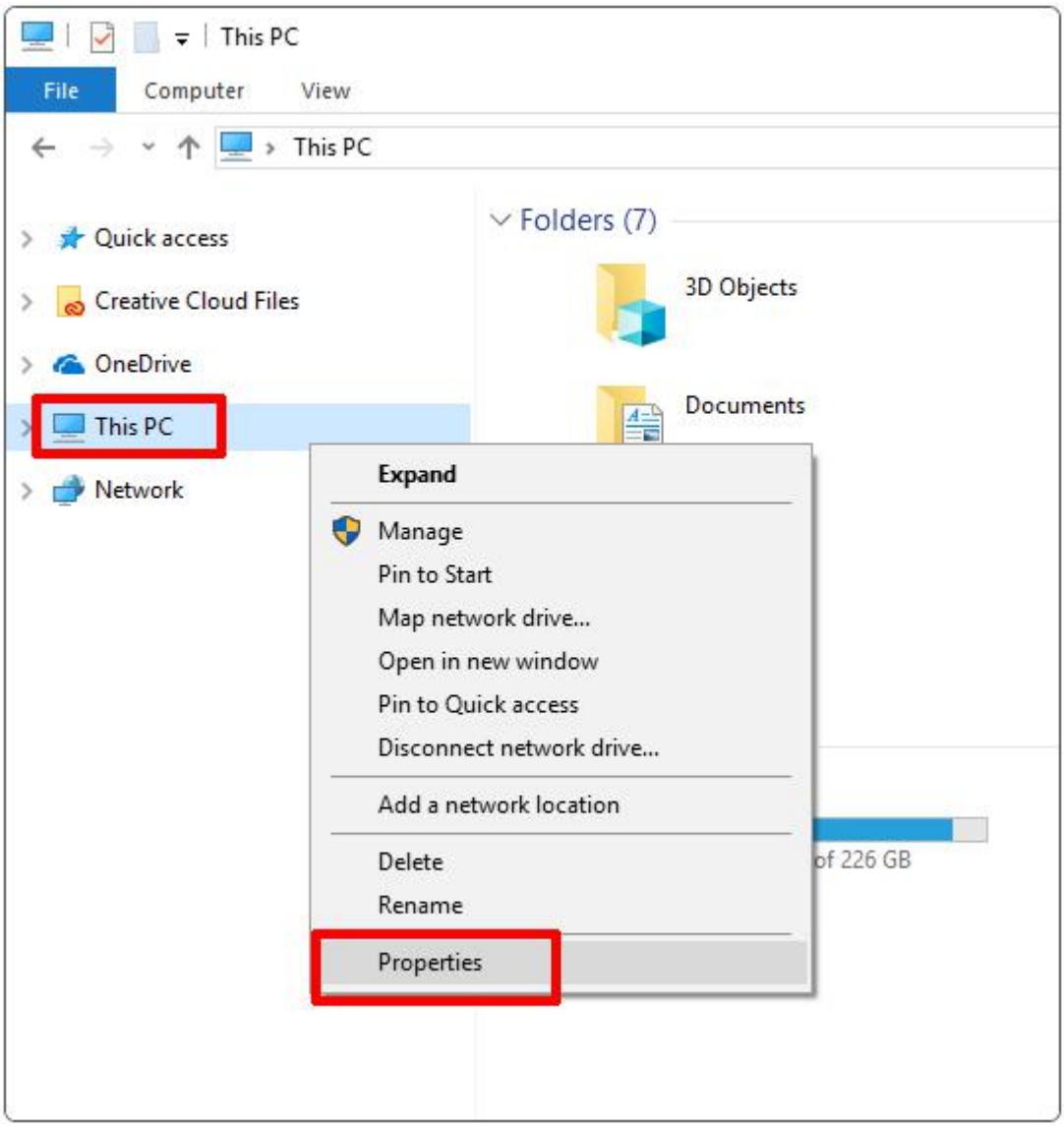
Official Website: https://codewith.mu/

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

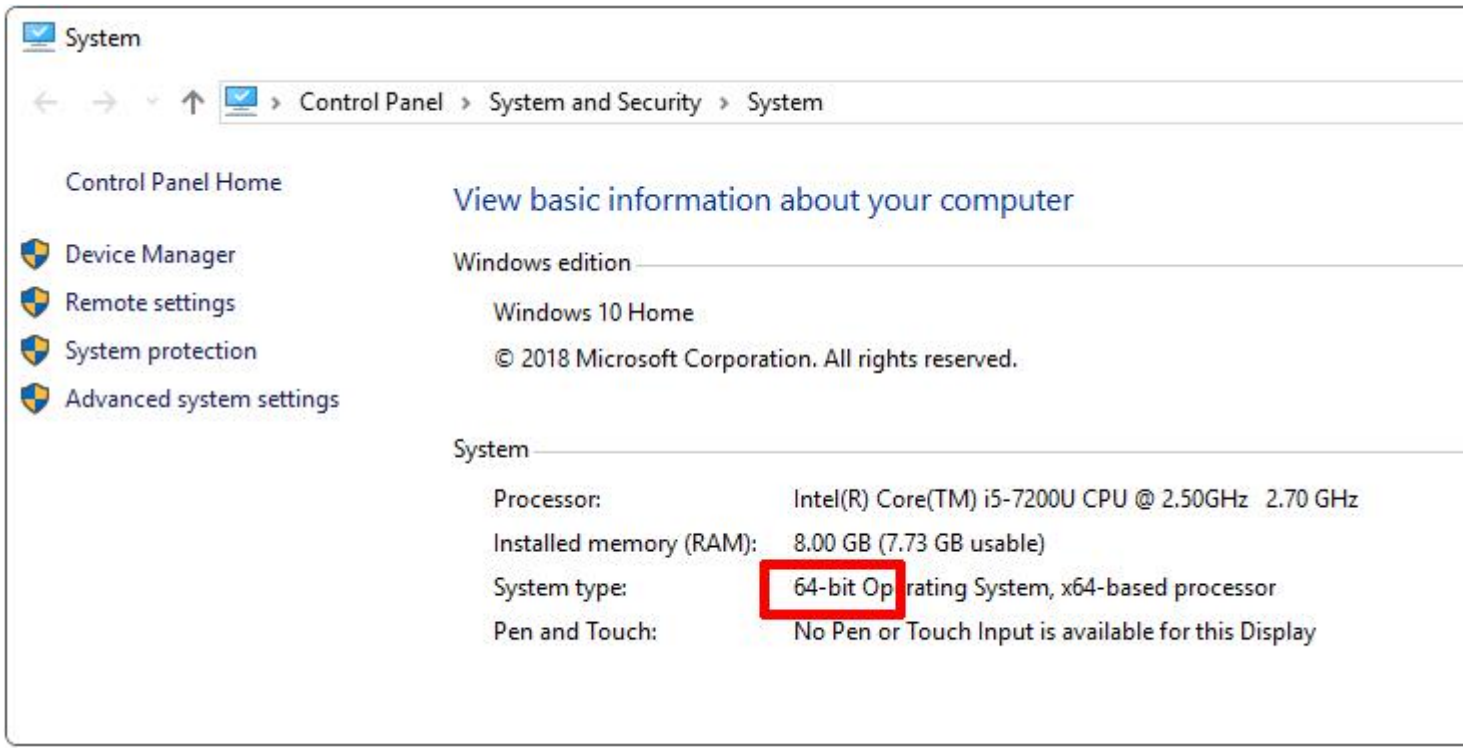
Mu doesn’ t support 32-bit Windows. The latest version is Mu 1.1.0-beta 2

1. Download Mu

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

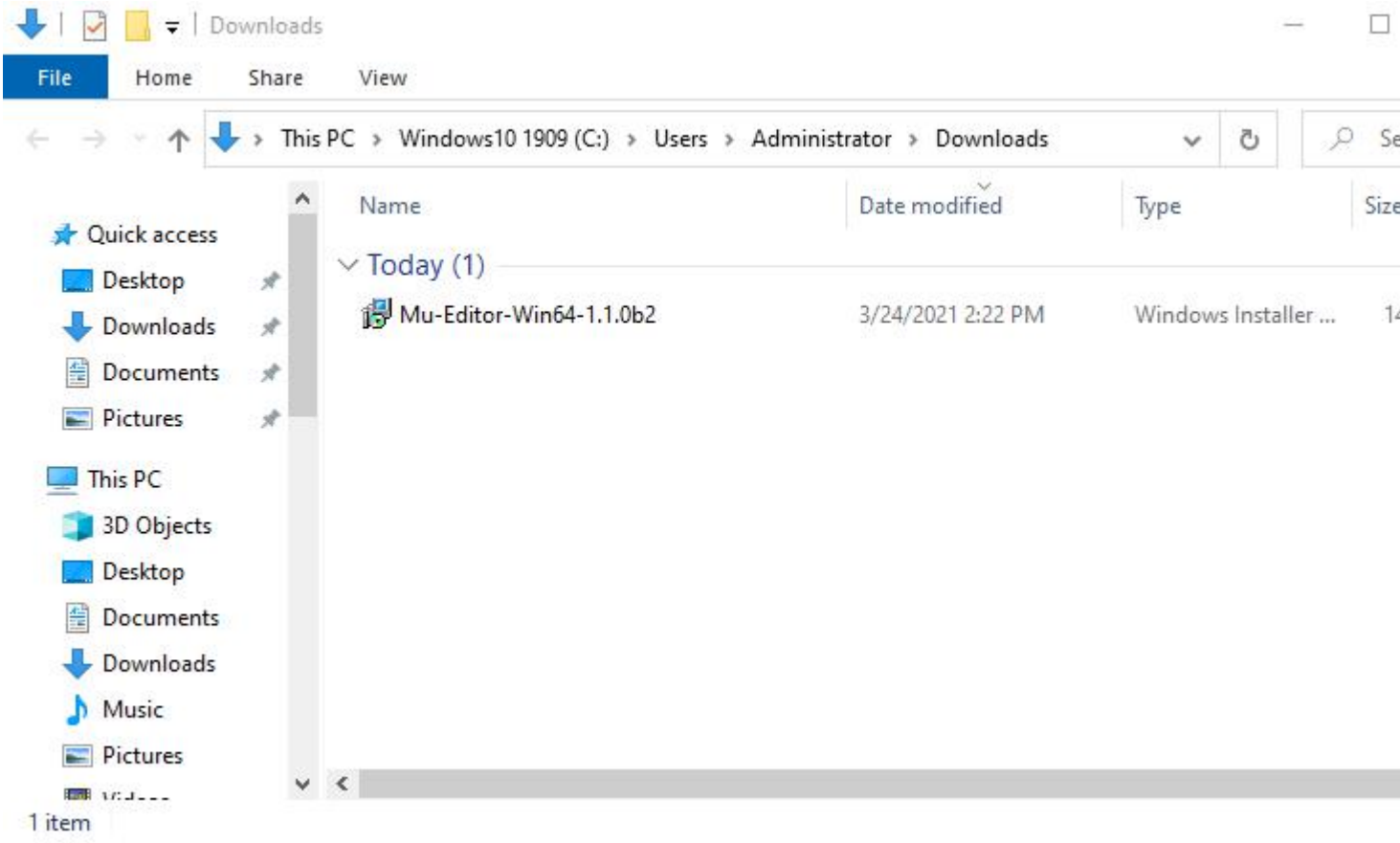


Below is shown system type of your computer.


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
© 2018 Microsoft Corporation. All rights reserved.
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
About
Tutorials
How to..?
Discuss
Developers
Language
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 Windo
The current recommended version is Mu 1.1.0-beta-2. We advise people to update to this version via the links for each support
system:
Windows Installer
64-bit
Instructions
Mac OSX Installer
Download
Instructions
Python Package (Linux or Native Python)
Instructions

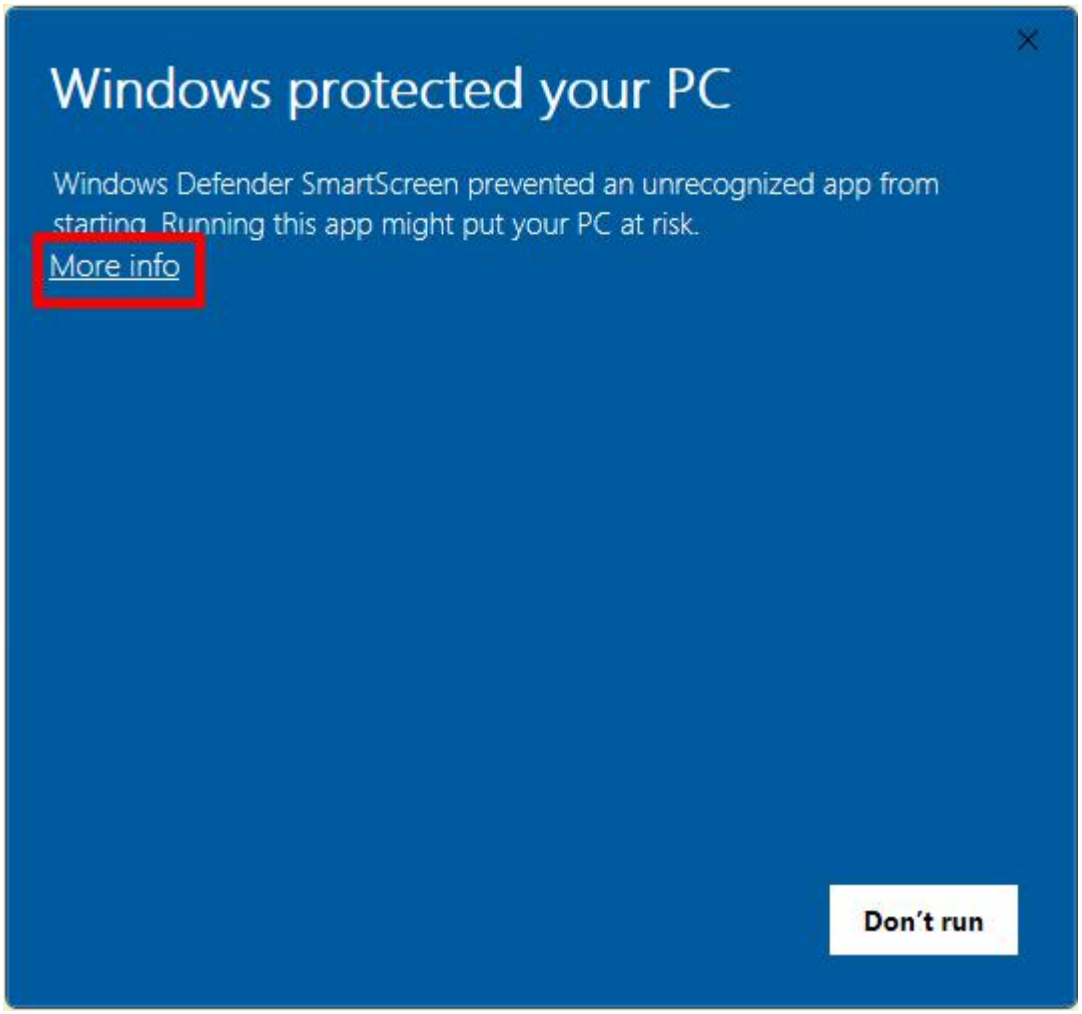
Enter link: https://codewith.mu/en/download to download the corresponding version of Mu.



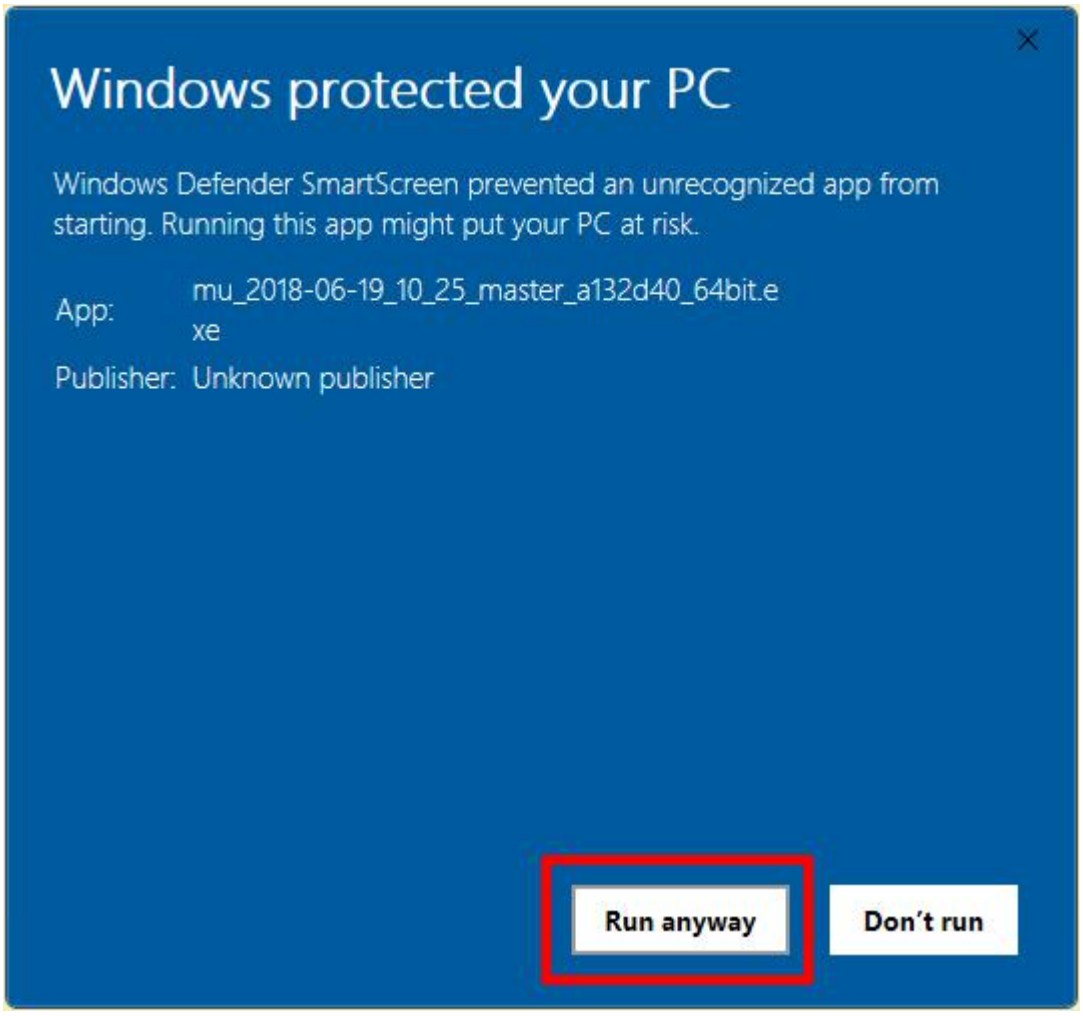
Mac OSX: https://codewith.mu/en/howto/1.1/install_macos

Windows 10

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

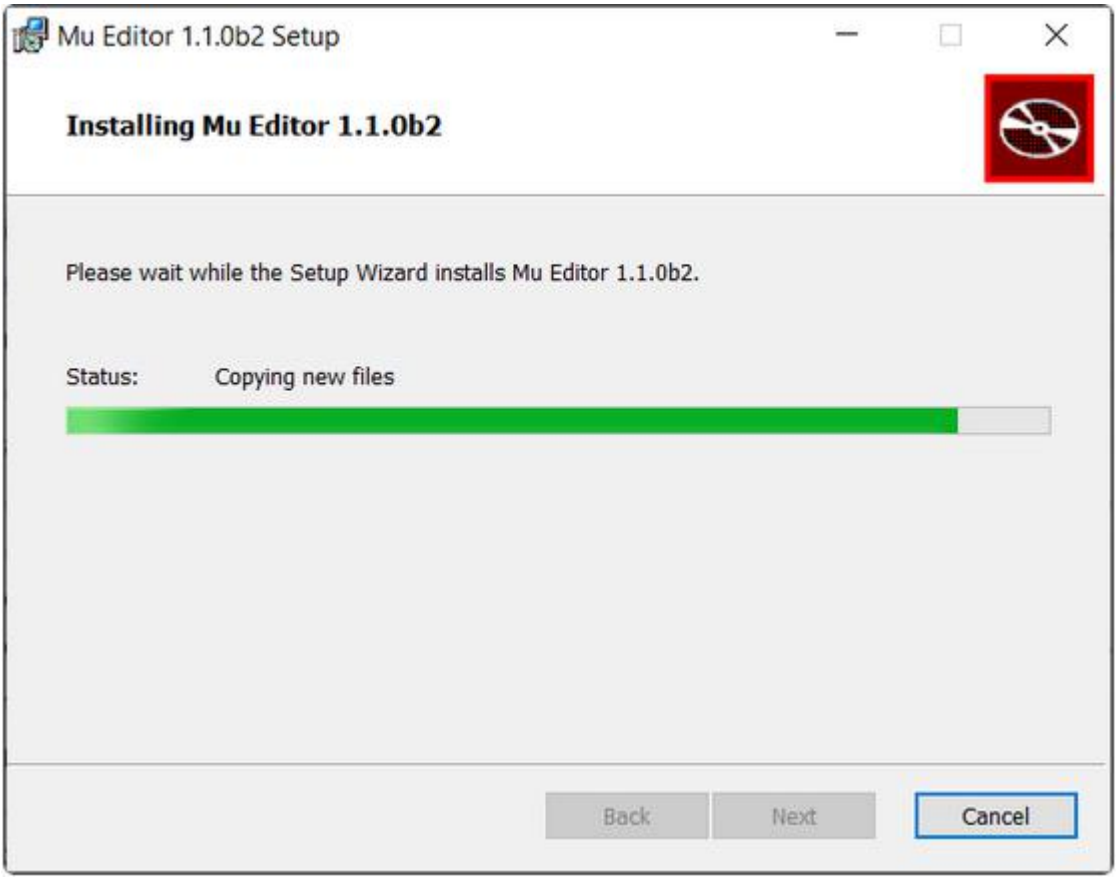


Then click "Run anyway".

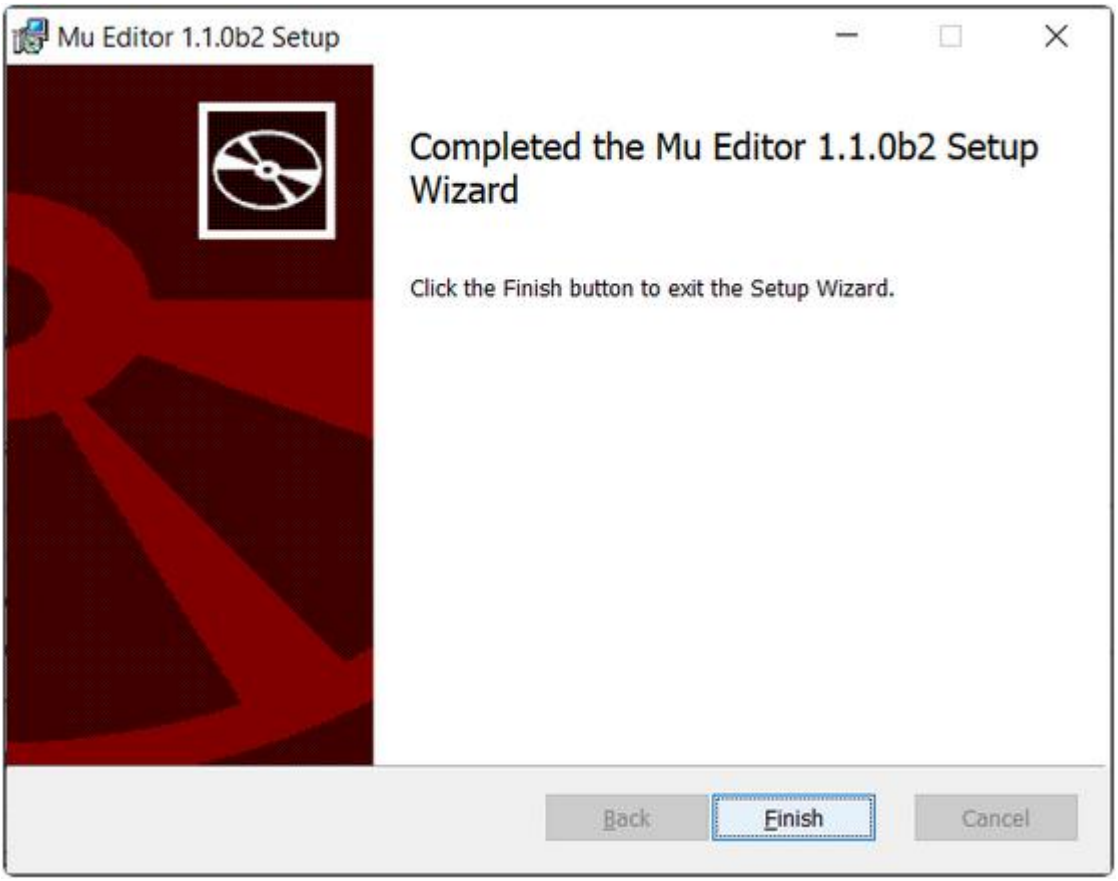


After it is installed, click "finish".


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
Print
Back
Install
Cancel

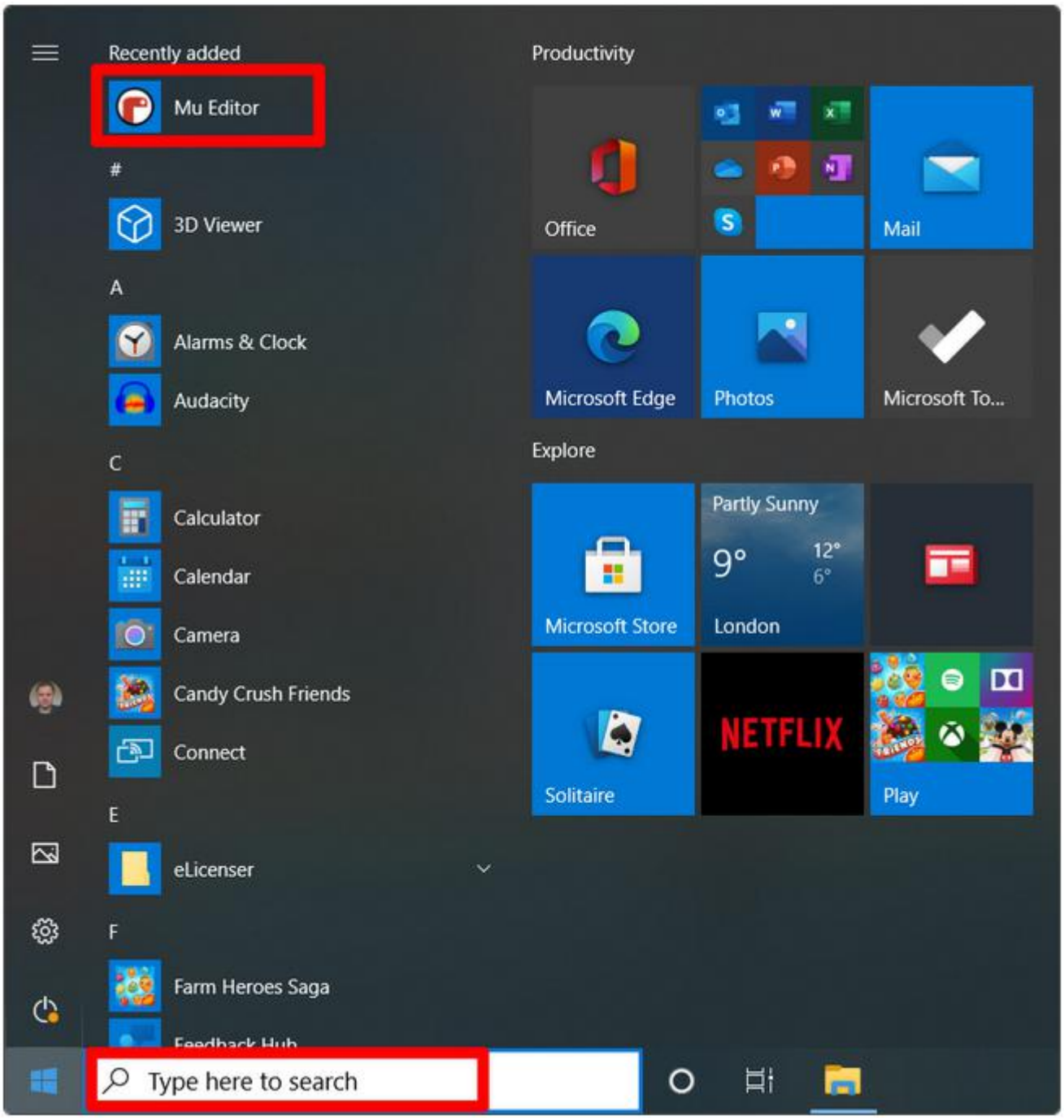

Mu Editor 1.1.0b2 Setup
Installing Mu Editor 1.1.0b2
Please wait while the Setup Wizard installs Mu Editor 1.1.0b2.
Status: Copying new files
Back
Next
Cancel

After it is installed, click “finish”.

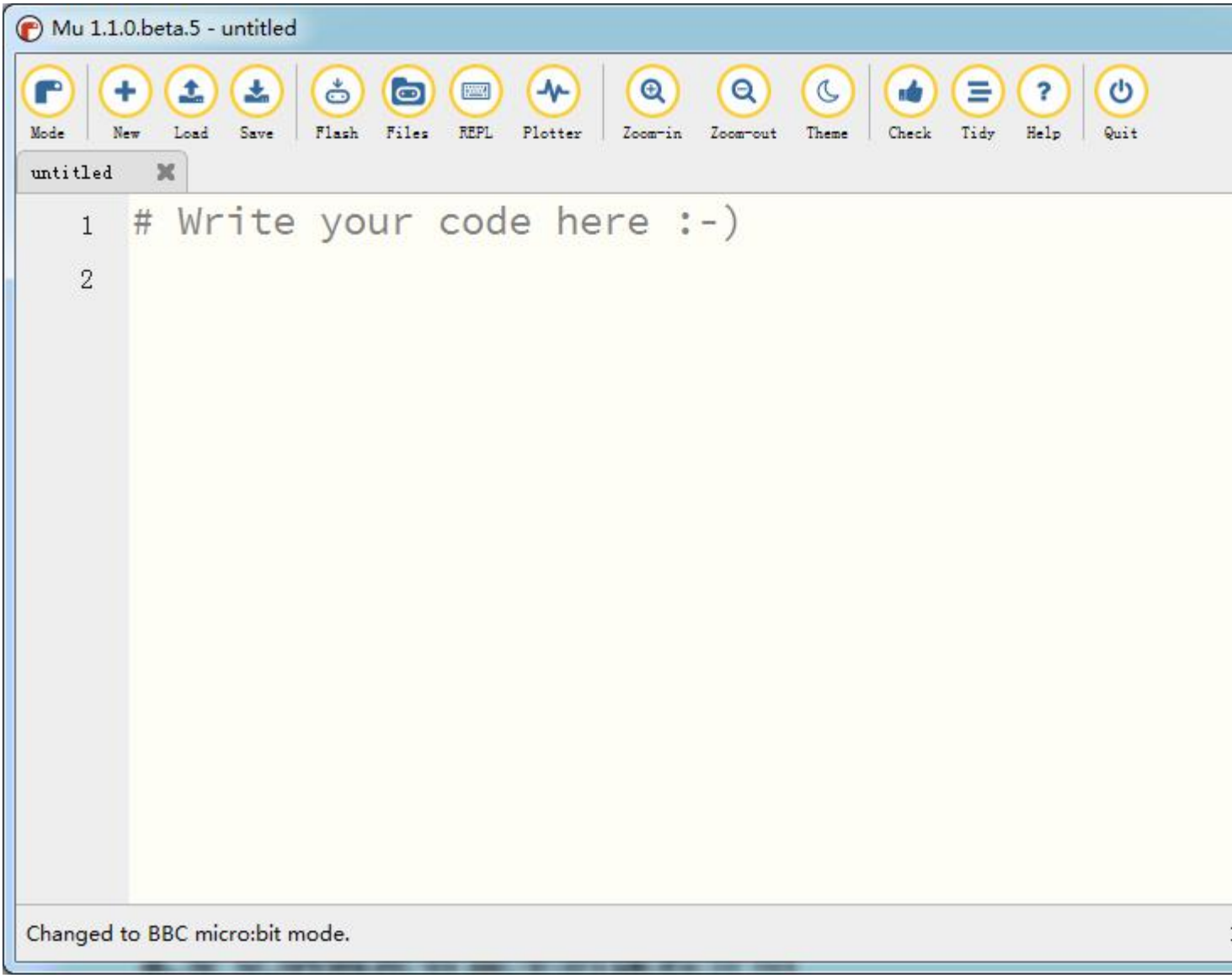


Start Mu

Next, find it according to the following picture



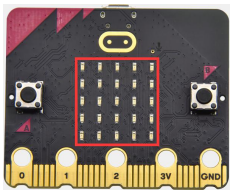
Its main interface is shown as follows:



8.Projects

(Note: project 1 to 12 will be conducted with the built-in sensors and LED dot matrix of the Micro:bit main board V2)

Project 1: Heartbeat



(1)Project Introduction

This project is easy to conduct with a micro:bit main board, a Micro USB cable and a computer.This experiment serves as a starter for your entry to the magical programming world of Micro:bit.

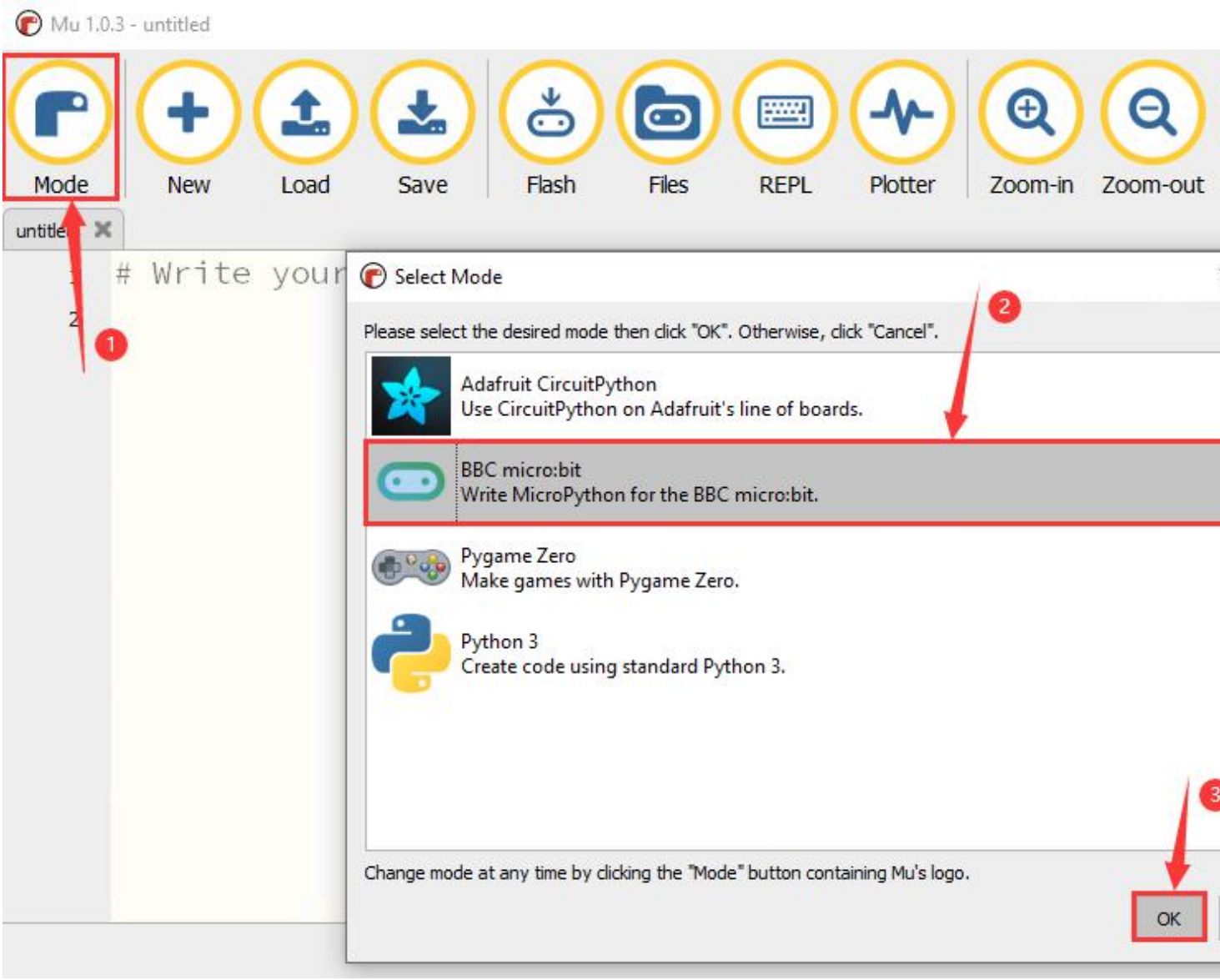
(2)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B.Open the offline version of Mu.

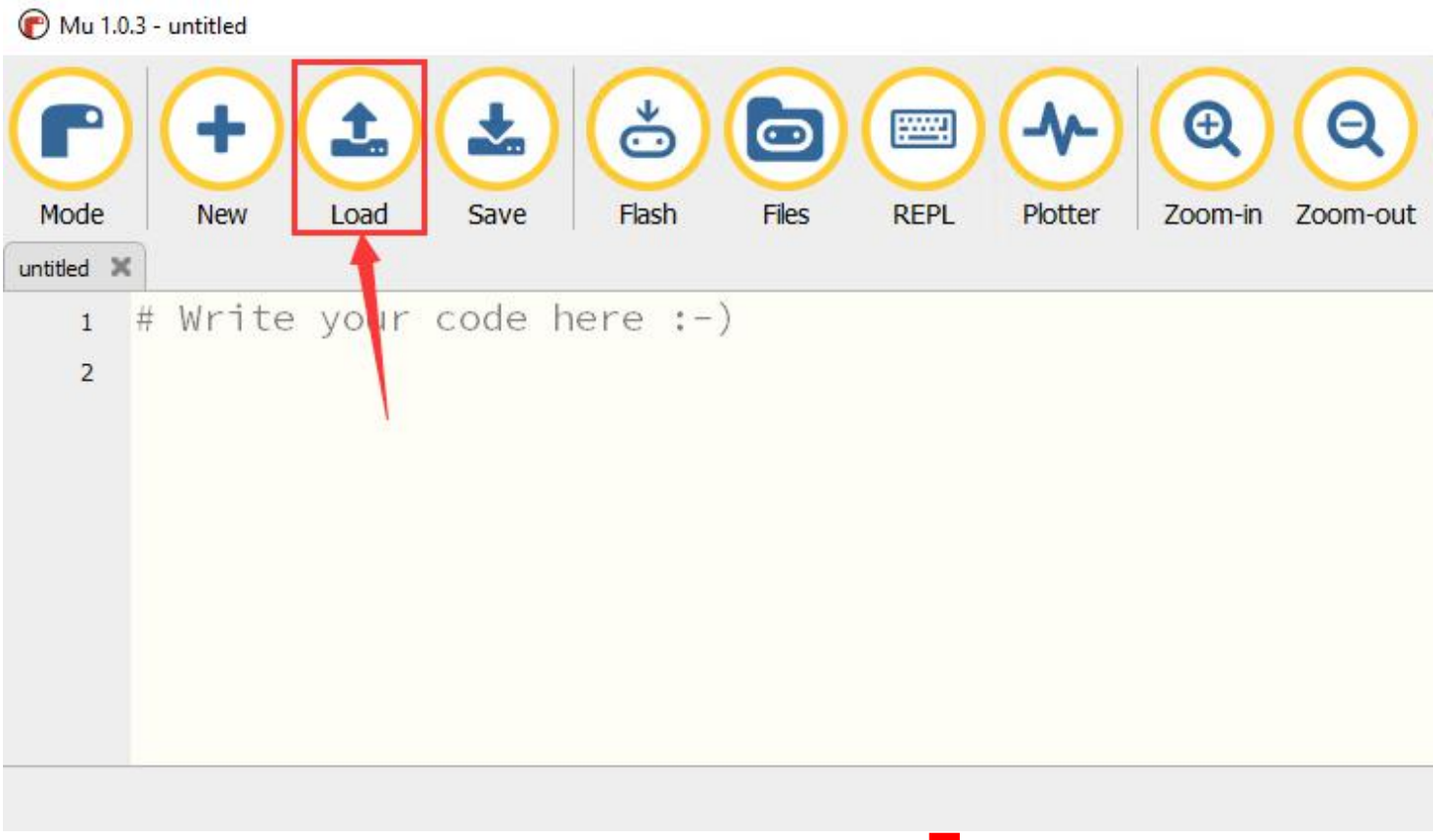
(3)Test Code：

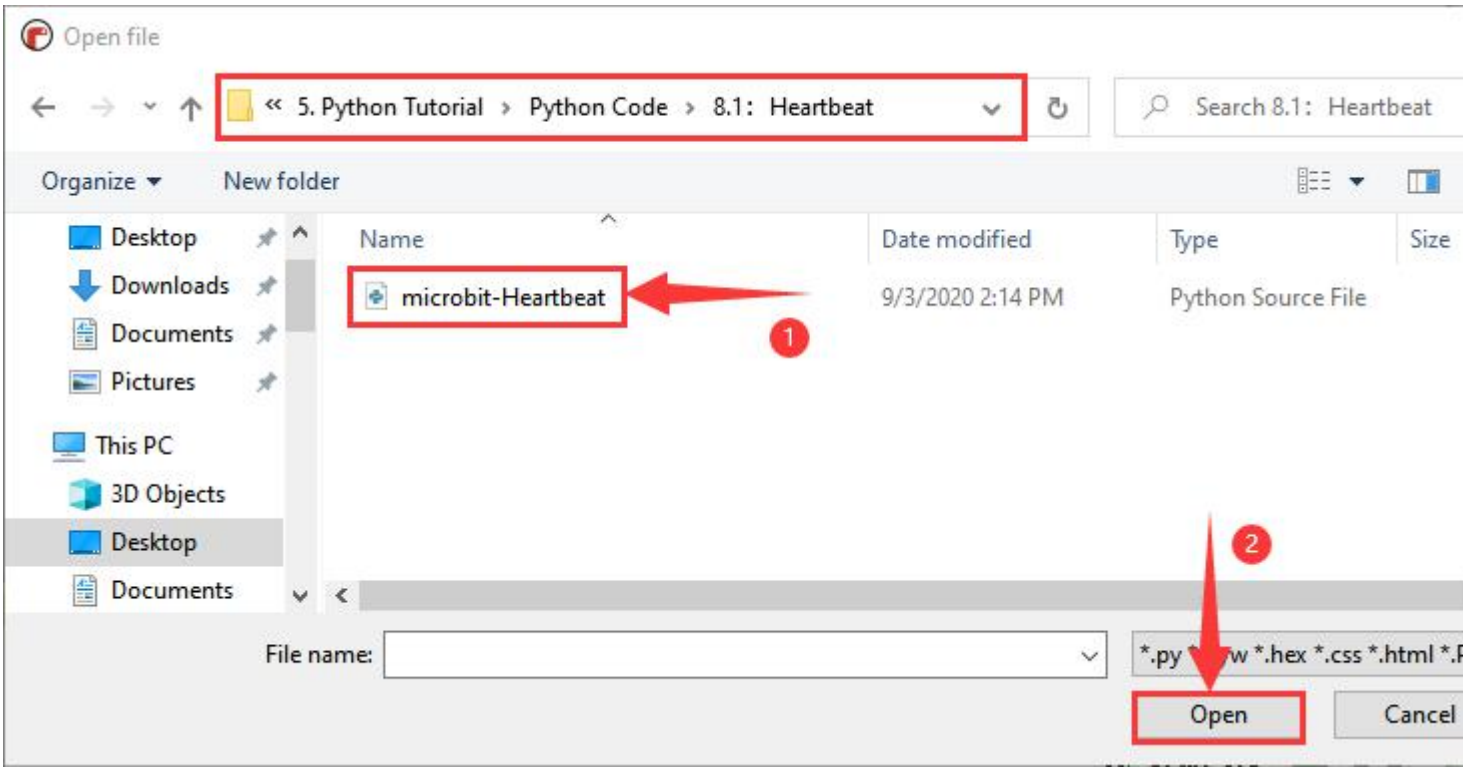
Open Mu software, click Mode, then click “BBC micro：bit” and “OK”：



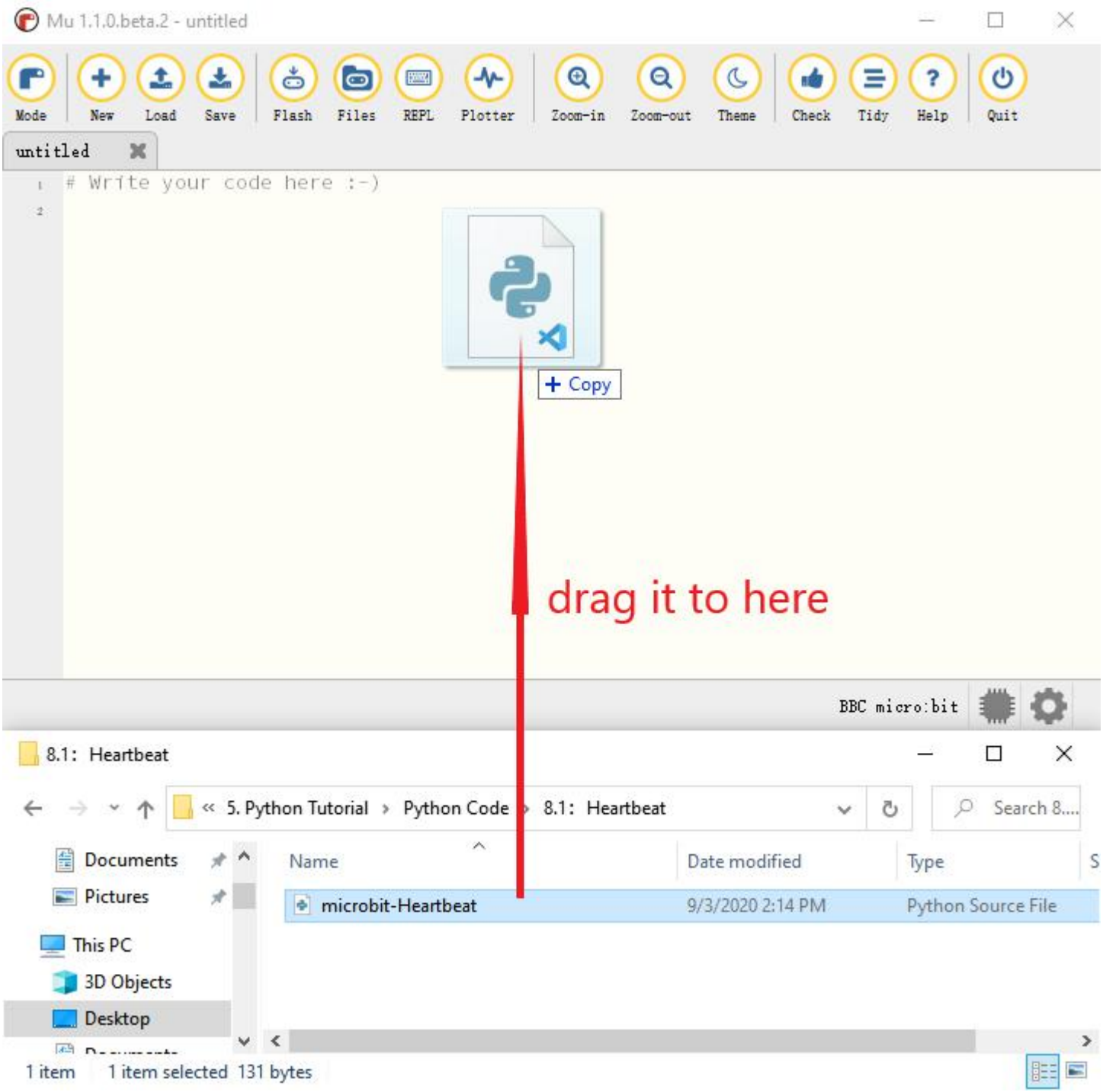
Tap "Load", select "Project 1: Heartbeat.py" file and click "open":

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 1: Heartbeat	Project 1 : Heartbeat.py



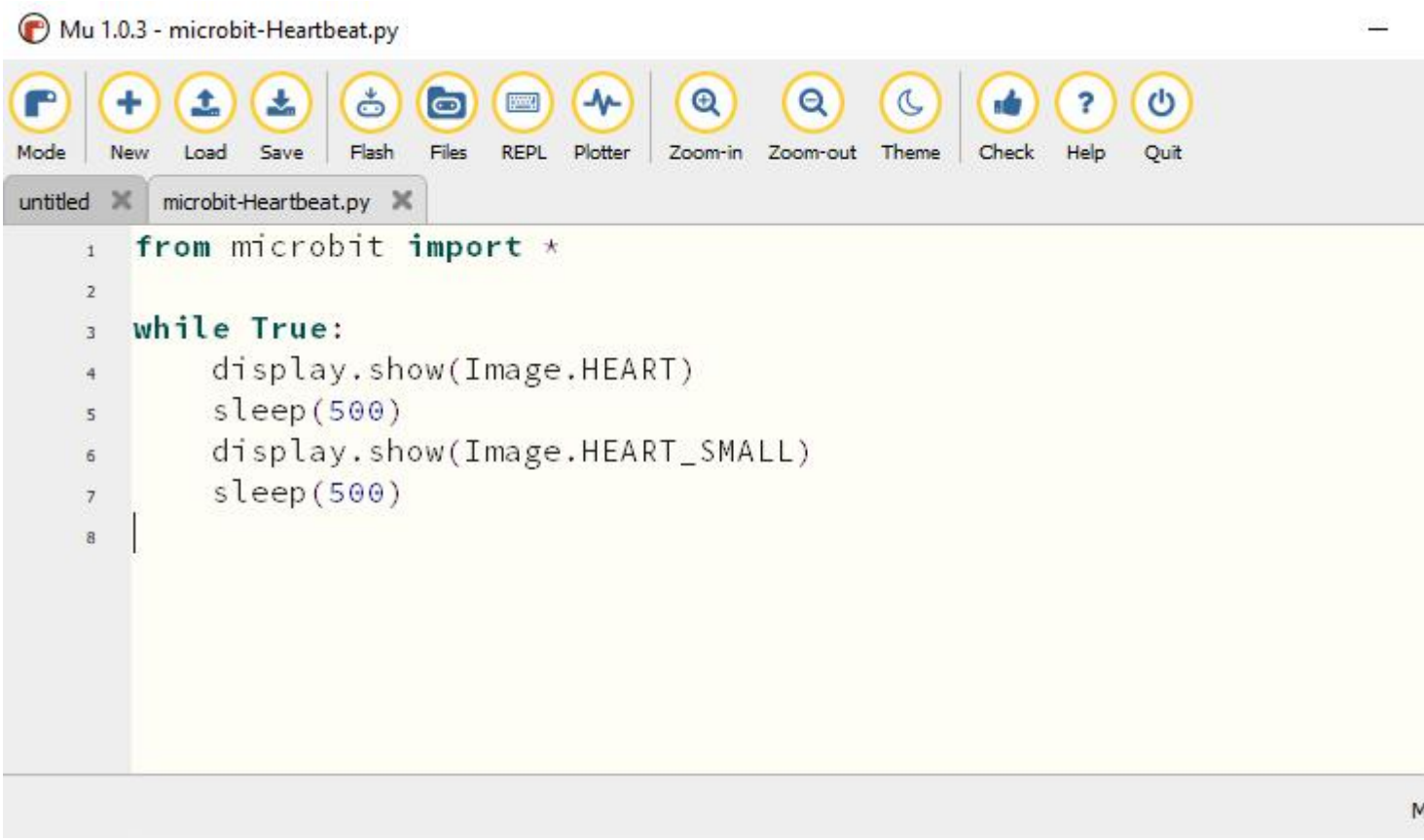


There is another way to import code. Open Mu software and drag file" Project1:Heartbeat.py" into it.



You can also input code in the edit window yourself.

(note:all English words and symbols must be written in English.)



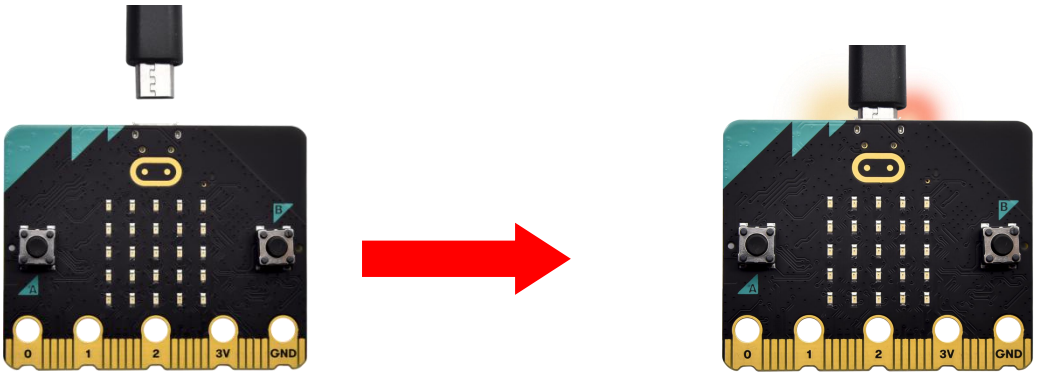
The following is a list of built-in images:

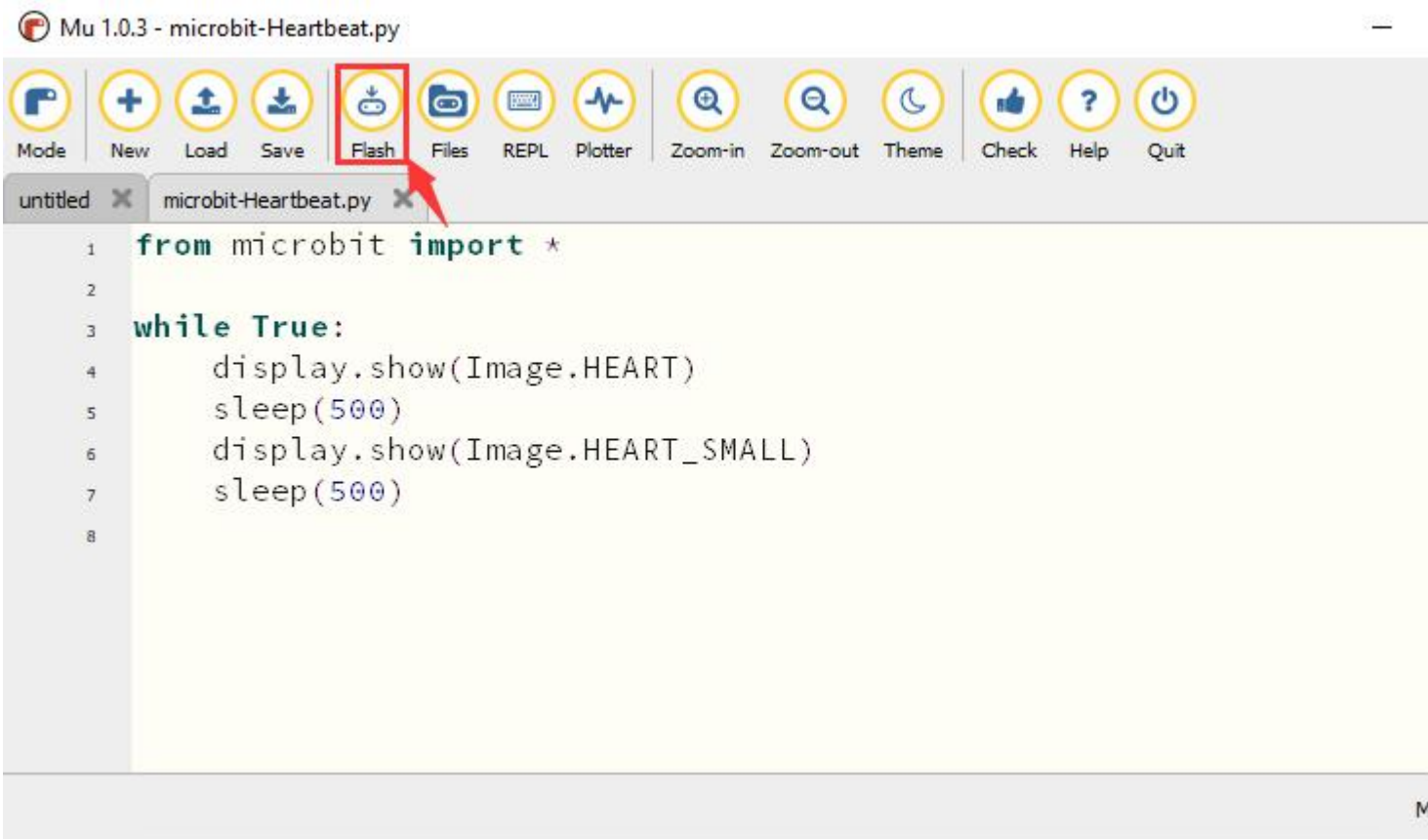
- Image.HEART
- Image.HEART_SMALL
- Image.HAPPY
- Image.SMILE
- Image.SAD
- Image.CONFUSED
- Image.ANGRY
- Image.ASLEEP
- Image.SURPRISED

- 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

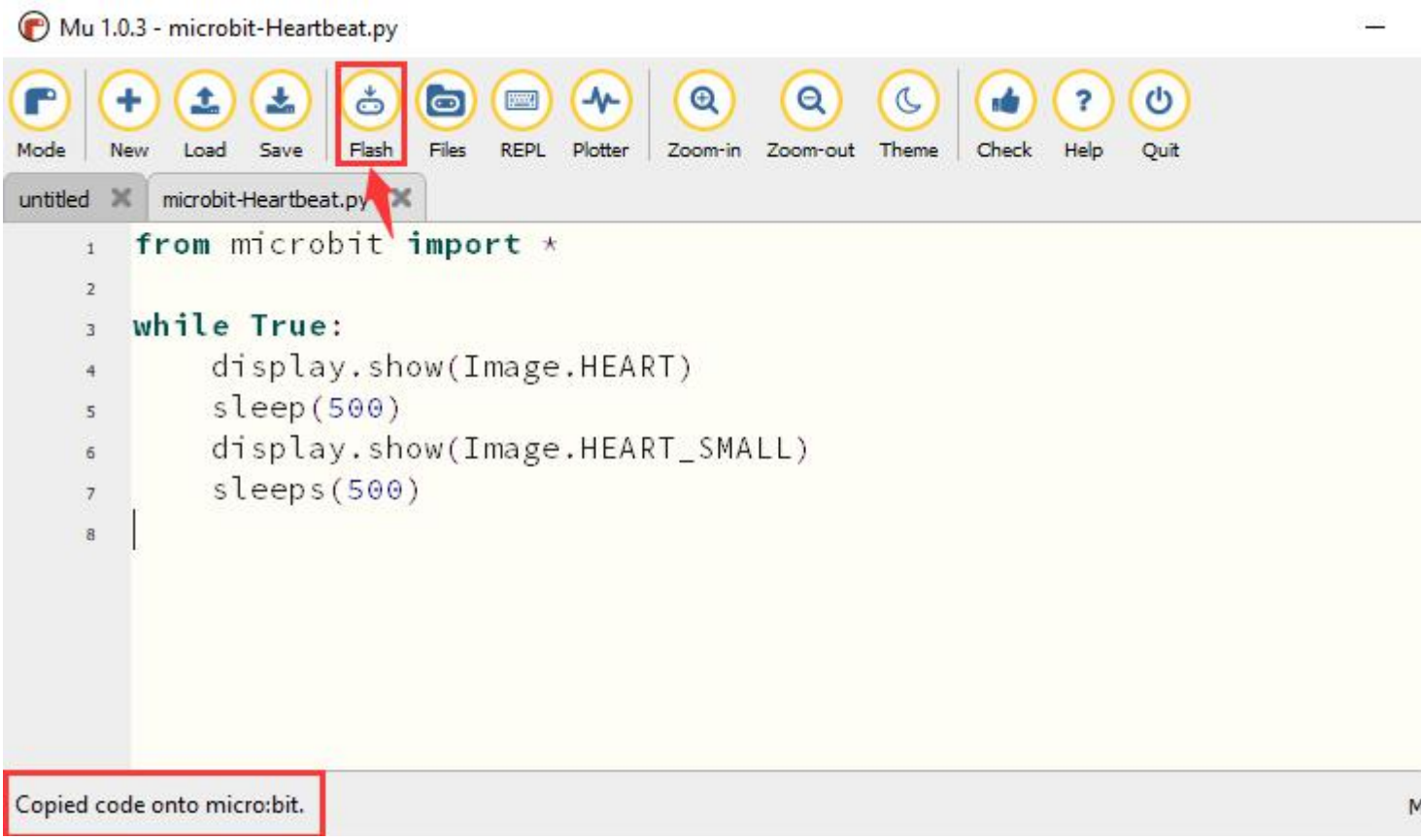
Connect micro:bit board to computer with USB cable, click “Flash” to download code to micro:bit board.



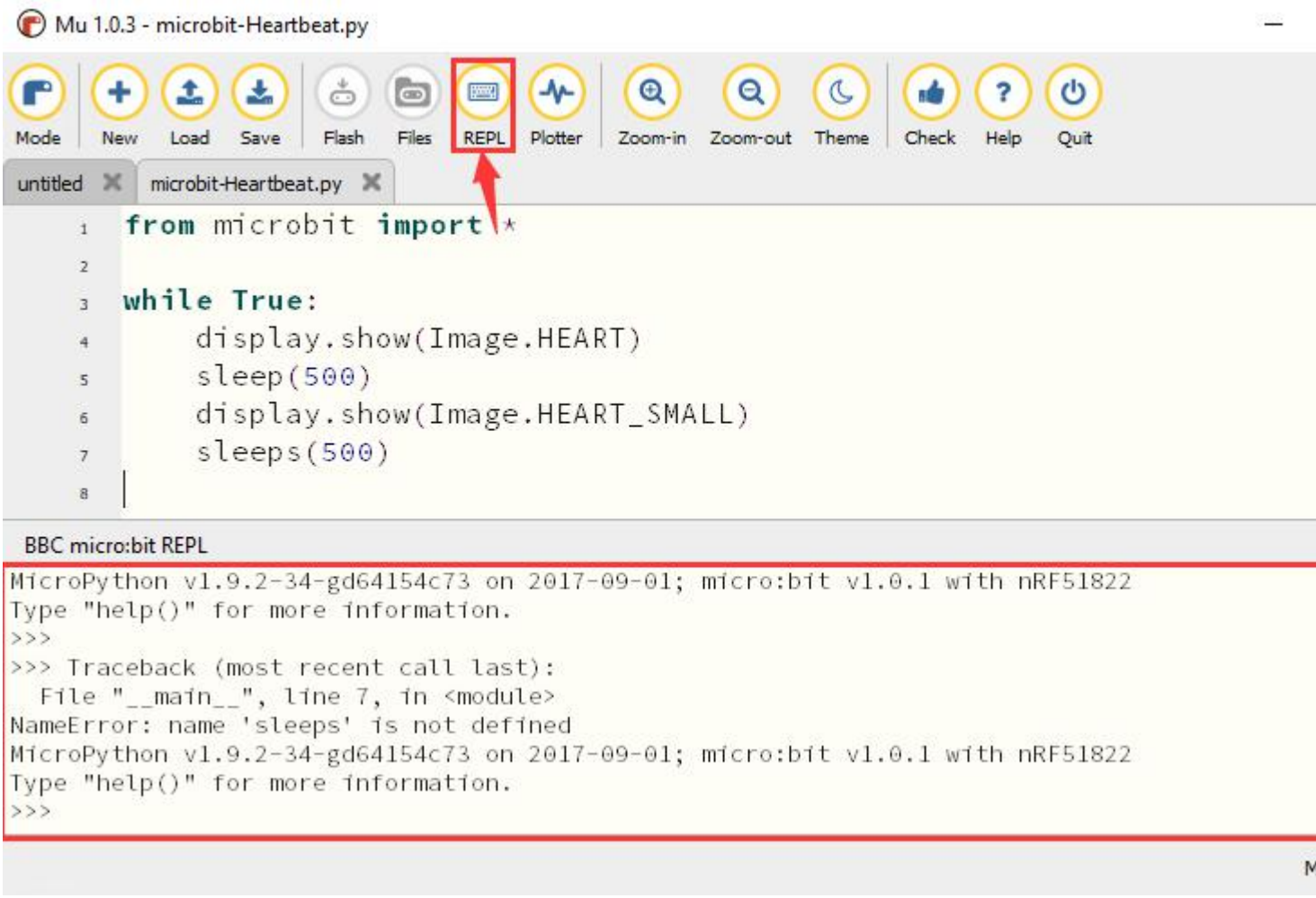


The code, even it is wrong, can be downloaded to micro:bit board successfully, yet not working on micro:bit board.

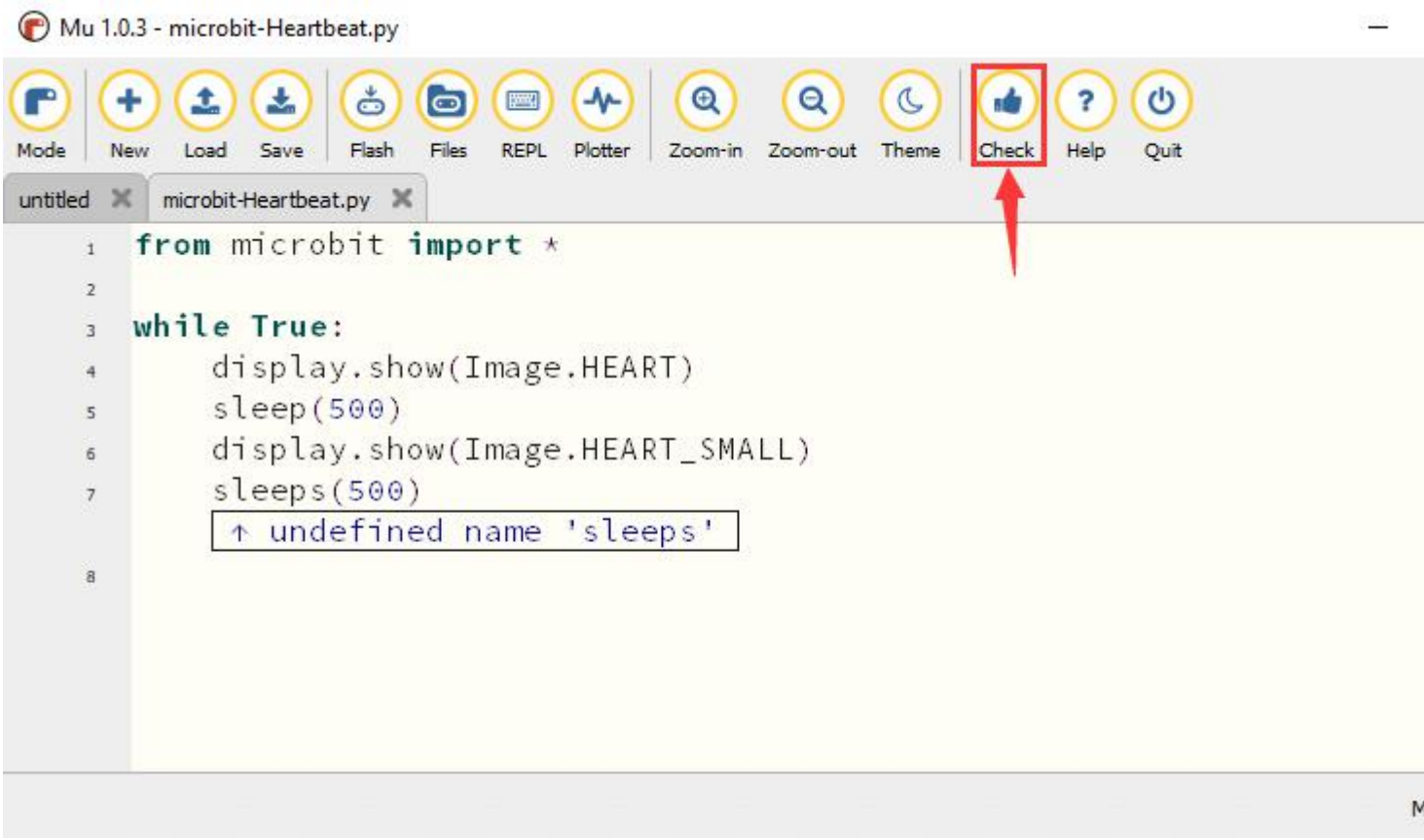
Click "Flash" to download code to micro:bit.



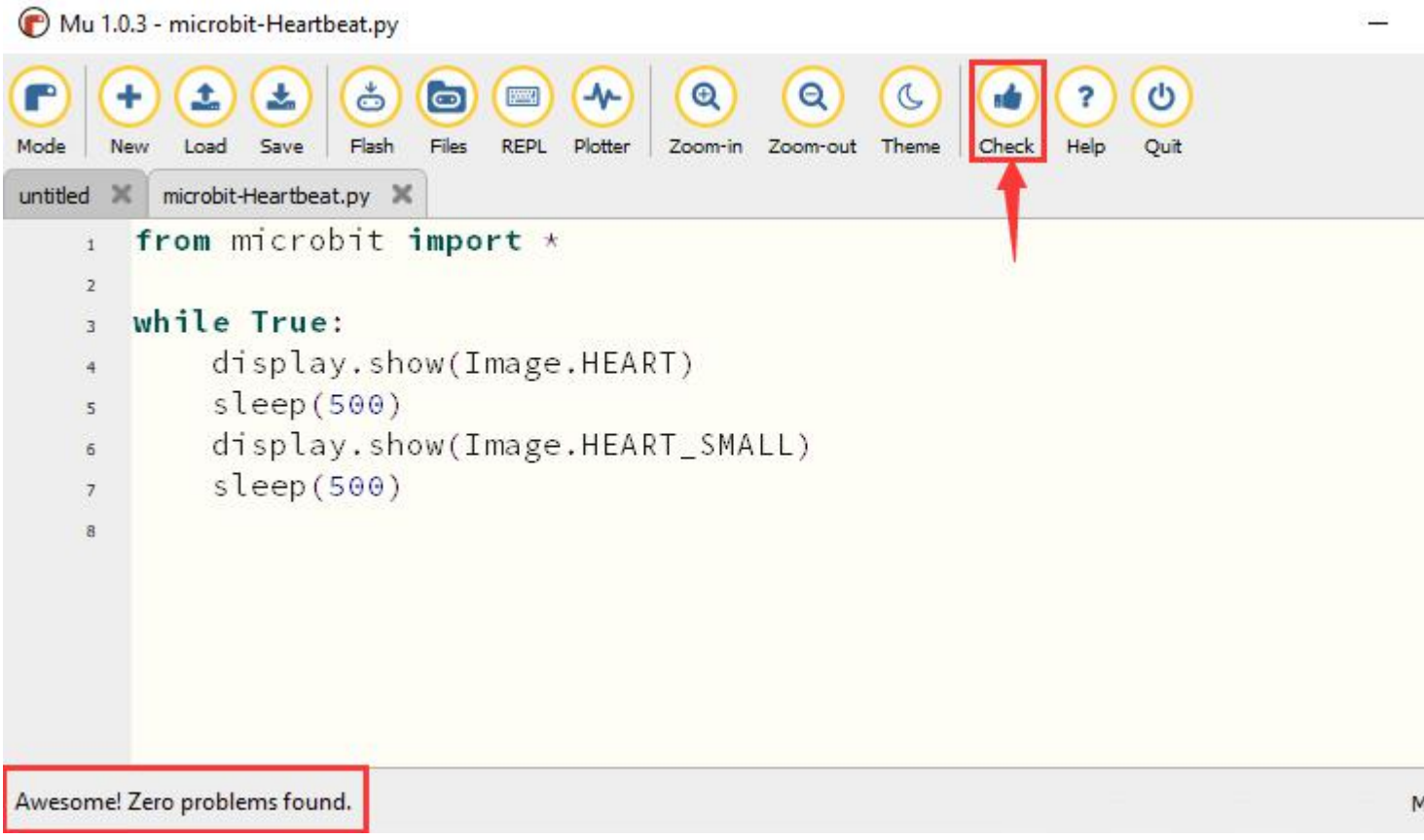
Click “REPL” and press the reset button on micro:bit, the error information will be displayed on REPL window, as shown below:



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.



Modify the code according to the prompt and click "Check".



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

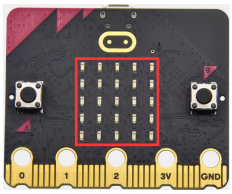
(4)Test Results:

After uploading test code to micro:bit main board, clicking "Flash" again and keeping the connection with the computer to power the main board, the LED dot matrix shows pattern "  " and then "  " alternatively.

(5)Code Explanation:

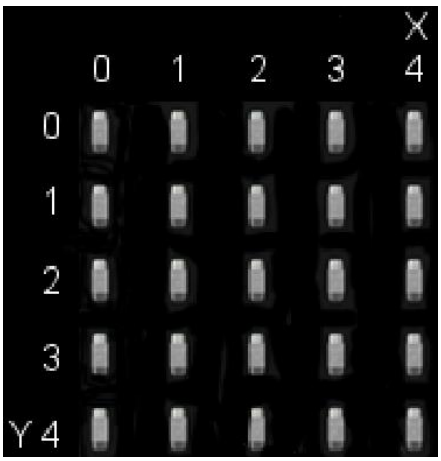
from microbit **import** *	Import the library file of micro: bit
while True:	This is a permanent loop that makes micro:bit execute the code of it.
display.show(Image.HEART)	micro: bit shows "❤"
sleep(500)	Delay in 500ms
display.show(Image.HEART_SMALL)	micro: bit displays "  "

Project 2: Light A Single LED



(1) Project Introduction

The LED dot matrix consists of 25 LEDs arranged in a 5 by 5 square. In order to locate these LEDs quickly, as the figure shown below, we can regarded this matrix as a coordinate system and create two aces by marking those in rows from 0 to 4 from top to bottom, and the ones in columns from 0 to 4 from the left to the right. Therefore, the LED sat in the second of the first line is (1,0) and the LED positioned in the fifth of the fourth column is (3,4) and others likewise.



(2)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B.Open the offline version of Mu.

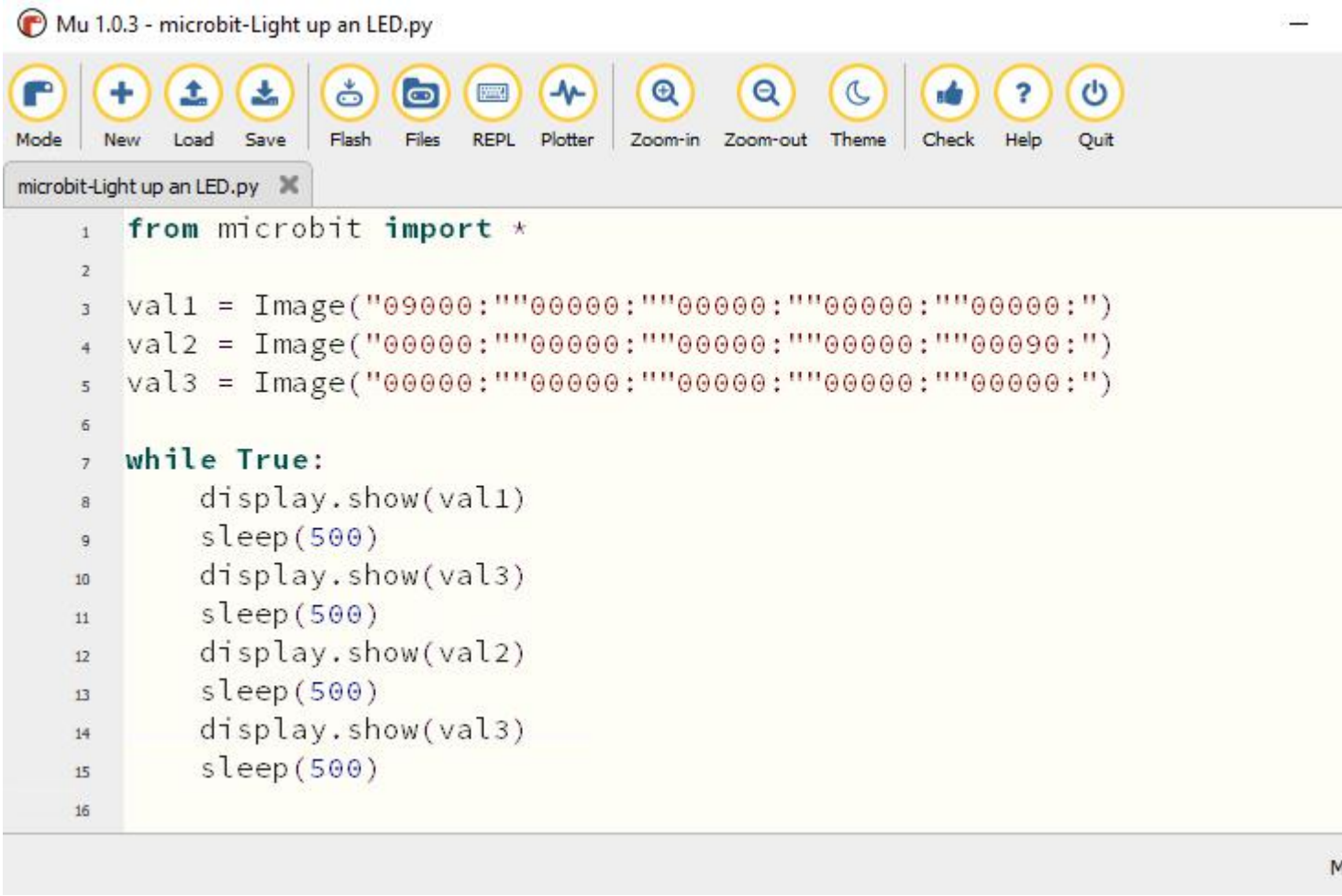
(3)Test Code:

Enter Mu software and open the file "Project 2: Light A Single LED.py" to import code:

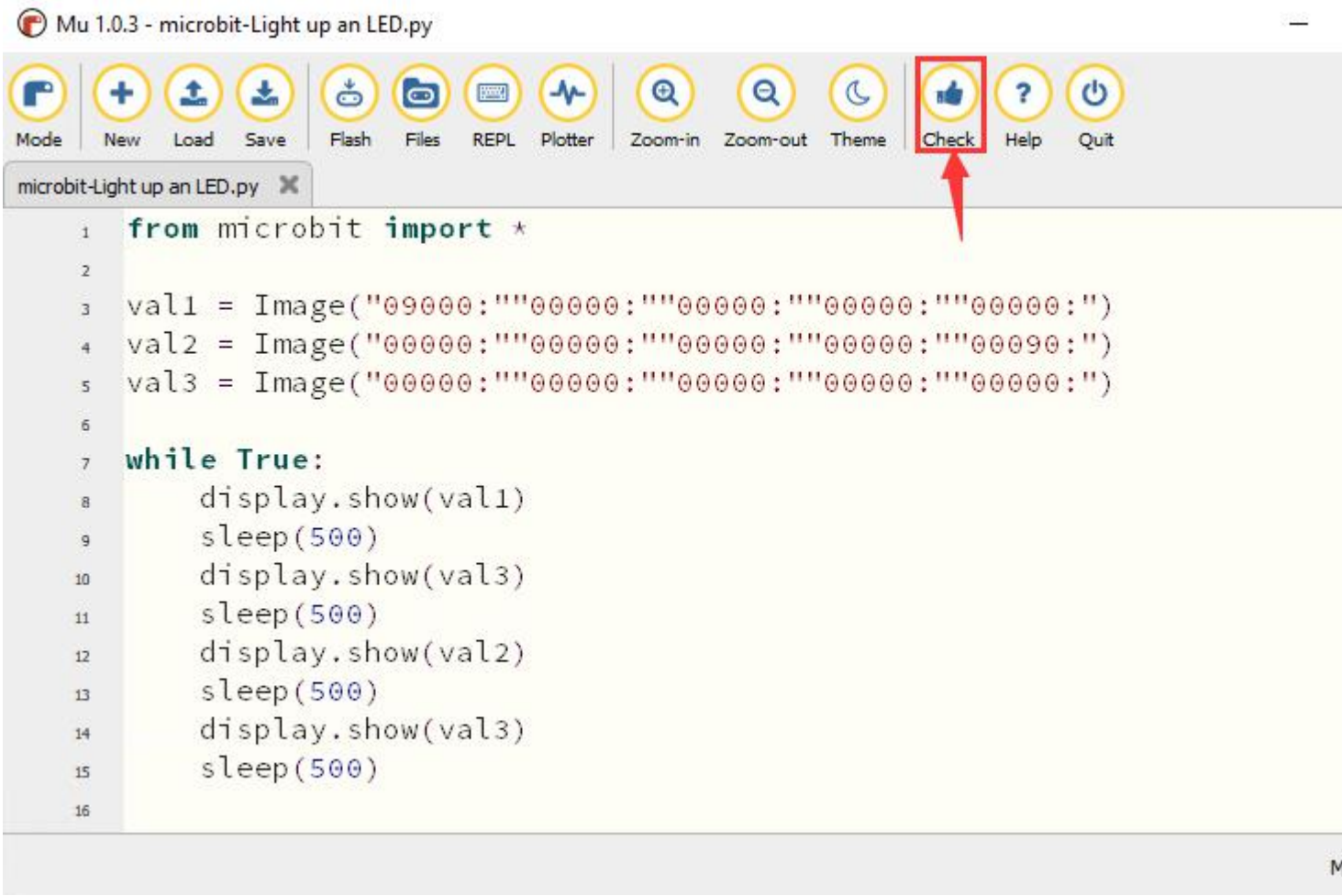
Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 2: Light A Single LED	Project 2: Light A Single LED.py

You can also input code in the editing window yourself.

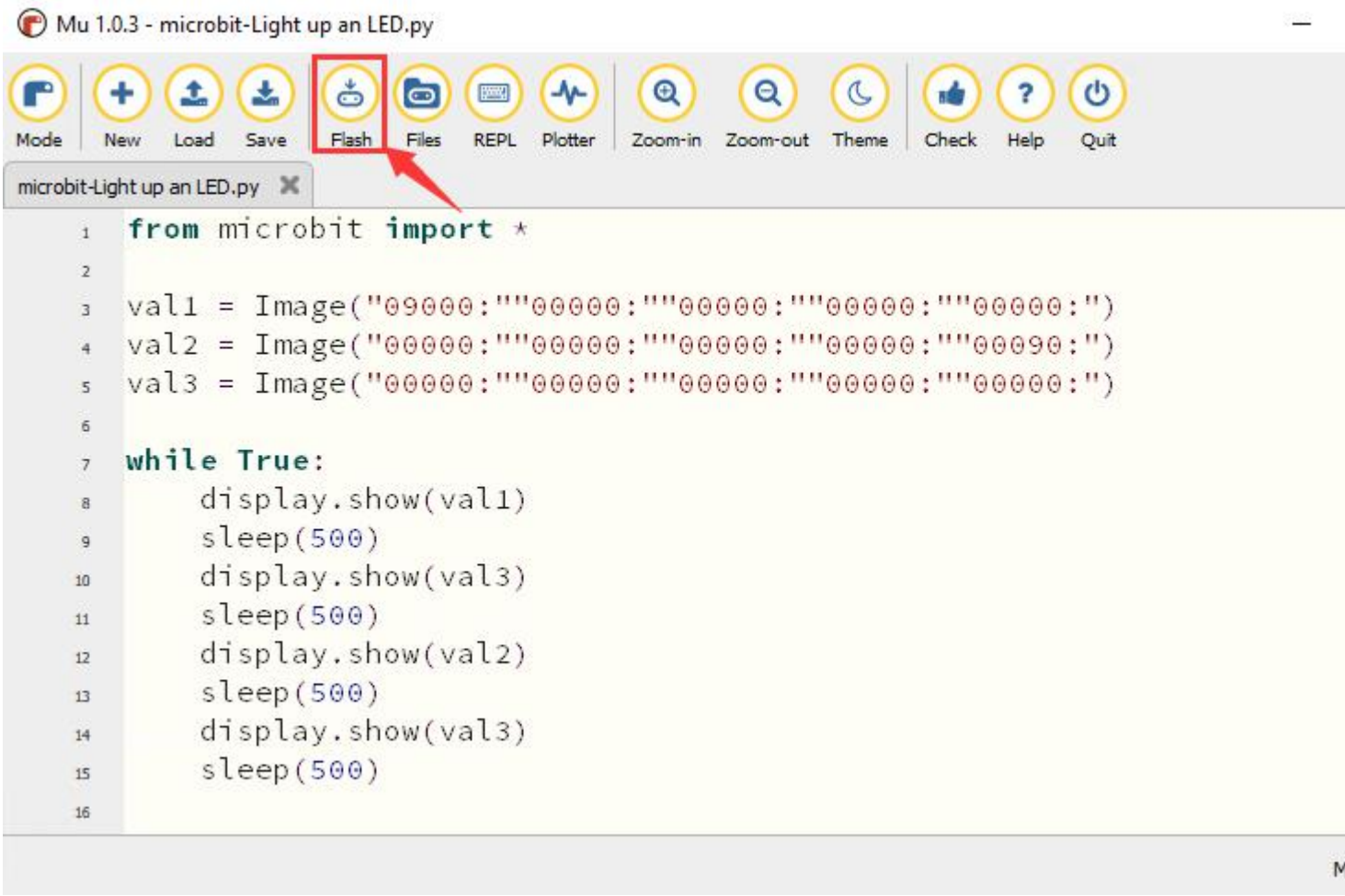
(Note:all English words and symbols must be written in English)



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



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



(4)Test Results:

After uploading test code to micro:bit main board and powering the main board via the USB cable, the LED in (1,0) lights up for 0.5s and the one in (3,4) shines for 0.5s and repeat this sequence.

(5)Code Explanation:

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

val1 = Image("09000:""00000:""00000:""00000:""00000:") val2 = Image("00000:""00000:""00000:""00000:""00090:") val3 = Image("00000:""00000:""00000:""00000:""00000:")	Set Image() to val1 Set pixel of LED on micro:bit to the value in 0~9 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

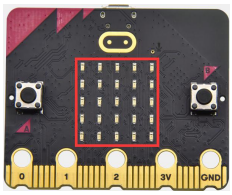
(6)Reference

sleep(ms) : delay time

For more details about delay, please refer to:

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

Project 3: LED Dot Matrix



(1) Project Introduction

Dot matrices are very commonplace in daily life. They have found wide applications in LED advertisement screens, elevator floor display, bus stop announcement and so on.

The LED dot matrix of Micro: Bit main board contains 25 LEDs in a grid. Previously, we have succeeded in controlling a certain LED to light by integrating its position value into the test code. Supported by the same

theory, we can turn on many LEDs at the same time to showcase patterns, digits and characters.

What’ s more, we can also click” show icon “ to choose the pattern we like to display. Last but not the least, we can design patterns by ourselves as well.

(2)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B. Open the offline version of Mu.

(3)Test Code:

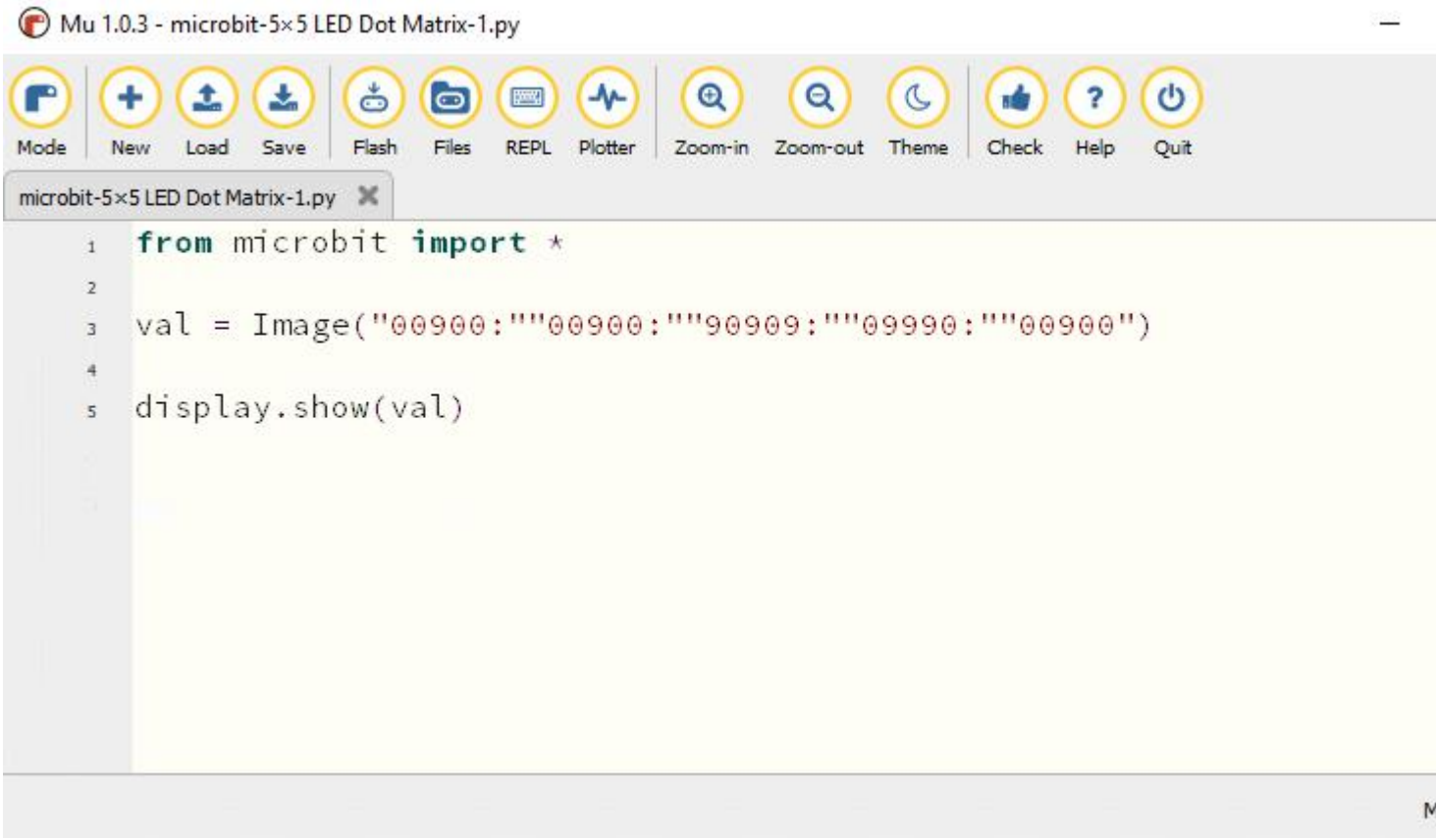
Code1:

You could open “Project 3： LED Dot Matrix-1.hex “file to Import code (How to load the project code?)

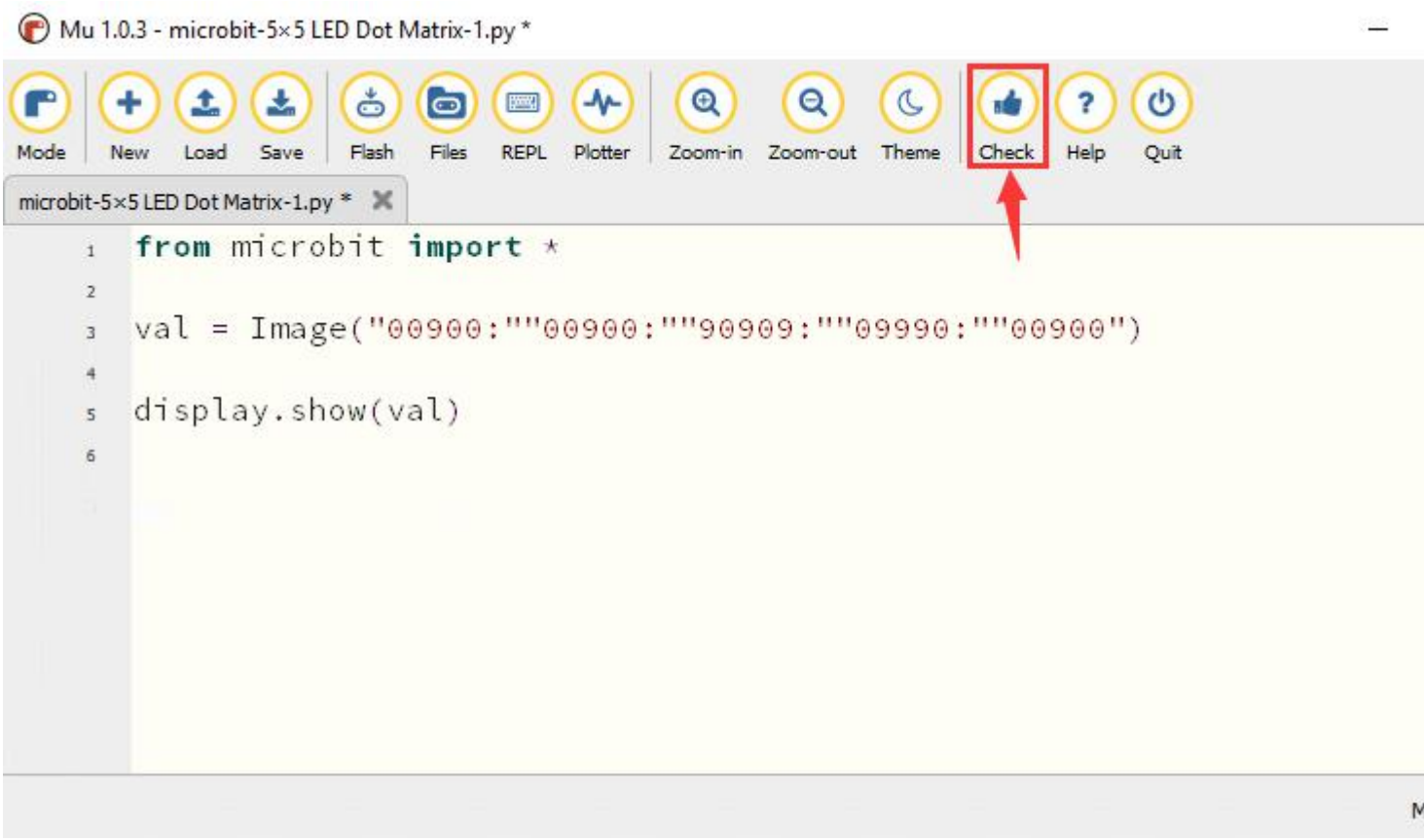
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 3： LED Dot Matrix-1.hex	Project 3 ： LED Dot Matrix-1.hex

You can also input code in the editing window yourself.

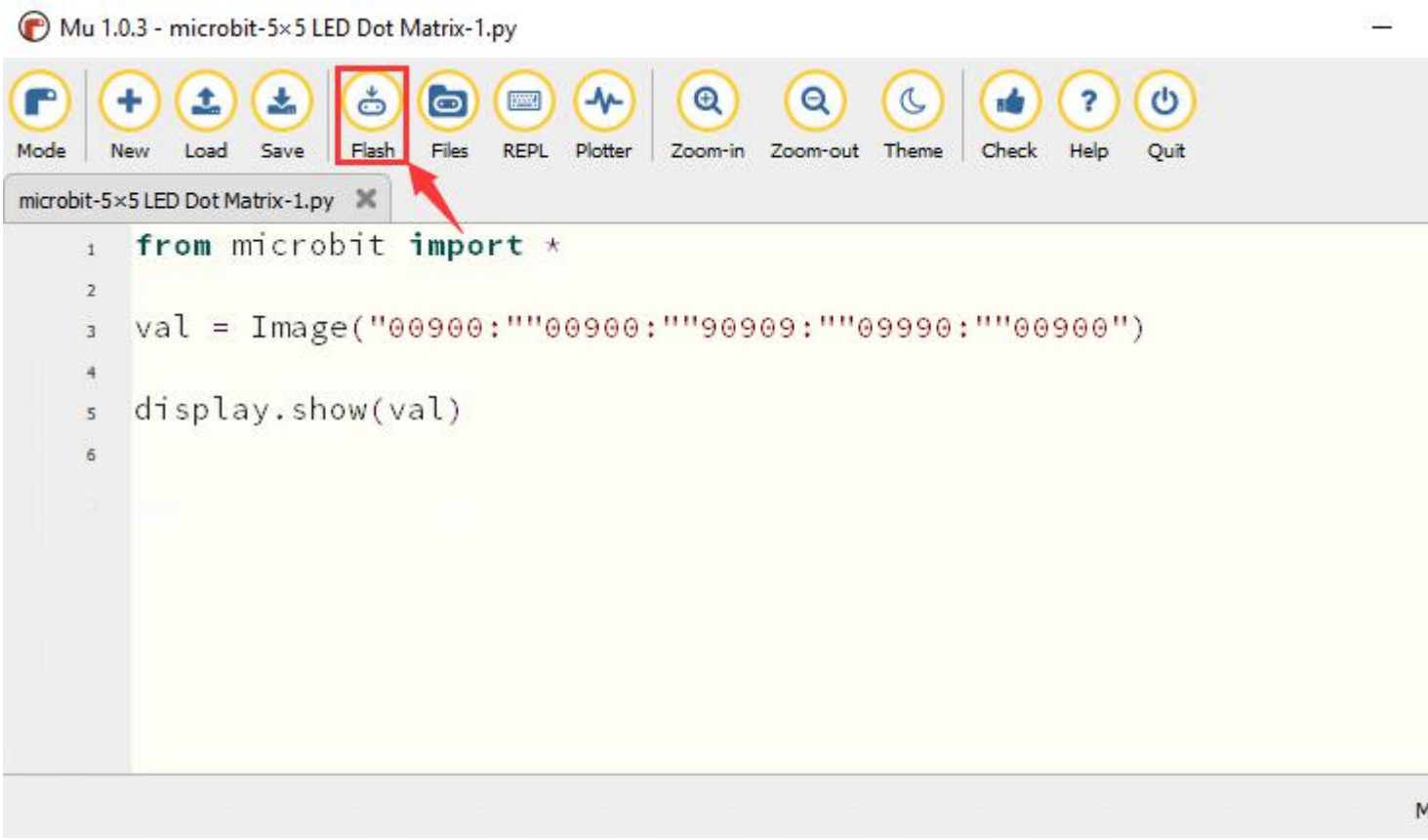
(note:all words and symbols must be written in English.)



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



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



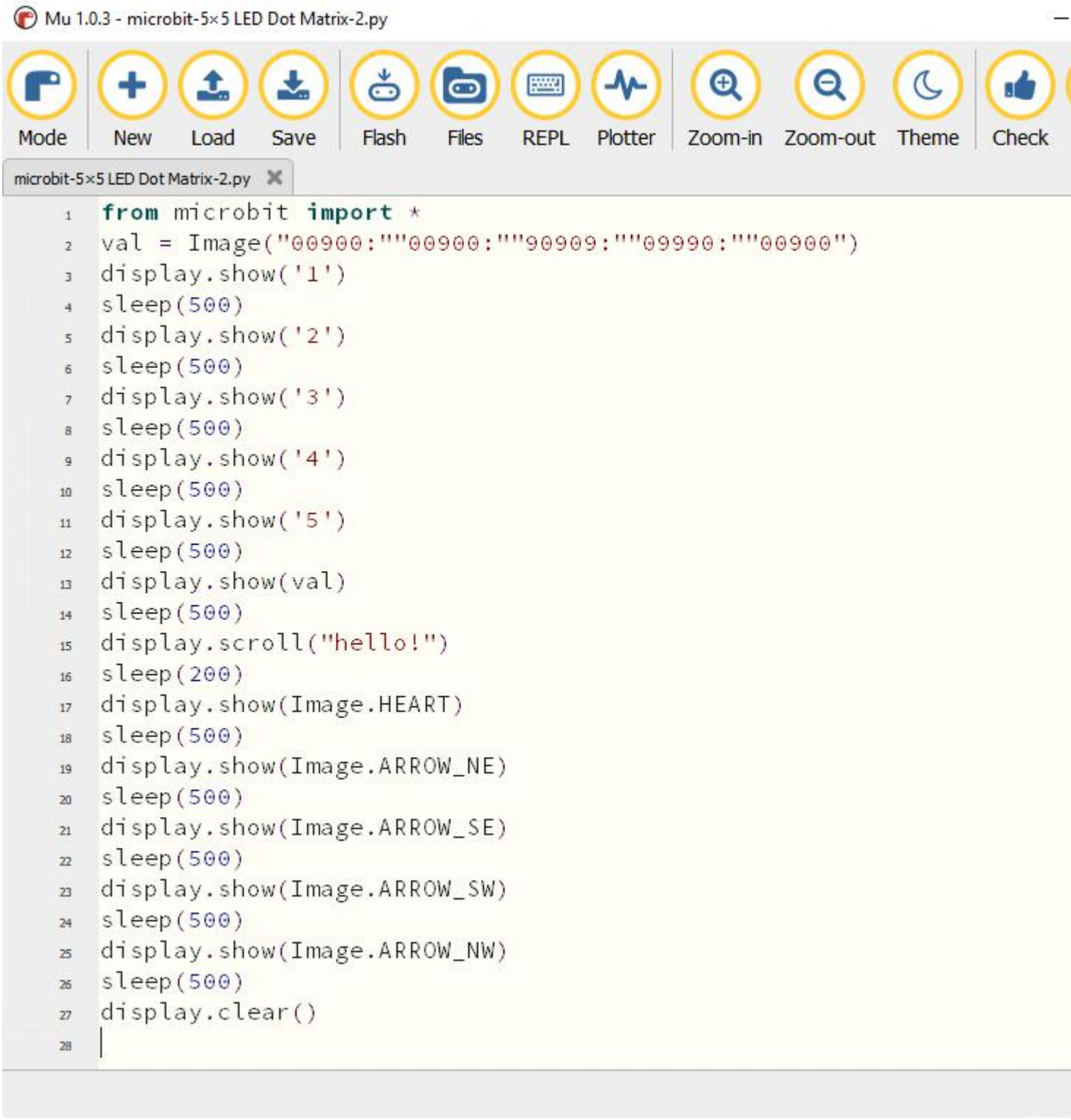
Code2:

You could open "Project 3: LED Dot Matrix-2.hex "file to Import code (How to load the project code?)

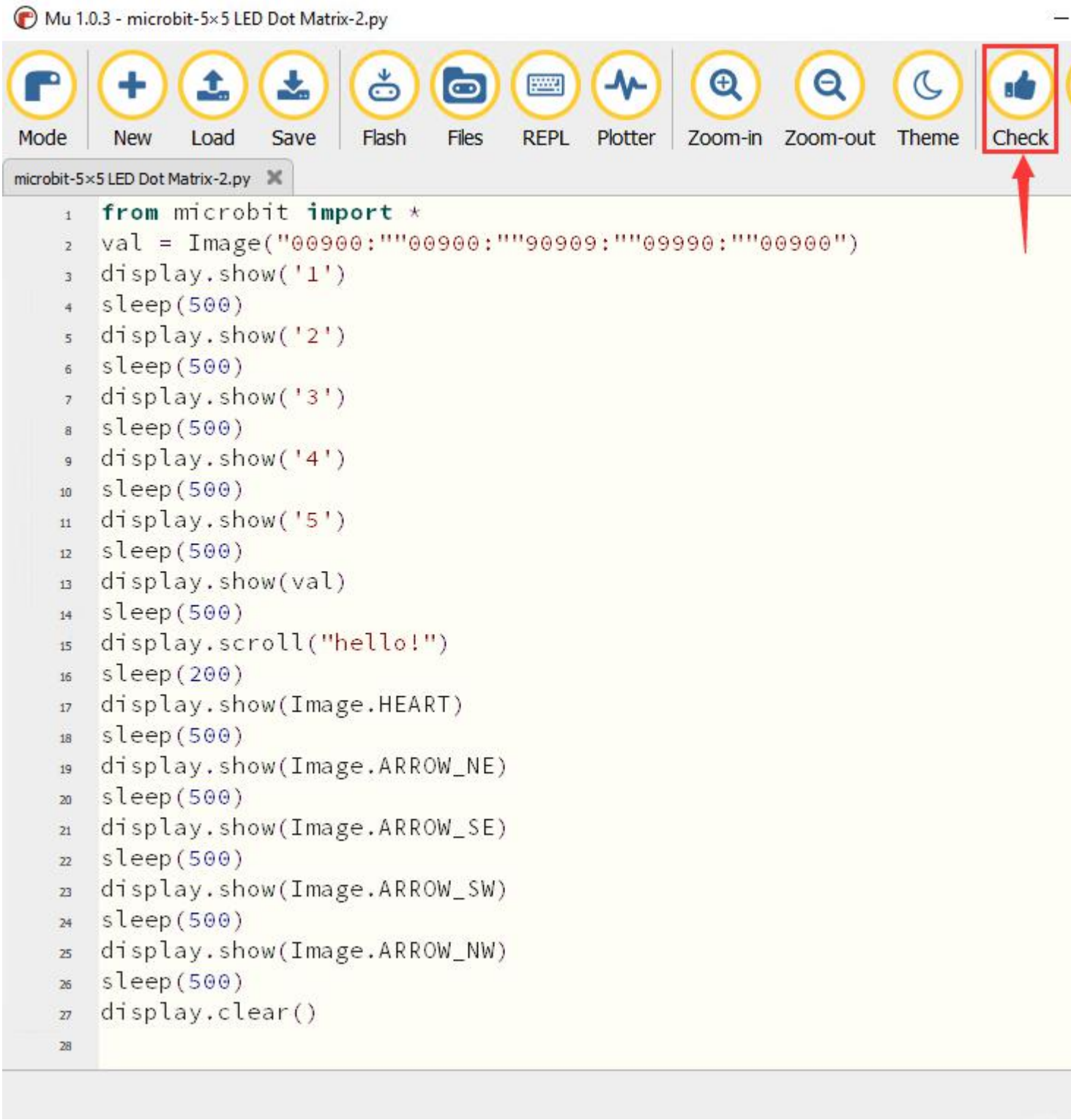
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 3: LED Dot Matrix-2.hex	Project 3: LED Dot Matrix-2.hex

You can also input code in the editing window yourself.

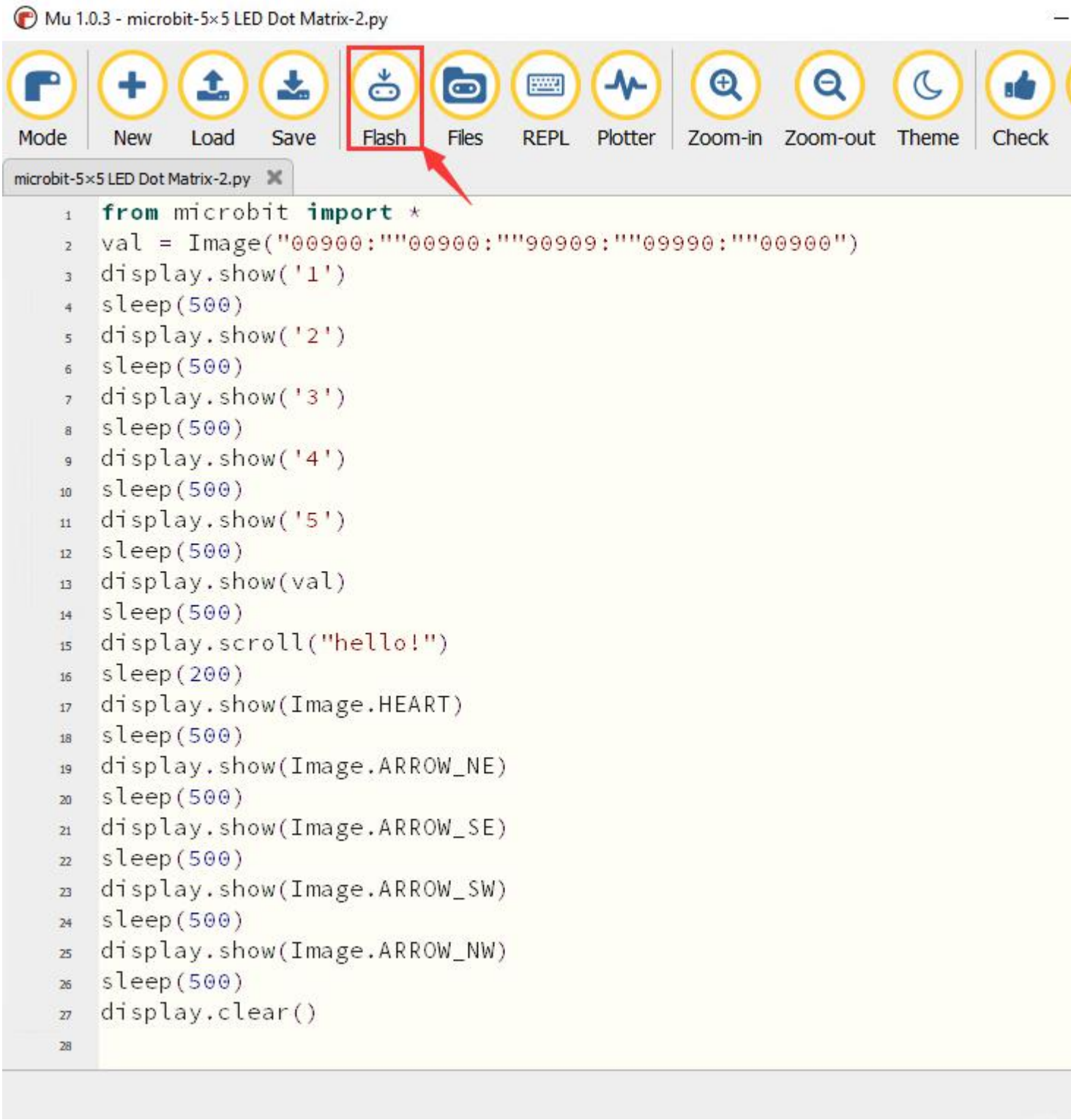
(note:all words and symbols must be written in English.)



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



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



(4)Test Results:

After uploading test code to micro:bit main board and powering the main board via the USB cable, we find that the 5*5 dot matrix start to show numbers 1,2,3,4 and 5, and then it alternatively shows a downward arrow  , word "Hello", a heart pattern  , an arrow pointing at northeast  , then at southeast  , then at southwest  , and then at northwest  .

(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:

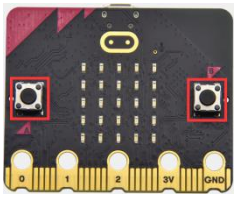
display.scroll() :

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

Project 4: Programmable Buttons

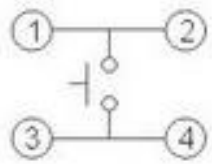


(1) Project Introduction

Buttons can be used to control circuits. In an integrated circuit with a push button, the circuit is connected when pressing the button and it is open the other way around.

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 two mountains.



Micro: Bit main board boasts three push buttons, two are programmable buttons(marked with A and B), and the one on the other side is a reset button. By pressing the two programmable buttons can input three different signals. We can press button A or B alone or press them together and the LED dot matrix shows A,B and AB respectively. Let’ s get started.

(2)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B. Open the offline version of Mu.

(3)Test Code1：

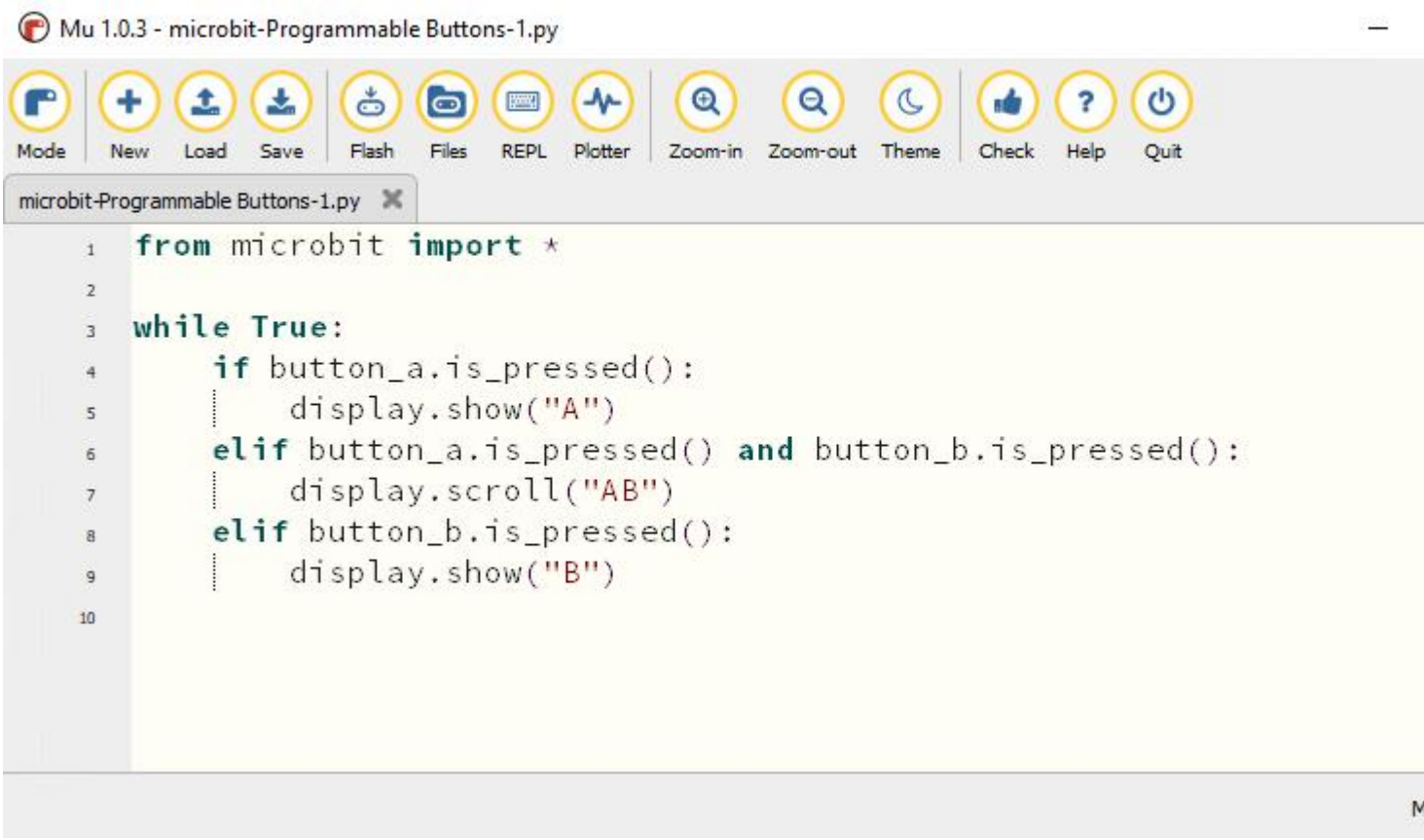
Enter Mu software and open the file "Project 4：Code-1.py" to import code:

(How to load the project code?)

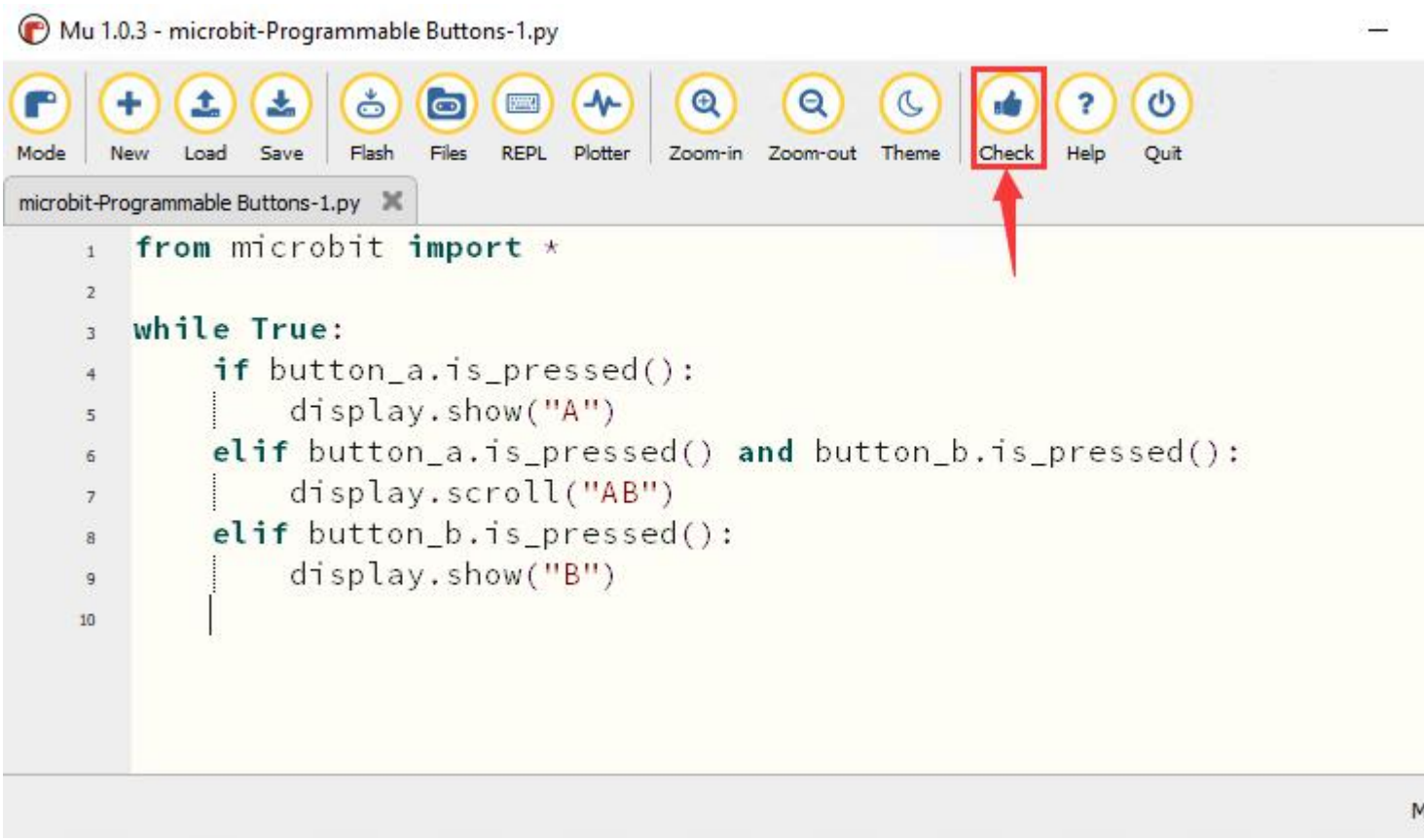
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 4 : Programmable Buttons	Project 4：Code-1.py

You can also input code in the editing window yourself.

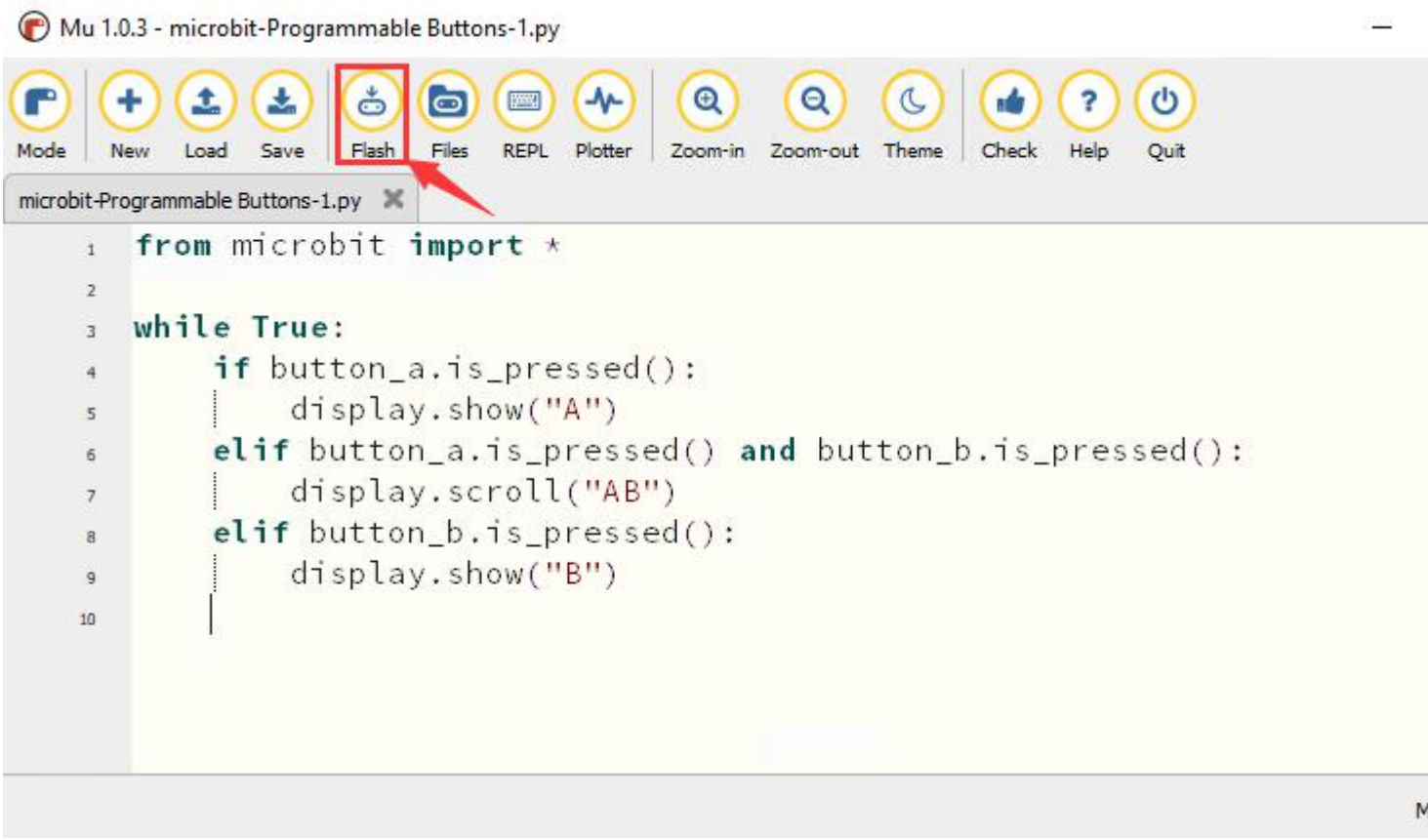
(note:all words and symbols must be written in English)



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



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



(4)Test Results1:

After uploading test code to micro:bit main board and powering the main board via the USB cable, the 5*5 LED dot matrix shows "A" if button A is pressed and then released, "B" if button B pressed and released, and "AB" if button A and B pressed together and then released.

(5)Test Code2:

Enter Mu software and open the file "Project 4: Code-2.py " to import code: (How to load the project code?)

File Type	Route	File Name
Python	KS4031(KS4032)/Python	Project 4: Code-2.py

file	Tutorial/Python Code/Project 4： Programmable Buttons	

You can also input code in the editing window yourself.

(note:all English words and symbols must be written in English)

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.

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.

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)
```

(6)Test Results2：

After uploading test code to micro:bit main board and powering the main board via the USB cable, when the button A is pressed, the LEDs turning red increase while when the button B pressed, the LEDs turning red reduce.

(7)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")	If button A is pressed micro:bit shows “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 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
if a == 0:
display.show(val1)
if a == 1:
	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
	Variable a=0
	exit the loop
	When a=0

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)
	micro:bit shows pattern val1
	When a=1
	micro:bit displays pattern val2
	When a=2
	micro:bit shows pattern val3
	If a=3
	micro:bit displays pattern val4
	If a=4
	micro:bit shows pattern val5
	If a=5
	micro:bit displays pattern val6

Project 5: Temperature Detection

(1) Project Introduction

The Micro:bit main board is not equipped with a temperature sensor, but uses the temperature sensor built into NFR52833 chip for temperature detection. Therefore, the detected temperature is more closer to the temperature of the chip, and there maybe deviation from the ambient temperature.

In this project, we use the sensor to test the temperature in the current environment, and display the test results in the display data (device). And then control the LED dot matrix to display different patterns by setting the temperature range detected by the sensor.

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

(2)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B. Open the offline version of Mu.

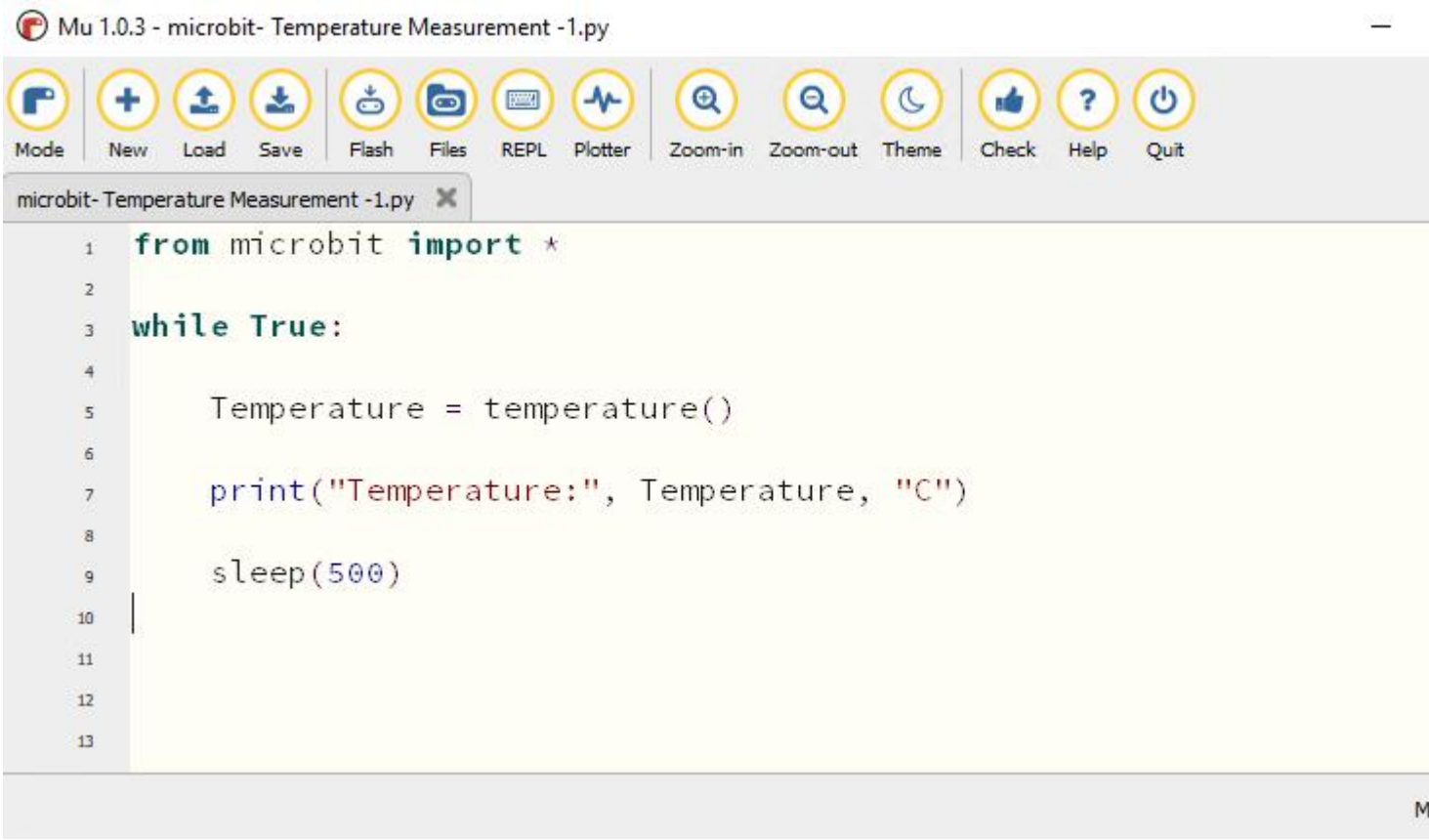
(3)Test Code1:

Enter Mu software and open the file “Project 5：Code-1.py” to import code:

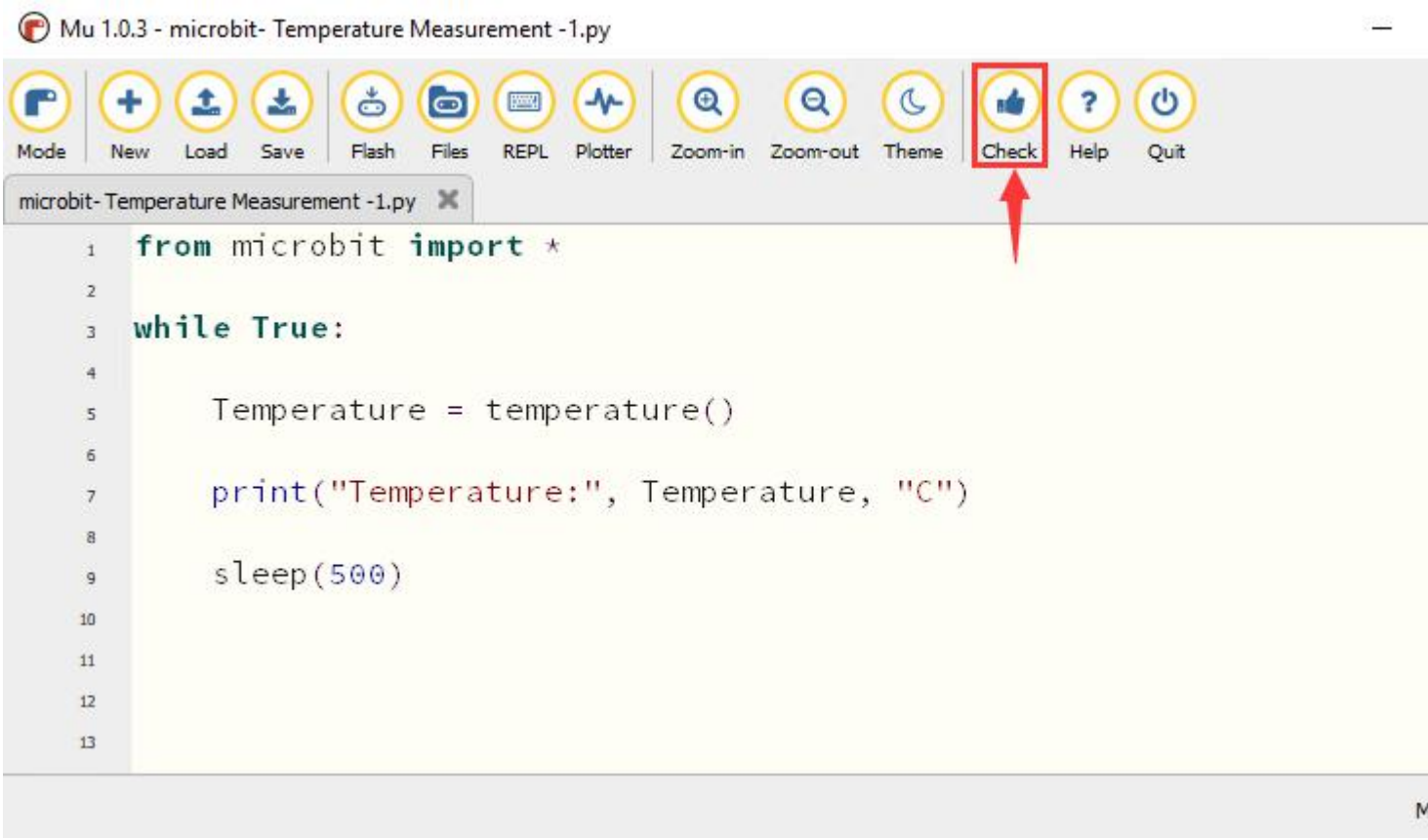
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python	Project 5： Code-1.py

	Tutorial/Python Code/Project 5 : Temperature Detection	

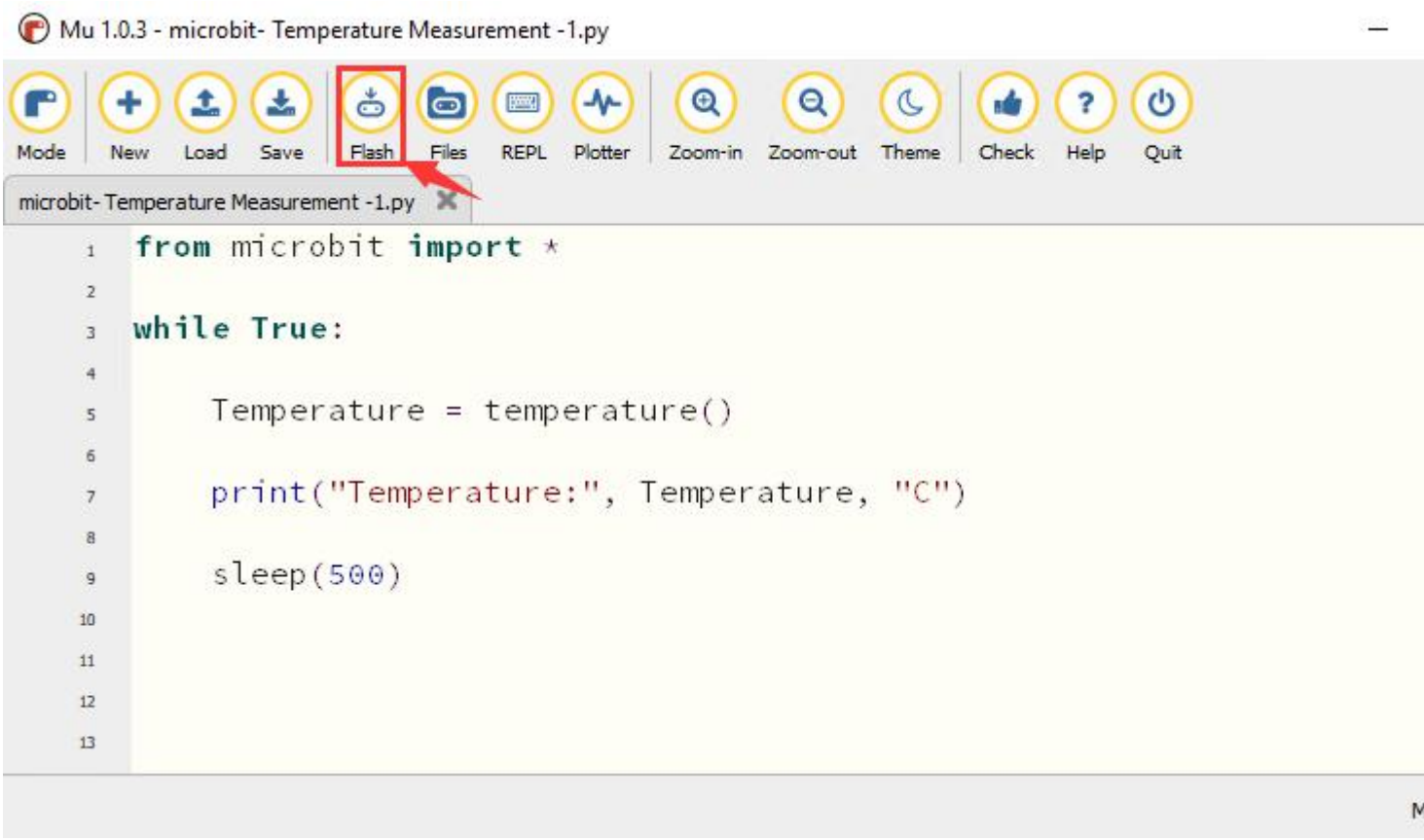
You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



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

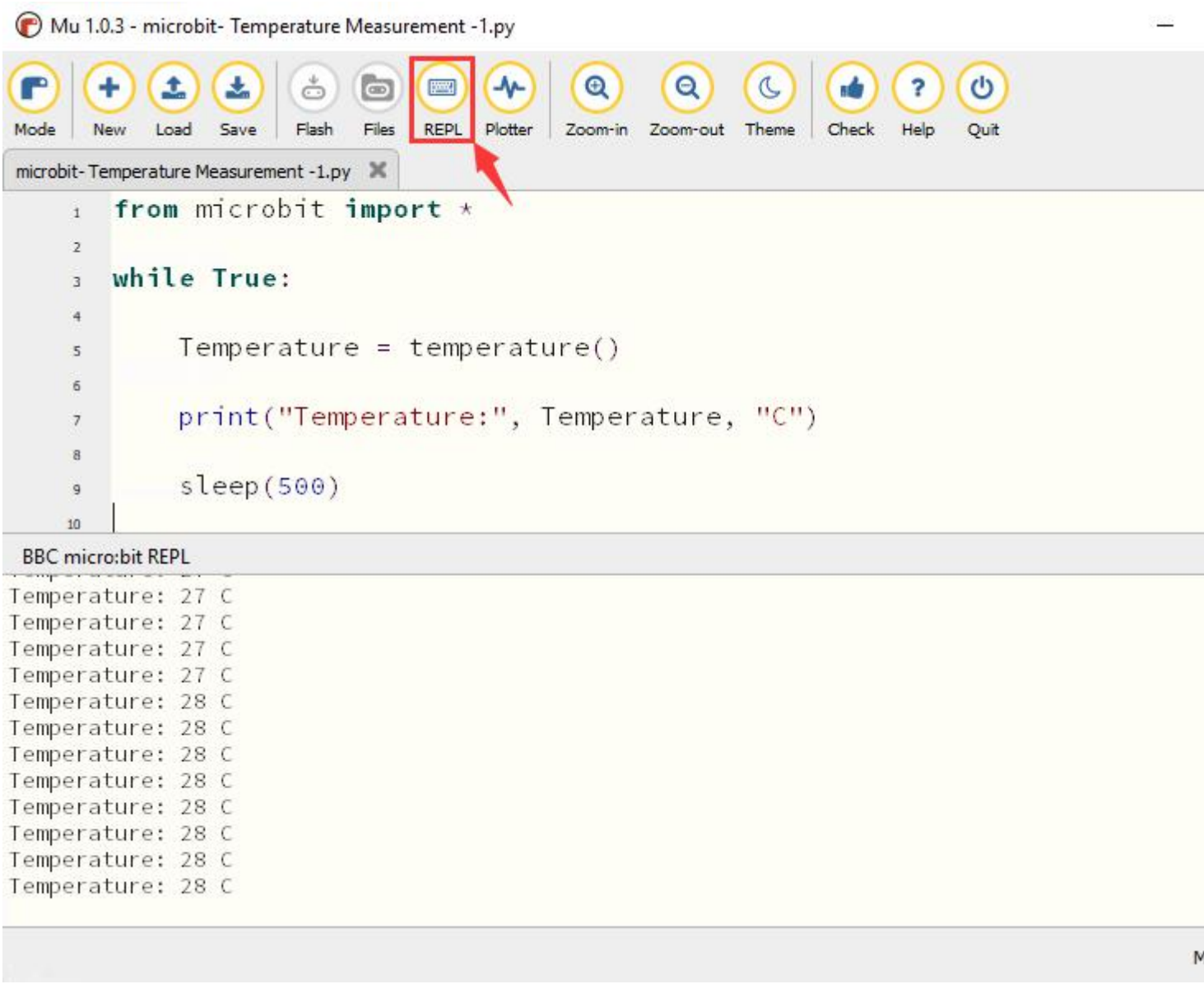


If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



(4)Test Results1:

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)



(5)Test Code2:

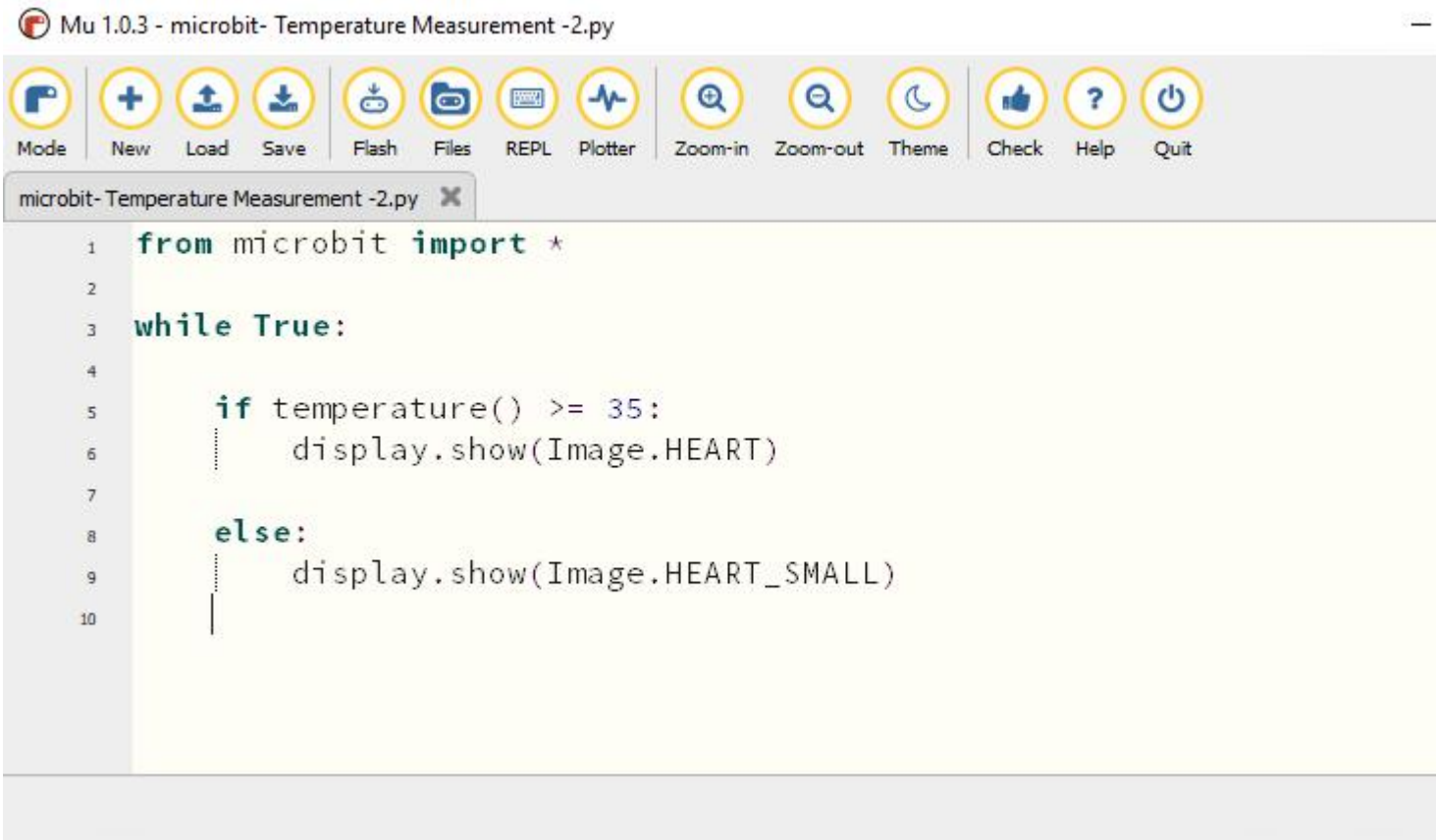
Enter Mu software and open the file "Project 5：Code-2.py" to import code:

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python	Project 5： Code-2.py

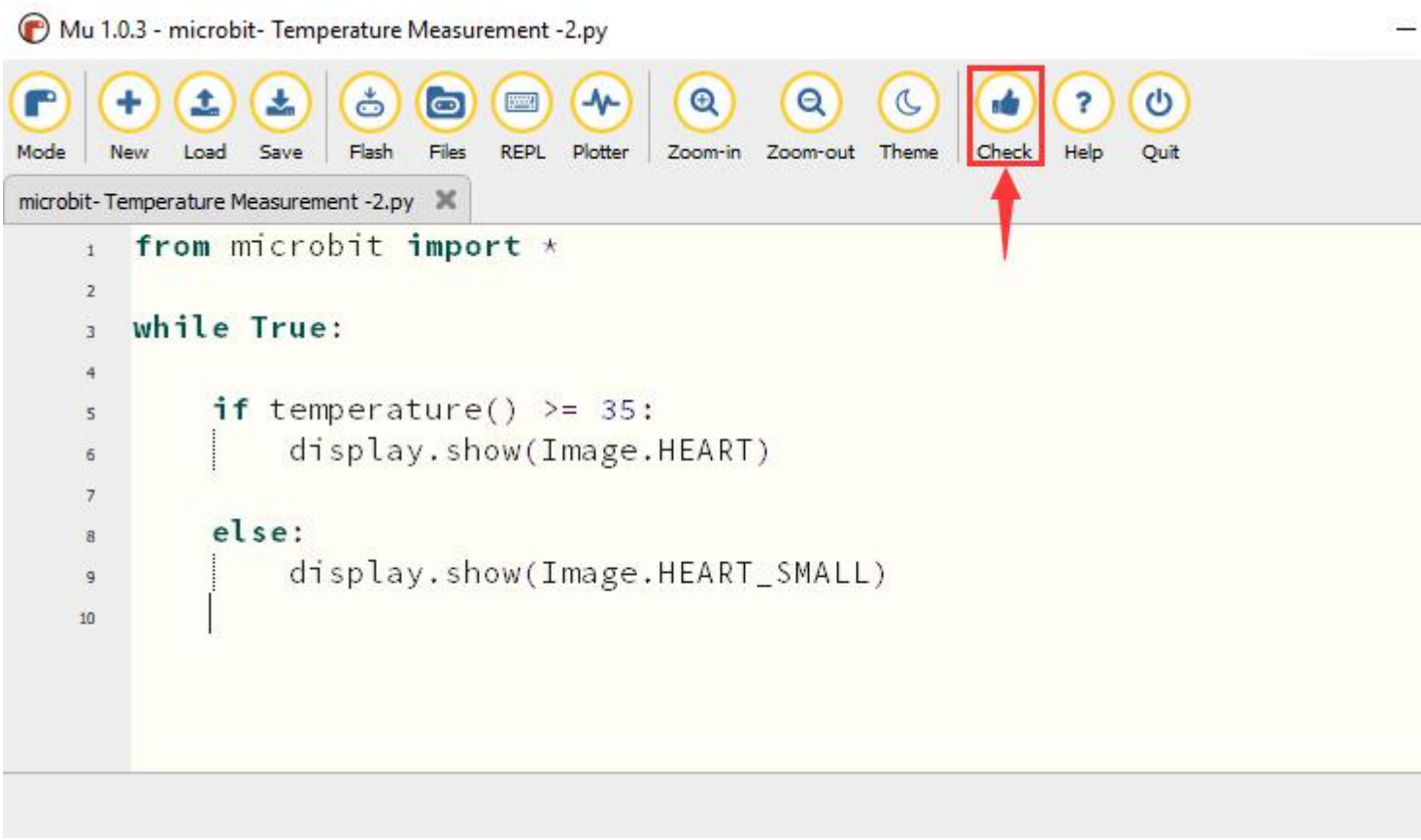
	Code/Project 5 : Temperature Detection	

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

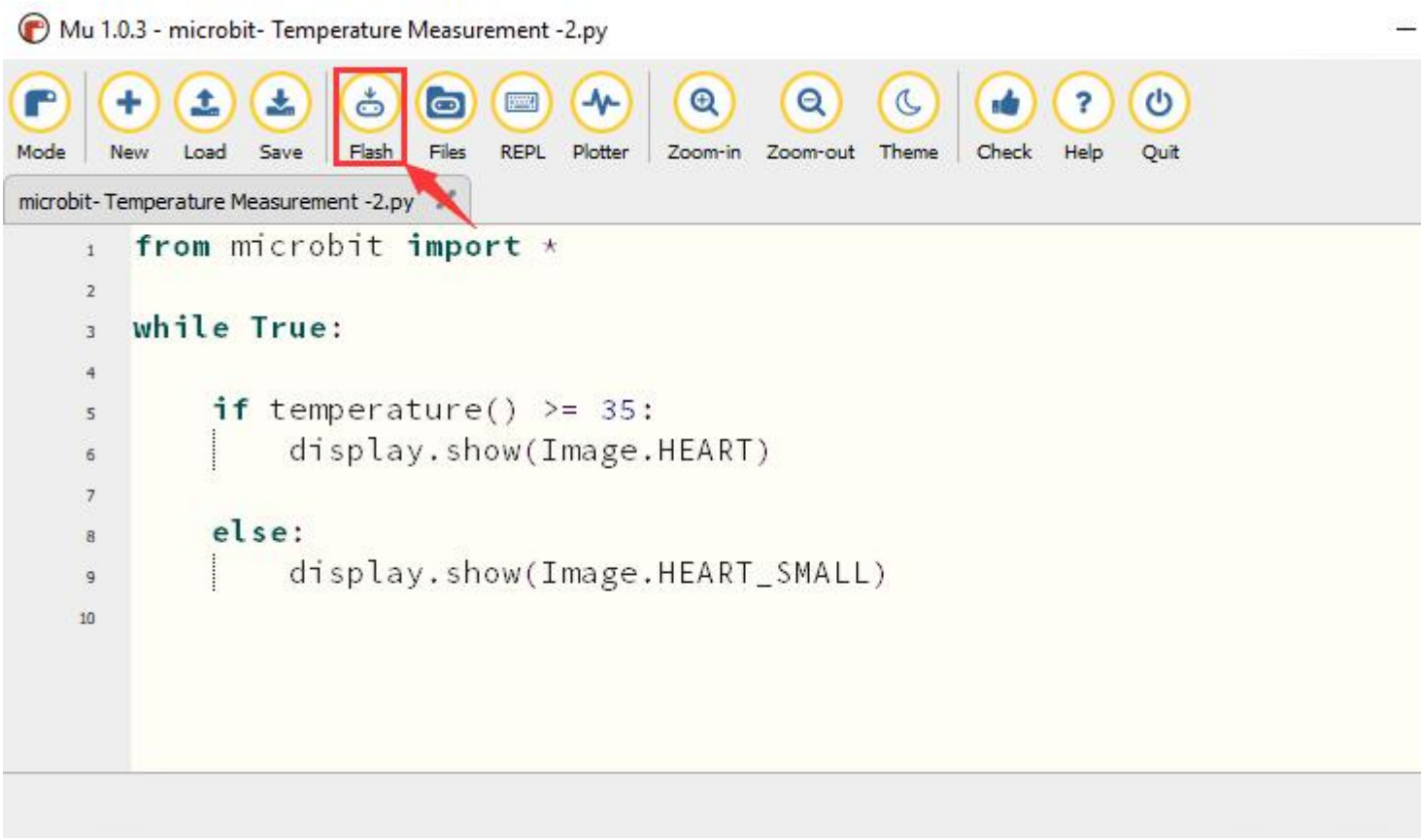
The temperature value can be set in compliance with the real temperature.



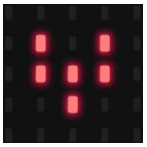
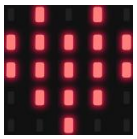
Click "Check" to examine error in the code. The program proves wrong if underlines and cursors are shown.



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



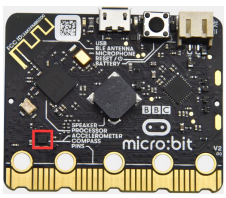
(6)Test Results2:

After uploading the code 2 to the board, when the ambient temperature is less than 35℃, the 5*5 LED dot matrix shows  . When the temperature is equivalent to or greater than 35℃, the pattern  appears.

(7)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 "  "

Project 6: Geomagnetic Sensor



(1)Project 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)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B.Open the offline version of Mu.

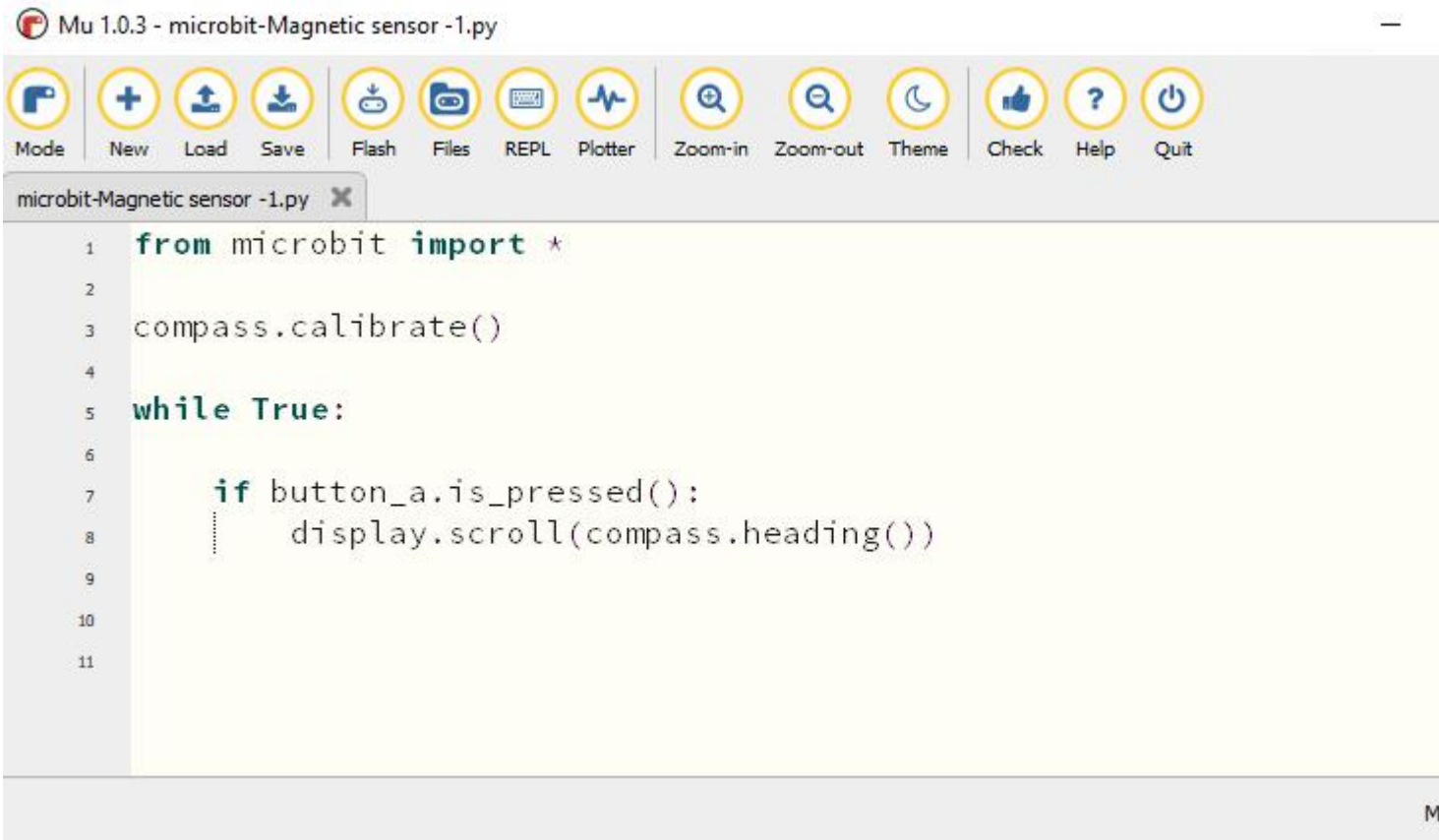
(3)Test Code1::

Enter Mu software and open the file “Project 6：Code-1.py” to import code:

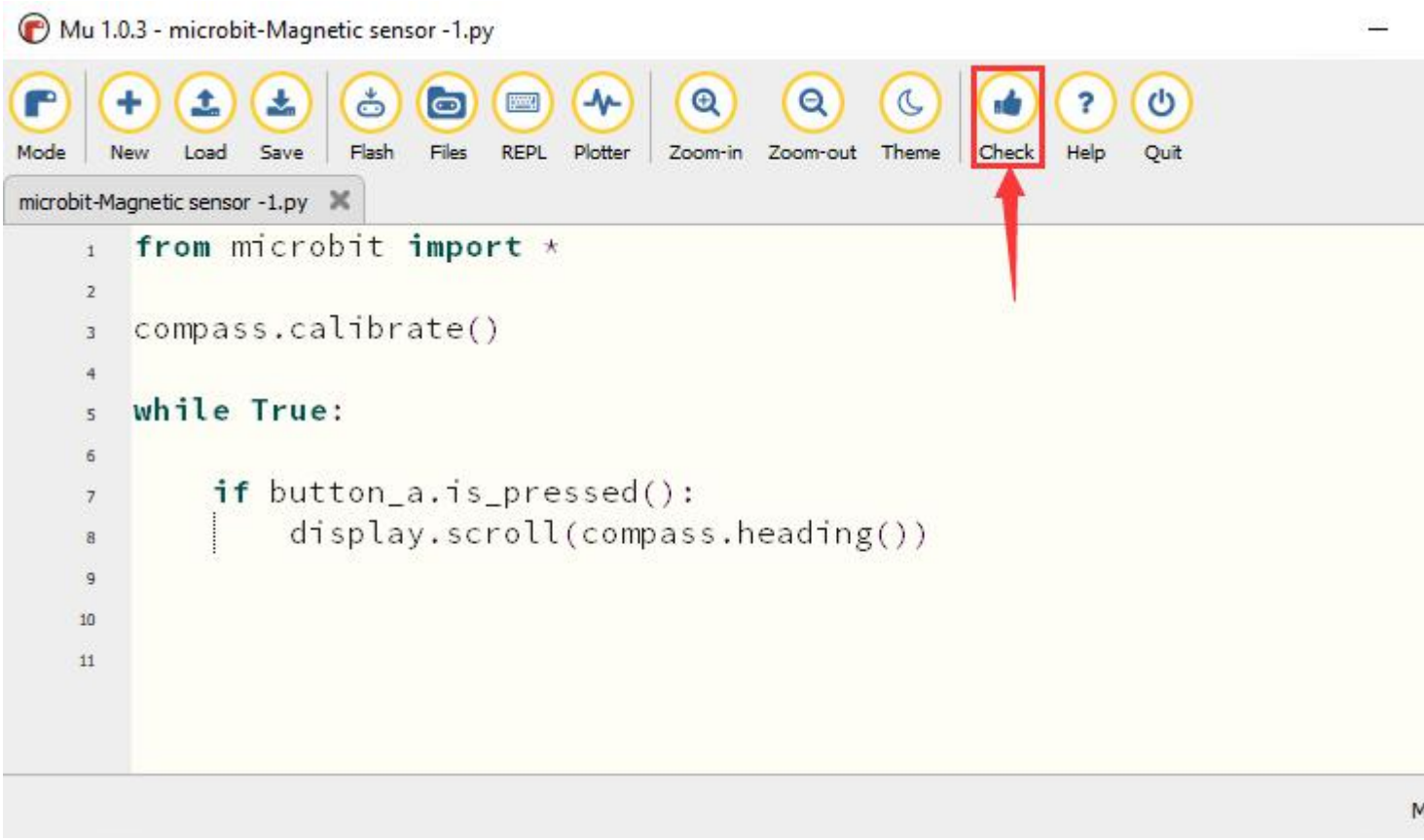
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 6 Geomagnetic Sensor	Project 6：Code-1.py

You can also input code in the editing window yourself.

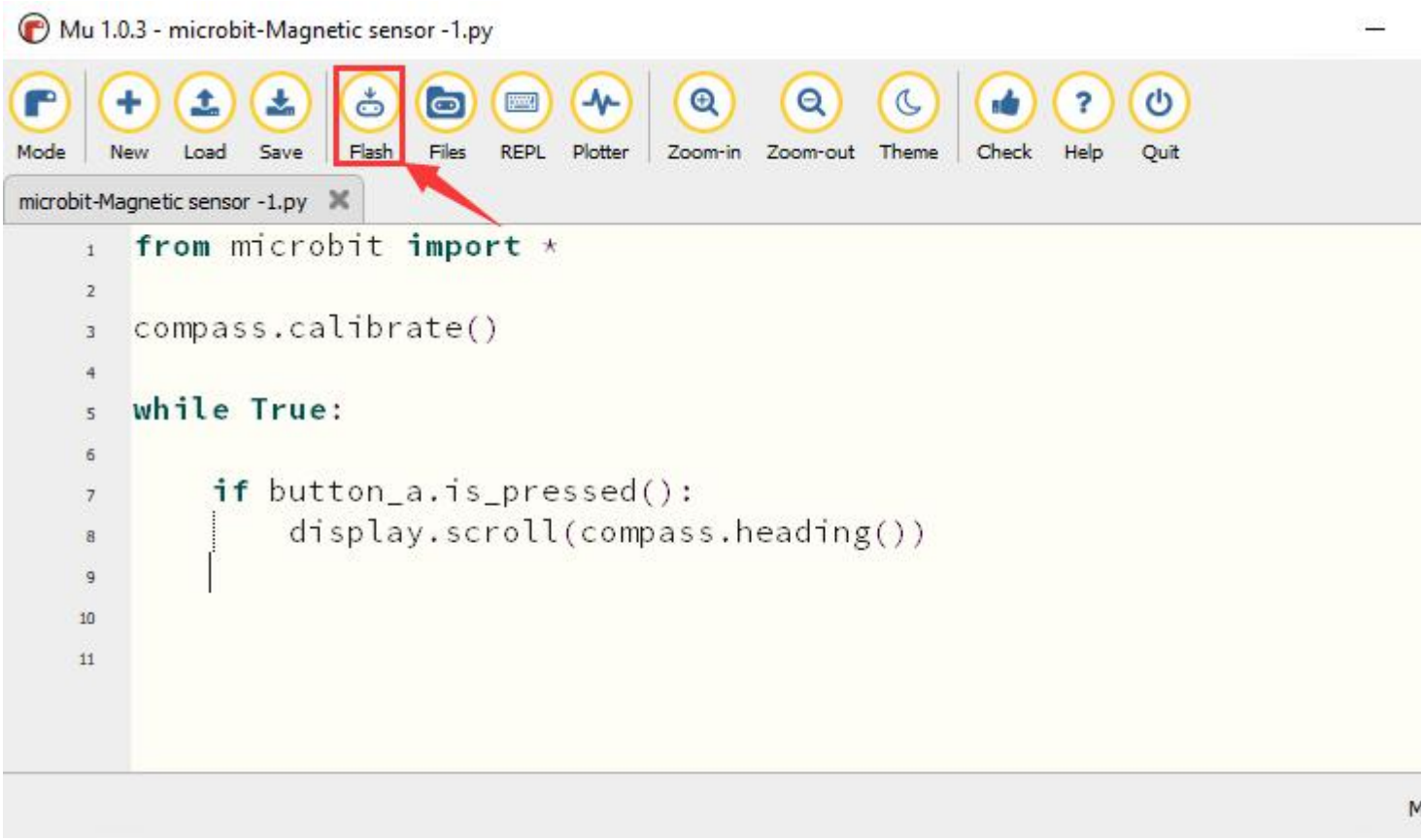
(note:all English words and symbols must be written in English)



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

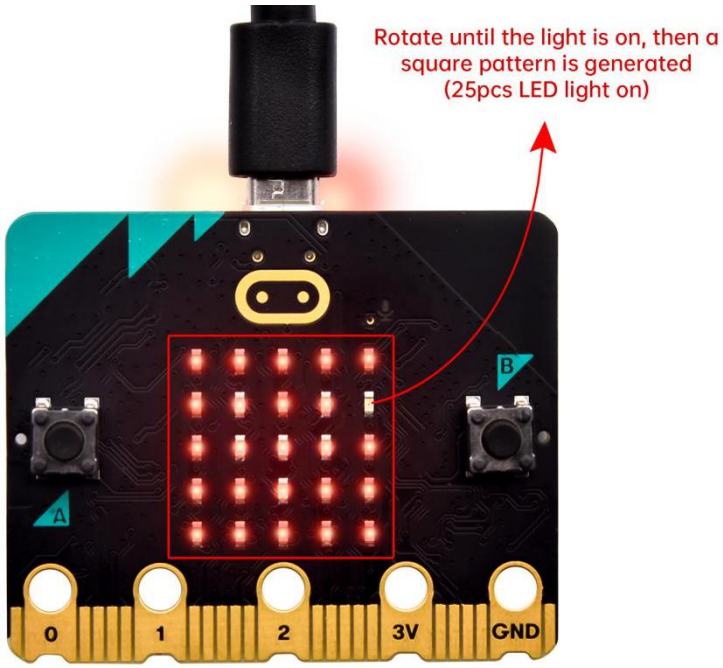


If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



(4)Test Result1：

After uploading test code1 to micro:bit main board and powering the board via the USB cable, and pressing the button A, the board asks us to calibrate compass and the LED dot matrix shows “TILT TO FILL SCREEN”. Then enter the calibration page. Rotate the board until all 25 red LEDs are on as shown below.

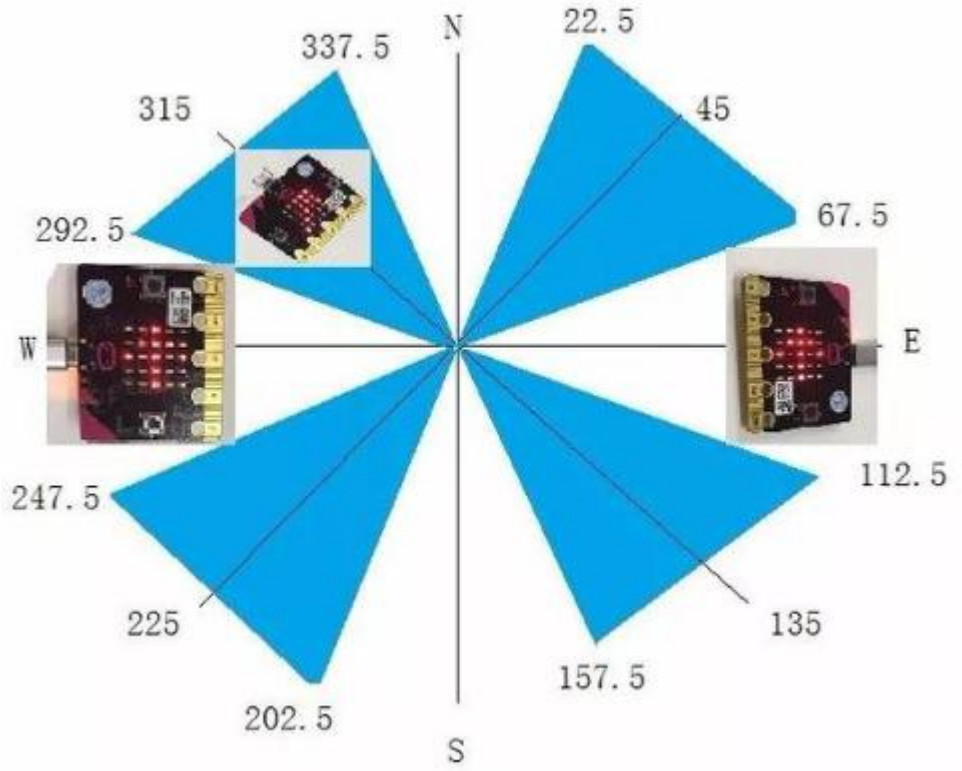


After that, a smile pattern  appears, which implies the calibration is done. When the calibration process is completed, pressing the button A will make the magnetometer reading display directly on the screen. And the direction north, east, south and west correspond to 0°, 90°, 180° and 270° respectively.

(5)Test Code2:

For the below picture, the arrow pointing to the upper right when the value ranges from 292.5 to 337.5. Because 0.5 can’ t be input in the code, the values we get are 293 and 338.

Then add other statements to make a set of complete code.



Enter Mu software and open the file “Project 6：Code-2.py” to import code:

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 6 Geomagnetic Sensor	Project 6：Code-2.py

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

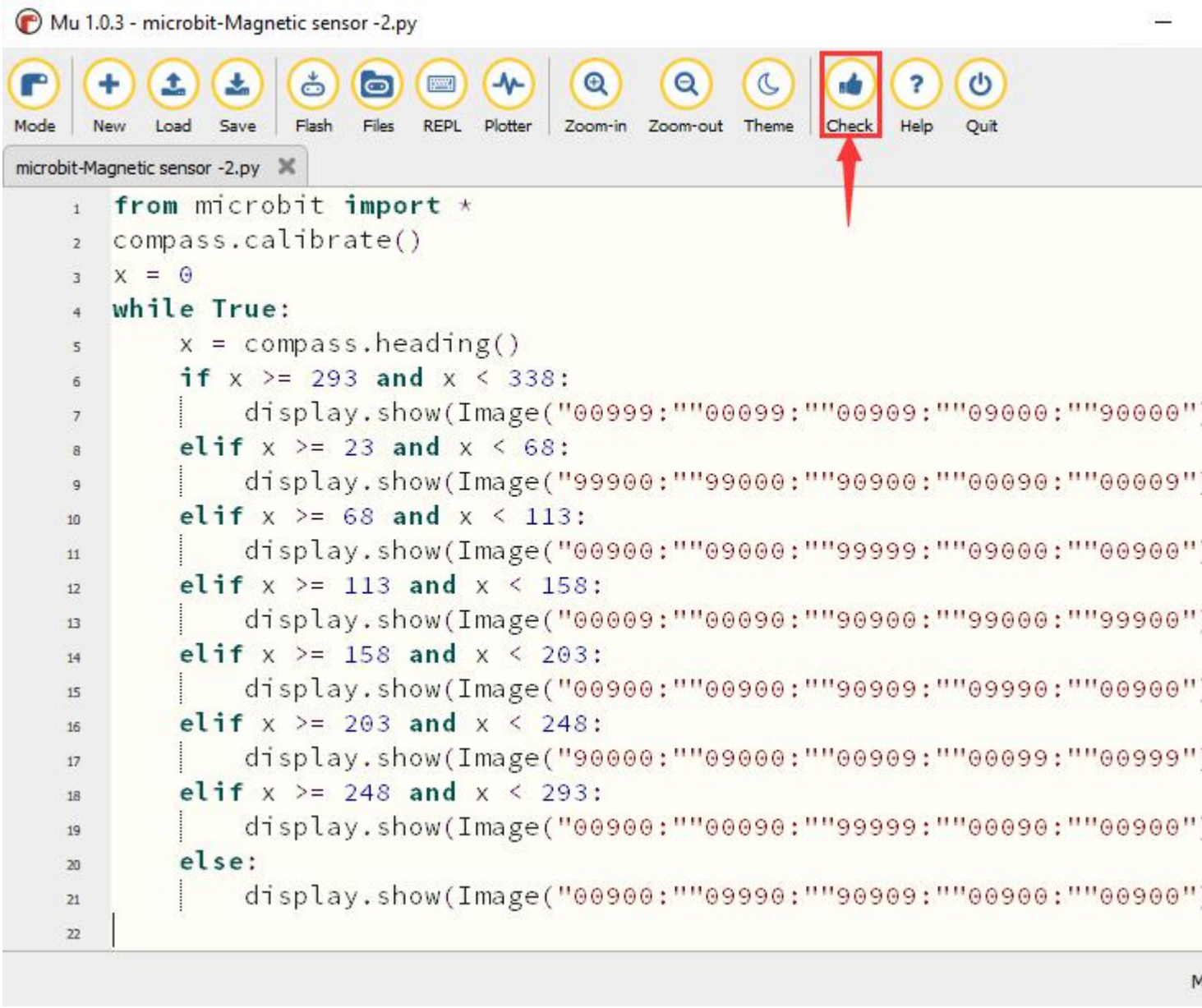
Mu 1.0.3 - microbit-Magnetic sensor -2.py

Mode New Load Save Flash Files REPL Plotter Zoom-in Zoom-out Theme Check Help Quit

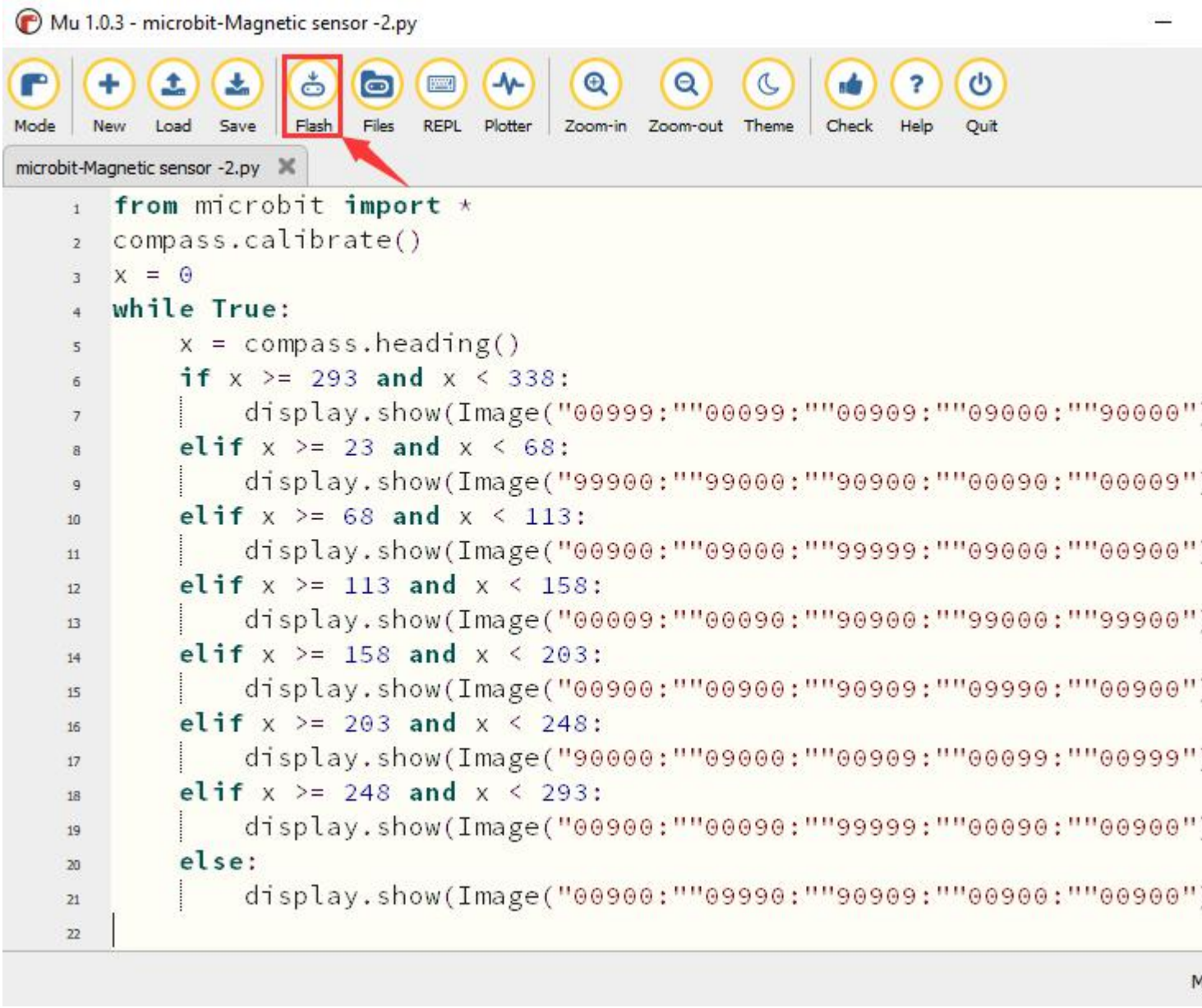
microbit-Magnetic sensor -2.py

```
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.



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



(6)Test Results2:

Upload code 2 and plug micro:bit into power. After calibration, tilt micro:bit board, and the LED dot matrix displays the direction signs.

(6)Code Explanation:

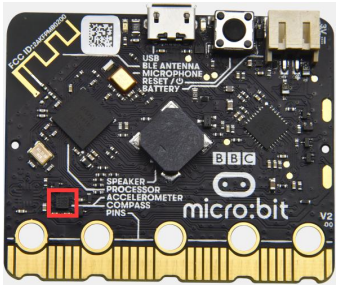
from microbit **import** *	Import the

	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"))	Micro:bit shows the Northeast arrow sign
display.show(Image("99900:""99000:""90900:""00090:""00009"))	
display.show(Image("00900:""09000:""99999:""09000:""00900"))	Micro:bit shows the Northwest arrow sign
display.show(Image("00009:""00090:""90900:""99000:""99900"))	
display.show(Image("00900:""00900:""90909:""09990:""00900"))	Micro:bit shows the west arrow sign
display.show(Image("90000:""09000:""00909:""00099:""00999"))	
display.show(Image("00900:""00090:""99999:""00090:""00900"))	Micro:bit shows the Southwest arrow sign
display.show(Image("00900:""09990:""90909:""00900:""00900"))	
	Micro:bit shows the

	South arrow sign Micro:bit shows the South arrow sign Micro:bit shows the East arrow sign Micro:bit shows the North arrow sign

Project 7: Accelerometer



(1) Project Introduction

The Micro: Bit main board V2 has a built-in LSM303AGR gravity acceleration sensor, also known as accelerometer, with a resolution of 8/10/12 bits. The code section sets the range to 1g, 2g, 4g, and 8g.

We often use accelerometer to detect the status of machines.

In this project, we will introduce how to measure the position of the board with the accelerometer. And then have a look at the original three-axis data output by the accelerometer.

(2)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B. Open the offline version of Mu.

(3)Test Code1:

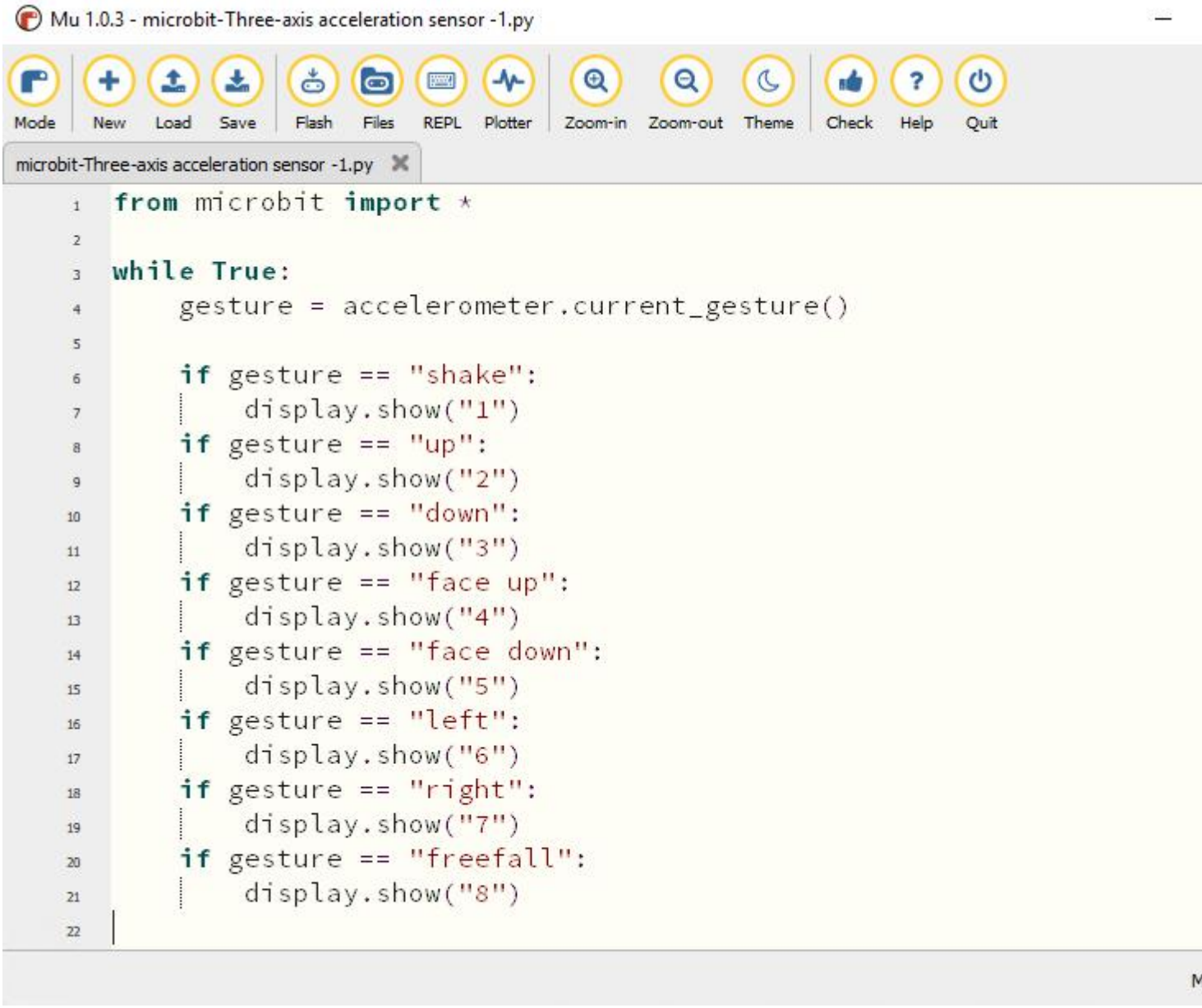
Enter Mu software and open the file "Project 7: Accelerometer-1.py" to import code:

(How to load the project code?)

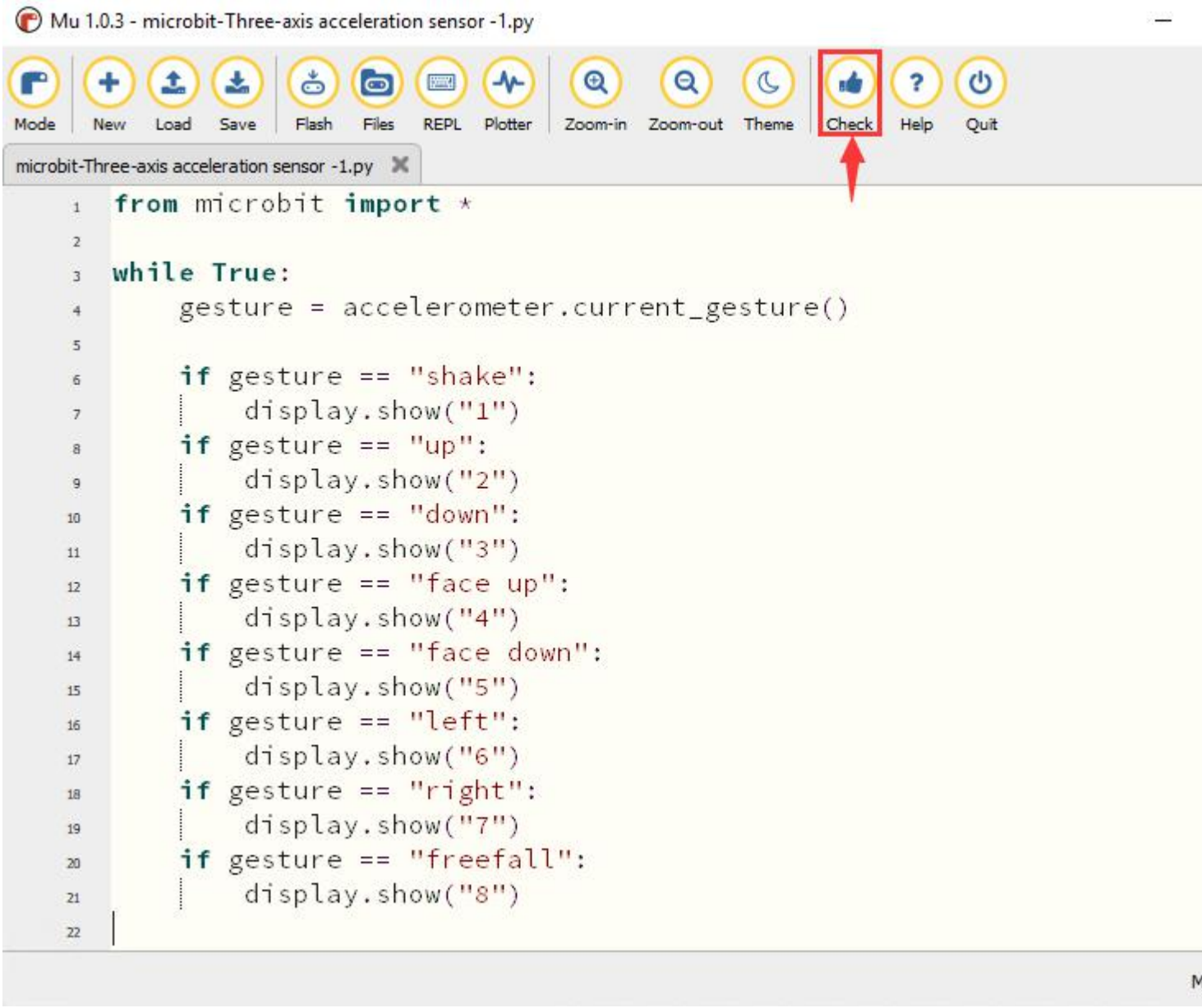
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 7 :	Project 7 : Accelerometer-1.py

	Accelerometer	

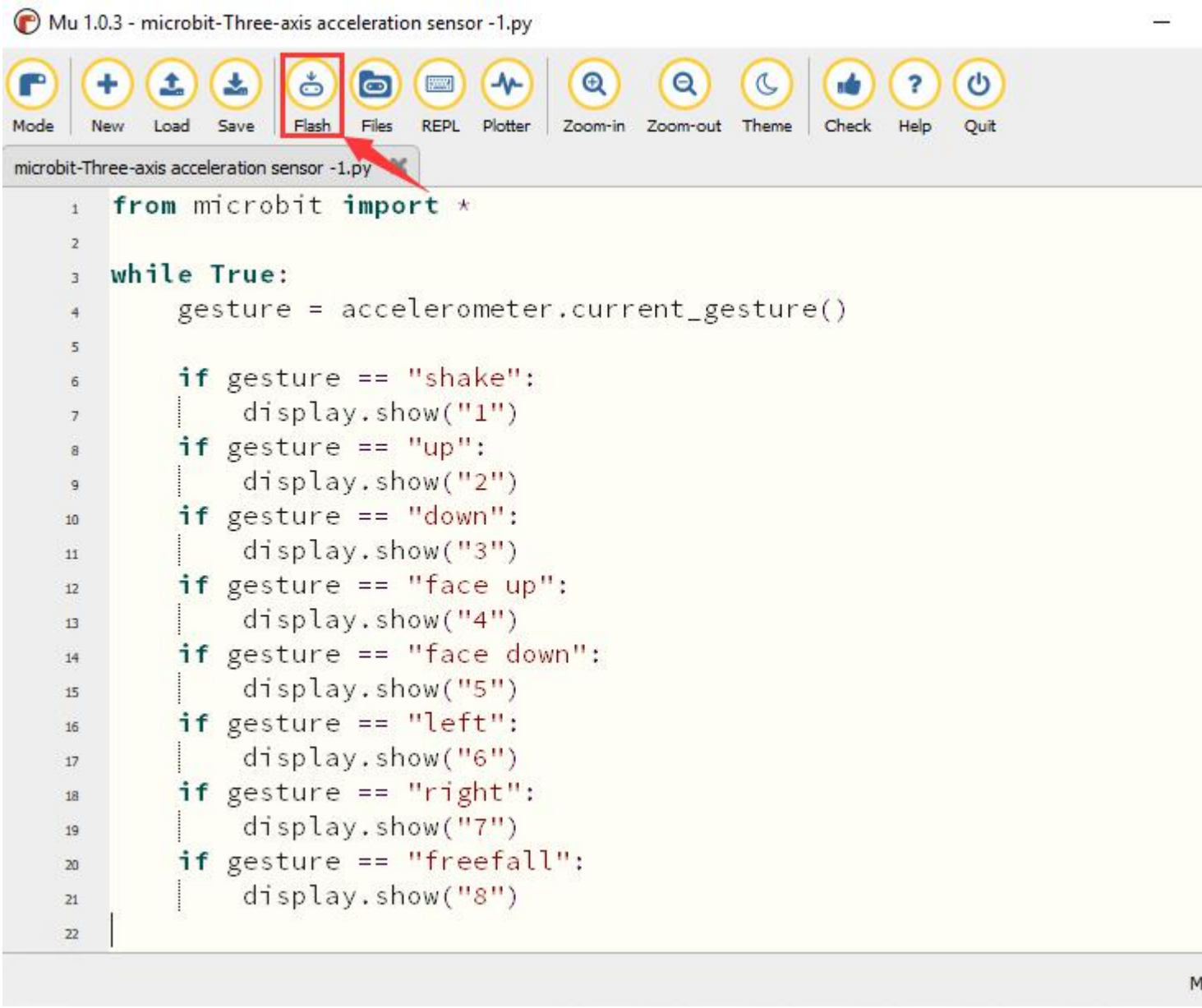
You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



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



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



(4)Test Results1:

After uploading the test code 1 to micro:bit main board and powering the board via the USB cable, if we shake the Micro: Bit main board, no matter at any direction, the LED dot matrix displays the digit “1”.

When it is kept upright（make its logo above the LED dot matrix）, the number 2 shows.

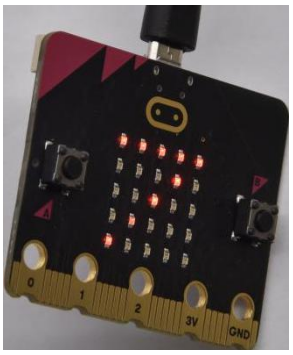
When it is kept upside down(make its logo below the LED dot matrix) , it shows as below.

When it is placed still on the desk, showing its front side, the number 4 appears.

When it is placed still on the desk, showing its back side, the number 5 exhibits.

When the board is tilted to the left , the LED dot matrix shows the number 6 as shown below.

When the board is tilted to the right , the LED dot matrix displays the number 7 as shown below:



When the board is knocked to the floor, this process can be considered as a free fall and the LED dot matrix shows the number 8. (Please note that this test is not recommended for it may damage the main board.)

Attention: if you' d like to try this function, you can also set the acceleration to 3g, 6g or 8g. But still ,we do not recommend.

(5)Test code2:

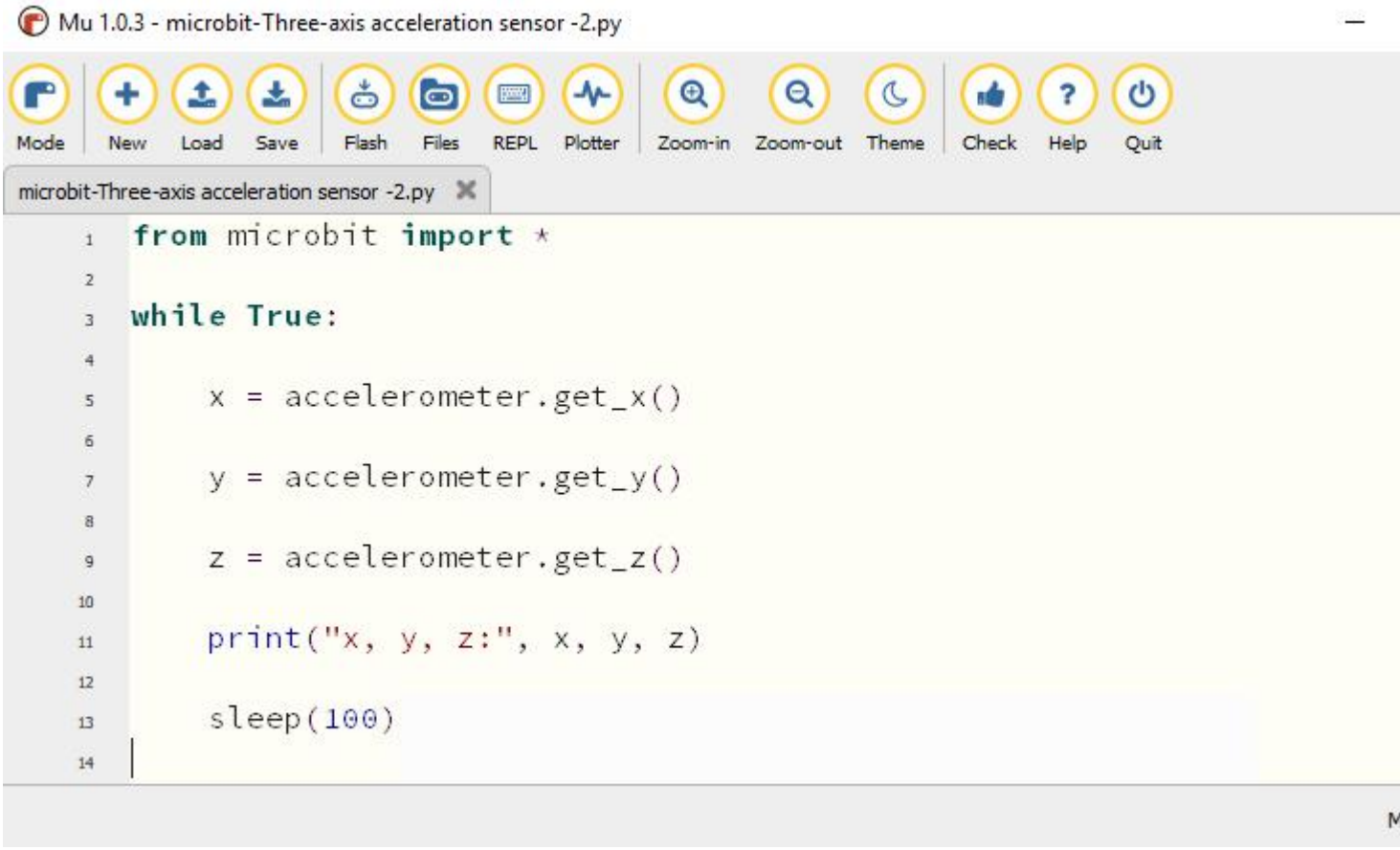
Enter Mu software and open the file "Project 7: Accelerometer-2.py" to import code:

(How to load the project code?)

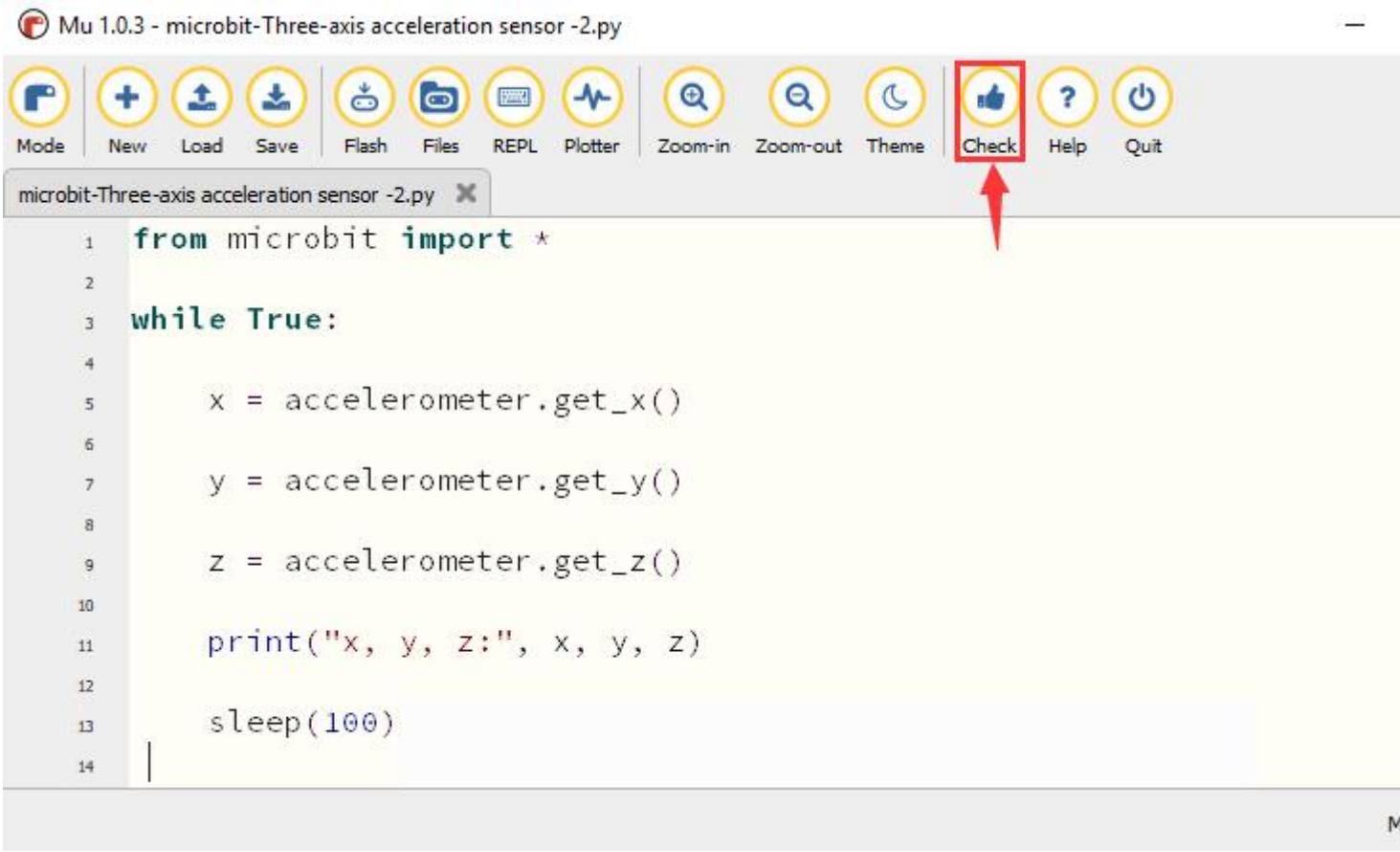
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python	Project 7 : Accelerometer-2.py

	Tutorial/Python Code/Project 7 : Accelerometer	

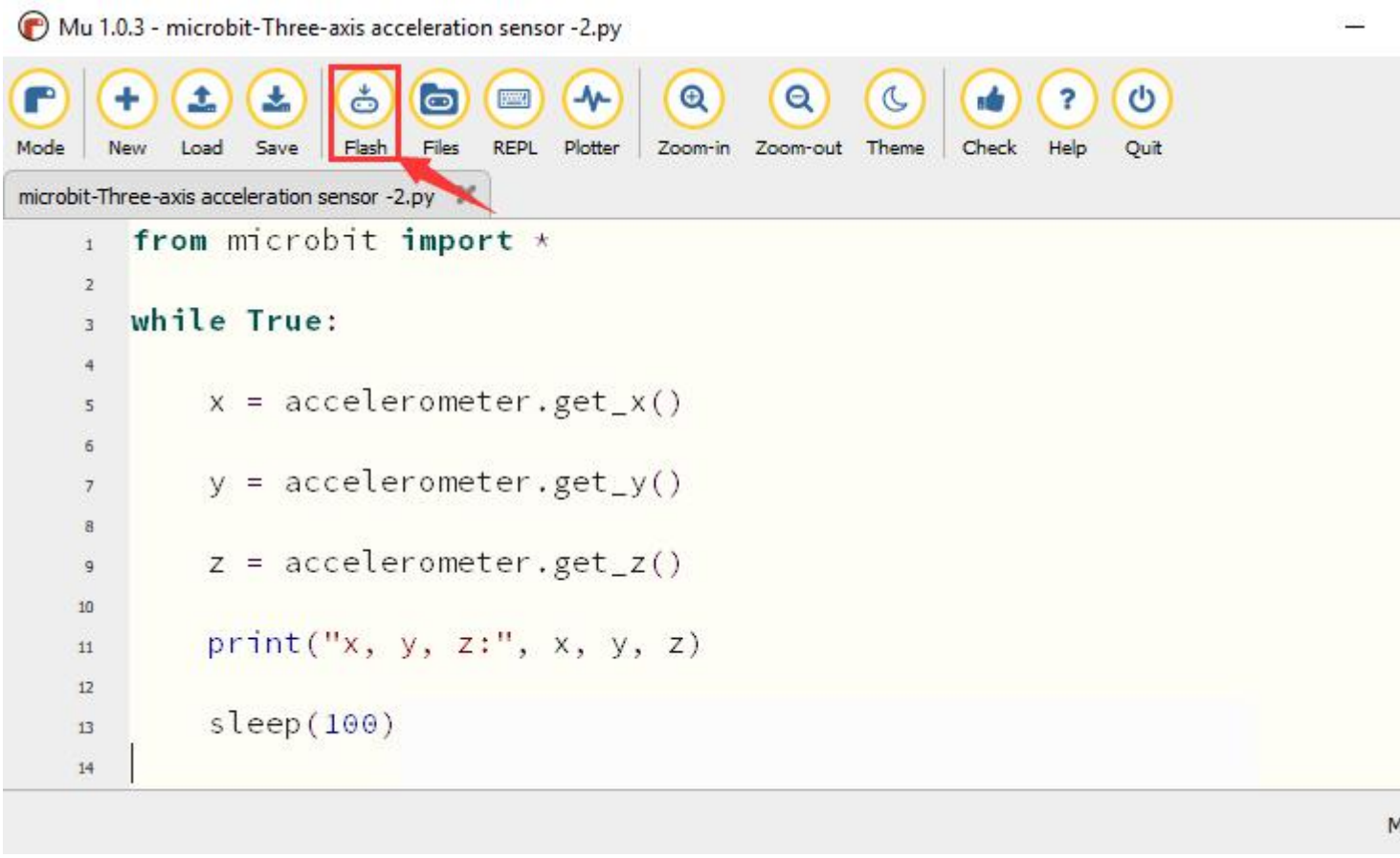
You can also input code in the editing window yourself.(note:all English words and symbols must be written in English)



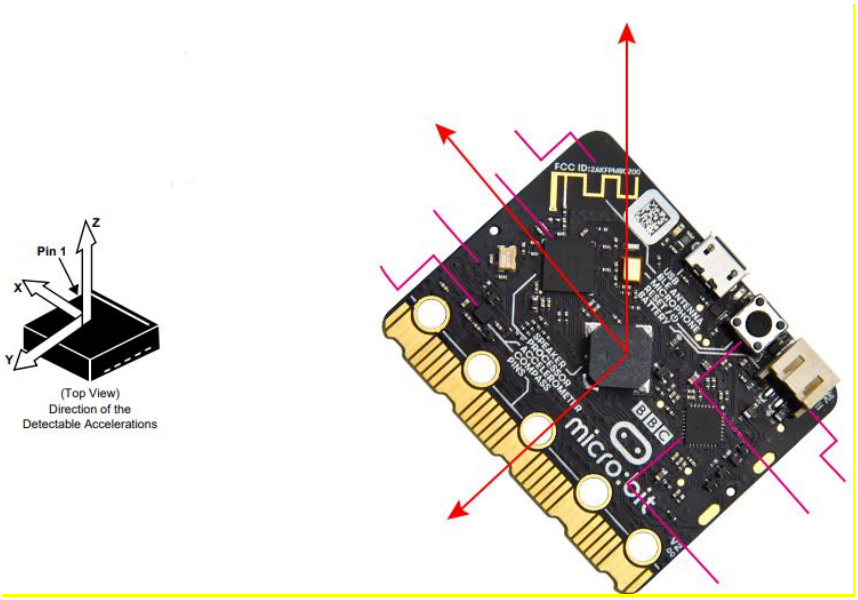
Click "Check" to examine error in the code. The program proves wrong if underlines and cursors are shown.



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



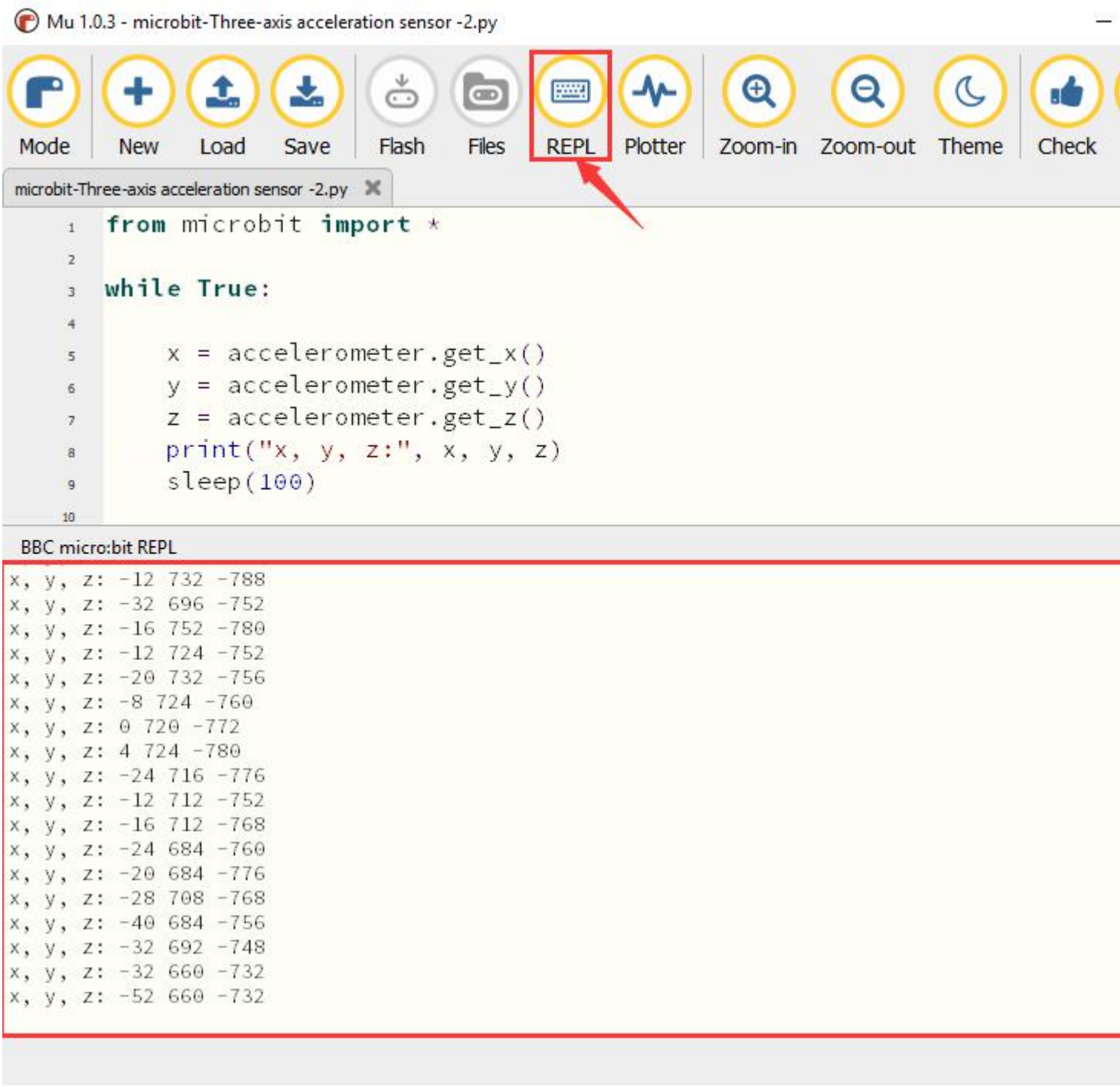
After referring to the MMA8653FC data manual and the hardware schematic diagram of the Micro: Bit main board, the accelerometer coordinate of the Micro: Bit are shown in the figure below:



(6)Test Results2:

Upload the test code 1 to micro:bit main board and power the board via 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:



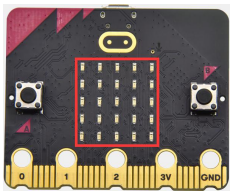
(7)Code Explanation:

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") **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")	Shaking micro:bit board, number 1 will appear When log points to the North, number 2 will show up. 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

Project 8: Light Detection



(1) Project Introduction

In this project, we focus on the light detection function of the Micro: Bit main board. It is achieved by the LED dot matrix since the main board is not equipped with a photoresistor.

(2)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B. Open the offline version of Mu.

(3)Test Code:

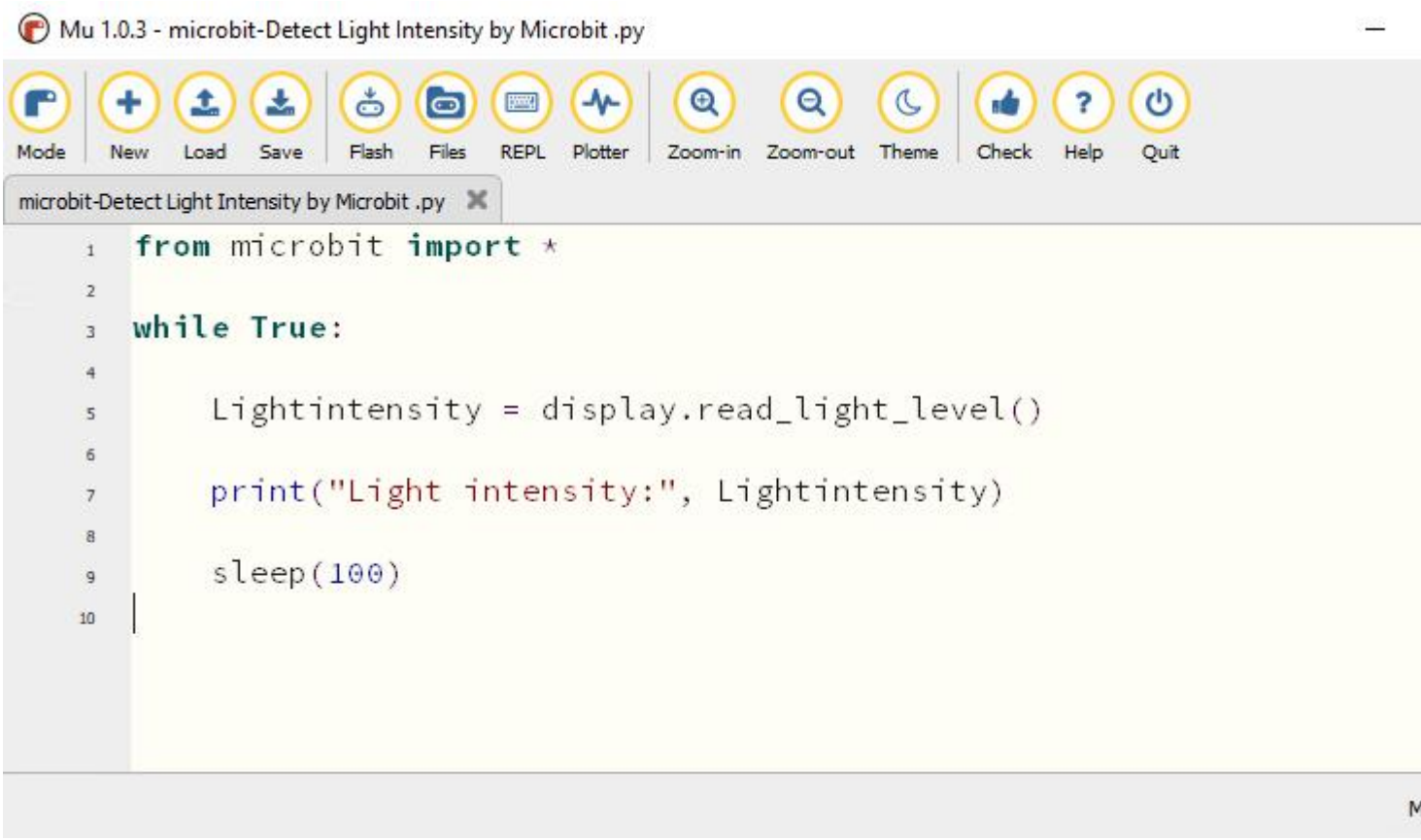
Enter Mu software and open the file "project 8: Light Detection.py" to import code:

(How to load the project code?)

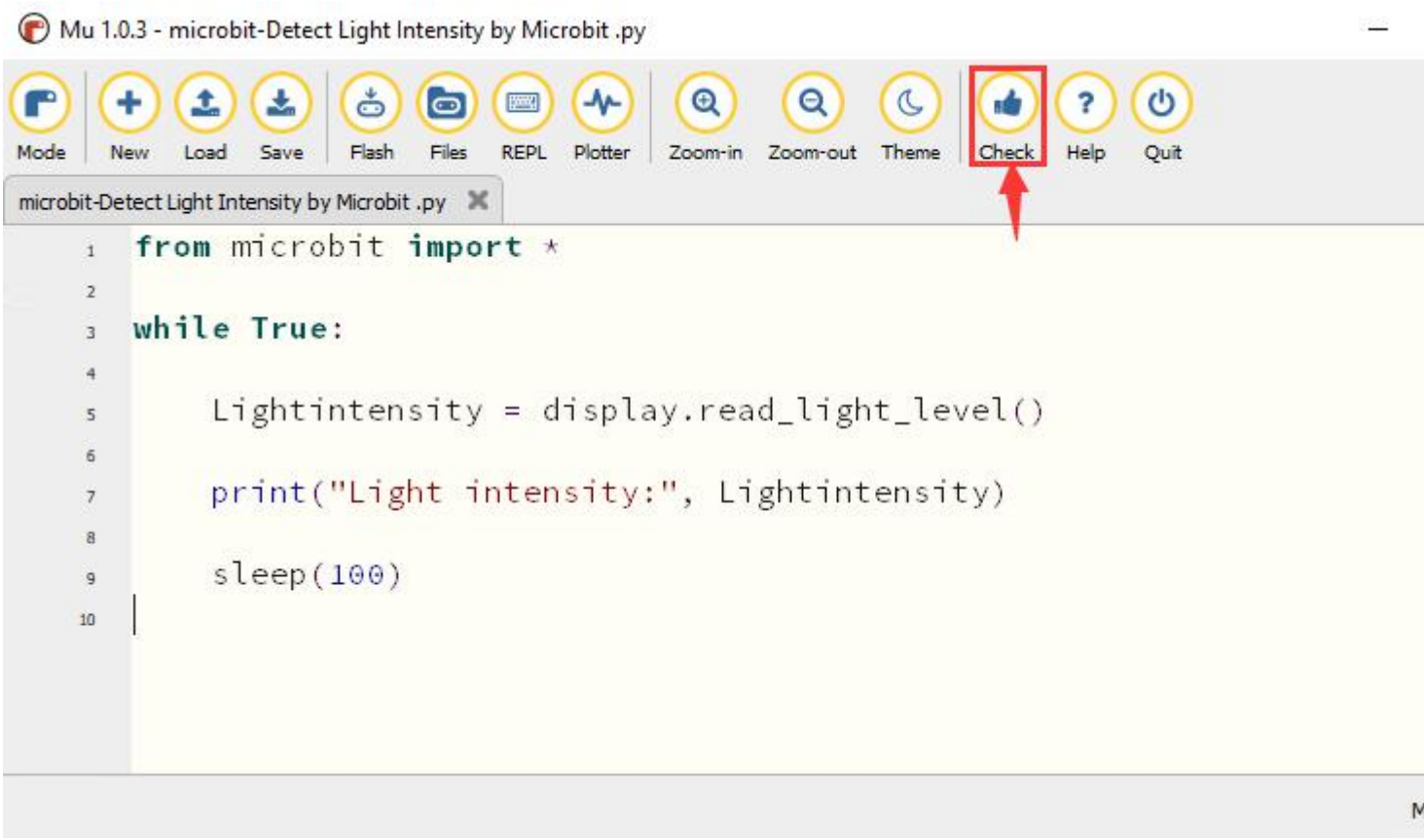
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project Code/Project 8: Light Detection	project 8: Light Detection.py

You can also input code in the editing window yourself.

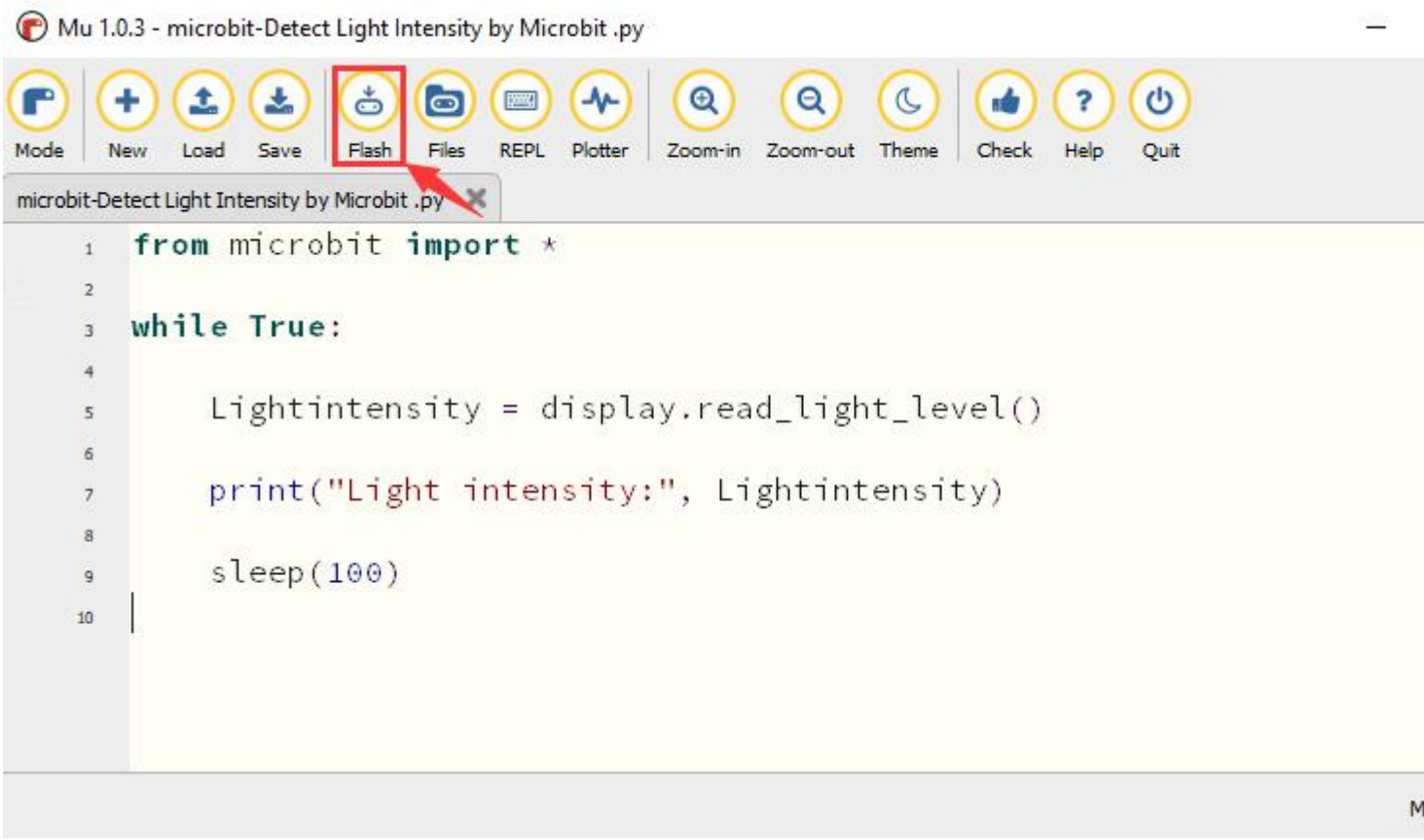
(note:all English words and symbols must be written in English)



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



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

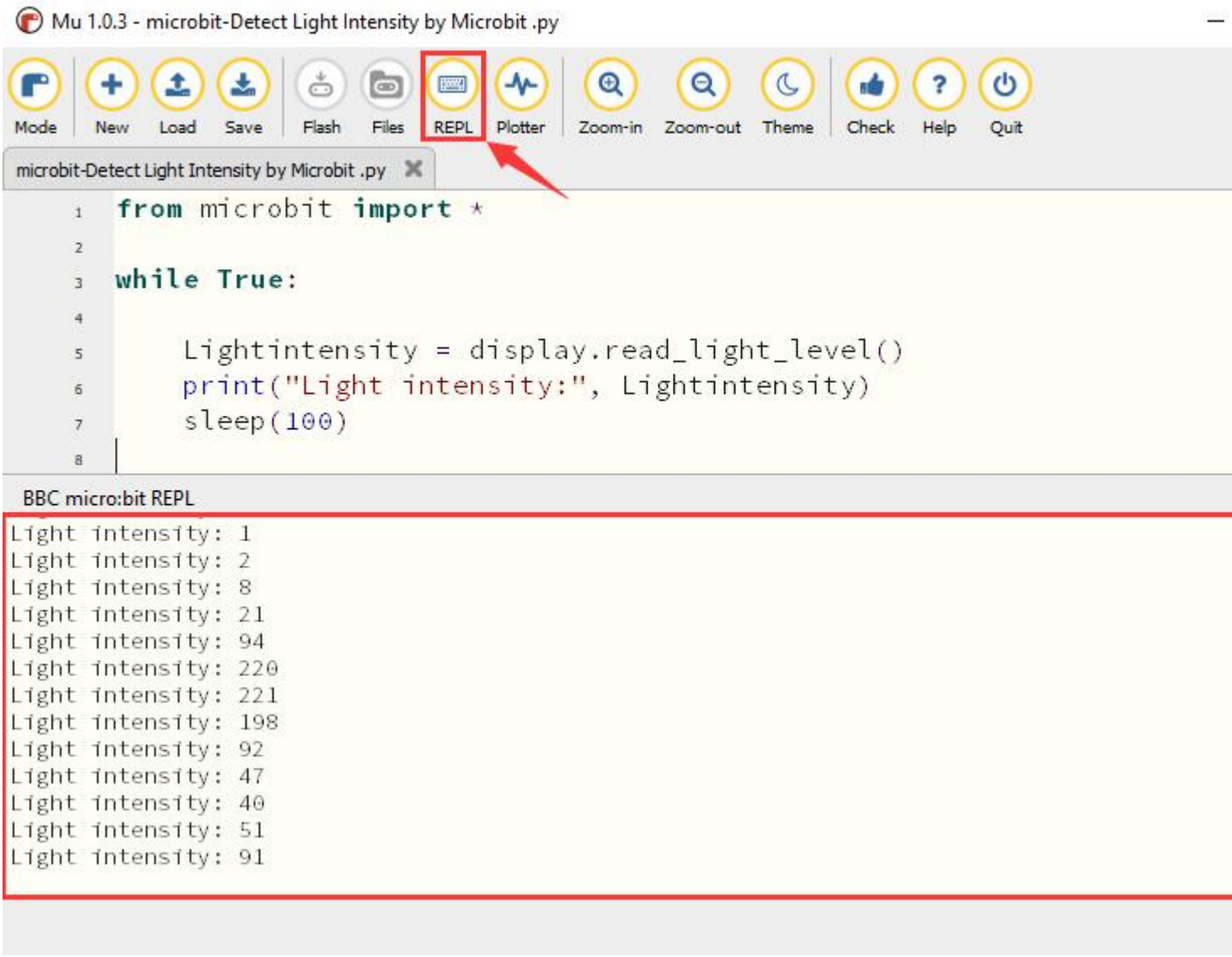


(4)Test Results:

Upload the test code to micro:bit main board, power the board via the USB cable and click "Show console Device".

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.

When the LED dot matrix is covered by hand, the light intensity showed is approximately 0; when the LED dot matrix is exposed to light,the light intensity displayed gets stronger with the light.



(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

Project 9: Speaker

(1) Project Introduction

Micro: Bit main board has an built-in speaker, which makes adding sound to the programs easier. It can also be programmed to air all kinds of tones, like playing the song *Ode to Joy.*

(2)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B.Open the offline version of Mu.

(3)Test Code1:

Enter Mu software and open the file "Project 9: Speaker.py" to import code:

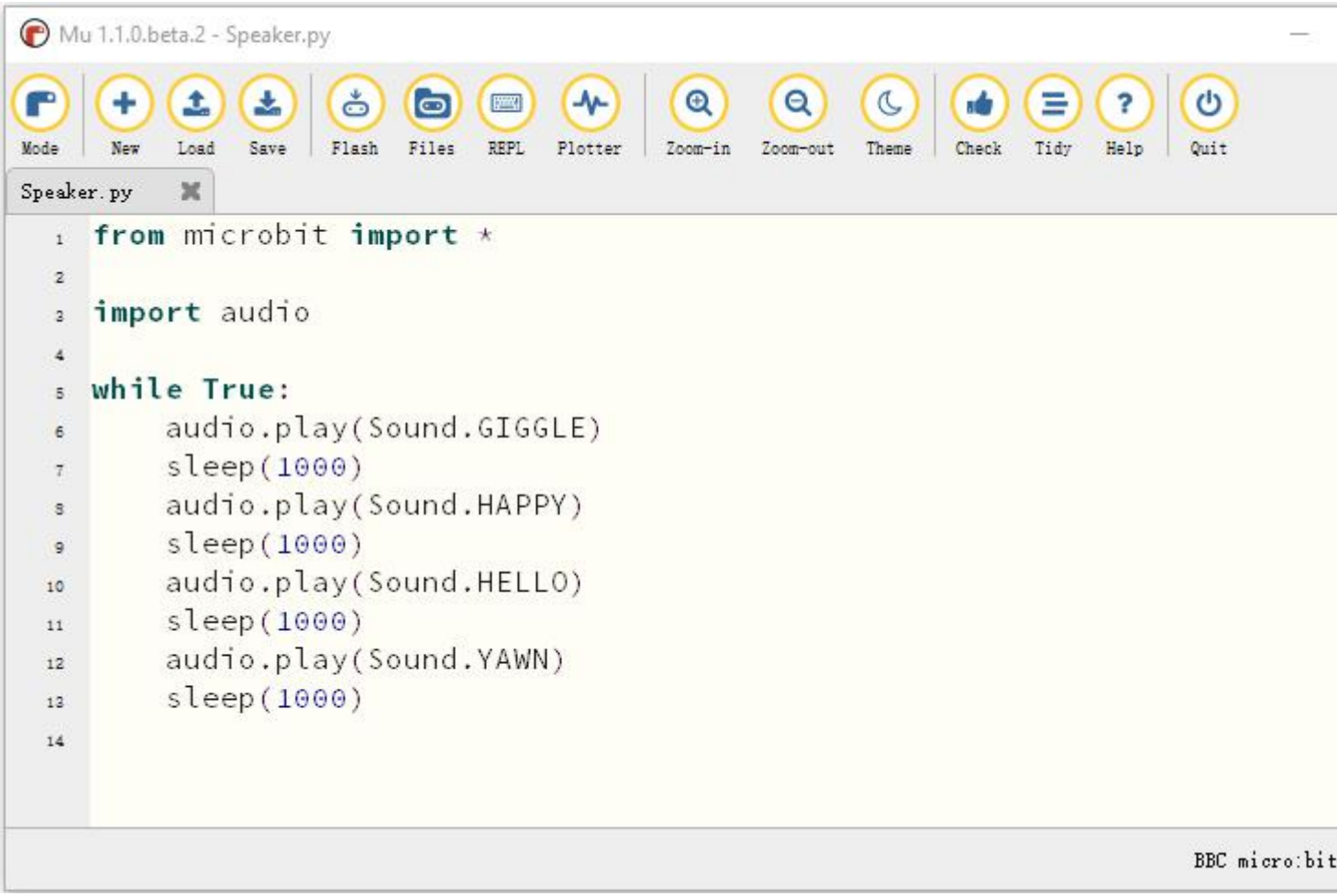
(How to load the project code?)

File Type	Route	File Name

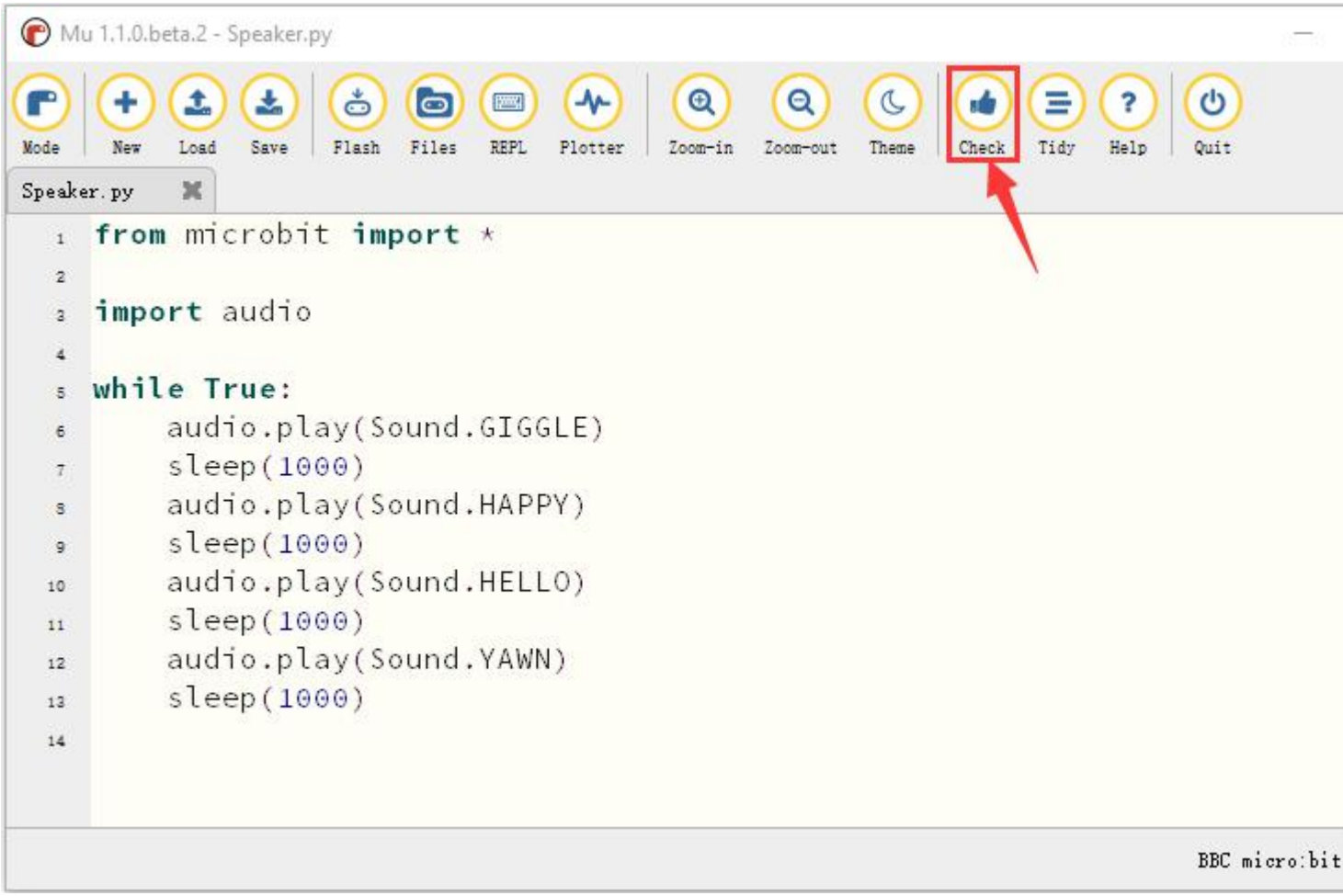
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 9：Speaker	Project 9 : Speaker.py

You can also input code in the editing window yourself.

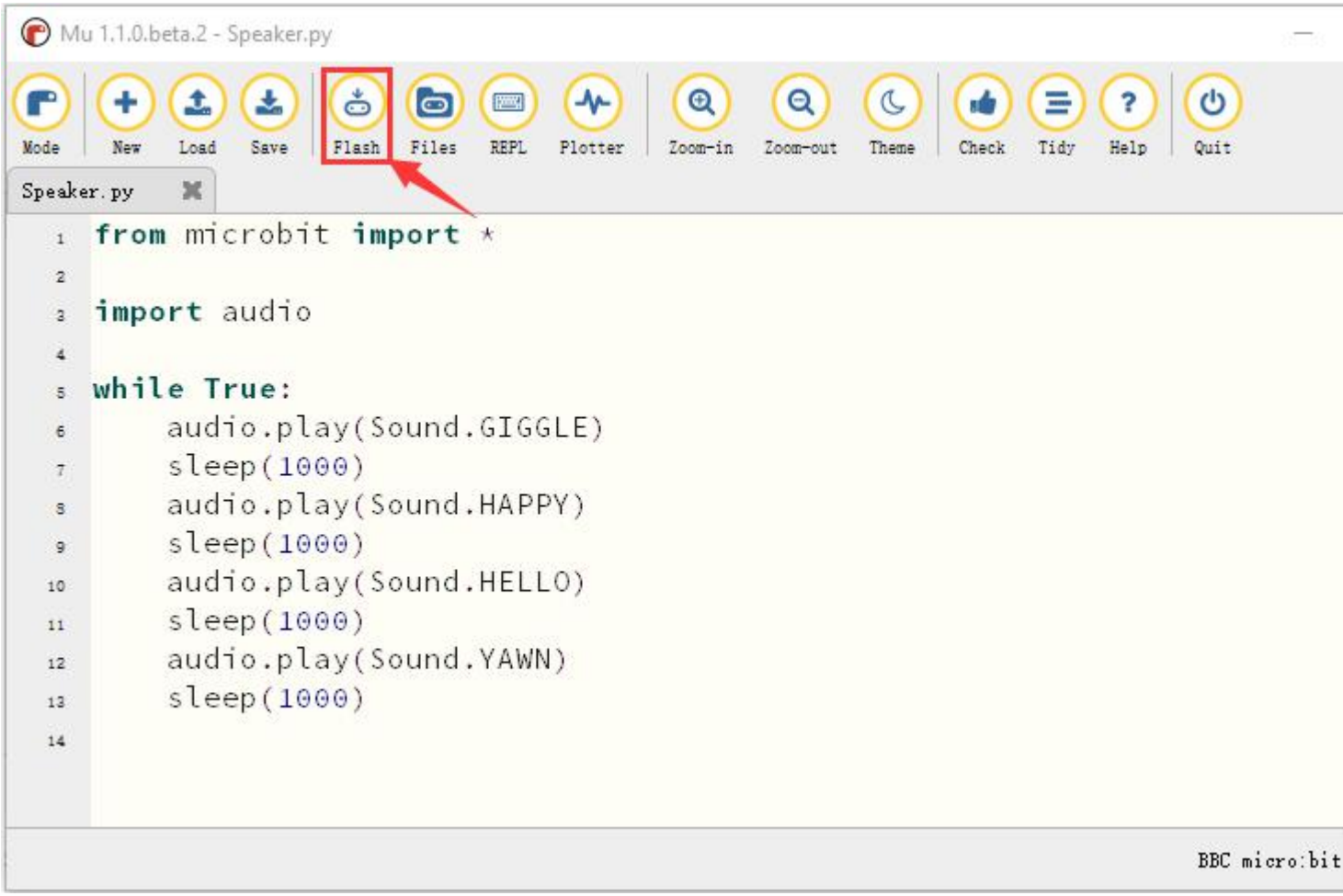
(note:all English words and symbols must be written in English)



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



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



(4)Test Results1:

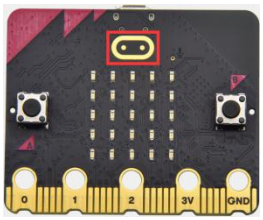
After uploading the test code1 to micro:bit main board and powering the board via the USB cable, the speaker utters sound and the LED dot matrix shows the logo of music.

(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

Project 10: Touch-sensitive Logo



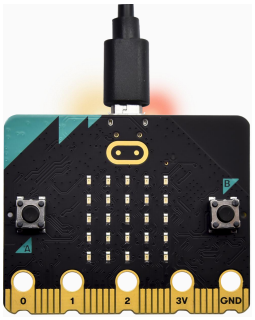
(1) Project Introduction

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)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;



B.Open the offline version of Mu.

(3)Test Code:

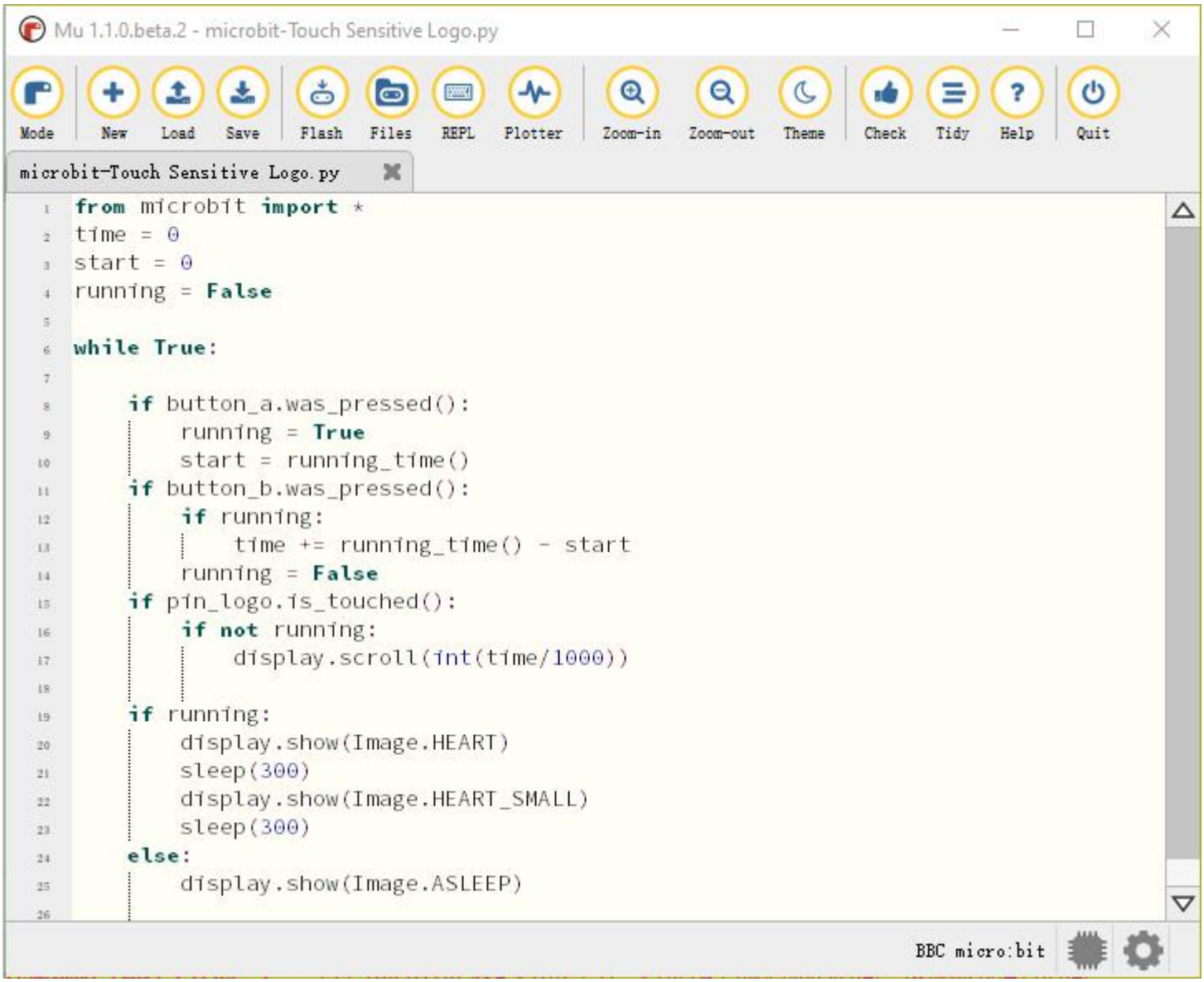
Enter Mu software and open the file "Project 10: Touch-sensitive Logo.py" to import code:

(How to load the project code?)

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 10 : Touch-sensitive Logo	Project 10: 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)



How Micro:bit works?

A. The runtime is recorded in milliseconds(ms) .

B. When you press button A, a variable named start is set to the current running time.

C. When you press button B, the start time will be subtracted from the new

running time to calculate how much time has passed since you started the stopwatch. This difference is added to the total time, which is stored in a variable named time.

D. If you press the golden logo, the program will display the total elapsed time on the LED display. It converts time from milliseconds (thousandths of a second) to seconds by dividing by 1000. It uses the integer division operator to give an integer (integer) result.

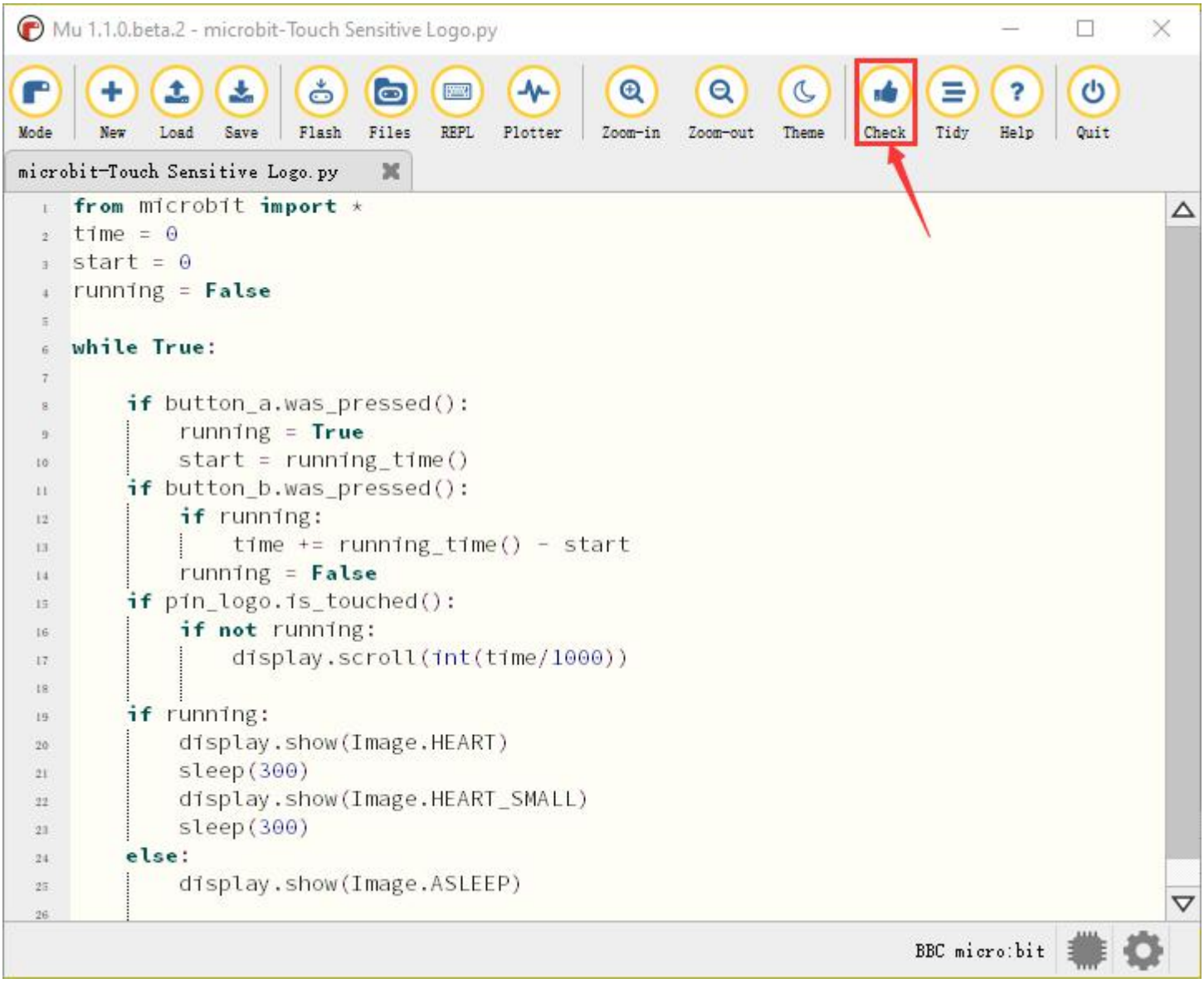
E. The program is also controlled by a Boolean variable named running. Boolean variable can only have two values: true or false. If "running" is "true", it means that the stopwatch has started. If "running" is false, it means that the stopwatch has not started or has stopped.

F. If "running" is true, the beating heart pattern is displayed on the LED dot matrix screen.

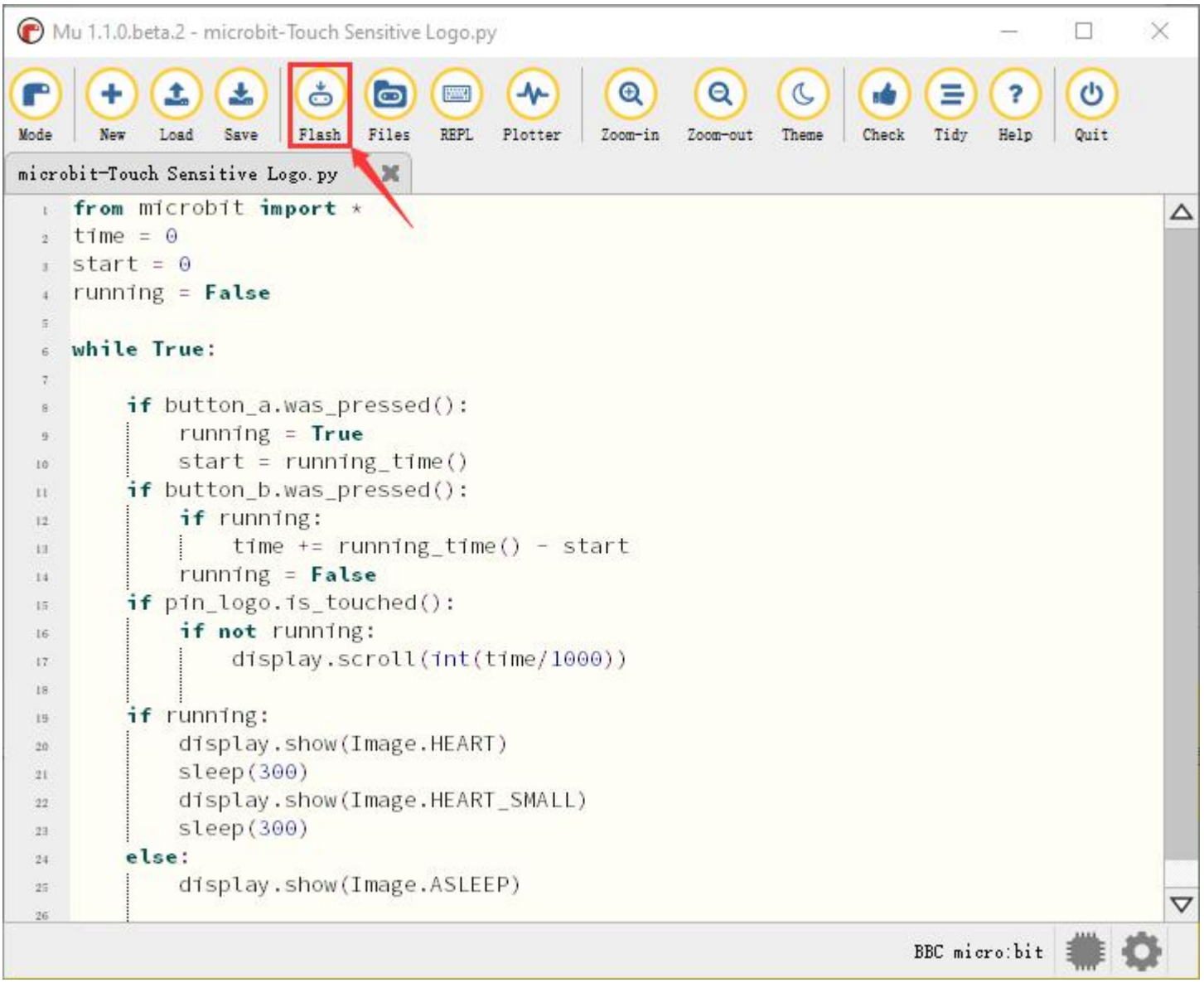
G. (7) If the stopwatch has stopped and the "running" is false, when you press the golden logo, it will only display the time.

H. If the stopwatch has been started and"running" is true, it only need to ensure that the time variable will only change when button B is pressed, and the code can also prevent false readings.

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



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

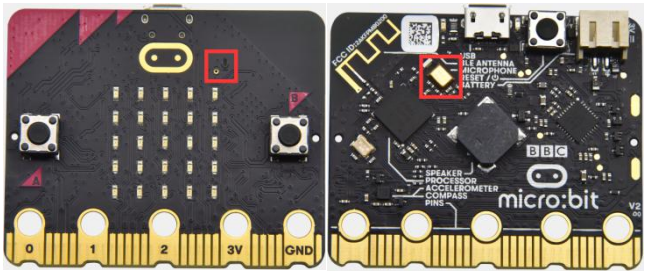


(4)Test Results:

Upload the test code to micro:bit main board and power the board via the USB cable, and press button A to start the stopwatch. When timing, the beating heart pattern will be displayed on the LED dot matrix screen. Press button B to stop it and you can start and stop it at any time. It will keep recording time, just like a real stopwatch. Press the golden logo on the front of the micro:bit to display the measured time in seconds. And time

can be reset to zero by pressing the reset button on the back of it.

Project 11: Microphone



(1) Project Introduction

The Micro: Bit main board is built with a microphone which can test the volume of ambient environment. When you clap, the microphone LED indicator turns 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)Preparations:

A. Attach the Micro:bit main board to your computer via the USB cable;

B.Open the offline version of Mu.

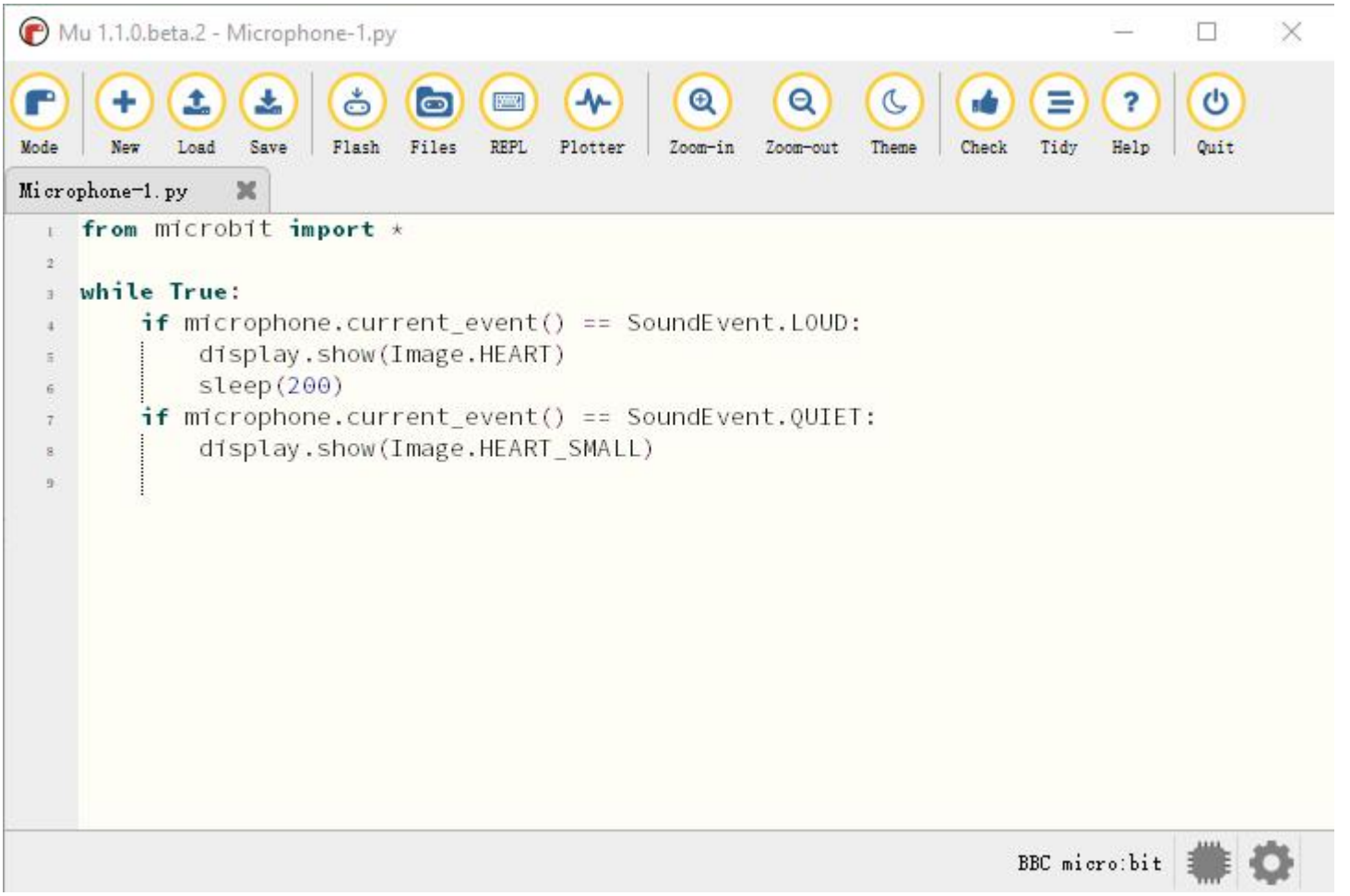
(3)Test Code 1:

Enter Mu software and open the file "Project 11: Microphone-1.py" to import code:

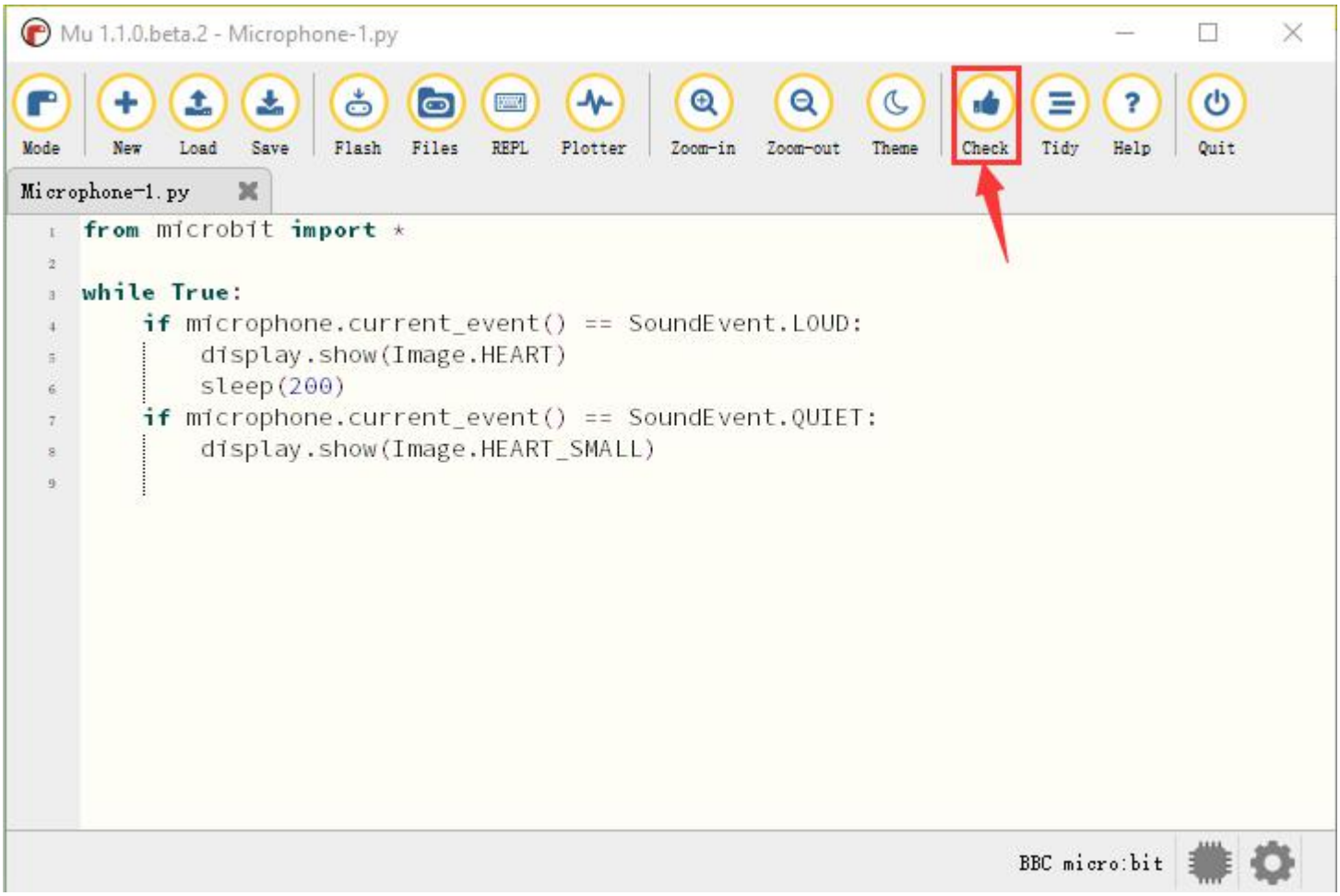
(How to load the project code?)

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 11 : Microphone	Project 11 : Microphone-1.py

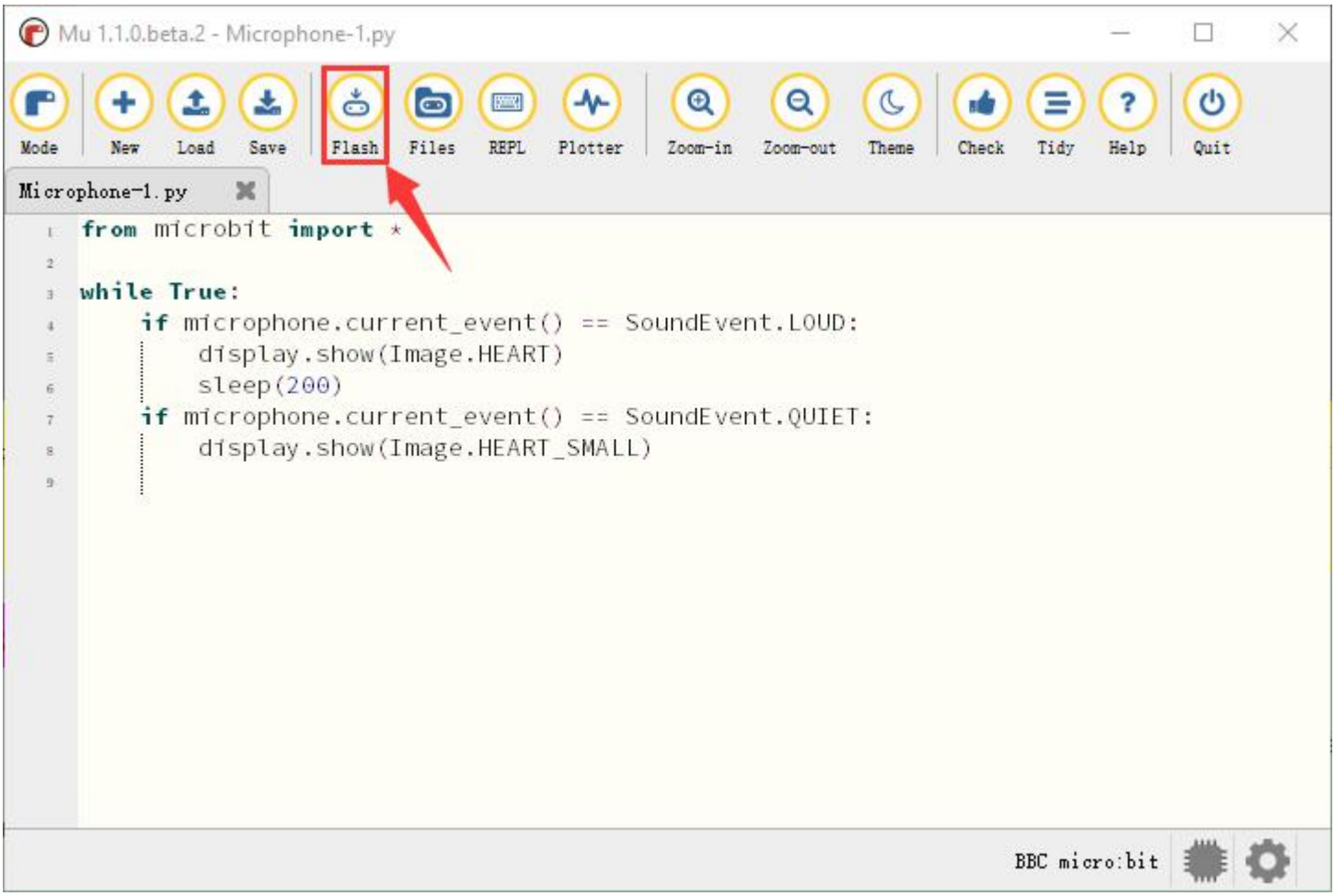
You can also input code in the editing window yourself. (note:all English words and symbols must be written in English)



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



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



(4)Test Results1:

After uploading test code to micro:bit main board and powering the board via the USB cable, the LED dot matrix displays pattern "  " when you claps and pattern  when it is quiet around.

(5)Test Code2:

Enter Mu software and open the file "Project 11: Microphone-2.py" to import code:

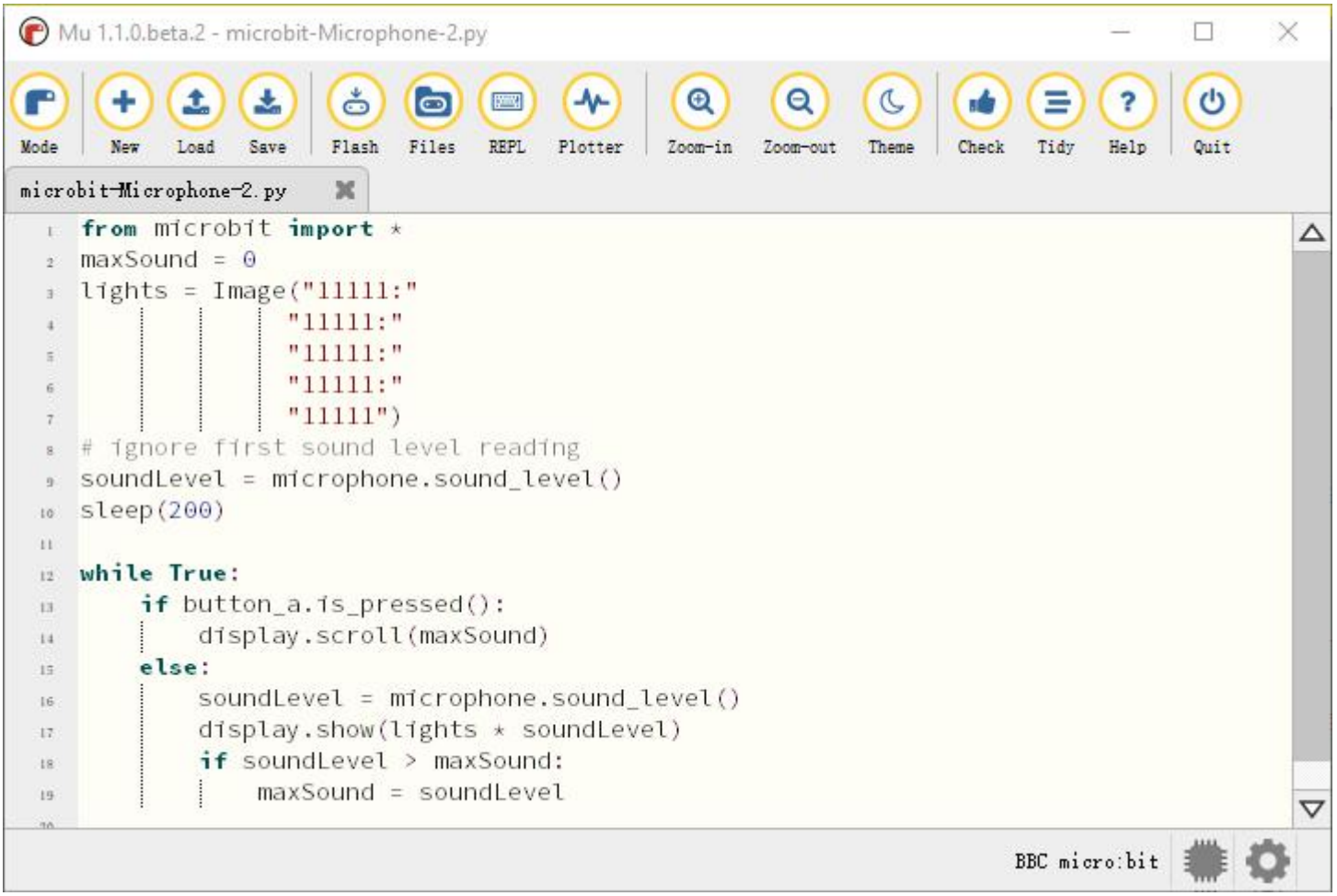
(How to load the project code?)

File Type	Route	File Name

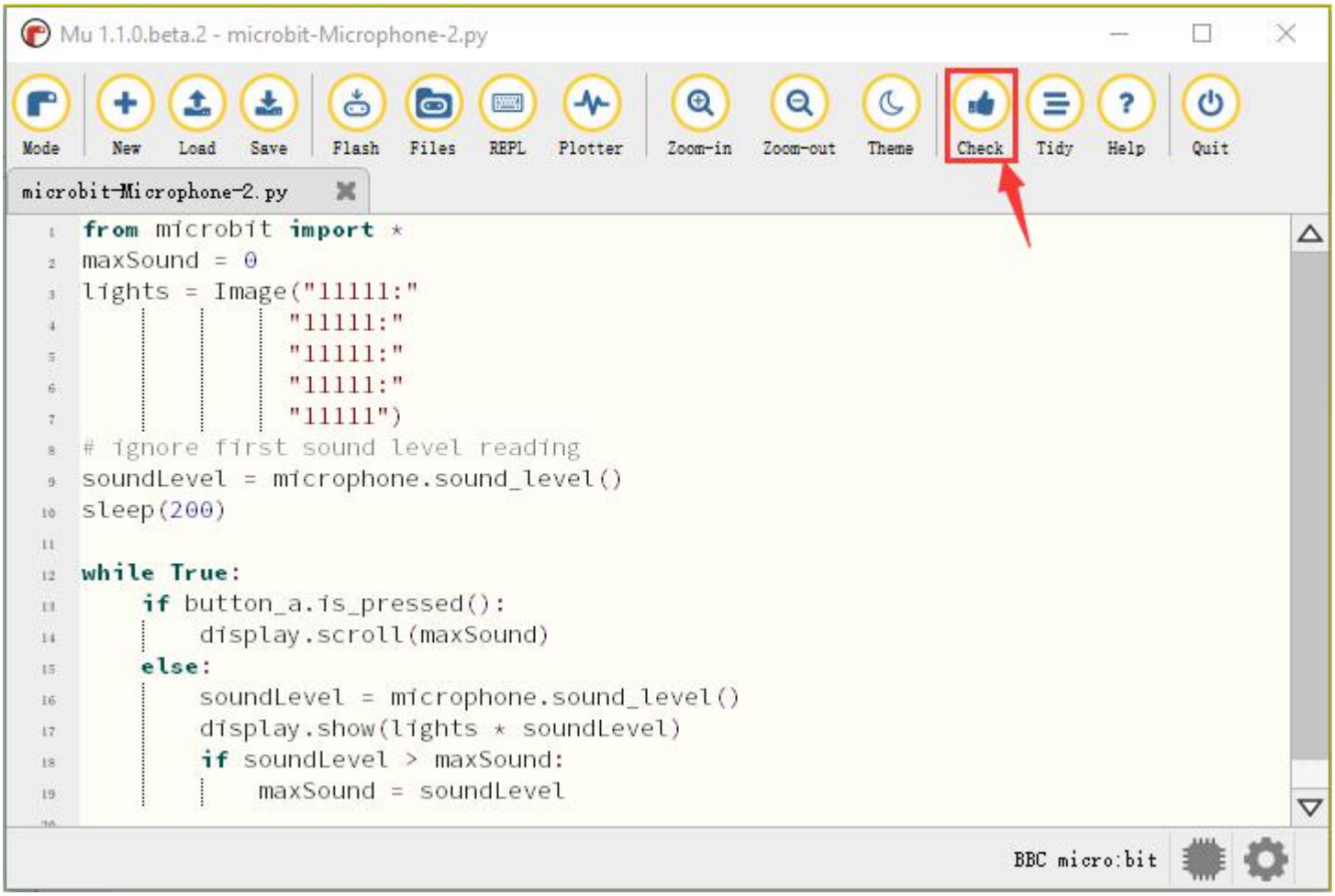
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 11 : Microphone	Project 11 : Microphone-2.py

You can also input code in the editing window yourself.

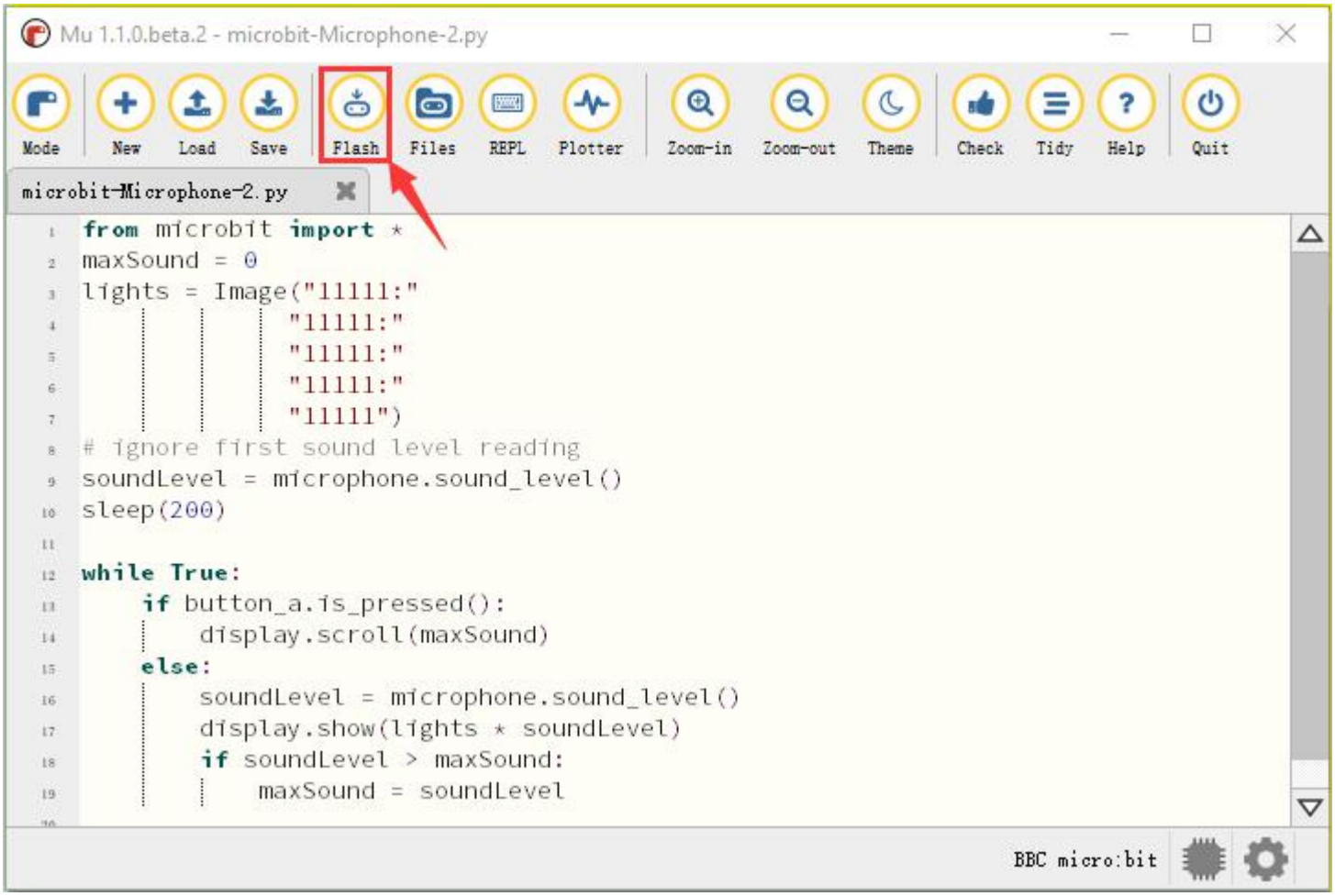
(note:all English words and symbols must be written in English)



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



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



(6)Test Results2:

Upload test code to micro:bit main board and power the board via the USB cable. When the button A is pressed, the LED dot matrix displays the value of the biggest volume(please note that the biggest volume can be reset via the Reset button on the other side of the board) while when clapping, the LED dot matrix shows the pattern of the sound.

(7)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

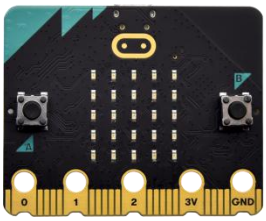
	microphone.sound_level () to the variable soundLevel
if button_a.is_pressed(): display.scroll(maxSound) **else:** soundLevel = microphone.sound_level() display.show(lights * soundLevel) **if** soundLevel > maxSound: maxSound = soundLevel	if the button A is pressed LED lights show the sound value If not 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

Project 12: Touch-sensitive Logo Controlled Speaker

(1) Project Introduction

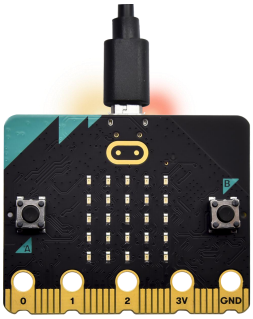
In the previous projects, we have learned about the touch-sensitive logo and the speaker respectively. In the project, we will combine these two components to play music. That' s the logo will be applied to control the speaker to sing songs.

(2)Components Needed:

	
Micro:bit main board *1	USB cable*1

(3)Connection Diagram:

Attach the Micro:bit main board to your computer via the USB cable.



(4)Test Code:

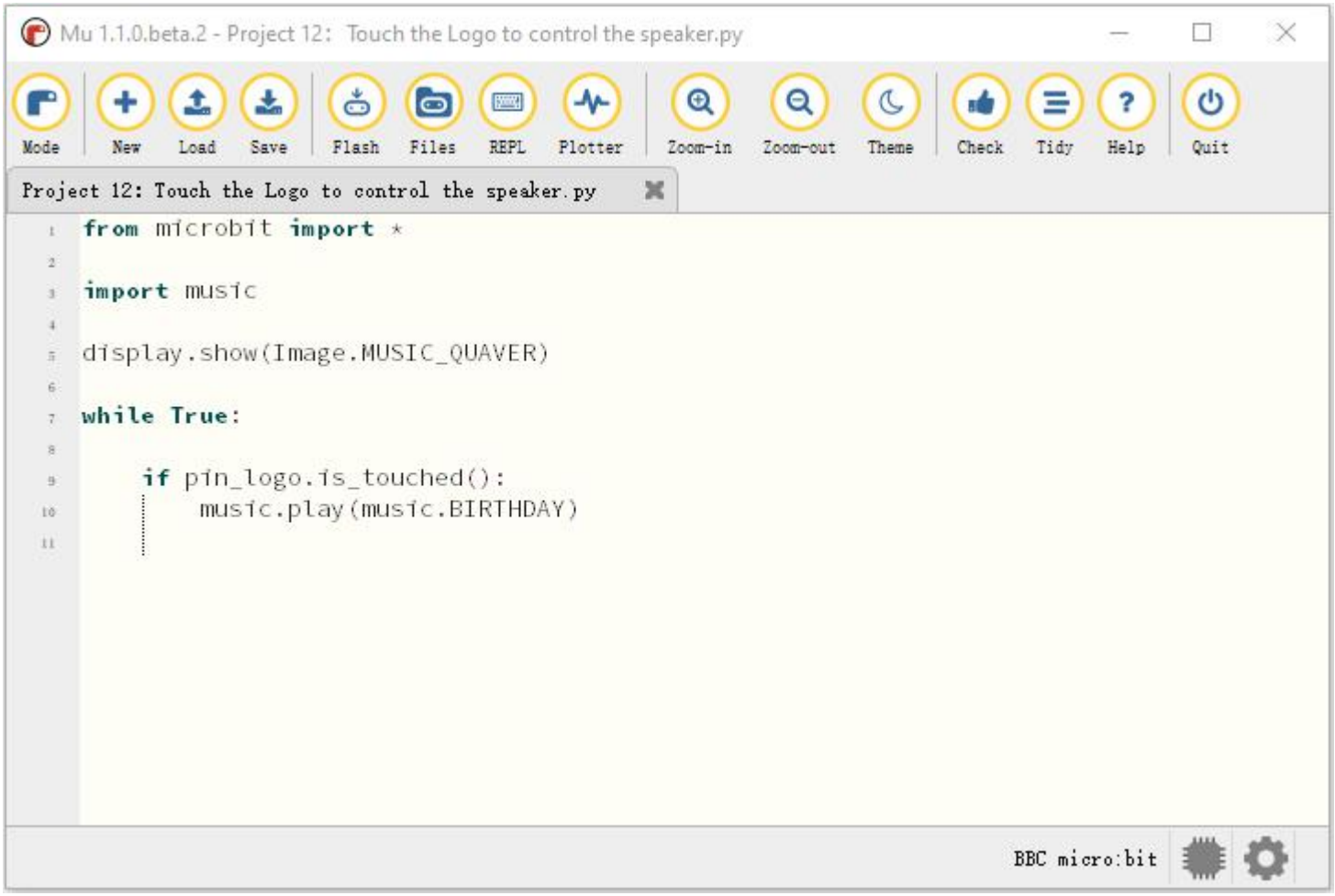
Enter Mu software and open the file "Project 12: Touch-sensitive Logo Controlled Speaker.py" to import code:

(How to load the project code?)

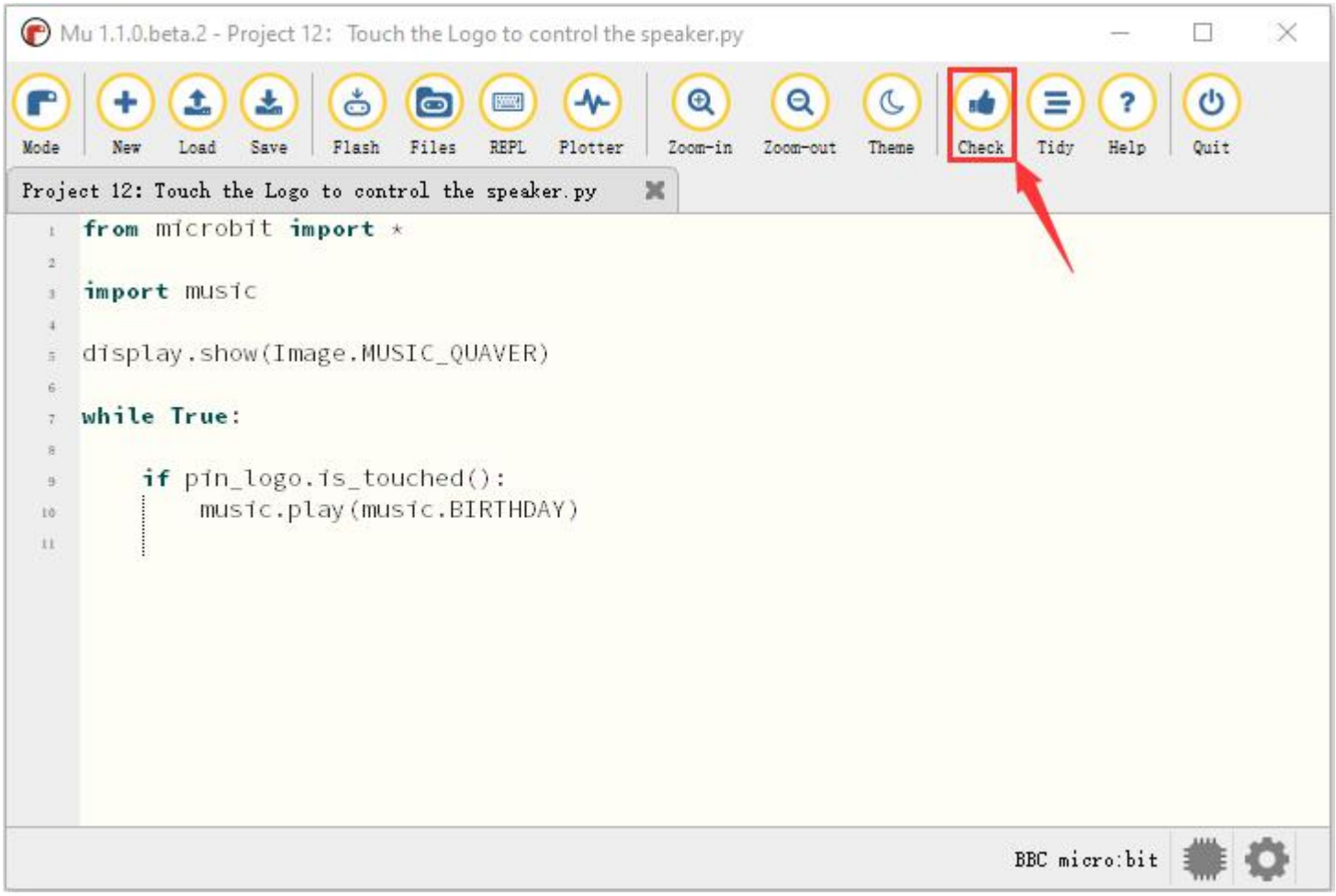
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 12 : Touch-sensitive Logo Controlled Speaker	Project 12: Touch-sensitive Logo Controlled Speaker.py

You can also input code in the editing window yourself.

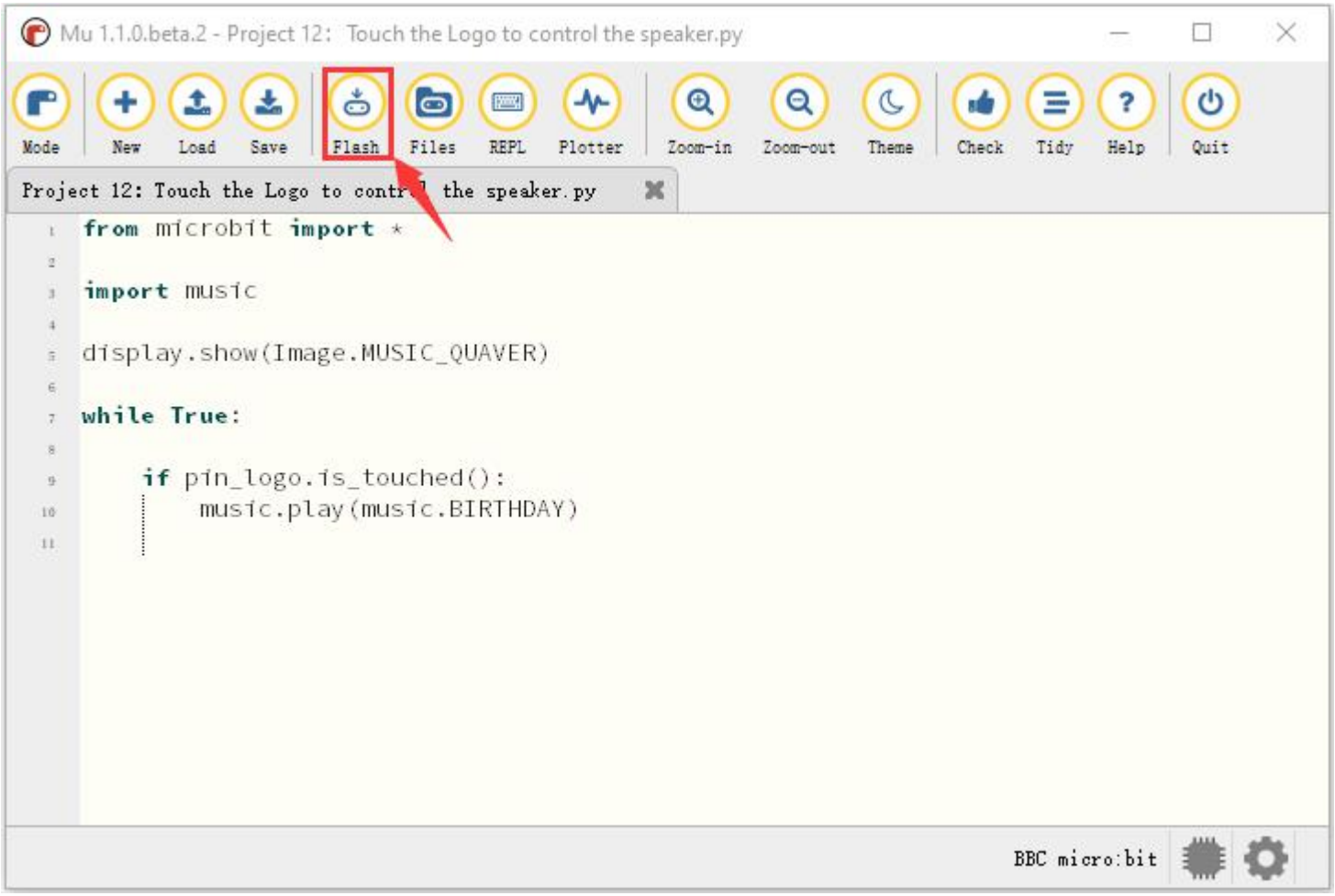
(note:all words and symbols must be written in English)



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



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



(5)Test Results:

After uploading test code to micro:bit main board and powering the board via the USB cable, the speaker plays the song *Happy Birthday to You* when the logo is touched.

(6)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.

display.show（Image.MUSIC_QUAVER）	Music logo shows on the LED dot matrix on the micro:bit
if pin_logo. is_touched( ):	When the logo is touched, it executes the following command
music.play（music.BIRTHDAY）	The speaker plays the song" *Happy Birthday to You*"

Bluetooth Wireless Communication

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

The former projects are the introduction of sensors and modules. The further lessons are challenging for new starters.

(Note: In order to prevent the micro:bit board from being burned,

disconnect the micro USB cable from it and turn off the power on the micro:bit motor drive board before installing it on the car expansion board and dial the POWER switch to the OFF end; likewise, before removing the the main board from the car expansion board, disconnect the micro USB cable from it and turn off the power on the micro:bit motor drive backplane.

Project 13:Colorful Lights

(1)Project Description

This module consists of a commonly used LED with 7colors but in white appearance. It can automatically flash different colors to create fantastic light effects when high level is input like a normal LED.

(2)Experimental Preparation:

- Insert micro:bit board into slot of keyestudio 4WD Mecanum Robot Car
- Place batteries into battery holder
- Dial power switch to ON end
- Connect micro:bit to computer by USB cable
- Open the offline version of Mu.

(3)Test Code:

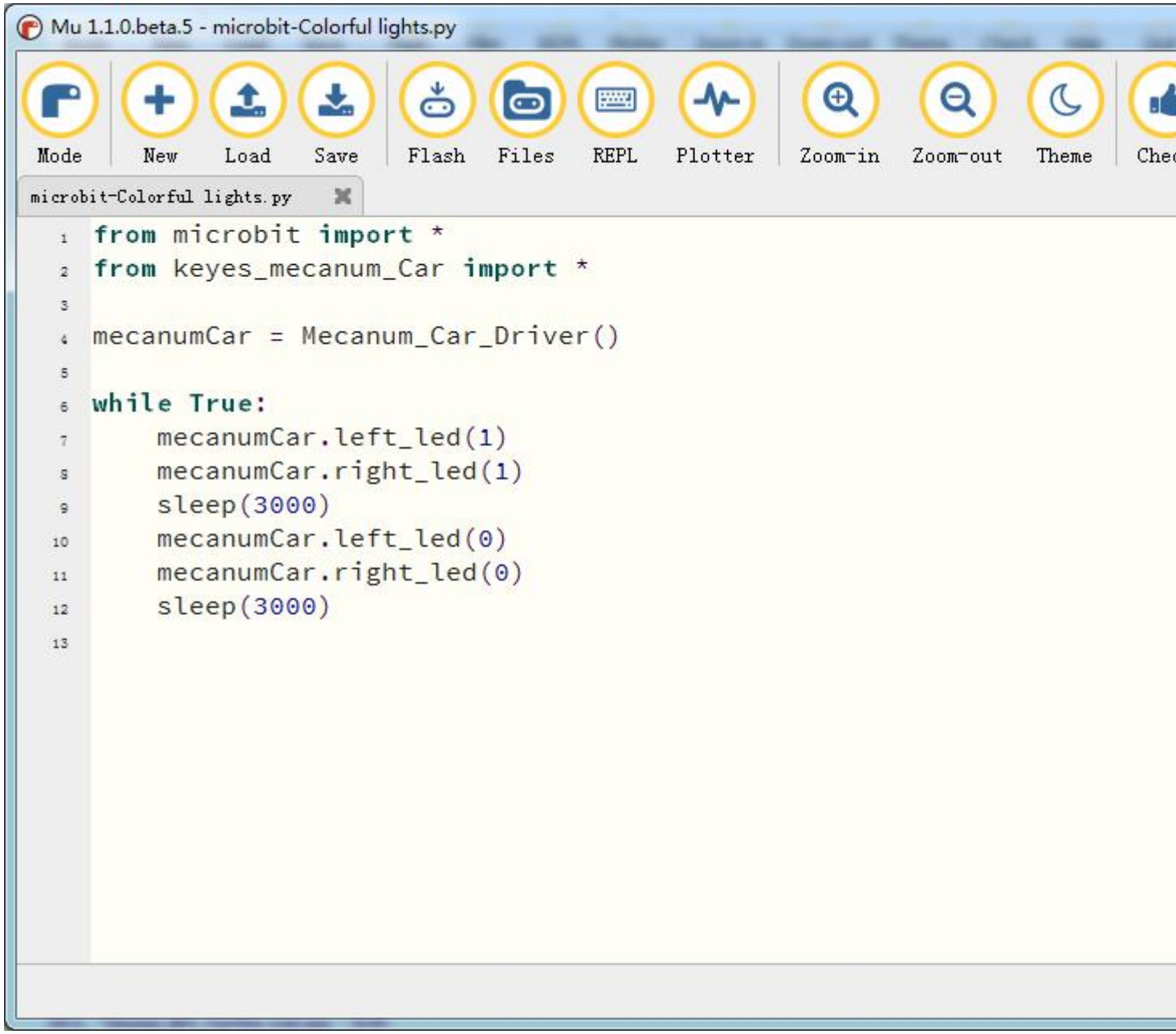
Enter Mu software and open the file "Project 13: Colorful Lights.py" to import code:

(How to load the project code?)

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 13 : Colorful Lights	Project 13: Colorful Lights.py

You can also input code in the editing window yourself.

(note:all words and symbols must be written in English)



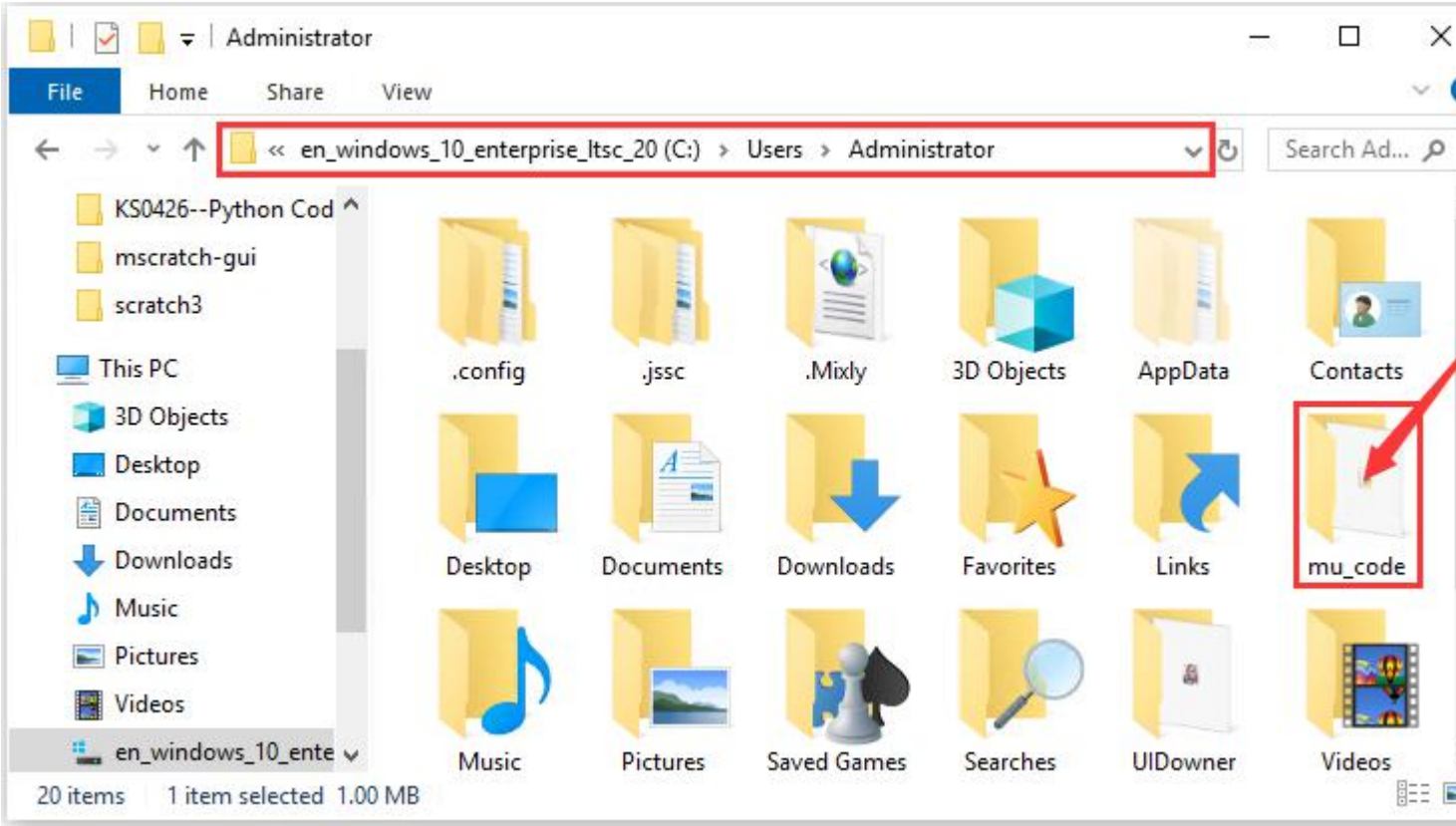
Don't click "Flash", but import the "keyes_mecanum_Car.py" library file into the micro:bit. This file contains the control method of the Micro:bit Mini Smart Mecanum Wheel Smart Car.

Import the "keyes_mecanum_Car.py" library file.

The default directory where Mu saves files is "Mu_code", which is located in the root directory of the user directory. Reference link: https://codewith.mu/en/tutorials/1.0/files

For example, in the windows system, suppose your system is installed on the C drive of the computer, and the user name is "Administrator", then the path of the "mu_code" directory is "C:\Users\Administrator\mu_ code". On Linux systems, the path of the "mu_code" directory is "~/home/mu_code".

Enter the "mu_code" folder.

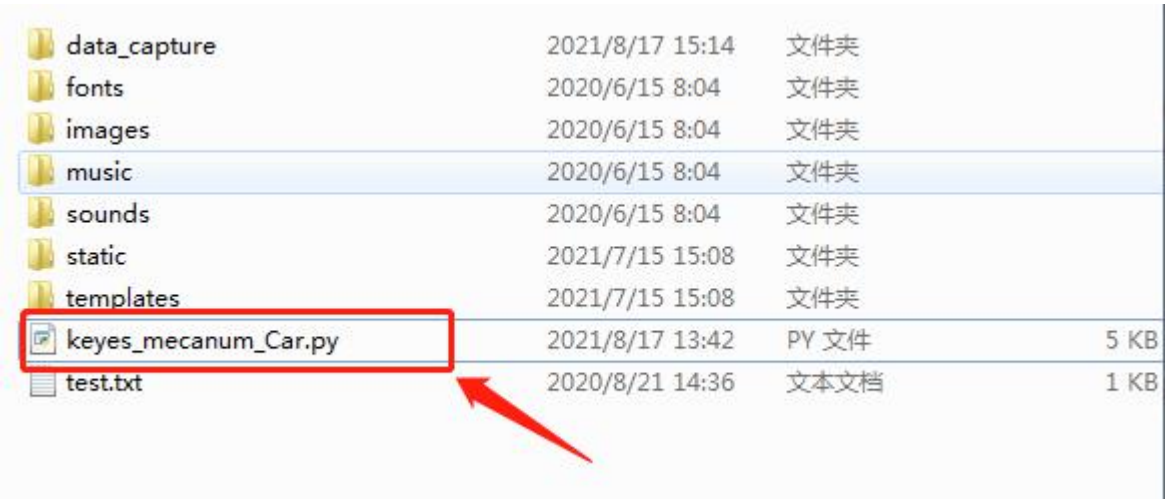


Copy "keyes_mecanum_Car.py "library file to folder" mu_code " and the

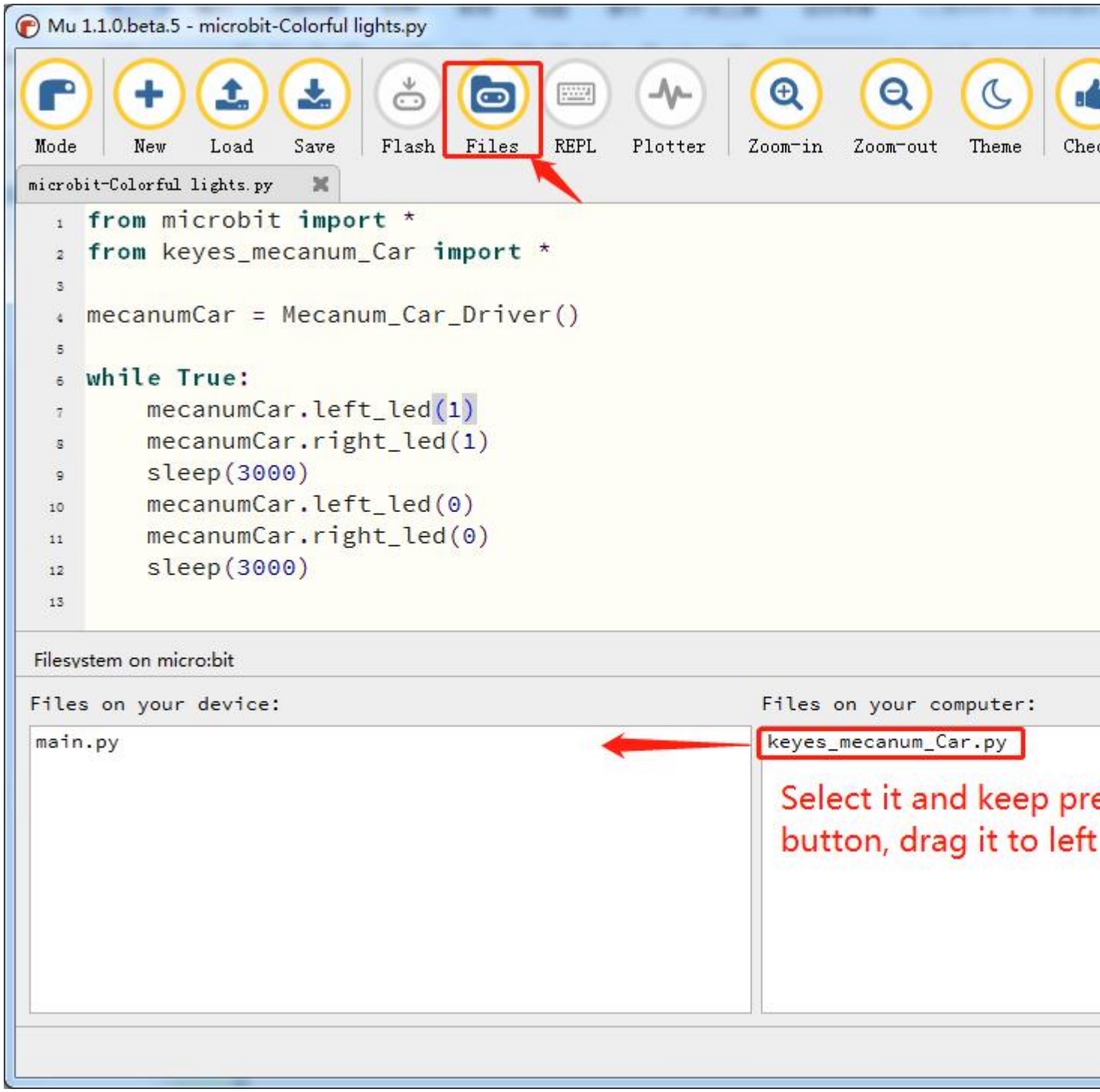
path is :

File type	Path	File name
Python file	../PythonCode/LibrariesmecanumCar_python_Libraries	keyes_mecanum_Car.py

When the copy is done, it should be look like this:

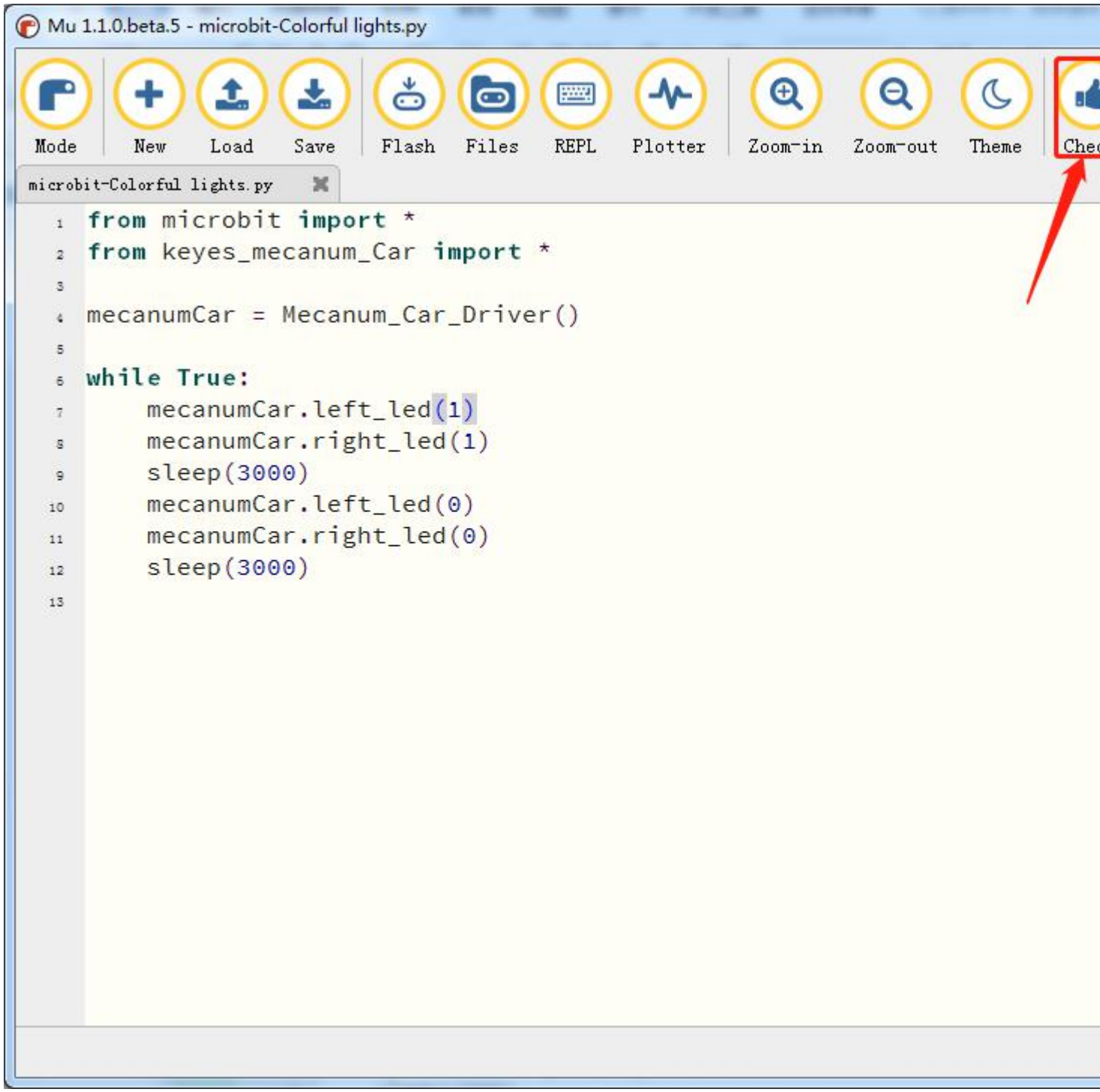


First open the Mu software and connect the micro:bit to your computer, then click the "Files" , and then drag the "keyes_mecanum_Car.py" library file to micro:bit.



After a few seconds, the import is complete and you can see it in the box on the left.

After the library file is imported successfully, you also need to click the "Check" button to check the code for errors. If a cursor or an underline appears on a certain line, it indicates that there is an error in the program.

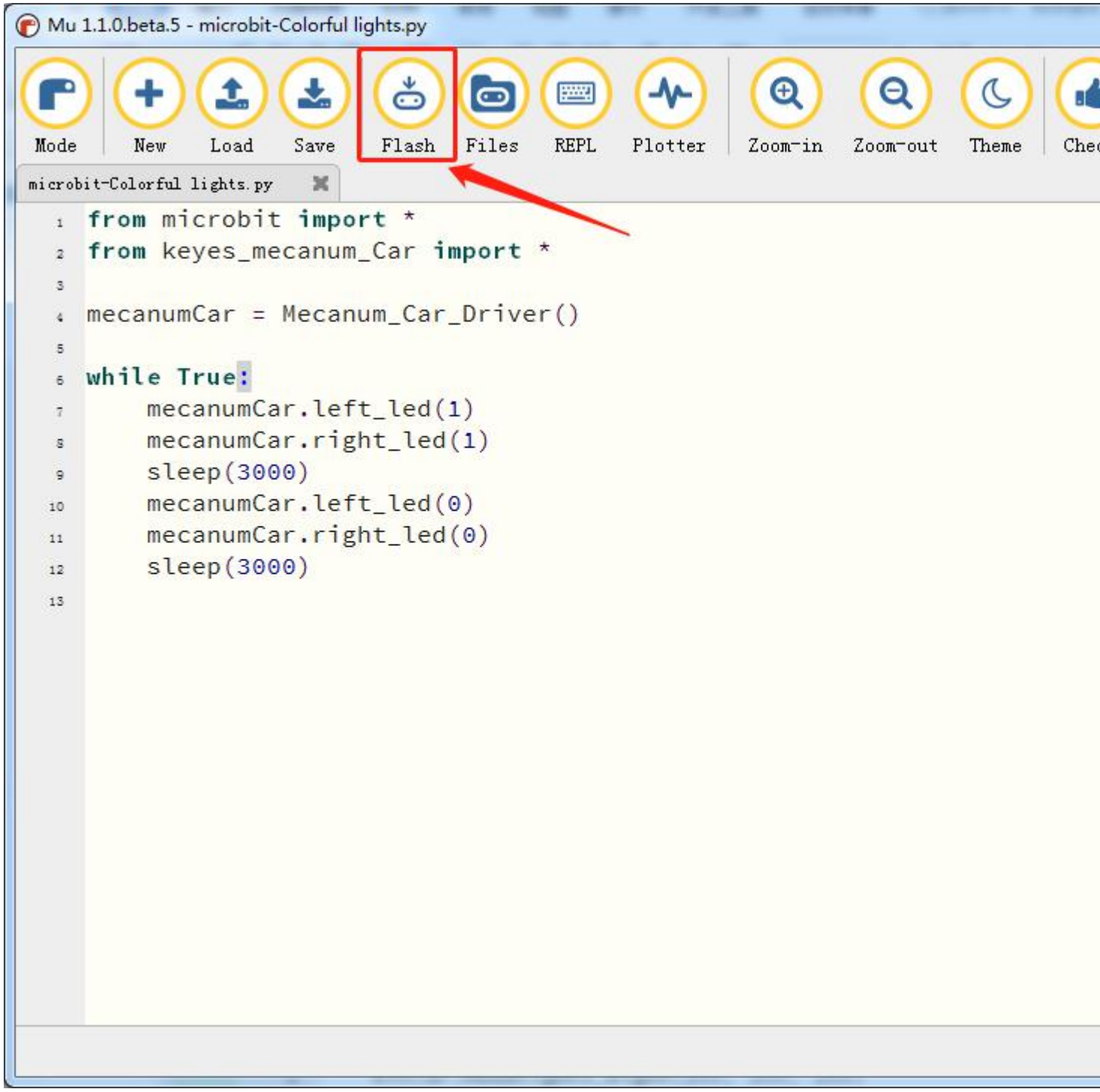


However, during this process, the following prompt will appear even if there is no error in the code. These prompts are just warnings, not code error prompts. In other words, the entire code is error-free.

```
↑ 'from keyes_mecanum_Car import *' used; unable to detect undefined nam
```

```
↑ 'Mecanum_Car_Driver' may be undefined, or defined from star imports: k
```

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



If it indicates an error after clicking the "Flash" button, please confirm whether you have imported the "keyes_mecanum_Car.py" library file that we provided to micro:bit.

Note:

Before programming with Micropython, you need to import the "keyes_mecanum_Car.py" library file to the micro:bit. If you program with different micro:bit, the library file"keyes_mecanum_Car.py" needs to be imported again to a new micro:bit.

(4)Test Results:

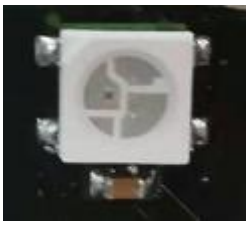
Download code to micro:bit board and dial POWER switch to ON end, 2 RGB lights of smart car flash in 3s and then stop in 3s and repeat this pattern.

(5)Code Explanation:

from microbit **import** *	Import the library file of micro:bit
from keyes_mecanum_Car **import ***	Import the library file of

	keyes_mecanum_Car
mecanumCar = Mecanum_Car_Driver()	Instantiate an object Mecanum_Car_Driver() as mecanumCar
while True:	This is a permanent loop that makes micro:bit execute the code of it.
mecanumCar.left_led(1)	Light up the colorful light on the left. (1 is on, 0 is off)
mecanumCar.right_led(1)	Light up the colorful lights on the right. (1 is on, 0 is off)
sleep(3000)	Delay in 3000ms
mecanumCar.left_led(0)	Turn off the colorful lights on the left. (1 is on, 0 is off)
mecanumCar.right_led(0)	Turn off the colorful lights on the right. (1 is on, 0 is off)

Project 14:WS2812 RGB LEDs



(1)Project 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. In this lesson, 3 sets of test code are provided to make the 4 WS2812 RGB LEDs display different effects.

Sample	Color	RGB Value (R,G,B)	Color Code (16 colors)	Sample	Color	RGB Value (R,G,B)	Color Code (16 colors))
	Red	255, 0, 0	#FF0000		Orange	255, 165, 0	#FFA500
	Yellow	255, 255, 0	#FFFF00		Green	0, 255, 0	#00FF00
	Blue	0, 255, 0	#0000FF		Indigo	75, 0, 130	#4B0082

	Violet	238, 130, 238	#EE82EE		Purple	160, 32, 240	#A020F0
	Black	0, 0, 0	#000000		White	255, 255, 255	#FFFFFF
.....	.....	.....	.....	.....	.....	.....	.....
Change the value of the R,G and B to get different colors							

(2)Experimental Preparation:

- Insert micro:bit board into slot of keyestudio 4WD Mecanum Robot Car
- Place batteries into battery holder
- Dial power switch to ON end
- Connect micro:bit to computer by USB cable
- Open the offline version of Mu.

(3)Test Code:

Code1:

Enter Mu software and open the file "Project 14: WS2812 RGB LEDs.py" to import code:

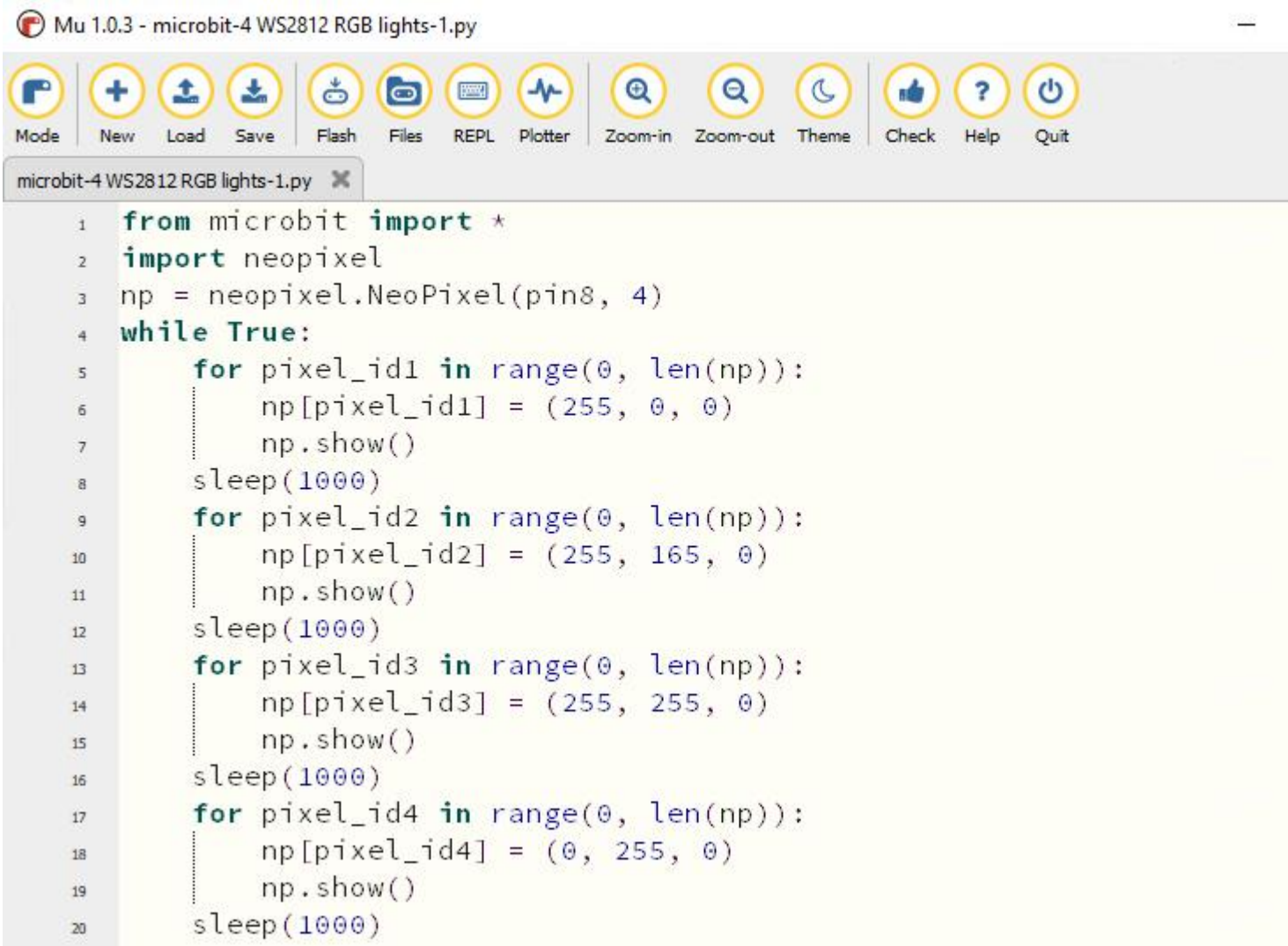
(How to load the project code?)

File Type	Route	File Name

Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 14： WS2812 RGB LEDs	Code-1.py

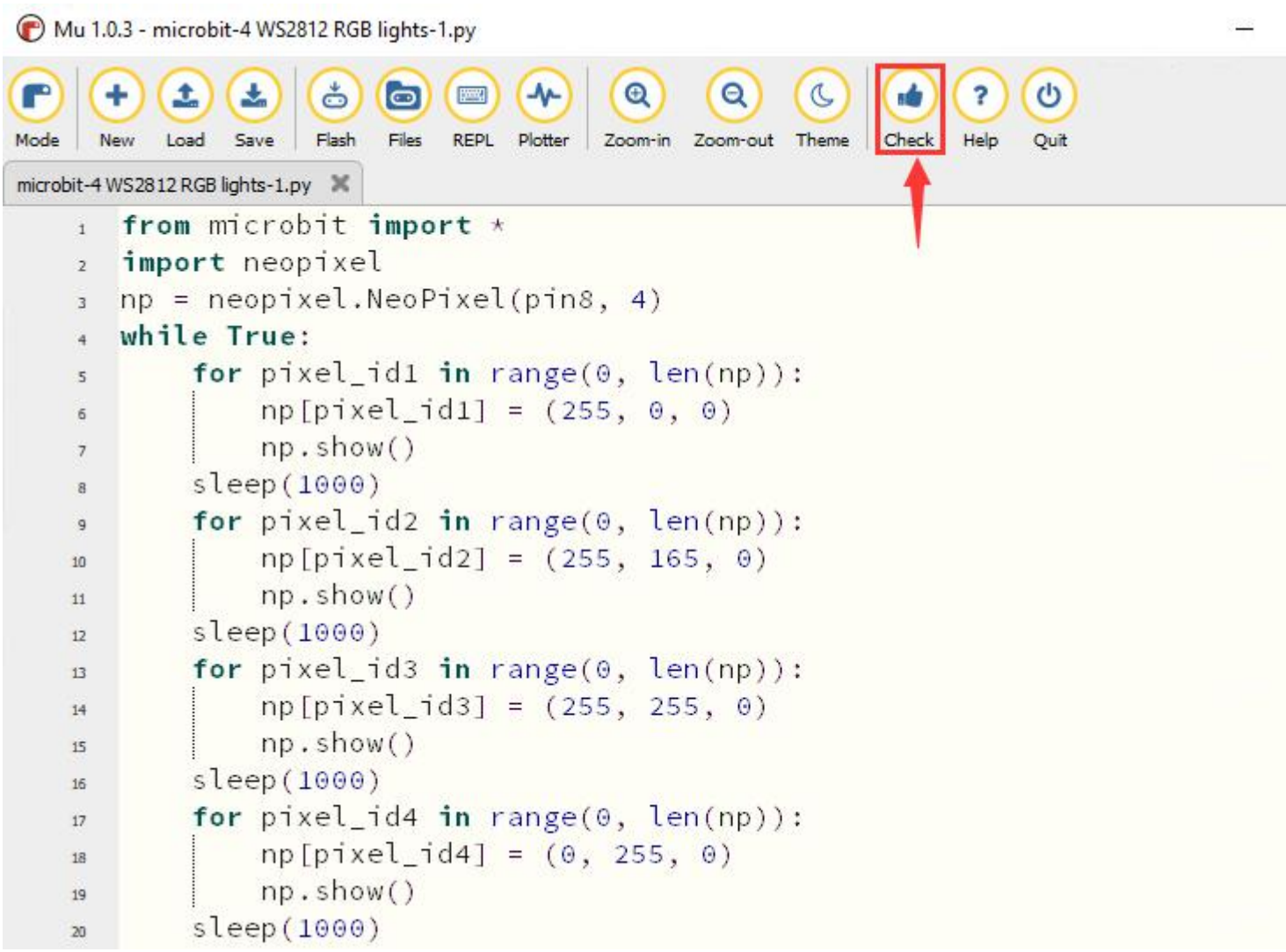
You can also input code in the editing window yourself.

(note:all words and symbols must be written in English)



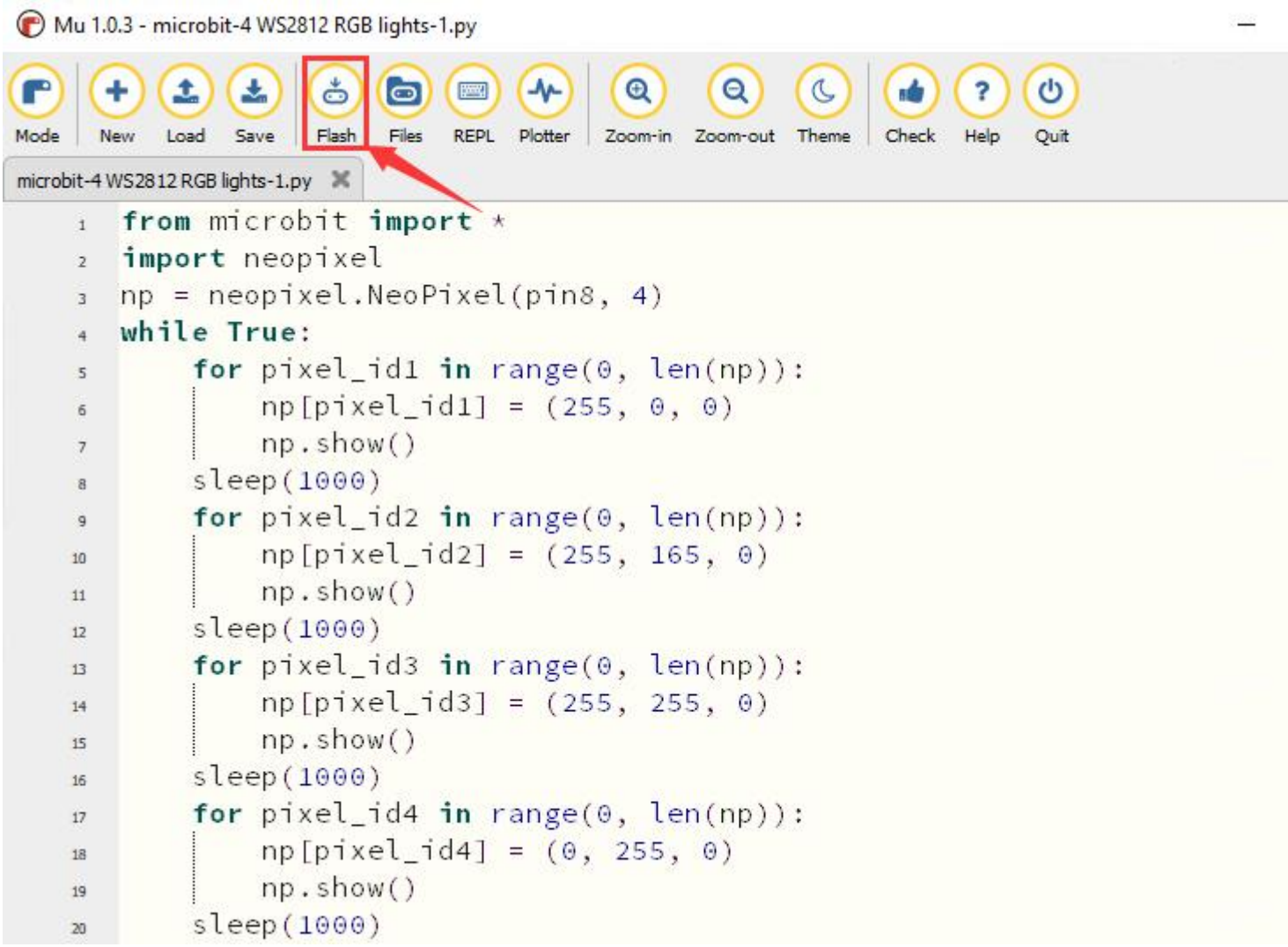
```
    for pixel_id5 in range(0, len(np)):
        np[pixel_id5] = (0, 0, 255)
        np.show()
    sleep(1000)
    for pixel_id6 in range(0, len(np)):
        np[pixel_id6] = (75, 0, 130)
        np.show()
    sleep(1000)
    for pixel_id7 in range(0, len(np)):
        np[pixel_id7] = (238, 130, 238)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

Code2:

Enter Mu software and open the file "Project 14: WS2812 RGB LEDs.py" to import code:

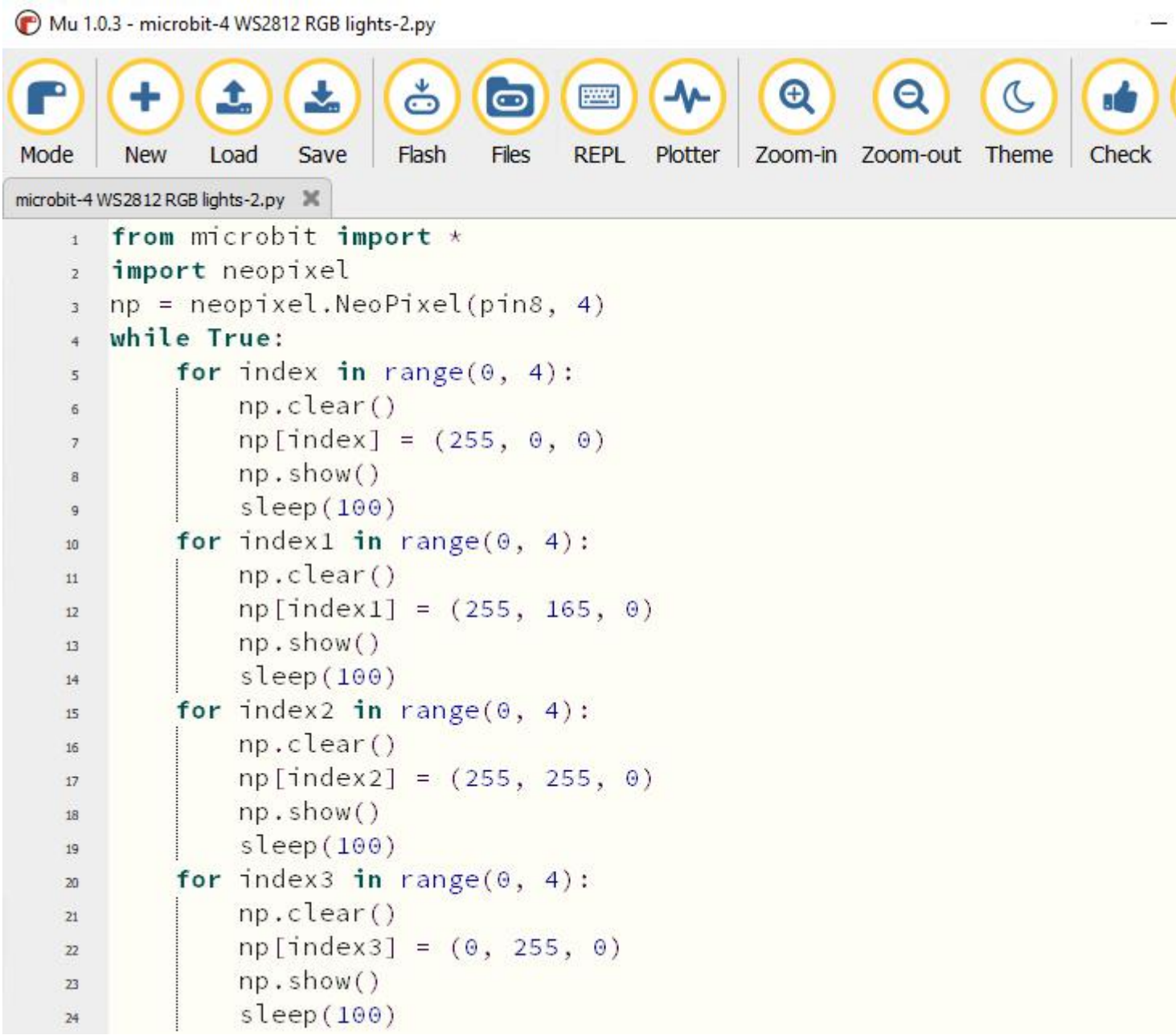
(How to load the project code?)

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 14: WS2812	Code-2.py

	RGB LEDs	

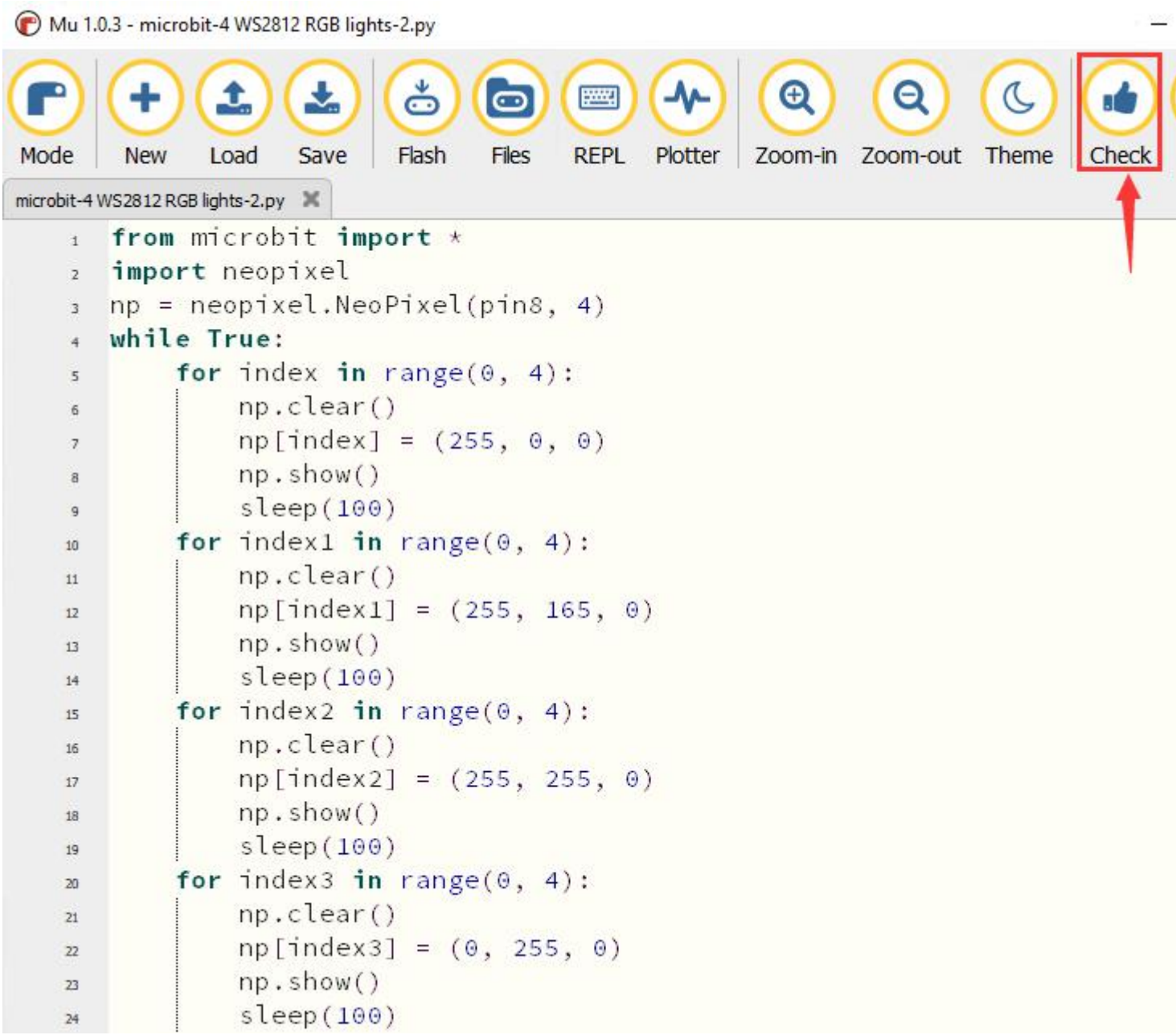
You can also input code in the editing window yourself.

(note:all words and symbols must be written in English)



```
    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.




```
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.

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)

```

Code3:

Enter Mu software and open the file "Project 14: WS2812 RGB LEDs.py" to import code:

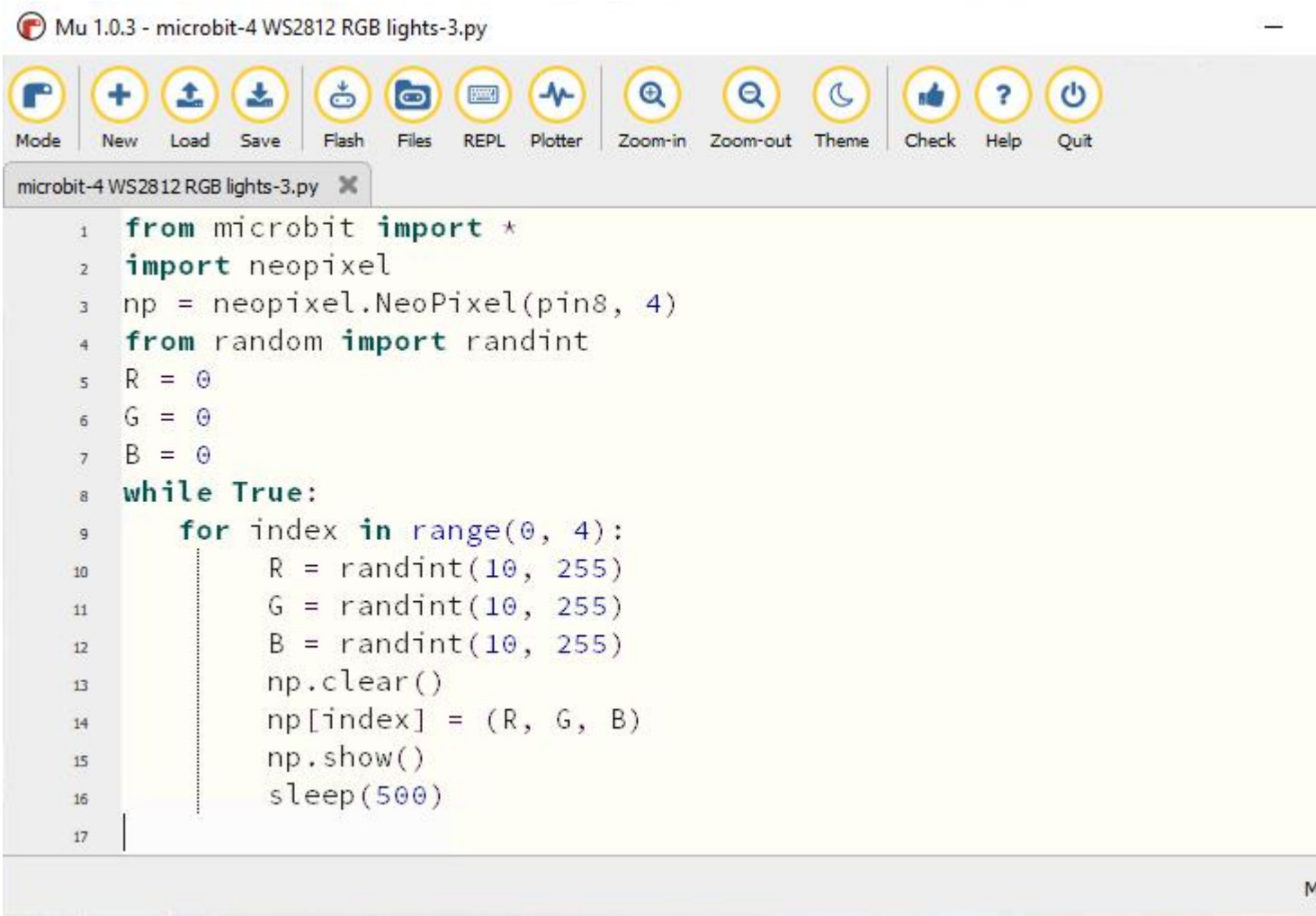
(How to load the project code?)

File Type	Route	File Name
Python	KS4031(KS4032)	Code-3.py

file	folder/Python Tutorial/Python Code/Project 14： WS2812 RGB LEDs	

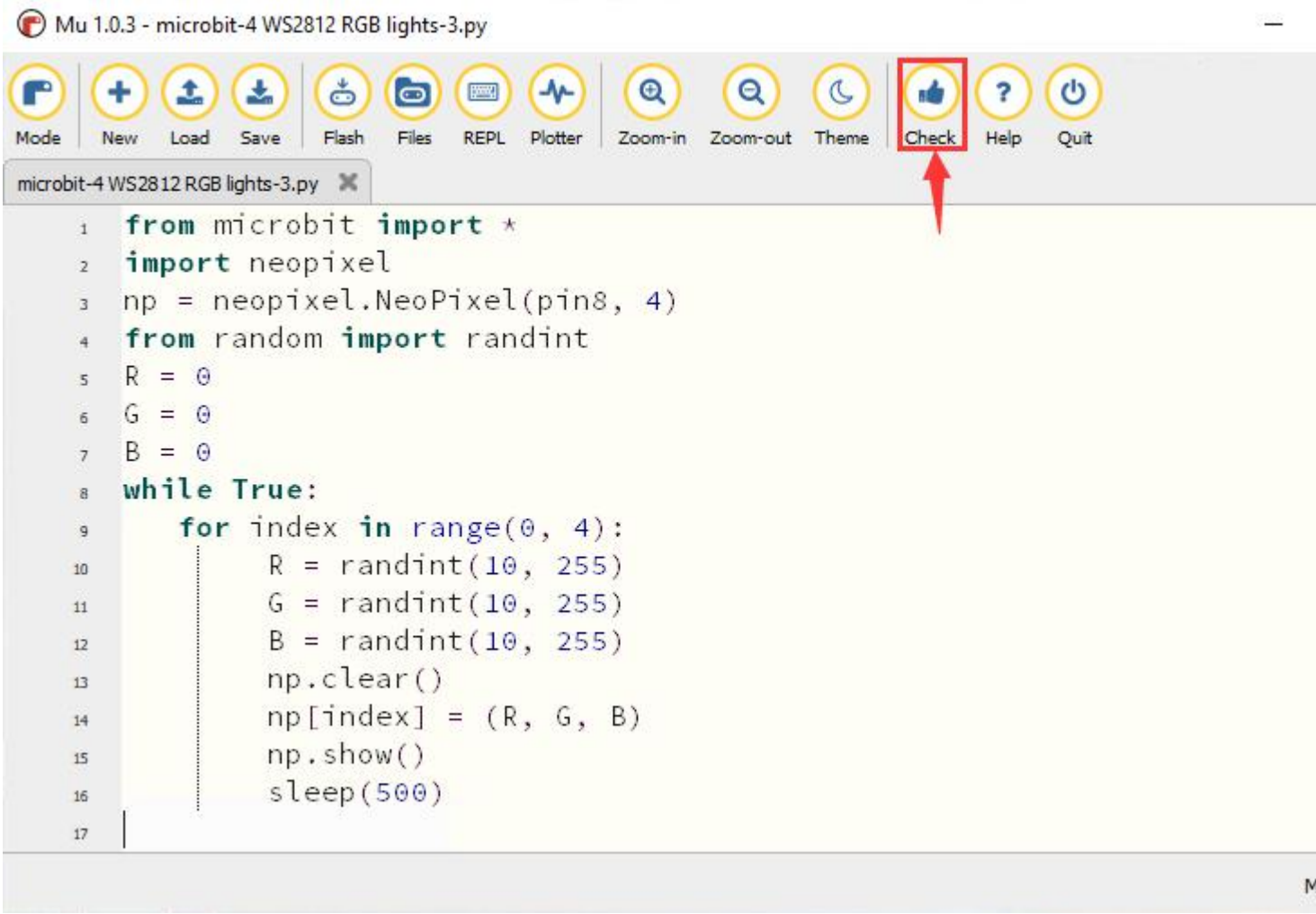
You can also input code in the editing window yourself.

(note:all words and symbols must be written in English)

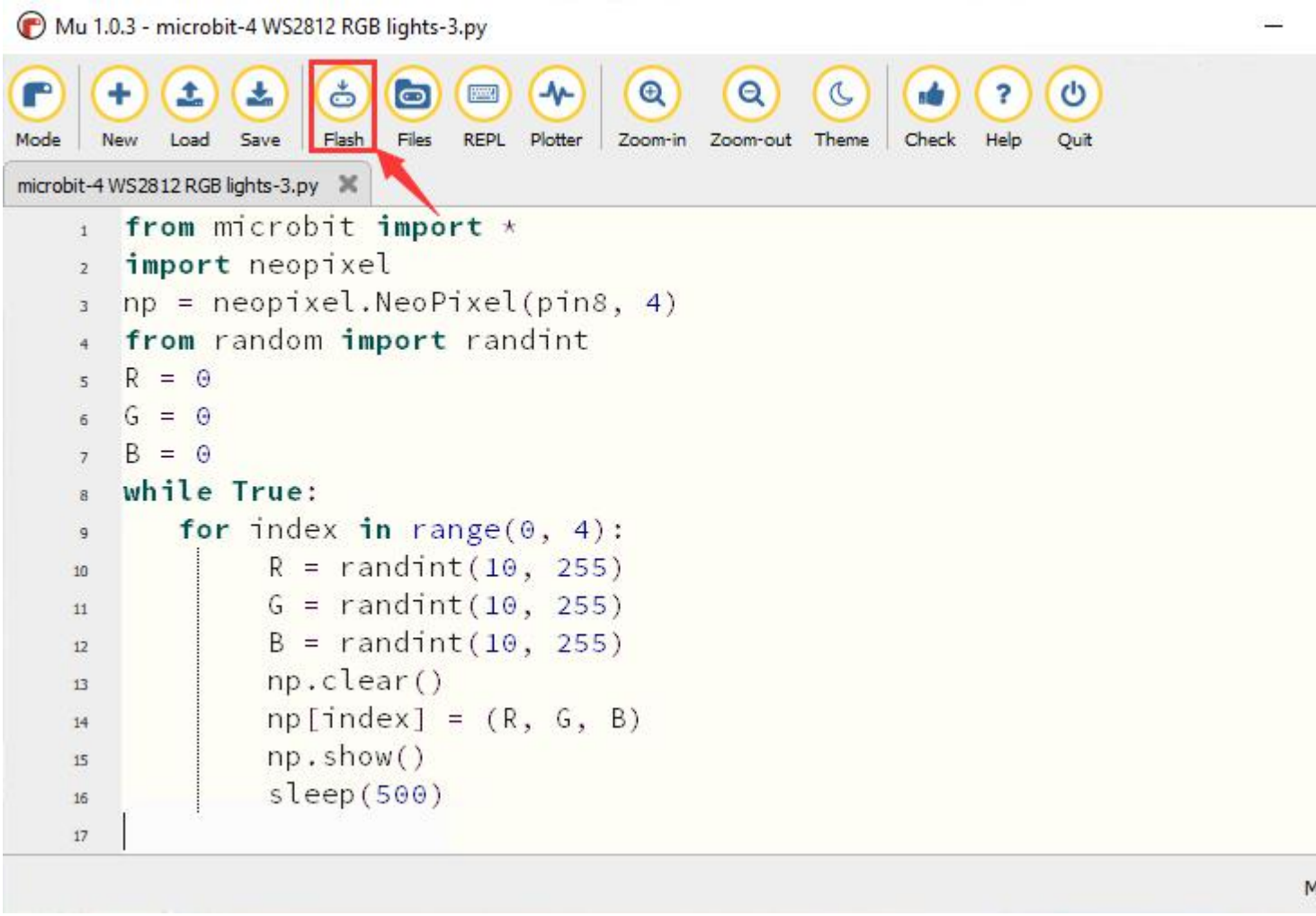


Click “Check” to examine error in the code. The program proves wrong if

underlines and cursors are shown.



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



(4)Test Results:

Download code 1 to micro：bit, and dial POWER to ON end. All four WS2812RGB LEDs light up a different color a time 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.

(5)Code Explanation:

from microbit **import** *	Import the library file of micro: bit
import neopixel	Import the library file of neopixel
np = neopixel.NeoPixel(pin8, 4)	LED Set Neopixel to pin P8, and initialize 4 LEDs
np.clear()	The RGB lights on the Neopixel strip 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)):	For the RGB pixels in the range of (0, len(np)), pixel_id1
for index **in** range(0, 4):	The RGB pixels in the range (0, 4) are index
np.show()	Display the current pixel on the Neopixel strip

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) np[pixel_id9] = (255, 255, 255)	Set the RGB light on the Neopixel strip to pixel_id1 to turn on the red light; Set the RGB light on the Neopixel strip to pixel_id2 to turn on the orange light; Set the RGB light on the Neopixel strip to pixel_id3 to turn on the yellow light; Set the RGB light on the Neopixel strip to pixel_id4 to turn on the green light; Set the RGB light on the Neopixel strip to pixel_id5 to turn on the blue light; Set the RGB light on the Neopixel strip to pixel_id6 to turn on the indigo light; Set the RGB light on the Neopixel strip to pixel_id7 to turn on the violet light; Set the RGB light on the Neopixel strip to pixel_id1 to turn on the purple light; Set the RGB light on the Neopixel strip to pixel_id1 to turn on the white light;
from random **import** randint	Import randint from random variables

np[pixel_id] = (R, G, B)	Set the RGB light on the Neopixel strip to pixel_id to turn on colorful light;
R = 0 G = 0 B = 0	Set the initial value of variable R to 0 Set the initial value of variable G to 0 Set the initial value of variable 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)

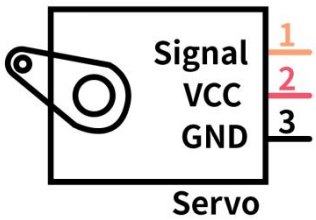
Project 15:Servo

(1)Project Description

For those DIY smart cars, they often have the function of automatic obstacle avoidance. In the DIY process, we need a servo to control the ultrasonic module to rotate left and right, and then detect the distance between the car and the obstacle, so as to control the car to avoid the obstacle. If other microcontrollers are used to control the rotation of the servo, we need to set a certain frequency and a certain width of pulse to

control the servo angle. But if the micro:bit main board is used to control the servo angle, we only need to set the control angle in the development environment where the corresponding pulse will be automatically set to control the servo rotation. In this project, you will learn how to control the servo to rotate back and forth between 0° and 90°.

Servo motor is a position control rotary actuator. It mainly consists of housing, circuit board, core-less motor, gear and position sensor. Its working principle is that the servo receives the signal sent by MCU or receiver, and produces a reference signal with a period of 20ms and width of 1.5ms, then compares the acquired DC bias voltage to the voltage of the potentiometer and obtains the voltage difference output.



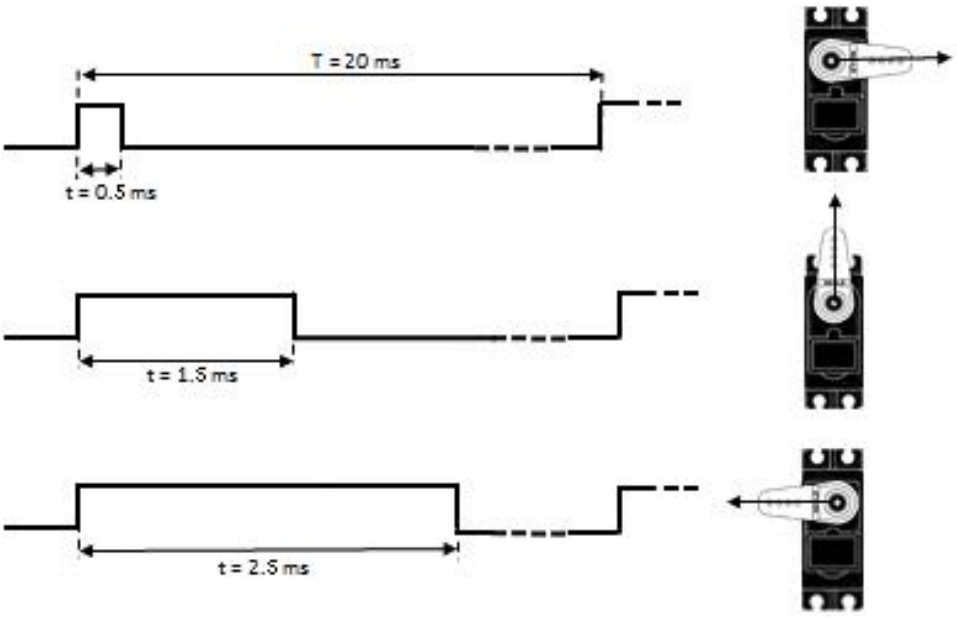
For the servo used in this project, the brown wire is the ground, the red one is the positive wire, and the orange one is the signal wire.

(2)Background Information of the Servo

The rotation angle of servo motor is controlled by regulating the duty cycle of PWM (Pulse-Width Modulation) signal. The standard cycle of PWM signal is 20ms (50Hz). Theoretically, the width is distributed between 1ms-2ms, but in fact, it's between 0.5ms-2.5ms. The width

corresponds to the rotation angle from 0° to 180°. But note that for different brand motor, the same signal may have different rotation angle.

t	Duty Cycle	Direction
0.5 ms	0.5/20 = 2.5%	0 degs
1.5 ms	1.5/20 = 7.5%	90 degs
2.5 ms	2.5/20 = 12.5%	180 degs



After measurement, the pulse range of the servo is 0.65ms~2.5ms. For a 180 degree servo, the corresponding control relationship is as follows:

Time on High Level	Angle of the Servo	Reference Signal Cycle Time (20ms)
0.65ms	0 degree	0.65ms high level+19.35ms low level
1.5ms	90 degrees	1.5ms high level+18.5ms low level
2.5ms	180degrees	2.5ms high level+17.5ms low

		level

(3)Parameters:

- Working voltage: DC 4.8V ~ 6V
- Operating angle range: about 180 ° (at 500 → 2500 μsec)
- Pulse width range: 500 → 2500 μsec
- No-load speed: 0.12 ± 0.01 sec / 60 (DC 4.8V) 0.1 ± 0.01 sec / 60 (DC 6V)
- No-load current: 200 ± 20mA (DC 4.8V) 220 ± 20mA (DC 6V)
- Stopping torque: 1.3 ± 0.01kg · cm (DC 4.8V) 1.5 ± 0.1kg · cm (DC 6V)
- Stop current: ≦ 850mA (DC 4.8V) ≦ 1000mA (DC 6V)
- Standby current: 3 ± 1mA (DC 4.8V) 4 ± 1mA (DC 6V)

It should be noted that do not use a computer for power supply, because if the current demand is greater than 500mA, the servo may be burned out. It is recommended to use an external battery for power supply.

(4)Experimental Preparation:

- Insert micro:bit board into slot of keyestudio 4WD Mecanum Robot Car
- Place batteries into battery holder
- Dial power switch to ON end

- Connect micro:bit to computer by USB cable
- Open the offline version of Mu.

(5)Test Code:

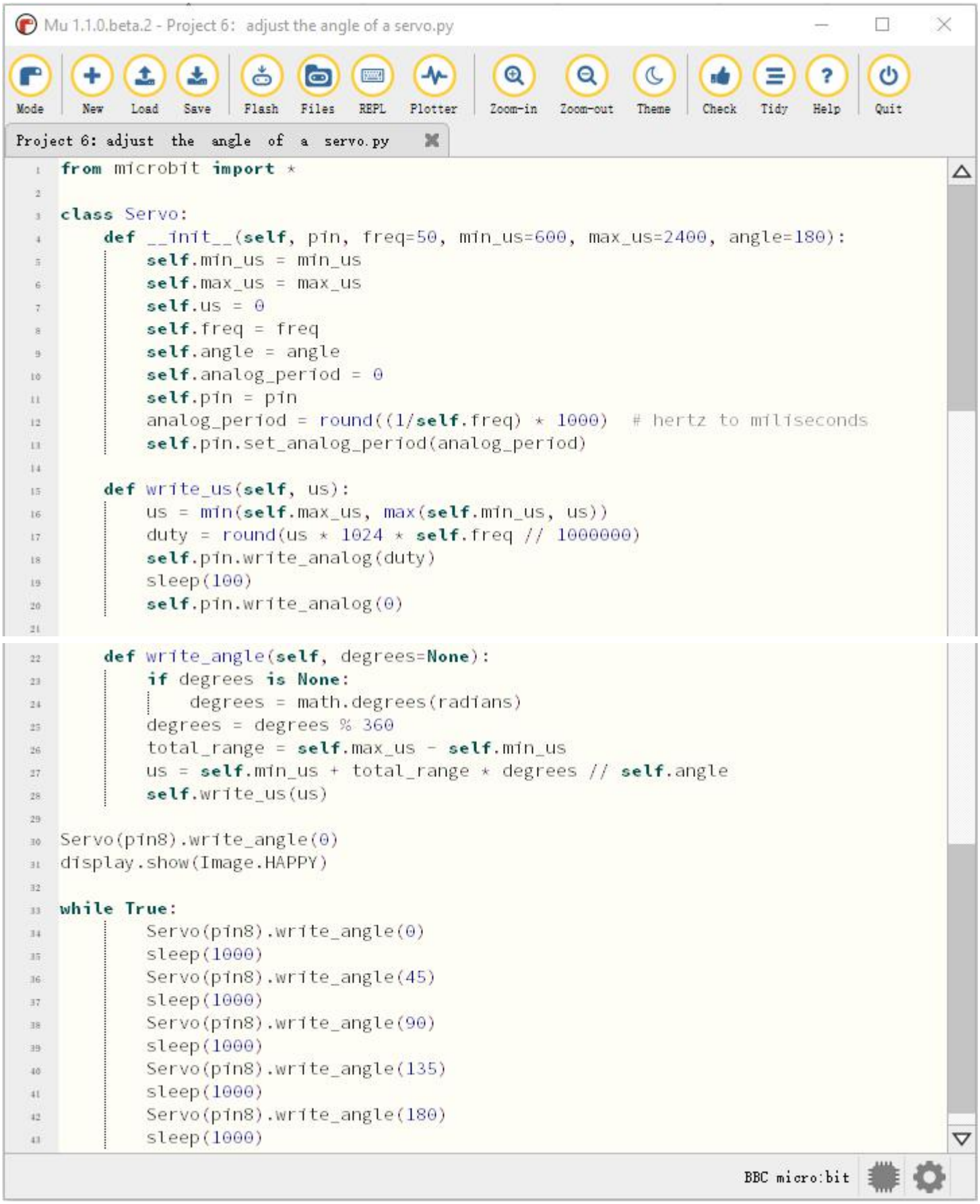
Enter Mu software and open the file "Project 15：Servo.py" to import code:

(How to load the project code?)

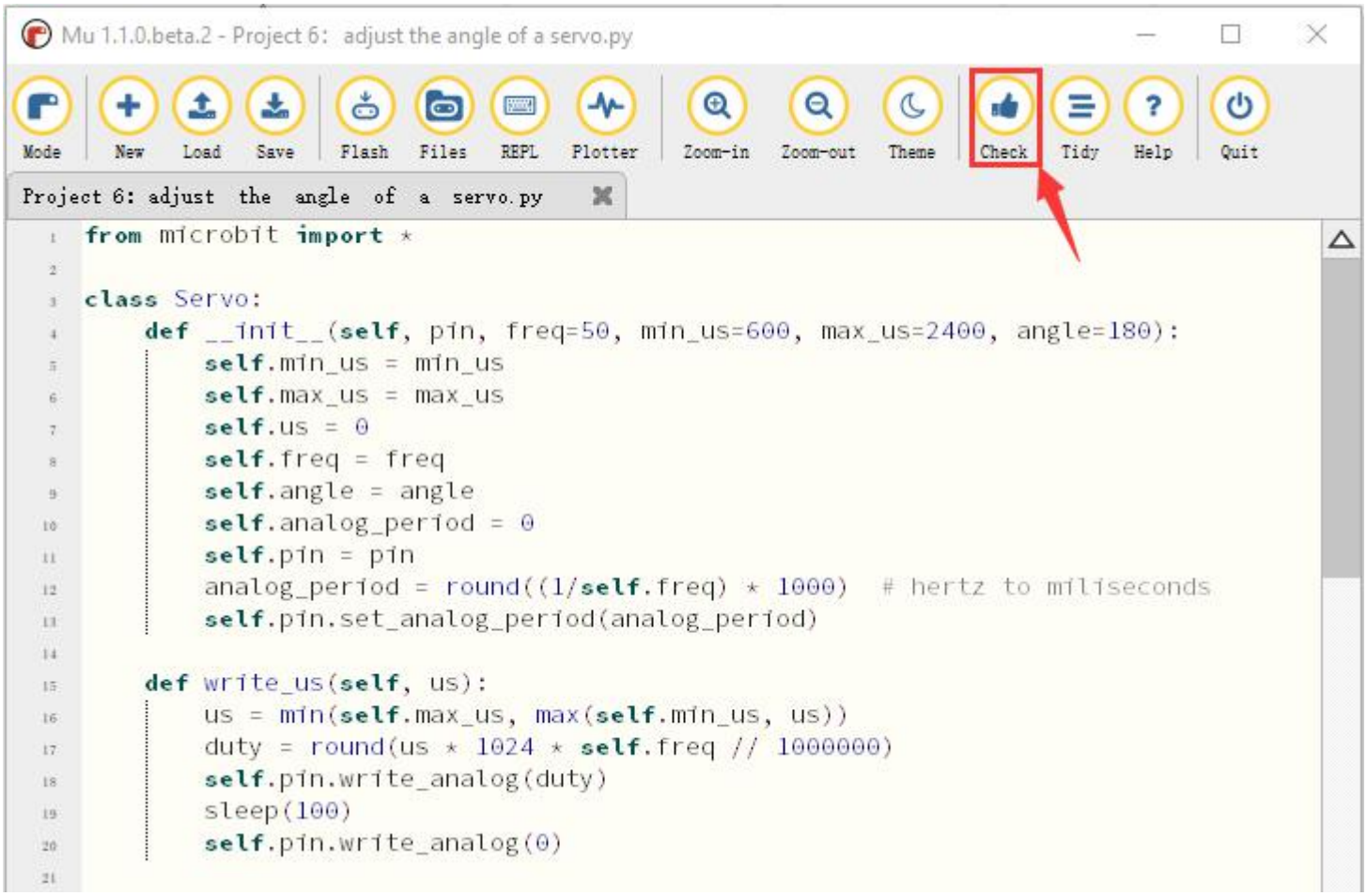
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 15：Servo	Project 15：Servo

You can also input code in the editing window yourself.

(note:all words and symbols must be written in English)


Mu 1.1.0.beta.2 - Project 6: adjust the angle of a servo.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Tidy
Help
Quit
Project 6: adjust the angle of a servo.py
from microbit import *
class Servo:
def __init__(self, pin, freq=50, min_us=600, max_us=2400, angle=180):
self.min_us = min_us
self.max_us = max_us
self.us = 0
self.freq = freq
self.angle = angle
self.analog_period = 0
self.pin = pin
analog_period = round((1/self.freq) * 1000) # hertz to miliseconds
self.pin.set_analog_period(analog_period)
def write_us(self, us):
us = min(self.max_us, max(self.min_us, us))
duty = round(us * 1024 * self.freq // 1000000)
self.pin.write_analog(duty)
sleep(100)
self.pin.write_analog(0)
def write_angle(self, degrees=None):
if degrees is None:
degrees = math.degrees(radians)
degrees = degrees % 360
total_range = self.max_us - self.min_us
us = self.min_us + total_range * degrees // self.angle
self.write_us(us)
Servo(pin8).write_angle(0)
display.show(Image.HAPPY)
while True:
Servo(pin8).write_angle(0)
sleep(1000)
Servo(pin8).write_angle(45)
sleep(1000)
Servo(pin8).write_angle(90)
sleep(1000)
Servo(pin8).write_angle(135)
sleep(1000)
Servo(pin8).write_angle(180)
sleep(1000)
BBC micro:bit

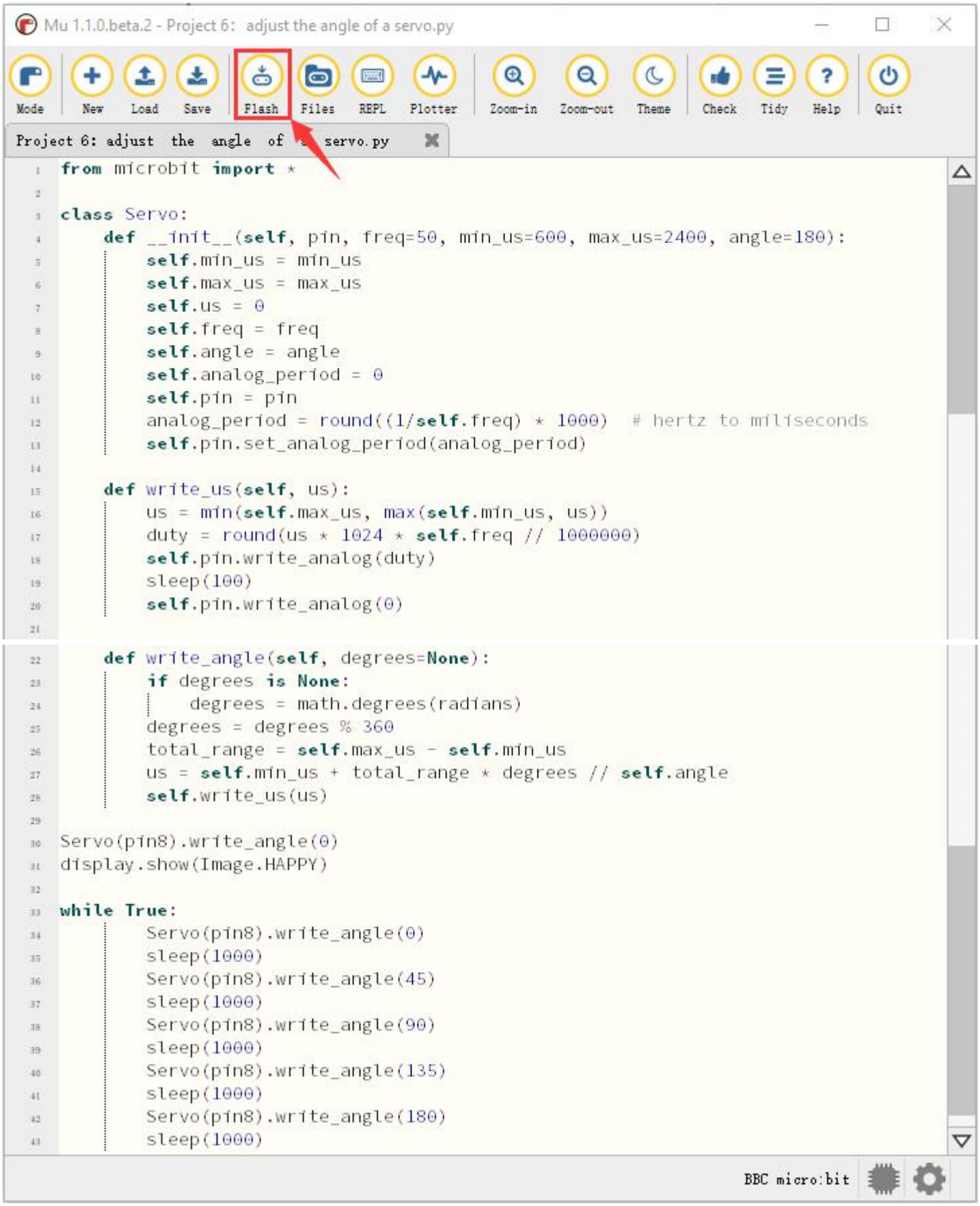
Click “Check” to examine error in the code. The program proves wrong if underlines and cursors are shown.



```
    def write_angle(self, degrees=None):
        if degrees is None:
            degrees = math.degrees(radians)
        degrees = degrees % 360
        total_range = self.max_us - self.min_us
        us = self.min_us + total_range * degrees // self.angle
        self.write_us(us)

Servo(pin8).write_angle(0)
display.show(Image.HAPPY)

while True:
        Servo(pin8).write_angle(0)
        sleep(1000)
        Servo(pin8).write_angle(45)
        sleep(1000)
        Servo(pin8).write_angle(90)
        sleep(1000)
        Servo(pin8).write_angle(135)
        sleep(1000)
        Servo(pin8).write_angle(180)
        sleep(1000)
```

BBC micro:bit

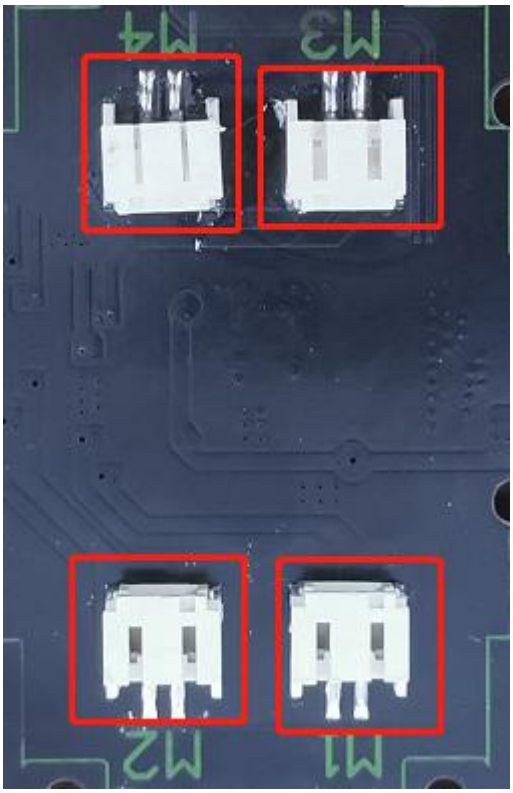
If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.


Mu 1.1.0.beta.2 - Project 6: adjust the angle of a servo.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
Check
Tidy
Help
Quit
Project 6: adjust the angle of a servo.py
from microbit import *
class Servo:
def __init__(self, pin, freq=50, min_us=600, max_us=2400, angle=180):
self.min_us = min_us
self.max_us = max_us
self.us = 0
self.freq = freq
self.angle = angle
self.analog_period = 0
self.pin = pin
analog_period = round((1/self.freq) * 1000) # hertz to miliseconds
self.pin.set_analog_period(analog_period)
def write_us(self, us):
us = min(self.max_us, max(self.min_us, us))
duty = round(us * 1024 * self.freq // 1000000)
self.pin.write_analog(duty)
sleep(100)
self.pin.write_analog(0)
def write_angle(self, degrees=None):
if degrees is None:
degrees = math.degrees(radians)
degrees = degrees % 360
total_range = self.max_us - self.min_us
us = self.min_us + total_range * degrees // self.angle
self.write_us(us)
Servo(pin8).write_angle(0)
display.show(Image.HAPPY)
while True:
Servo(pin8).write_angle(0)
sleep(1000)
Servo(pin8).write_angle(45)
sleep(1000)
Servo(pin8).write_angle(90)
sleep(1000)
Servo(pin8).write_angle(135)
sleep(1000)
Servo(pin8).write_angle(180)
sleep(1000)
BBC micro:bit

(6)Test Results:

After uploading the test code, dialing POWER switch to ON end and powering it by external power , the LED dot matrix shows a smiley pattern and the servo rotates in the pattern 0°~45°~90°~135°~180°~0°.

Project 16:Motor



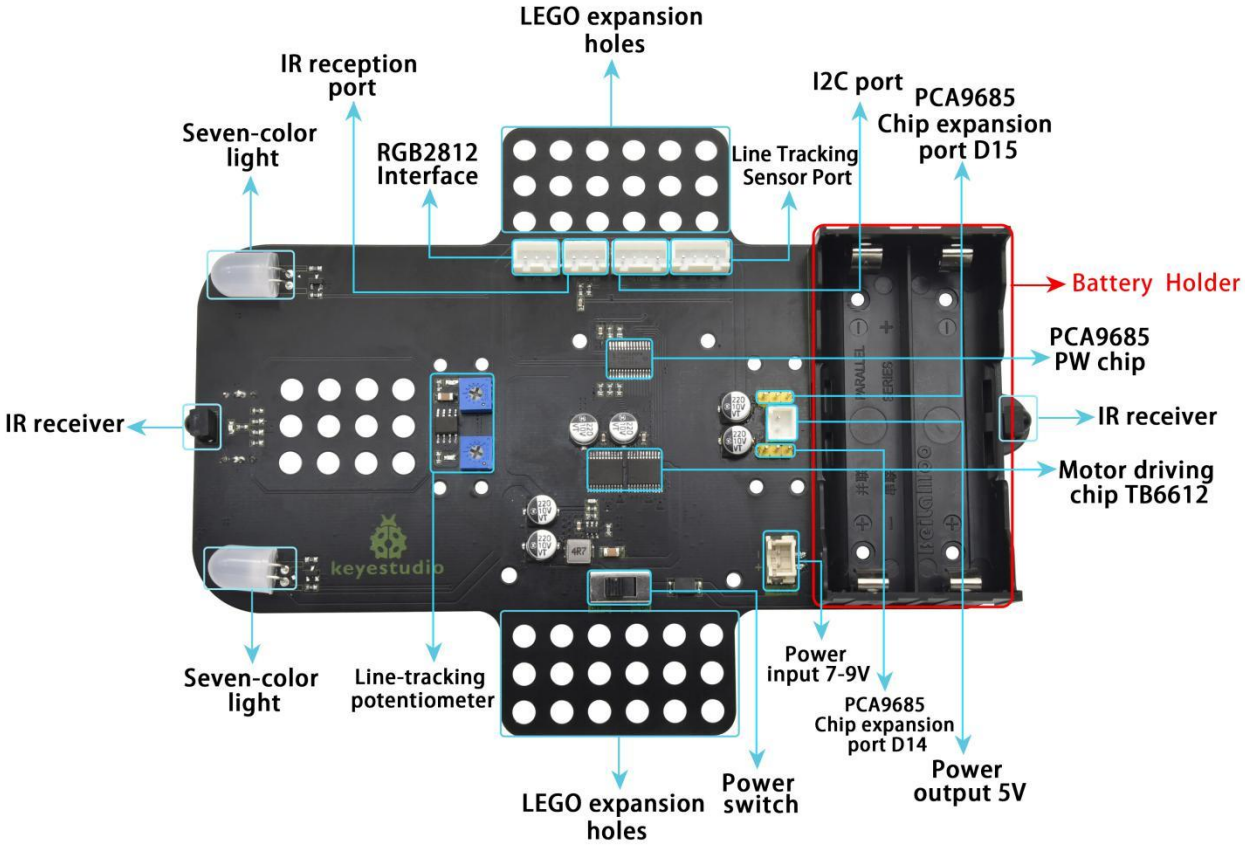
(1)Project Description

The Keyestudio 4WD Mecanum Robot Car is equipped with 4 DC reduction motors, also called gear reduction motor, which is developed on the

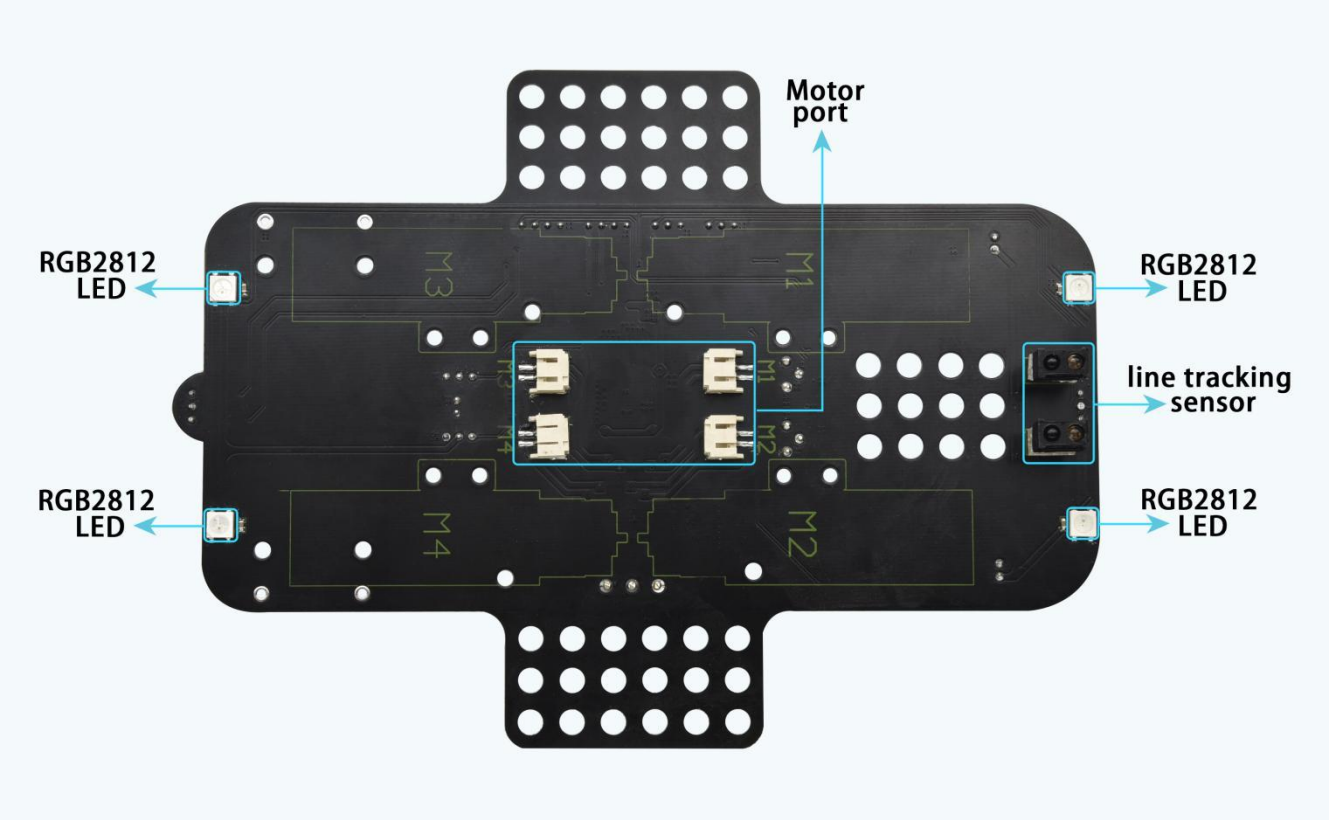
ordinary DC motor. It has a matching gear reduction box which provides a lower speed but a larger torque. Furthermore, different reduction ratios of the box can provide different speeds and torques.
Gear motor is the integration of gearmotor and motor, which is applied widely in steel and machine industry

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

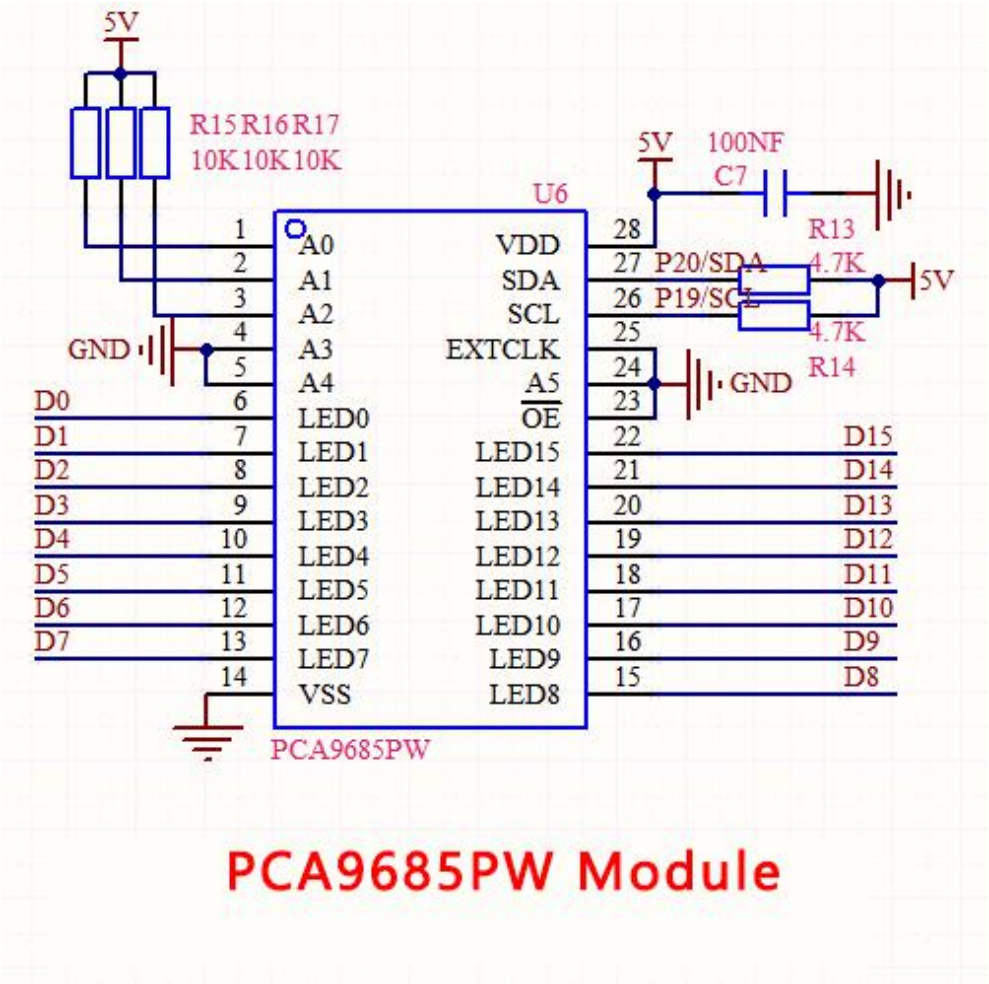
Details about chips:


LEGO expansion holes
IR reception port
I2C port
PCA9685 Chip expansion port D15
Seven-color light
RGB2812 Interface
Line Tracking Sensor Port
Battery Holder
PCA9685 PW chip
IR receiver
IR receiver
Motor driving chip TB6612
keyestudio
Seven-color light
Line-tracking potentiometer
Power input 7-9V
PCA9685 Chip expansion port D14
Power output 5V
LEGO expansion holes
Power switch

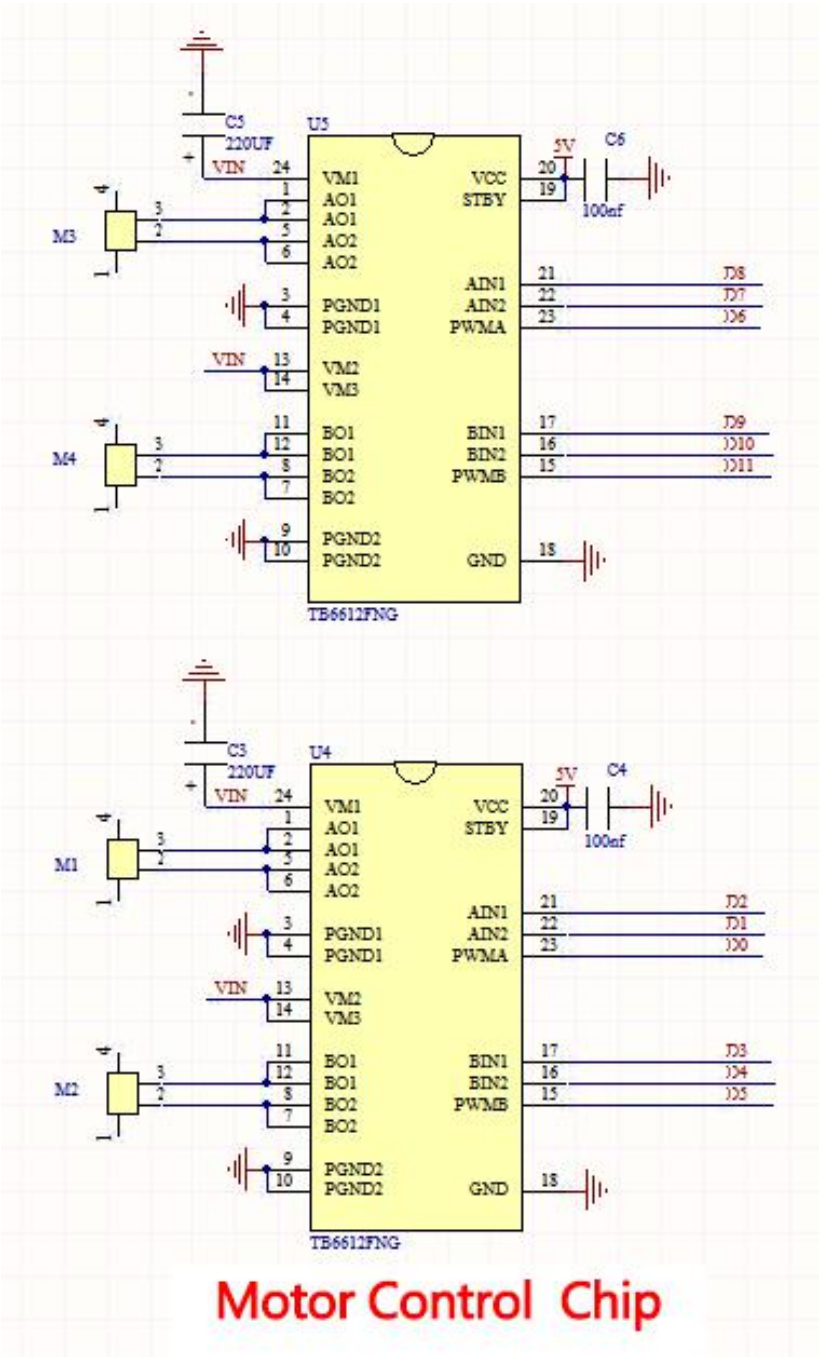
Front


Motor port
RGB2812 LED
RGB2812 LED
line tracking sensor
RGB2812 LED
RGB2812 LED
M3
M1
M4
M2

Back



PCA9685PW Module



(2)Experimental Preparation:

- Insert micro:bit board into slot of keyestudio 4WD Mecanum Robot Car
- Place batteries into battery holder
- Dial power switch to ON end
- Connect micro:bit to computer by USB cable

➢ Open the offline version of Mu.

(3)Test Code:

Enter Mu software and open the file "Project 16：Motor.py" to import code:

(How to load the project code?)

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 16：Motor	Code-1.py

You can also input code in the editing window yourself.

(note:all words and symbols must be written in English)

Mu 1.1.0.beta.5 - microbit-Motor Driving-1.py

Mode | New | Load | Save | Flash | Files | REPL | Plotter | Zoom-in | Zoom-out | Theme | Chec

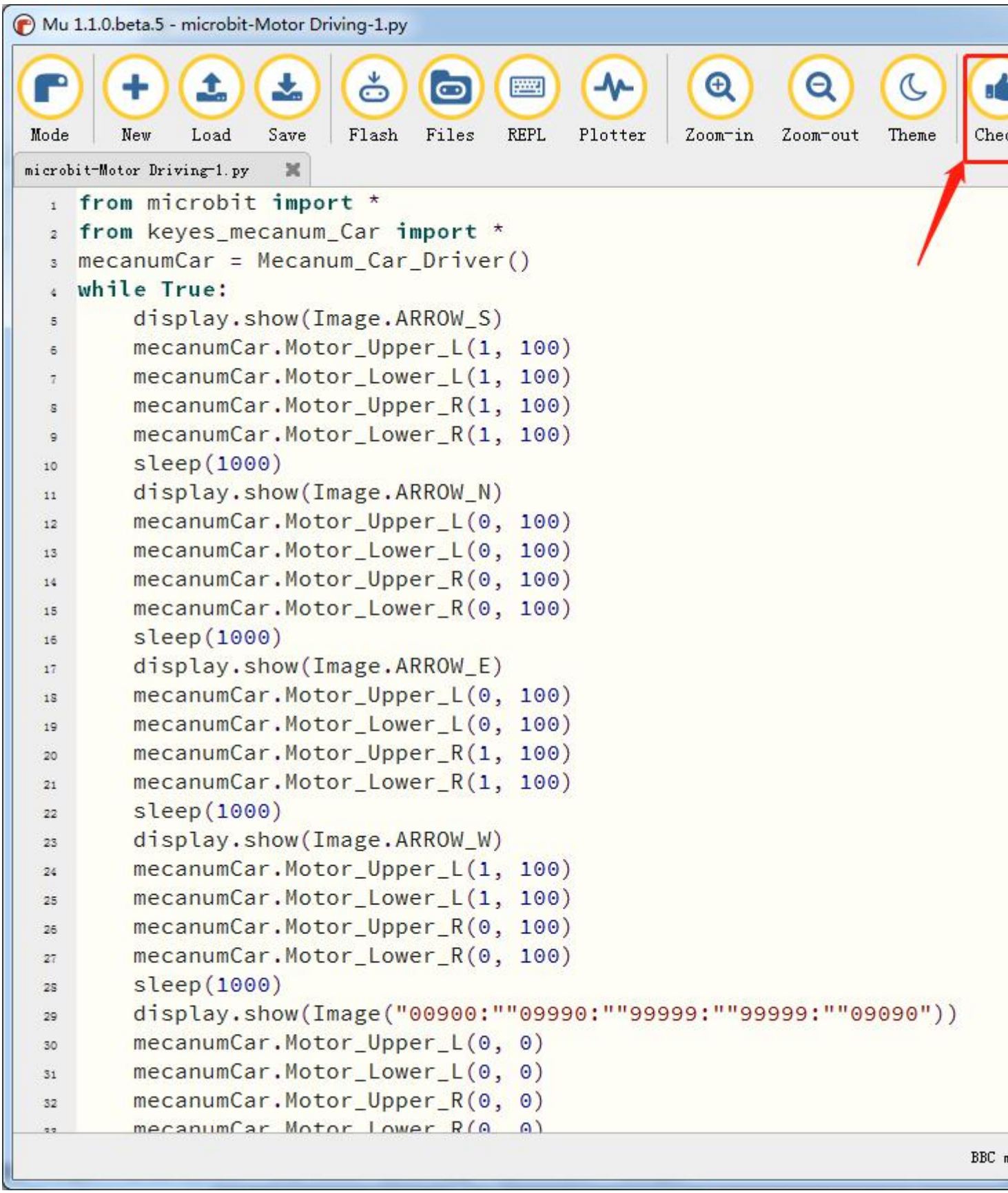
microbit-Motor Driving-1.py

```
from microbit import *
from keyes_mecanum_Car import *
mecanumCar = Mecanum_Car_Driver()
while True:
    display.show(Image.ARROW_S)
    mecanumCar.Motor_Upper_L(1, 100)
    mecanumCar.Motor_Lower_L(1, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(1000)
    display.show(Image.ARROW_N)
    mecanumCar.Motor_Upper_L(0, 100)
    mecanumCar.Motor_Lower_L(0, 100)
    mecanumCar.Motor_Upper_R(0, 100)
    mecanumCar.Motor_Lower_R(0, 100)
    sleep(1000)
    display.show(Image.ARROW_E)
    mecanumCar.Motor_Upper_L(0, 100)
    mecanumCar.Motor_Lower_L(0, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(1000)
    display.show(Image.ARROW_W)
    mecanumCar.Motor_Upper_L(1, 100)
    mecanumCar.Motor_Lower_L(1, 100)
    mecanumCar.Motor_Upper_R(0, 100)
    mecanumCar.Motor_Lower_R(0, 100)
    sleep(1000)
    display.show(Image("00900:""09990:""99999:""99999:""09090"))
    mecanumCar.Motor_Upper_L(0, 0)
    mecanumCar.Motor_Lower_L(0, 0)
    mecanumCar.Motor_Upper_R(0, 0)
    mecanumCar.Motor_Lower_R(0, 0)
```

BBC

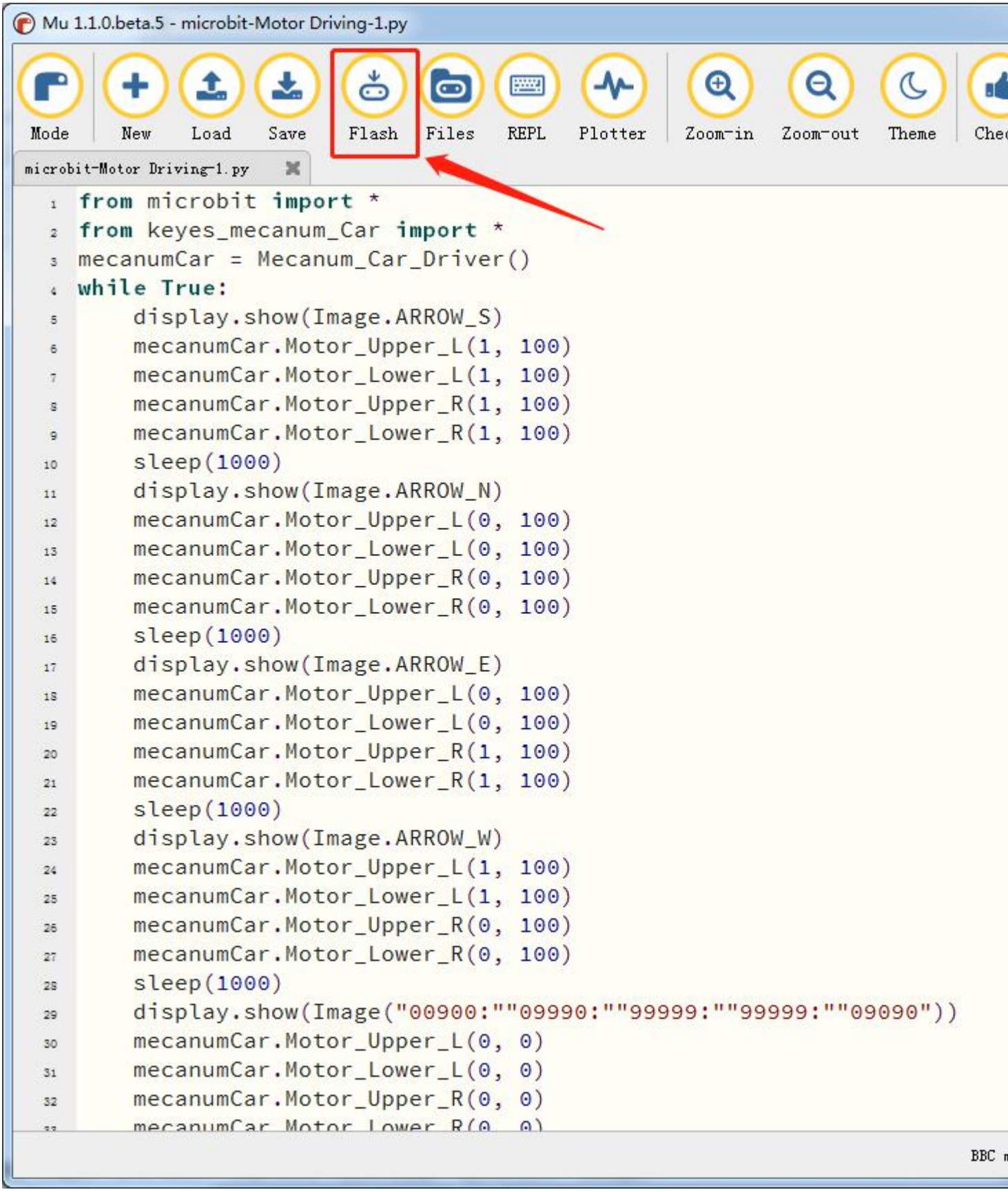
Click “Files” to import “keyes_mecanum_Car.py “library file tomicro:bit (How to import files?). No need to do it again if you have imported it before.

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



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

download code to micro:bit board.



Code 2:

Enter Mu software and open the file "Project 16: Motor.py" to import code:

(How to load the project code?)

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 16: Motor	Code-2.py

You can also input code in the editing window yourself.

(note:all words and symbols must be written in English)

Mu 1.1.0.beta.5 - microbit-Motor Driving-2.py

Mode | New | Load | Save | Flash | Files | REPL | Plotter | Zoom-in | Zoom-out | Theme | Chec

microbit-Motor Driving-2.py

```
from microbit import button_a, button_b, display, Image, sleep
from keyes_mecanum_Car import *
mecanumCar = Mecanum_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)
    mecanumCar.Motor_Upper_L(1, 100)
    mecanumCar.Motor_Lower_L(1, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(1000)
    mecanumCar.Motor_Upper_L(0, 100)
    mecanumCar.Motor_Lower_L(0, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(650)
    mecanumCar.Motor_Upper_L(1, 100)
    mecanumCar.Motor_Lower_L(1, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(1000)
    mecanumCar.Motor_Upper_L(0, 0)
    mecanumCar.Motor_Lower_L(0, 0)
    mecanumCar.Motor_Upper_R(0, 0)
    mecanumCar.Motor_Lower_R(0, 0)
    b = 0
def run_O():
    global b
```

BBC micro:bit

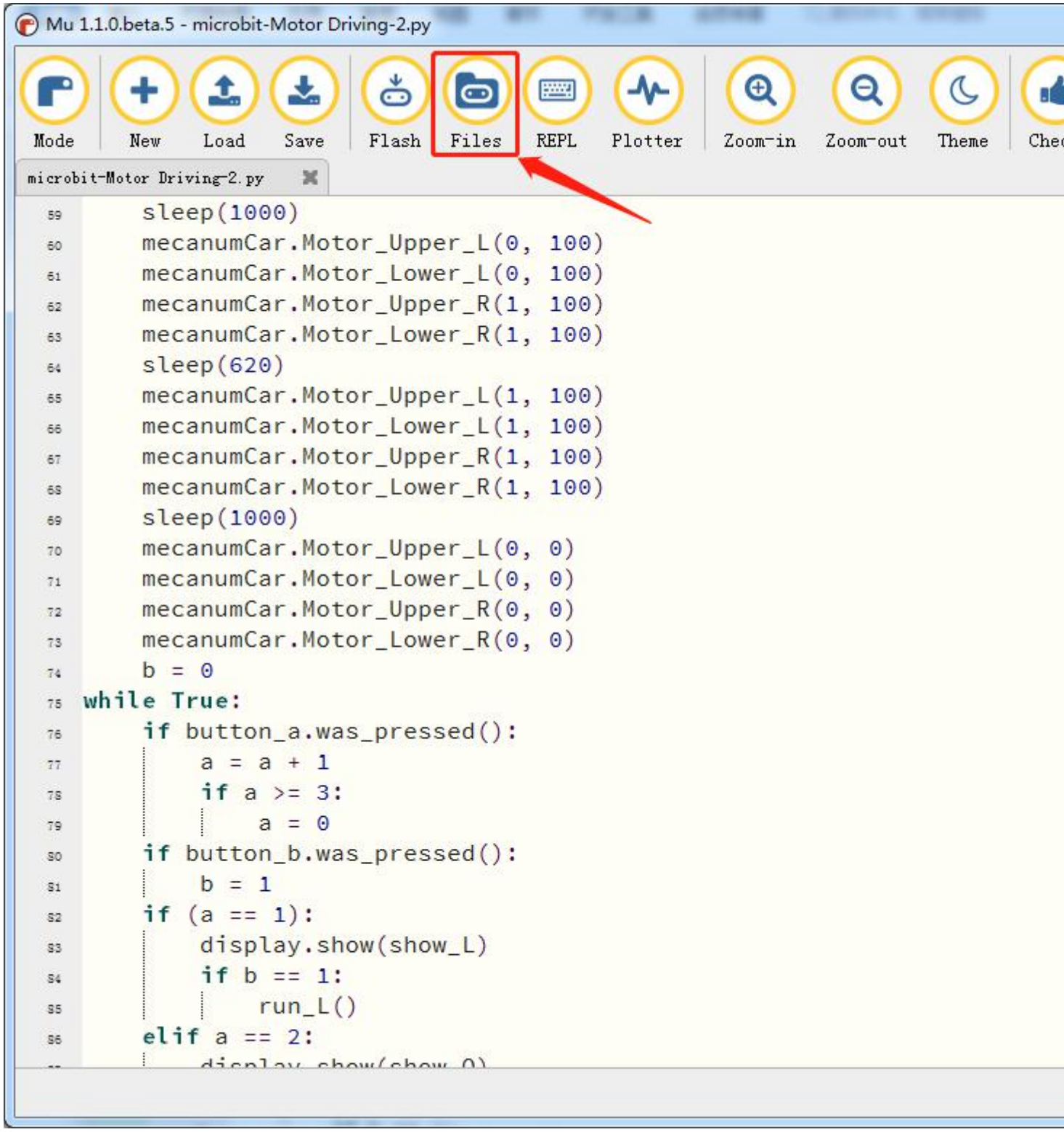
```
    global b
    sleep(1000)
    mecanumCar.Motor_Upper_L(1, 100)
    mecanumCar.Motor_Lower_L(1, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(1000)
    mecanumCar.Motor_Upper_L(0, 100)
    mecanumCar.Motor_Lower_L(0, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(620)
    mecanumCar.Motor_Upper_L(1, 100)
    mecanumCar.Motor_Lower_L(1, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(1000)
    mecanumCar.Motor_Upper_L(0, 100)
    mecanumCar.Motor_Lower_L(0, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(620)
    mecanumCar.Motor_Upper_L(1, 100)
    mecanumCar.Motor_Lower_L(1, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(1000)
    mecanumCar.Motor_Upper_L(0, 100)
    mecanumCar.Motor_Lower_L(0, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(620)
    mecanumCar.Motor_Upper_L(1, 100)
```

BBC micro:bit

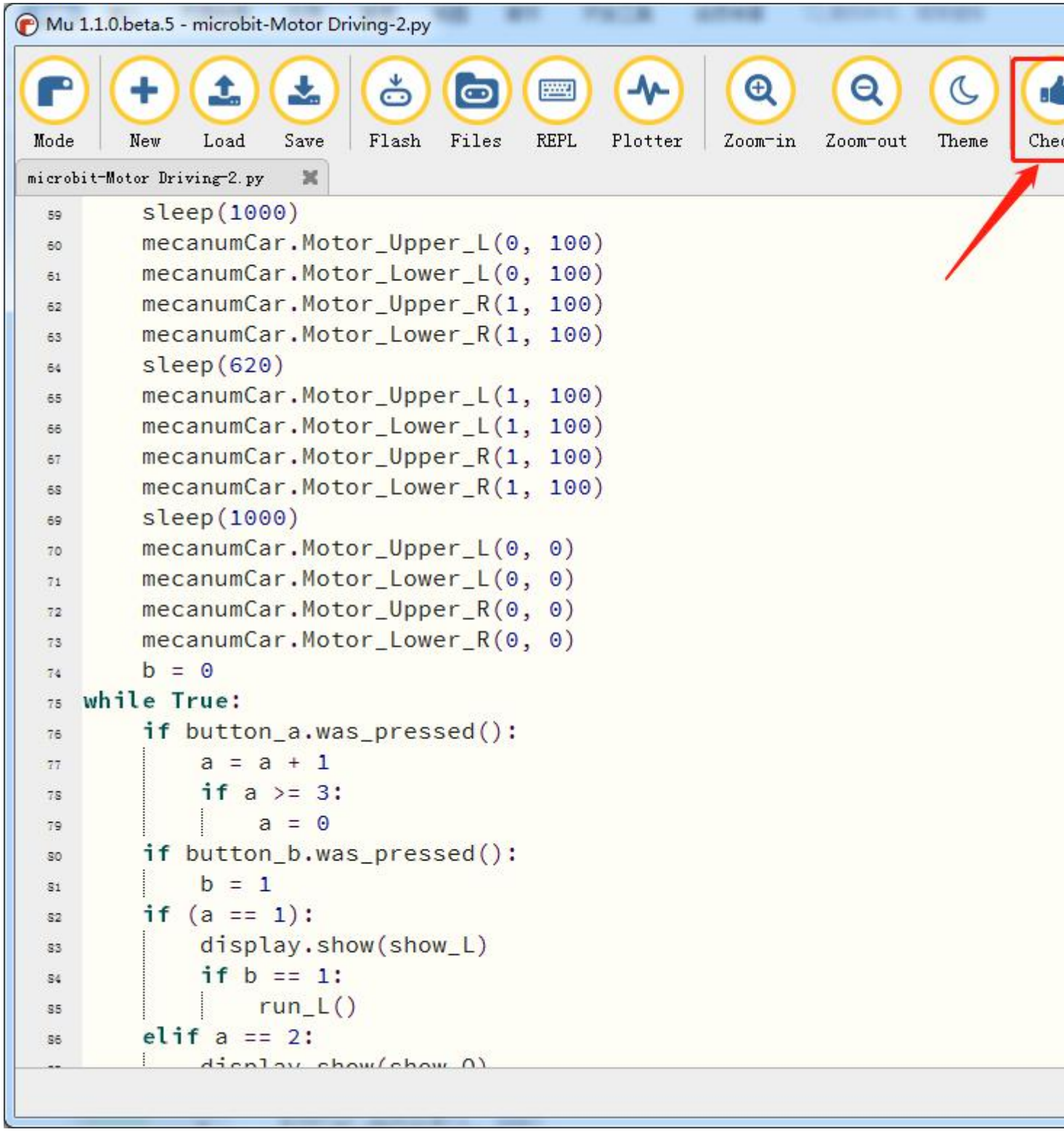
```
    mecanumCar.Motor_Upper_L(1, 100)
    mecanumCar.Motor_Lower_L(1, 100)
    mecanumCar.Motor_Upper_R(1, 100)
    mecanumCar.Motor_Lower_R(1, 100)
    sleep(1000)
    mecanumCar.Motor_Upper_L(0, 0)
    mecanumCar.Motor_Lower_L(0, 0)
    mecanumCar.Motor_Upper_R(0, 0)
    mecanumCar.Motor_Lower_R(0, 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()

```

BBC micro:bit

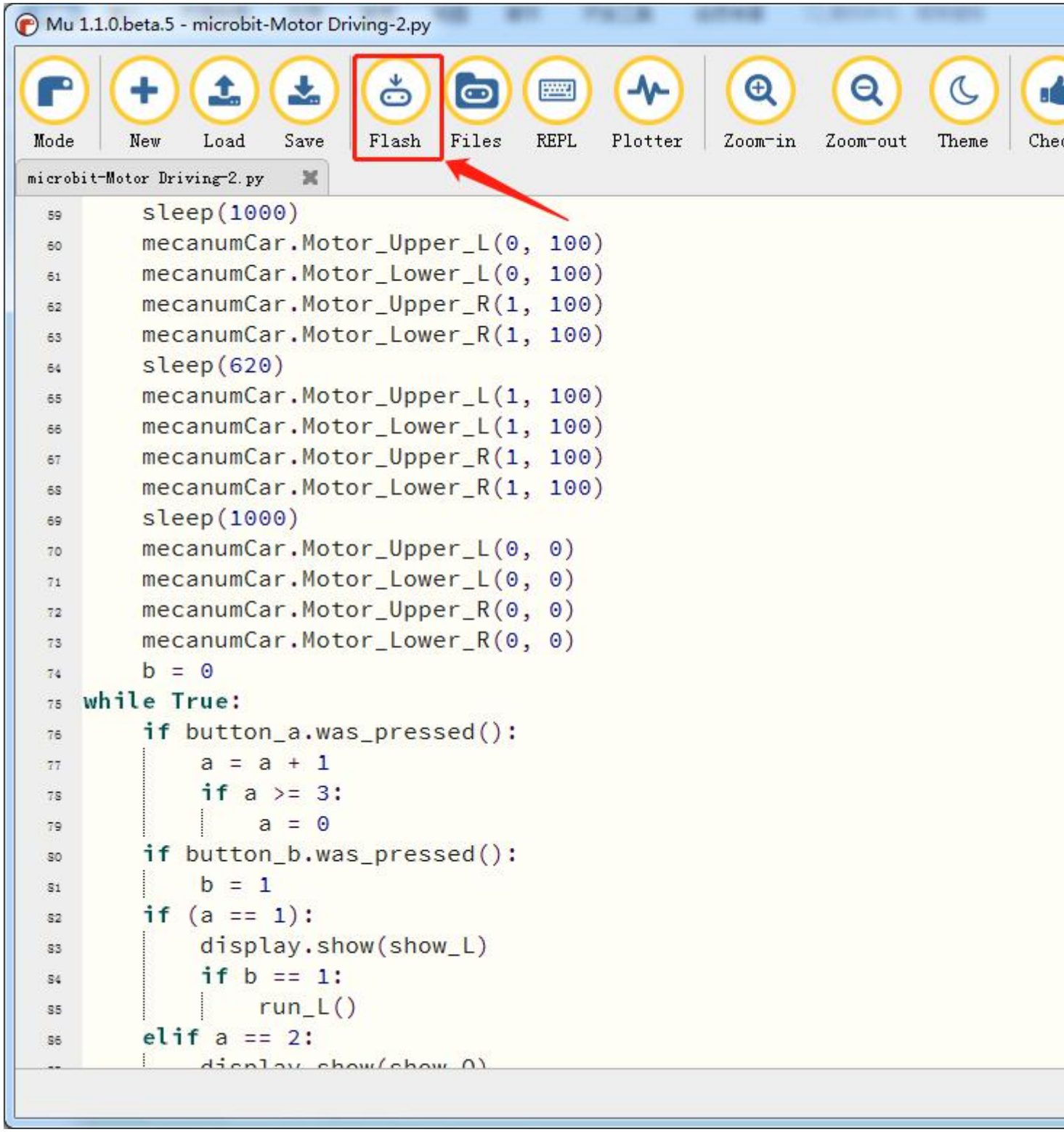
Click “Files” to import “keyes_mecanum_Car.py “library file tomicro:bit (How to import files?). No need to do it again if you have imported it before.



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



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



(4)Test Results:

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.

Download code 2 to micro:bit board, dial POWER switch to ON end.
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,"□" is shown on micro:bit, and route of car is "□". The car repeats this pattern.

(5)Code Explanation:

from microbit **import** button_a, button_b, display, Image, sleep	Due to insufficient memory, only the necessary parts such as button_a, button_b, display, Image, sleep and so on in the micro:bit library file are imported here
from keyes_mecanum_Car **import ***	Import library file keyes_mecanum_Car
mecanumCar =Mecanum_Car_Driver()()	Instantiate an object Mecanum_Car_Driver()() as mecanumCar

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 “❤”
mecanumCar.Motor_Upper_L(1, 100) mecanumCar.Motor_Lower_L(1, 100) mecanumCar.Motor_Upper_R(1, 100) mecanumCar.Motor_Lower_R(1, 100)	The left motor of car rotates clockwise at the speed of PWM100 （1: clockwise，0: anticlockwise；PWM100 means speed（0~255）） The rear left motor of car rotates clockwise at the speed of PWM100.

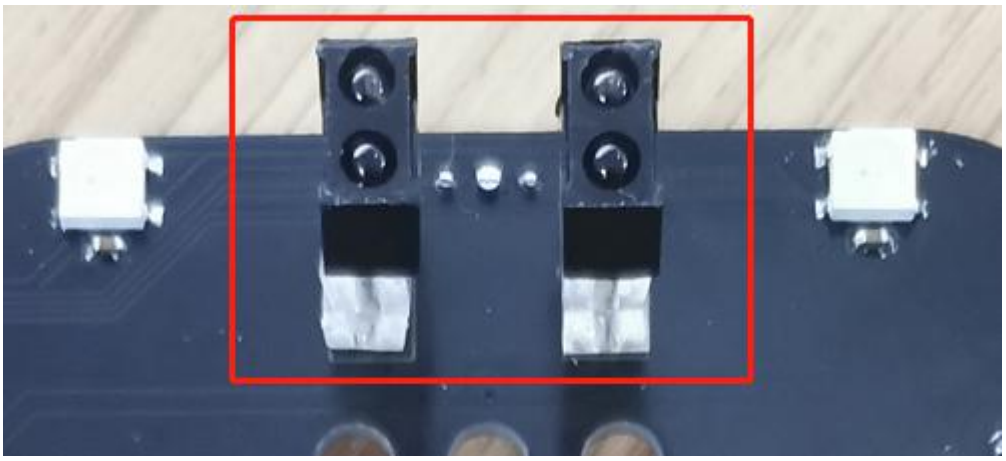
	The front right motor of car rotates clockwise at the speed of PWM100. The rear right motor of car rotates clockwise at the speed of PWM100.
mecanumCar.Motor_Upper_L(0, 100) mecanumCar.Motor_Lower_L(0, 100) mecanumCar.Motor_Upper_R(0, 100) mecanumCar.Motor_Lower_R(0, 100)	The front left motor of car rotates anticlockwise at the speed of PWM100. The rear left motor of car rotates anticlockwise at the speed of PWM100. The front right motor of car rotates anticlockwise at the speed of PWM100. The rear right motor of car rotates anticlockwise at the

	speed of PWM100.
sleep(1000)	Delay in 1000ms
a = 0 b = 0	Set the initial value of variable a to 0 Set the initial value of variable b to 0
def run_L(): **def** run_O():	Define sub-function run_L() Define sub-function run_O()
show_L = Image("90000:""90000:""90000:""90000:""99999")	Assign Image() to the variable 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()	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

elif a == 2:	If a=2
display.show(show_O)	micro:bit shows “O” image
if b == 1:	If b=1
run_O()	The track of car is route O

Project 17： Line Tracking Sensor

17.1: Detect Line Tracking Sensor



(1)Project Description

The motor driving board of the Keyestudio 4WD Mecanum Robot Car comes with a dual-channel line tracking sensors which adopt TCRT5000 IR tubes and 2 potentiometers.

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.

(2)Working Principle:

When the car runs above a white road, the infrared transmitter tube installed under the car emits infrared signals to detect the road and the receiver tube receives signals sending back. Then the output end outputs low level(0); when it detects black lines, it outputs high level(1).

The 2-way tracking sensor integrated port on the 4WD Mecanum Robot Car is connected to the collection port of G ,5V ,P1 and P2 on the micro:bit expansion board, which is controlled by the P1 and P2 of the micro:bit. The left TCRT5000 infrared pair tube on the sensor is controlled by P1, and the right one by P2.

After putting a white paper on the bottom of the 4WD Mecanum Robot Car,we rotate the two potentiometers on the 2-way tracking sensor. When the indicator light on the sensor module is on, pick up the car to make the

two wheels on the 4WD Mecanum Robot Car separate. The height of the white paper is about 1.5cm, the indicator light on the sensor module is off, and then the sensitivity is adjusted.

(2)Experimental Preparation:

- Insert micro:bit board into slot of keyestudio 4WD Mecanum Robot Car
- Place batteries into battery holder
- Dial power switch to ON end
- Connect micro:bit to computer by USB cable
- Open the offline version of Mu.

(4)Test Code:

Enter Mu software and open the file "Project 17: Line Tracking Sensor.py" to import code:

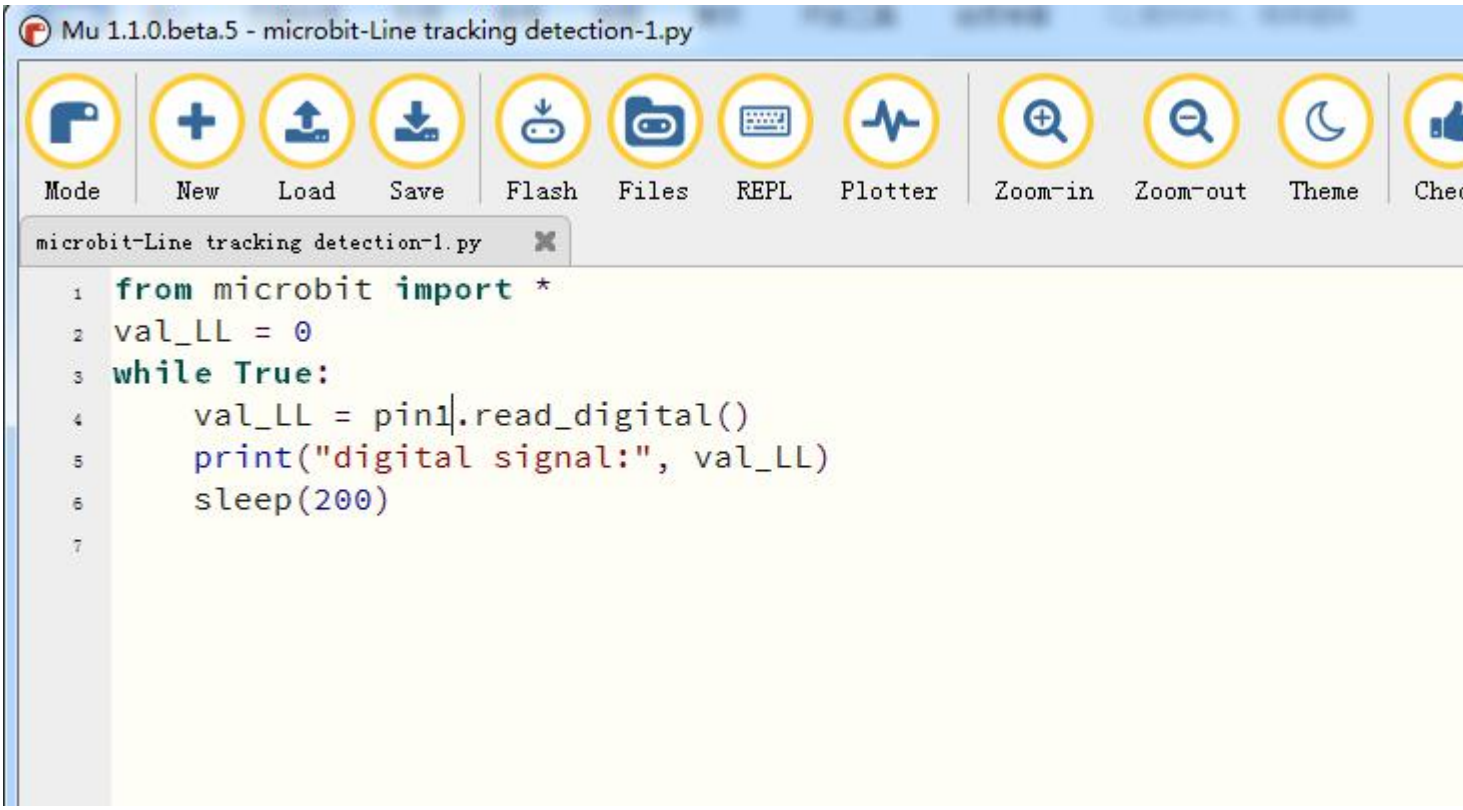
(How to load the project code?)

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 17 : Line	Code-1.py

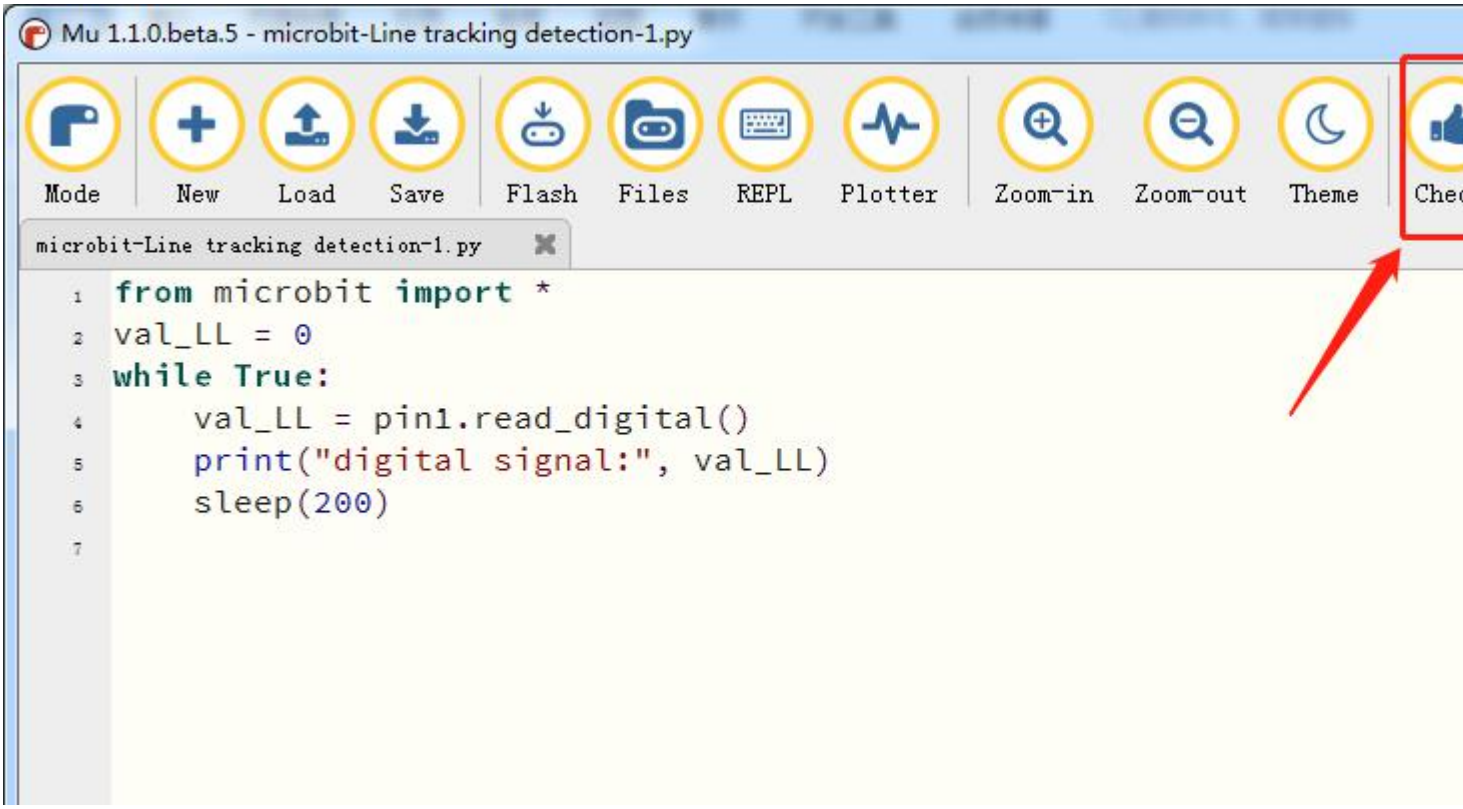
	Tracking Sensor/17.1	

You can also input code in the editing window yourself.

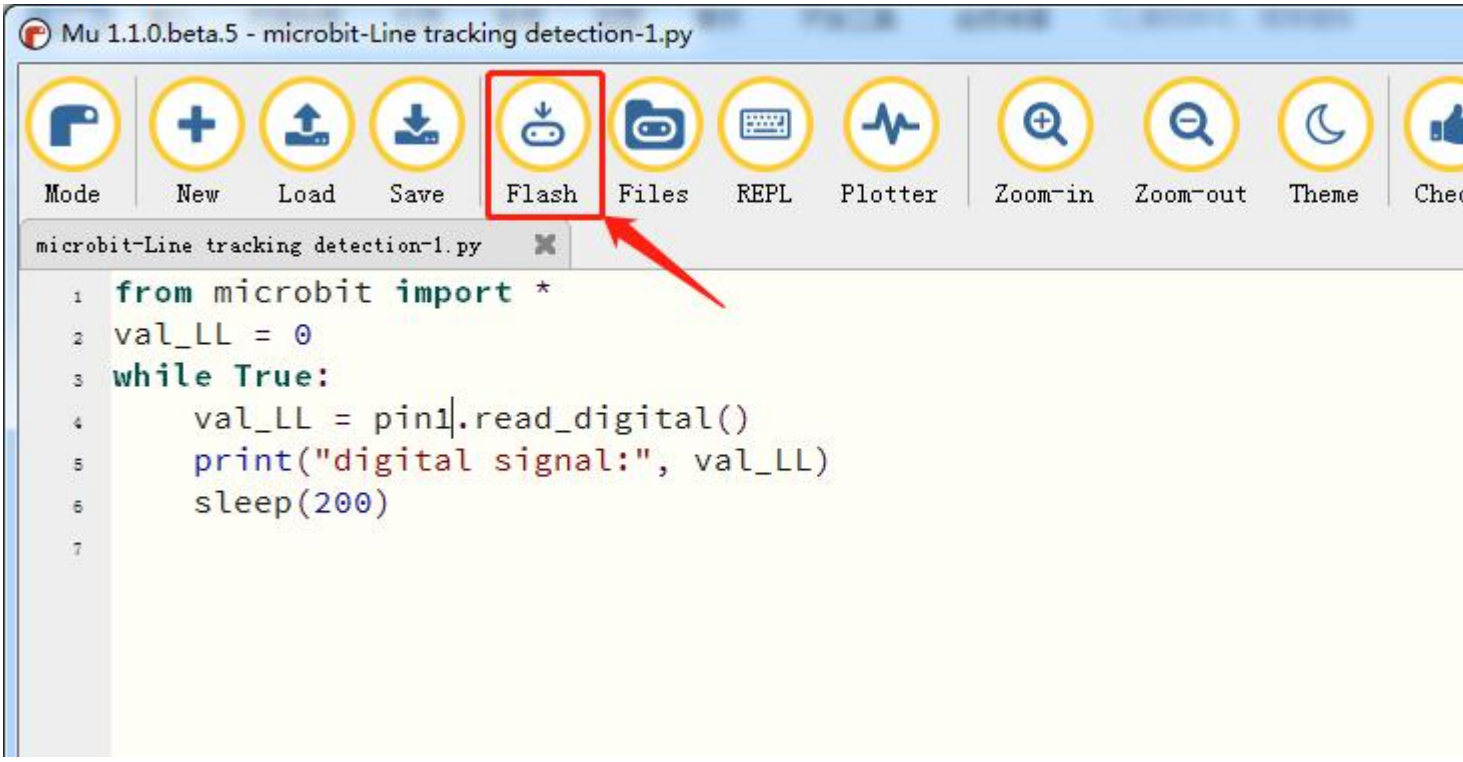
(note:all words and symbols must be written in English)



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

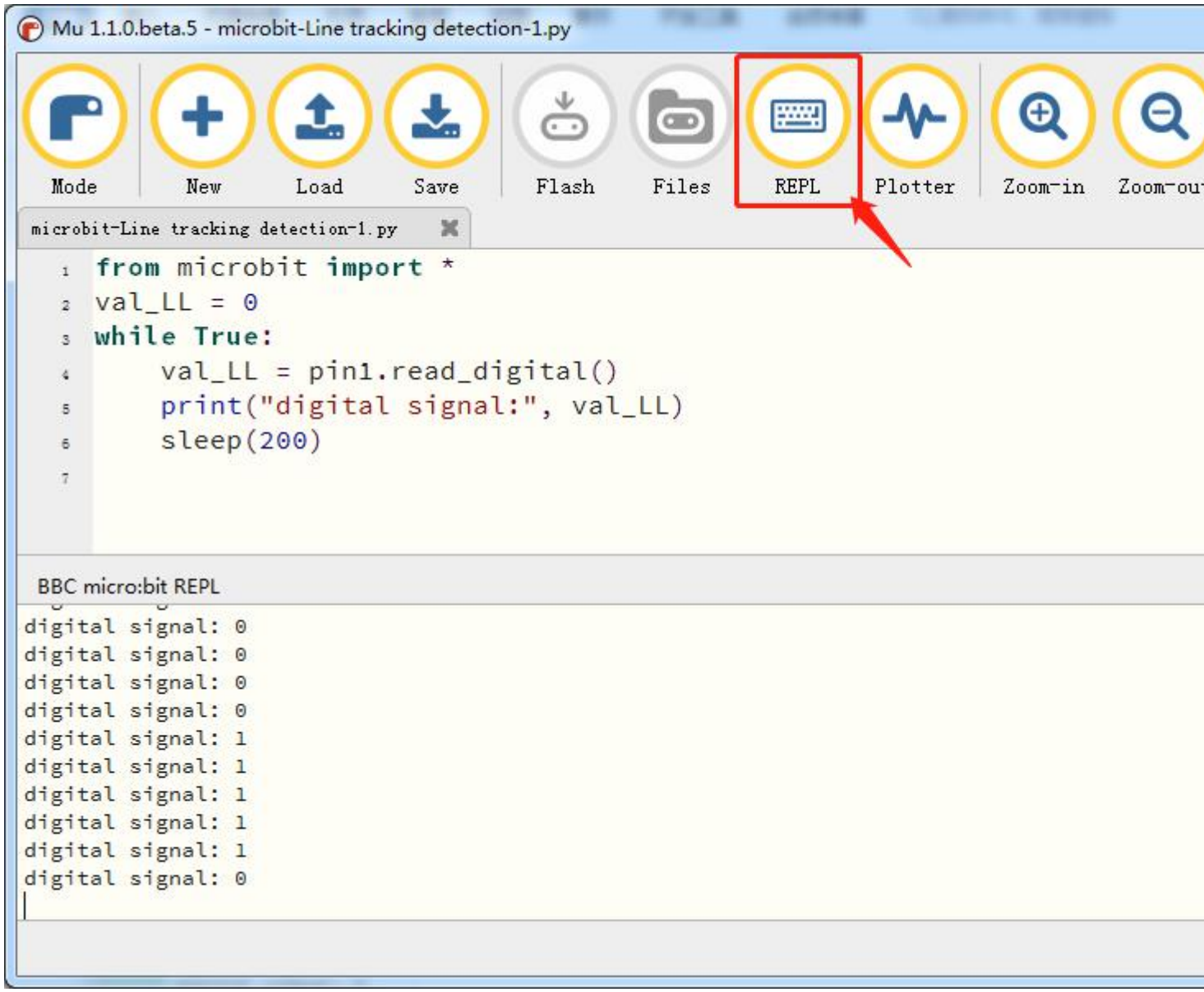


If the code is correct, connect micro:bit to computer and click "Flash" to download code to micro:bit board.



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.



Code2:

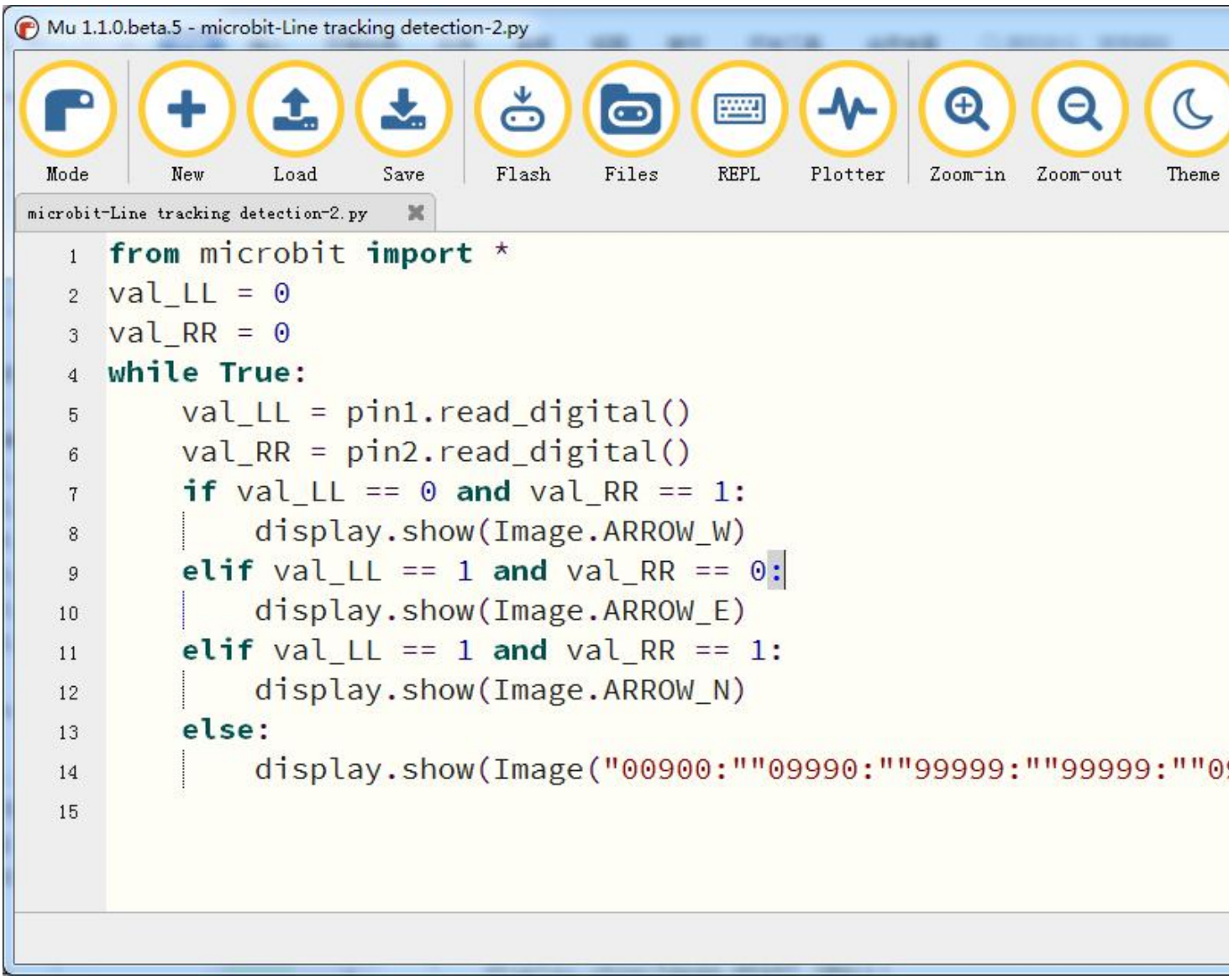
Enter Mu software and open the file "Project 17: Line Tracking Sensor.py" to import code:

(How to load the project code?)

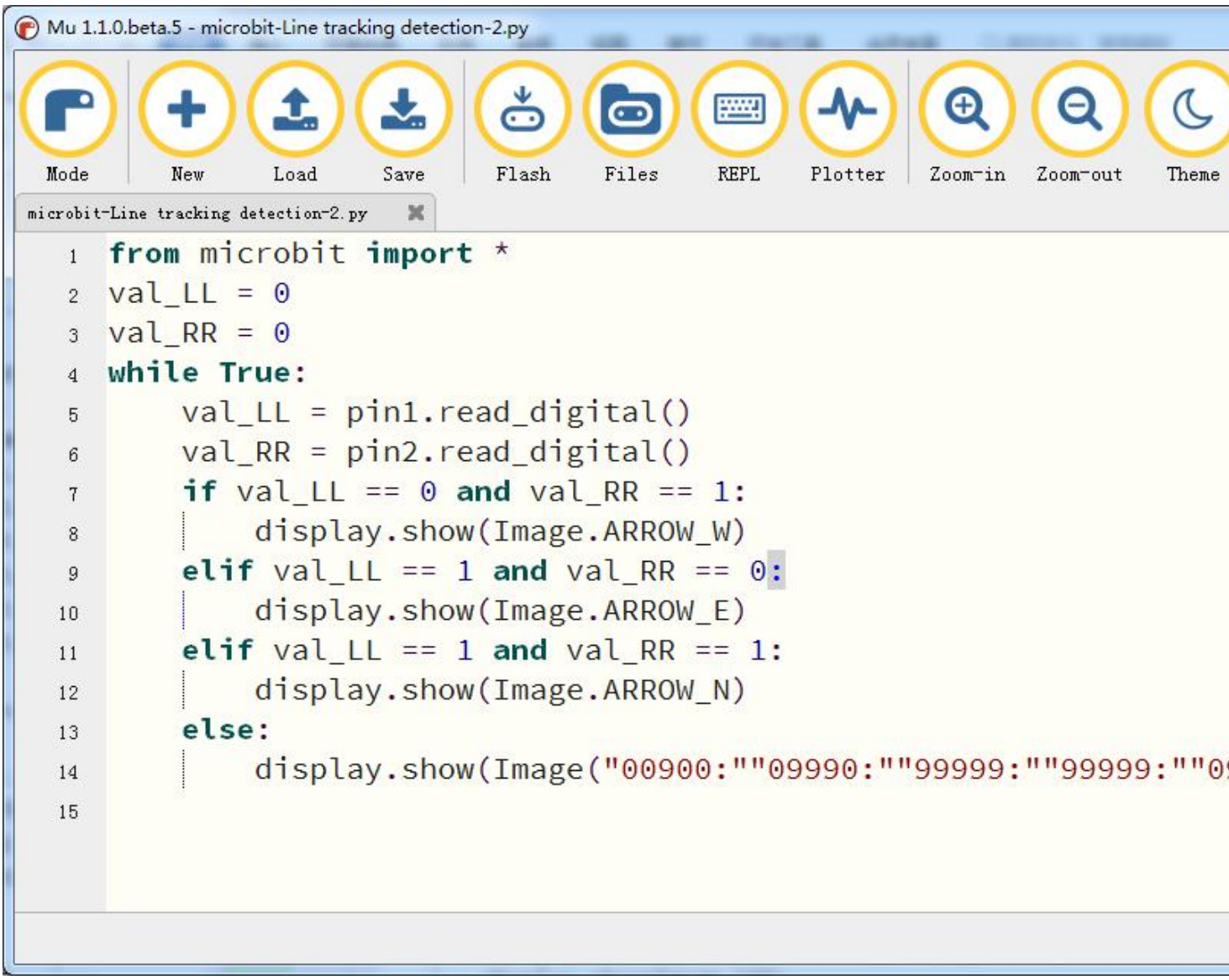
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 17 : Line Tracking Sensor/17.1	Code-2.py

You can also input code in the editing window yourself.

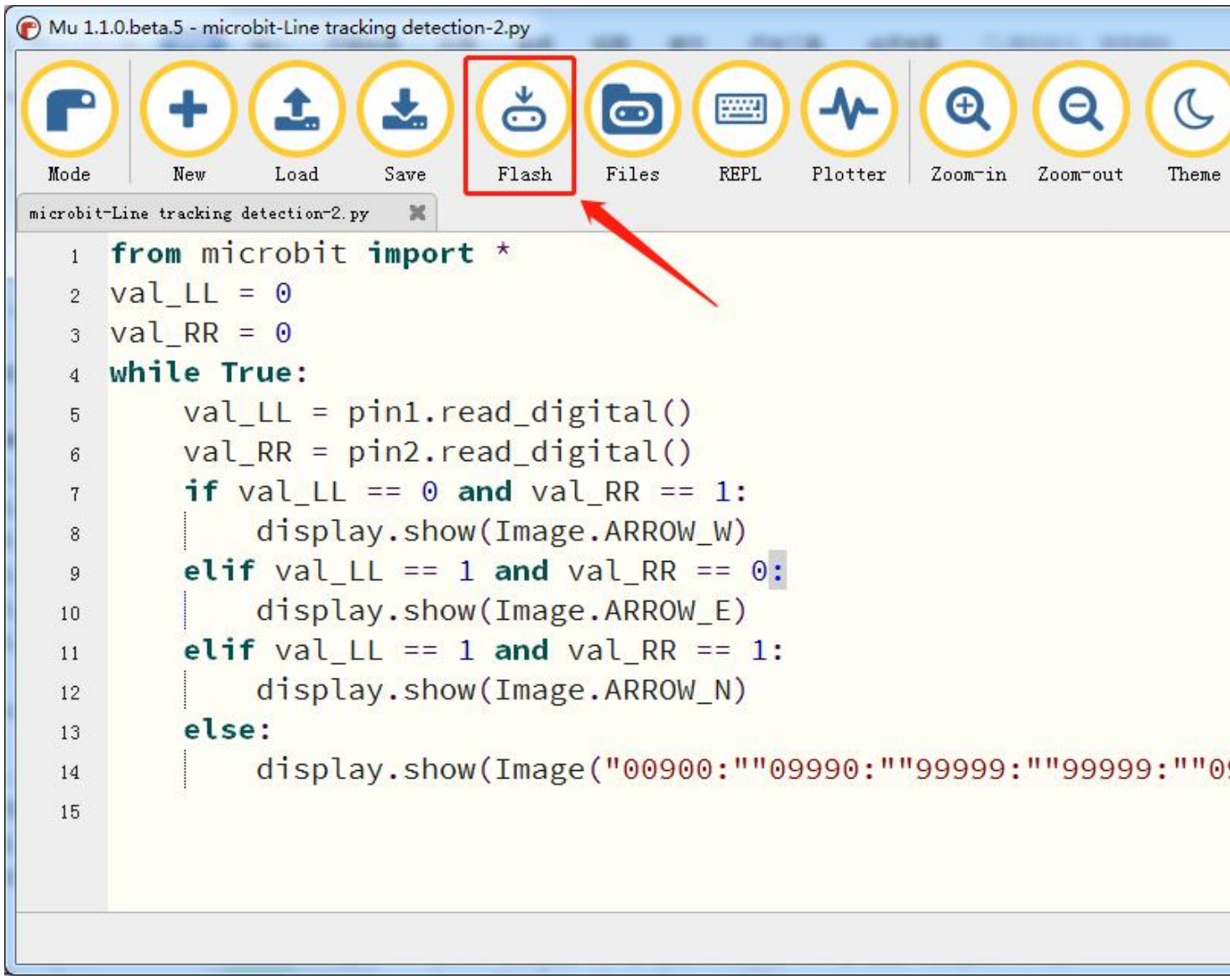
(note:all words and symbols must be written in English)



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



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



(5)Test Results:

Download code 2 to the micro:bit, when only the left TCRT5000 infrared pair tube on the line tracking sensor detects a white object, the micro bit LED dot matrix displays a "←" pattern, and the indicator light on the left side of the tracking sensor lights up;

When only the right TCRT5000 infrared pair tube on the sensor detects a

white object, the micro bit LED dot matrix displays a "→" pattern, and the indicator light on the right side of the tracking sensor lights up;

When both the TCRT5000 infrared pair tubes on the sensor detect a white object, the micro bit LED dot matrix displays a "❤" pattern, and the indicator light on the both sides of the tracking sensor light up;

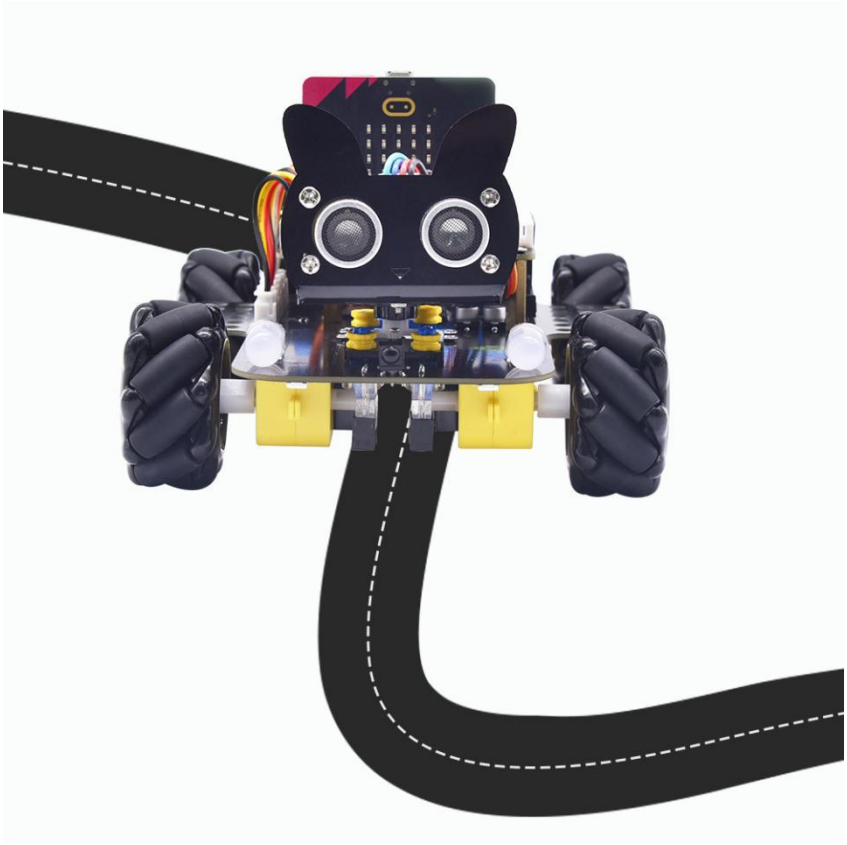
When none of the TCRT5000 infrared pair tubes on the sensor detect a white object, the micro bit LED dot matrix displays a "↑" pattern, and the indicator light on the both sides of the tracking sensor remain off;

(6)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_RR = 0	Set the initial value of val_RR to 0
while True:	This is a permanent loop that makes micro:bit execute the code of it.
val_LL = pin1.read_digital()	Set the digital signal read by TCRT5000 IR tube connected to P1 to val_LL
val_RR = pin2.read_digital()	Set the digital signal read by TCRT5000 IR tube connected to P2 to val_LL

if val_LL **==** 0 **and** val_RR **== 1:** display.show(Image.ARROW_W) **elif** val_LL **==** 1 **and** val_RR **== 0:** **display.show(Image.ARROW_E)** **elif** val_LL == 1 **and** val_RR **== 1:** **display.show(Image.ARROW_N)** else: **display.show(Image("00900:""09990:""99999:""99999:""09090"))**	If val_LL = 0 and val_RR = 1 is true The symbol "←" is displayed on the left of the LED dot matrix on the micro:bit; If val_LL =1 and val_RR = 0 is true The symbol "→" is displayed in the middle of the LED dot matrix; If val_LL =1 and val_RR = 1 is true The symbol "↑" is displayed on the right of the LED dot matrix; When none of the above conditions are met, the LED dot matrix displays the pattern "❤".

17.2: Line Tracking Smart Car



(1)Project 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.

(2)The Working Principle

The smart car will make different moves according to the value received by the 3 channel line tracking sensor.

Left/Right TCRT5000 IR Tunes（Level）		4WD Mecanum Robot Car
LOW（0）	HIGH（1）	Turn Right
HIGH（1）	LOW（0）	Turn Left
HIGH（1）	HIGH（1）	Go forward
LOW（0）	LOW（0）	Stop

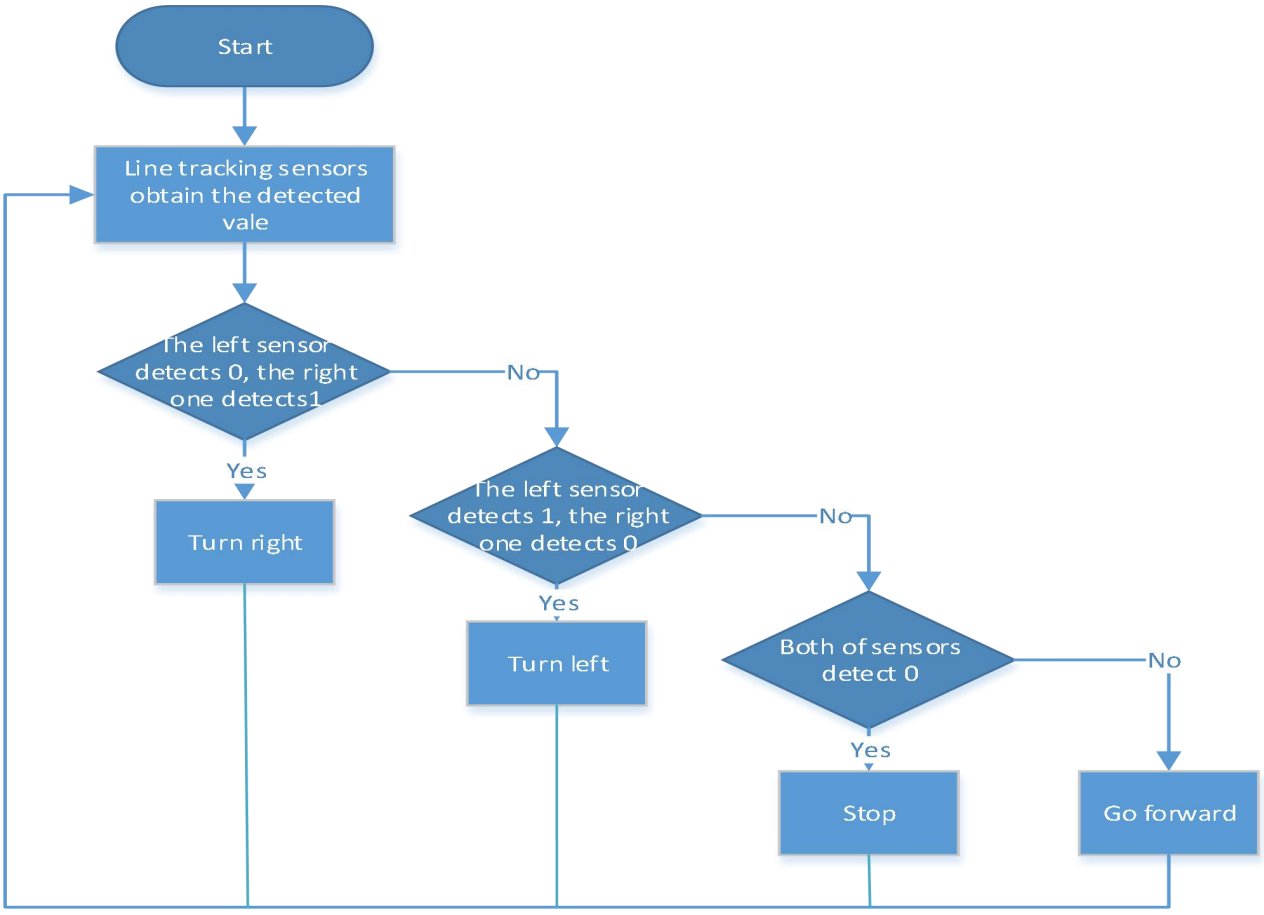
The 2-way tracking sensor integrated port on the 4WD Mecanum Robot Car is connected to the collection port of G ,5V ,P1 and P2 on the micro:bit expansion board, which is controlled by the P1 and P2 of the micro:bit. The left TCRT5000 infrared pair tube on the sensor is controlled by P1, and the right one by P2.

(2)Experimental Preparation:

- Insert micro:bit board into slot of keyestudio 4WD Mecanum Robot Car
- Place batteries into battery holder
- Dial power switch to ON end
- Connect micro:bit to computer by USB cable
- Open the offline version of Mu.

Warning: The 2-way tracking sensor should be used in environments without infrared interference such as sunlight. Sunlight contains a lot of invisible light, such as infrared and ultraviolet. In an environment with strong sunlight, the 2-way tracking sensor cannot work properly.

(3)Flow Chart:



(4)Test Code:

Enter Mu software and open the file "Project 17: Line Tracking Sensor.py" to import code:

(How to load the project code?)

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 17 : Line Tracking Sensor/17.2	Line tracking car.py

You can also input code in the editing window yourself.

(note:all words and symbols must be written in English)

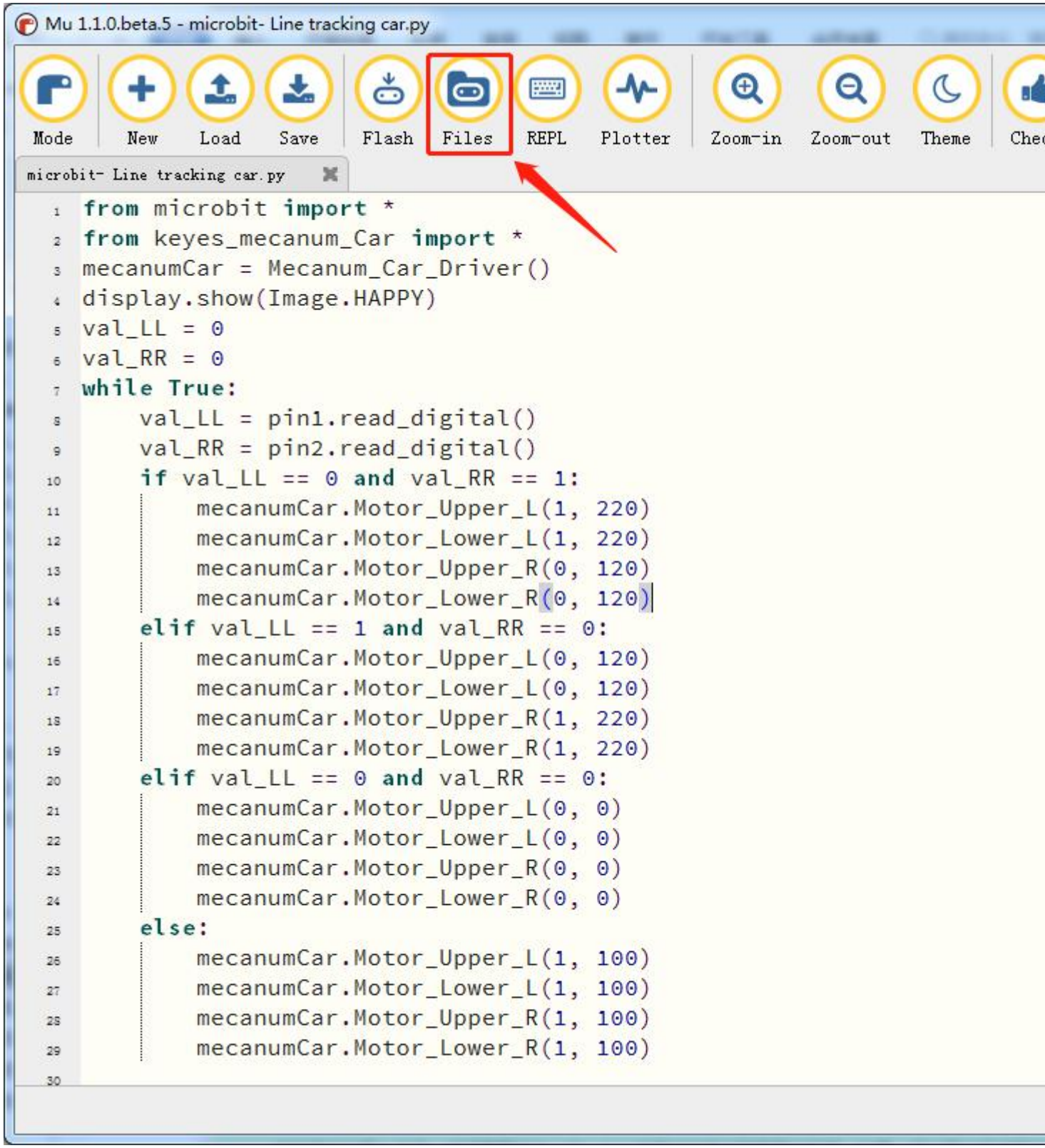
Mu 1.1.0.beta.5 - microbit- Line tracking car.py

Mode | New | Load | Save | Flash | Files | REPL | Plotter | Zoom-in | Zoom-out | Theme | Chec

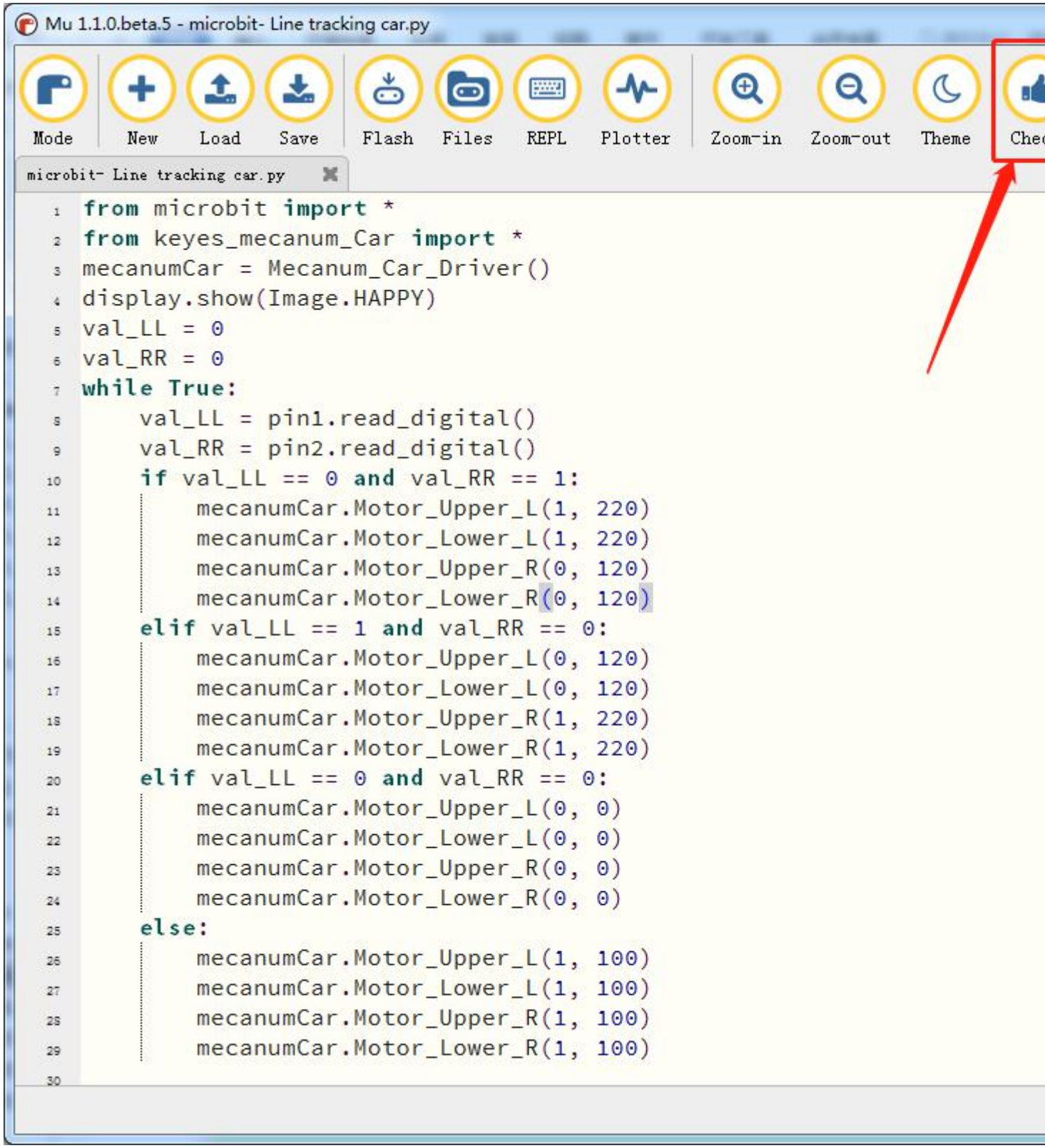
microbit- Line tracking car.py

```
from microbit import *
from keyes_mecanum_Car import *
mecanumCar = Mecanum_Car_Driver()
display.show(Image.HAPPY)
val_LL = 0
val_RR = 0
while True:
    val_LL = pin1.read_digital()
    val_RR = pin2.read_digital()
    if val_LL == 0 and val_RR == 1:
        mecanumCar.Motor_Upper_L(1, 220)
        mecanumCar.Motor_Lower_L(1, 220)
        mecanumCar.Motor_Upper_R(0, 120)
        mecanumCar.Motor_Lower_R(0, 120)
    elif val_LL == 1 and val_RR == 0:
        mecanumCar.Motor_Upper_L(0, 120)
        mecanumCar.Motor_Lower_L(0, 120)
        mecanumCar.Motor_Upper_R(1, 220)
        mecanumCar.Motor_Lower_R(1, 220)
    elif val_LL == 0 and val_RR == 0:
        mecanumCar.Motor_Upper_L(0, 0)
        mecanumCar.Motor_Lower_L(0, 0)
        mecanumCar.Motor_Upper_R(0, 0)
        mecanumCar.Motor_Lower_R(0, 0)
    else:
        mecanumCar.Motor_Upper_L(1, 100)
        mecanumCar.Motor_Lower_L(1, 100)
        mecanumCar.Motor_Upper_R(1, 100)
        mecanumCar.Motor_Lower_R(1, 100)

```

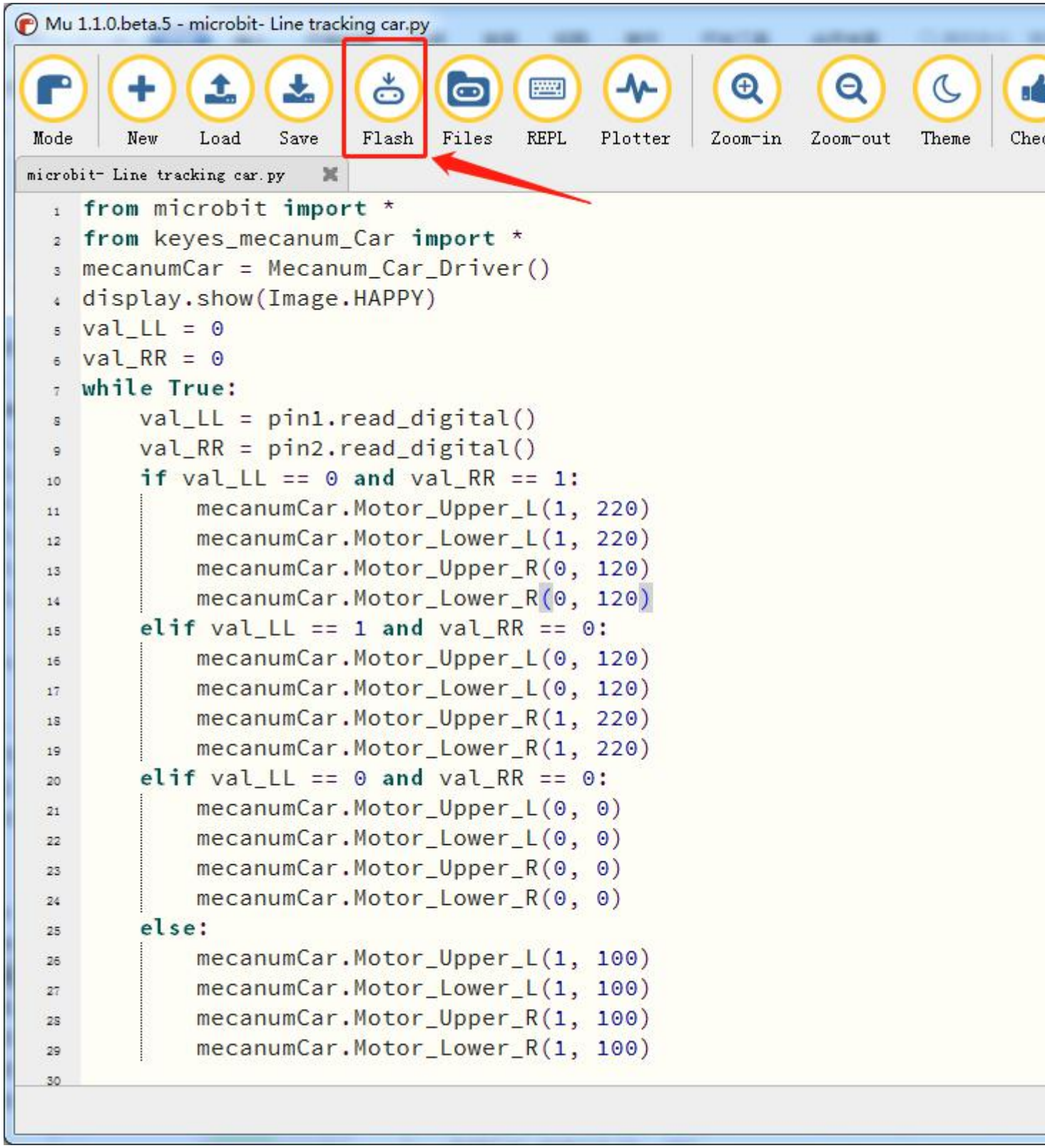
Click “Files” to import “keyes_mecanum_Car.py “library file tomicro:bit (How to import files?). No need to do it again if you have imported it before.



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



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



(5)Test Results:

Download code to micro:bit and dial POWER to ON end, line tacking car goes forward along black line .

Note: turn on the switch at the back of micro:bit car.

the width of black line should be larger than the width of line tracking sensor.

Avoid to test smart car under the strong light.

(6)Code Explanation:

from microbit **import ***	Import the library of micro:bit
from keyes_mecanum_Car **import ***	Import the library of keyes_mecanum_Car
mecanumCar = Mecanum_Car_Driver()	Instantiate an object Mecanum_Car_Driver() as mecanumCar
display.show(Image.HAPPY)	The LED dot matrix on the micro:bit displays a "smile" pattern
while True:	This is a permanent loop that makes micro:bit execute the code of it.
val_LL = pin1.read_digital()	Assign the digital signal read by the TCRT5000 infrared pair tube connected to the P1 control port to

	the variable val_LL
val_RR = pin2.read_digital()	Assign the digital signal read by the TCRT5000 infrared pair tube connected to the P2 control port to the variable val_RR

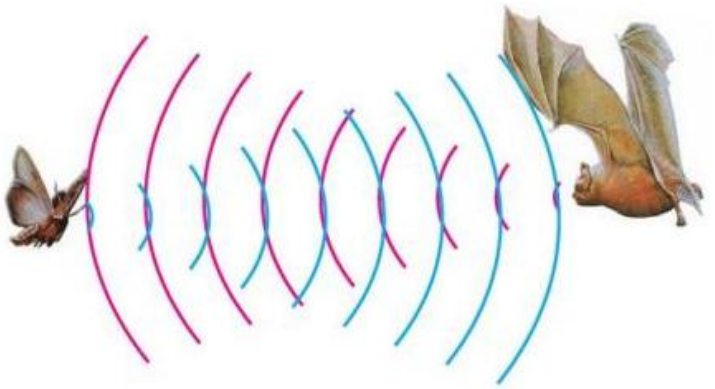
if val_LL == 0 and val_RR == 1: mecanumCar.Motor_Upper_L(1, 220) mecanumCar.Motor_Lower_L(1, 220) mecanumCar.Motor_Upper_R(0, 120) mecanumCar.Motor_Lower_R(0, 120) **elif val_LL == 1 and val_RR == 0:** mecanumCar.Motor_Upper_L(0, 120) mecanumCar.Motor_Lower_L(0, 120) mecanumCar.Motor_Upper_R(1, 220) mecanumCar.Motor_Lower_R(1, 220) **elif val_LL == 0 and val_RR == 0:** mecanumCar.Motor_Upper_L(0, 0) mecanumCar.Motor_Lower_L(0, 0) mecanumCar.Motor_Upper_R(0, 0) mecanumCar.Motor_Lower_R(0, 0) **else:** mecanumCar.Motor_Upper_L(1, 100) mecanumCar.Motor_Lower_L(1, 100) mecanumCar.Motor_Upper_R(1, 100) mecanumCar.Motor_Lower_R(1, 100)	**if val_LL = 0 and val_RR = 1 is true**, the front left motor of car rotates clockwise at the speed of PWM220; the rear left motor of car rotates clockwise at the speed of PWM220; the front right motor of car rotates anticlockwise at the speed of PWM120; the rear right motor of car rotates anticlockwise at the speed of PWM120; **if val_LL = 1 and val_RR = 0 is true,** the front left motor of car rotates anticlockwise at the speed of PWM120; the rear left motor of car rotates anticlockwise at the speed of PWM120; the front right motor of car rotates clockwise at the speed of PWM220; the rear right motor of car rotates clockwise at the speed of PWM220;

	if val_LL = 0 and val_RR = 0 is true, the front left motor of car rotates at the speed of 0 and stops; the rear left motor of car rotates at the speed of 0 and stops; the front right motor of car rotates clockwise at the speed of 0 and stops; the rear right motor of car rotates clockwise at the speed of 0 and stops; **When none of the above conditions are met,** the front left motor of car rotates clockwise at the speed of PWM100; the rear left motor of car rotates clockwise at the speed of PWM100; the front right motor of car rotates clockwise at the speed of PWM100; the rear right motor of car rotates clockwise at the speed of PWM100;

Project 18: Ultrasonic Following Smart Car

18.1: Ultrasonic Ranging

(1)Project Description



The 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.

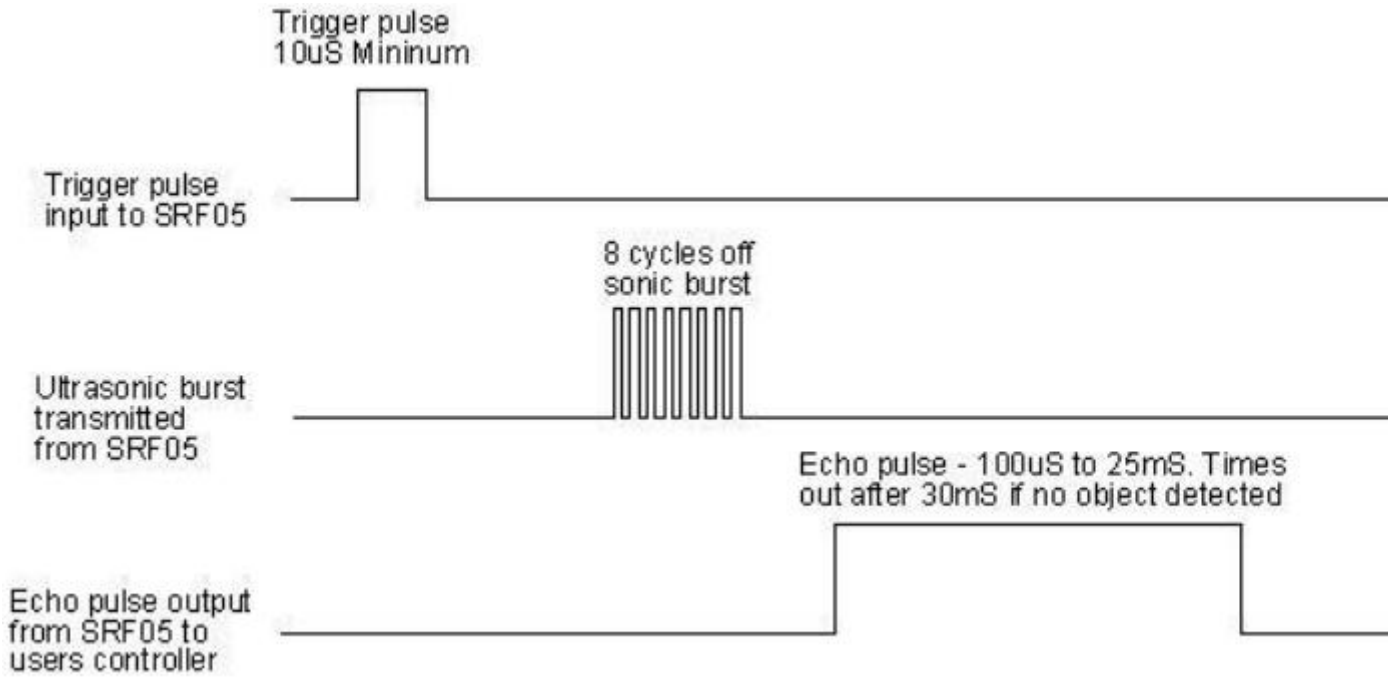
The ultrasonic sensor is being used in a wide range of electronics projects for creating obstacle detection and distance measuring application as well as various other applications.

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 (TRIG)and echo signal(ECHO).

According to the above wiring diagram, the integrated port of the ultrasonic sensor module is connected to the 5V G P15 P16 port on the micro:bit motor drive backplane. The Trig (T) pin is controlled by P15 of the micro:bit and the pin of Echo (E) the P16.

(2)Working Principle:



(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 340m/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)Parameters:

- Working voltage: 3-5.5V (DC)
- Working current: 15mA
- Working frequency: 40khz
- Maximum detection distance: about 3m
- Minimum detection distance: 2-3cm
- Precision: up to 0.2cm
- Sensing angle: less than 15 degrees
- Input trigger pulse: 10us TTL level
- Output echo signal: output TTL level signal (high), proportional to range

(4)Experimental Preparation:

- Insert micro:bit board into slot of keyestudio 4WD Mecanum Robot Car
- Place batteries into battery holder
- Dial power switch to ON end
- Connect micro:bit to computer by USB cable

➢ Open the offline version of Mu.

(5)Test Code:

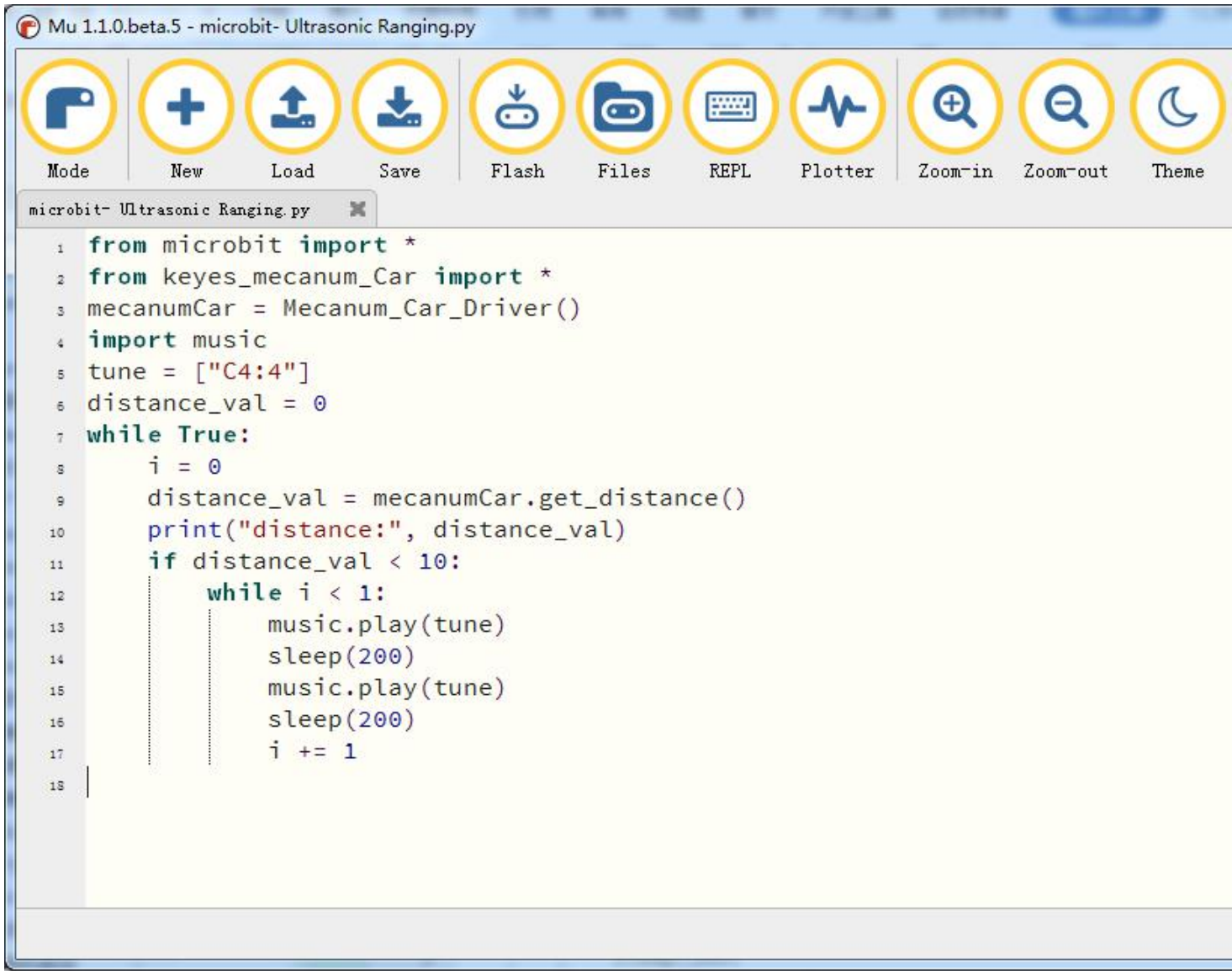
Enter Mu software and open the file "Project 18：Ultrasonic Following Smart Car.py" to import code:

(How to load the project code?)

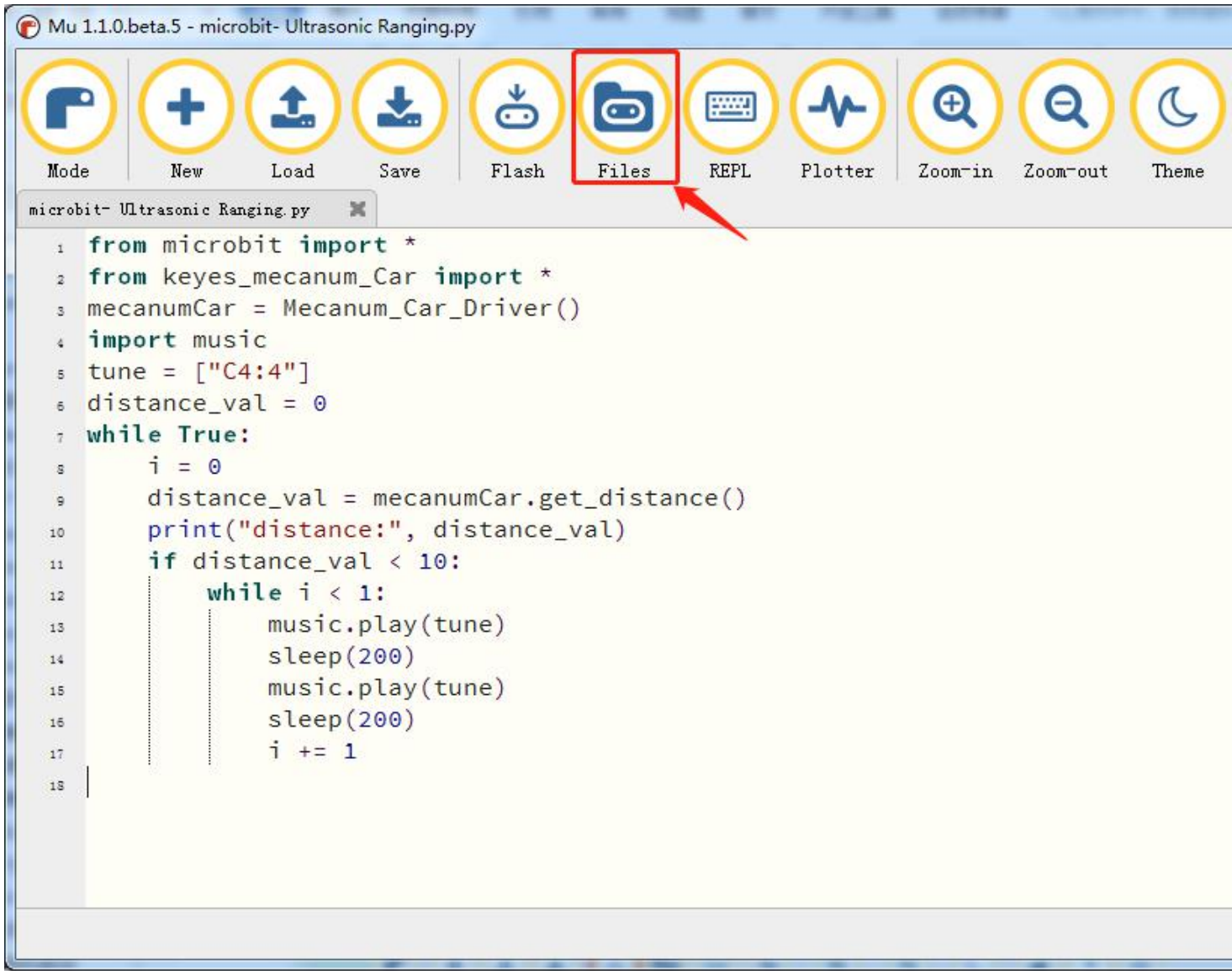
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project Code/Project 18 : Ultrasonic Following Smart Car/18.1 : Ultrasonic Ranging	Ultrasonic Ranging.py

You can also input code in the editing window yourself.

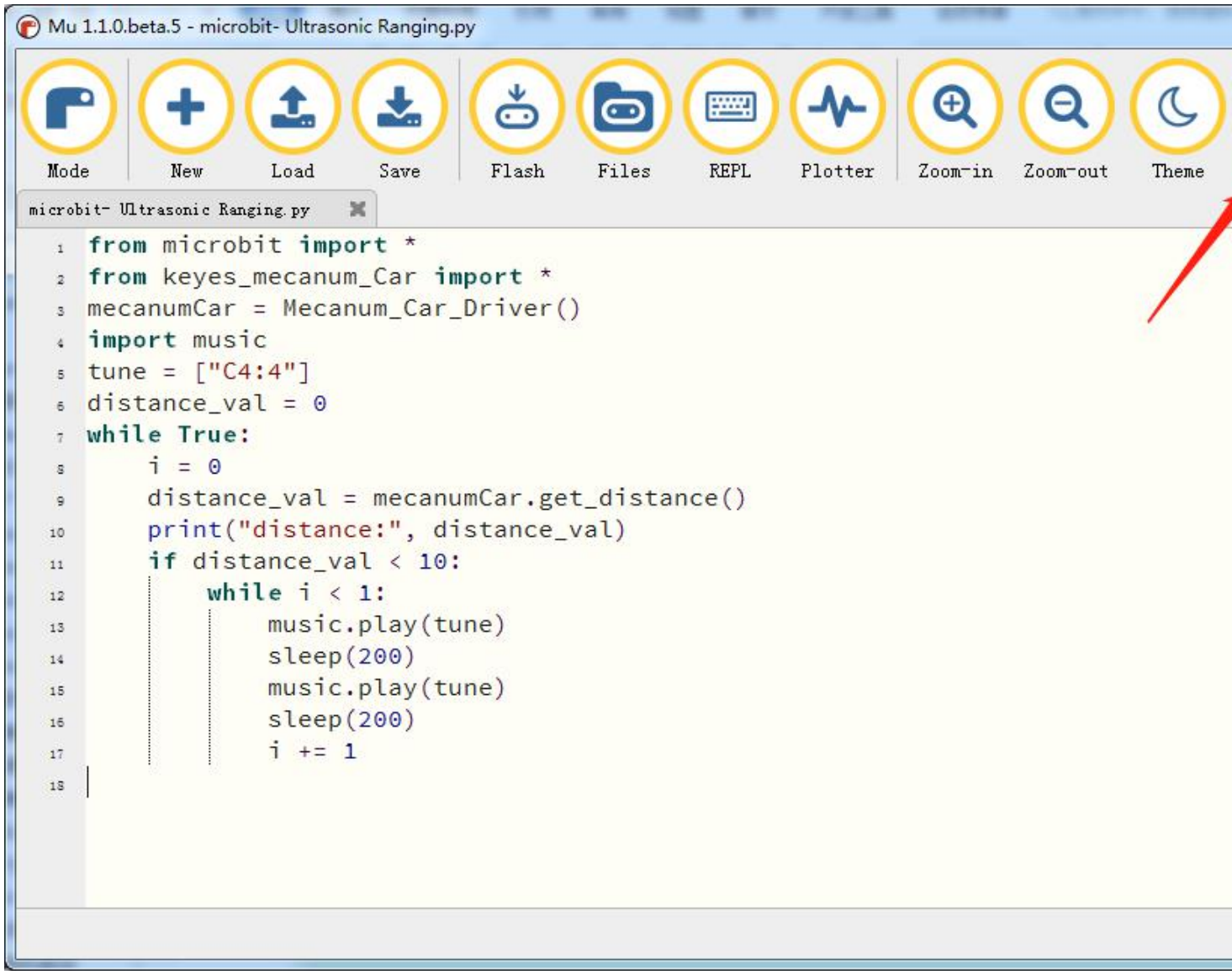
(note:all words and symbols must be written in English)



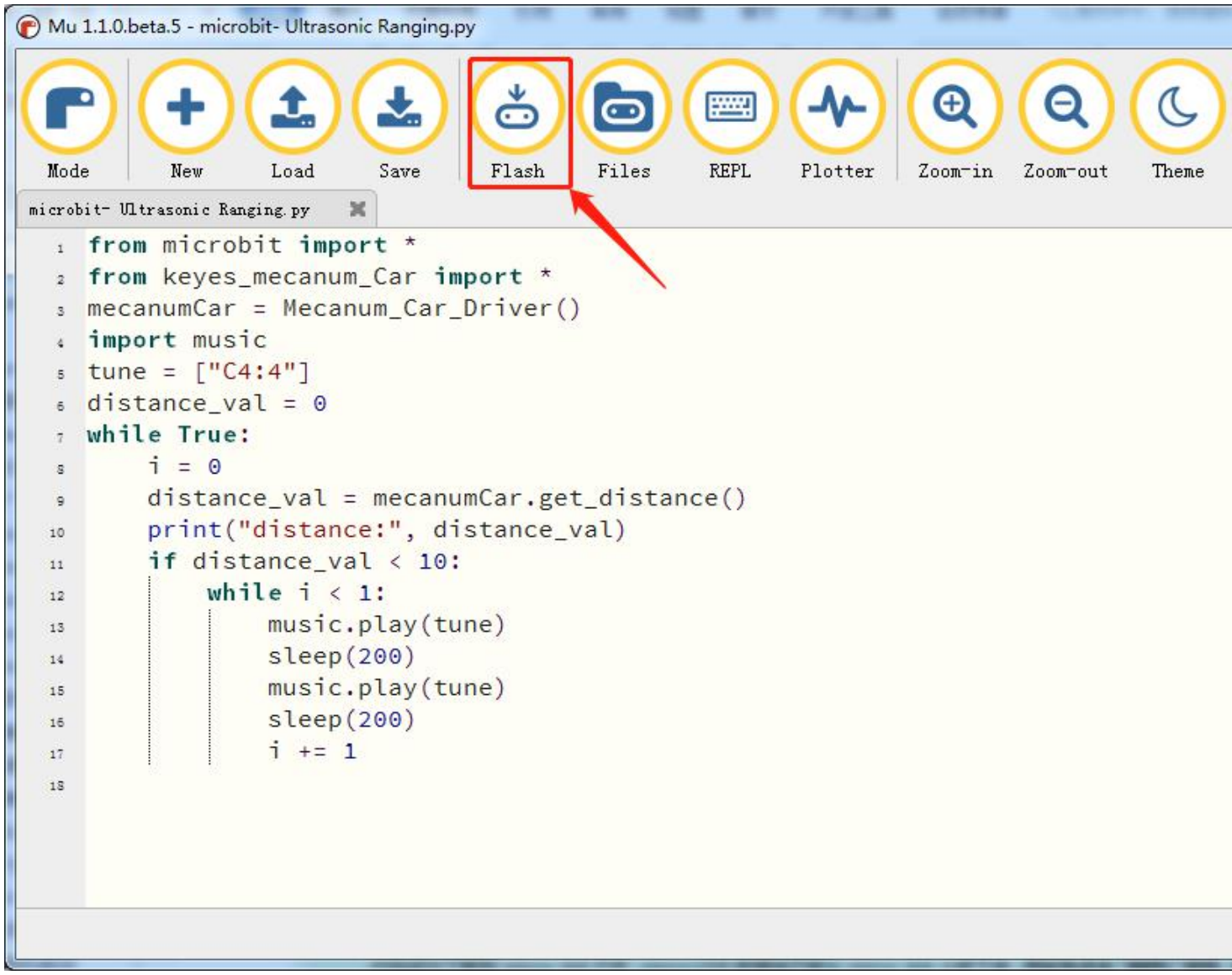
Click “Files” to import “keyes_mecanum_Car.py “library file tomicro:bit (How to import files?). No need to do it again if you have imported it before.



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



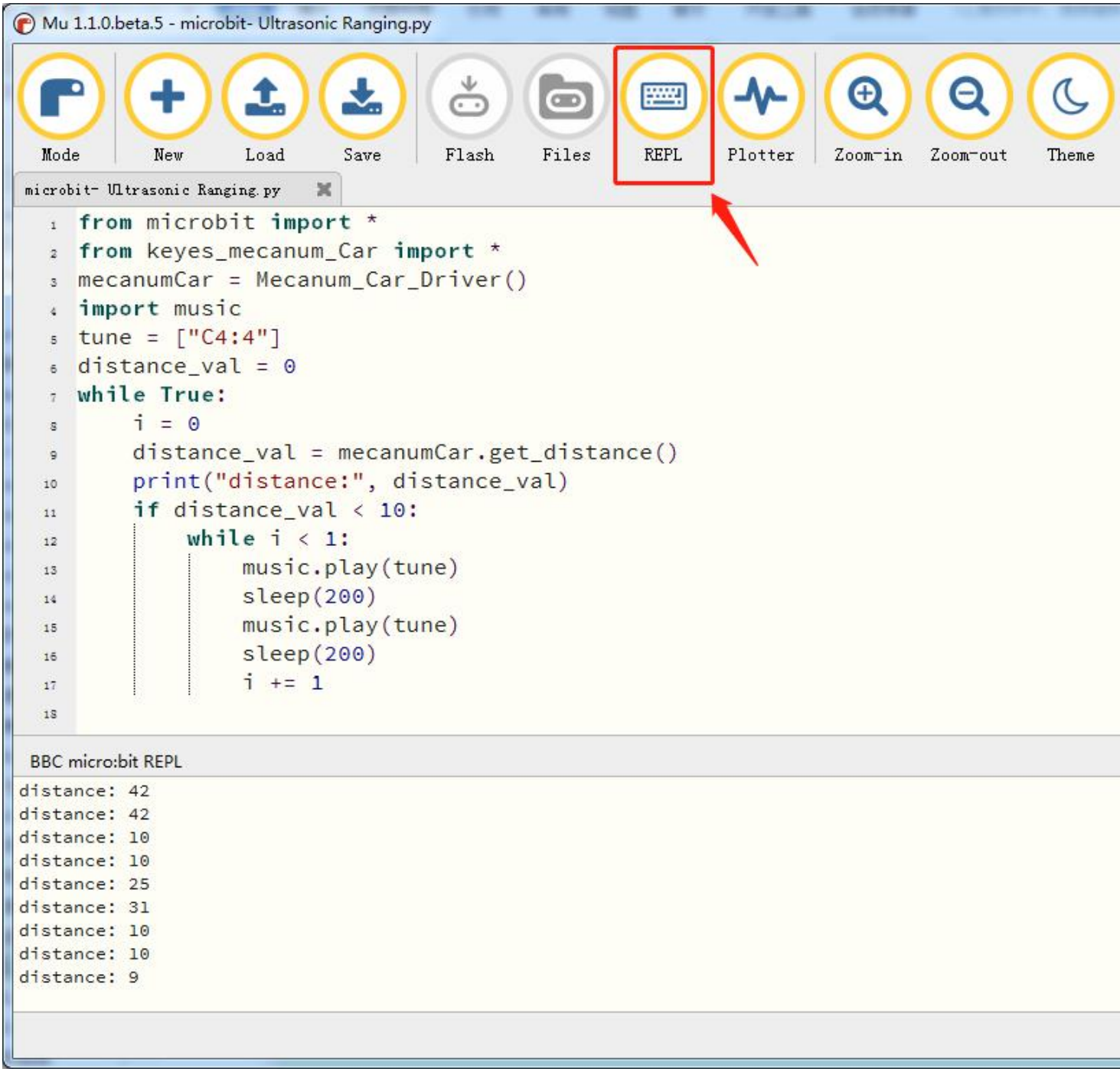
If the code is correct, connect micro:bit to computer and click “Flash” to download code to micro:bit board.



(6)Test Results:

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.



(7)Code Explanation:

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

*	keyes_mecanum_Car
mecanumCar = Mecanum_Car_Driver()()	instantiate Mecanum_Car_Driver()() to mecanumCar
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 = mecanumCar.get_distance()	Assign mecanumCar.get_distance()to variable distance_val
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

18.2: Ultrasonic Avoidance Car

(1)Project Description

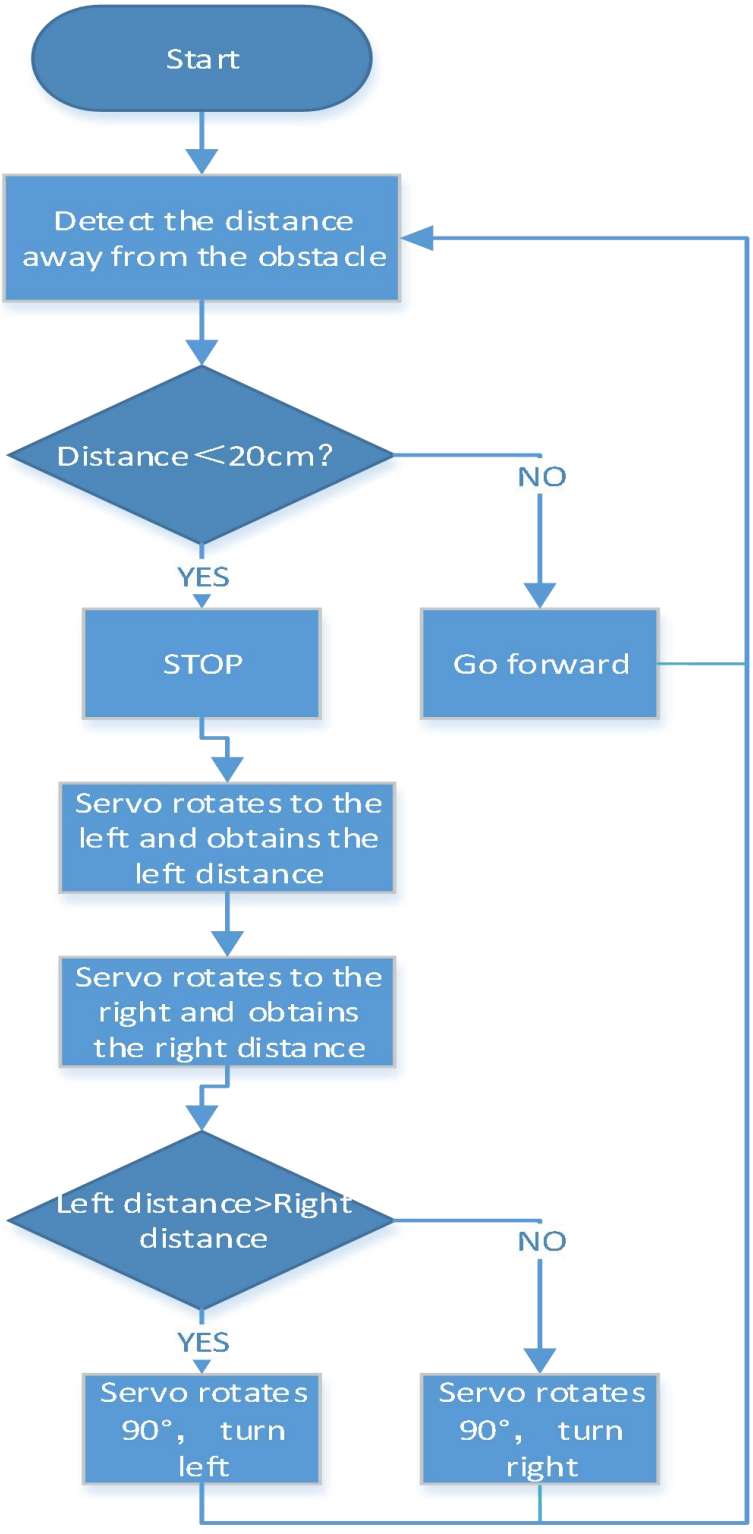
We’ ve learned the knowledge of obstacle avoidance sensor. In this project, we will integrate ultrasonic sensor, and car expansion board to make an ultrasonic avoidance car.

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:

- Insert micro:bit board into slot of keyestudio 4WD Mecanum Robot Car
- Place batteries into battery holder
- Dial power switch to ON end
- Connect micro:bit to computer by USB cable
- Open the offline version of Mu.

(3)Flow Chart:



(4)Test Code:

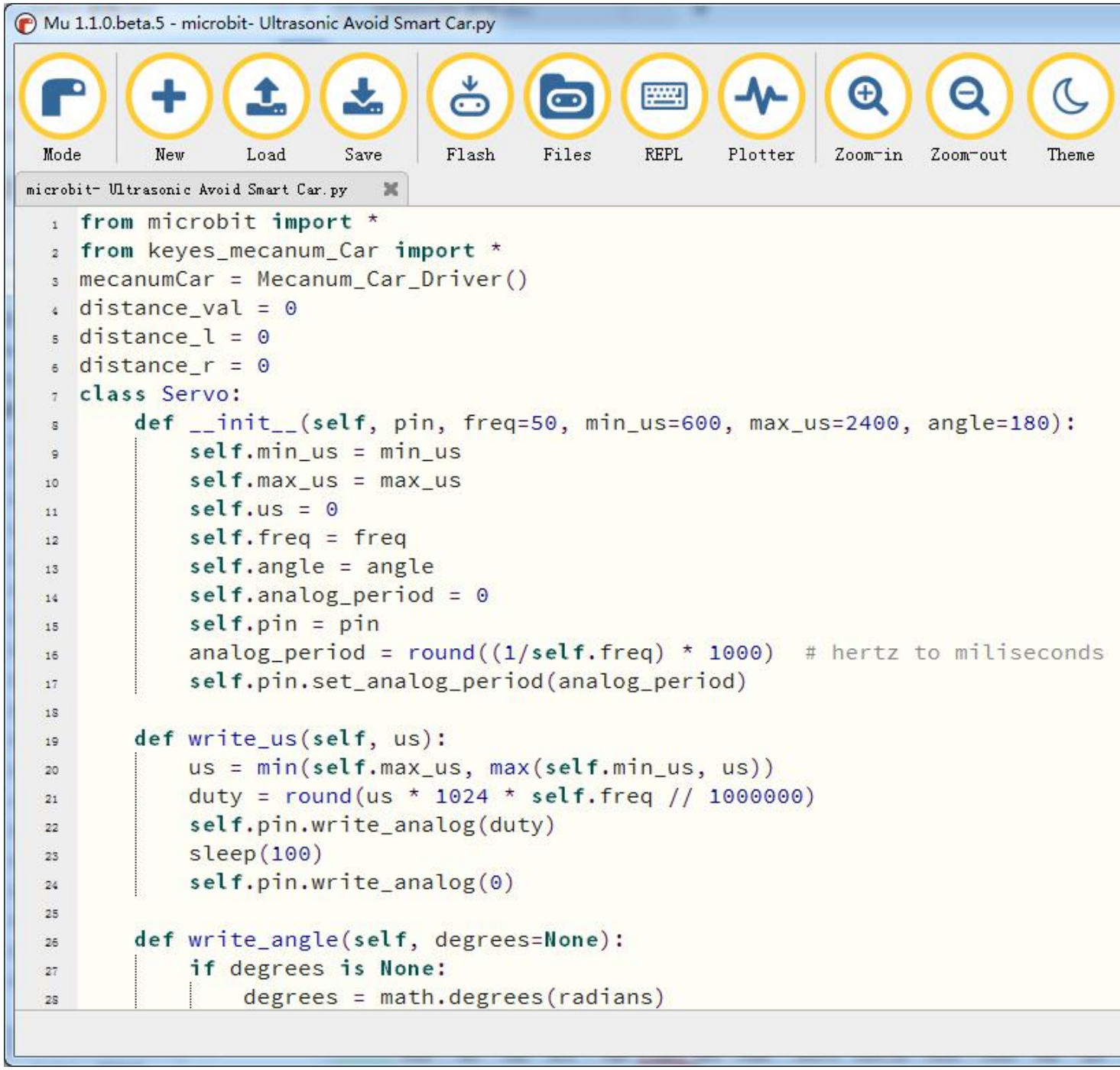
Enter Mu software and open the file "Project 18：Ultrasonic Following Smart Car.py" to import code:

(How to load the project code?)

File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project 18：Ultrasonic Following Smart Car/18.2：Ultrasonic Avoidance Car	Ultrasonic Avoidance Car.py

You can also input code in the editing window yourself.

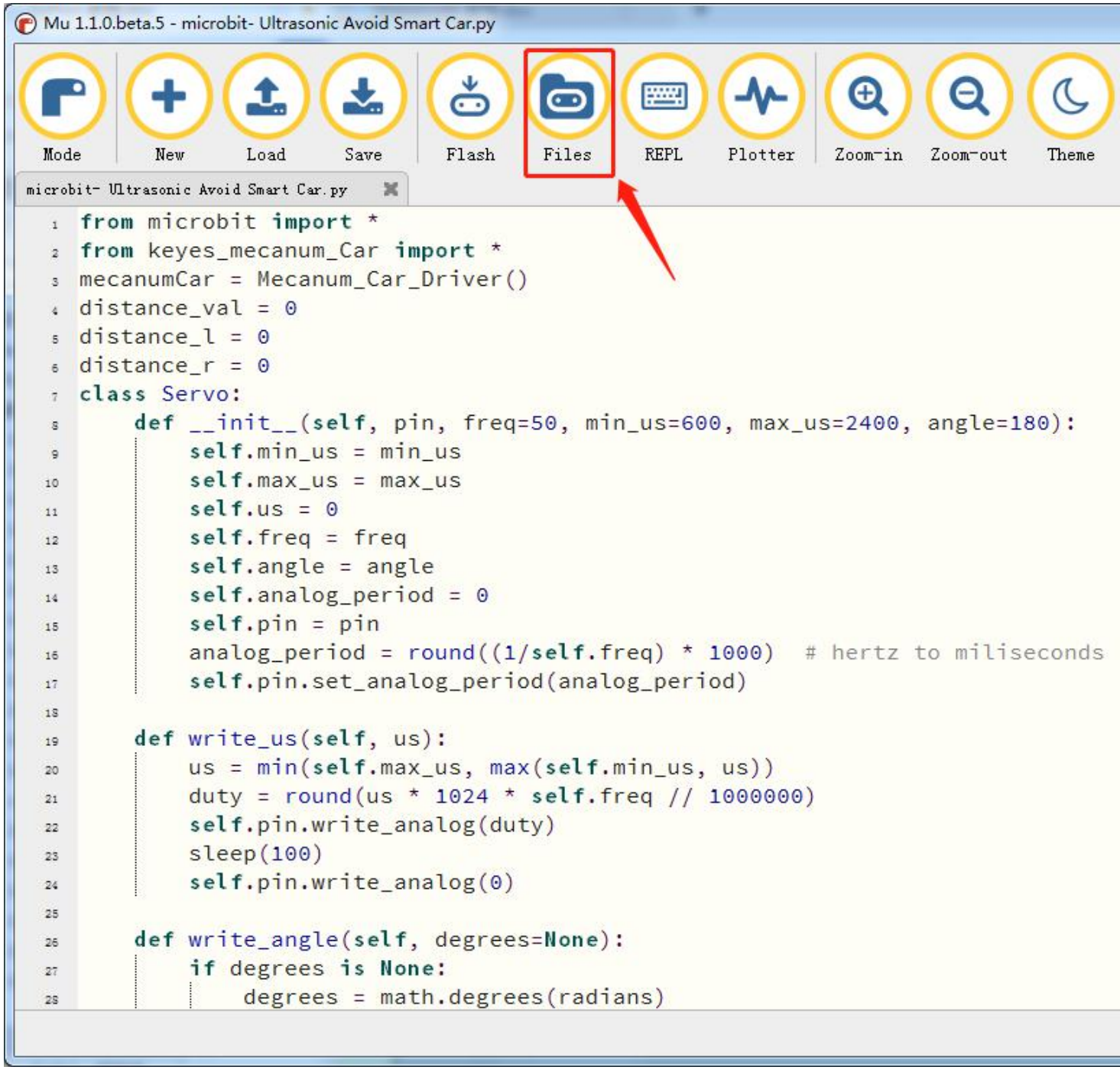
(note:all words and symbols must be written in English)


Mu 1.1.0.beta.5 - microbit- Ultrasonic Avoid Smart Car.py
Mode
New
Load
Save
Flash
Files
REPL
Plotter
Zoom-in
Zoom-out
Theme
microbit- Ultrasonic Avoid Smart Car.py
from microbit import *
from keyes_mecanum_Car import *
mecanumCar = Mecanum_Car_Driver()
distance_val = 0
distance_l = 0
distance_r = 0
class Servo:
def __init__(self, pin, freq=50, min_us=600, max_us=2400, angle=180):
self.min_us = min_us
self.max_us = max_us
self.us = 0
self.freq = freq
self.angle = angle
self.analog_period = 0
self.pin = pin
analog_period = round((1/self.freq) * 1000) # hertz to miliseconds
self.pin.set_analog_period(analog_period)
def write_us(self, us):
us = min(self.max_us, max(self.min_us, us))
duty = round(us * 1024 * self.freq // 1000000)
self.pin.write_analog(duty)
sleep(100)
self.pin.write_analog(0)
def write_angle(self, degrees=None):
if degrees is None:
degrees = math.degrees(radians)

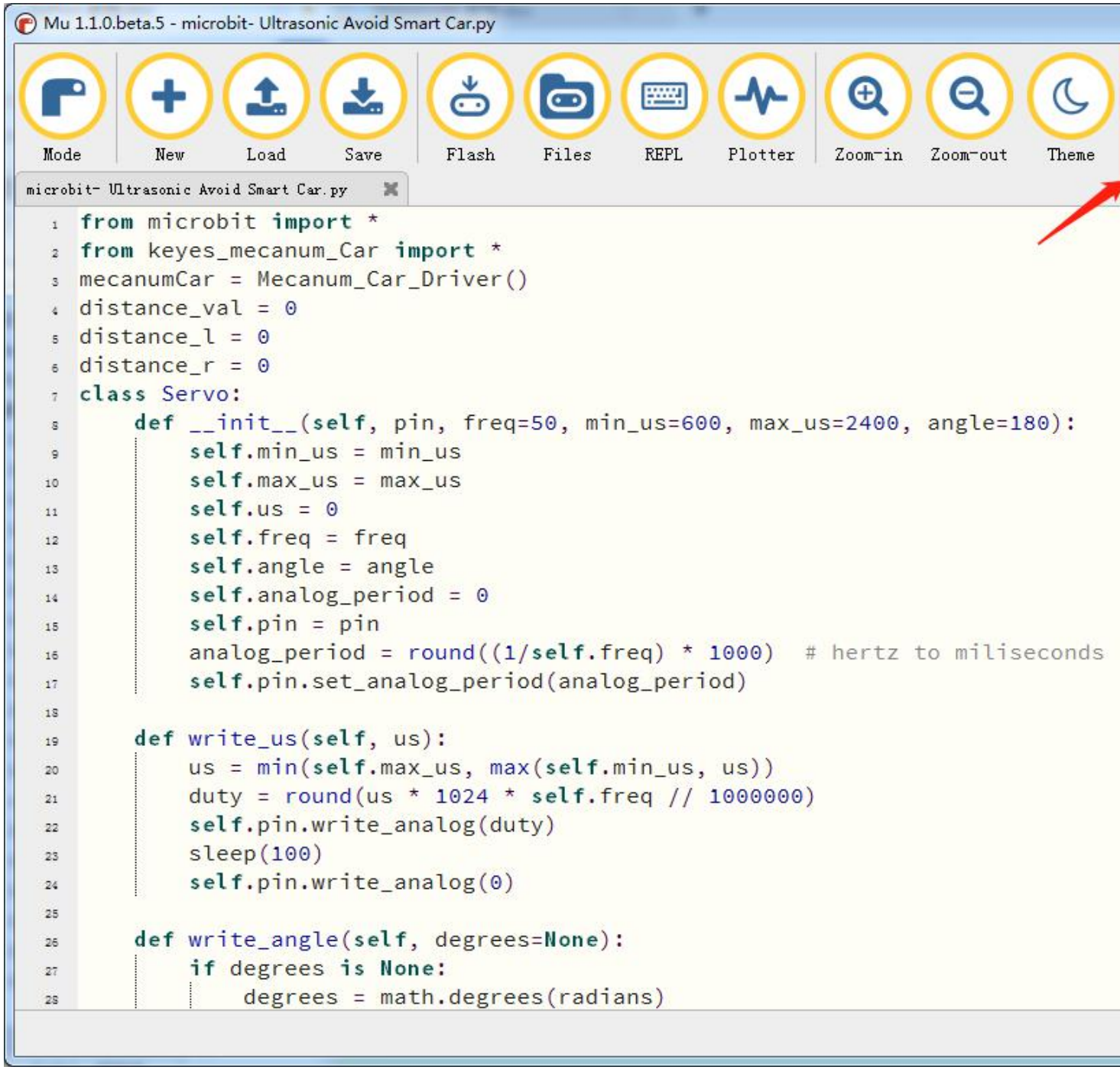
```
        degrees = degrees % 360
        total_range = self.max_us - self.min_us
        us = self.min_us + total_range * degrees // self.angle
        self.write_us(us)

Servo(pin14).write_angle(90)

while True:

    distance_val = mecanumCar.get_distance()

    if distance_val < 20:
        mecanumCar.Motor_Upper_L(0, 0)
        mecanumCar.Motor_Lower_L(0, 0)
        mecanumCar.Motor_Upper_R(0, 0)
        mecanumCar.Motor_Lower_R(0, 0)
        sleep(500)
        Servo(pin14).write_angle(180)
        sleep(500)
        distance_l = mecanumCar.get_distance()
        sleep(500)

        Servo(pin14).write_angle(0)
        sleep(500)
        distance_r = mecanumCar.get_distance()
        sleep(500)

        if distance_l > distance_r:
```

```
            mecanumCar.Motor_Upper_L(0, 150)
            mecanumCar.Motor_Lower_L(0, 150)
            mecanumCar.Motor_Upper_R(1, 150)
            mecanumCar.Motor_Lower_R(1, 150)
            Servo(pin14).write_angle(90)
            sleep(300)
        else:
            mecanumCar.Motor_Upper_L(1, 150)
            mecanumCar.Motor_Lower_L(1, 150)
            mecanumCar.Motor_Upper_R(0, 150)
            mecanumCar.Motor_Lower_R(0, 150)
            Servo(pin14).write_angle(90)
            sleep(300)

    else:
        mecanumCar.Motor_Upper_L(1, 150)
        mecanumCar.Motor_Lower_L(1, 150)
        mecanumCar.Motor_Upper_R(1, 150)
        mecanumCar.Motor_Lower_R(1, 150)
```

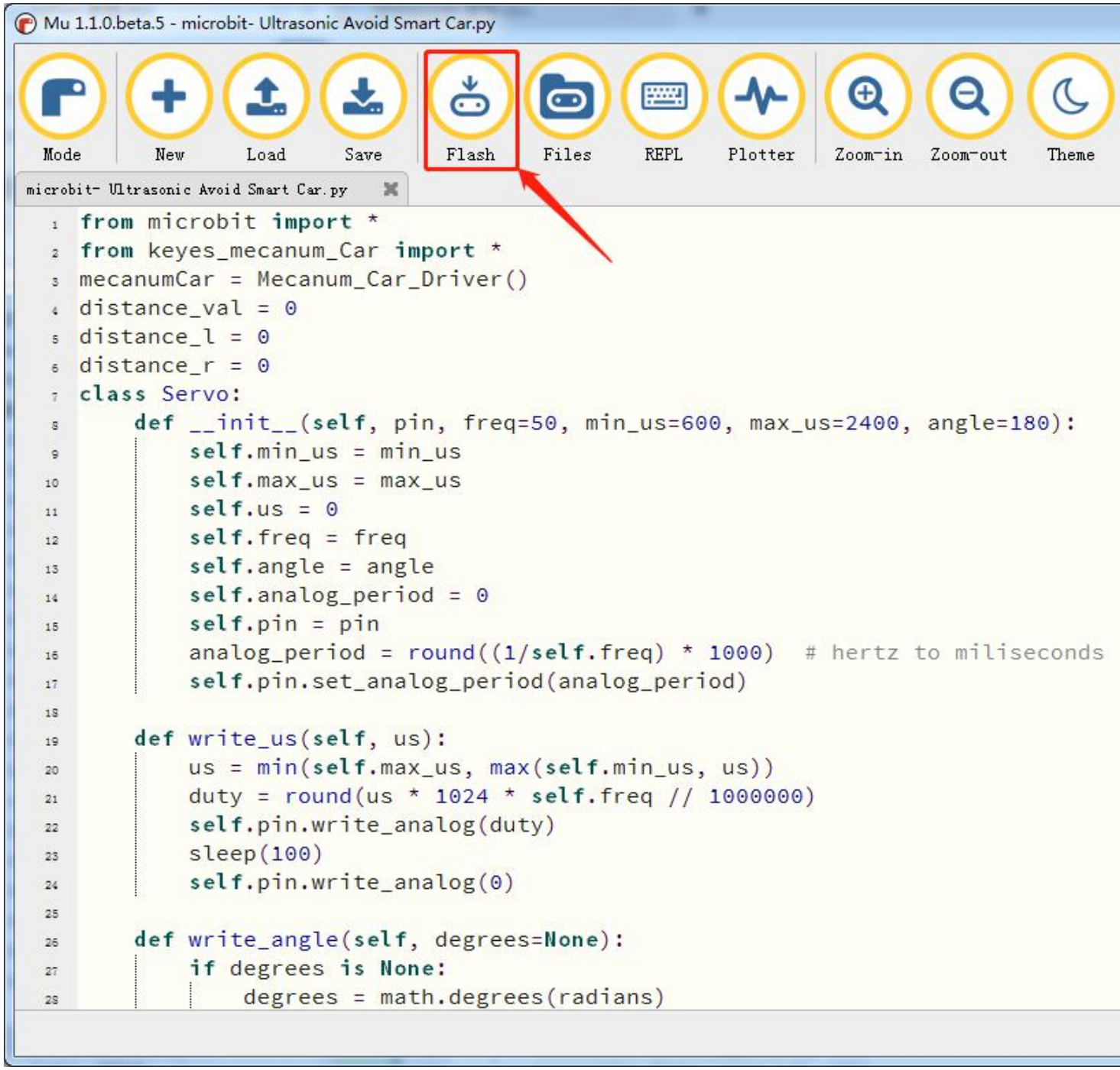
Click “Files” to import “keyes_mecanum_Car.py “library file tomicro:bit (How to import files?). No need to do it again if you have imported it before.



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



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



(5)Test Results:

Download code to micro:bit, dial to ON end, and dial POWER to ON end. When the obstacle distance is greater than 20cm, the car goes forward ; on the contrary, smart car turns left.

(6)Code Explanation:

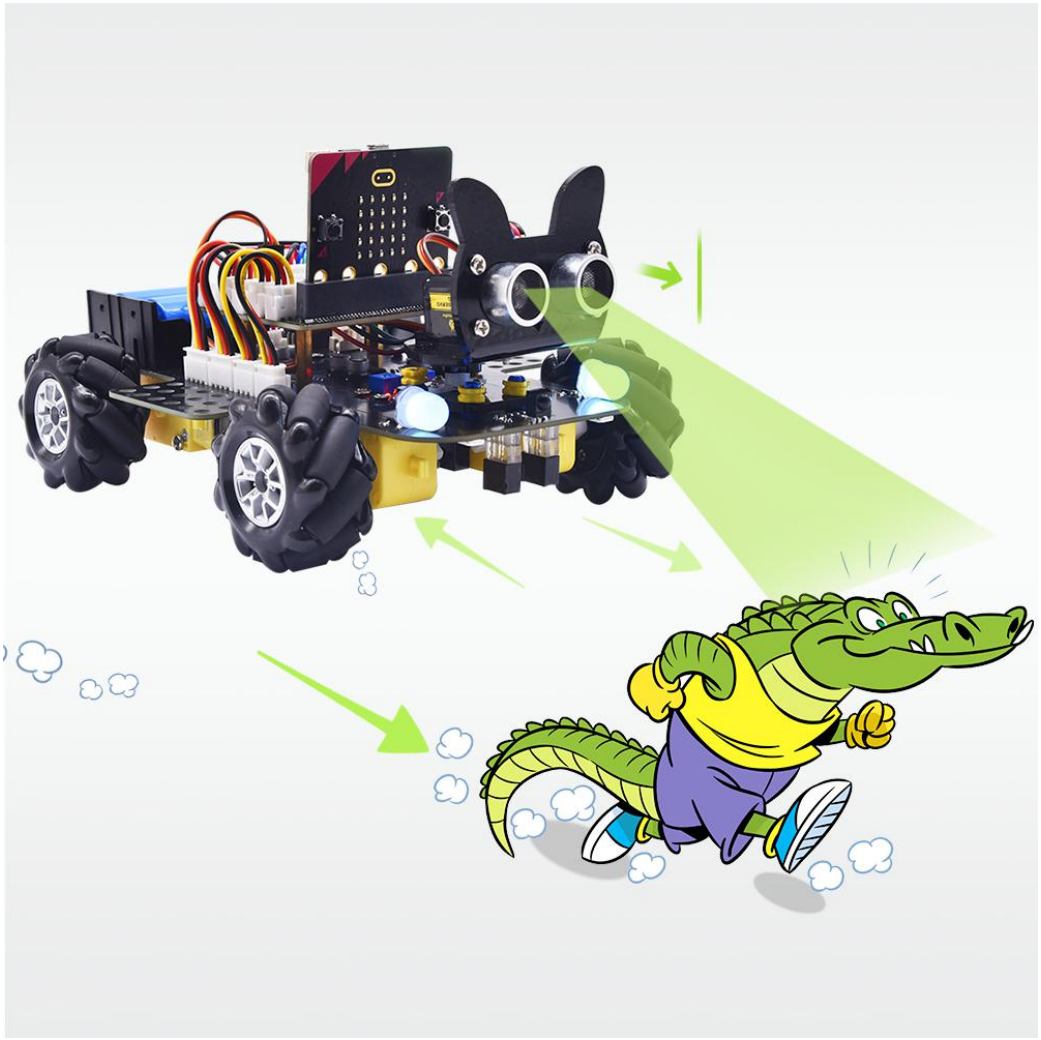
from microbit **import ***	Import the library of micro:bit
from keyes_mecanum_Car **import ***	Import the library of keyes_mecanum_Car
mecanumCar = Mecanum_Car_Driver()()	Instantiate Mecanum_Car_Driver()()to mecanumCar
distance_val = 0	Set the initial value of the variable distance_val to 0
distance_l = 0	Set the initial value of the variable distance_l to 0
distance_r = 0	Set the initial value of the variable distance_r to 0
Servo(pin14).write_angle(90)	The steering gear is connected to P14, the rotation angle is 90 degrees
while True:	This is a permanent loop that makes micro:bit execute the code of it.
distance_val = mecanumCar.get_distance()	Assign mecanumCar.get_distance()to variable distance_val
if distance_val < 20: mecanumCar.Motor_Upper_L(0, 0) mecanumCar.Motor_Lower_L(0, 0)	If distance_val <20 is established (stop) The left front motor of the Mecanum

mecanumCar.Motor_Upper_R(0, 0)
mecanumCar.Motor_Lower_R(0, 0)
sleep(500)
Servo(pin14).write_angle(180)
distance_l = mecanumCar.get_distance()
Servo(pin14).write_angle(0)
distance_r = mecanumCar.get_distance()
if distance_l > distance_r:
mecanumCar.Motor_Upper_L(0, 150)
mecanumCar.Motor_Lower_L(0, 150)
mecanumCar.Motor_Upper_R(1, 150)
mecanumCar.Motor_Lower_R(1, 150)
Servo(pin14).write_angle(90)
sleep(300)
else:
mecanumCar.Motor_Upper_L(1,
	wheel smart car stops rotating;
	The left rear motor of the Mecanum wheel smart car stops rotating;
	The right front motor of the Mecanum wheel smart car stops rotating;
	The right rear motor of the Mecanum wheel smart car stops rotating;
	Delay in 500ms
	The servo connected to P14 rotates to 180 degrees;
	Assign mecanumCar.get_distance() to the variable distance_l;
	The servo connected to P14 turns to 0 degrees;
	Assign mecanumCar.get_distance() to the variable distance_r;
	If distance_l> distance_r condition is true (turn left)
	The front left motor of car rotates clockwise at the speed of PWM150.
	The rear left motor of car rotates

150) mecanumCar.Motor_Lower_L(1, 150) mecanumCar.Motor_Upper_R(0, 150) mecanumCar.Motor_Lower_R(0, 150) Servo(pin14).write_angle(90) sleep(300) else: mecanumCar.Motor_Upper_L(1, 150) mecanumCar.Motor_Lower_L(1, 150) mecanumCar.Motor_Upper_R(1, 150) mecanumCar.Motor_Lower_R(1, 150)	clockwise at the speed of PWM150. The front right motor of car rotates anticlockwise at the speed of PWM150. The rear right motor of car rotates anticlockwise at the speed of PWM150. The servo connected to P14 turns to 90 degrees; Delay in 300ms; If distance_l> distance_r condition is not true (turn right), The front left motor of car rotates anticlockwise at the speed of PWM150. The rear left motor of car rotates anticlockwise at the speed of PWM150. The front right motor of car rotates clockwise at the speed of PWM150. The rear right motor of car rotates clockwise at the speed of PWM150.

	The servo connected to P14 turns to 90 degrees; Delay in 300ms; If condition distance_val <20 is not true (move forward) The front left motor of car rotates clockwise at the speed of PWM150. The rear left motor of car rotates clockwise at the speed of PWM150. The front right motor of car rotates clockwise at the speed of PWM150. The rear right motor of car rotates clockwise at the speed of PWM150. The servo connected to P14 turns to 90 degrees; Delay in 300ms;

18.3: Ultrasonic Following Smart Car



(1)Description:

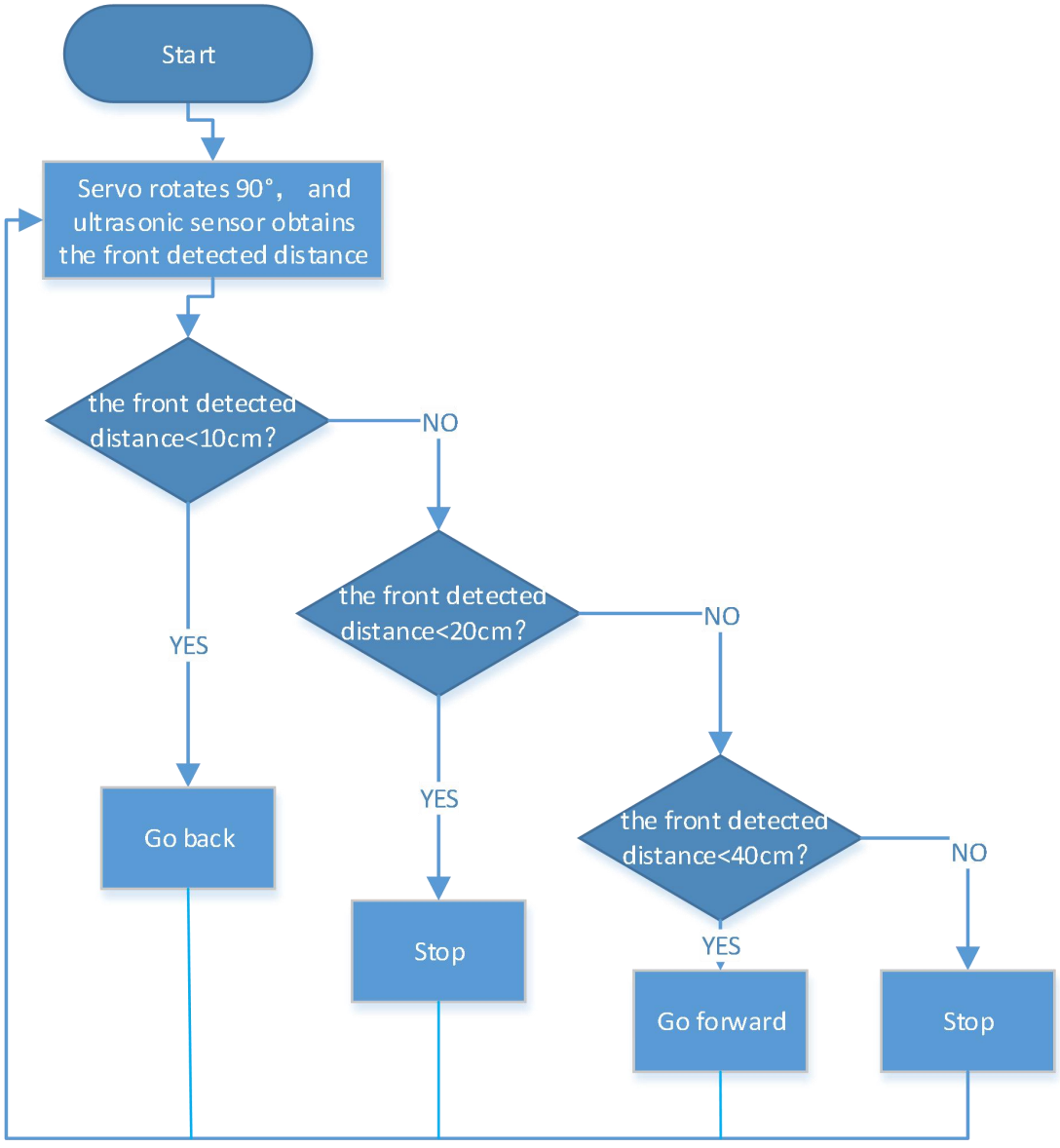
In previous lesson, we’ ve learned the basic principle of line tracking sensor. Next, we will combine ultrasonic sensor with car shield to make an ultrasonic follow car.

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

(2)Experimental Preparation:

- Insert micro:bit board into slot of keyestudio 4WD Mecanum Robot Car
- Place batteries into battery holder
- Dial power switch to ON end
- Connect micro:bit to computer by USB cable
- Open the offline version of Mu.

(3)Flow Chart:



(4)Test Code:

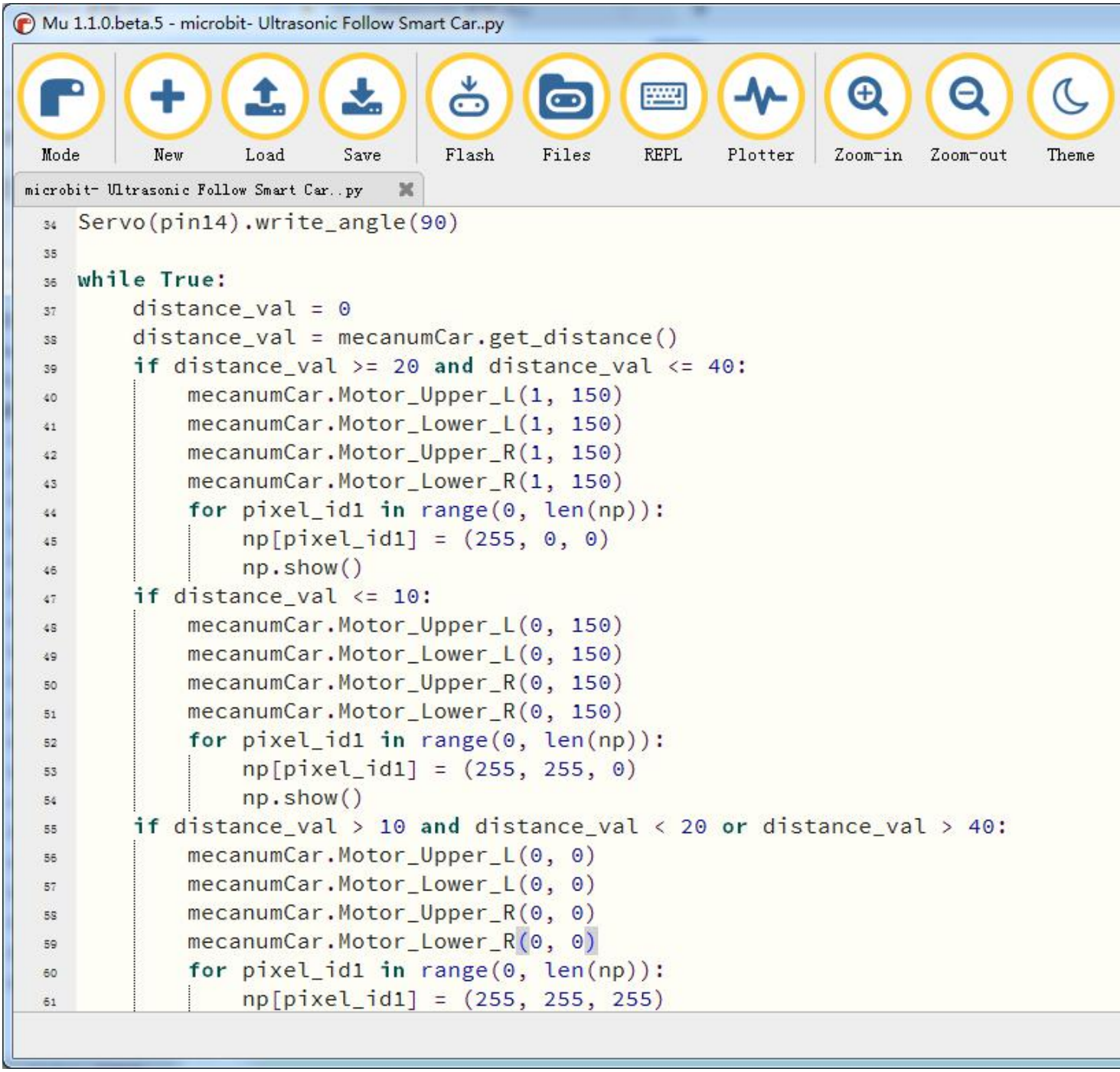
Enter Mu software and open the file "18.3: Ultrasonic Follow Smart Car.py" to import code:

(How to load the project code?)

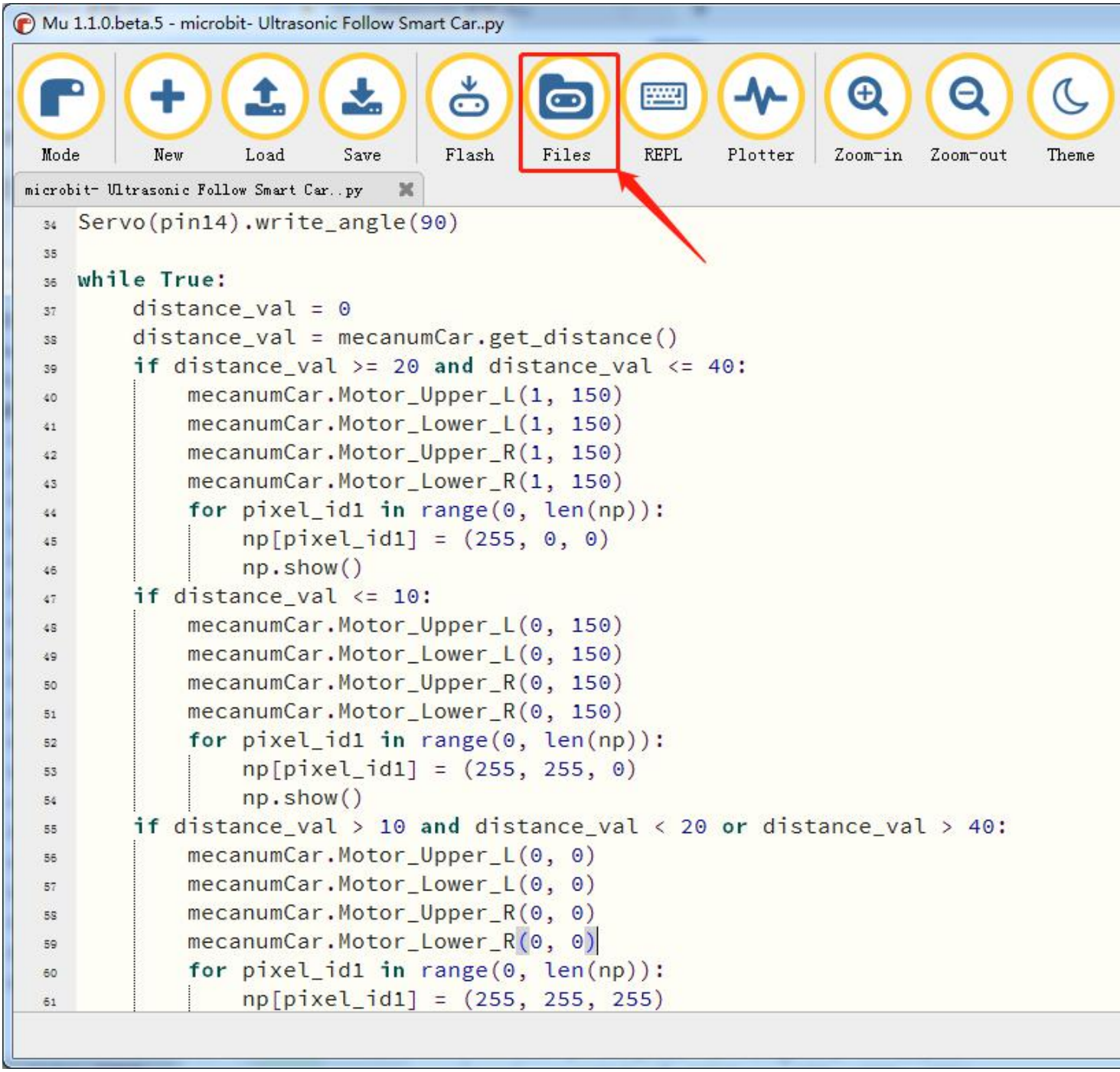
File Type	Route	File Name
Python file	KS4031(KS4032) folder/Python Tutorial/Python Code/Project Code/Project 18 : Ultrasonic Following Smart Car/18.3 : Ultrasonic Follow Smart Car	Ultrasonic Follow Smart Carr.py

You can also input code in the editing window yourself.

(note:all words and symbols must be written in English)



Click “Files” to import “keyes_mecanum_Car.py “library file tomicro:bit (How to import files?). No need to do it again if you have imported it before.



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

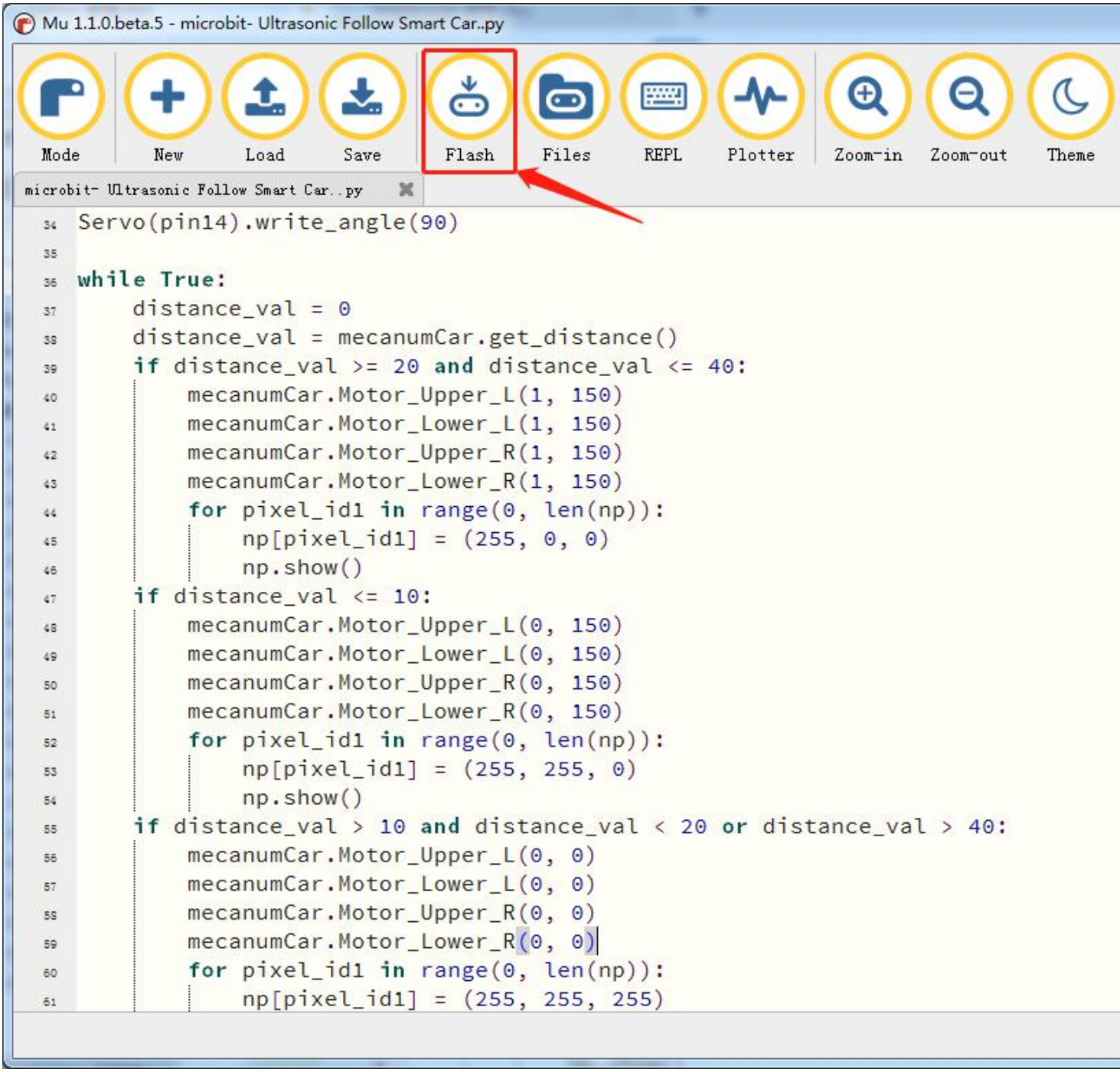
Mu 1.1.0.beta.5 - microbit- Ultrasonic Follow Smart Car..py

Mode | New | Load | Save | Flash | Files | REPL | Plotter | Zoom-in | Zoom-out | Theme

microbit- Ultrasonic Follow Smart Car..py

```
Servo(pin14).write_angle(90)

while True:
    distance_val = 0
    distance_val = mecanumCar.get_distance()
    if distance_val >= 20 and distance_val <= 40:
        mecanumCar.Motor_Upper_L(1, 150)
        mecanumCar.Motor_Lower_L(1, 150)
        mecanumCar.Motor_Upper_R(1, 150)
        mecanumCar.Motor_Lower_R(1, 150)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 0, 0)
            np.show()
    if distance_val <= 10:
        mecanumCar.Motor_Upper_L(0, 150)
        mecanumCar.Motor_Lower_L(0, 150)
        mecanumCar.Motor_Upper_R(0, 150)
        mecanumCar.Motor_Lower_R(0, 150)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 0)
            np.show()
    if distance_val > 10 and distance_val < 20 or distance_val > 40:
        mecanumCar.Motor_Upper_L(0, 0)
        mecanumCar.Motor_Lower_L(0, 0)
        mecanumCar.Motor_Upper_R(0, 0)
        mecanumCar.Motor_Lower_R(0, 0)
        for pixel_id1 in range(0, len(np)):
            np[pixel_id1] = (255, 255, 255)
```

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



(5)Test Results:

Download code to micro:bit, dial POWER switch to ON end on shield, smart car could 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_mecanum_Car **import ***	Import the library of keyes_mecanum_Car
mecanumCar = Mecanum_Car_Driver()()	Instantiate Mecanum_Car_Driver()()to mecanumCar
import neopixel	Import the library of neopixel
np = neopixel.NeoPixel(pin8, 4)	Set Neopixel to pin P8, and initialize 4 LEDs
Servo(pin14).write_angle(90)	The servo connected to P14 pin turns to 90 degrees
while True:	This is a permanent loop that makes micro:bit execute the code of it.
distance_val = 0	Set the initial value of the variable distance_val to 0
distance_val = mecanumCar.get_distance()	Assign mecanumCar.get_distance() to the variable distance_val
if distance_val >= 20 **and**	If distance_val ≥20 and distance_val

distance_val <= 40: mecanumCar.Motor_Upper_L(1, 150) mecanumCar.Motor_Lower_L(1, 150) mecanumCar.Motor_Upper_R(1, 150) mecanumCar.Motor_Lower_R(1, 150) **for** pixel_id1 **in** range(0, len(np)): np[pixel_id1] = (255, 0, 0) np.show() **if** distance_val <= 10: mecanumCar.Motor_Upper_L(0, 150) mecanumCar.Motor_Lower_L(0, 150) mecanumCar.Motor_Upper_R(0, 150) mecanumCar.Motor_Lower_R(0, 150) **for** pixel_id1 **in** range(0, len(np)): np[pixel_id1] = (255, 255, 0) np.show() **if** distance_val > 10**and** distance_val < 20 **or** distance_val > 40: mecanumCar.Motor_Upper_L(0, 0) mecanumCar.Motor_Lower_L(0, 0)	≤ 40 are true, The car moves forward. RGB pixels in the range of (0, len(np)) are pixel_id1 Set pixel_id1 to light up red Display pixels on Neopixel strip If distance_val ≤10 holds The car moves back. RGB pixels in the range of (0, len(np)) are pixel_id1 Set pixel_id1 to bright yellow light Display pixels on Neopixel strip If distance_val>10 and distance_val<20 or distance_val>40 is true The car stops. RGB pixels in the range of (0, len(np)) are pixel_id1

mecanumCar.Motor_Upper_R(0, 0) mecanumCar.Motor_Lower_R(0, 0) **for** pixel_id1 **in** range(0, len(np)): np[pixel_id1] = (255, 255, 255) np.show()	Set pixel_id1 to bright white light Display pixels on Neopixel strip

9. Resources

Download PDF files: https://fs.keyestudio.com/KS4031-4032

BBC microbit MicroPython:

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

MicroPython:

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

ustruct library:

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

math library:

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

utime(sleep_us,tick_us) library:

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