

Welcome

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How to Start

When reading this, you should have downloaded the ZIP file for this product.
Unzip it and you will get a folder containing tutorials and related files. Please start with this PDF tutorial.

- ! Unzip the ZIP file instead of opening the file in the ZIP file directly.
- ! Do not move, delete or rename files in the folder just unzipped.

Get Support

Encounter problems? Don't worry! Refer to "TroubleShooting.pdf" or contact us.

When there are packaging damage, quality problems, questions encountering in use, etc., just send us an email. We will reply to you within one working day and provide a solution.

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Attention

Pay attention to safety when using and storing this product:

- This product is not suitable for children under 12 years of age because of small parts and sharp parts.
- Minors should use this product under the supervision and guidance of adults.
- This product contains small and sharp parts. Do not swallow, prick and scratch to avoid injury.
- This product contains conductive parts. Do not hold them to touch power supply and other circuits.
- To avoid personal injury, do not touch parts rotating or moving while working.
- The wrong operation may cause overheat. Do not touch and disconnect the power supply immediately.
- Operate in accordance with the requirements of the tutorial. Fail to do so may damage the parts.
- Store this product in a dry and dark environment. Keep away from children.
- Turn off the power of the circuit before leaving.

Any concerns?  support@freenove.com

About

Freenove provides open source electronic products and services.

Freenove is committed to helping customers learn programming and electronic knowledge, quickly implement product prototypes, realize their creativity and launch innovative products. Our services include:

- Kits for learning programming and electronics
- Kits compatible with Arduino®, Raspberry Pi®, micro:bit®, ESP32®, etc.
- Kits for robots, smart cars, drones, etc.
- Components, modules and tools
- Design and customization

To learn more about us or get our latest information, please visit our website:

<http://www.freenove.com>

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Prepare

ESP32 is a micro control unit with integrated Wi-Fi launched by Espressif, which features strong properties and integrates rich peripherals. It can be designed and studied as an ordinary Single Chip Microcontroller (SCM) chip, or connected to the Internet and used as an Internet of Things device.

ESP32 can be developed both either with C/C++ language or micropython language. In this tutorial, we use micropython. With Micropython is as easy to learn as Python with little code, making it ideal for beginners. Moreover, the code of ESP32 is completely open-source, so beginners can quickly learn how to develop and design IOT smart household products including smart curtains, fans, lamps and clocks.

We divide each project into four parts, namely Component List, Component Knowledge, Circuit and Code. Component List helps you to prepare material for the experiment more quickly. Component Knowledge allows you to quickly understand new electronic modules or components, while Circuit helps you understand the operating principle of the circuit. And Code allows you to easily master the use of ESP32 and its accessory kit. After finishing all the projects in this tutorial, you can also use these components and modules to make products such as smart household, smart cars and robots to transform your creative ideas into prototypes and new and innovative products.

In addition, if you have any difficulties or questions with this tutorial or toolkit, feel free to ask for our quick and free technical support through support@freenove.com

ESP32-WROVER

ESP32-WROVER has launched a total of two antenna packages, PCB on-board antenna and IPEX antenna respectively. The PCB on-board antenna is an integrated antenna in the chip module itself, so it is convenient to carry and design. The IPEX antenna is a metal antenna derived from the integrated antenna of the chip module itself, which is used to enhance the signal of the module.

PCB on-board antenna

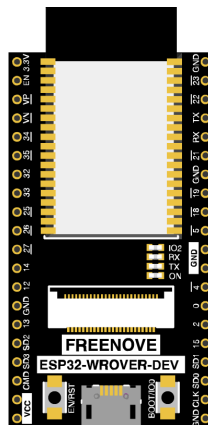


IPEX antenna

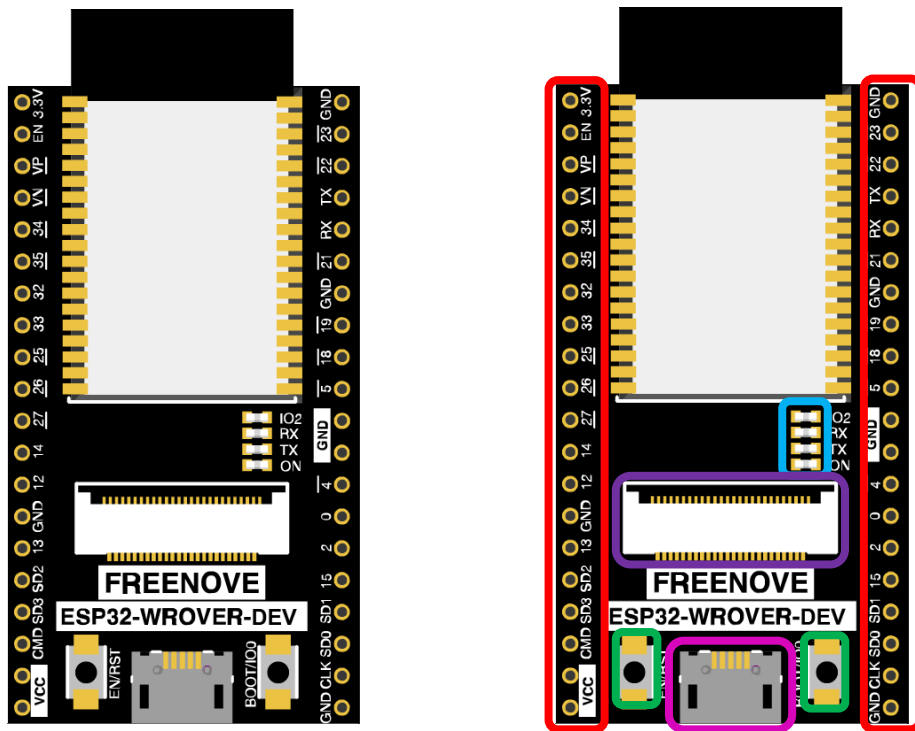


In this tutorial, the ESP32-WROVER is designed based on the PCB on-board antenna package.






ESP32-WROVER



The hardware interfaces of ESP32-WROVER are distributed as follows:



Compare the left and right images. We've boxed off the resources on the ESP32-WROVER in different colors to facilitate your understanding of the ESP32-WROVER.

Box color	Corresponding resources introduction
	GPIO pin
	LED indicator
	Camera interface
	Reset button, Boot mode selection button
	USB port

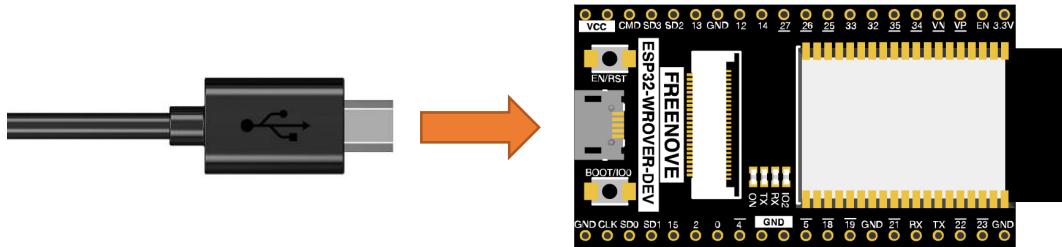
0.3 Installing CH340 (Important)

ESP32 uses CH340 to download codes. So before using it, we need to install CH340 driver in our computers.

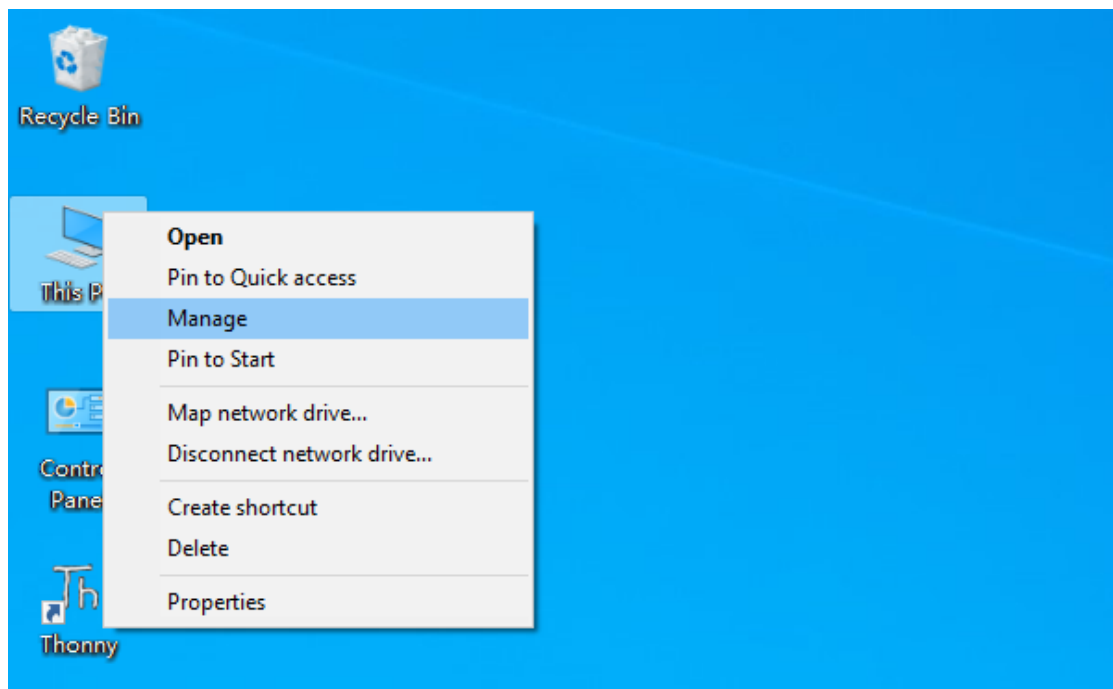
Windows

Check whether CH340 has been installed

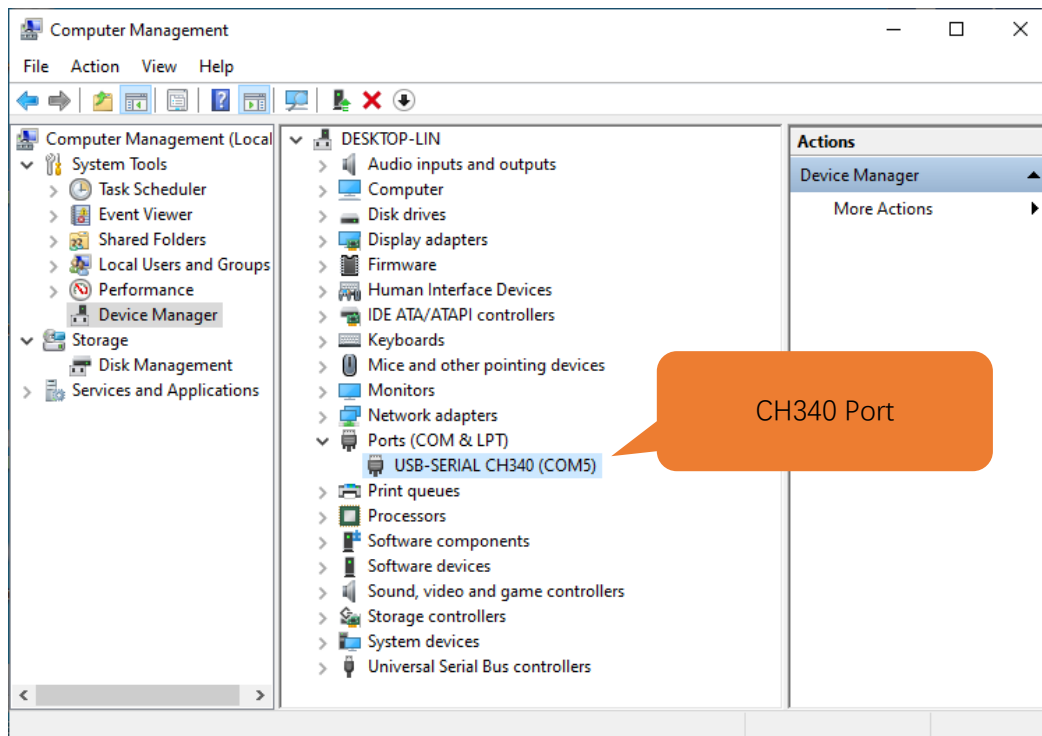
1. Connect your computer and ESP32 with a USB cable.



2. Turn to the main interface of your computer, select "This PC" and right-click to select "Manage".



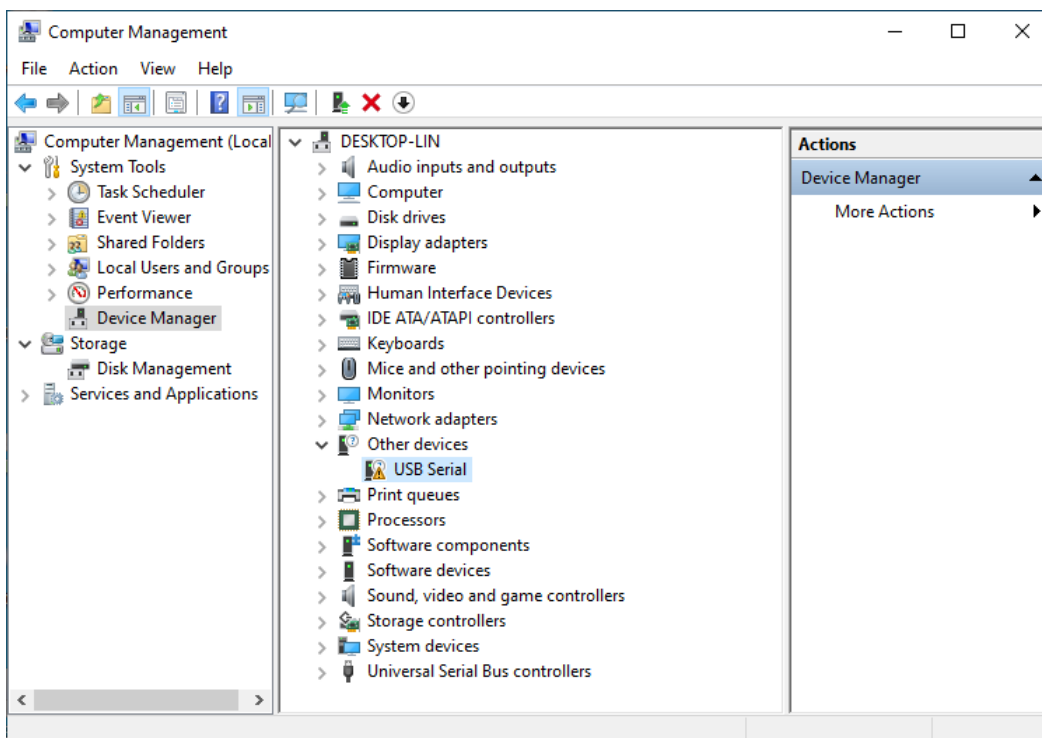
- Click "Device Manager". If your computer has installed CH340, you can see "USB-SERIAL CH340 (COMx)". And you can click [here](#) to move to the next step.



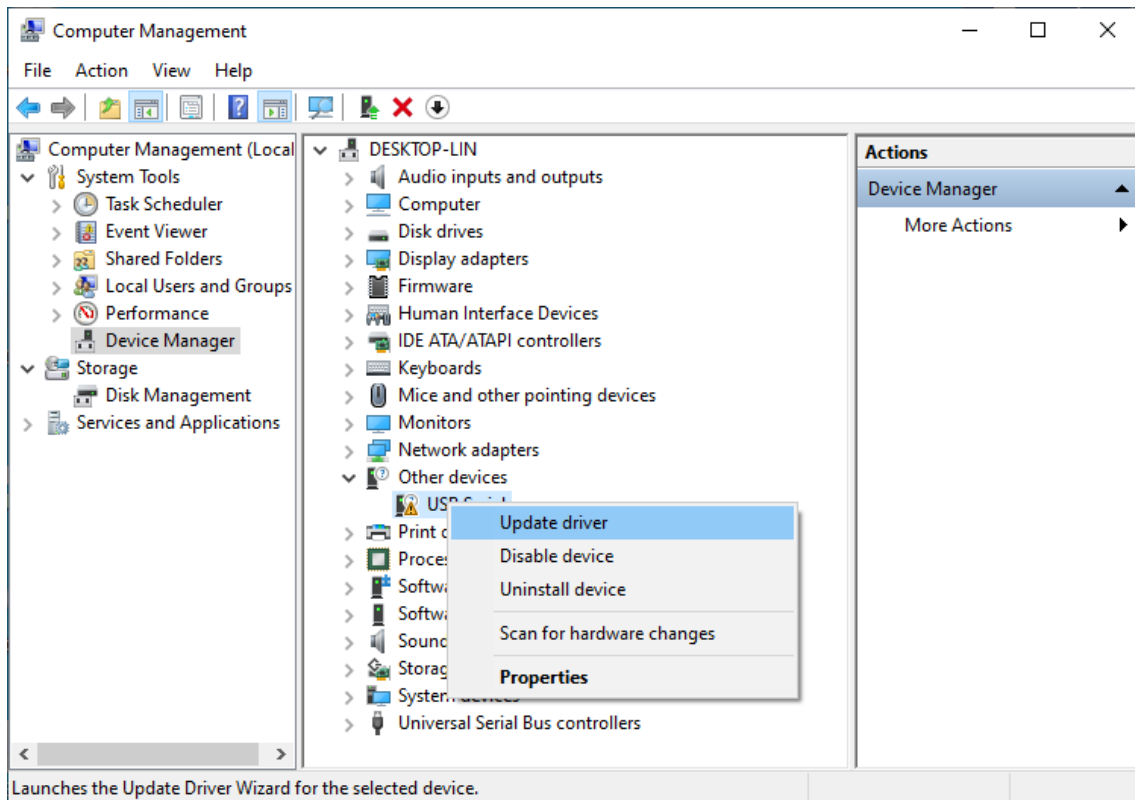
Installing CH340

Method1

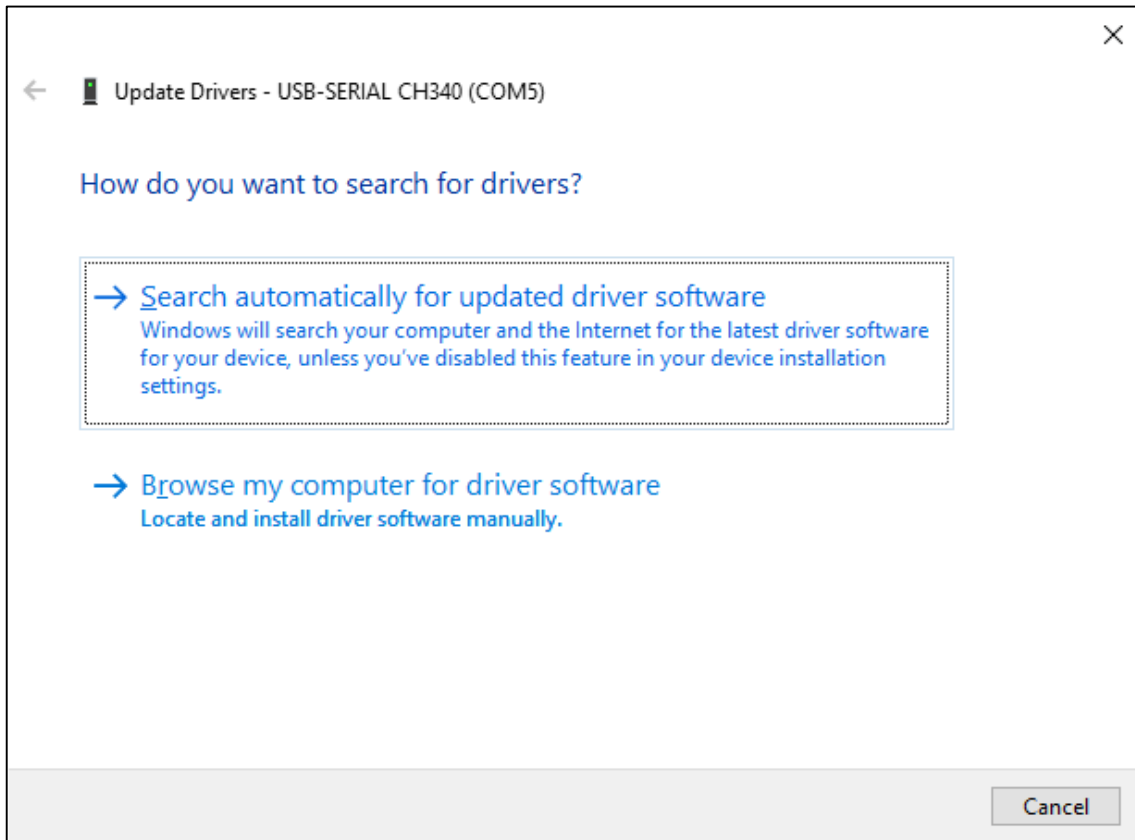
- If you have not yet installed CH340, you'll see the following interface.



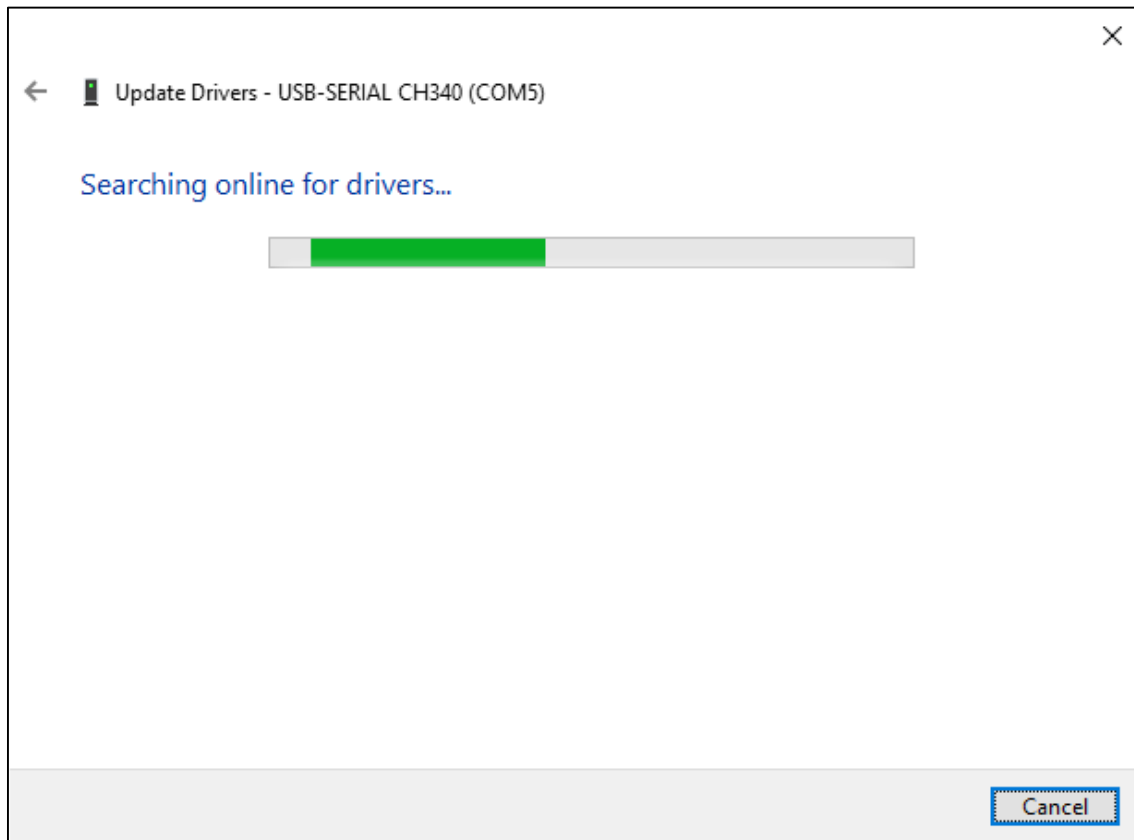
- Click "USB Serial" and right-click to select "Update driver".



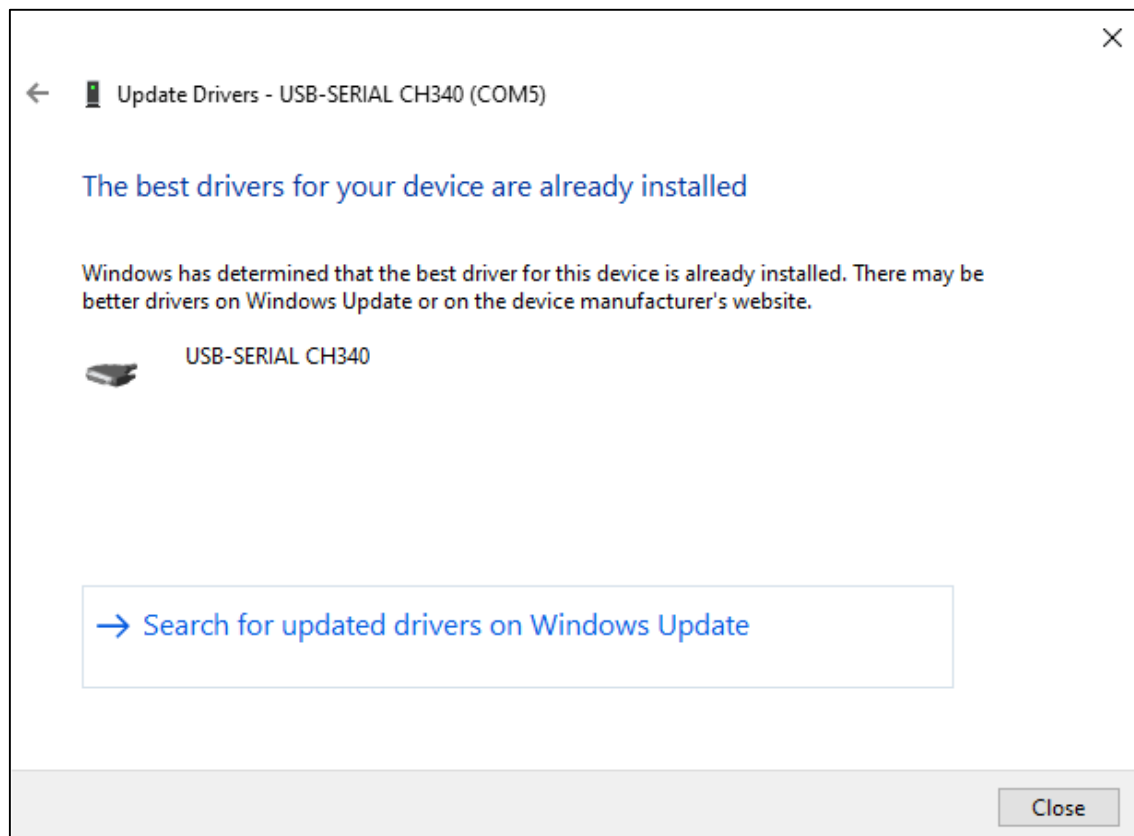
- Click "Search automatically for updated driver software".



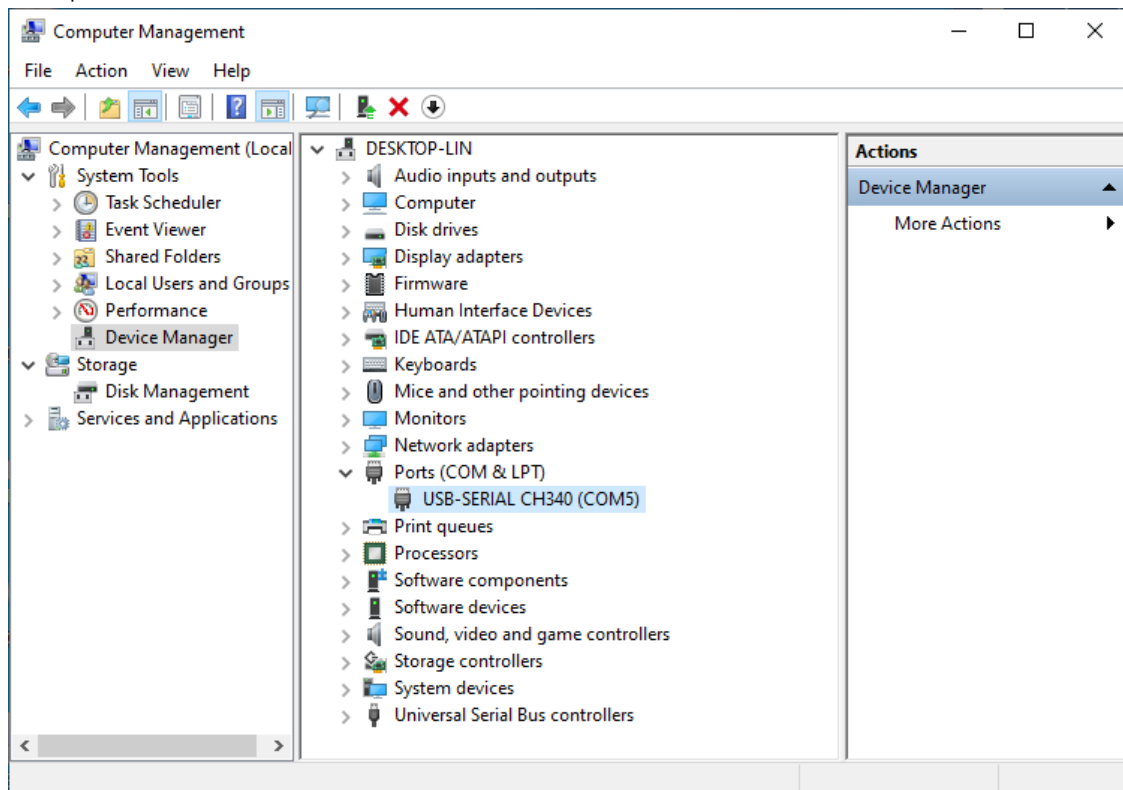
- Wait for CH340 to finish installation.



- When you see the following interface, it indicates that CH340 has been installed to your computer. You can close the interface.



6. When ESP32 is connected to computer, you can see the following interface. Click here to move to the next step.



Method2

- First, download CH340 driver, click <http://www.wch-ic.com/search?q=CH340&t=downloads> to download the appropriate one based on your operating system.

index / search / search CH340

All (14)

Downloads (7)

Products (4)

Application (2)

Video (1)

News (0)

keyword CH340

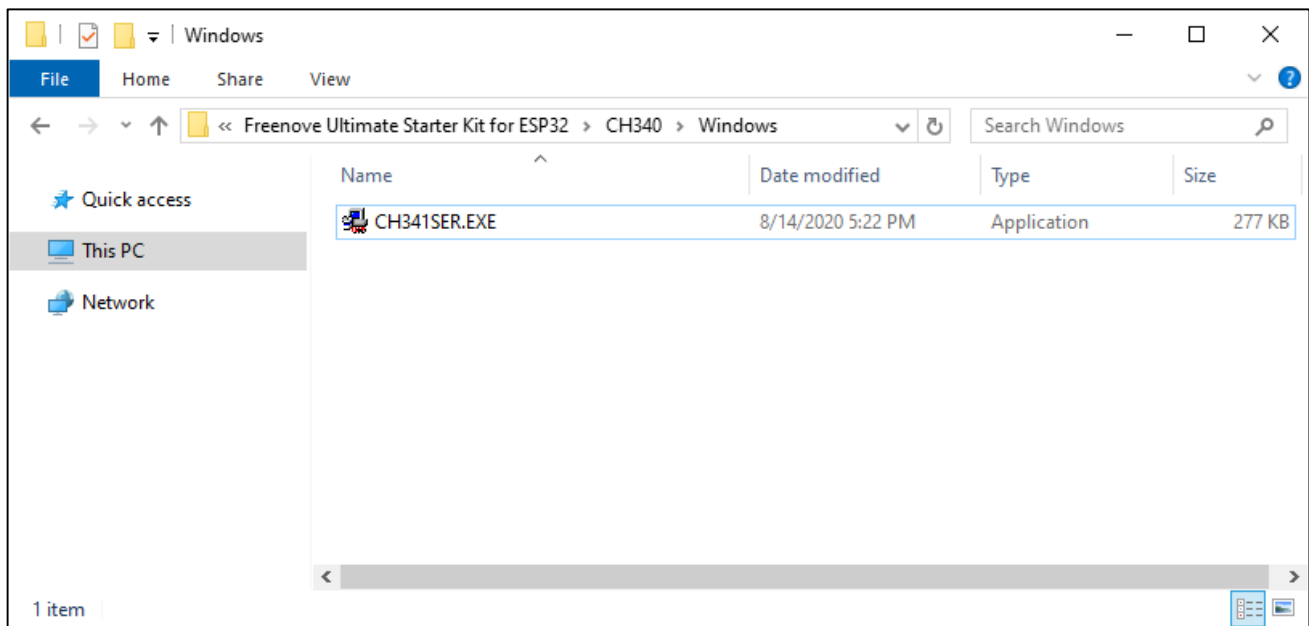
Downloads (7)

file category	file content	version	upload time
Driver&Tools			
CH341SER.EXE	CH340/CH341 USB to serial port Windows driver, supports 32/64-bit Windows 10/8.1/8/7/VISTA/XP, Server 2016/2012/2008/2003, 2000/ME/98	3.5	2019-03-18
CH341SER.ZIP	CH340/CH341 USB to serial port Windows driver, includes DLL dynamic library and non-standard baud rate settings and other instructions. Supports 32/64-bit Windows 10/8.1/8/7/VISTA/XP, Server 2016/2012/2008/2003, 2000/ME/98	3.5	2019-03-05
CH341SER_ANDROID...	CH340/CH341 USB to serial port Android free drive application library, for Android OS 3.1 and above version which supports USB Host mode already, no need to load Android kernel driver, no root privileges. Contains apk, lib library, File (Host Driver), App Demo Example (USB to UART Den...	1.6	2019-04-19
CH341SER_LINUX...	CH340/CH341 USB to serial port LINUX driver	1.5	2018-03-18
CH341SER_MAC.ZI...	CH340/CH341 USB to serial port MAC OS driver	1.5	2018-07-05
Others			
PRODUCT_GUIDE.P...	Electronic selection of product selection manual, please refer to related product technical manual for more technical information.	1.4	2018-12-29
InstallNoteOn64...	Instructions for the driver after 18 years of August cannot be installed under some 64-bit WIN7 (English)	1.0	2019-01-10

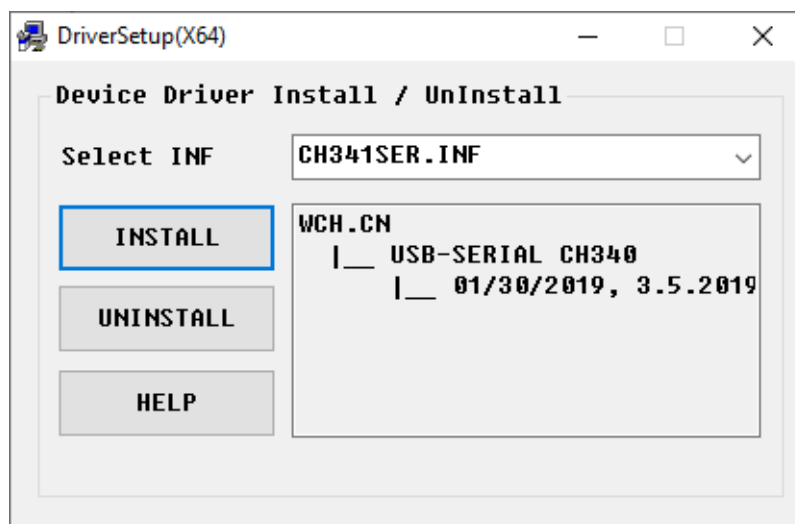
You can also open “Freenove_Ultimate_Starter_Kit_for_ESP32/CH340”, we have prepared the installation package.

Name	Date modified	Type	Size
Linux	8/14/2020 5:24 PM	File folder	
MAC	8/14/2020 5:23 PM	File folder	
Windows	8/14/2020 5:23 PM	File folder	

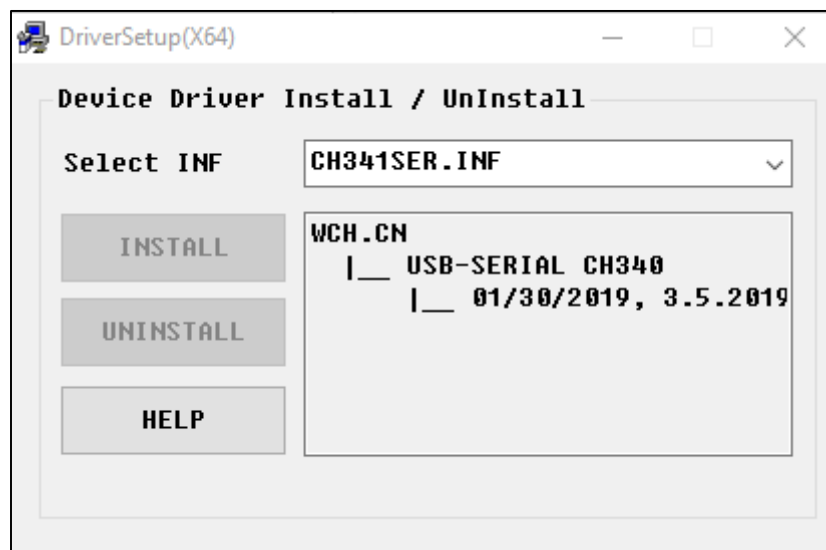
2. Open the folder "Freenove_Ultimate_Starter_Kit_for_ESP32/CH340/Windows/ch341ser"



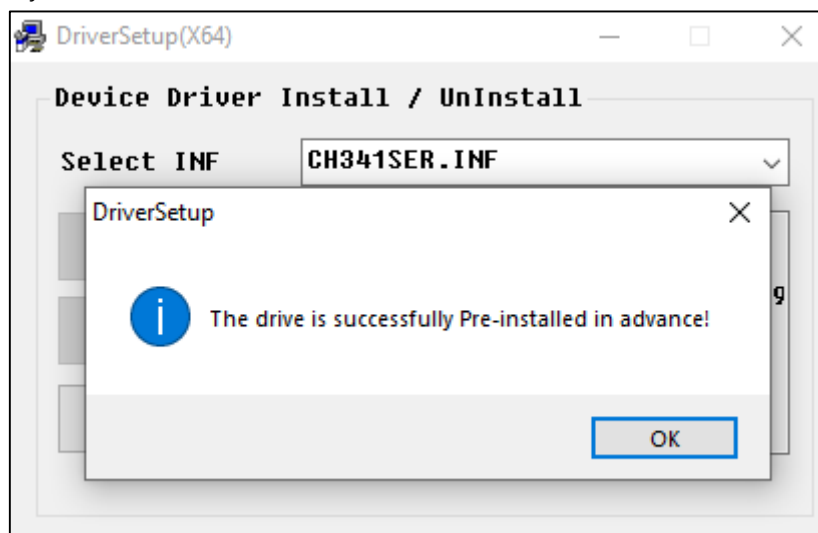
3. Double click "CH341SER.EXE".



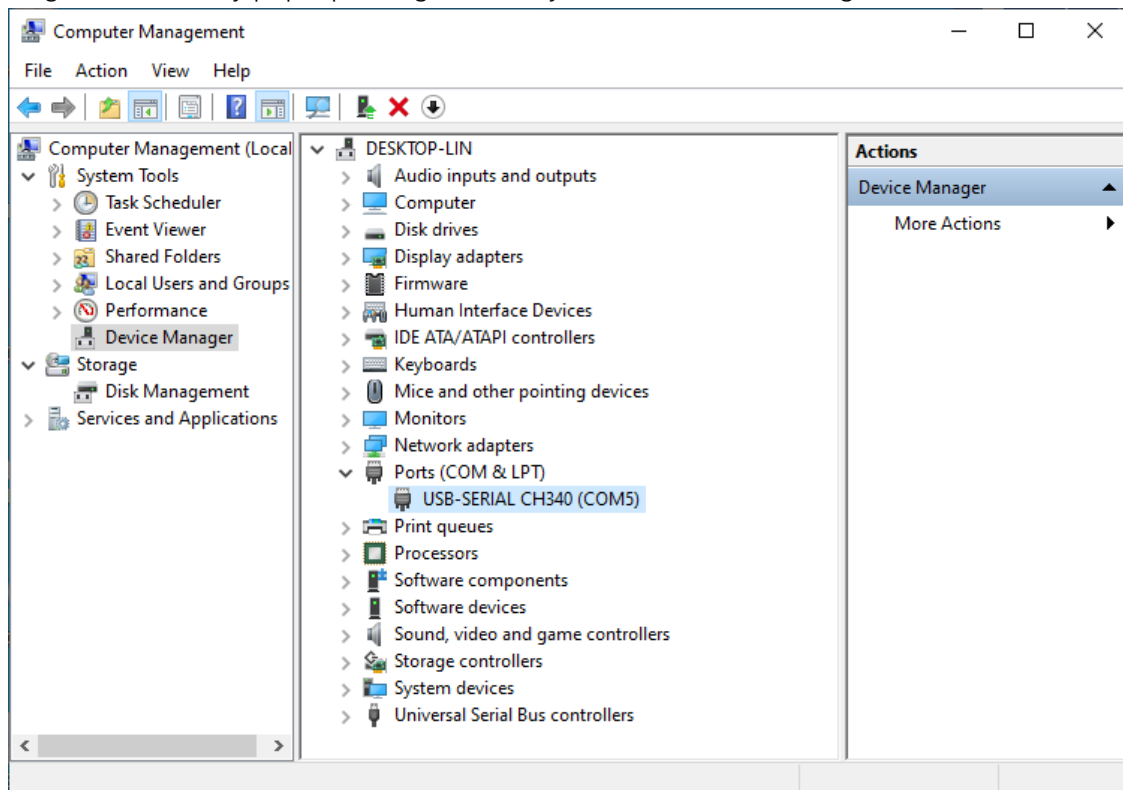
4. Click "INSTALL" and wait for the installation to complete.



5. Install successfully. Close all interfaces.



6. When ESP32 is connected to computer, select "This PC", right-click to select "Manage" and click "Device Manager" in the newly pop-up dialog box, and you can see the following interface.



7. So far, CH340 has been installed successfully. Close all dialog boxes.

MAC

First, download CH340 driver, click <http://www.wch-ic.com/search?q=CH340&t=downloads> to download the appropriate one based on your operating system.

The screenshot shows the WCH website's search results for the keyword 'ch340'. The left sidebar shows navigation options: All (14), Downloads (7), Products (4), Application (2), Video (1), and News (0). The main content area displays a table of downloads under the heading 'Downloads(7)'.

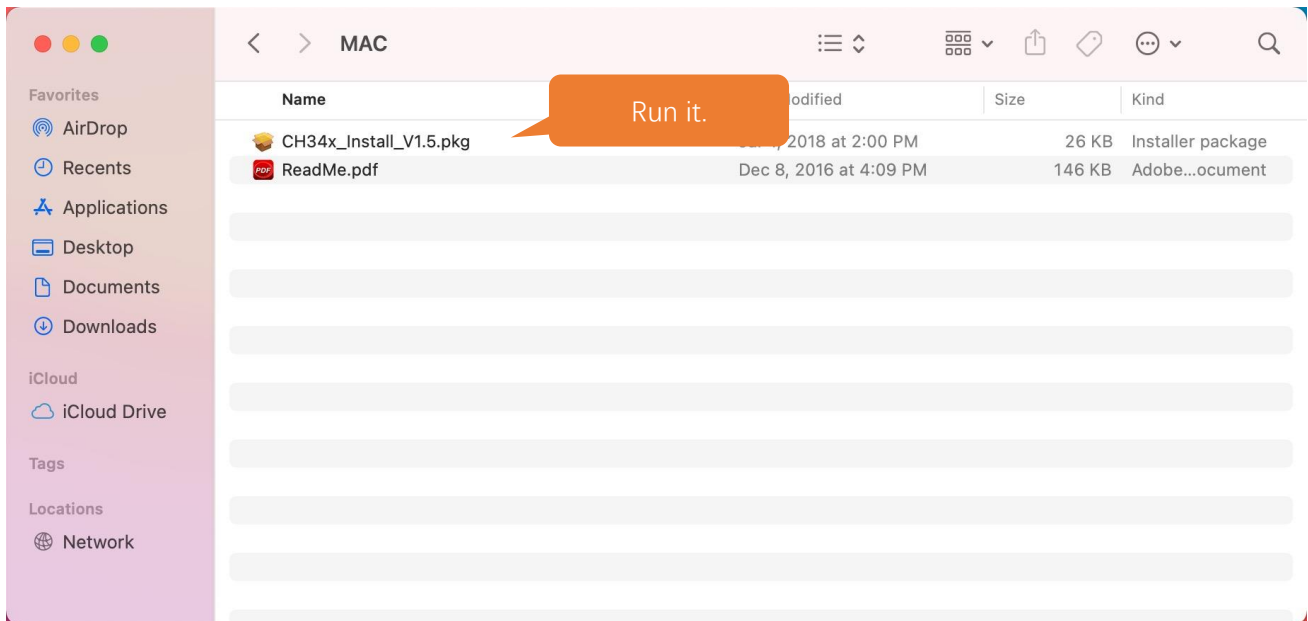
file category	file content	version	upload time
Driver&Tools			
CH341SER.EXE	CH340/CH341 USB to serial port Windows driver, supports 32/64-bit Windows 10/8.1/8/7/VISTA/XP, Server 2016/2012/2008/2003, 2000/ME/98	3.5	2019-03-18
CH341SER.ZIP	CH340/CH341 USB to serial port Windows driver, includes DLL dynamic library and non-standard baud rate settings and other instructions. Supports 32/64-bit Windows 10/8.1/8/7/VISTA/XP, Server 2016/2012/2008/2003, 2000/ME/98	3.5	2019-03-05
CH341SER_ANDROID...	CH340/CH341 USB to serial port Android free drive application library, for Android OS 3.1 and above version which supports USB Host mode already, no need to load Android kernel driver, no root privileges. Contains apk, lib library file (Java Driver), App Demo Example, AT Demo SDK).	1.6	2019-04-19
CH341SER_LINUX....	CH340/CH341 USB to serial port LINUX driver	1.5	2018-03-18
CH341SER_MAC.ZI...	CH340/CH341 USB to serial port MAC OS driver	1.5	2018-07-05
Others			

Callout boxes in the image point to the following categories:

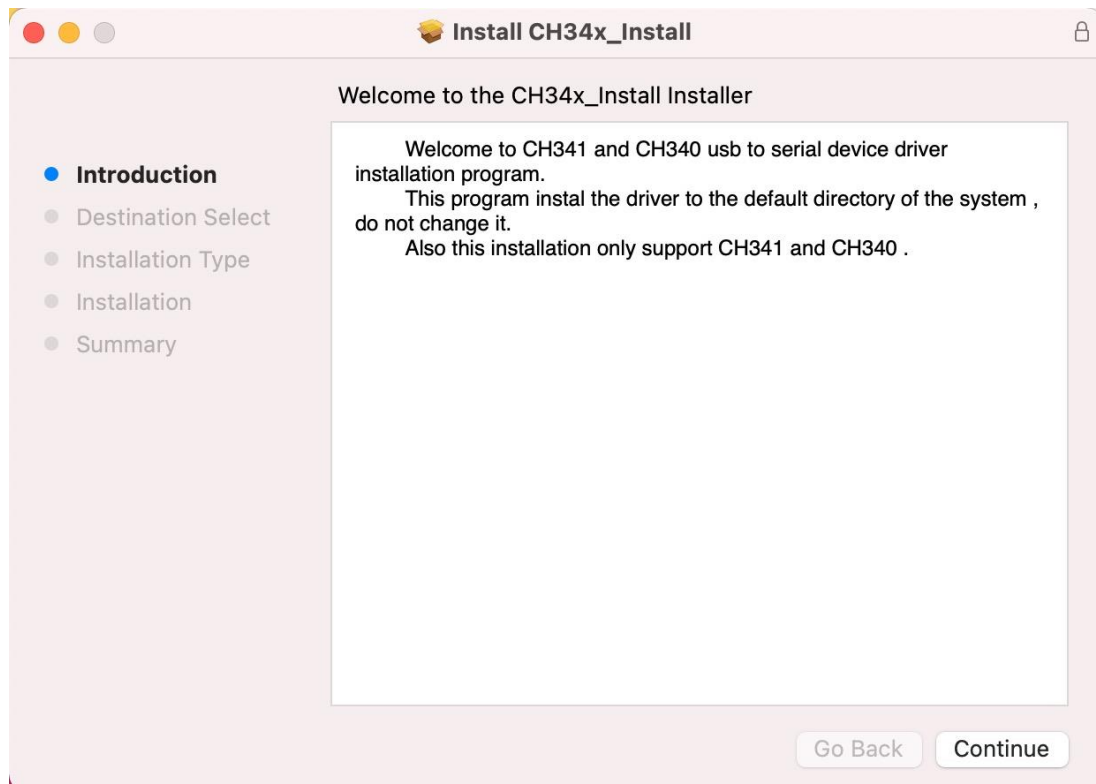
- Windows**: Points to CH341SER.EXE and CH341SER.ZIP.
- Linux**: Points to CH341SER_LINUX....
- MAC**: Points to CH341SER_MAC.ZI...

If you would not like to download the installation package, you can open “Freenove_Ultimate_Starter_Kit_for_ESP32/CH340”, we have prepared the installation package.

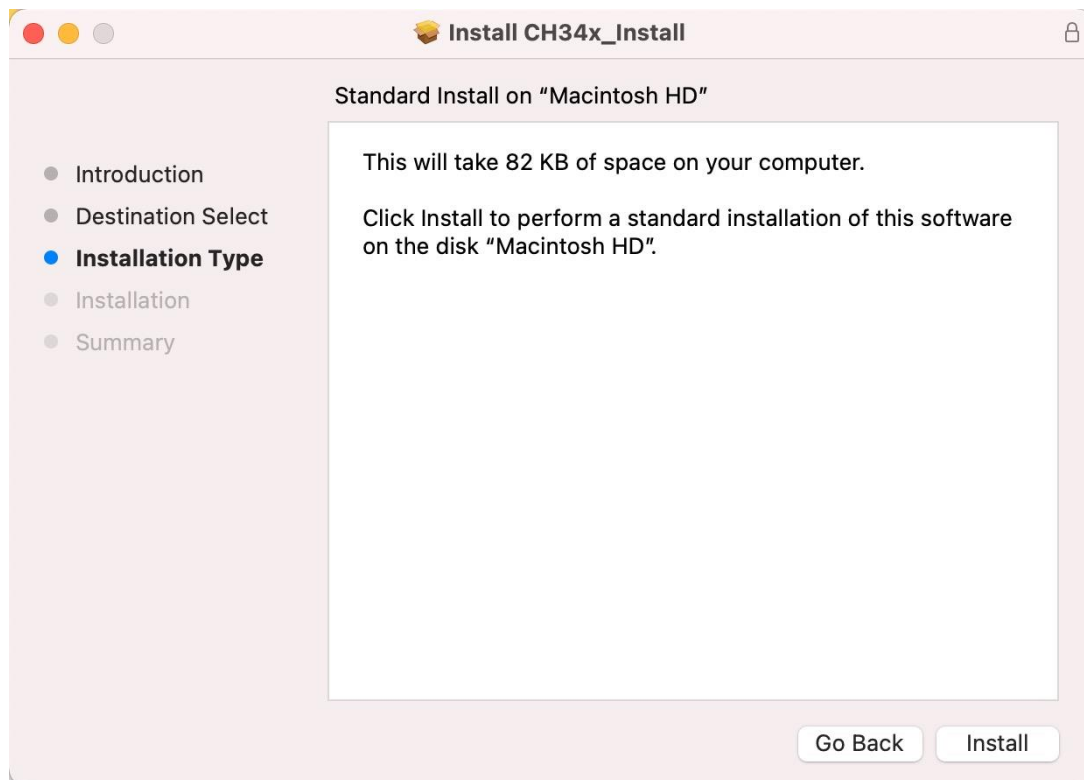
Second, open the folder “Freenove_Ultimate_Starter_Kit_for_ESP32/CH340/MAC/”



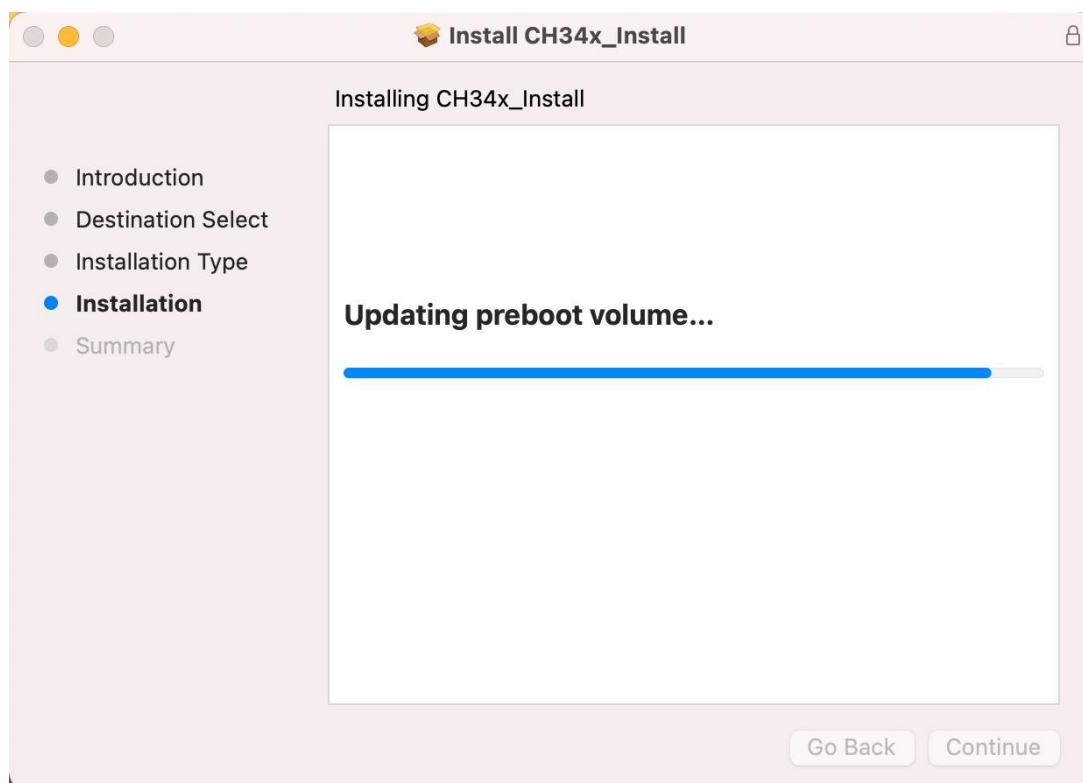
Third, click Continue.



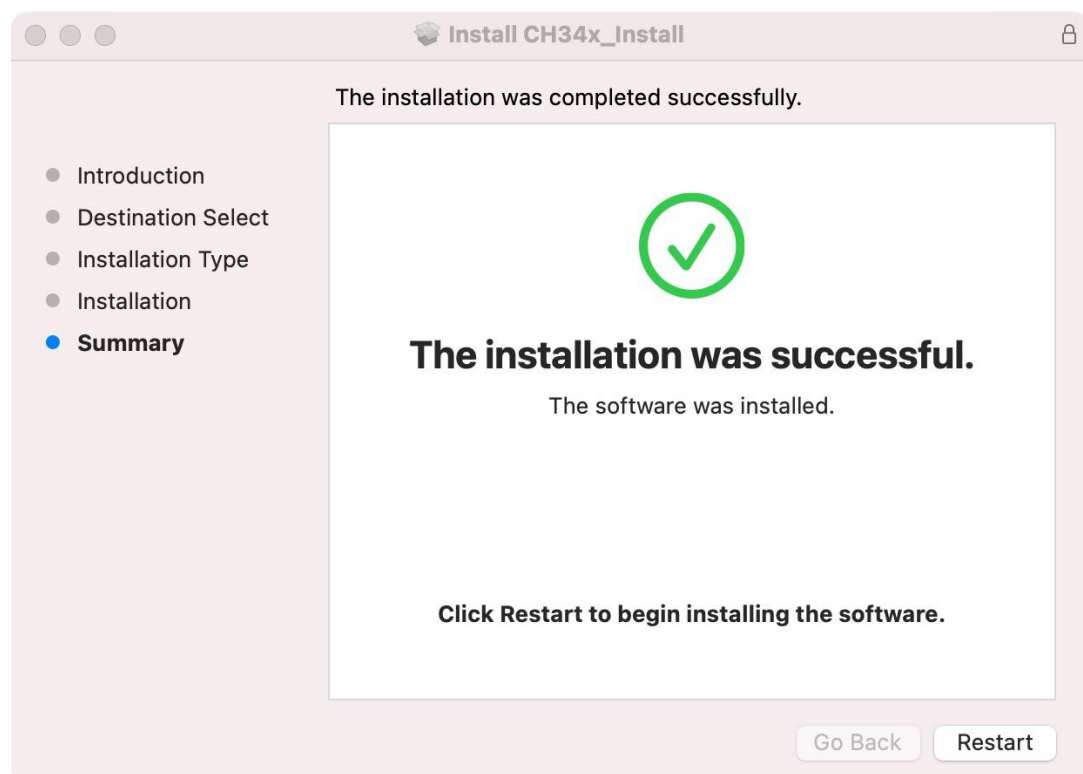
Fourth, click Install.



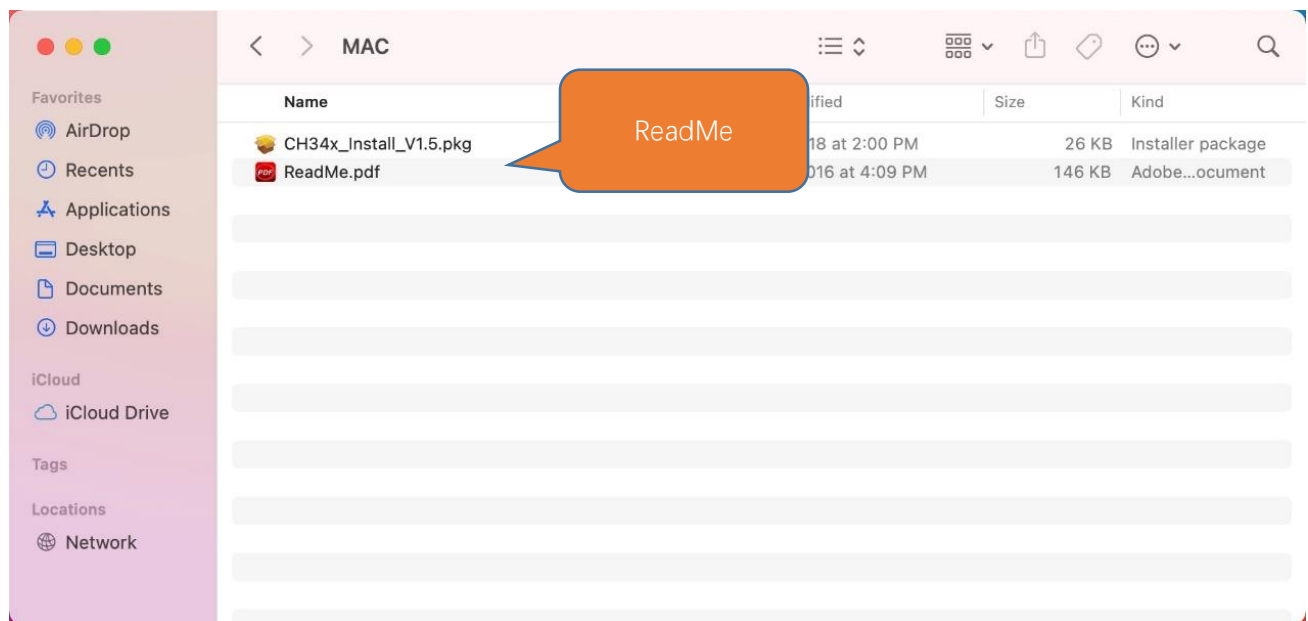
Then, waiting Finish.



Finally, restart your PC.



If you still haven't installed the CH340 by following the steps above, you can view readme.pdf to install it.



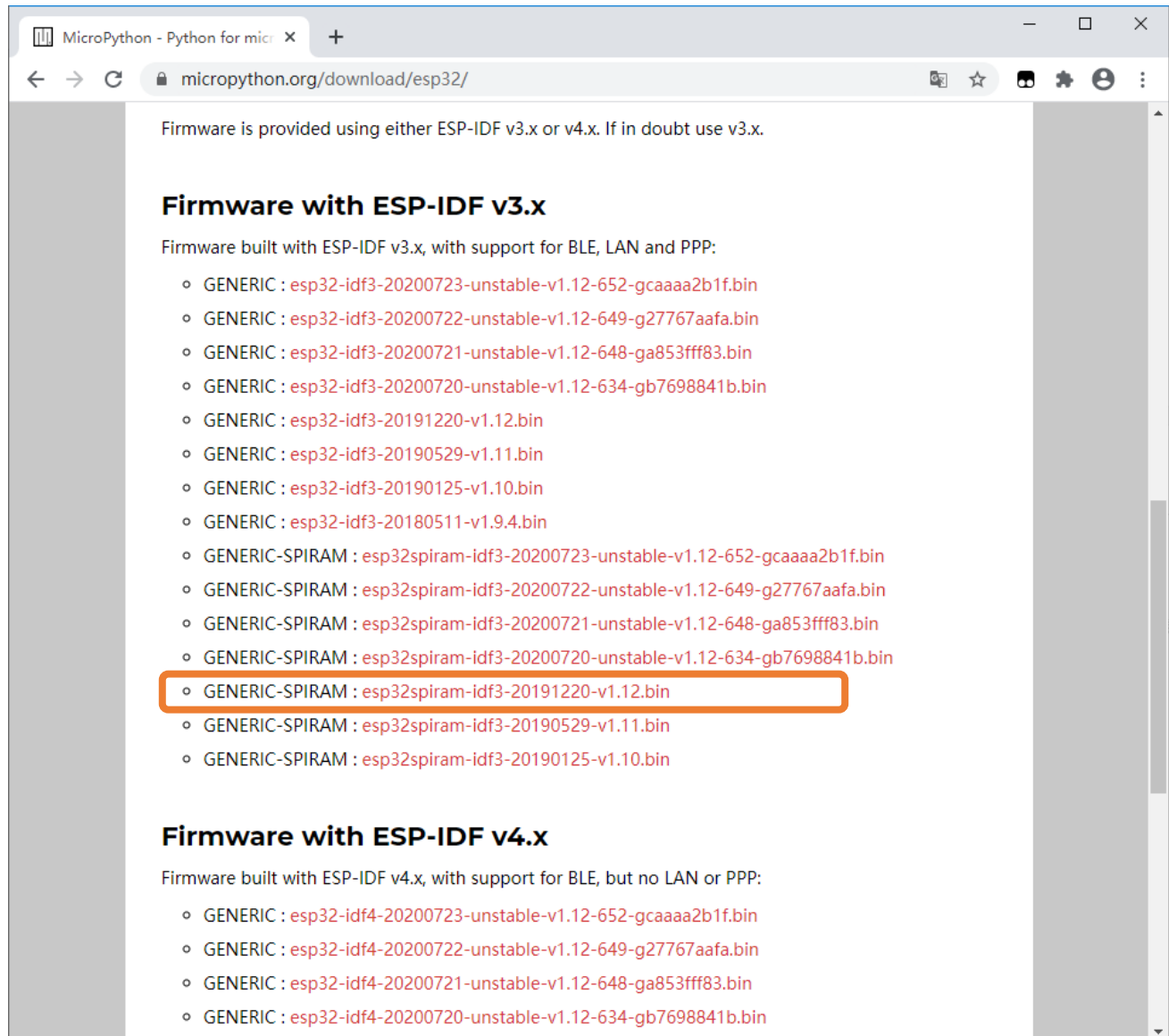
0.4 Burning Micropython Firmware (Important)

To run Python programs on ESP32, we need to burn a firmware to ESP32 first.

Downloading Micropython Firmware

Official website of microPython: <http://micropython.org/>

Webpage listing firmware of microPython for ESP32: <https://micropython.org/download/esp32/>



Firmware is provided using either ESP-IDF v3.x or v4.x. If in doubt use v3.x.

Firmware with ESP-IDF v3.x

Firmware built with ESP-IDF v3.x, with support for BLE, LAN and PPP:

- GENERIC : [esp32-idf3-20200723-unstable-v1.12-652-gcaaaa2b1f.bin](#)
- GENERIC : [esp32-idf3-20200722-unstable-v1.12-649-g27767aafa.bin](#)
- GENERIC : [esp32-idf3-20200721-unstable-v1.12-648-ga853fff83.bin](#)
- GENERIC : [esp32-idf3-20200720-unstable-v1.12-634-gb7698841b.bin](#)
- GENERIC : [esp32-idf3-20191220-v1.12.bin](#)
- GENERIC : [esp32-idf3-20190529-v1.11.bin](#)
- GENERIC : [esp32-idf3-20190125-v1.10.bin](#)
- GENERIC : [esp32-idf3-20180511-v1.9.4.bin](#)
- GENERIC-SPIRAM : [esp32spiram-idf3-20200723-unstable-v1.12-652-gcaaaa2b1f.bin](#)
- GENERIC-SPIRAM : [esp32spiram-idf3-20200722-unstable-v1.12-649-g27767aafa.bin](#)
- GENERIC-SPIRAM : [esp32spiram-idf3-20200721-unstable-v1.12-648-ga853fff83.bin](#)
- GENERIC-SPIRAM : [esp32spiram-idf3-20200720-unstable-v1.12-634-gb7698841b.bin](#)
- **GENERIC-SPIRAM : [esp32spiram-idf3-20191220-v1.12.bin](#)**
- GENERIC-SPIRAM : [esp32spiram-idf3-20190529-v1.11.bin](#)
- GENERIC-SPIRAM : [esp32spiram-idf3-20190125-v1.10.bin](#)

Firmware with ESP-IDF v4.x

Firmware built with ESP-IDF v4.x, with support for BLE, but no LAN or PPP:

- GENERIC : [esp32-idf4-20200723-unstable-v1.12-652-gcaaaa2b1f.bin](#)
- GENERIC : [esp32-idf4-20200722-unstable-v1.12-649-g27767aafa.bin](#)
- GENERIC : [esp32-idf4-20200721-unstable-v1.12-648-ga853fff83.bin](#)
- GENERIC : [esp32-idf4-20200720-unstable-v1.12-634-gb7698841b.bin](#)

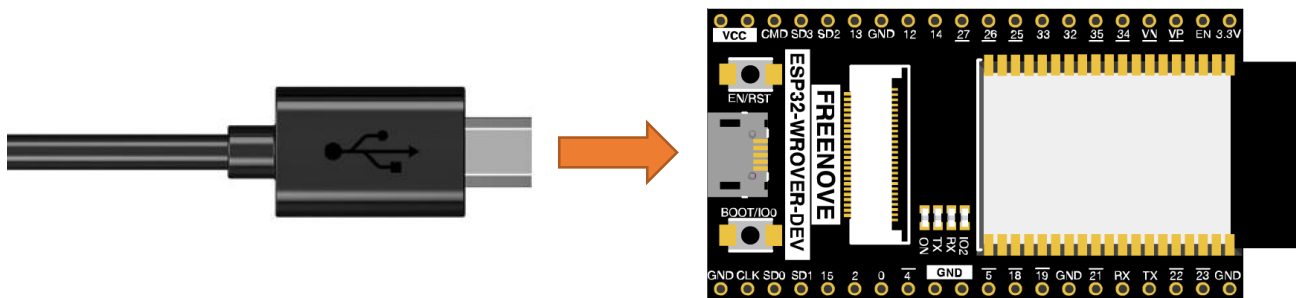
Firmware used in this tutorial is **esp32spiram-idf3-20191220-v1.12.bin**

Click the following link to download directly: <https://micropython.org/resources/firmware/esp32spiram-idf3-20191220-v1.12.bin>

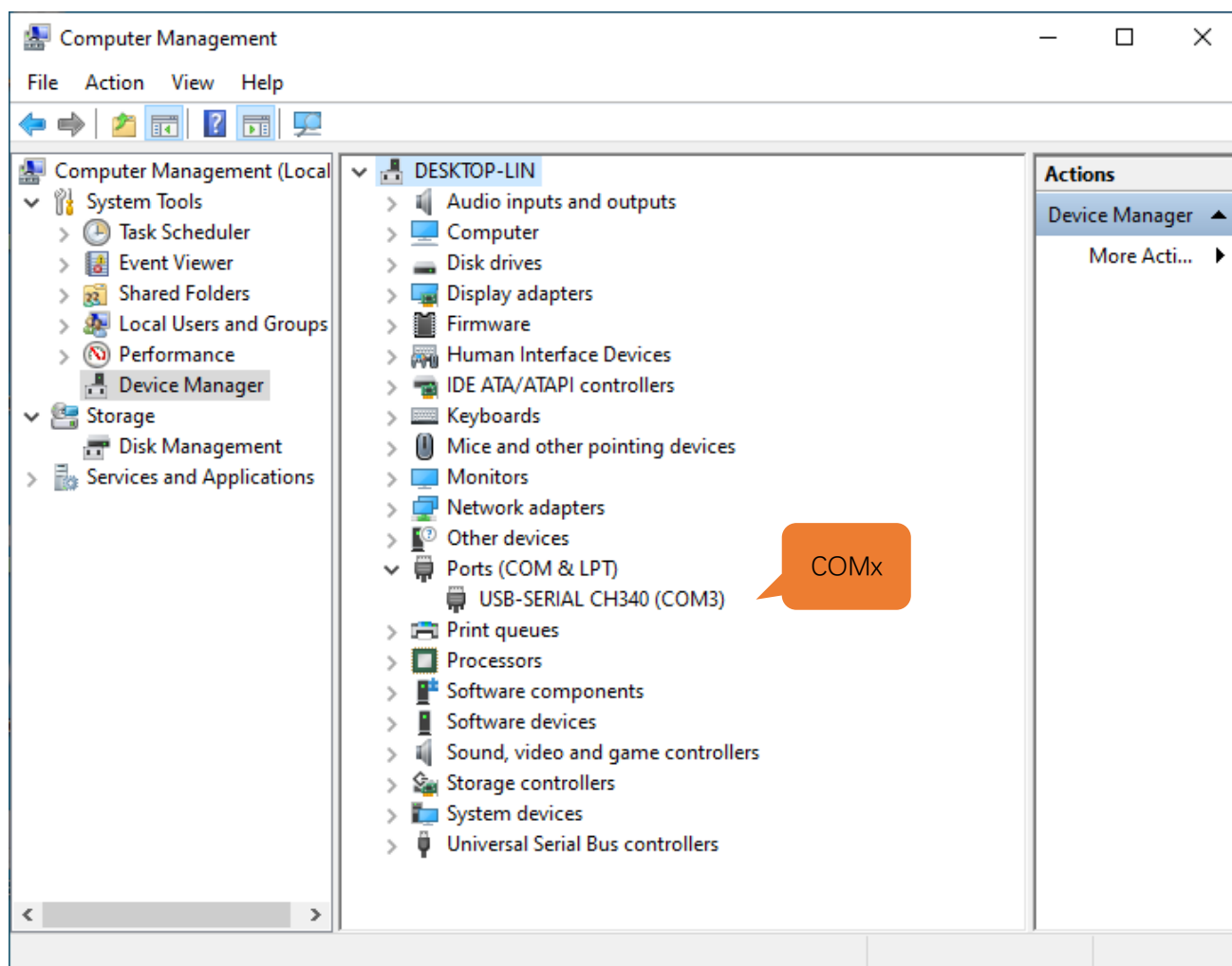
This file is also provided in our data folder "Freenove_Ultimate_Starter_Kit_for_ESP32/Python/Python_Firmware".

Burning a Micropython Firmware

Connect your computer and ESP32 with a USB cable.

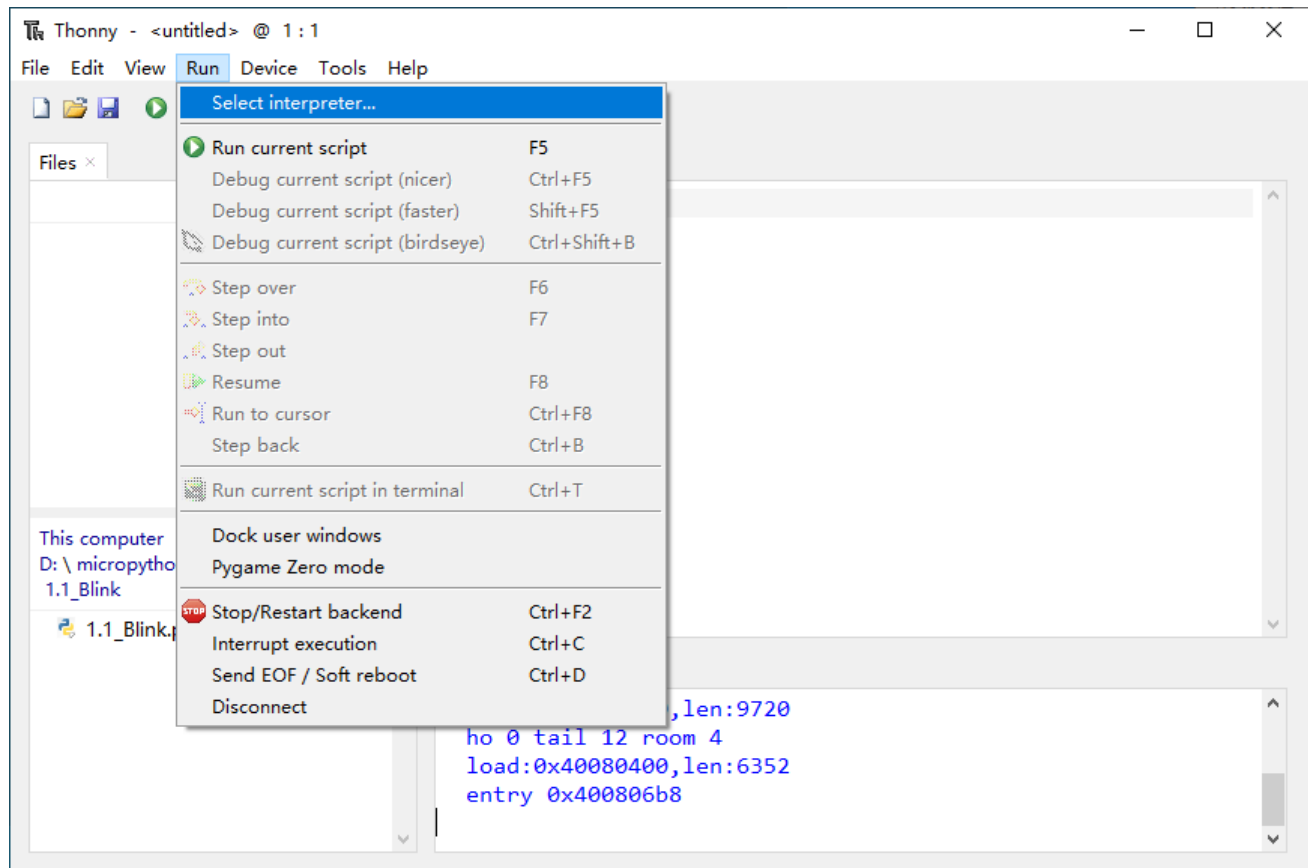


Make sure that the driver has been installed successfully and that it can recognize COM port correctly. Open device manager and expand "Ports".

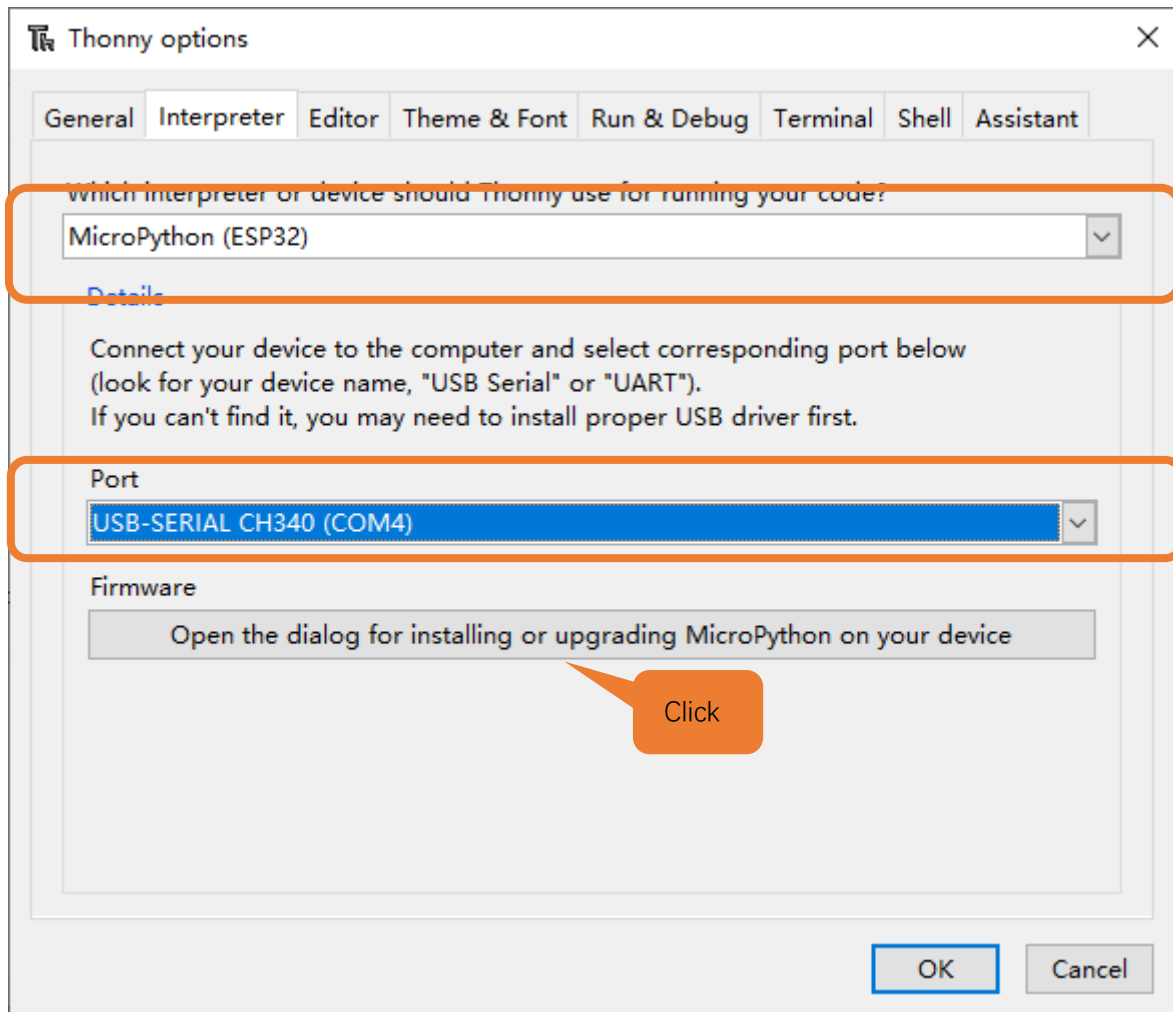


Note: the port of different people may be different, which is a normal situation.

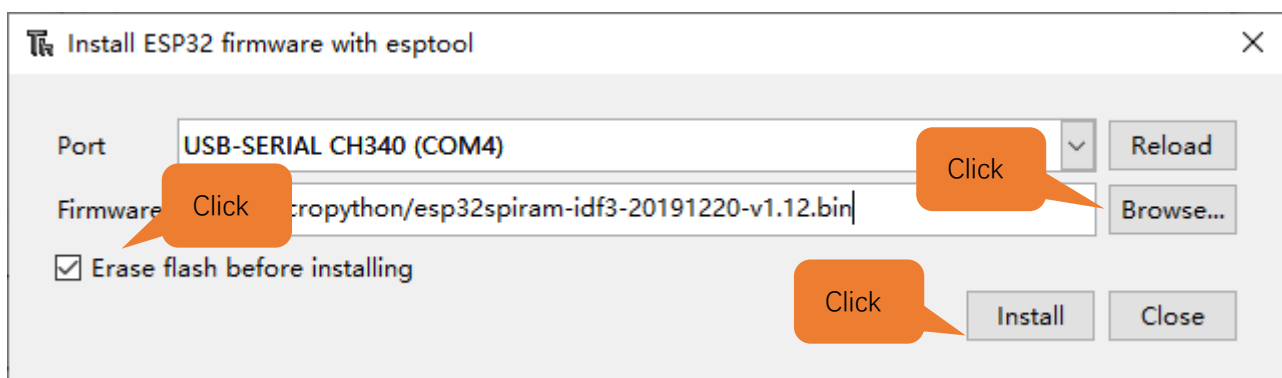
1. Open Thonny, click “run” and select “Select interpreter...”



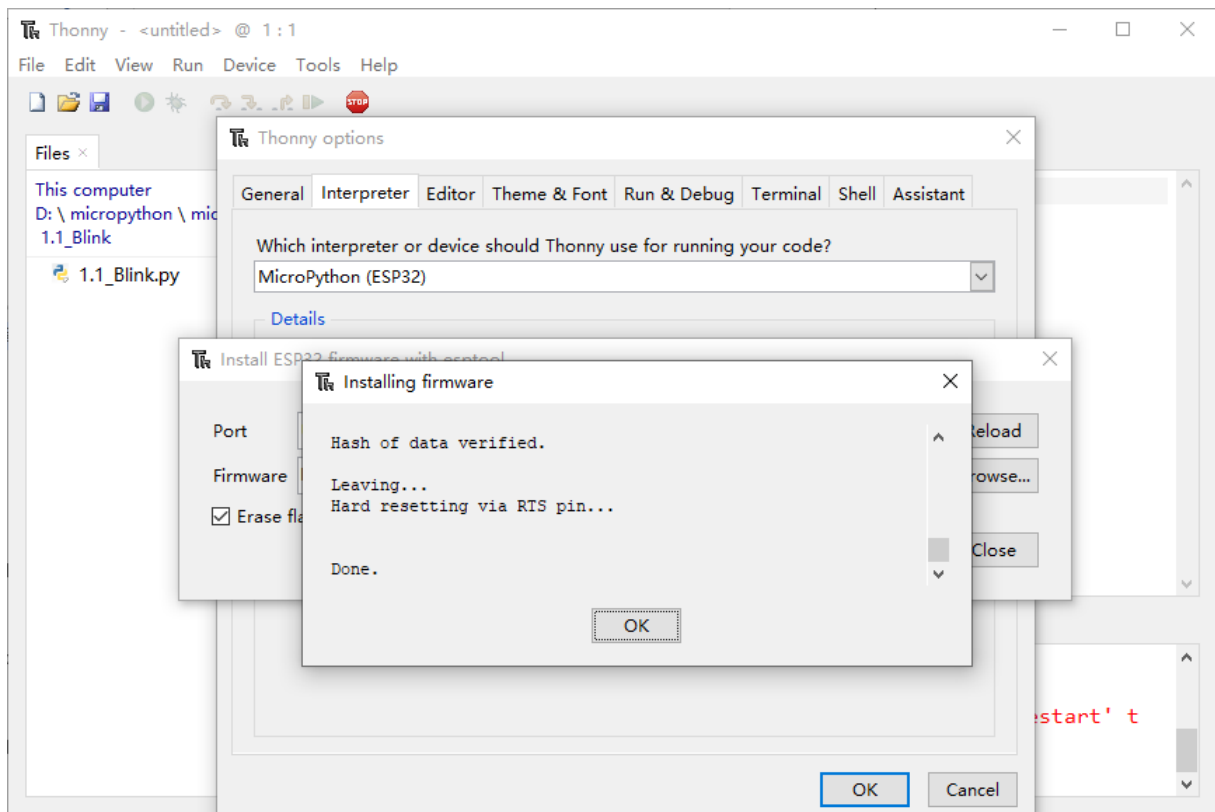
2. Select "Micropython (ESP32)", select "USB-SERIAL CH340 (COM4)", and then click the long button under "Firmware".



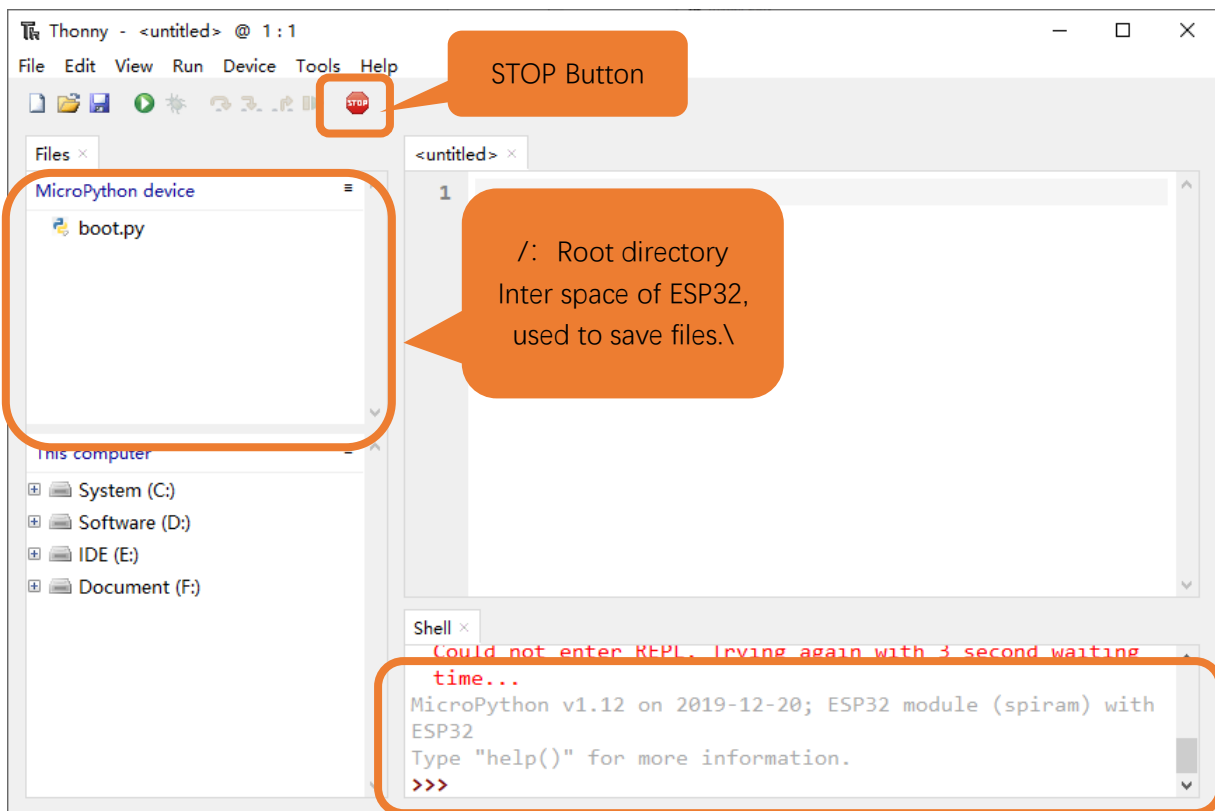
3. The following dialog box pops up. Select "USB-SERIAL CH340 (COM4)" for "Port" and then click "Browse...". Select the previous prepared microPython firmware "**esp32spiram-idf3-20191220-v1.12.bin**". Check "Erase flash before installing" and click "install" to wait for the prompt of finishing installation



4. Wait for the installation to be done.



5. Close all dialog boxes, turn to main interface and click "STOP". As shown in the illustration below

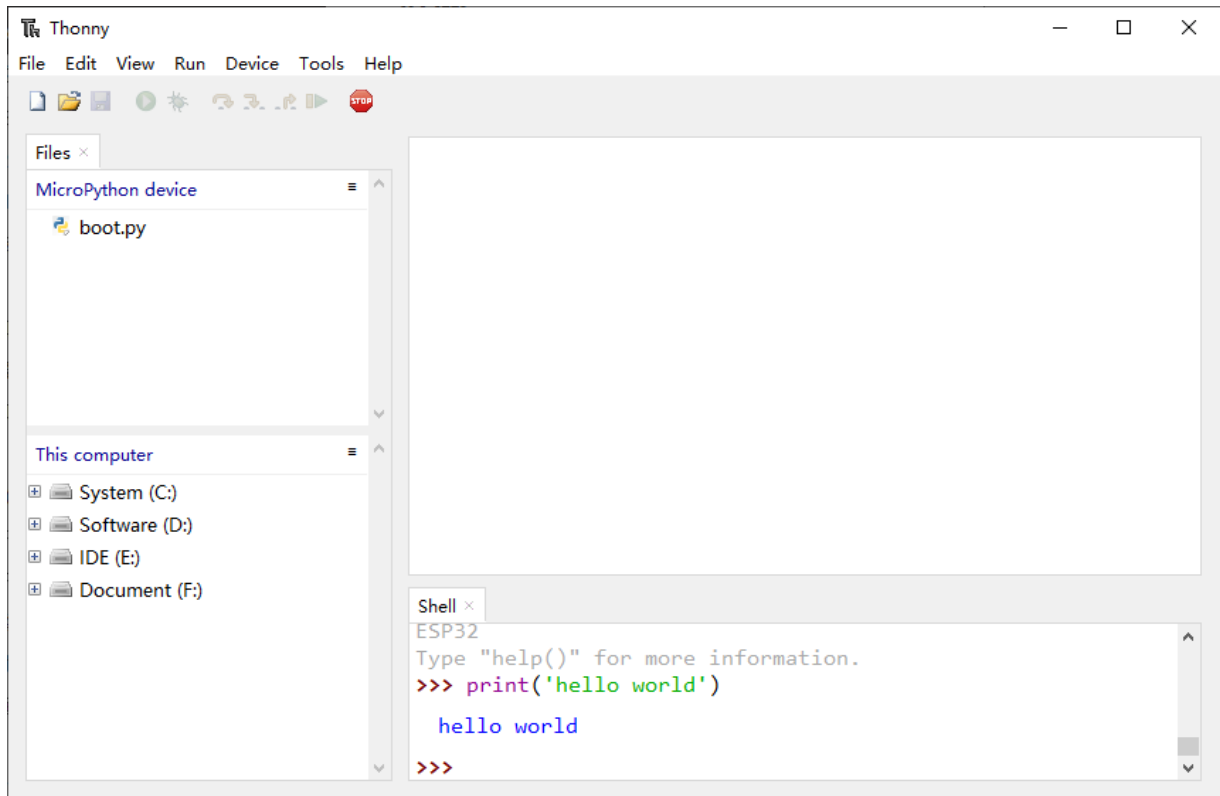


6. So far, all the preparations have been made.

0.5 Testing codes (Important)

Testing Shell Command

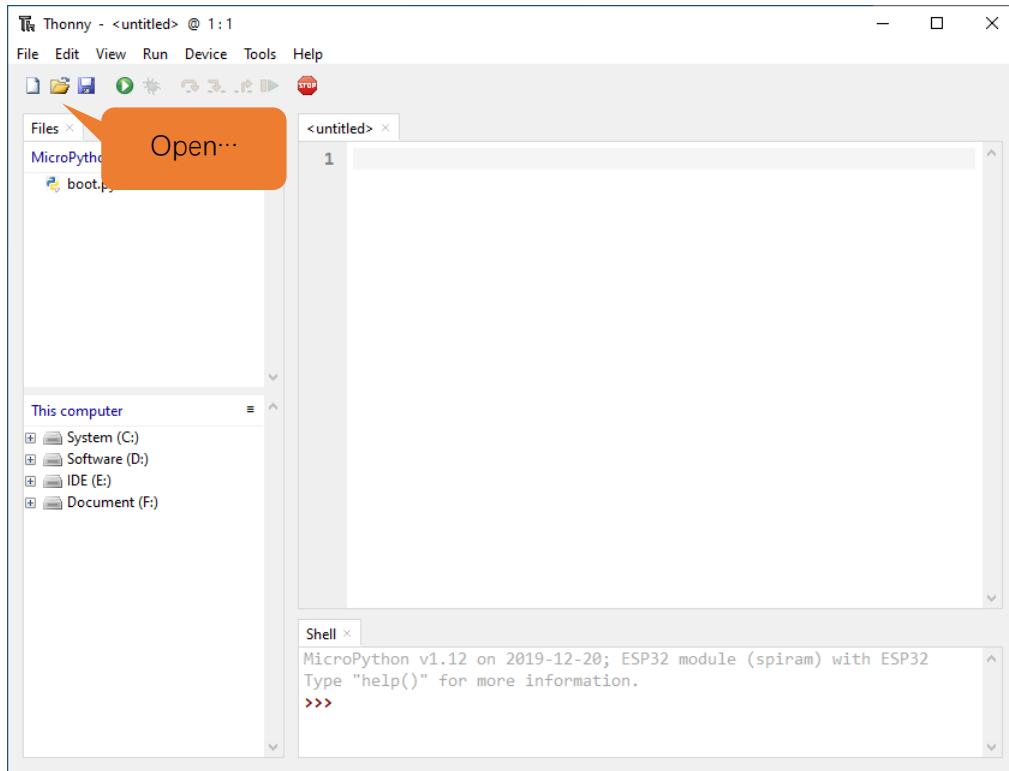
Enter `print('hello world')` in "Shell" and press Enter.



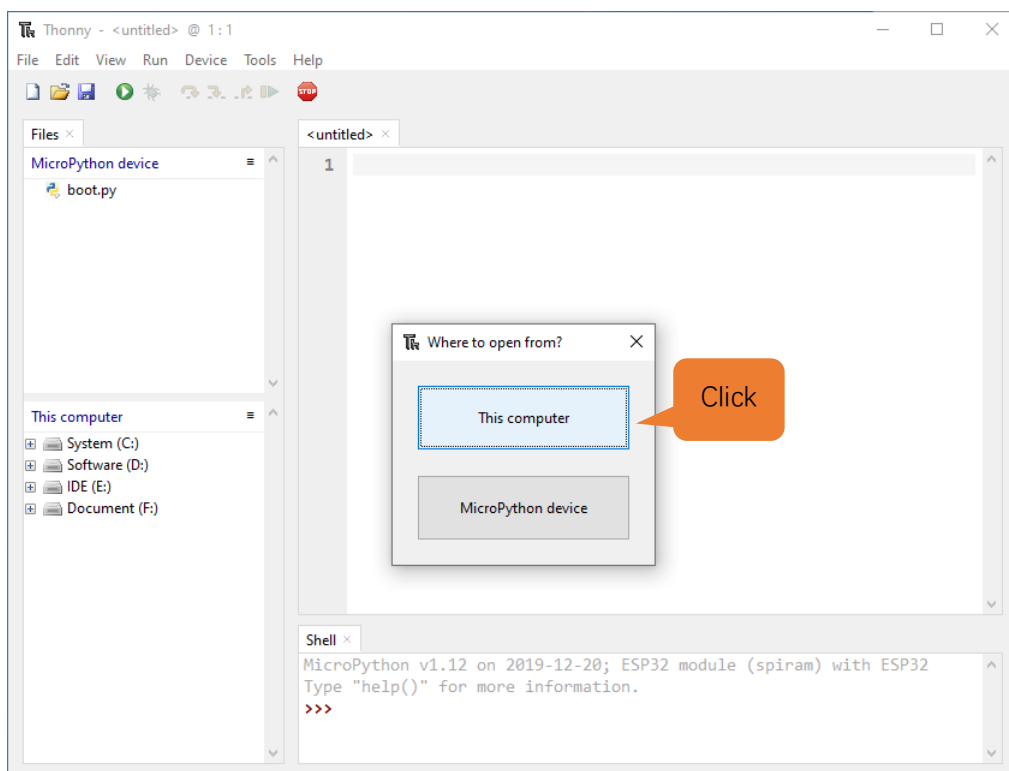
Running Online

ESP32 needs to be connected to a computer when it is run online. Users can use Thonny to write and debug programs.

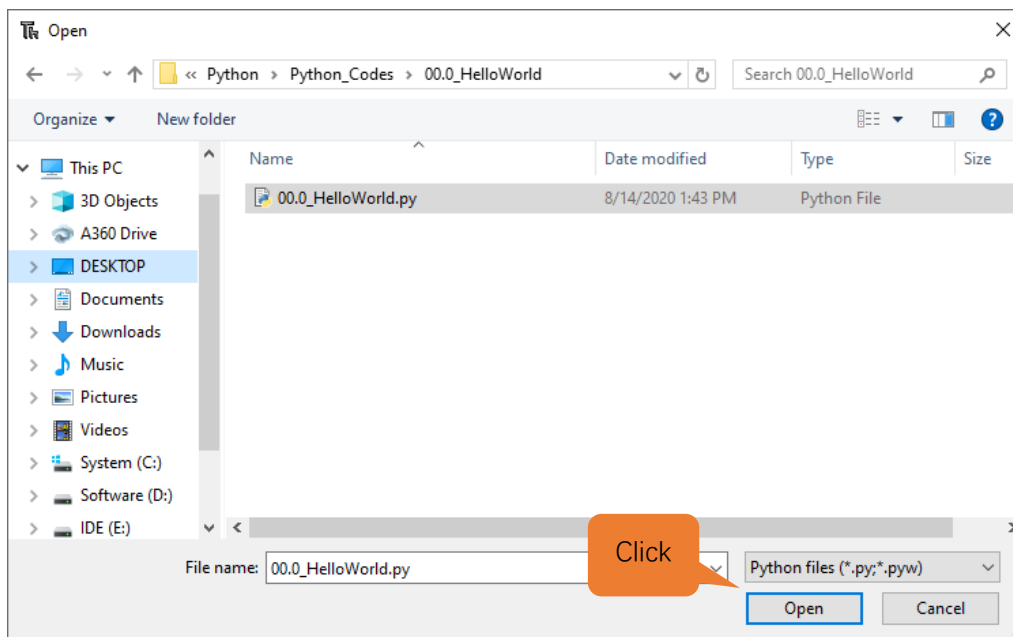
1. Open Thonny and click “Open…”.



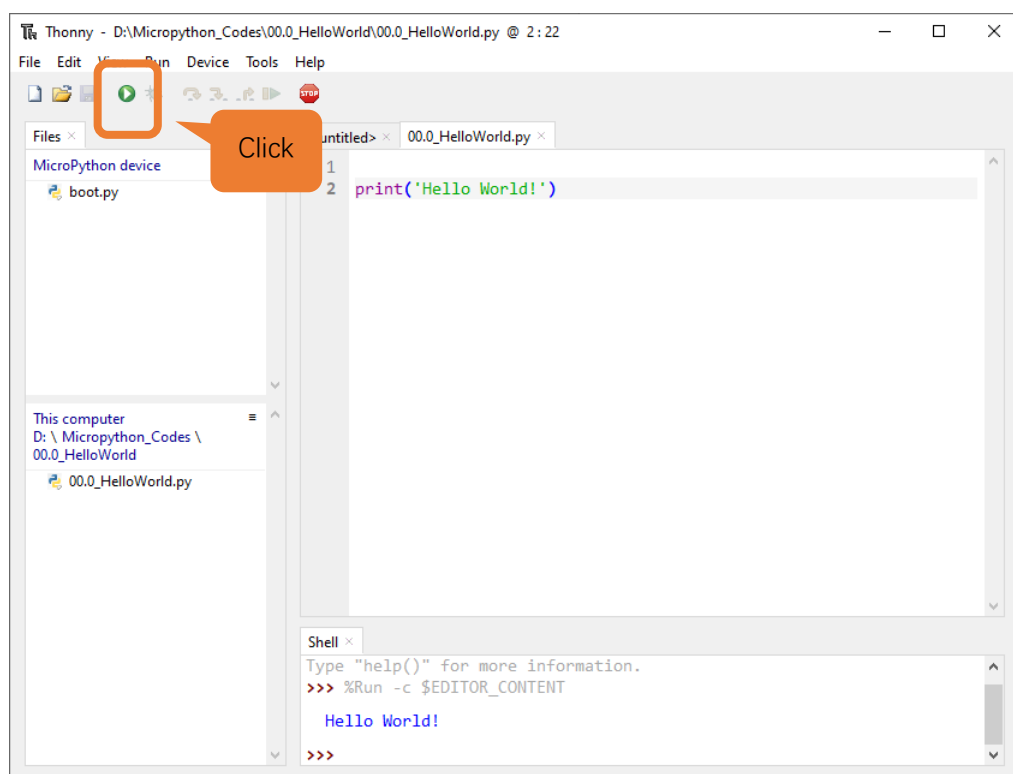
2. On the newly pop-up window, click “This computer”.



In the new dialog box, select “00.0_HelloWorld.py” in “Freenove_Ultimate_Starter_Kit_for_ESP32/Python/Python_Codes/00.0_HelloWorld” folder.



Click “Run current script” to execute the program and “Hello World” will be printed in “Shell”.

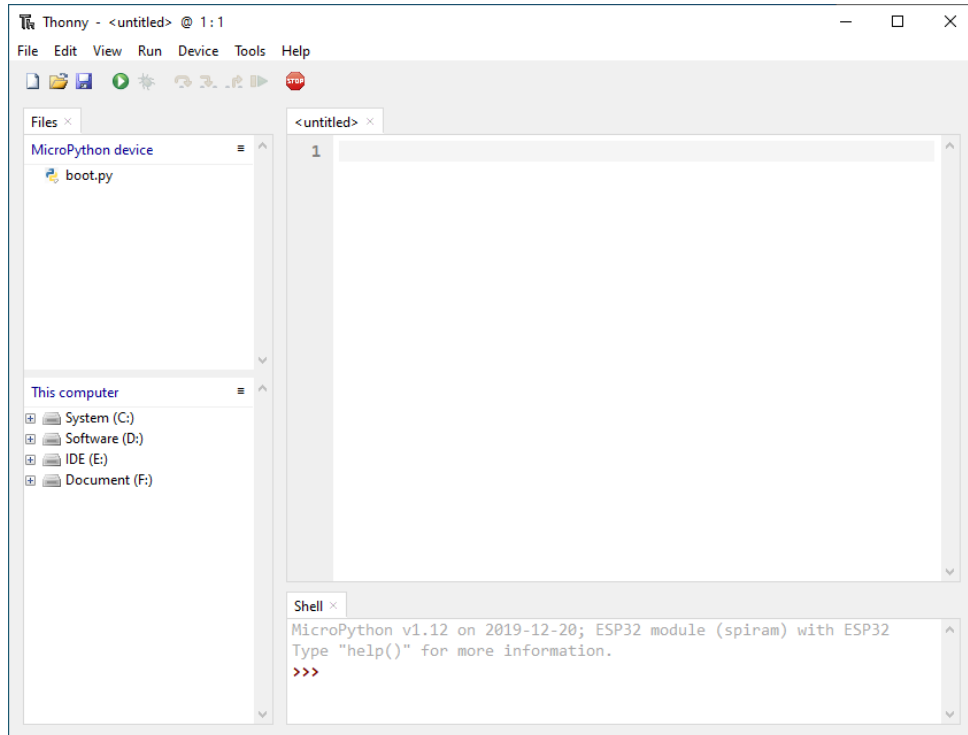


Note: When running online, if you press the reset key of ESP32, user's code will not be executed again. If you wish to run the code automatically after resetting the code, please refer to the following [Running Offline](#).

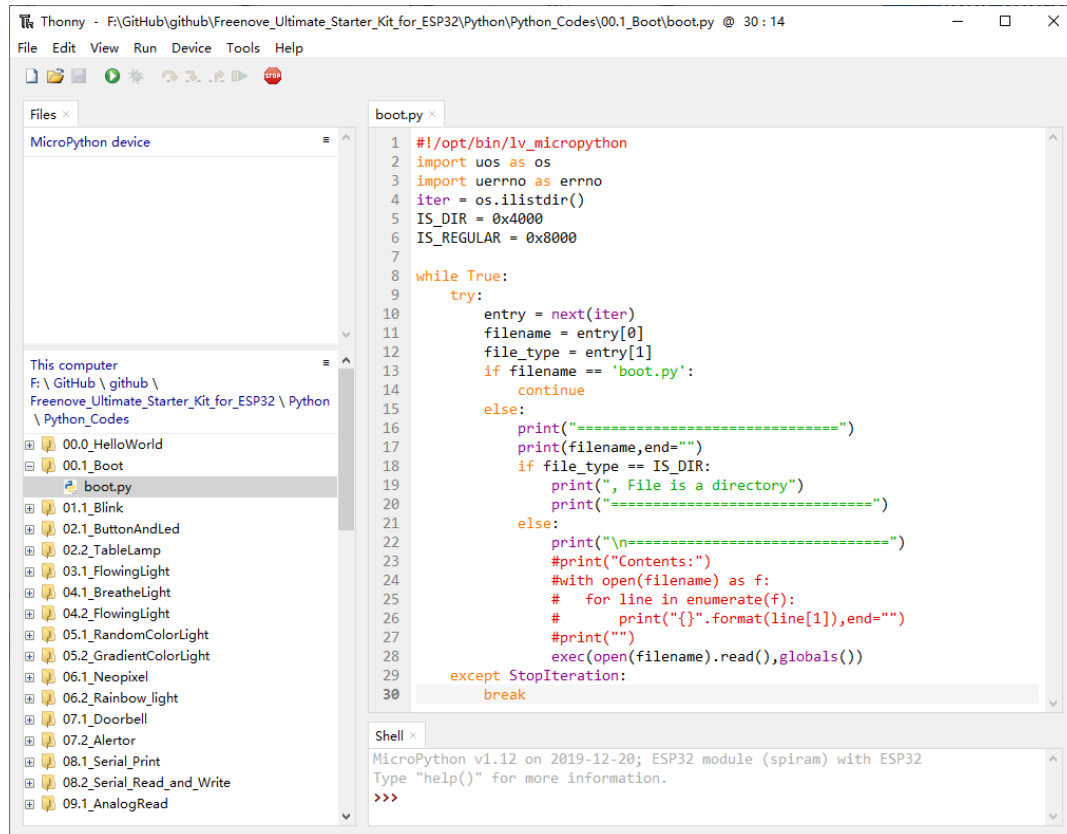
Running Offline (Importance)

After ESP32 is reset, it runs the file `boot.py` in root directory first and then runs file `main.py`, and finally, it enters "Shell". Therefore, to make ESP32 execute user's programs after resetting, we need to add a guiding program in `boot.py` to execute user's code.

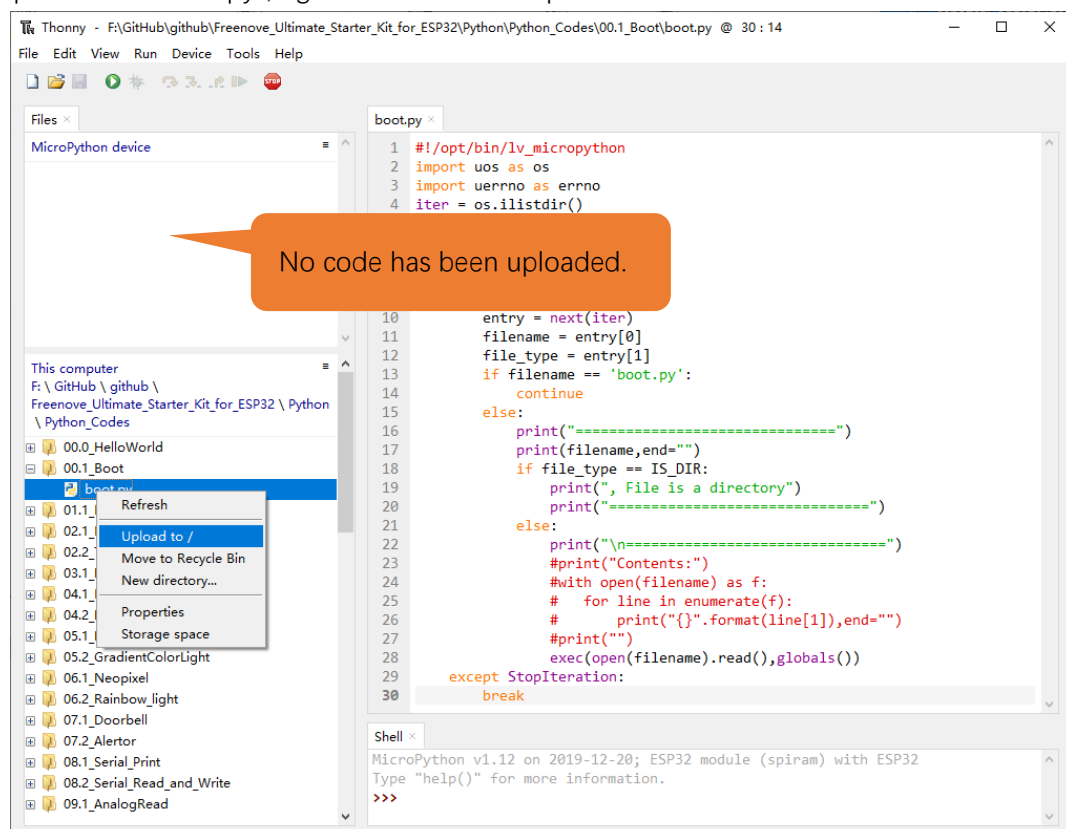
1. Move the program folder "**Freenove_Ultimate_Starter_Kit_for_ESP32/Python/Python_Codes**" to disk(D) in advance with the path of "**D:/Micropython_Codes**". Open "Thonny".



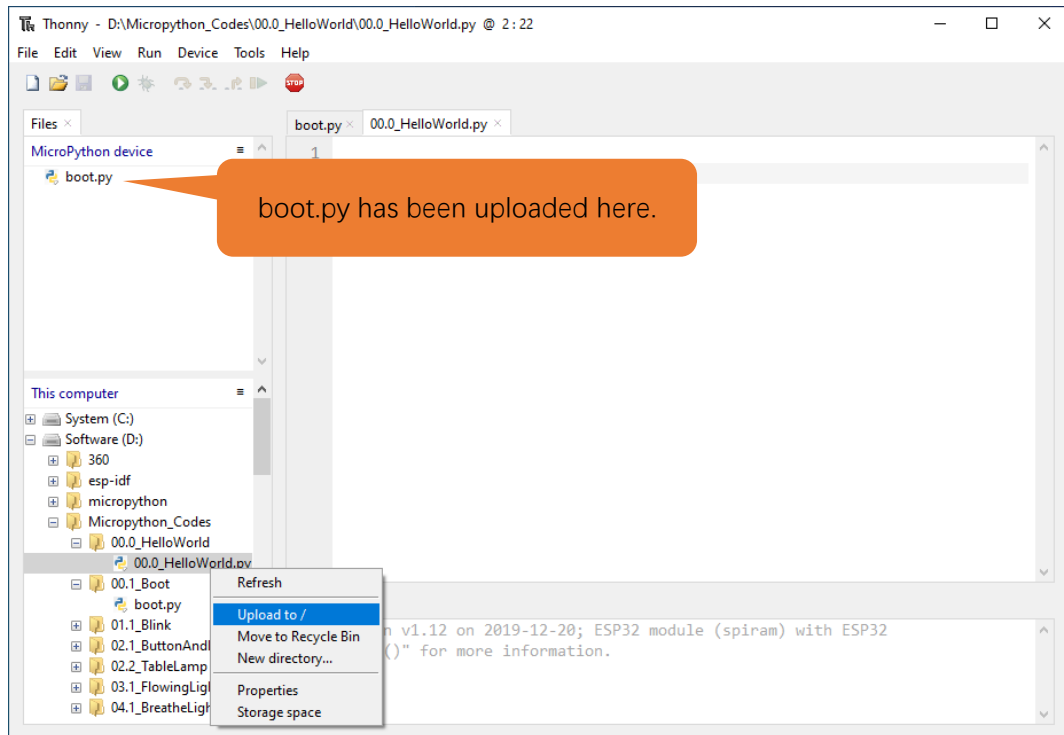
2. Expand "00.1_Boot" in the "Micropython_Codes" in the directory of disk(D), and double-click `boot.py`, which is provided by us to enable programs in "MicroPython device" to run offline.



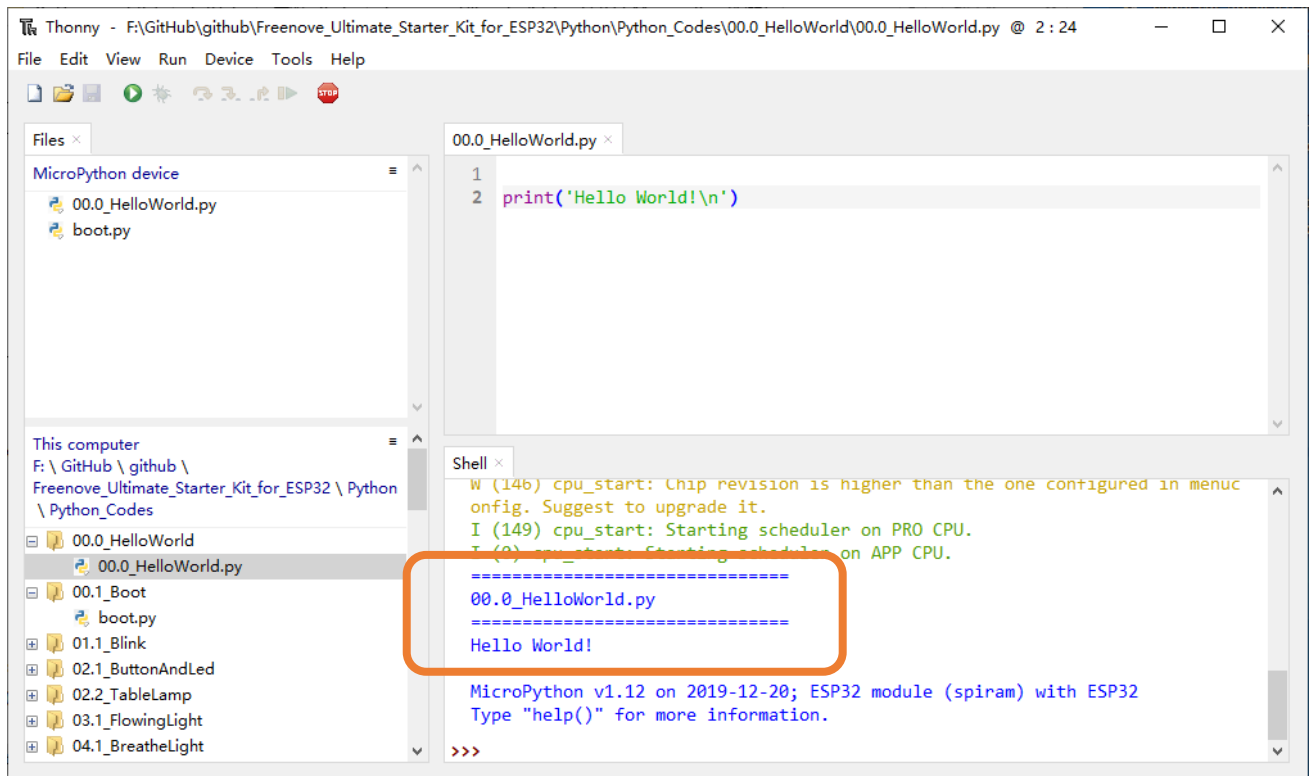
If you want your written programs to run offline, you need to upload `boot.py` we provided and all your codes to "MicroPython device" and press ESP32's reset key. Here we use programs 00.0 and 00.1 as examples. Select "`boot.py`", right-click to select "Upload to /".



Similarly, upload “00.0_HelloWorld.py” to “MicroPython device”.



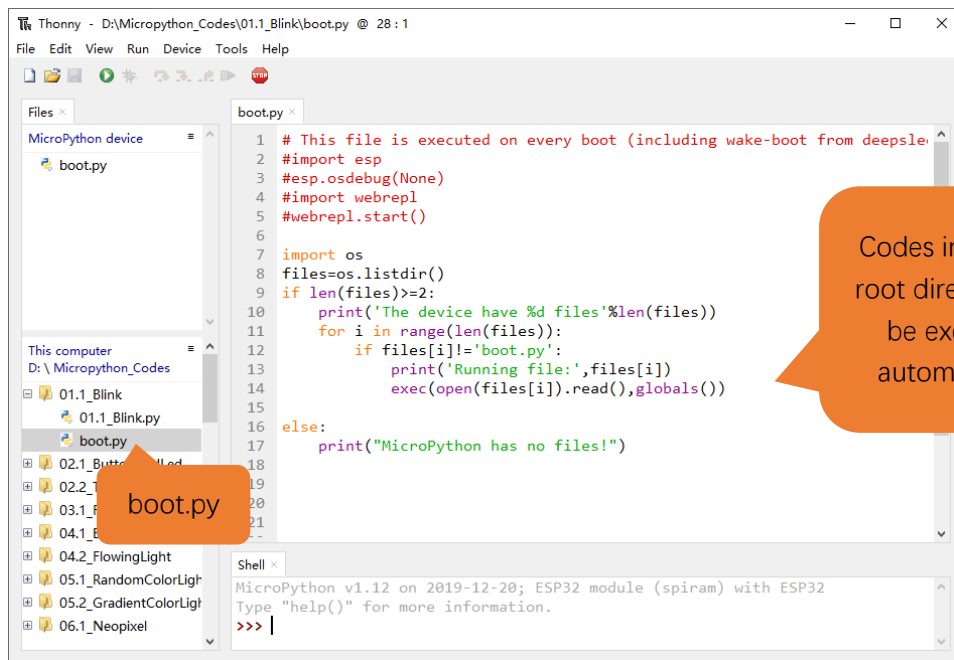
3. Press the reset key and in the box of the illustration below, you can see the code is executed.



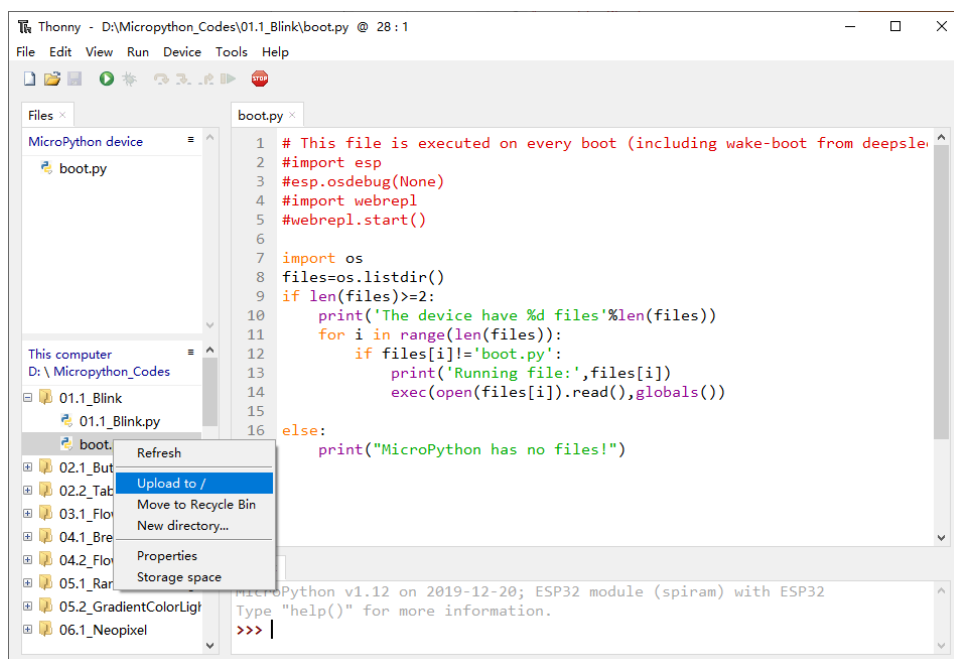
0.6 Thonny Common Operation

Uploading Code to ESP32

For convenience, we take the operation on “boot.py” as an example here. We have added “boot.py” to every code directory. Each time when ESP32 restarts, if there is a “boot.py” in the root directory, it will execute this code first.

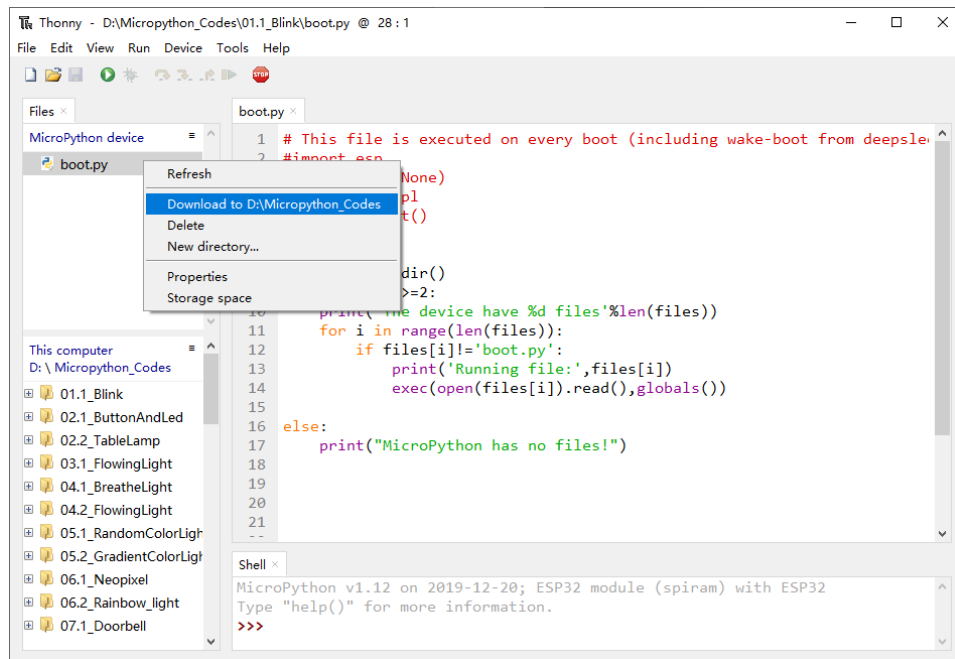


Select “boot.py” in “01.1_Blink”, right-click your mouse and select “Upload to /” to upload code to ESP32's root directory.



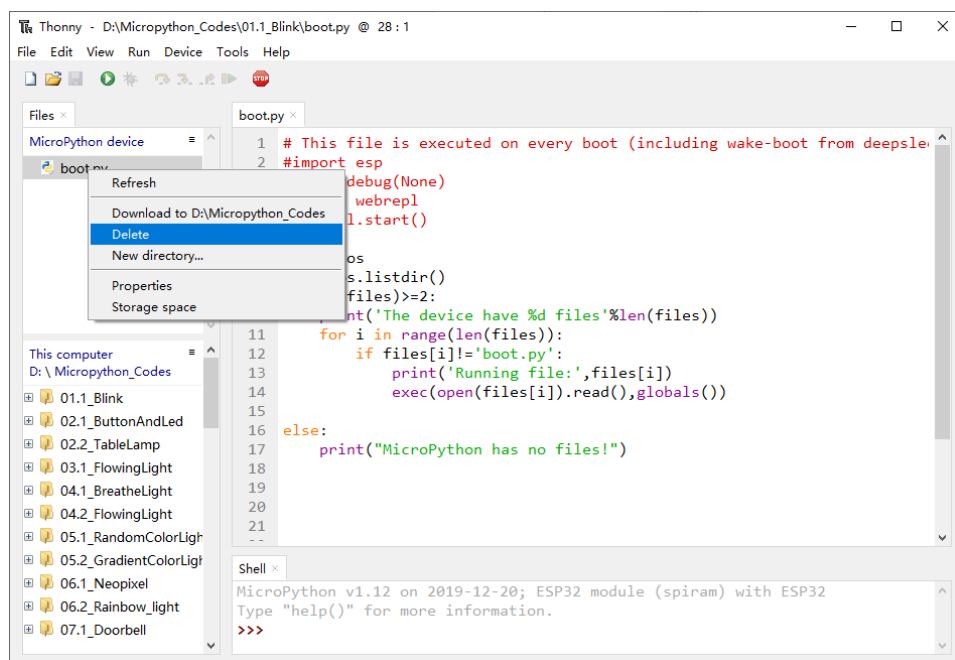
Downloading Code to Computer

Select “boot.py” in “MicroPython device”, right-click to select “Download to ...” to download the code to your computer.



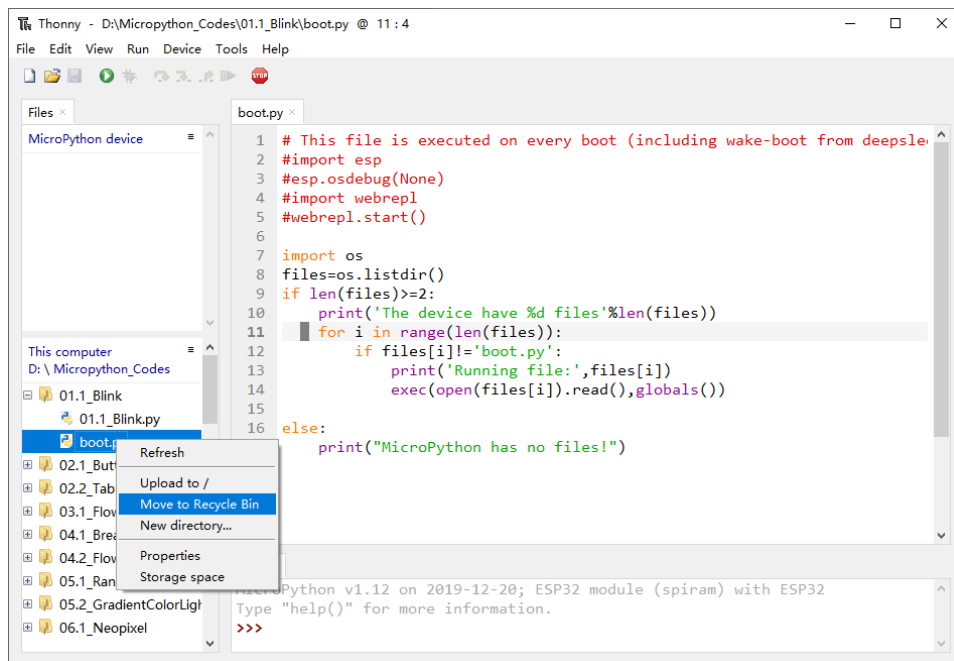
Deleting Files from ESP32's Root Directory

Select “boot.py” in “MicroPython device”, right-click it and select “Delete” to delete “boot.py” from ESP32's root directory.



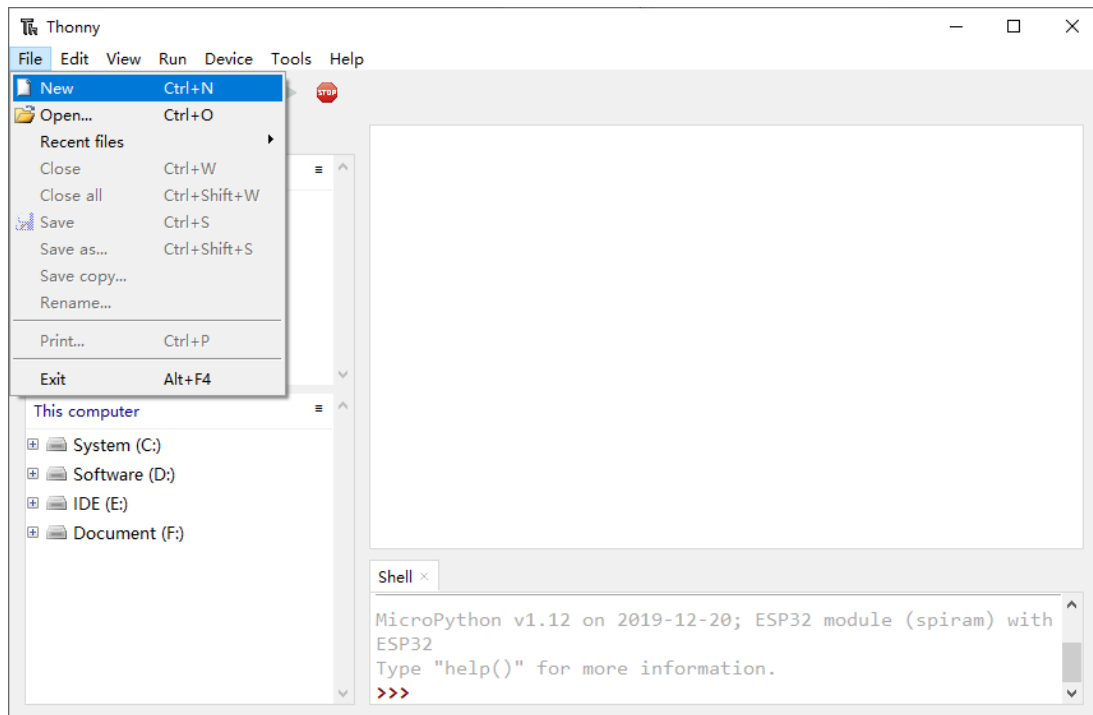
Deleting Files from your Computer Directory

Select “boot.py” in “01.1_Blink”, right-click it and select “Move to Recycle Bin” to delete it from “01.1_Blink”.

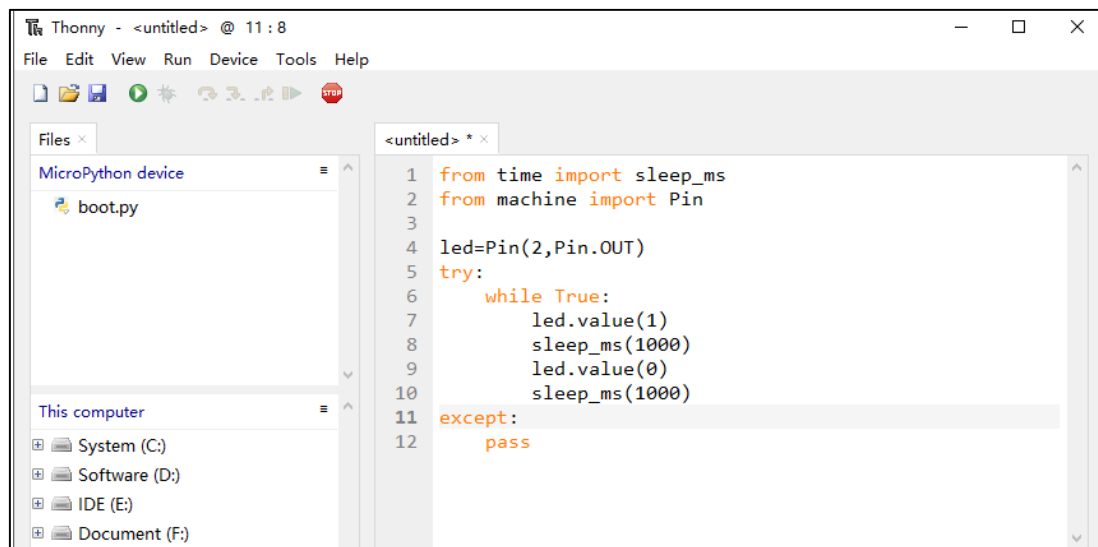


Creating and Saving the code

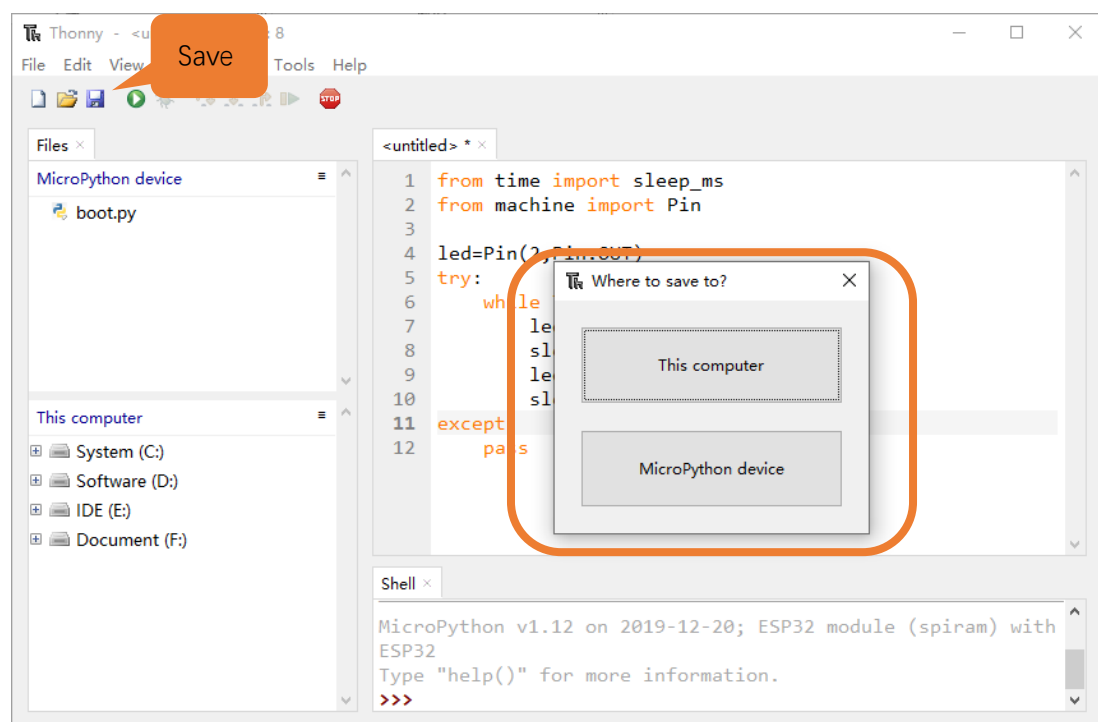
Click “File”→“New” to create and write codes.



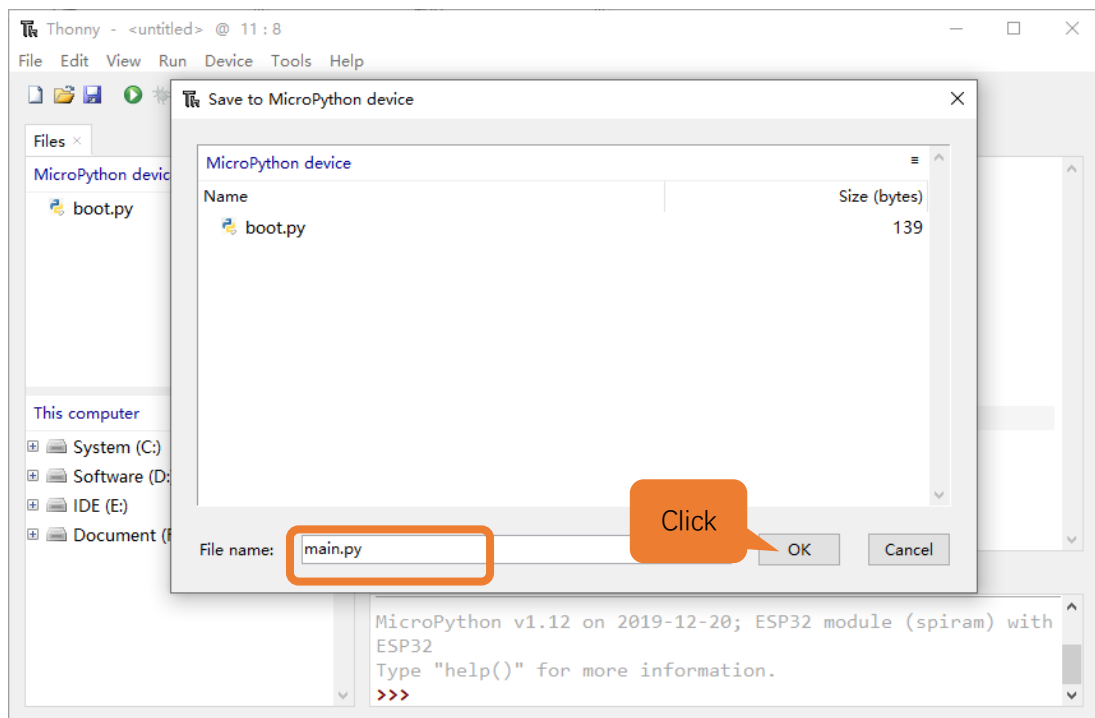
Enter codes in the newly opened file. Here we use codes of “01.1_Blink.py” as an example.



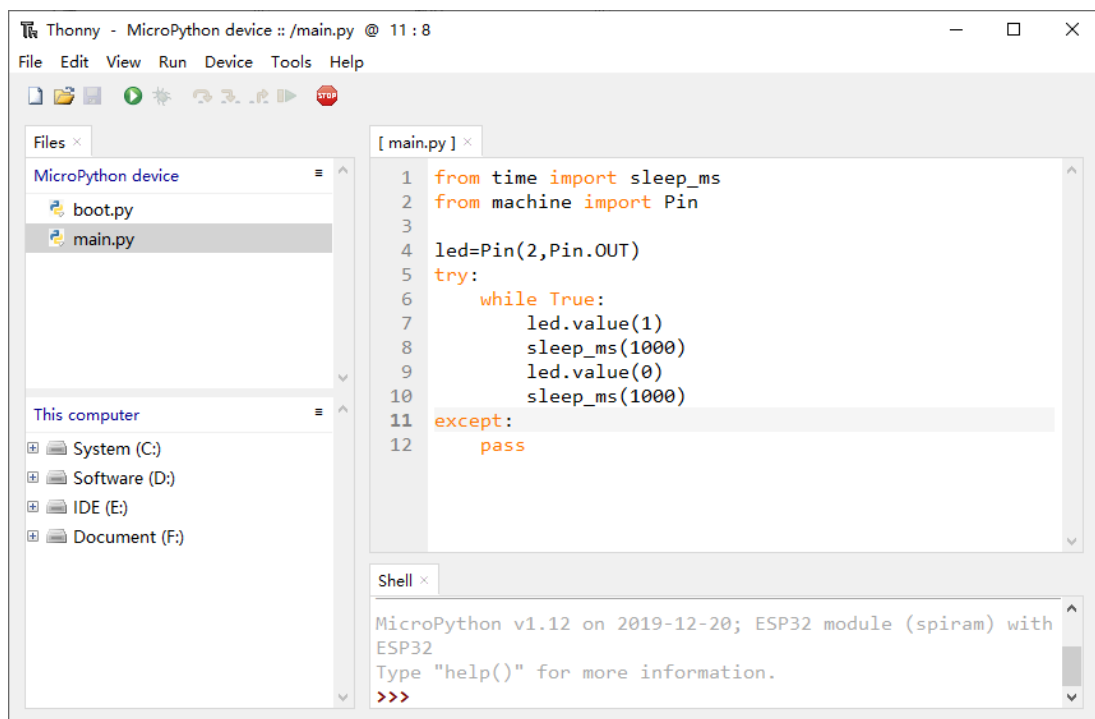
Click “Save” on the menu bar. You can save the codes either to your computer or to ESP32-WROVER.



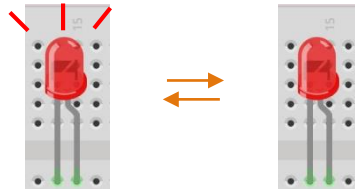
Select "MicroPython device", enter "main.py" in the newly pop-up window and click "OK".



You can see that codes have been uploaded to ESP32-WROVER.



Disconnect and reconnect USB cable, and you can see that LED is ON for one second and then OFF for one second, which repeats in an endless loop.



0.7 Note

Though there are many pins available on ESP32, some of them have been connected to peripheral equipment, so we should avoid using such pins to prevent pin conflicts. For example, when downloading programs, make sure that the pin state of Strapping Pin, when resetting, is consistent with the default level; do NOT use Flash Pin; Do NOT use Cam Pin when using Camera function.

Strapping Pin

The state of Strapping Pin can affect the functions of ESP32 after it is reset, as shown in the table below.

Voltage of Internal LDO (VDD_SDIO)					
Pin	Default	3.3 V		1.8 V	
MTDI	Pull-down	0		1	
Bootling Mode					
Pin	Default	SPI Boot		Download Boot	
GPIO0	Pull-up	1		0	
GPIO2	Pull-down	Don't-care		0	
Enabling/Disabling Debugging Log Print over U0TXD During Bootling					
Pin	Default	U0TXD Active		U0TXD Silent	
MTDO	Pull-up	1		0	
Timing of SDIO Slave					
Pin	Default	Falling-edge Sampling Falling-edge Output	Falling-edge Sampling Rising-edge Output	Rising-edge Sampling Falling-edge Output	Rising-edge Sampling Rising-edge Output
MTDO	Pull-up	0	0	1	1
GPIO5	Pull-up	0	1	0	1

If you have any difficulties or questions with this tutorial or toolkit, feel free to ask for our quick and free technical support through support@freenove.com at any time.

or check: https://www.espressif.com/sites/default/files/documentation/esp32-wrover_datasheet_en.pdf

Flash Pin

GPIO6-11 has been used to connect the integrated SPI flash on the module, and is used when GPIO 0 is power on and at high level. Flash is related to the operation of the whole chip, so the external pin GPIO6-11 cannot be used as an experimental pin for external circuits, otherwise it may cause errors in the operation of

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the program.

GPIO16-17 has been used to connect the integrated PSRAM on the module.

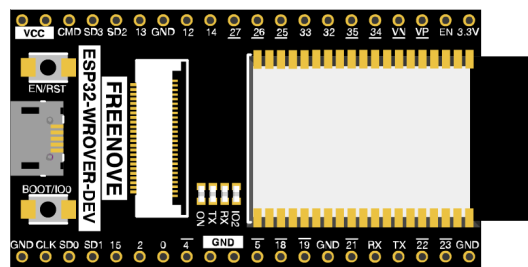
Because of external pull-up, MTDI pin is not suggested to be used as a touch sensor. For details, please refer to Peripheral Interface and Sensor chapter in "[ESP32 Data Sheet](#)".

For more relevant information, please click:

https://www.espressif.com/sites/default/files/documentation/esp32-wrover_datasheet_en.pdf.

Cam Pin

When using the cam camera of our ESP32-WROVER, please check the pins of it. Pins with underlined numbers are used by the cam camera function, if you want to use other functions besides it, please avoid using them.



CAM_Pin	GPIO_pin
I2C_SDA	GPIO26
I2C_SCL	GPIO27
CSI_VYSNC	GPIO25
CSI_HREF	GPIO23
CSI_Y9	GPIO35
XCLK	GPIO21
CSI_Y8	GPIO34
CSI_Y7	GPIO39
CSI_PCLK	GPIO22
CSI_Y6	GPIO36
CSI_Y2	GPIO4
CSI_Y5	GPIO19
CSI_Y3	GPIO5
CSI_Y4	GPIO18

If you have any questions about the information of GPIO, you can click [here](#) to go back to ESP32-WROVER to view specific information about GPIO.

Or check: https://www.espressif.com/sites/default/files/documentation/esp32-wrover_datasheet_en.pdf.

Chapter 1 LED (Important)

This chapter is the Start Point in the journey to build and explore ESP32 electronic projects. We will start with simple “Blink” project.

Project 1.1 Blink

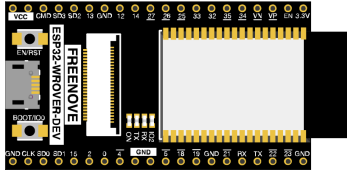
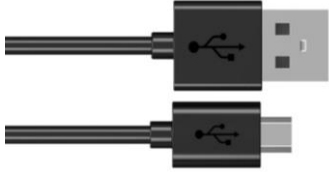
In this project, we will use ESP32 to control blinking a common LED.

If you have not yet installed Thonny, click [here](#).

If you have not yet downloaded Micropython Firmware, click [here](#).

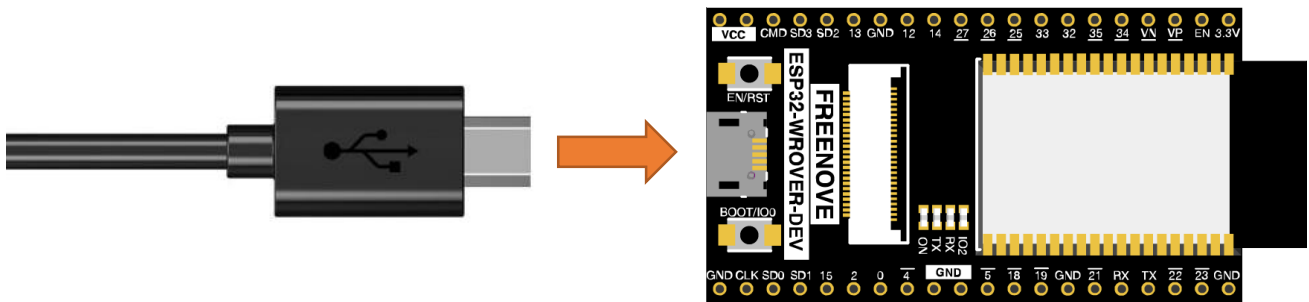
If you have not yet loaded Micropython Firmware, click [here](#).

Component List

ESP32-WROVER x1 	USB cable 
---	--

Power

ESP32-WROVER needs 5v power supply. In this tutorial, we need connect ESP32-WROVER to computer via USB cable to power it and program it. We can also use other 5v power source to power it.



In the following projects, we only use USB cable to power ESP32-WROVER by default.

In the whole tutorial, we don't use T extension to power ESP32-WROVER. So 5V and 3.3V (including EXT 3.3V) on the extension board are provided by ESP32-WROVER.

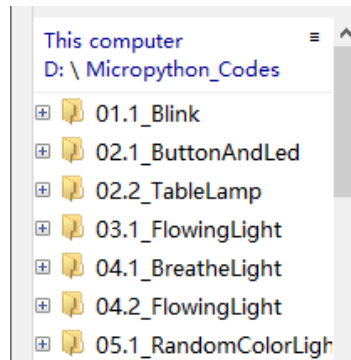
We can also use DC jack of extension board to power ESP32-WROVER. In this way, 5v and EXT 3.3v on extension board are provided by external power resource.

Code

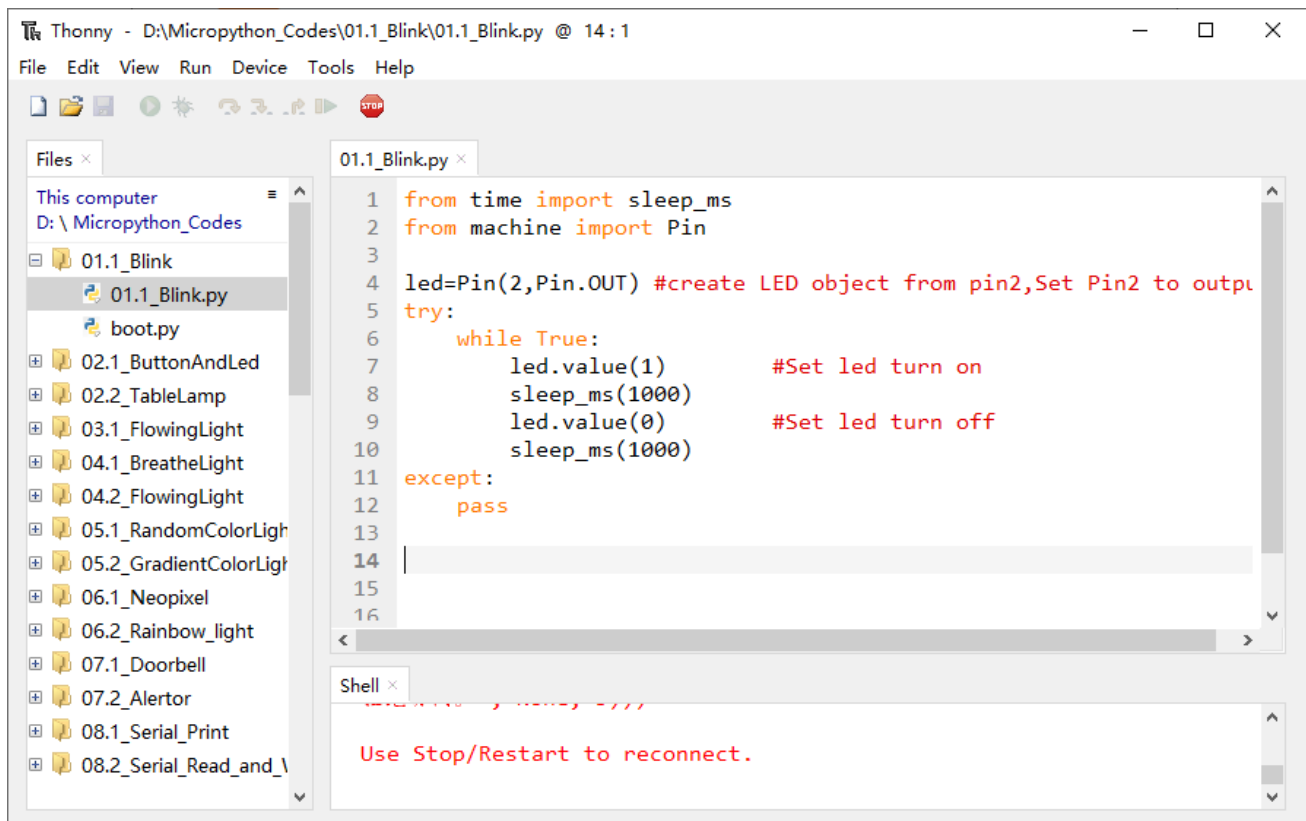
Codes used in this tutorial are saved in “**Freenove_Ultimate_Starter_Kit_for_ESP32/Python/Python_Codes**”. You can move the codes to any location. For example, we save the codes in Disk(D) with the path of “**D:/Micropython_Codes**”.

01.1_Blink

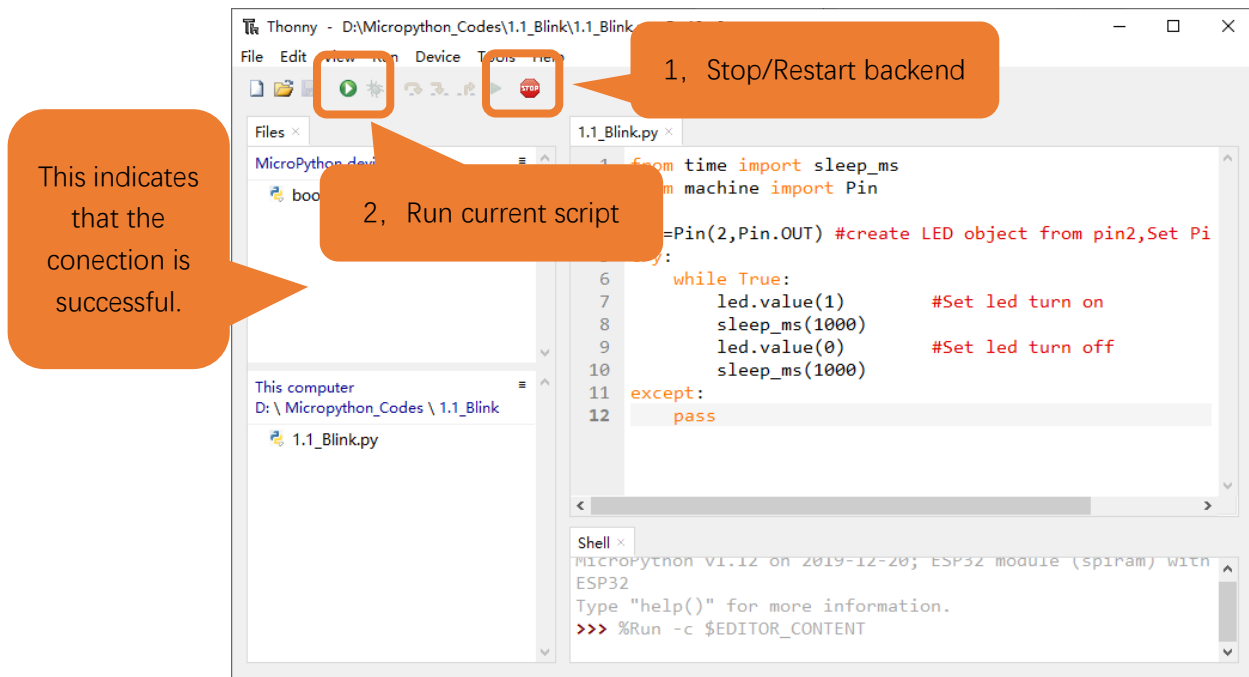
Open “Thonny”, click “This computer”→“D:”→“Micropython_Codes”.



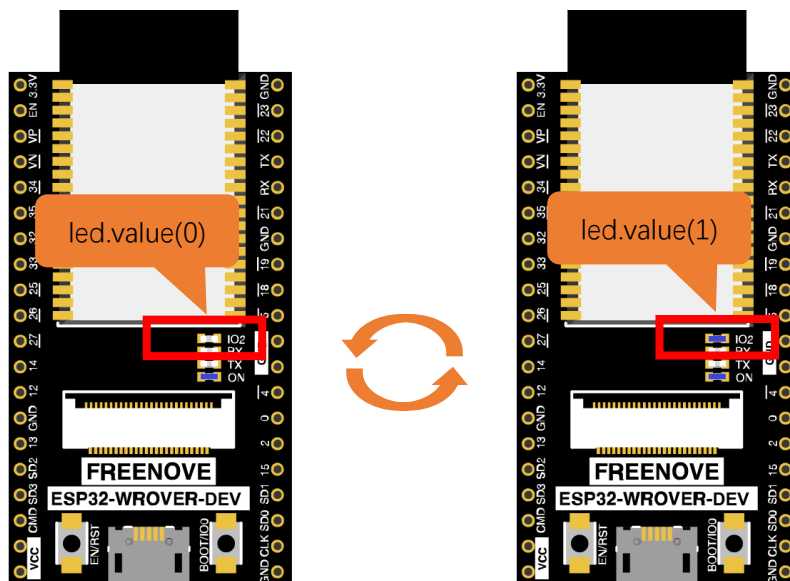
Expand folder “01.1_Blink” and double click “01.1_Blink.py” to open it. As shown in the illustration below.



Make sure ESP32 has been connected with the computer with ESP32 correctly. Click “Stop/Restart backend” or press the reset button, and then wait to see what interface will show up.

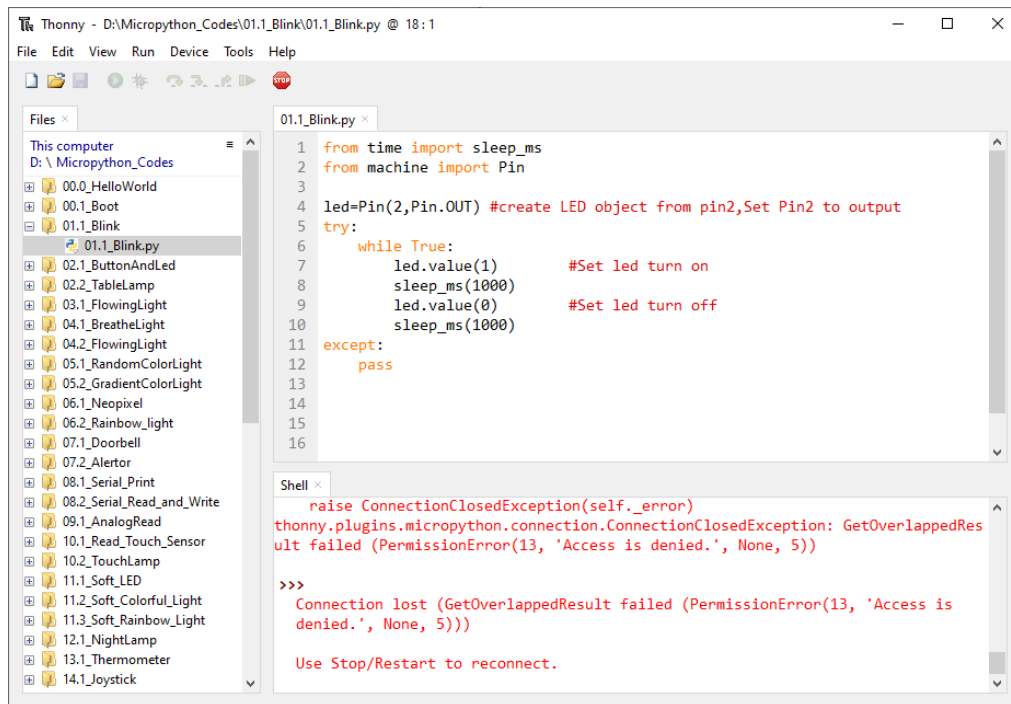


Click "Run current script" shown in the box above, the code starts to be executed and the LED in the circuit starts to blink.



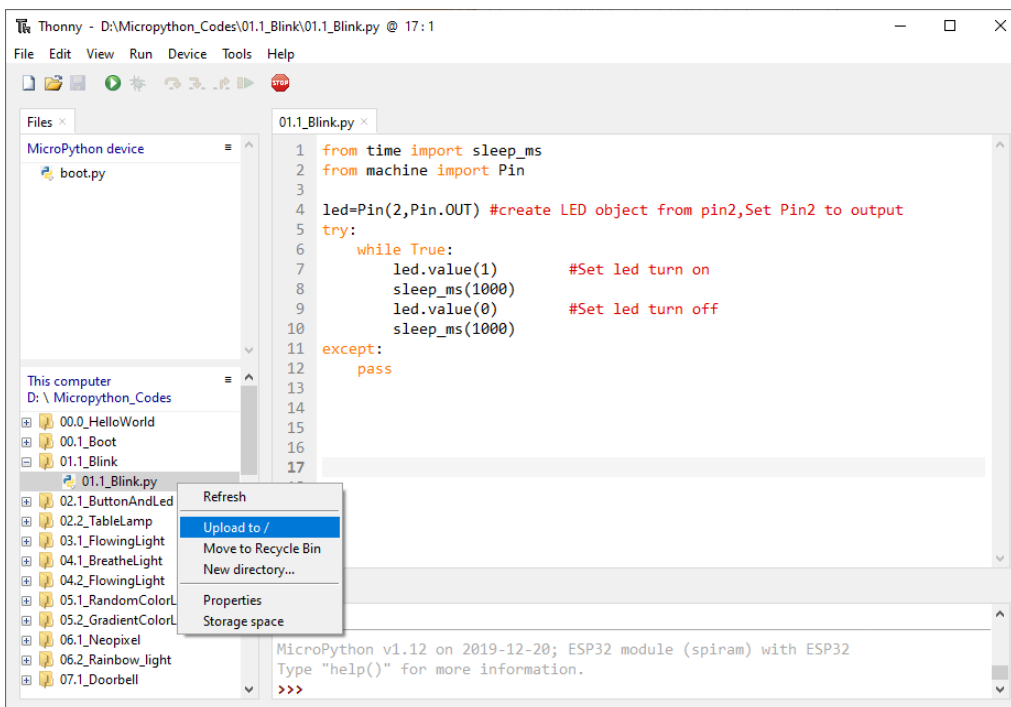
Note:

This is the code [running online](#). If you disconnect USB cable and repower ESP32 or press its reset key, LED stops blinking and the following messages will be displayed in Thonny.

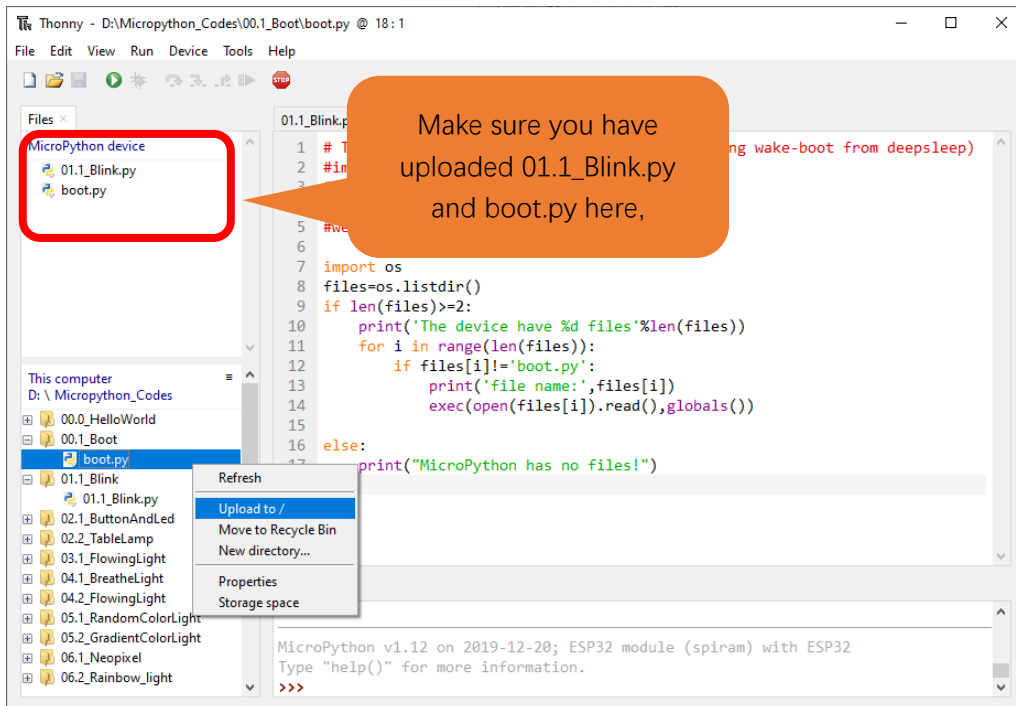


Uploading code to ESP32

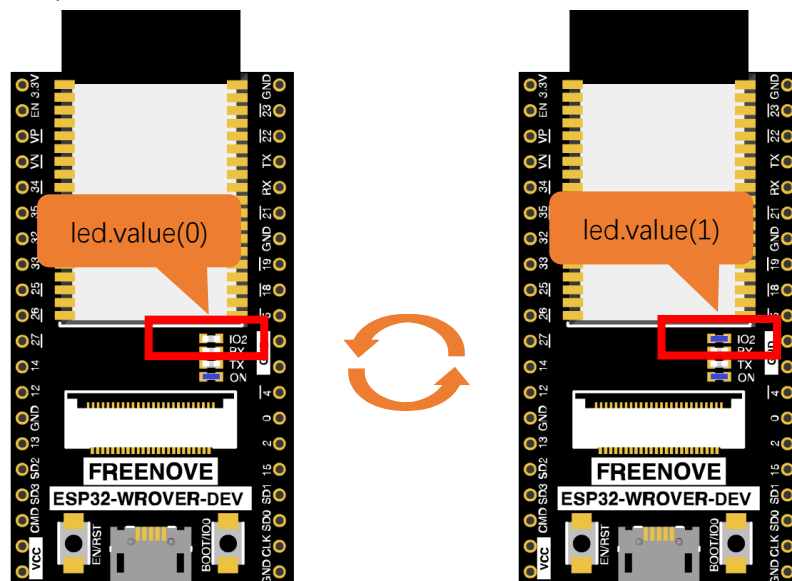
As shown in the following illustration, right-click the file 01.1_Blink.py and select “Upload to /” to upload code to ESP32.



Upload boot.py in the same way.

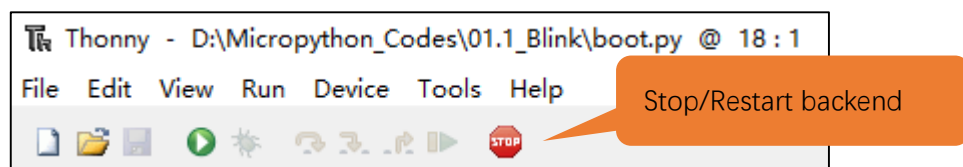


Press the reset key of ESP32 and you can see LED is ON for one second and then OFF for one second, which repeats in an endless loop.



Note:

Codes here is run offline. If you want to stop running offline and enter Shell, just click "Stop" in Thonny.



If you have any concerns, please contact us via: support@freenove.com

Any concerns? [✉ support@freenove.com](mailto:support@freenove.com)

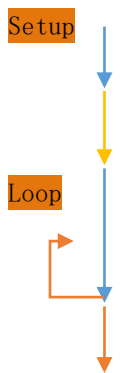
The following is the program code:

```

1  from time import sleep_ms
2  from machine import Pin
3
4  led=Pin(2,Pin.OUT) #create LED object from pin2,Set Pin2 to output
5  try:
6      while True:
7          led.value(1) #Set led turn on
8          sleep_ms(1000)
9          led.value(0) #Set led turn off
10         sleep_ms(1000)
11 except:
12     pass

```

Each time a new file is opened, the program will be executed from top to bottom. When encountering a loop construction, it will execute the loop statement according to the loop condition.



```

1  from time import sleep_ms
2  from machine import Pin
3
4  led=Pin(2,Pin.OUT) #create LED object from pin2,Set Pin2 to output
5  try:
6      while True:
7          ...
8          ...
11 except:
12     pass

```

Print() function is used to print data to Terminal. It can be executed in Terminal directly or be written in a Python file and executed by running the file.

```
print("Hello world!")
```

Each time when using the functions of ESP32, you need to import modules corresponding to those functions: Import sleep_ms module of time module and Pin module of machine module.

```

1  from time import sleep_ms
2  from machine import Pin

```

Configure GPIO2 of ESP32-WROVER to output mode and assign it to an object named "led".

```
4  led=Pin(2,Pin.OUT) #create LED object from pin2,Set Pin2 to output
```

It means that from now on, LED represents GPIO2 that is in output mode.

Set the value of LED to 1 and GPIO2 will output high level.

```
7  led.value(1) #Set led turn on
```

Set the value of LED to 0 and GPIO2 will output low level.

```
9  led.value(0) #Set led turn on
```

Execute codes in a while loop.

```

6      while True:
...          ...

```

Put statements that may cause an error in “try” block and the executing statements when an error occurs in “except” block. In general, when the program executes statements, it will execute those in “try” block. However, when an error occurs to ESP32 due to some interference or other reasons, it will execute statements in “except” block.

“Pass” is an empty statement. When it is executed, nothing happens. It is useful as a placeholder to make the structure of a program look better.

```
5  try:
...
11 except:
12     pass
```

The single-line comment of Micropython starts with a “#” and continues to the end of the line. Comments help us to understand code. When programs are running, Thonny will ignore comments.

```
9  #Set led turn on
```

MicroPython uses indentations to distinguish different blocks of code instead of braces. The number of indentations is changeable, but it must be consistent throughout one block. If the indentation of the same code block is inconsistent, it will cause errors when the program runs.

```
6  while True:
7      led.value(1) #Set led turn on
8      sleep_ms(1000)
9      led.value(0) #Set led turn off
10     sleep_ms(1000)
```

How to import python files

Whether to import the built-in python module or to import that written by users, the command “import” is needed.

If you import the module directly you should indicate the module to which the function or attribute belongs when using the function or attribute (constant, variable) in the module. The format should be: <module name>.<function or attribute>, otherwise an error will occur.

```
import random

num = random.randint(1, 100)
print(num)
```

If you only want to import a certain function or attribute in the module, use the from...import statement. The format is as follows

```
from random import randint
num = randint(1, 100)
print(num)
```

When using “from...import” statement to import function, to avoid conflicts and for easy understanding, you can use “as” statement to rename the imported function, as follows

```
from random import randint as rand
num = rand(1, 100)
print(num)
```

Reference

Class machine

Before each use of the **machine** module, please add the statement **"import machine"** to the top of python file.

machine.freq(freq_val): When freq_val is not specified, it is to return to the current CPU frequency; Otherwise, it is to set the current CPU frequency.

freq_val: 80000000(80MHz)、160000000(160MHz)、240000000(240MHz)

machine.reset(): A reset function. When it is called, the program will be reset.

machine.unique_id(): Obtains MAC address of the device.

machine.idle(): Turns off any temporarily unused functions on the chip and its clock, which is useful to reduce power consumption at any time during short or long periods.

machine.disable_irq(): Disables interrupt requests and return the previous IRQ state. The disable_irq () function and enable_irq () function need to be used together; Otherwise the machine will crash and restart.

machine.enable_irq(state): To re-enable interrupt requests. The parameter **state** should be the value that was returned from the most recent call to the disable_irq() function

machine.time_pulse_us(pin, pulse_level, timeout_us=1000000):

Tests the duration of the external pulse level on the given pin and returns the duration of the external pulse level in microseconds. When pulse level = 1, it tests the high level duration; When pulse level = 0, it tests the low level duration.

If the setting level is not consistent with the current pulse level, it will wait until they are consistent, and then start timing. If the set level is consistent with the current pulse level, it will start timing immediately.

When the pin level is opposite to the set level, it will wait for timeout and return "-2". When the pin level and the set level is the same, it will also wait timeout but return "-1". **timeout_us** is the duration of timeout.

Class Pin(id[, mode, pull, value])

Before each use of the **Pin** module, please add the statement “**from machine import Pin**” to the top of python file.

id: Arbitrary pin number

mode: Mode of pins

Pin.IN: Input Mode

Pin.OUT: Output Mode

Pin.OPEN_DRAIN: Open-drain Mode

Pull: Whether to enable the internal pull up and down mode

None: No pull up or pull down resistors

Pin.PULL_UP: Pull-up Mode, outputting high level by default

Pin.PULL_DOWN: Pull-down Mode, outputting low level by default

Value: State of the pin level, 0/1

Pin.init(mode, pull): Initialize pins

Pin.value([value]): Obtain or set state of the pin level, return 0 or 1 according to the logic level of pins. Without parameter, it reads input level. With parameter given, it is to set output level.

value: It can be either True/False or 1/0.

Pin.irq(trigger, handler): Configures an interrupt handler to be called when the pin level meets a condition.

trigger:

Pin.IRQ_FALLING: interrupt on falling edge

Pin.IRQ_RISING: interrupt on rising edge

3: interrupt on both edges

Handler: callback function

Class time

Before each use of the **time** module, please add the statement “**import time**” to the top of python file

time.sleep(sec): Sleeps for the given number of seconds

sec: This argument should be either an int or a float.

time.sleep_ms(ms): Sleeps for the given number of milliseconds, ms should be an int.

time.sleep_us(us): Sleeps for the given number of microseconds, us should be an int.

time.time(): Obtains the timestamp of CPU, with second as its unit.

time.ticks_ms(): Returns the incrementing millisecond counter value, which recounts after some values.

time.ticks_us(): Returns microsecond

time.ticks_cpu(): Similar to ticks_ms() and ticks_us(), but it is more accurate(return clock of CPU).

time.ticks_add(ticks, delta): Gets the timestamp after the offset.

ticks: ticks_ms()、ticks_us()、ticks_cpu()

delta: Delta can be an arbitrary integer number or numeric expression

time.ticks_diff(old_t, new_t): Calculates the interval between two timestamps, such as ticks_ms(), ticks_us() or ticks_cpu().

old_t: Starting time

new_t: Ending time

What's next?

THANK YOU for participating in this learning experience! If you have completed all of the projects successfully you can consider yourself an ESP32 Master.

We have reached the end of this Tutorial. If you find errors, omissions or you have suggestions and/or questions about the Tutorial or component contents of this Kit, please feel free to contact us: support@freenove.com

We will make every effort to make changes and correct errors as soon as feasibly possible and publish a revised version.

If you are interesting in processing, you can study the Processing.pdf in the unzipped folder.

If you want to learn more about Arduino, Raspberry Pi, Smart Cars, Robotics and other interesting products in science and technology, please continue to visit our website. We will continue to launch fun, cost-effective, innovative and exciting products.

<http://www.freenove.com/>

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