Arduino / Python

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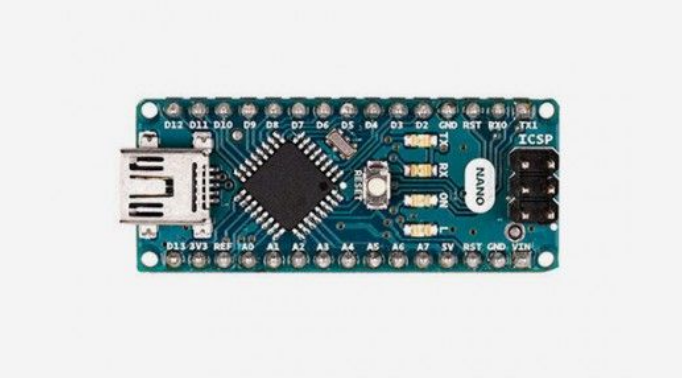
Arduino

- 一家製作開源硬體和開源軟體的公司
- Arduino 允許任何人製造 Arduino 板和軟體分發

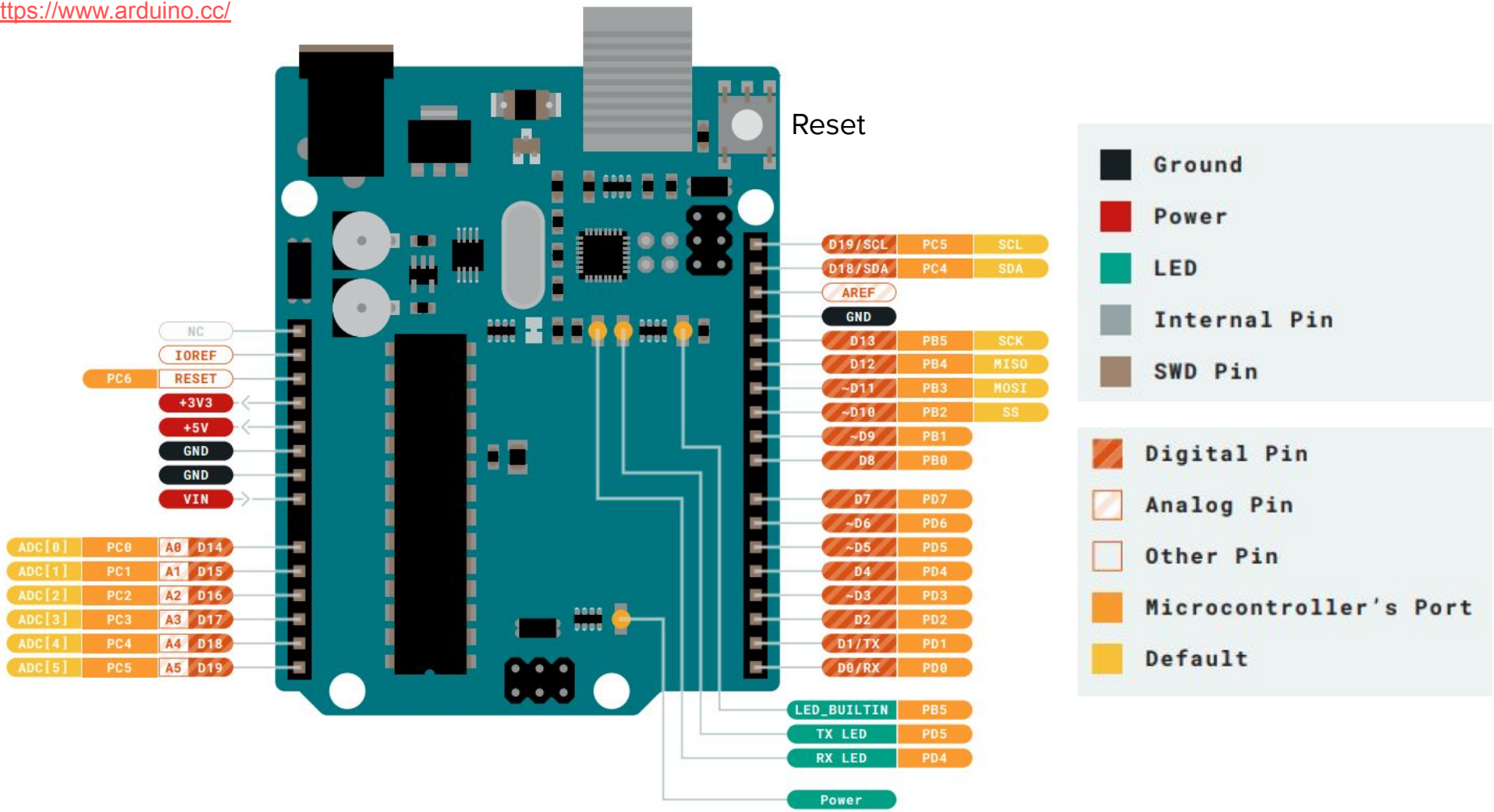
系列產品

Arduino UNO



Arduino NANO

https://www.arduino.cc/



Arduino 特色

- Inexpensive（便宜）
- Cross-platform（跨平台）
- Simple, clear programming environment（ 簡潔的開發環境）
- Open source and extensible software（開源且易於擴充的軟體）
- Open source and extensible hardware（開源且易於擴充的硬體）

Arduino 程式開發環境

- Code online on the Arduino Web Editor - 須安裝代理程式
- Code offline on the Arduino Desktop IDE
  - Windows / Mac OS X / Linux
  - Portable versions (Windows / Linux)
  - Chrome extension

https://www.arduino.cc/en/software

Arduino Desktop IDE

https://www.arduino.cc/en/software

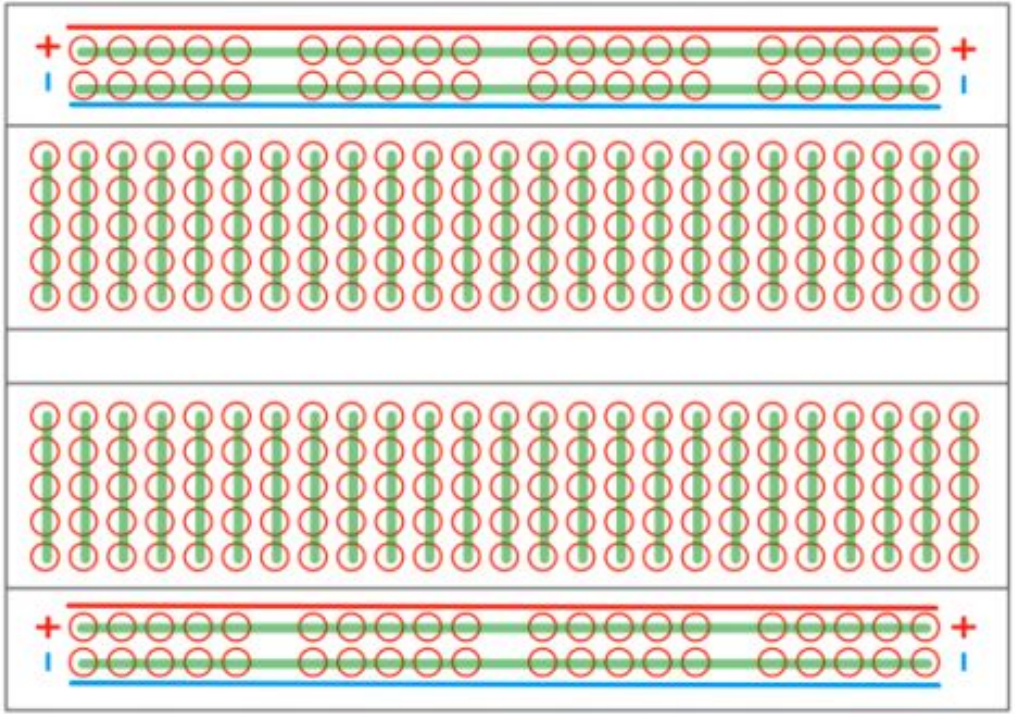
Blink Example

1. Launch Arduino IDE
2. TOOL → BOARD: Select Arduino/Genuino UNO
3. TOOL → PORT: COMX(ARDUINO/ GENUINO UNO)
4. FILE → EXAMPLES → BASICS → BLINK
5. VERIFY 
6. Upload 

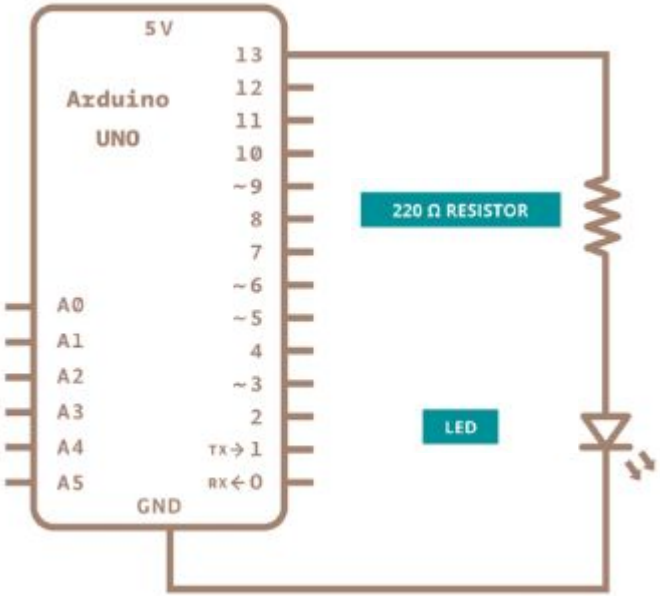
Code for Blink

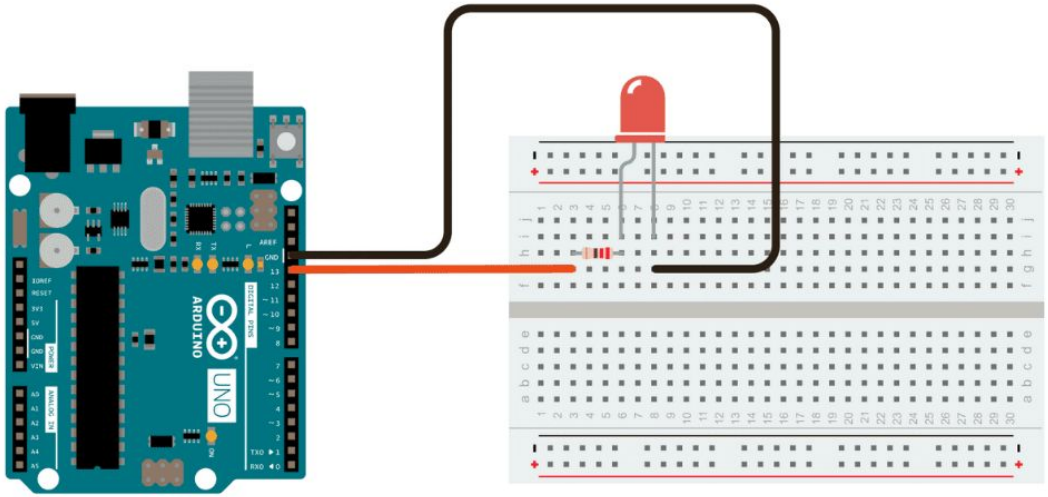
```
void setup() {
     // initialize digital pin LED_BUILTIN as an output.
     pinMode(LED_BUILTIN, OUTPUT);  // LED_BUILTIN = D13 for UNO
}

// the loop function runs over and over again forever
void loop() {
     digitalWrite(LED_BUILTIN, HIGH);    // turn the LED on (HIGH is the voltage level)
     delay(1000);                        // wait for a second
     digitalWrite(LED_BUILTIN, LOW);     // turn the LED off by making the voltage LOW
     delay(1000);                        // wait for a second
}
```

Bread Board



Circuit Design





Firmata / Python

Firmata (I)

微控制器通信協議

讓電腦或手持式裝置控制微控制器

Arduino 對於 Firmata 的整合度很高

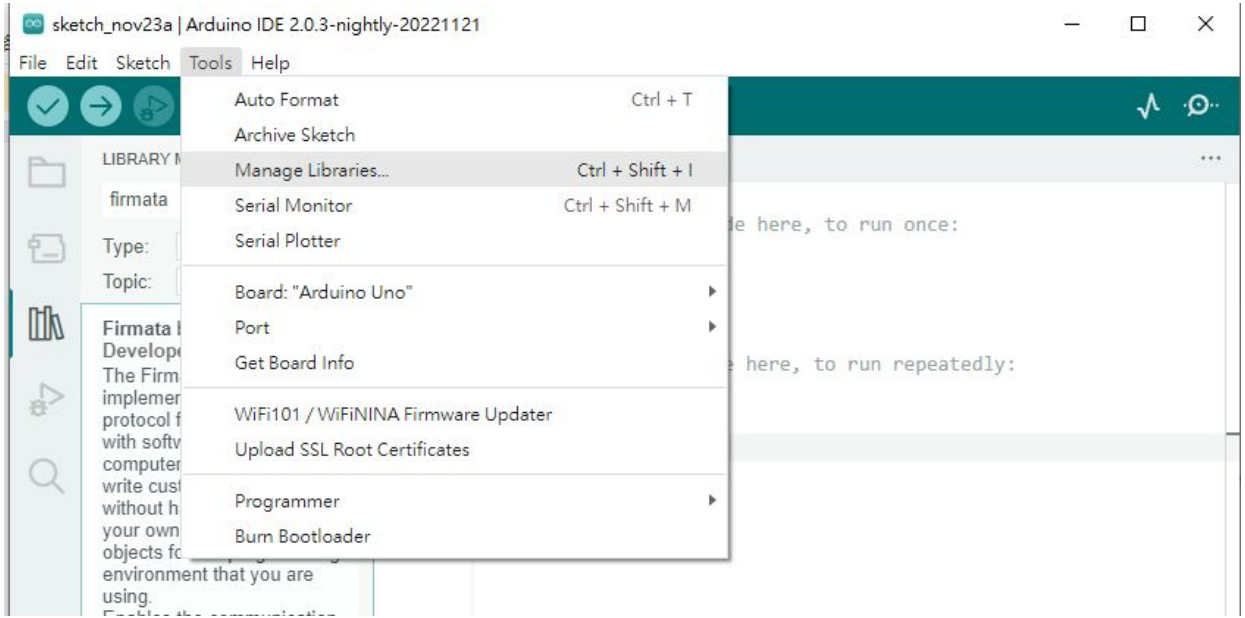
Arduino 的 IDE 內建多個 Farmata 應用

Firmata (II)

- Python 控制 Arduino 有很多套件
  - https://github.com/firmata/pyduino
  - https://github.com/lupeke/python-firmata
  - https://github.com/tino/pyFirmata
  - https://mryslab.github.io/telemetrix
  - ...
- pyduino / python-firmata developed early (a little old...)
- pyFirmata is easier / telemetrix is advanced
- We will use pyFirmata in this lesson

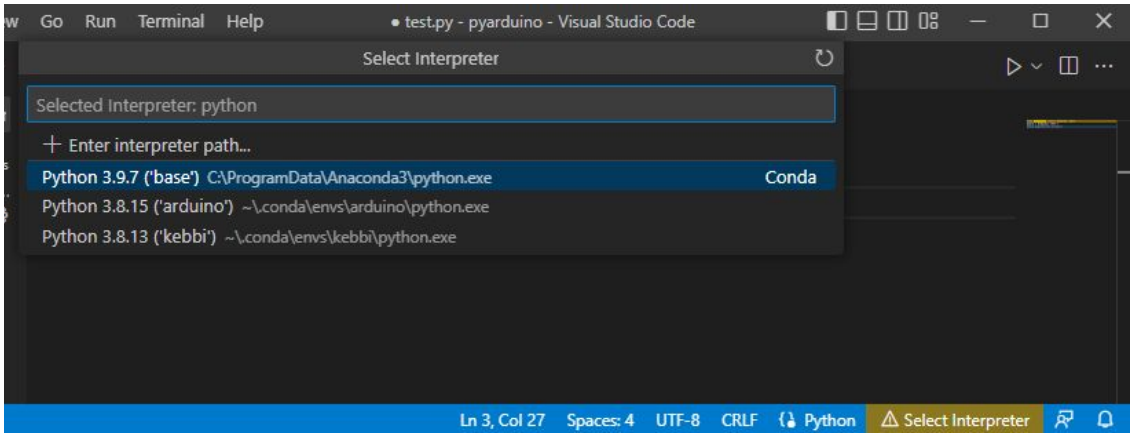
Install Arduino Firmata

- Tools => Manage Libraries...
- Search firmata
- Install Firmata
- File => Examples => Firmata => StandardFirmata
- Verify and Upload



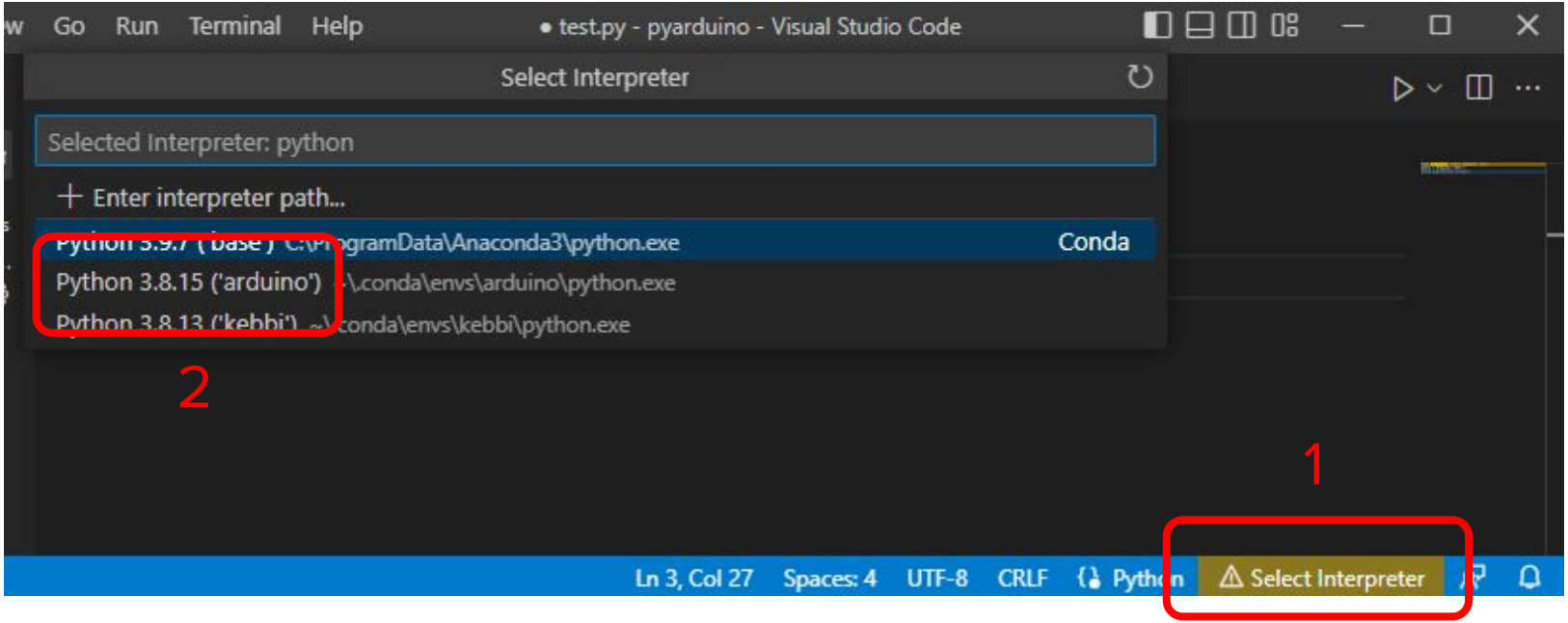
Install Python Firmata

- Windows Start => Anaconda 3 => Anaconda Prompt
- conda create -n arduino python=3.8
- conda activate arduino
- pip install pyfirmata
- code . (if you have installed VSC)
- choose proper python version



Choose proper python in VSC

- Select Interpreter
- arduino

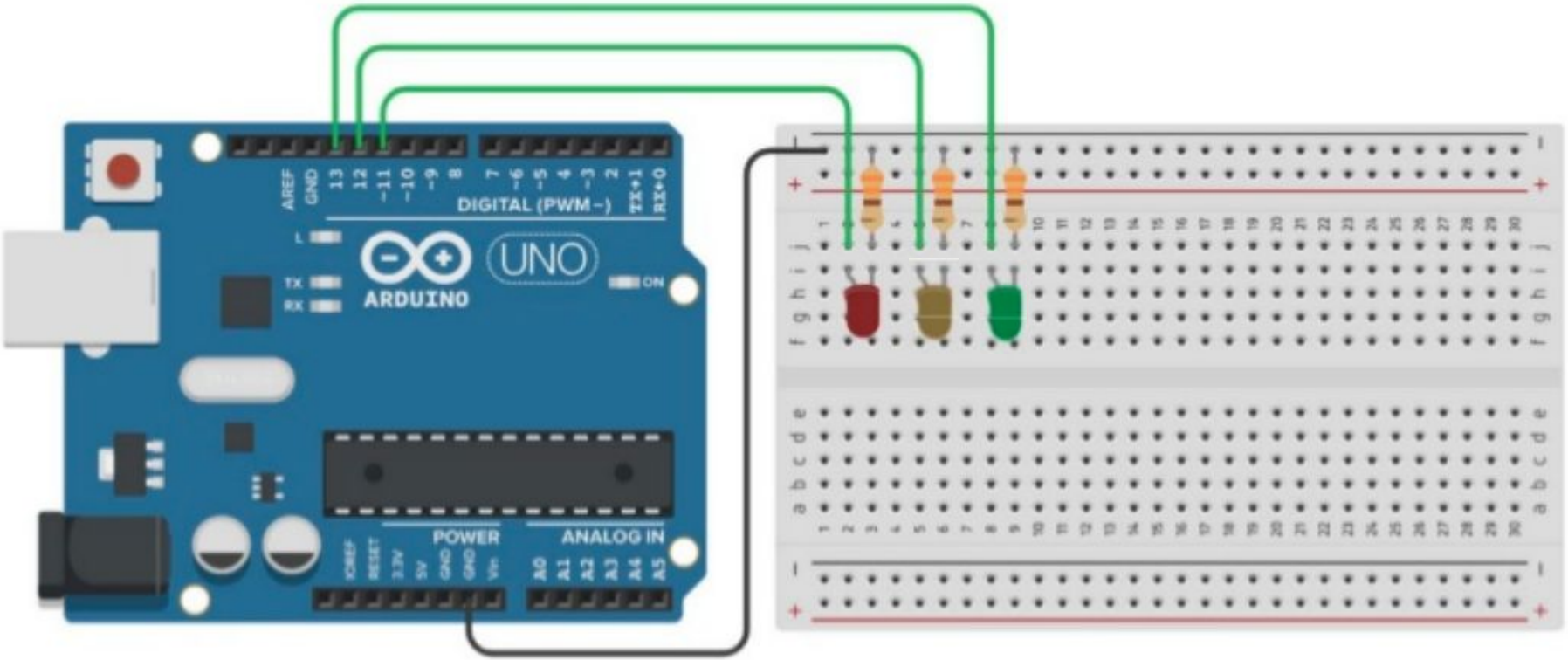


Test code

```
from pyfirmata import Arduino
board = Arduino('COM3')
board.digital[13].write(1)
```

紅綠燈

紅綠燈


AREF
GND
13
12
~11
~10
~9
8
7
~6
~5
4
~3
2
TX→1
RX←0
DIGITAL (PWM~)
L
TX
RX
ARDUINO
UNO
ON
POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
GND
Vin
A0
A1
A2
A3
A4
A5

On and Off

```
from pyfirmata import Arduino
import time

board = Arduino('COM3')

RED = 11
YELLOW = 12
GREEN = 13

while True:
    board.digital[RED].write(1)     # turn on RED
    board.digital[YELLOW].write(1)  # turn on YELLOW
    board.digital[GREEN].write(1)   # turn on GREEN
    time.sleep(1);                  # wait for a second
    board.digital[RED].write(0)     # turn off RED
    board.digital[YELLOW].write(0)  # turn off YELLOW
    board.digital[GREEN].write(0)   # turn off GREEN
    time.sleep(1);                  # wait for a second
```

On and Off

```
from pyfirmata import Arduino
import time

board = Arduino('COM3')

LEDS = [11, 12, 13]

while True:
    for led in LEDS:
        board.digital[led].write(1) # turn on LED
    time.sleep(1);                  # wait for a second
    for led in LEDS:
        board.digital[led].write(0) # turn off LED
    time.sleep(1);                  # wait for a second
```

On and Off

```
from pyfirmata import Arduino
import time

board = Arduino('COM3')

LEDS = [11, 12, 13]

def switchLED(state):
    for led in LEDS:
        board.digital[led].write(state) # set LED state
    time.sleep(1)

while True:
    switchLED(1)
    switchLED(0)
```

練習 1

紅、黃、綠依次輪流亮起，一次一個，每次 1 sec。

- 紅燈亮 : 1 sec
- 黃燈亮 : 1 sec
- 綠燈亮 : 1 sec
- 紅燈亮 : 1 sec
- 黃燈亮 : 1 sec
- 綠燈亮 : 1 sec

練習 2

紅、黃、綠依次輪流亮起，一次加一個，三個全亮後熄滅重來，每次 1 sec。

- 紅燈亮：1 sec
- 紅黃燈亮：1 sec
- 紅黃綠燈亮：1 sec
- 全部熄滅：1 sec
- 紅燈亮：1 sec
- 紅黃燈亮：1 sec
- 紅黃綠燈亮：1 sec

練習 3

與練習2相同，紅、黃、綠依次輪流亮起。
第一輪每次亮 2 sec，第二輪每次亮1 sec，第三輪每次亮 0.5 sec...，六輪一循環。

- 紅燈亮 :2 sec
- 紅黃燈亮 :2 sec
- 紅黃綠燈亮 :2 sec
- 全部熄滅 :1 sec
- 紅燈亮 :1 sec
- 紅黃燈亮 :1 sec
- 紅黃綠燈亮 :1 sec
- ...

練習 4

- 紅燈亮：5 sec
- 黃燈閃爍：3 sec, 6 flashes
- 綠燈亮：5 sec
- 黃燈閃爍：3 sec, 6 flashes
- 紅燈亮：5 sec
- ...

練習 5

自由創作：可使用更多 LED 燈，做出自己想要的效果。