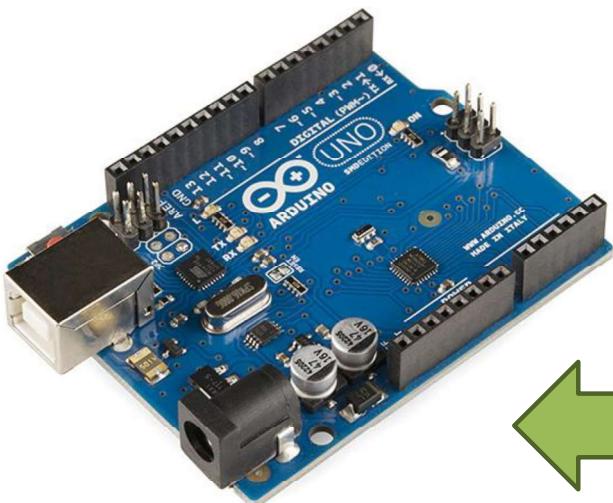


# Outline

- Ameba & Arduino 開發板介紹
- Ameba & Arduino 開發環境介紹
- 開發板應用教學：LED、RGB 3色LED、超音波感測、溫溼度、光亮度、土壤濕度。
- 中華電信IoT大平台介紹
- 核心服務介紹
  - MQTT
- 操作說明
- 將資料上傳至IoT大平台

# Ameba & Arduino開發板介紹

# Arduino



Arduino UNO 開發板

```
sketch_feb25a | Arduino 1.8.8
sketch_feb25a
void setup() {
  // put your setup code here, to run once:
}

void loop() {
  // put your main code here, to run repeatedly:
}
```

The screenshot shows the Arduino IDE window with the title bar 'sketch\_feb25a | Arduino 1.8.8'. The menu bar includes '檔案', '編輯', '草稿碼', '工具', and '說明'. Below the menu is a toolbar with icons for file operations. The main area contains the code editor with the sketch 'sketch\_feb25a'. The code consists of two functions: 'setup()' and 'loop()'. A green arrow points from the word 'CODE' to the code editor area.

Arduino IDE 開發介面

- <https://zh.wikipedia.org/wiki/Arduino>

# Arduino shields



WiFi 擴展板

Sensor擴展板    Arduino  
UNO



# Realtek Ameba Arduino

- Ameba是一張開發板，適合開發各式的感測器或物聯網應用。
- 介面有Wifi, GPIO, NFC, I2C, UART, SPI, PWM, ADC，這些介面可以接一些電子元件像是LED燈、開關、壓力計、溫濕度感測器、PM2.5粉塵感測器等等。
- 資料可以經由內建Wifi上傳到雲端，搭配手機的App實現物聯網的實作。



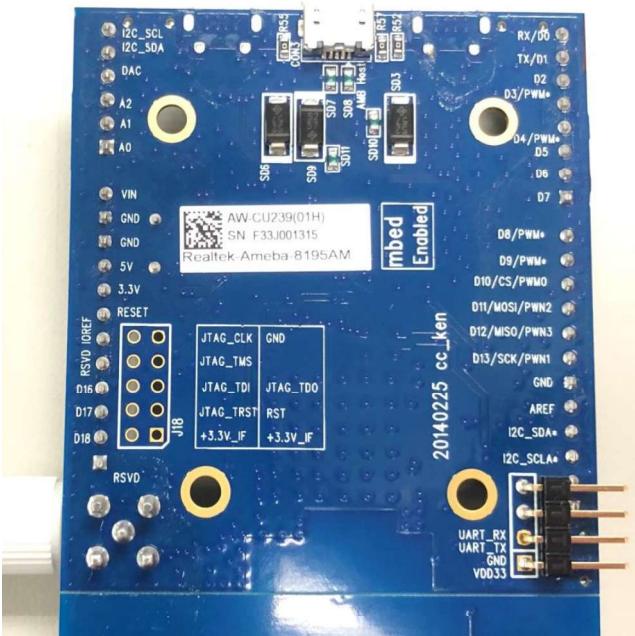
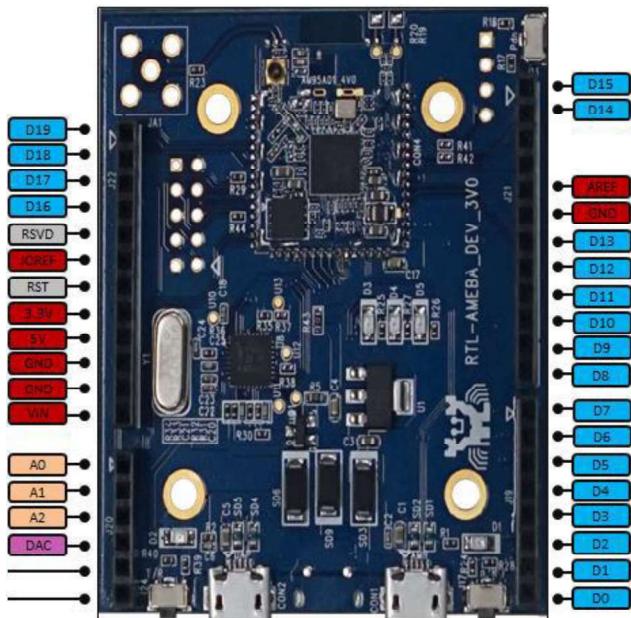
<https://www.amebait.com/ameba-arduino-getting-started/>

# RTL8195 規格

- **CPU**
  - 32-bit Arm®Cortex®-M3, up to 166MHz
- **Memory**
  - 1MB ROM, 2MB SDRAM and 512KB SRAM
- **Key Features**
  - -Integrated with 802.11 b/g/n 1x1 Wi-Fi
  - -NFC Tag with Read/Write Function
  - -10/100 Ethernet MII/ RMII/RGMII Interface
  - -USB OTG
  - -SDIO Device/SD card controller
  - -Hardware SSL engine
  - -Maximum 30 GPIOs
  - -2 SPI Interfaces and support both master and slave mode
  - -3 UART Interfaces including 2 HS-UART and one log UART
  - -4 I2C Interfaces and support both master and slave mode
  - -2 I2S/PCM Interfaces and support both master and slave mode
  - -4 PWM interfaces
  - -2 ADC interfaces
  - -1 DAC interfaces

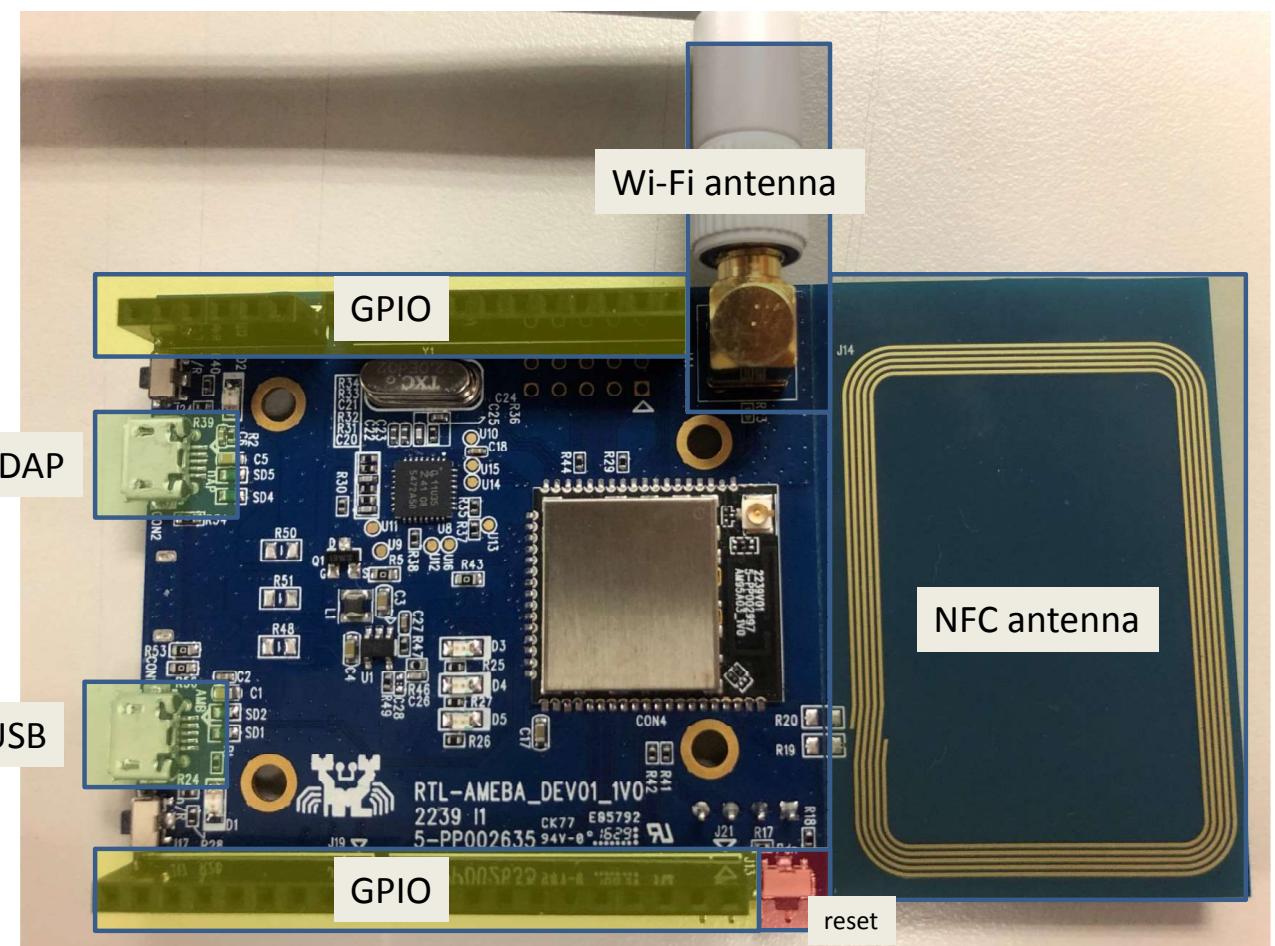
# Ameba與Arduino相容的腳位配置

## 1. 開發板背面註明腳位配置 >>

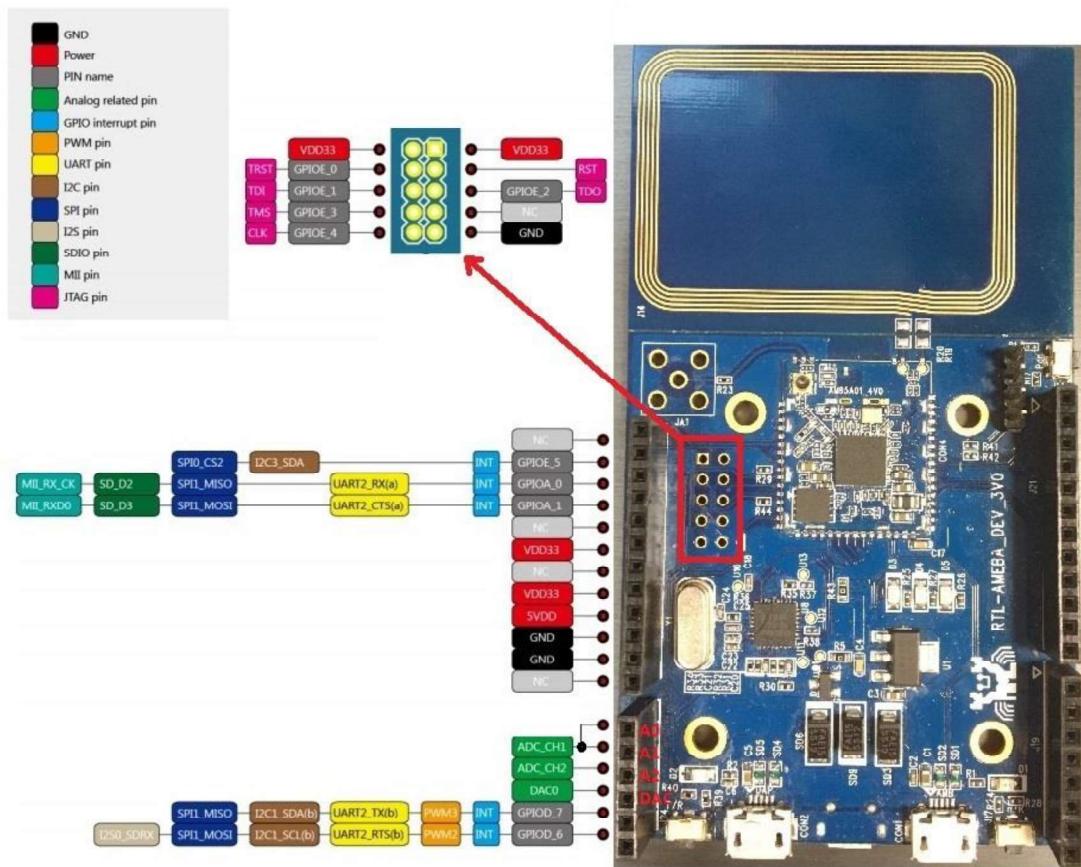


## << 2. 正面腳位對照圖

# 常用的硬體介面

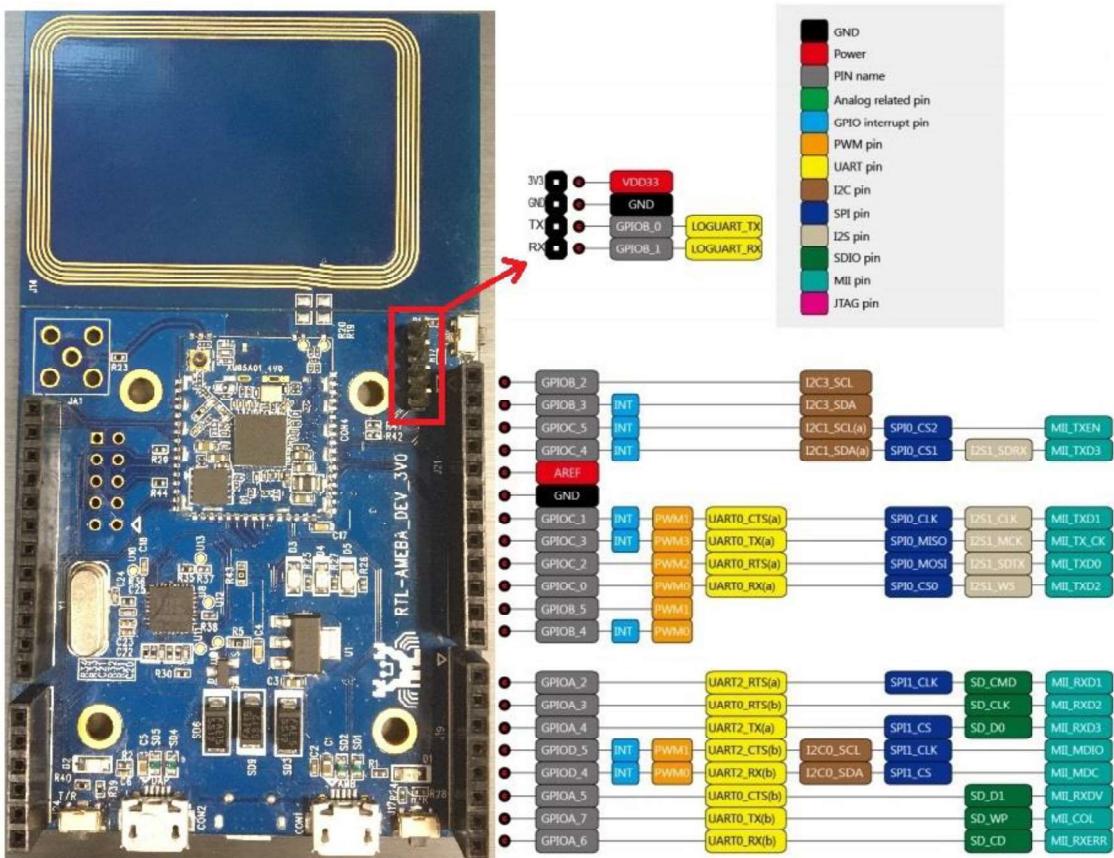


# 更詳細的Ameba腳位配置(左側)



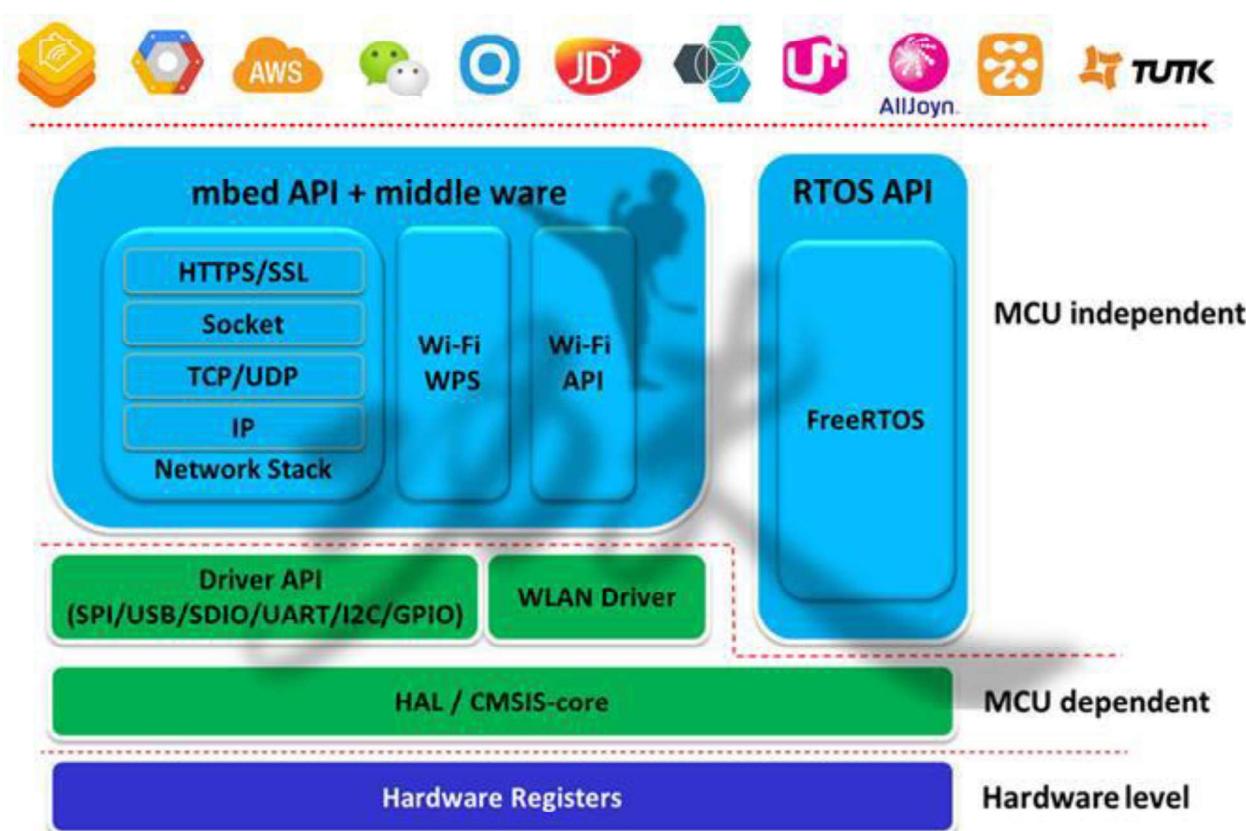
<https://os.mbed.com/platforms/Realtek-RTL8195AM/#board-schematics>

# 更詳細的Ameba腳位配置(右側)



<https://os.mbed.com/platforms/Realtek-RTL8195AM/#board-schematics>

# Ameba SDK



<https://www.amebaiot.com/ameba-sdk-intro/>

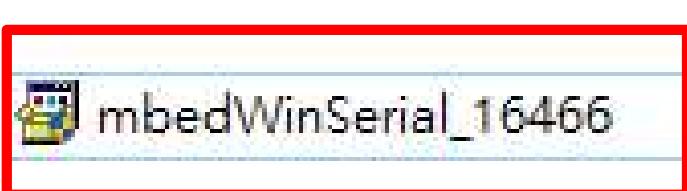
# Ameba & Arduino 開發環境介紹

# Ameba Driver

1. <https://www.amebait.com/>

The screenshot shows a web browser window with the URL <https://www.amebait.com/ameba-arduino-getting-started/>. The page title is "Realtek IoT/Arduino Solution". The navigation bar includes "Home", "Ameba Arduino", "Standard SDK", "Arm Mbed Enabled", "Ask Questions", and "Related Sites". The main content area has a breadcrumb trail: "Getting Started > Ameba RTL8195 [195]". Below this, there are sections for "Boards" (Ameba RTL8195), "Peripherals & Examples", "Trouble-shooting", and "Release & Plan". A note at the bottom states: "Windows XP/7/8 32位元/64位元，以及MAC OS作業系統。請確認您的電腦已經安裝了Windows 6.5之後的版本。". A red box labeled "2." highlights the "Ameba RTL8195" link in the breadcrumb.

3.



4.



# Arduino IDE – 下載

The screenshot shows the Arduino website's navigation bar with the "SOFTWARE" tab highlighted. A red box highlights the "SOFTWARE" tab, and the number "2." is placed next to it. Below the navigation bar, there is a section titled "ARDUINO WEB EDITOR" featuring a screenshot of the web editor interface and some descriptive text.

1. Go to official website- <https://www.arduino.cc/>

2.

Download the Arduino IDE

3. 根據OS下載

The screenshot shows the download page for Arduino 1.8.8. It features the Arduino logo and a brief description of the software. On the right side, there are download links for Windows and Mac OS X, each with a red box highlighting the link. The number "3." is placed next to the "Windows" link.

ARDUINO 1.8.8

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-

**Windows** Installer, for Windows XP and up  
**Windows** ZIP file for non admin install

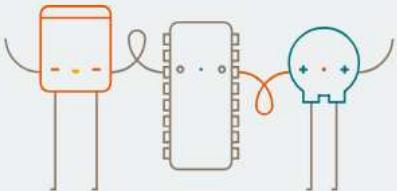
**Windows app** Requires Win 8.1 or 10  
Get

**Mac OS X** 10.8 Mountain Lion or newer

# Arduino IDE – 下載

## Contribute to the Arduino Software

Consider supporting the Arduino Software by contributing to its development. (US tax payers, please note this contribution is not tax deductible). Learn more on how your contribution will be used.



SINCE MARCH 2015, THE ARDUINO IDE HAS BEEN DOWNLOADED **30,266,739** TIMES. (IMPRESSIVE!) NO LONGER JUST FOR ARDUINO AND GENUINO BOARDS, HUNDREDS OF COMPANIES AROUND THE WORLD ARE USING THE IDE TO PROGRAM THEIR DEVICES, INCLUDING COMPATIBLES, CLONES, AND EVEN COUNTERFEITS. HELP ACCELERATE ITS DEVELOPMENT WITH A SMALL CONTRIBUTION! REMEMBER: OPEN SOURCE IS LOVE!

\$3    \$5    \$10    \$25    \$50    OTHER

你要贊助Arduino嗎?    否 / 是

JUST DOWNLOAD    CONTRIBUTE & DOWNLOAD

# Arduino IDE – 安裝



1. 點選安裝Arduino

2. 安裝完成前會跳出3個USB Driver安裝

- Arduino LLC USB Driver
- Arduino srl USB Driver
- COM & LPT Driver

3. 若無安裝3項USB Driver將會造成日後無法順利運作

# Arduino IDE – 安裝



Arduino IDE 需要有Java 環境，若跳出防火牆警示，請允許存取  
無跳出該警訊時，日後遭遇不明錯誤而無法開啟Arduino或上傳資料時  
則需要檢查防火牆是否有擋掉相關功能

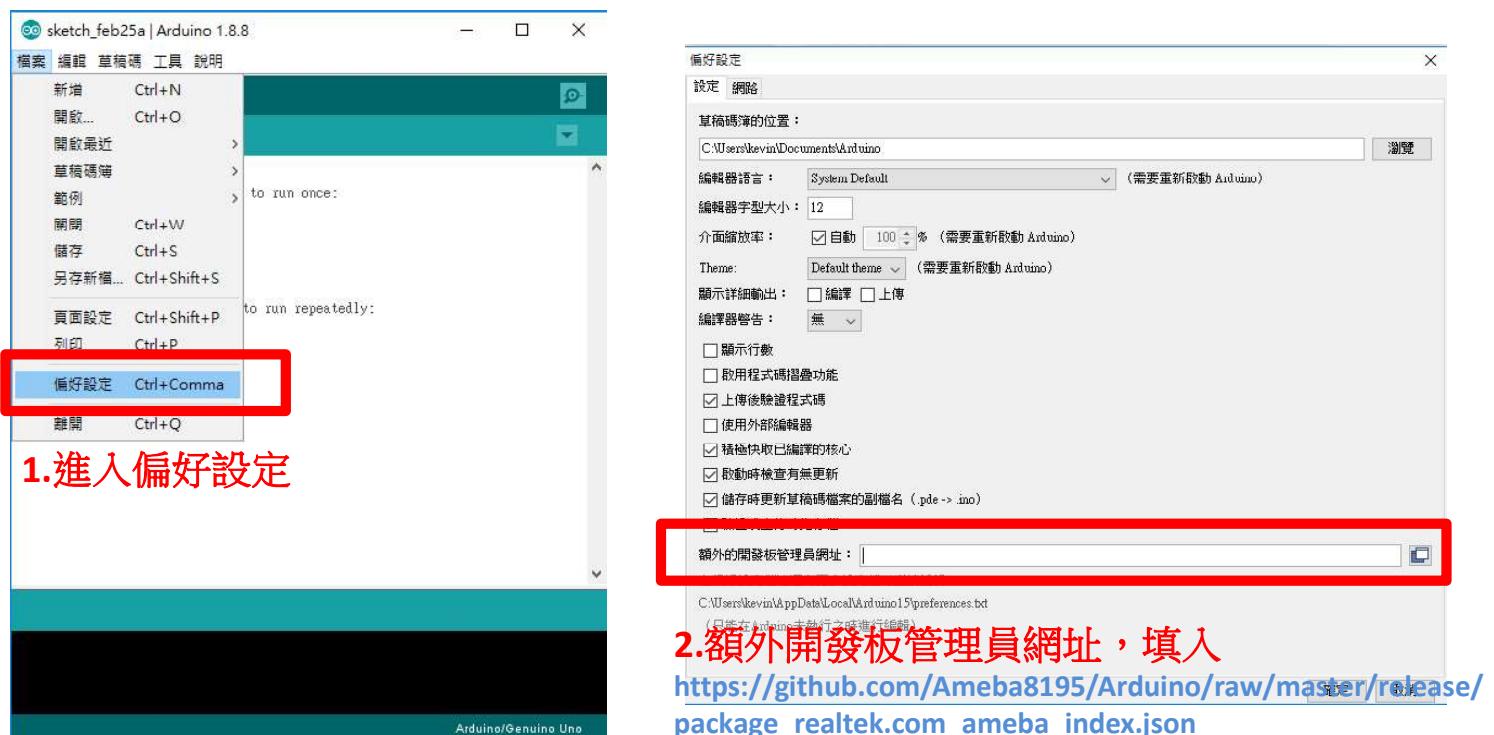
# Arduino IDE



- `setup()`函式內的程式碼於板子通電或 reset 後只會執行一次，此區域通常用來編寫初始化變數、宣告腳位、啟動函式庫。
- `loop()`函式內的程式碼會連續且重複的執行，此區域用來編寫控制板子動作的程式。

# Arduino IDE – 安裝開發板設定檔

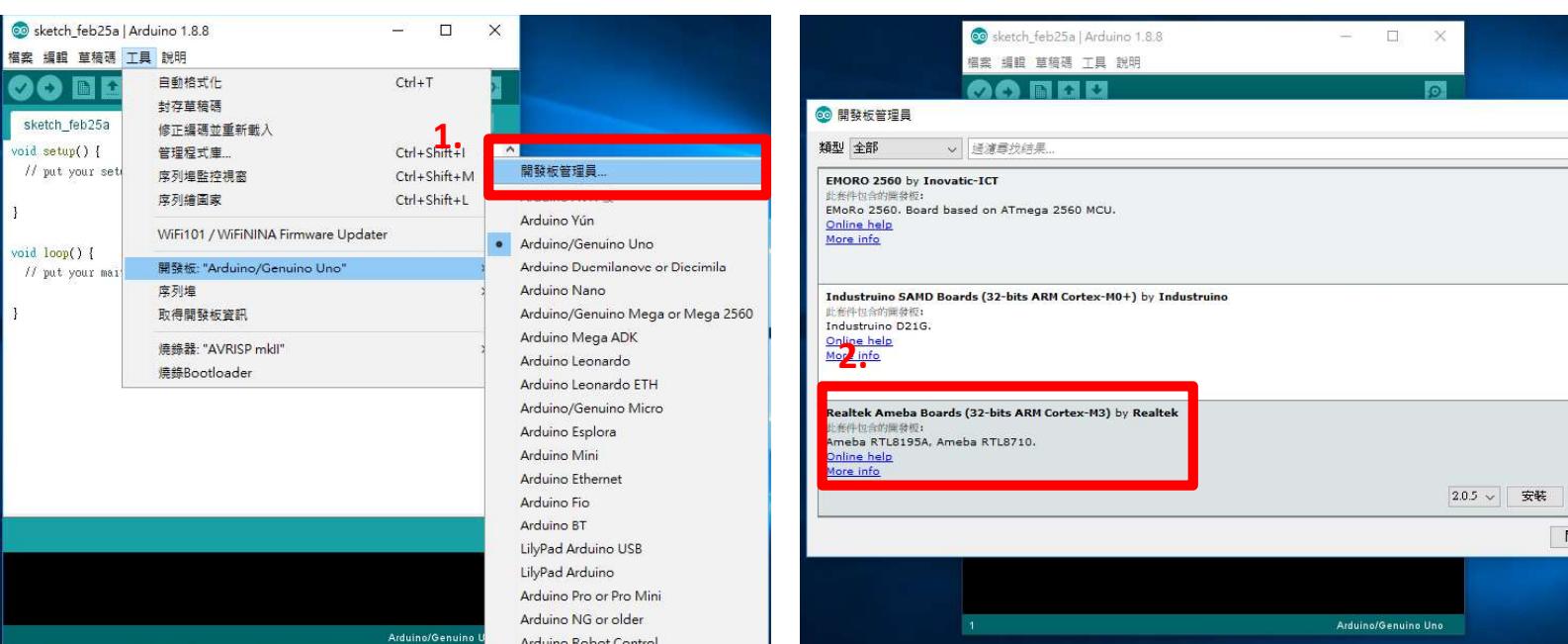
首次安裝的Arduino IDE 並沒有內建Ameba的開發板資料，  
需透過輸入Ameba官方提供的網址來讓下載。



1.進入偏好設定

2.額外開發板管理員網址，填入  
[https://github.com/Ameba8195/Arduino/raw/master/package\\_realtek.com\\_ameba\\_index.json](https://github.com/Ameba8195/Arduino/raw/master/package_realtek.com_ameba_index.json)

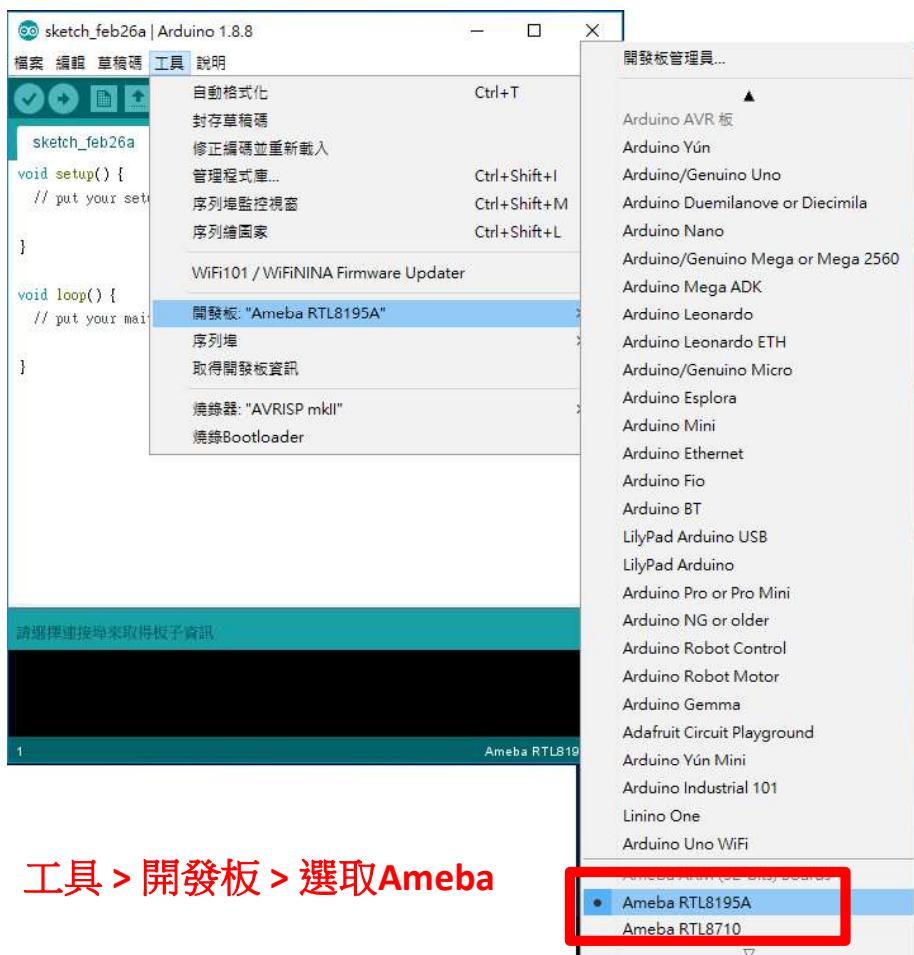
# Arduino IDE – 安裝開發板設定檔



1.進入開發板管理員

2.開發板管理工具會自動刷新，若有填入正確的網址則會找到  
Realtek Ameba Boards，選取並安裝該項目。

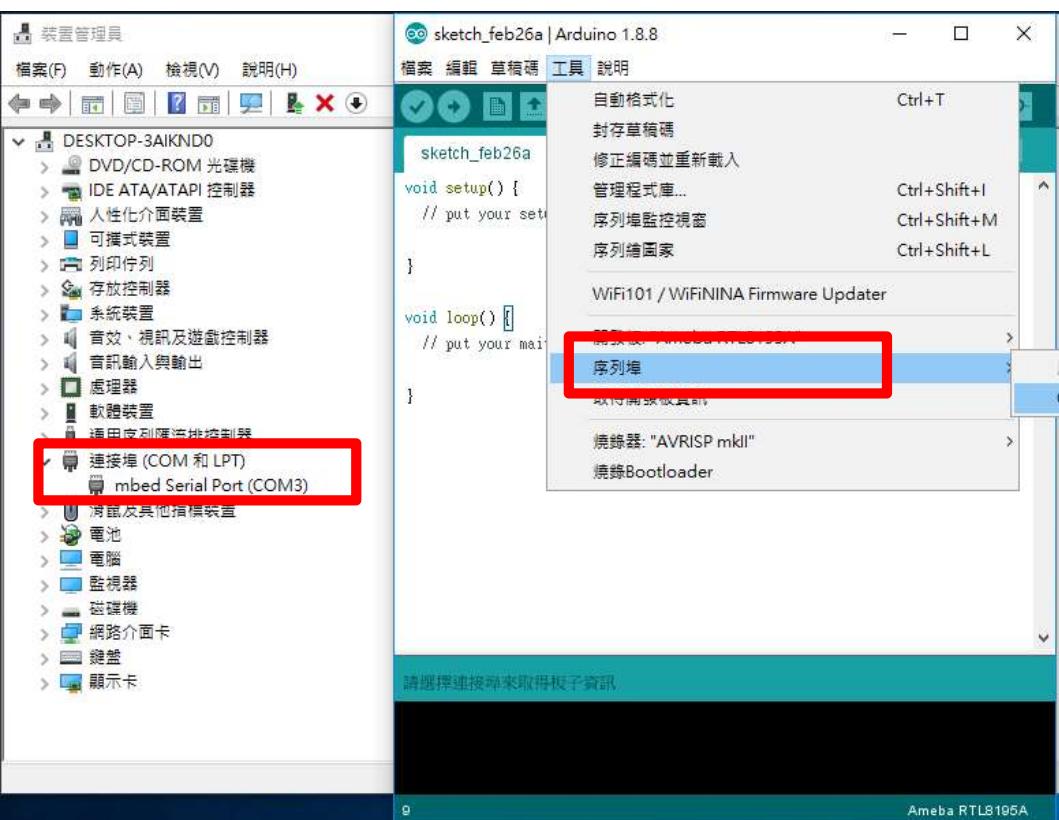
# Arduino IDE – 選取開發板



工具 > 開發板 > 選取Ameba

1. Arduino IDE 在上傳程式前會先編譯成開發板能解讀的內容
2. 依照不同的開發板需要選擇相對應的項目才能正確執行
3. 若發現不明原因無法上傳資料時可先檢查是否切換到相對應的開發板

# Arduino IDE – 選取COM port



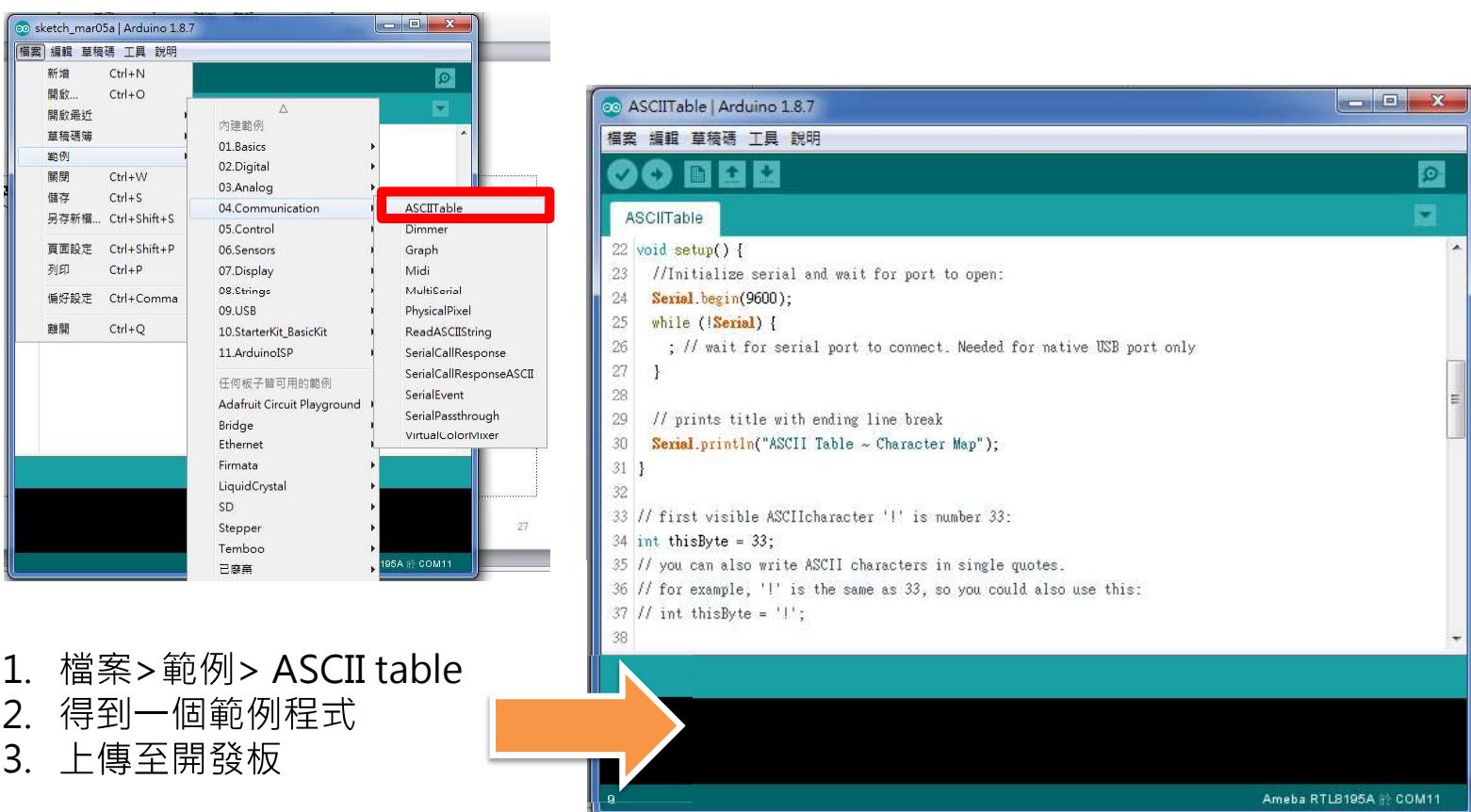
1. 將板子連接到電腦後開啟裝置管理員找到**COM port (mbed Serial Port COM3)**
2. 至Arduino IDE 工具>序列埠選取和裝置管理員一樣的**COM port**
3. 每次電腦重開機或重新拔插與USB端時都有可能會改變**COM port**
4. 若發現無法正常上傳資料至開發板時可先檢查**COM port**是否正確

# Troubleshooting - (WIN10)

- 參考自Ameba官方網站FAQ  
<https://www.amebait.com/ameba-arduino-faq/>
- Ameba目前支援Windows XP/7/8/10 32位元/64位元與MAC OS，以及Linux作業系統，在Win10使用Ameba板時會遇到無法上傳的問題。
- 更新DAP firmware:下載。更換DAP firmware的方式請參考如何更換DAP firmware。  
<https://www.amebait.com/change-dap-firmware>
- 更換DAP firmware的方式：  
<https://www.amebait.com/change-dap-firmware/>

# 開發板應用教學

# 使用範例程式測試開發板

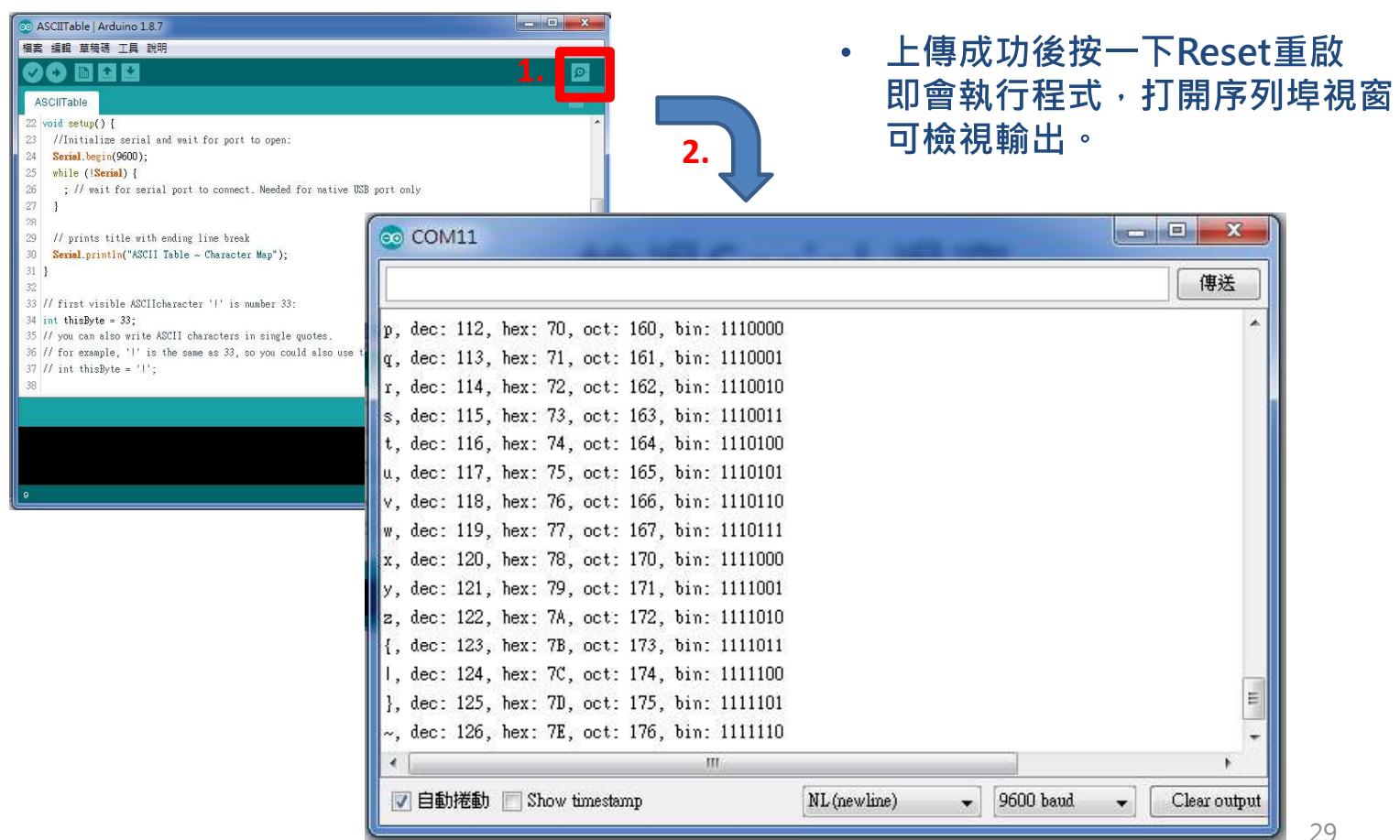


1. 檔案>範例> ASCII table
2. 得到一個範例程式
3. 上傳至開發板

# 使用範例程式測試開發板

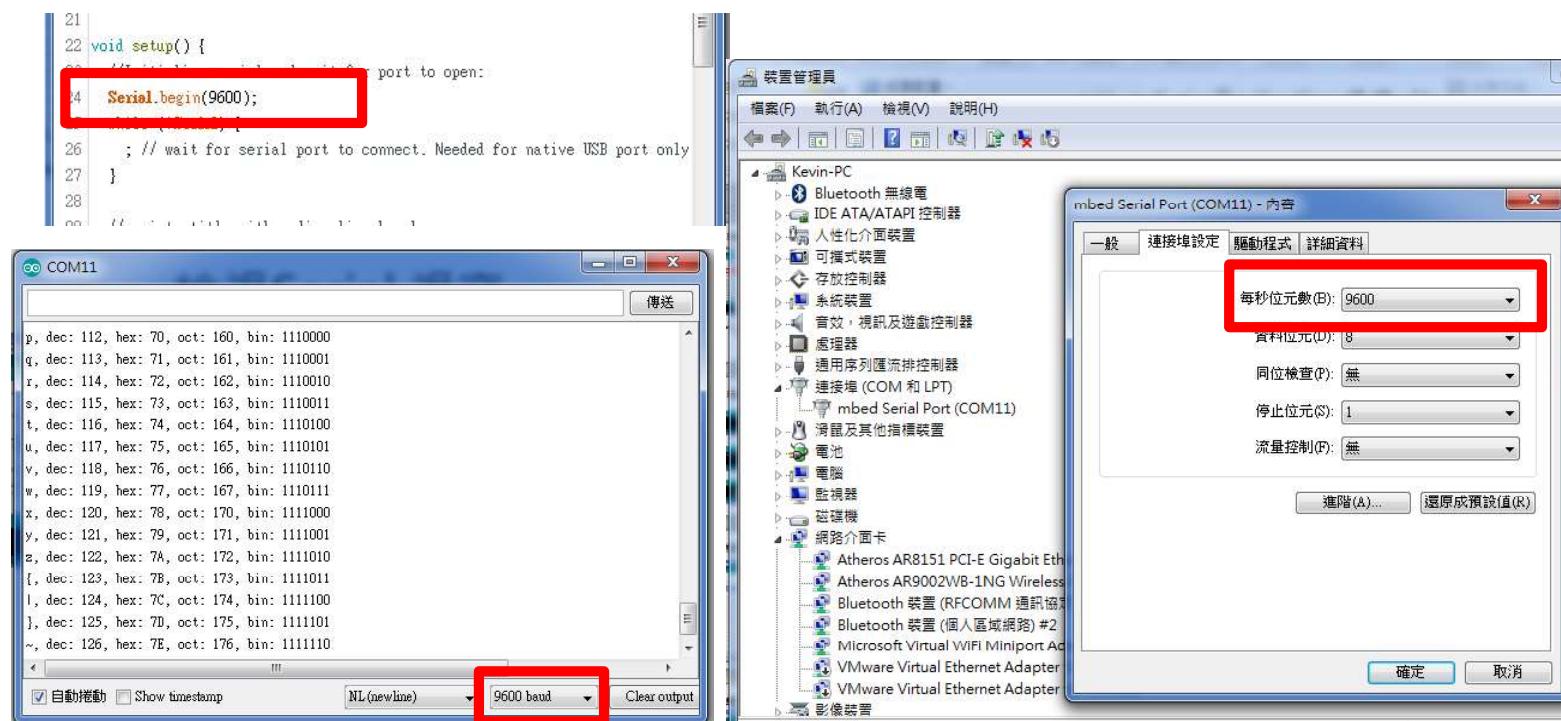


# 檢視序列埠視窗

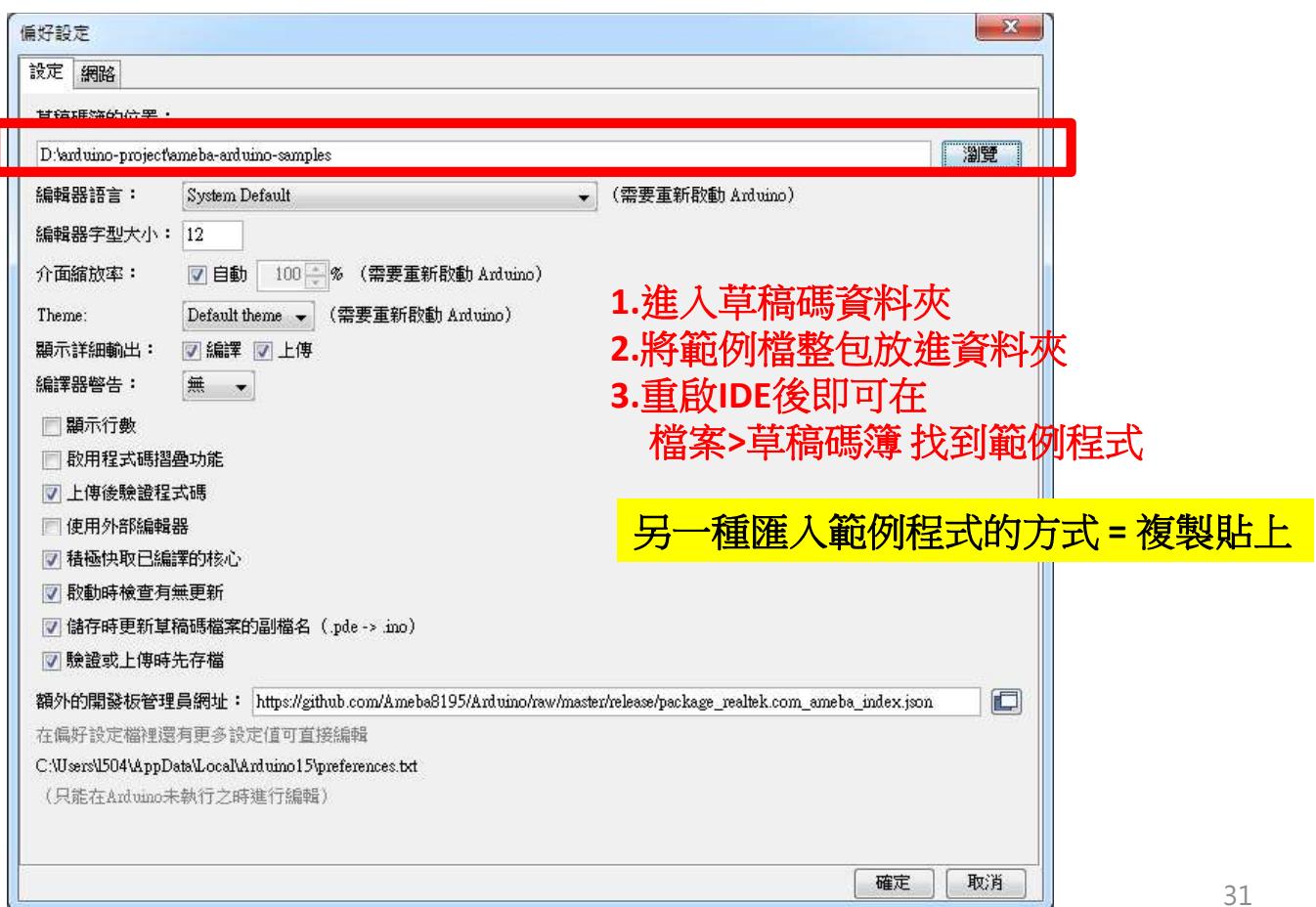


# 序列埠(Serial) Baud Rate

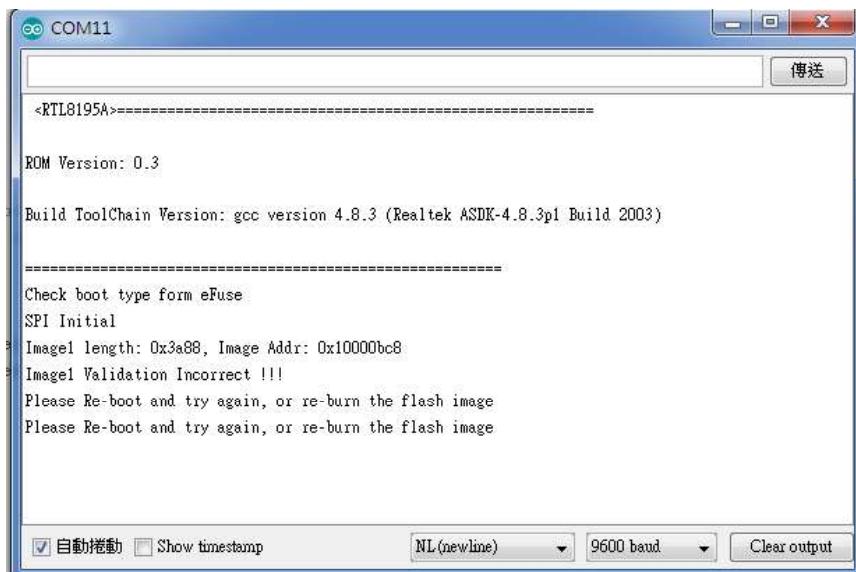
- 程式中若無特別宣告，Baud Rate為9600，若發現Serial視窗沒畫面可檢查三處的Baud Rate是否一致。



# 將範例匯入Arduino IDE



# Troubleshooting – 異常訊息



重開後Serial視窗指示重開機or重新燒錄flash image

- 先將Ameba板重開機，若無效則重新上傳程式

# Troubleshooting – 找不到開發板

```
22 char ssid[] = "KEVIN_PC";      // your network SSID (name)
23 char pass[] = "Fs821s46";       // your network password
24 int status  = WL_IDLE_STATUS;   // the Wifi radio's status
25
26
27 char mqttServer[]     = "iot.cht.com.tw";
28 char deviceId[]       = "10802236687";
```

```
upload finish
找不到在COM11的板子
```

27

欲開啟Serial 視窗時Arduino IDE 顯示找不到COM port 上的板子

- 關閉Serial 視窗稍後數秒再開一次Serial視窗
- Ameba板重開機時會需要時間和電腦重新連線  
若Ameba板還沒連到電腦就按Serial視窗IDE會找不到板子

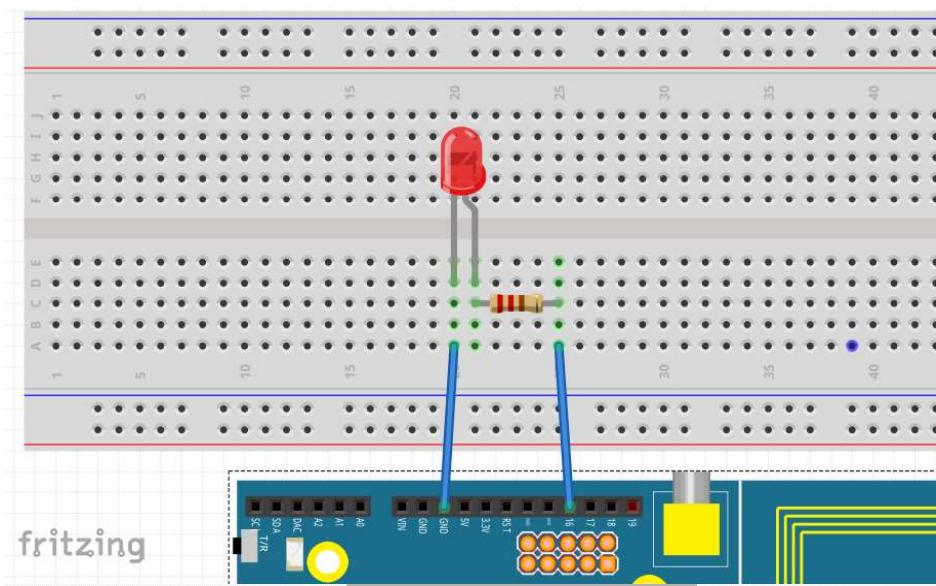
# LED – 程式

- (方法一)套用LED範例程式：範例 > Basic > Blink
- (方法二)自行編寫程式：

```
void setup() {  
    pinMode(8, OUTPUT); //宣告8號腳位為輸出腳位  
}  
void loop() {  
    digitalWrite(8, HIGH); // 8號腳位 > 高電位  
    delay(1000); // 停一秒(1000毫秒)  
    digitalWrite(8, LOW); // 8號腳位 > 低電位  
    delay(1000); // 停一秒  
}
```

- LED有極性，長腳端接正極(pin 8)短腳接地(GND)
- 正極與LED之間串接1K電阻防止LED燒毀

# LED 腳位配置



LED 恒亮

Ameba	LED
5V	長腳 / 正極
GND	短腳 / 負極

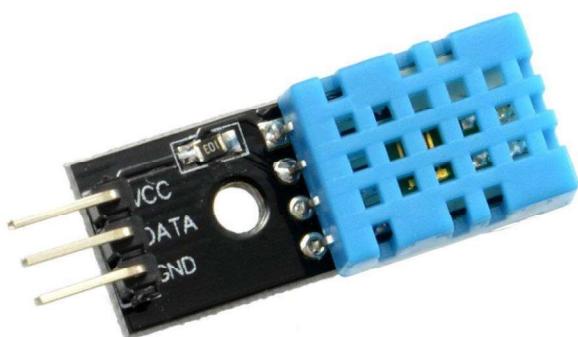
透過Ameba控制LED

Ameba	LED
D16	長腳 / 正極
GND	短腳 / 負極

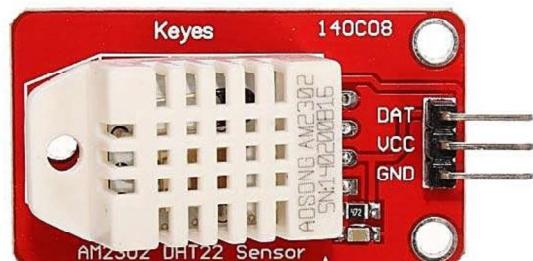
Exercise : 如何使用一個Ameba控制多個LED ?

# 溫溼度感測器

DHT11

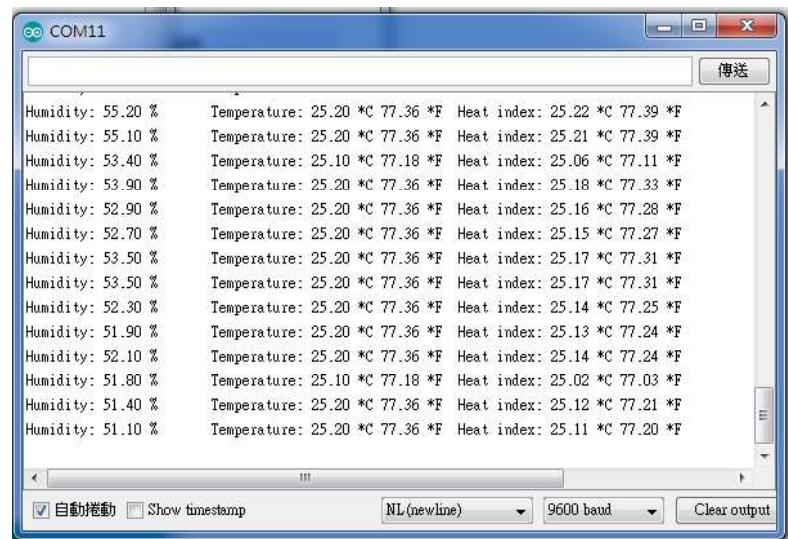


DHT22

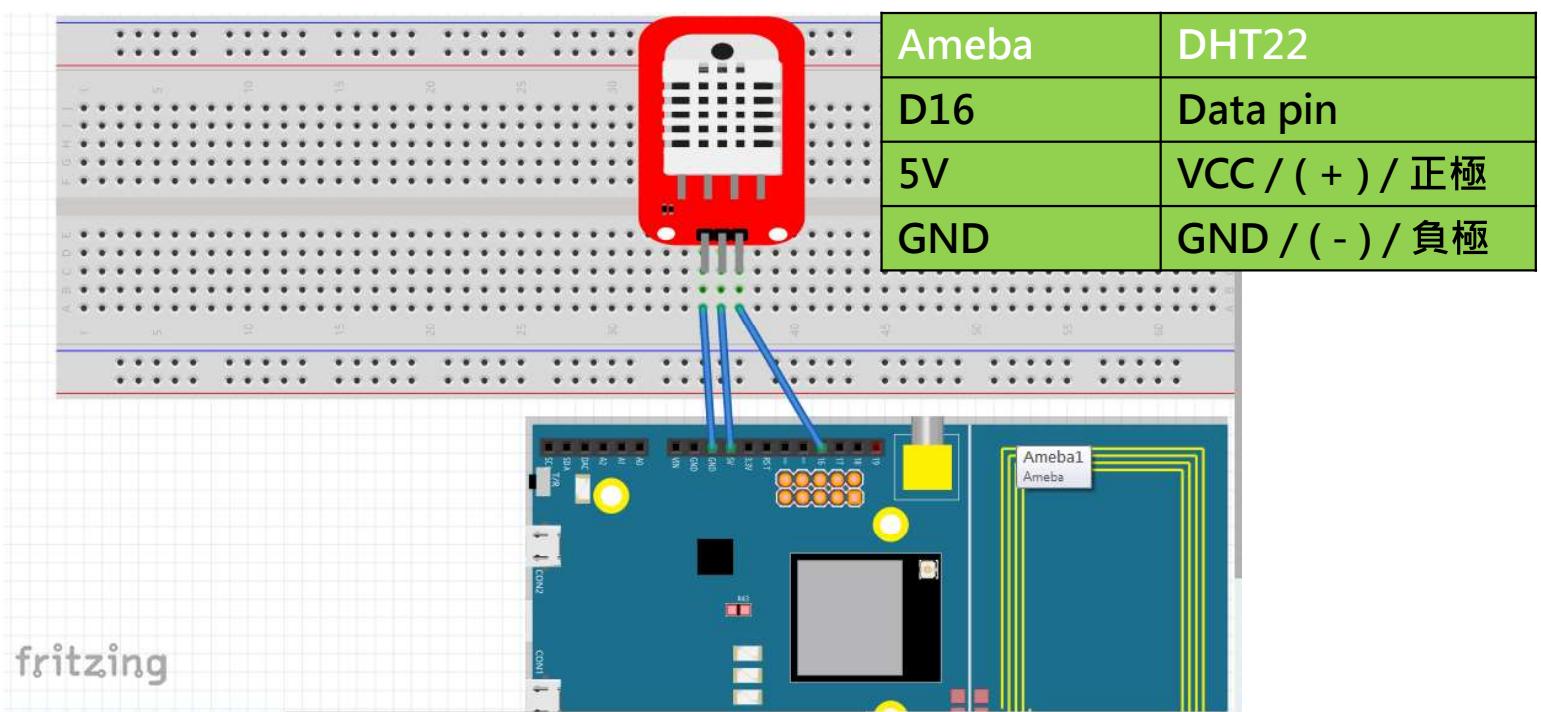


# 溫溼度感測器

- 開啟範例DHT tester
  - Import library
  - 宣告接收資料的腳位
  - 修改函式&顯示數值的方式



# 溫溼度感測器 – 腳位配置



## 整合控制

- 透過DHT22接收溫溼度資料
- 設定門檻值，當溫溼度高/低於門檻值時點亮LED燈。

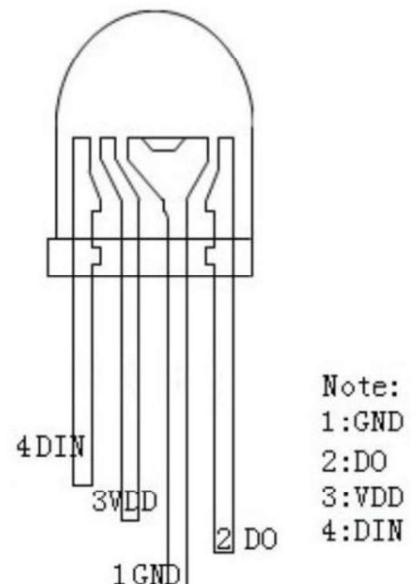
```
if(h>50)
{
    digitalWrite(led, HIGH);
    delay(500);
    digitalWrite(led, LOW);
}
```

# RGB LED

- 三組元件封裝一起的LED，共陽(正極)或共陰(負極)
- 單獨使用RGB LED時正極需個串接一顆電阻
- 課堂使用的模組已經有附電阻

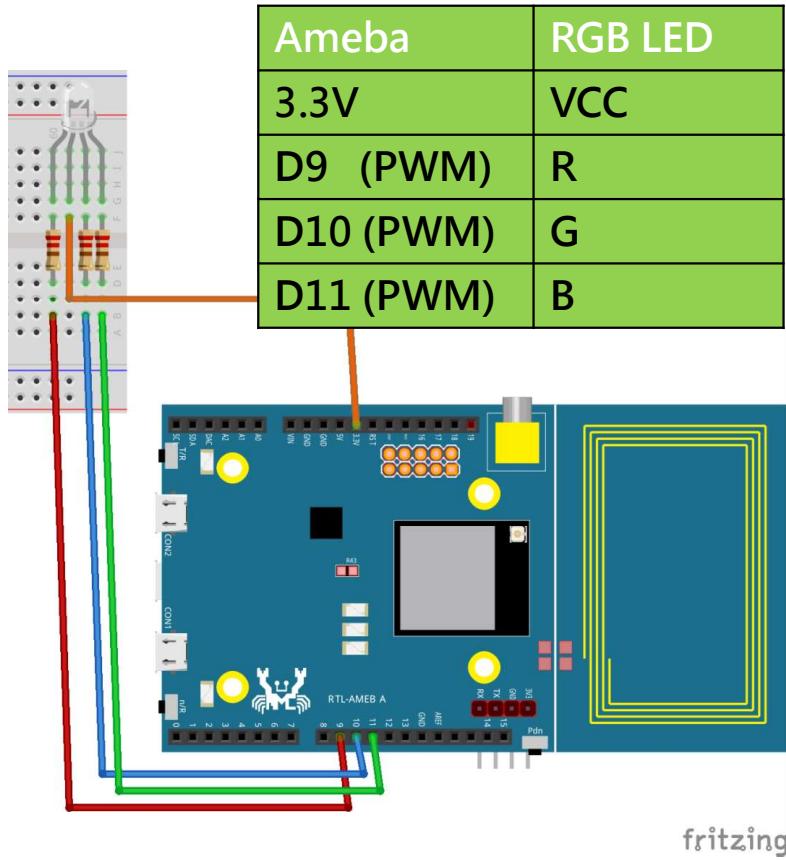
Exercise :

- VCC & GND單接
- VCC & GND共陰



<https://www.marcador.cc/arduino-%E5%85%A8%E5%BD%A9-led/>

# RGB LED 腳位



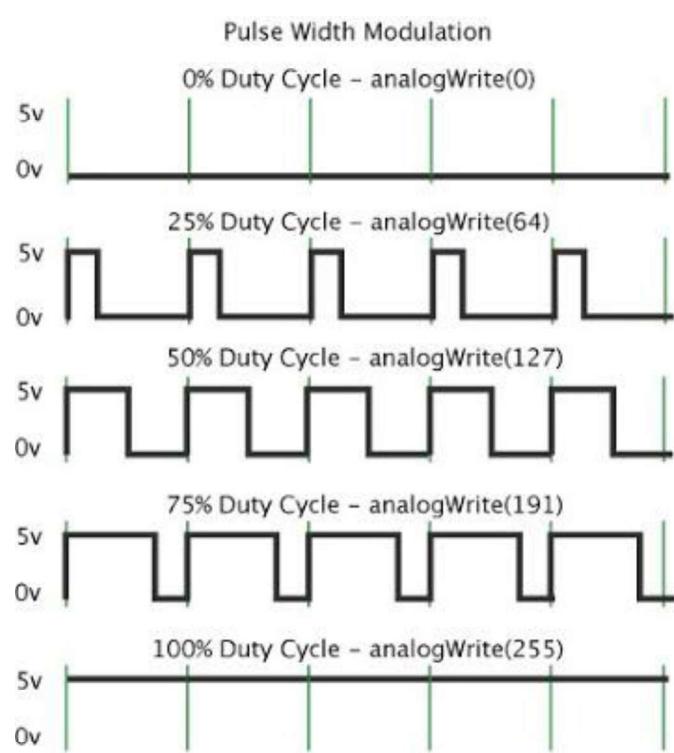
- 若使用模組則無需再接電組
- RGB腳位可任意，與程式配合即可
- 一定要接含有(PWM)標示的腳位才能使用程式調光。

fritzing

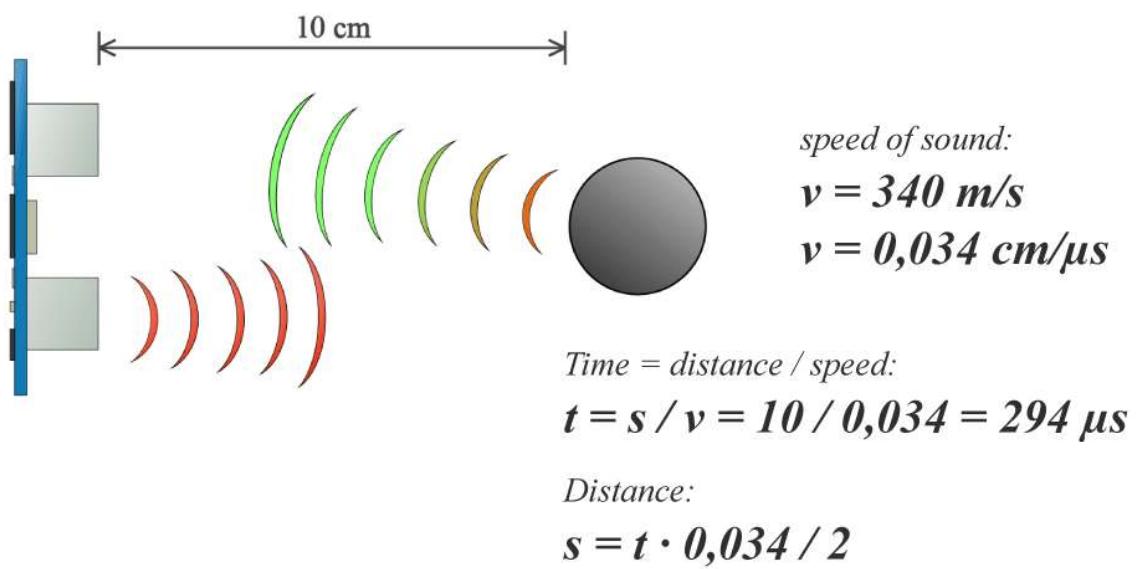
# RGB LED

- 使用範例Ameba\_RGBLED
  - digitalWrite() 單控制燈光明/暗
  - 自定義調色
- 使用範例Ameba\_RGBLED\_PWM
  - 一定要透過PWM腳位才能使用調光
  - analogWrite() 透過PWM控制燈光亮度
  - 呼吸燈

# PWM 原理



# 超音波感測器原理



# 超音波感測器

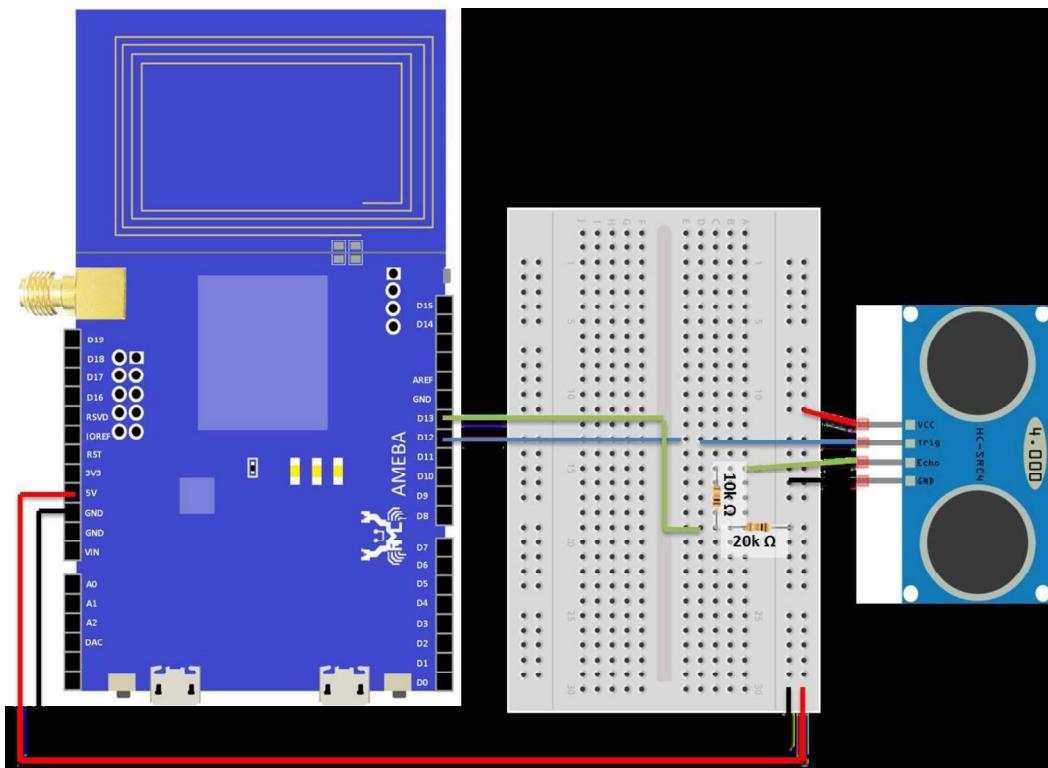
## HC-SR04

- This device has the following characteristics according to its datasheet:
  - Ranging distance: 2 cm to 450 cm
  - Resolution: 3 mm
  - Measuring angle: less than 15 degree

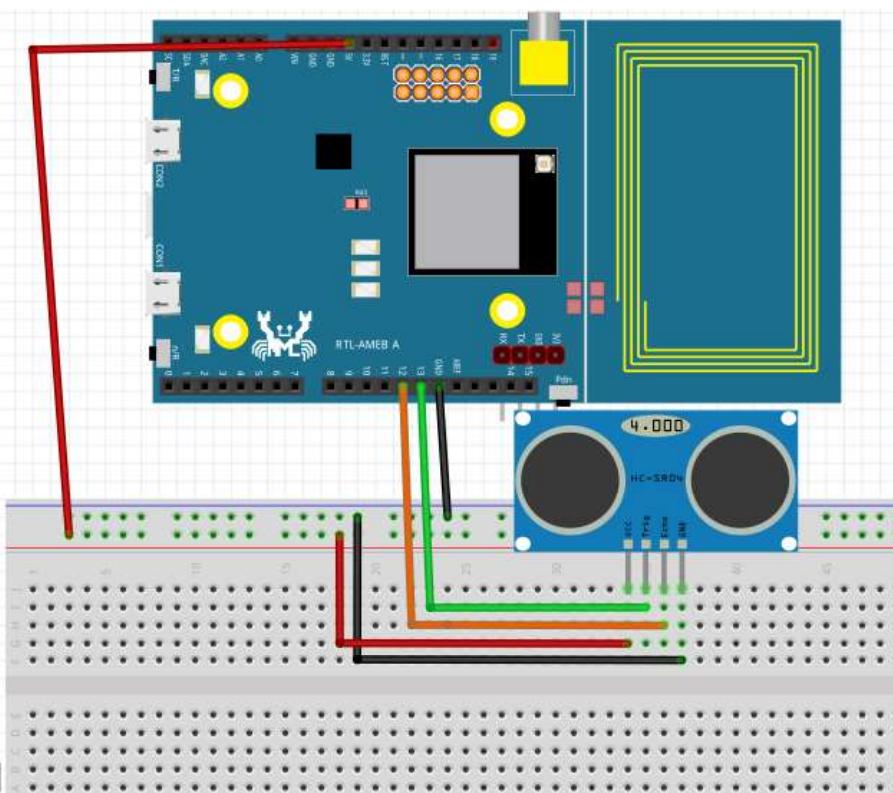


# 超音波感測器

若發現感測器數值異常，需要接上10K與20K電阻  
使Ameba在接收HC-SR04的Echo信號時經過分壓電路



# 超音波感測器腳位

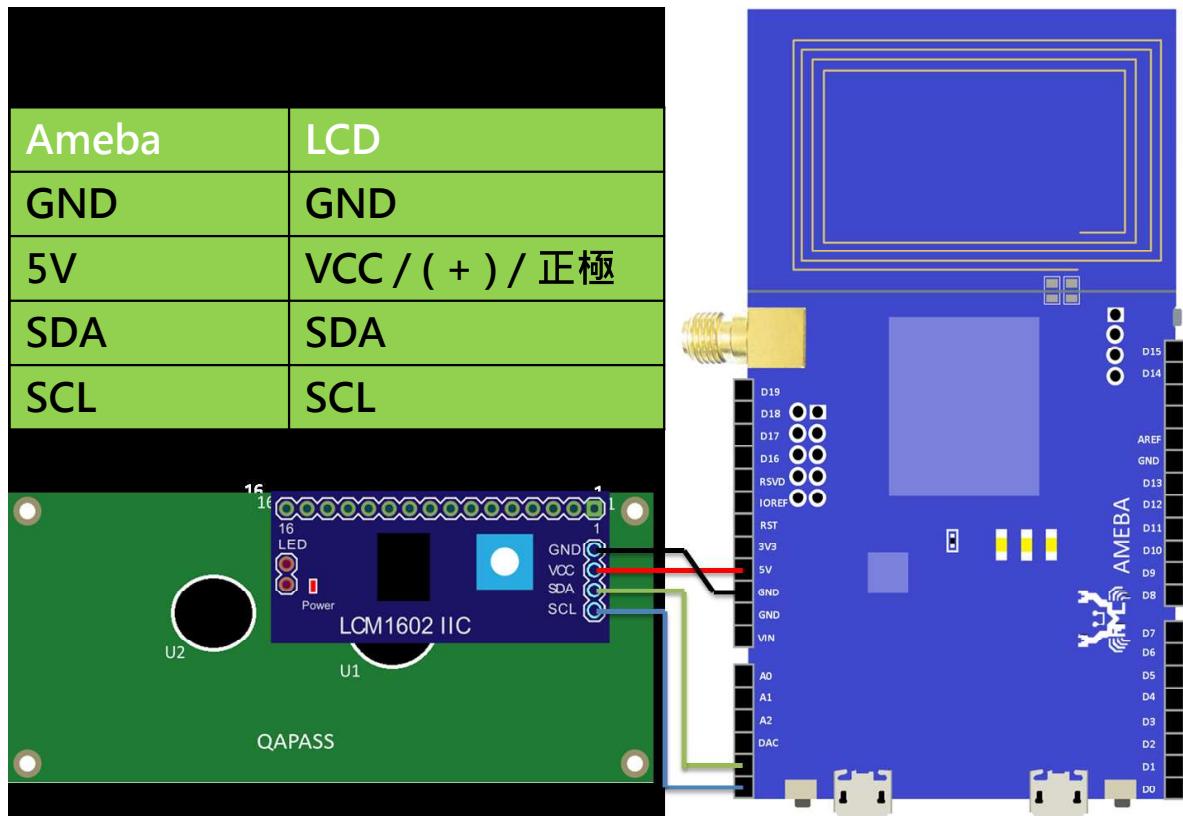


範例程式：UltraSonic  
需要接上10K與20K電阻

# 超音波感測器

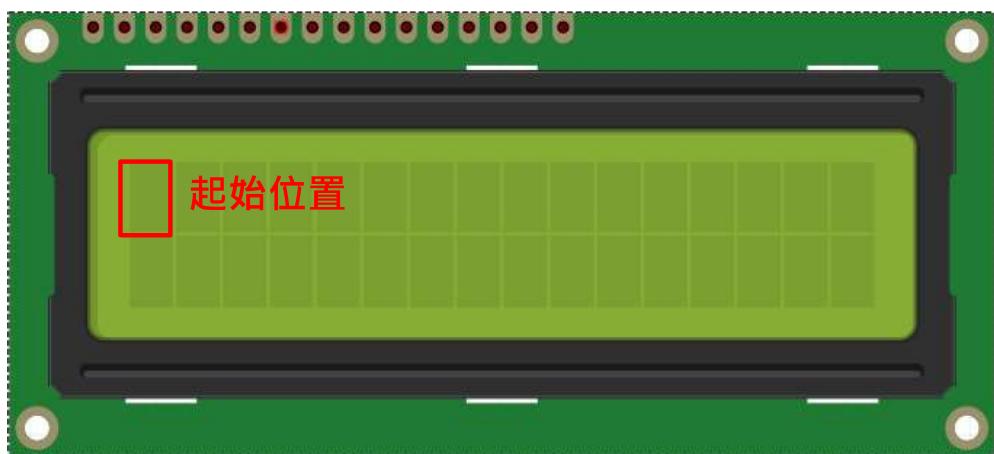
- Trig發射聲波，Echo接收
- 音速公式： $c = 331.5 + 0.607 \times t$ ( $t$  = 攝氏溫度)
  - 假設攝氏溫度20度 音速約為  $331.5 + 0.607 \times 20 = 343.64\text{m/s}$
  - $343.64 \times 100 / 1000000$  換算為  $0.034364\text{ cm/微秒}$
  - 音速每公分移動距離  $1 / 0.034364 = 29.1\text{ 微秒/cm}$

# 16x2 LCD模組



# 16x2 LCD模組

- 開範例 LCDTest
- Exercise：
  - 修改輸出內容



# 讓資料顯示在LCD面板上

- TempAndHumidityOnLcd



# 土壤溼度感測器

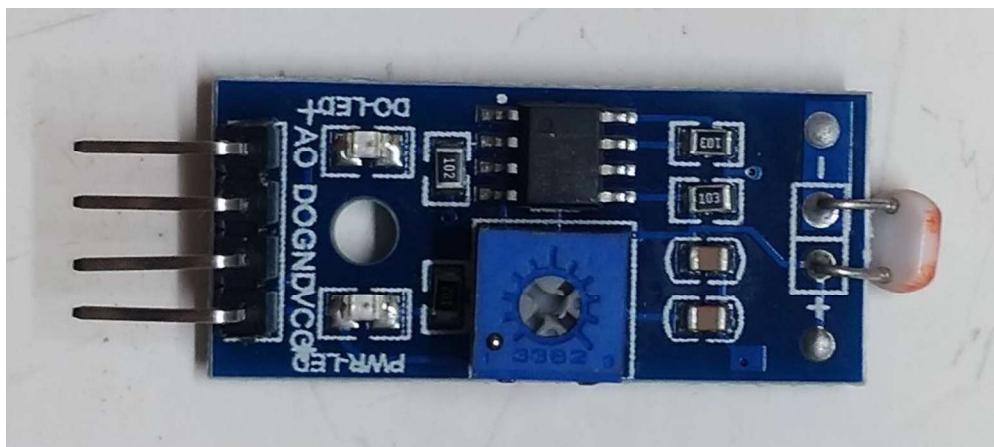
- AmebaMoistSensor

Ameba	Moist sensor
GND	GND
5V	VCC / ( + ) / 正極
A0	S

- 盆土測試 or 沾水，輸出為analog數值

# 光照射感測器

- 光線強度影響電阻值，光罩強度和電阻值成反比
- 數位與類比皆可
- 狹義上另有測量照度值的感測器



# 光照射度感測器

- 範例程式：DIY
- Exercise：  
根據環境亮度調整LED的強度

```
int SPin = A1;  
int SVal = 0;  
  
void setup() {  
    Serial.begin(9600);  
}  
  
void loop() {  
    CDSVal = analogRead(SPin);  
    Serial.println(SVal);  
    delay(2000);  
}
```

# 二氧化碳感測器

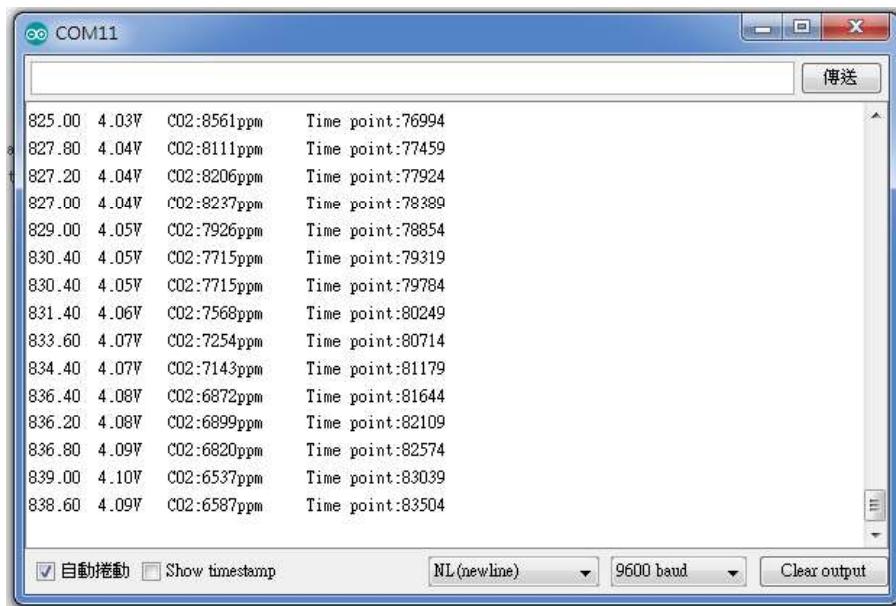
- MG811
- 電化學反應 [www.dzsc.com/uploadfile/company/299700/201076133217170.pdf](http://www.dzsc.com/uploadfile/company/299700/201076133217170.pdf)

Ameba	Moist sensor
GND	GND
5V	VCC / ( + ) / 正極
A0	AOUT



# 二氧化碳感測器

- 開啟範例CO2SensorAnalog
  - 感測器為類比輸出，接收的腳位需選擇A0~A6
  - 修改函式&顯示數值的方式



## 二氧化碳感測器

- 首次使用需極長時間預熱
- 需加熱到工作溫度才能測值
- 開發板需外接電源
- 繁複的校正流程

# 二氧化碳感測器校正

1. 大氣二氧化碳濃度約為0.04%(400ppm)
2. 人體吐氣時的氣體含有4%(40000ppm)的二氧化碳
3. 讀值前先讓感測器加熱數小時
4. 將感測器至於室外5分鐘，確認穩定後取數值
5. 收集吐氣於容器後將感測器置入5分鐘，確認穩定後取值
6. 修改程式參數

[https://www.dfrobot.com/wiki/index.php/CO2\\_Sensor\\_SKU:SEN0159](https://www.dfrobot.com/wiki/index.php/CO2_Sensor_SKU:SEN0159)

<http://a-chien.blogspot.com/2016/03/arduino-mg811.html>