RaspberryPi

GPIO and Calling APIs

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Introduction – What is Raspberry Pi

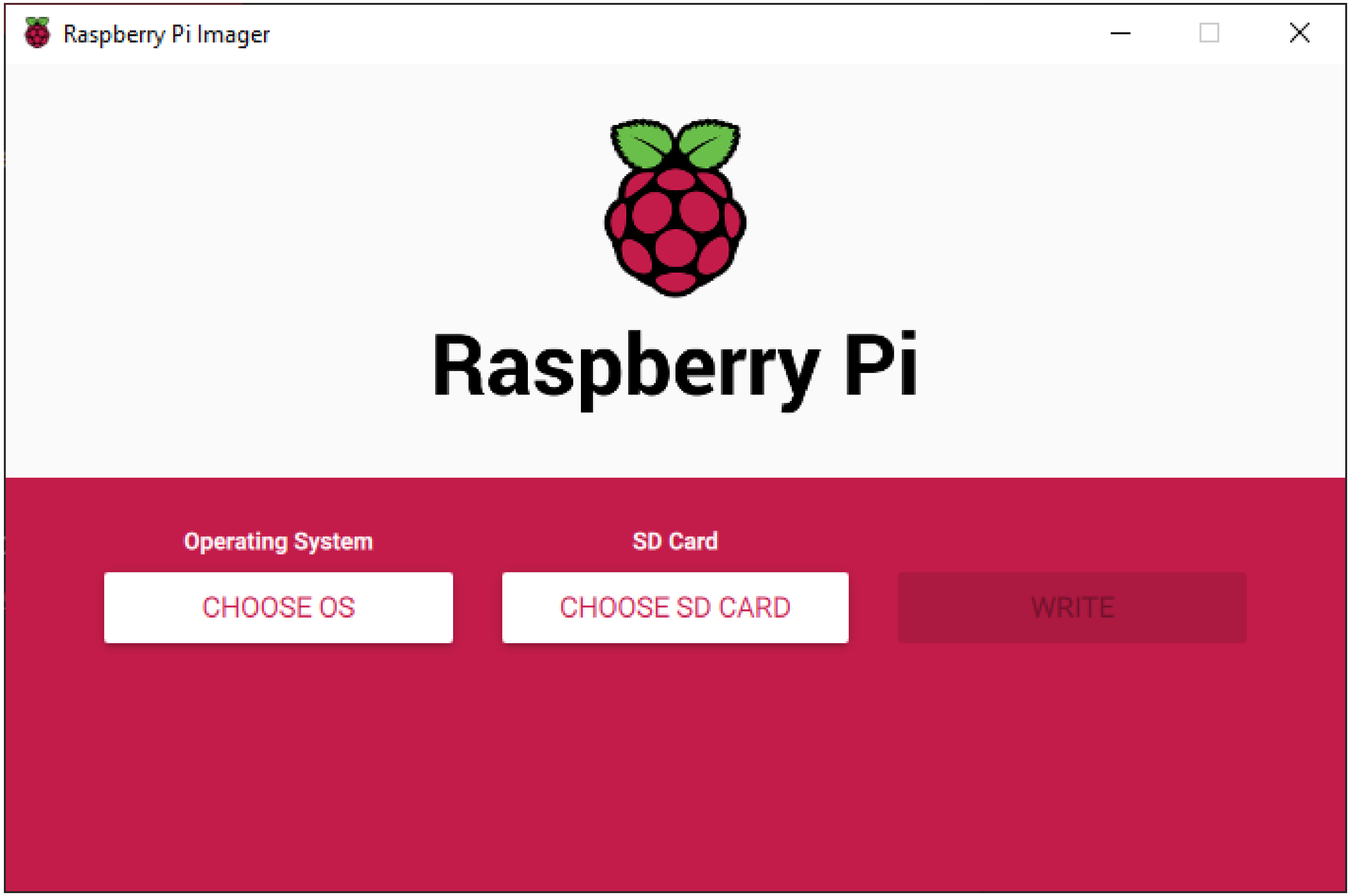
- **Credit-card sized computer**
- **Latest version: Raspberry Pi 4 B**
- **Used in many projects:**
  - Media Centers
  - File Servers
  - Game Consoles
  - Smart Mirrors
  - Etc.

Introduction – Downloading the OS

Download the Windows Installer:

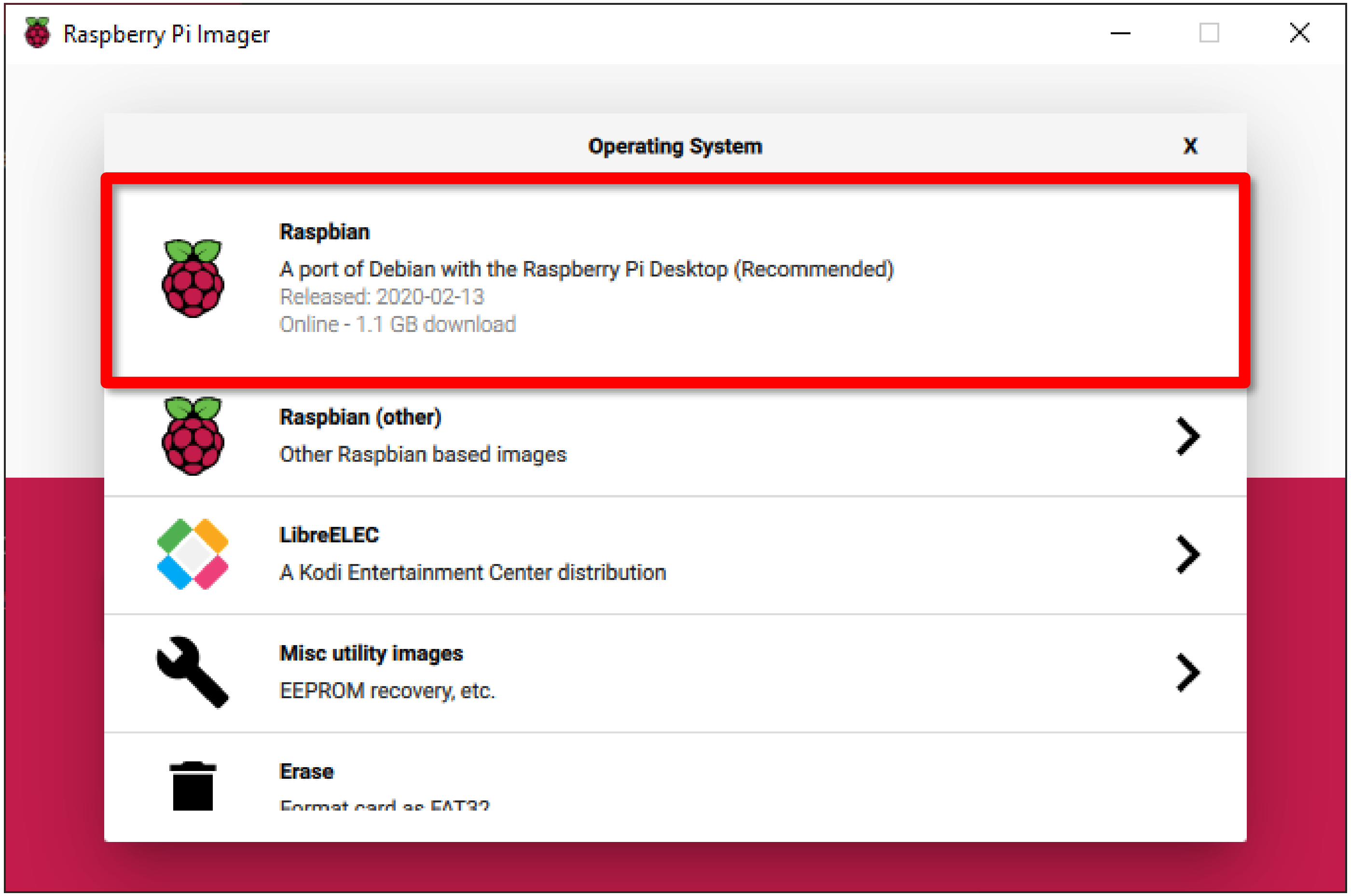
- https://downloads.raspberrypi.org/imager/imager.exe

Install and Run



Introduction – Downloading the OS

- Choose Raspbian as OS



Raspbian
A port of Debian with the Raspberry Pi Desktop (Recommended)
Released: 2020-02-13
Online - 1.1 GB download

Raspbian (other)
Other Raspbian based images

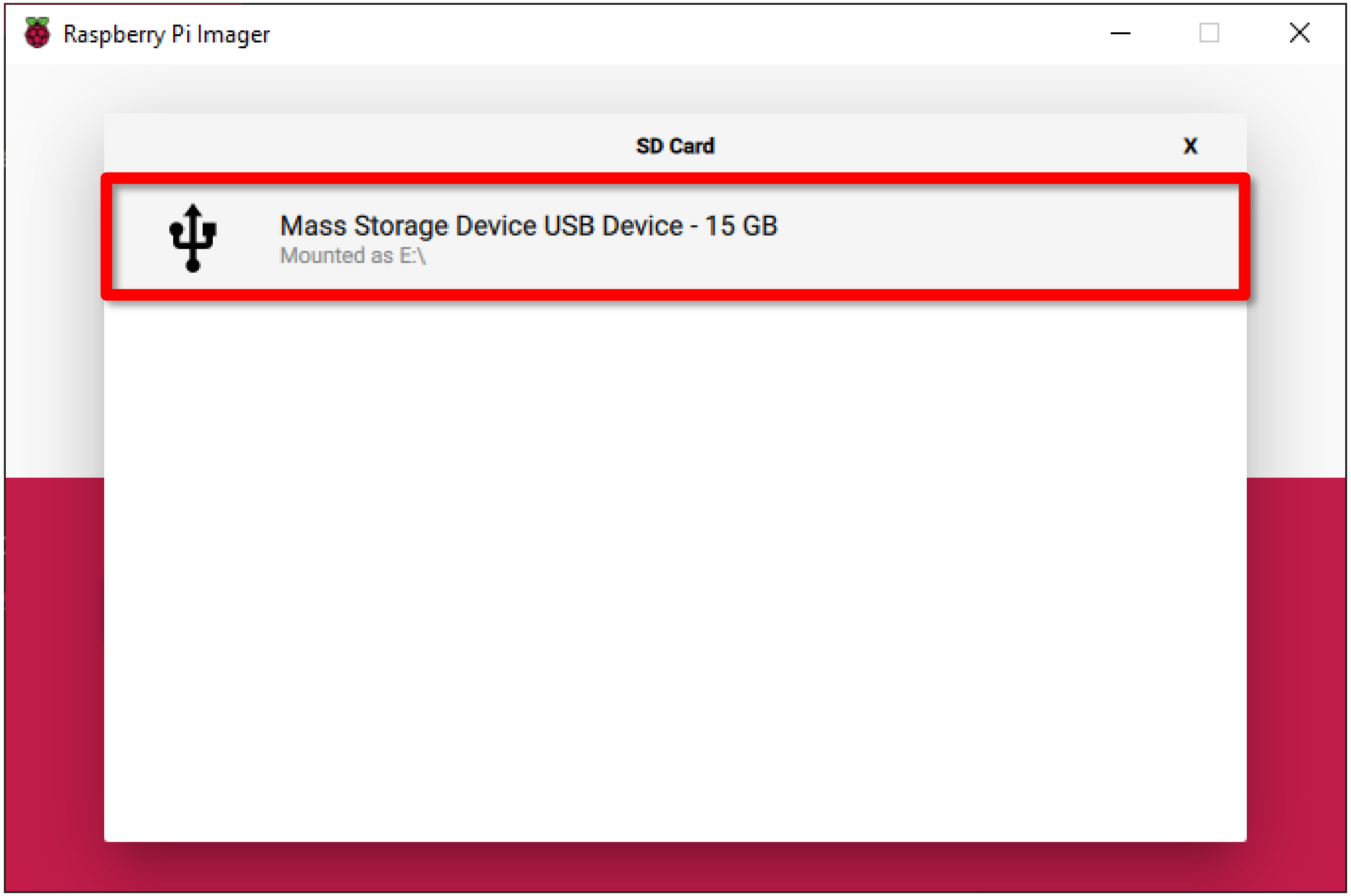
LibreELEC
A Kodi Entertainment Center distribution

Misc utility images
EEPROM recovery, etc.

Erase
Format card as FAT32

Introduction – Downloading the OS

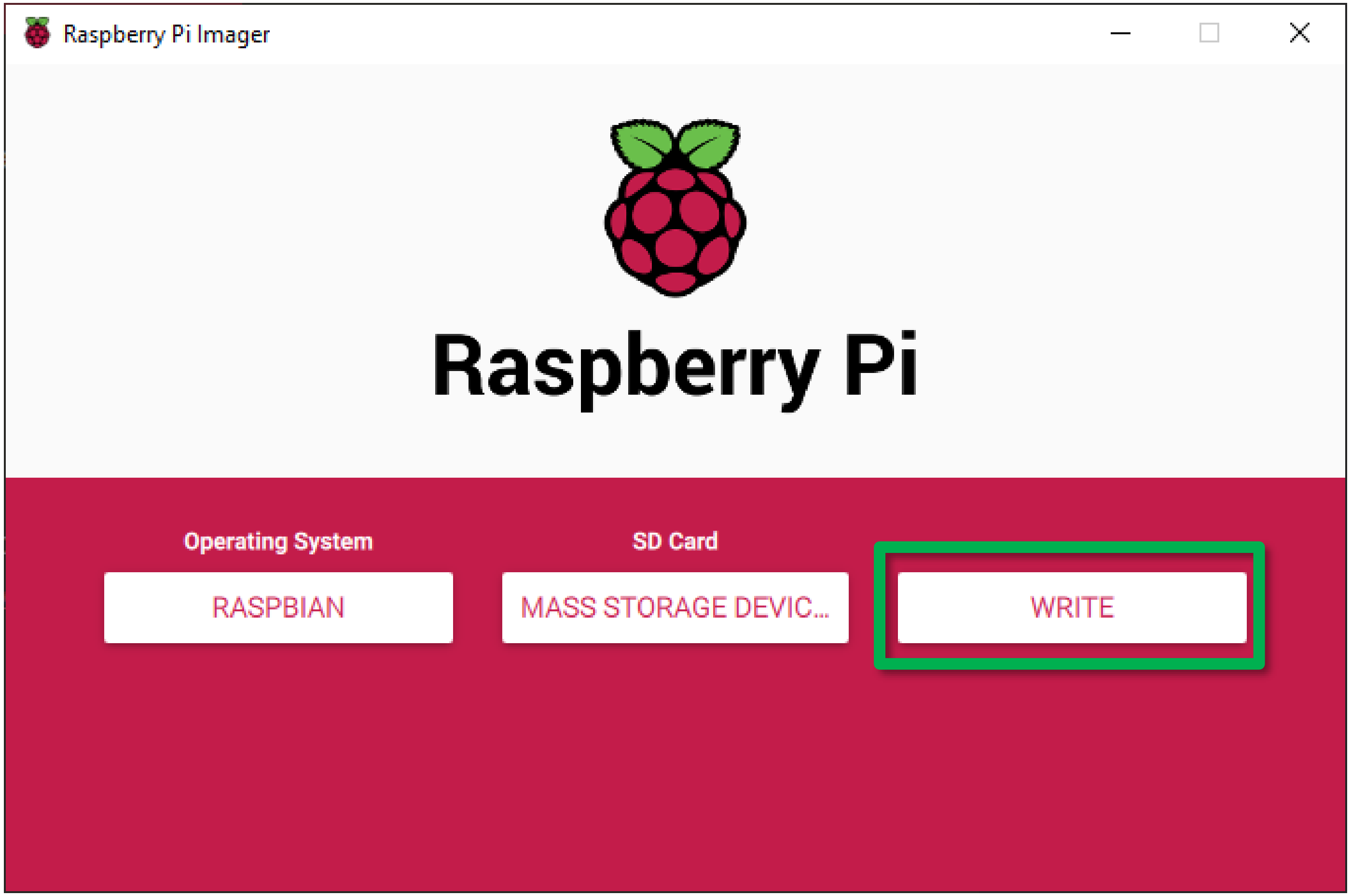
- Insert the SD card (use the USB adapter)
- Select the Correct SD card on the Imager Software



Mass Storage Device USB Device - 15 GB
Mounted as E:\

Introduction – Downloading the OS

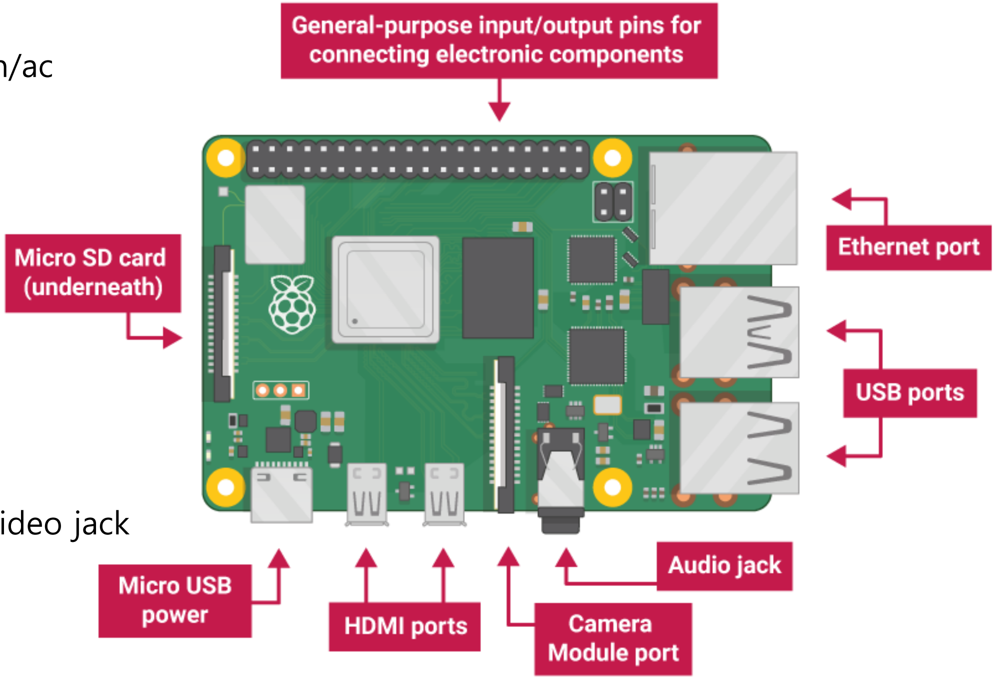
- Click "Write" to Install (Takes around 15 minutes)



Introduction – Back to Raspberry Pi

Raspberry Pi 4 B Specs:

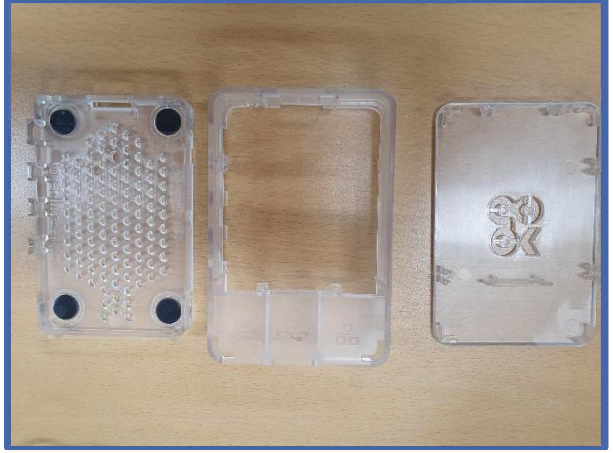
- 1.5GHz 64-bit quad-core ARM Cortex-A72 CPU
- 4GB RAM
- On-board wireless LAN – dual-band 802.11 b/g/n/ac
- On-board Bluetooth 5.0
- 2x USB 3.0 ports, 2x USB 2.0 ports
- Gigabit ethernet
- 40-pin GPIO header
- 2 micro-HDMI ports (up to 4Kp60 supported)
- DSI display port, CSI camera port
- Combined 3.5mm analog audio and composite video jack
- Micro-SD card slot
- USB-C power


General-purpose input/output pins for connecting electronic components
Micro SD card (underneath)
Ethernet port
USB ports
Micro USB power
HDMI ports
Camera Module port
Audio jack

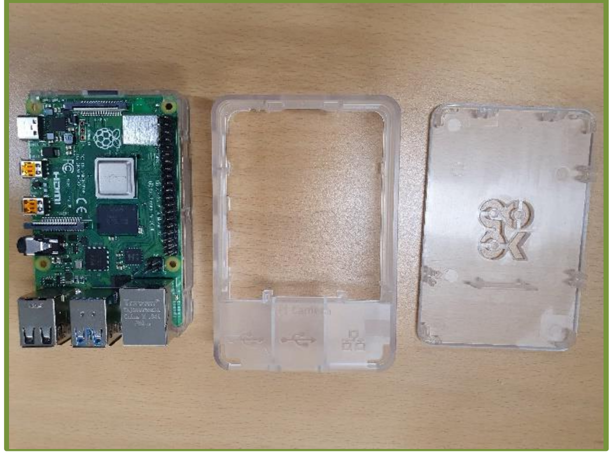
Introduction – Starting Up

Put the Raspberry Pi into the Case

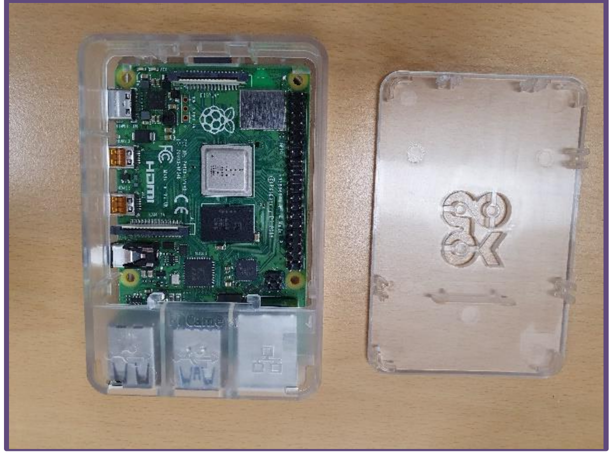
1.Split the case



2. Insert the over the bottom part



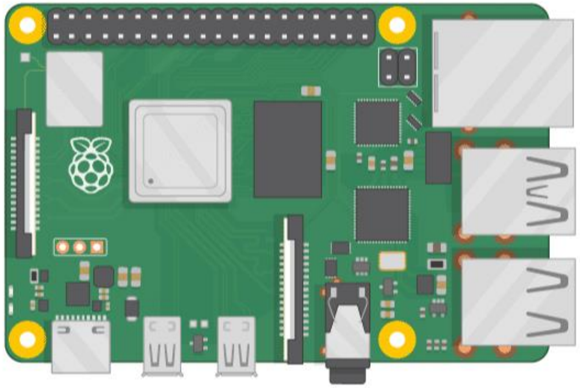
3. Insert the middle part over the board



Introduction – Starting Up

After Downloading and Installing the OS in to the SD card:

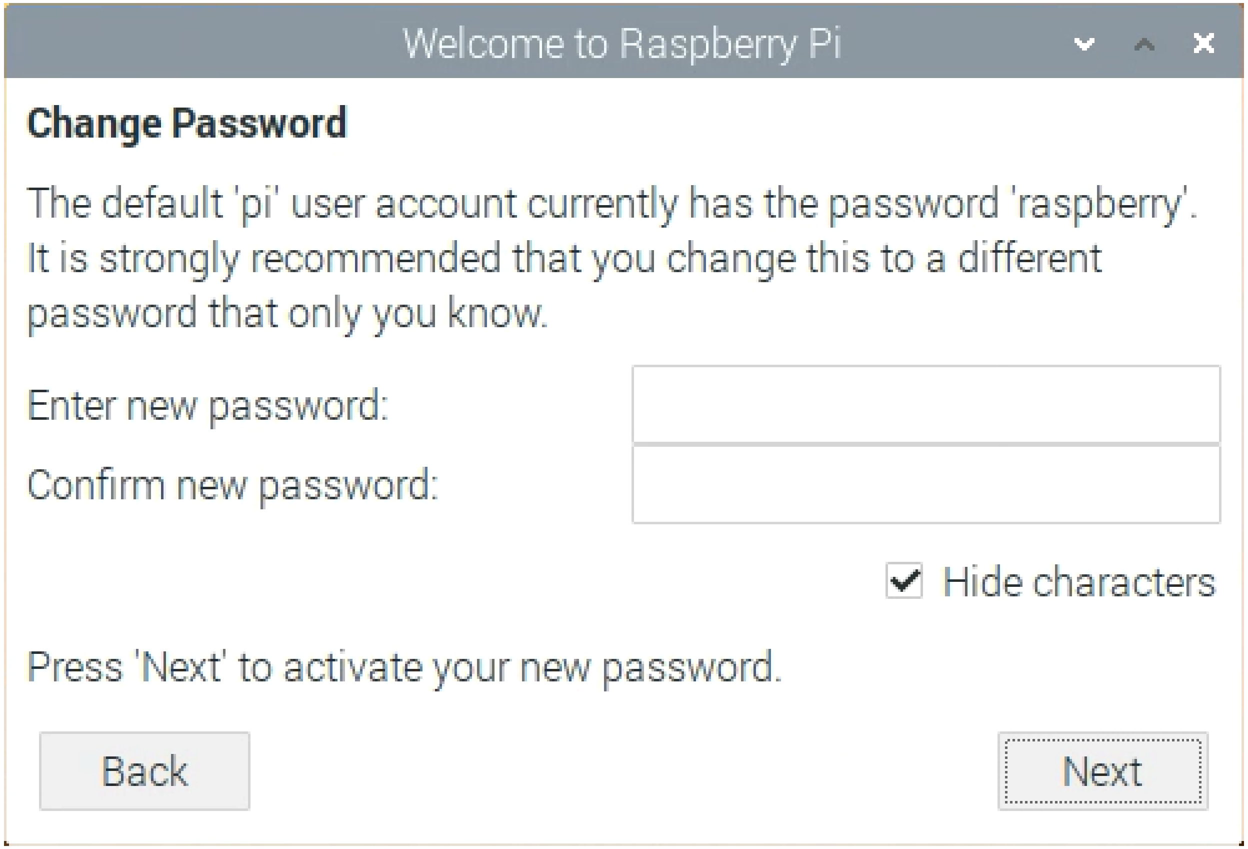
- Insert the SD card (underneath the board)
- Connect USB mouse and keyboard
- Connect monitor using the mini-HDMI cable
- Finally, connect the USB-C cable



The Raspberry Pi should boot up

Introduction – Finishing the Setup

- After starting up for the first time, the Welcome application starts up.
- Select the country and language
- For a password, choose ONE SPACE (press space bar once)



Change Password

The default 'pi' user account currently has the password 'raspberry'. It is strongly recommended that you change this to a different password that only you know.

Enter new password:

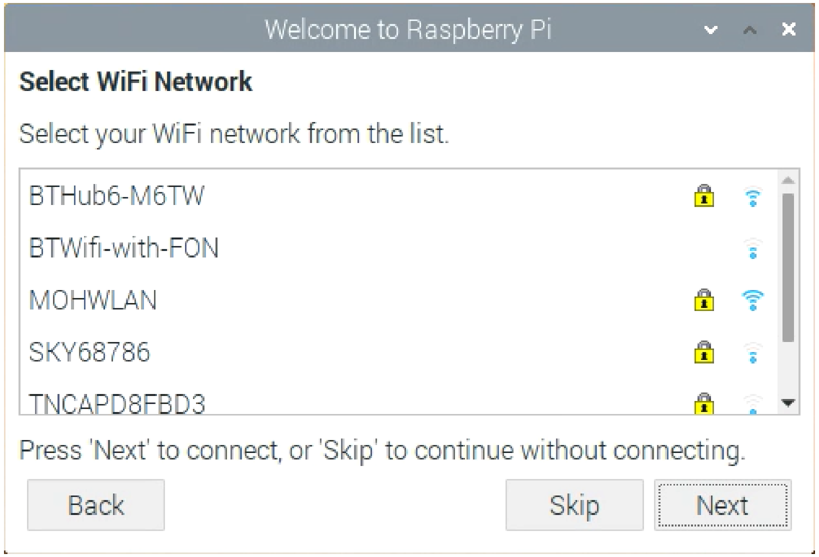
Confirm new password:

☑ Hide characters

Press 'Next' to activate your new password.

Introduction – Finishing the Setup

- Connect to a WiFi (might need to use a phone hotspot)
- The OS will update
- After finishing click 'Restart'



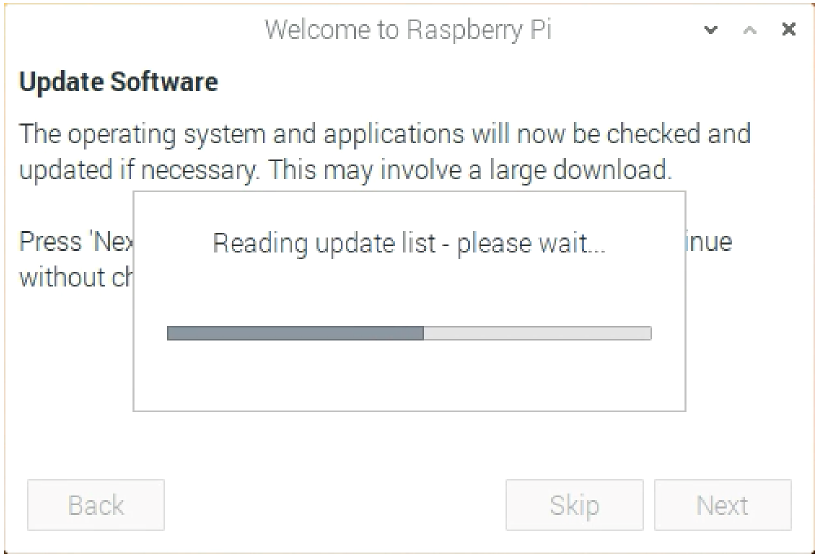
Welcome to Raspberry Pi

Select WiFi Network

Select your WiFi network from the list.

BTHub6-M6TW
BTWifi-with-FON
MOHWLAN
SKY68786
TNCAPD8FBD3

Press 'Next' to connect, or 'Skip' to continue without connecting.



Welcome to Raspberry Pi

Update Software

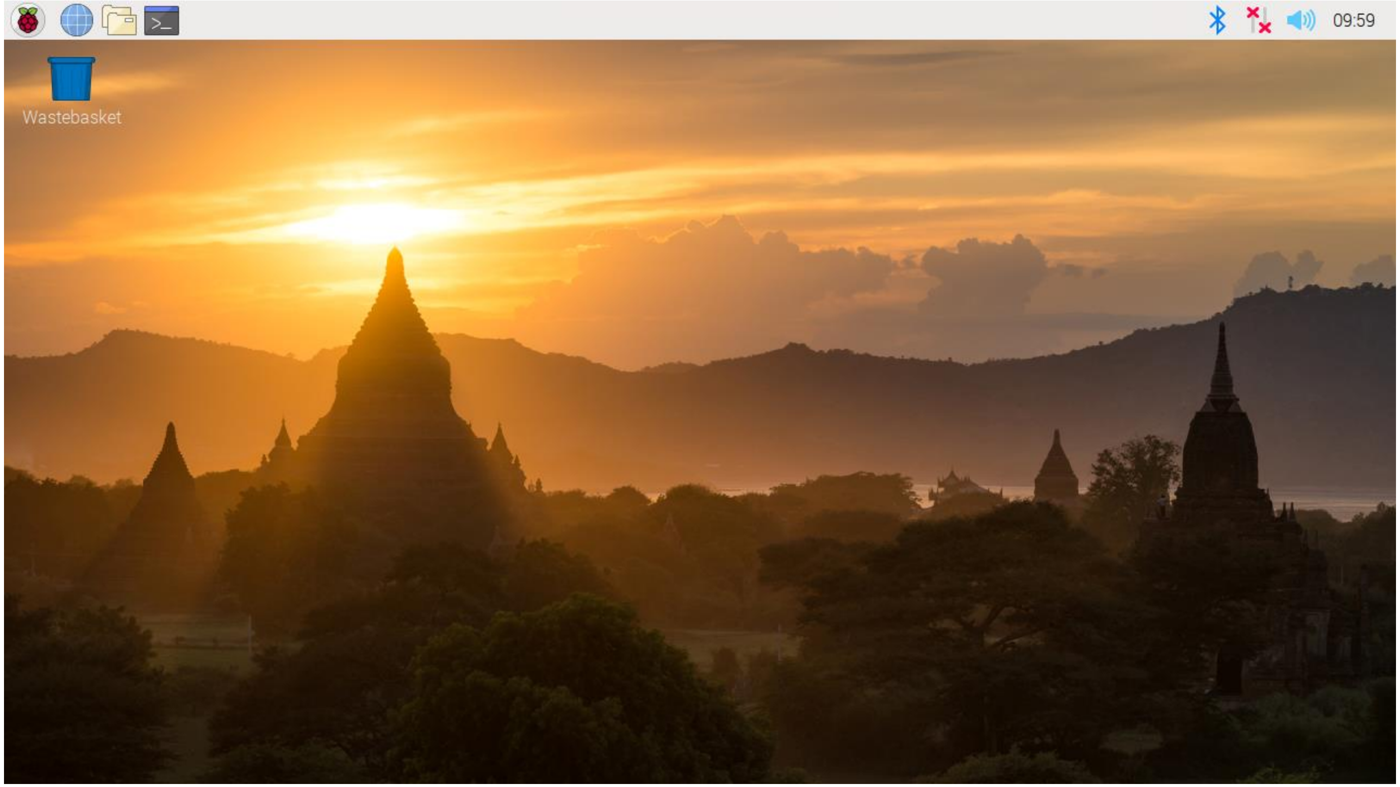
The operating system and applications will now be checked and updated if necessary. This may involve a large download.

Press 'Nex inue without ch

Reading update list - please wait...

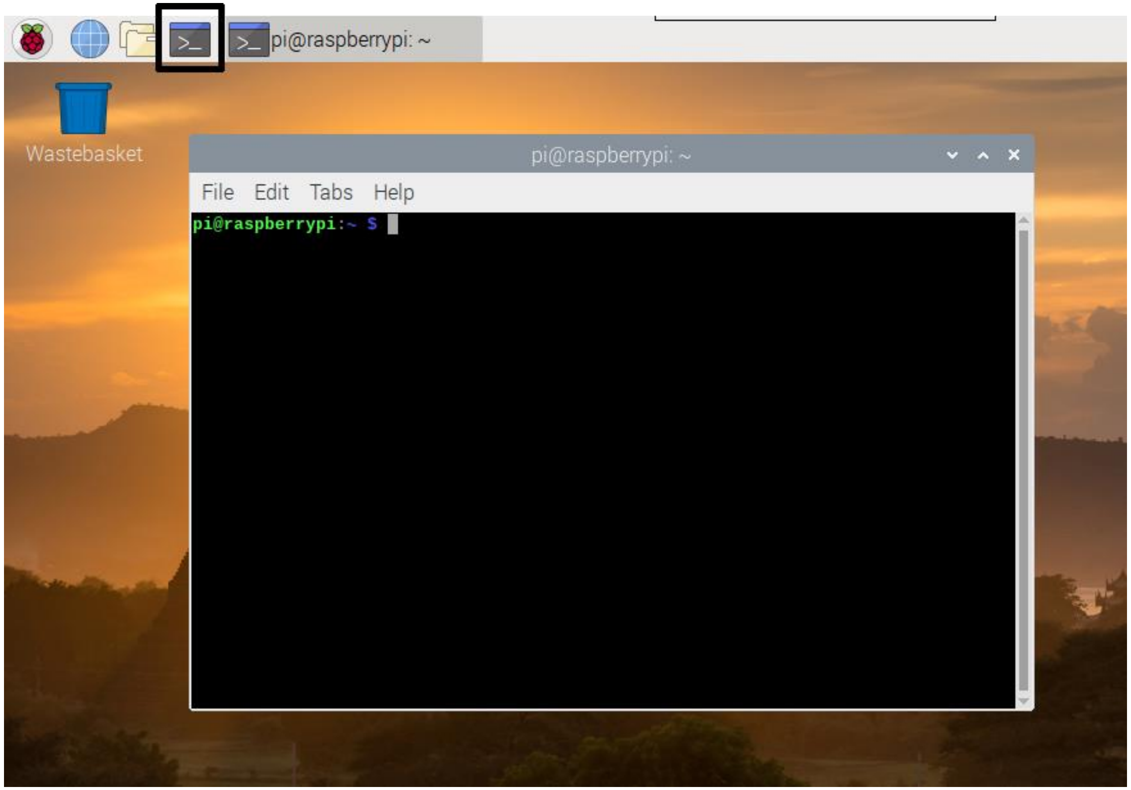
Introduction – Raspbian OS

- **Official Raspberry Pi OS**
- **Linux based distribution**



Introduction – Needed libraries

- **Open the terminal and run the following commands:**
  - sudo apt-get install wiringpi
  - sudo apt-get install libcurl4-openssl-dev

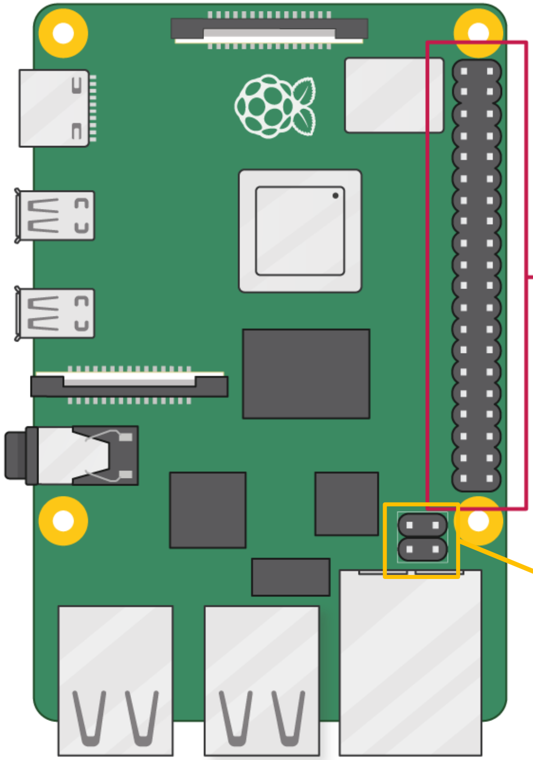


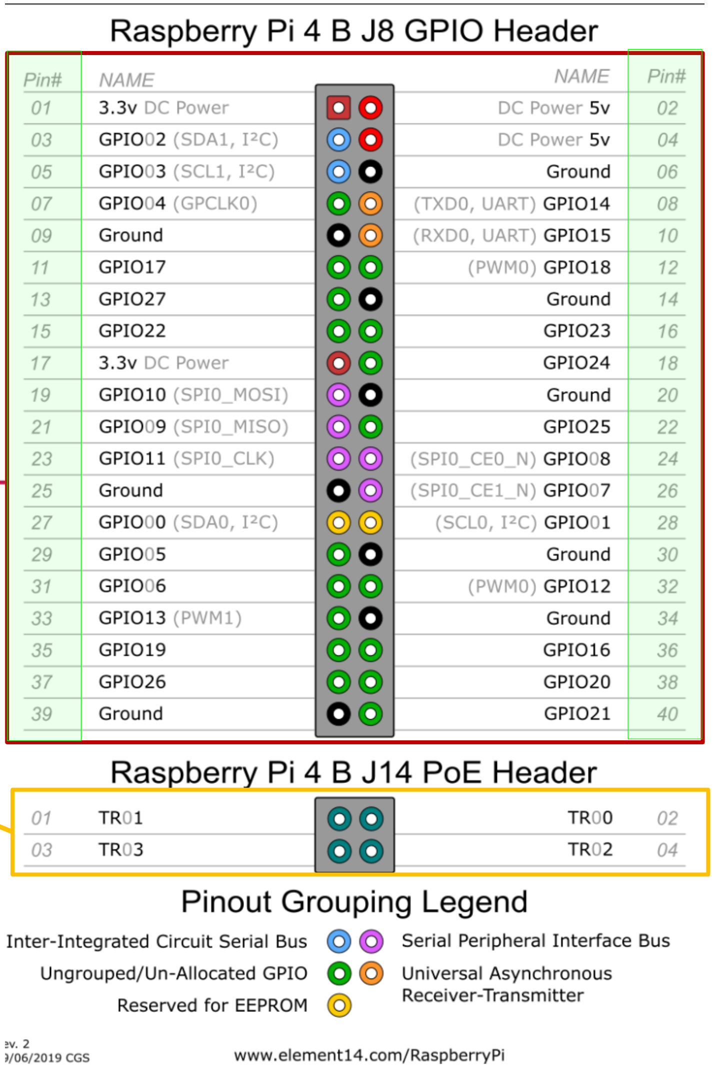
```
pi@raspberrypi:~ $
```

Part 1 - GPIO

LED and Button

GPIO – Pin Header





Raspberry Pi 4 B J8 GPIO Header

Pin#	NAME	NAME	Pin#
01	3.3v DC Power	DC Power 5v	02
03	GPIO02 (SDA1, I²C)	DC Power 5v	04
05	GPIO03 (SCL1, I²C)	Ground	06
07	GPIO04 (GPCLK0)	(TXD0, UART) GPIO14	08
09	Ground	(RXD0, UART) GPIO15	10
11	GPIO17	(PWM0) GPIO18	12
13	GPIO27	Ground	14
15	GPIO22	GPIO23	16
17	3.3v DC Power	GPIO24	18
19	GPIO10 (SPI0_MOSI)	Ground	20
21	GPIO09 (SPI0_MISO)	GPIO25	22
23	GPIO11 (SPI0_CLK)	(SPI0_CE0_N) GPIO08	24
25	Ground	(SPI0_CE1_N) GPIO07	26
27	GPIO00 (SDA0, I²C)	(SCL0, I²C) GPIO01	28
29	GPIO05	Ground	30
31	GPIO06	(PWM0) GPIO12	32
33	GPIO13 (PWM1)	Ground	34
35	GPIO19	GPIO16	36
37	GPIO26	GPIO20	38
39	Ground	GPIO21	40

Raspberry Pi 4 B J14 PoE Header

01	TR01	TR00	02
03	TR03	TR02	04

Pinout Grouping Legend

Inter-Integrated Circuit Serial Bus ○ ○ Serial Peripheral Interface Bus

Ungrouped/Un-Allocated GPIO ○ ○ Universal Asynchronous Receiver-Transmitter

Reserved for EEPROM ○

ev. 2
9/06/2019 CGS

www.element14.com/RaspberryPi

Hardware Pin number

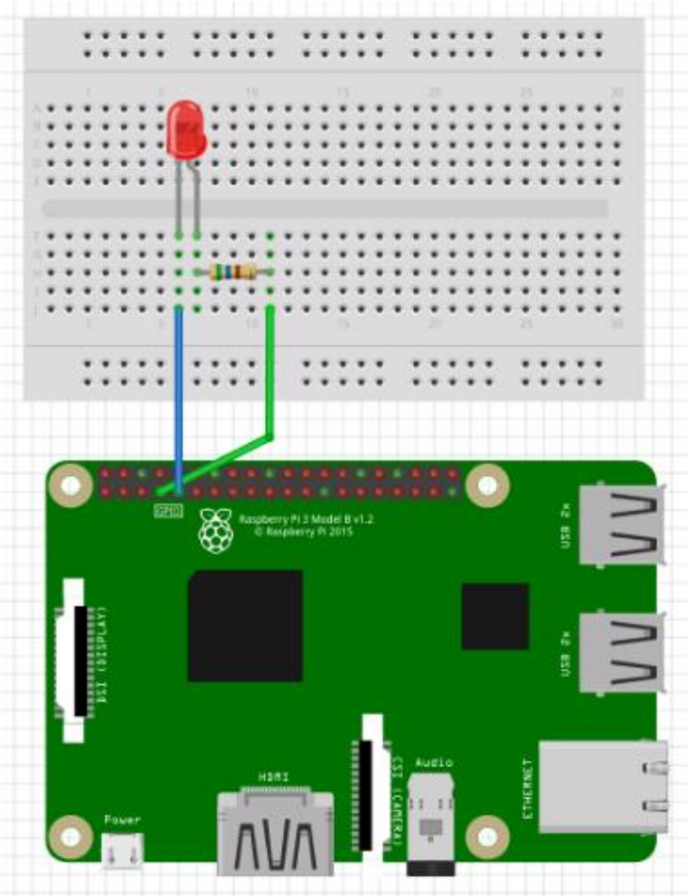
GPIO – Blink LED Schematic

Hardware:

- 1 LED
- 1 560Ω resistor
- 1 Breadboard
- 2 cables

Connections:

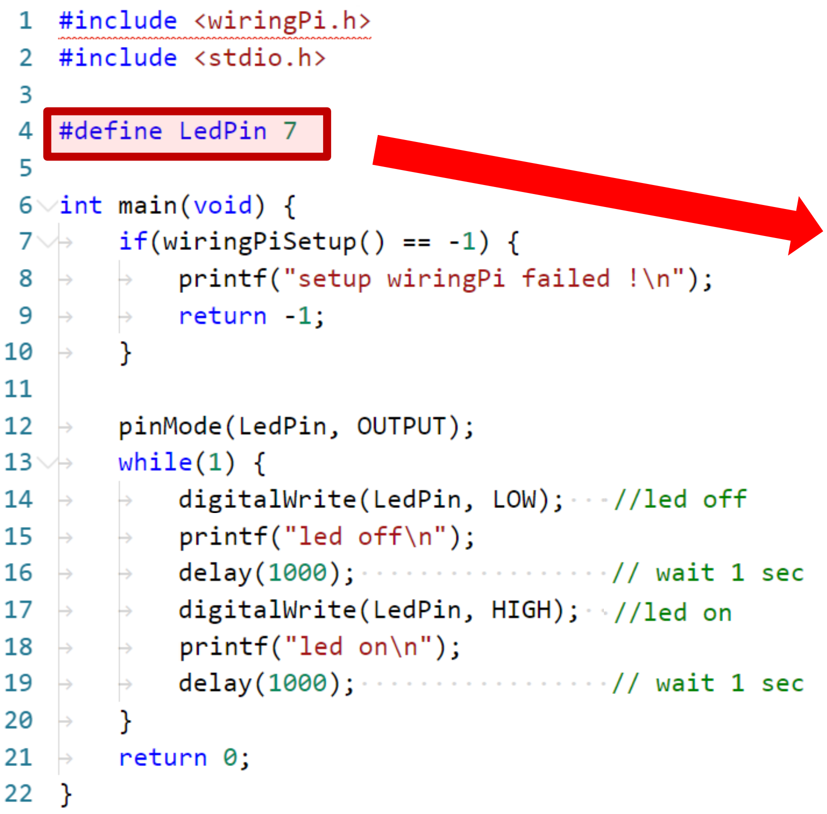
- Connect the hardware pin 7 to the resistor
- Connect the other side of the resistor to the LED anode
- Connect the LED cathode to GND



GPIO – Blink LED Code

Software Pin number

Hardware Pin number

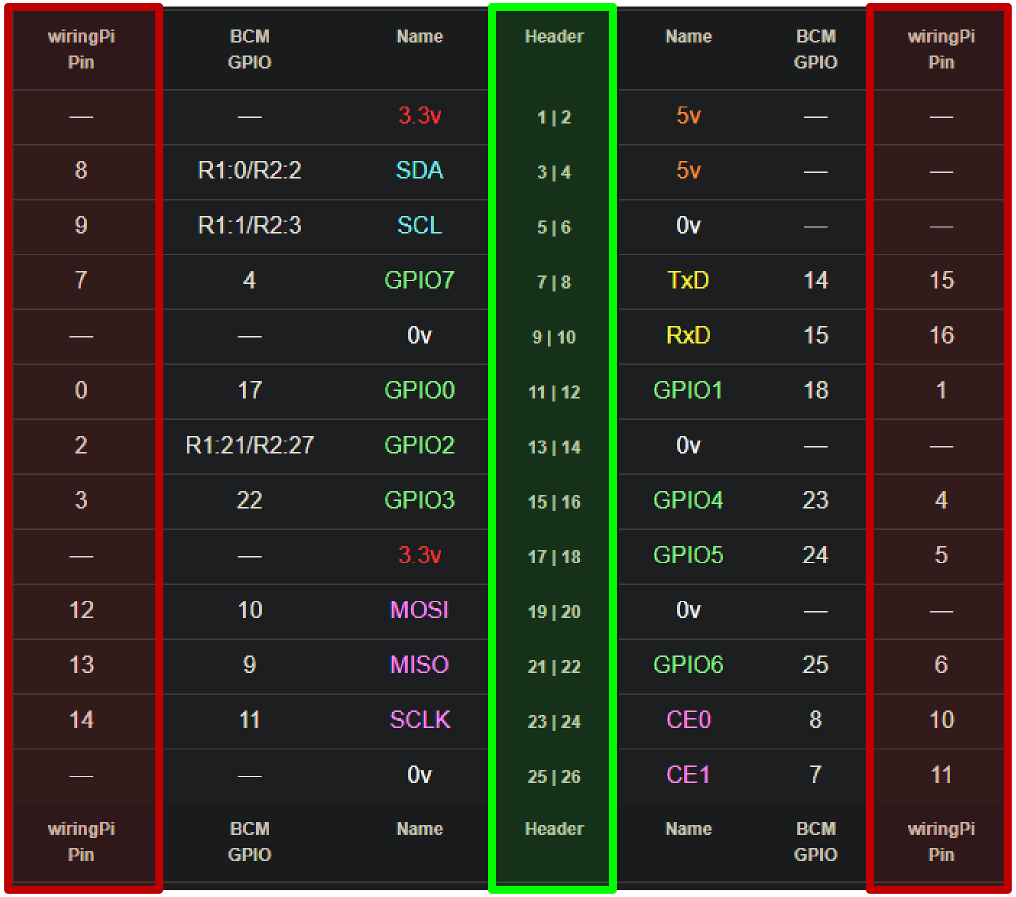


```c
#include <wiringPi.h>
#include <stdio.h>

#define LedPin 7

int main(void) {
    if(wiringPiSetup() == -1) {
        printf("setup wiringPi failed !\n");
        return -1;
    }

    pinMode(LedPin, OUTPUT);
    while(1) {
        digitalWrite(LedPin, LOW);   //led off
        printf("led off\n");
        delay(1000);                 // wait 1 sec
        digitalWrite(LedPin, HIGH);  //led on
        printf("led on\n");
        delay(1000);                 // wait 1 sec
    }
    return 0;
}
```



wiringPi Pin	BCM GPIO	Name	Header	Name	BCM GPIO	wiringPi Pin
—	—	3.3v	1 | 2	5v	—	—
8	R1:0/R2:2	SDA	3 | 4	5v	—	—
9	R1:1/R2:3	SCL	5 | 6	0v	—	—
7	4	GPIO7	7 | 8	TxD	14	15
—	—	0v	9 | 10	RxD	15	16
0	17	GPIO0	11 | 12	GPIO1	18	1
2	R1:21/R2:27	GPIO2	13 | 14	0v	—	—
3	22	GPIO3	15 | 16	GPIO4	23	4
—	—	3.3v	17 | 18	GPIO5	24	5
12	10	MOSI	19 | 20	0v	—	—
13	9	MISO	21 | 22	GPIO6	25	6
14	11	SCLK	23 | 24	CE0	8	10
—	—	0v	25 | 26	CE1	7	11
wiringPi Pin	BCM GPIO	Name	Header	Name	BCM GPIO	wiringPi Pin

GPIO – Blink LED

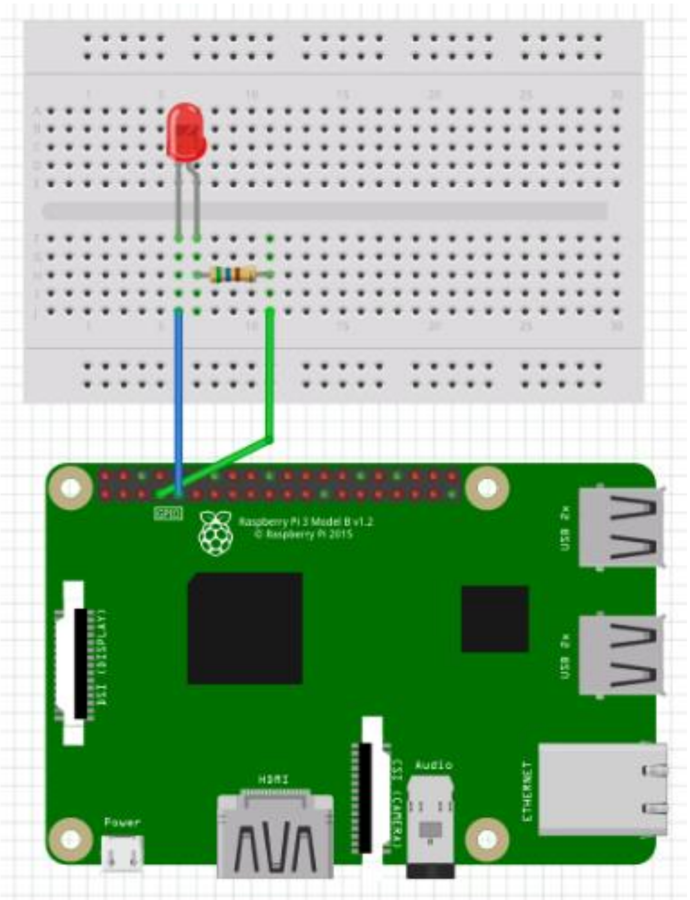
Compile:

- gcc -Wall blink.c -o blink –lwiringPi

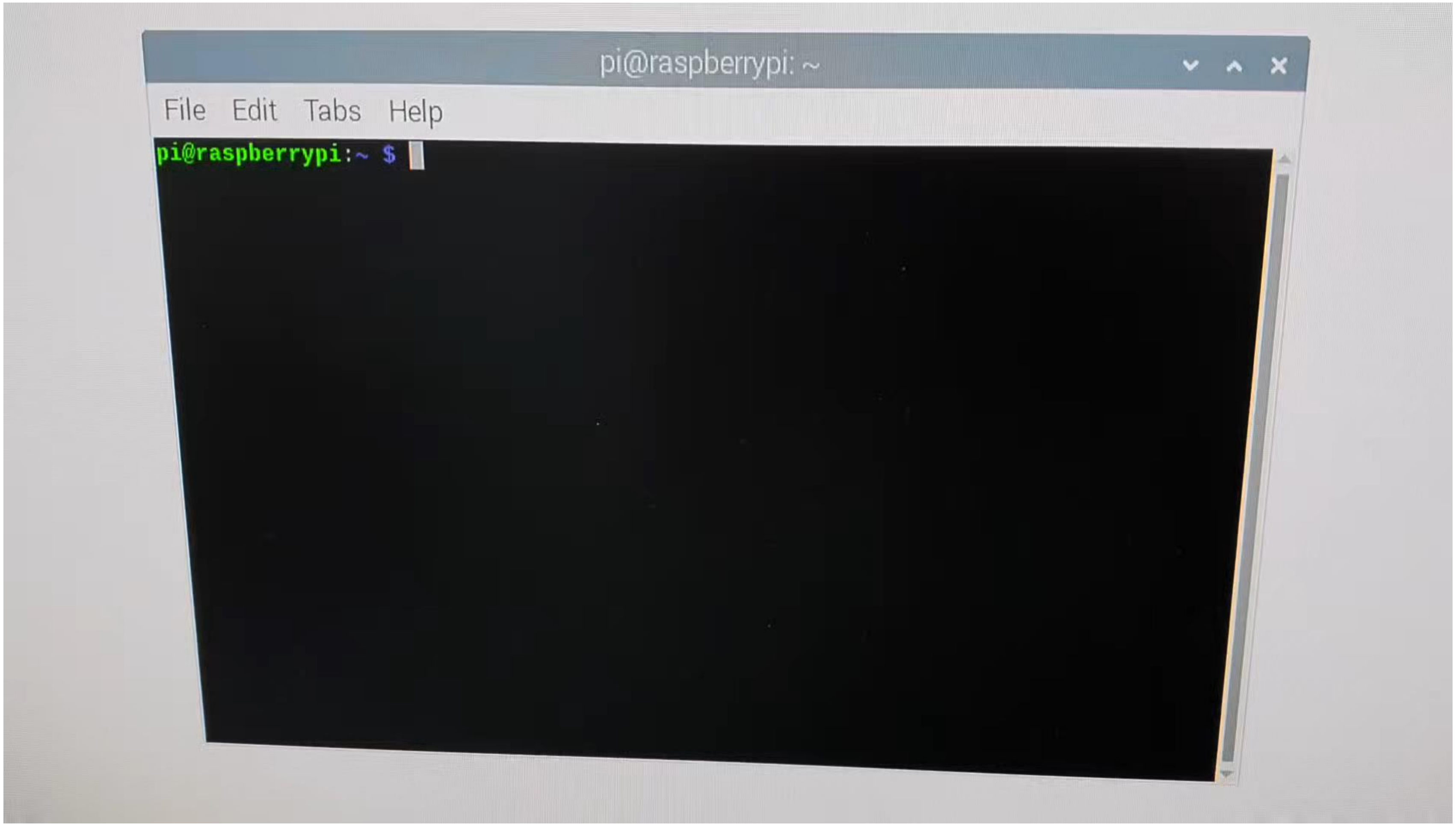
Run:

- ./blink

(Type on terminal)



GPIO – Blink LED



```
pi@raspberrypi:~ $
```

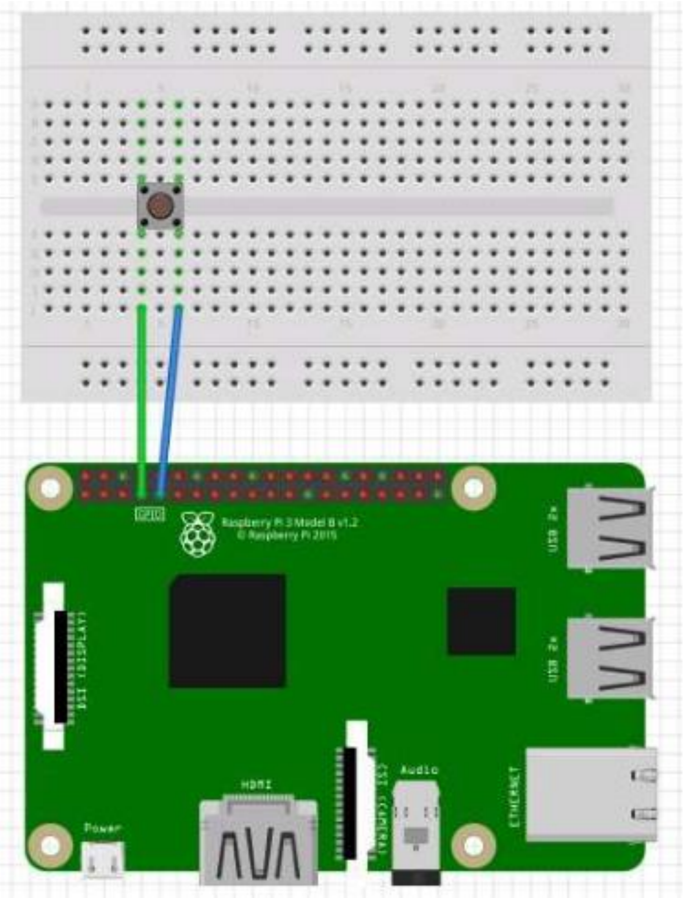
GPIO – Button Schematic

Hardware:

- 1 button
- 1 Breadboard
- 2 cables

Connections:

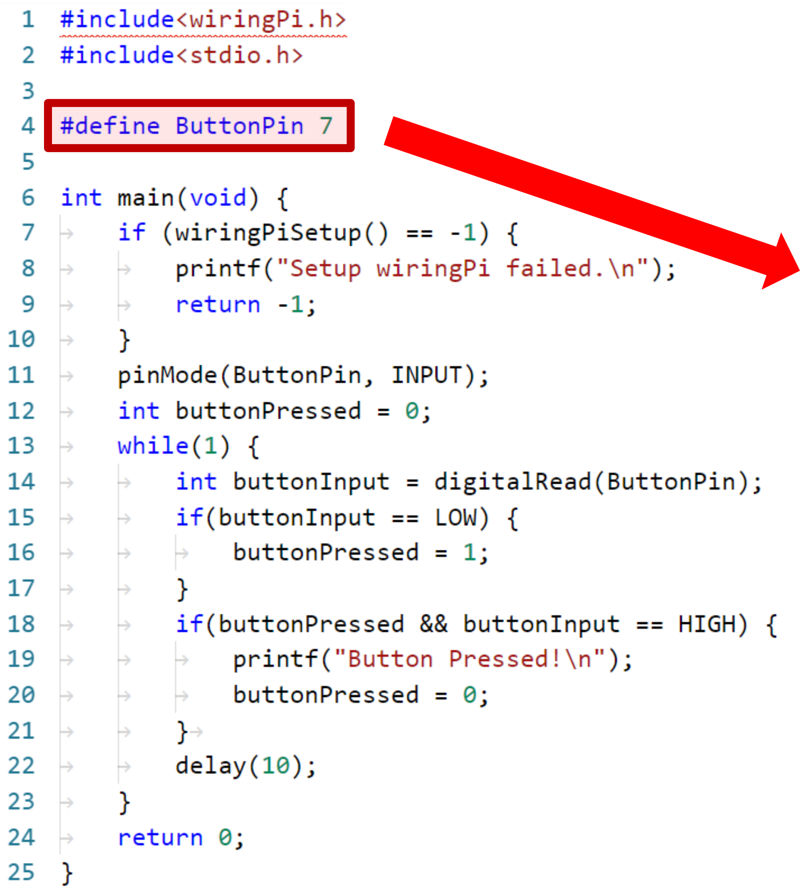
- Connect the hardware pin 7 to one of the sides of the button
- Connect the matching side to GND



GPIO – Button Code

Software Pin number

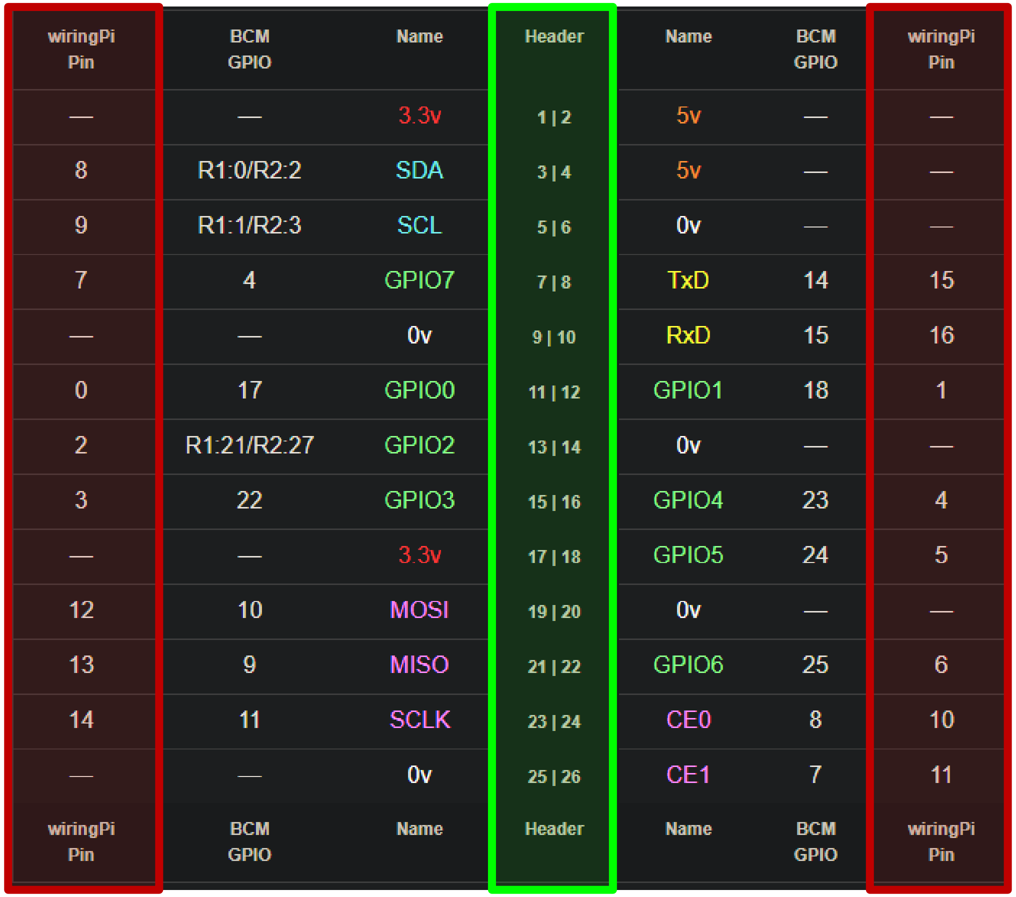
Hardware Pin number



```c
#include<wiringPi.h>
#include<stdio.h>

#define ButtonPin 7

int main(void) {
    if (wiringPiSetup() == -1) {
        printf("Setup wiringPi failed.\n");
        return -1;
    }
    pinMode(ButtonPin, INPUT);
    int buttonPressed = 0;
    while(1) {
        int buttonInput = digitalRead(ButtonPin);
        if(buttonInput == LOW) {
            buttonPressed = 1;
        }
        if(buttonPressed && buttonInput == HIGH) {
            printf("Button Pressed!\n");
            buttonPressed = 0;
        }
        delay(10);
    }
    return 0;
}
```



wiringPi Pin	BCM GPIO	Name	Header	Name	BCM GPIO	wiringPi Pin
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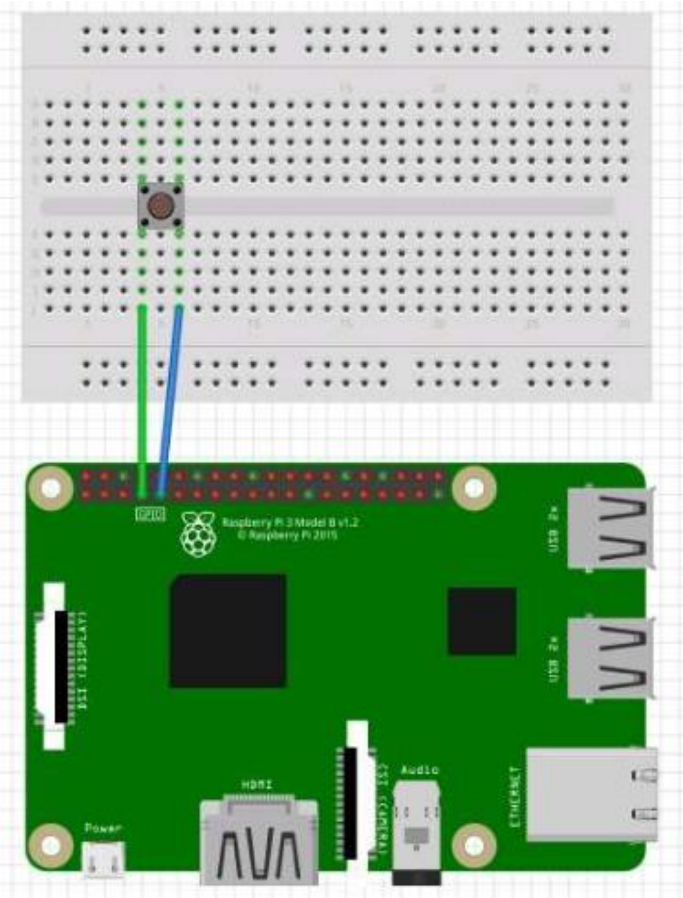
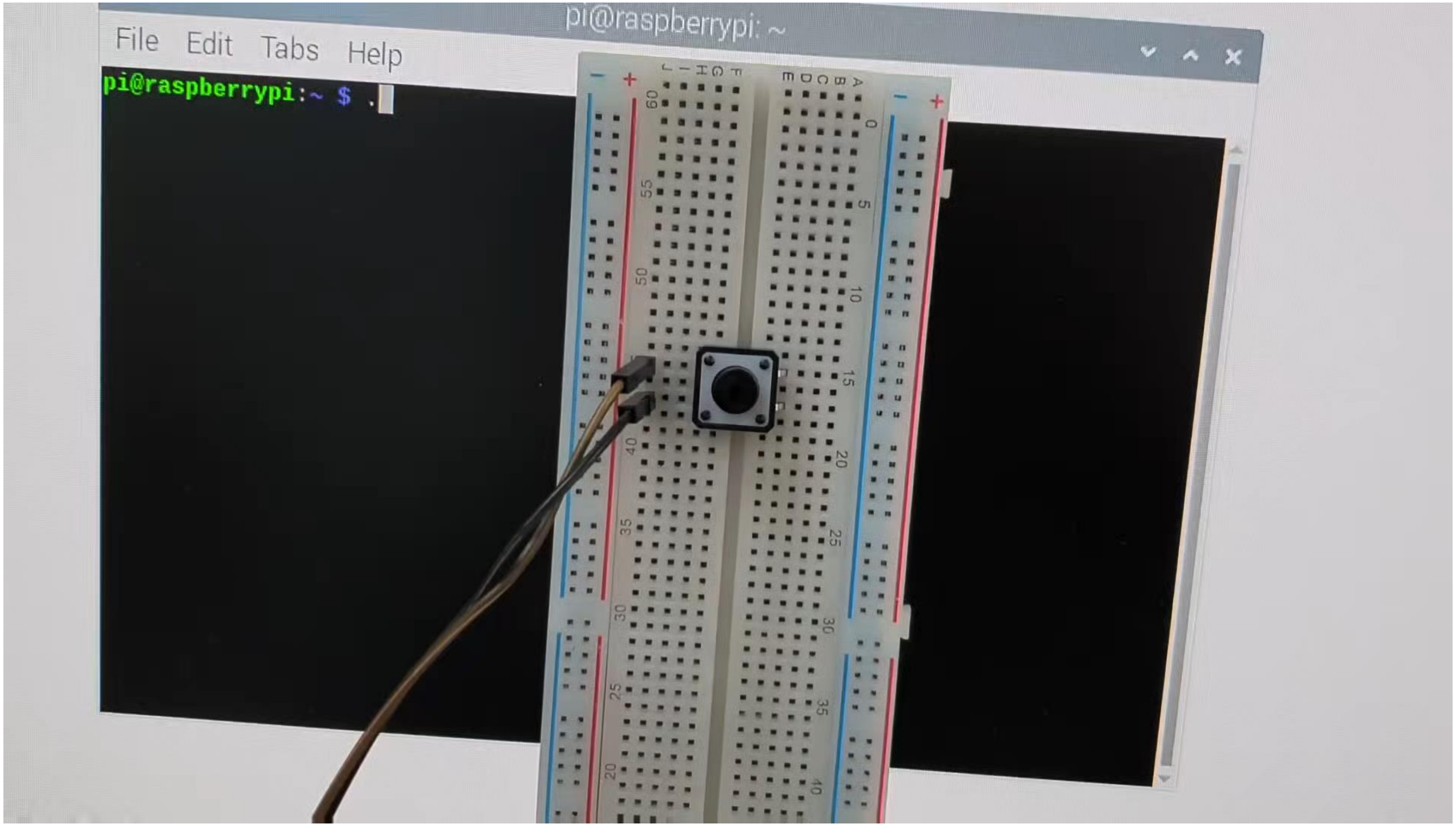
0	17	GPIO0	11 | 12	GPIO1	18	1
2	R1:21/R2:27	GPIO2	13 | 14	0v	—	—
3	22	GPIO3	15 | 16	GPIO4	23	4
—	—	3.3v	17 | 18	GPIO5	24	5
12	10	MOSI	19 | 20	0v	—	—
13	9	MISO	21 | 22	GPIO6	25	6
14	11	SCLK	23 | 24	CE0	8	10
—	—	0v	25 | 26	CE1	7	11
wiringPi Pin	BCM GPIO	Name	Header	Name	BCM GPIO	wiringPi Pin

GPIO – Button

- **On terminal:**
- **Compile:**
  - gcc -Wall button.c -o button –lwiringPi
- **Run:**
  - ./button



GPIO – Button



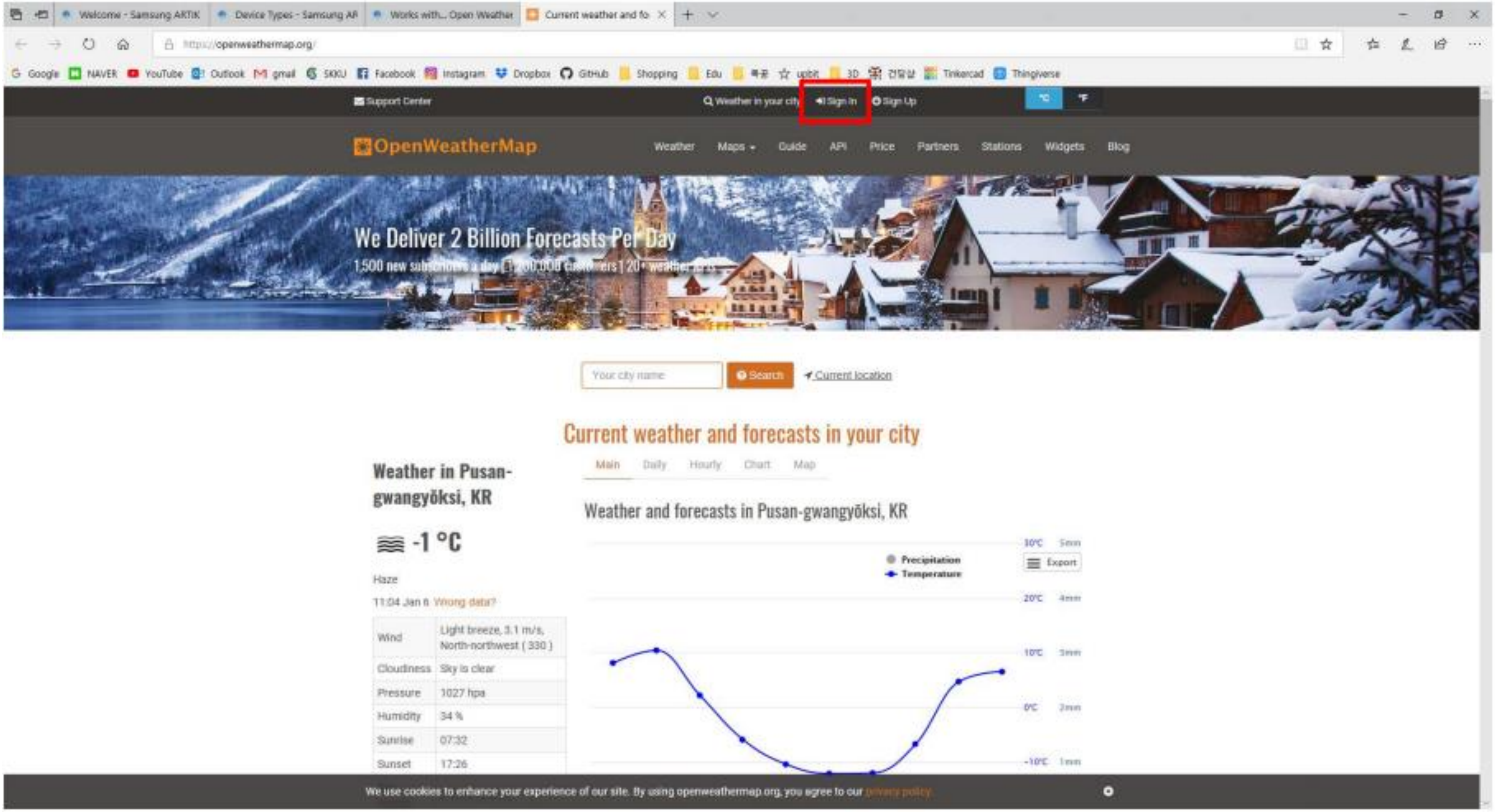
```
pi@raspberrypi:~ $ .
```

Part 2 – Calling APIs

Get Current Weather

Login to Open Weather Map

Open Weather Map - Sign Up: https://openweathermap.org



Current weather and forecasts in your city

Weather in Pusan-gwangyŏksi, KR

-1 °C

Haze

11:04 Jan 6 Wrong data?

Wind	Light breeze, 3.1 m/s, North-northwest (330)
Cloudiness	Sky is clear
Pressure	1027 hpa
Humidity	34 %
Sunrise	07:32
Sunset	17:26

Weather and forecasts in Pusan-gwangyŏksi, KR

We use cookies to enhance your experience of our site. By using openweathermap.org, you agree to our privacy policy.

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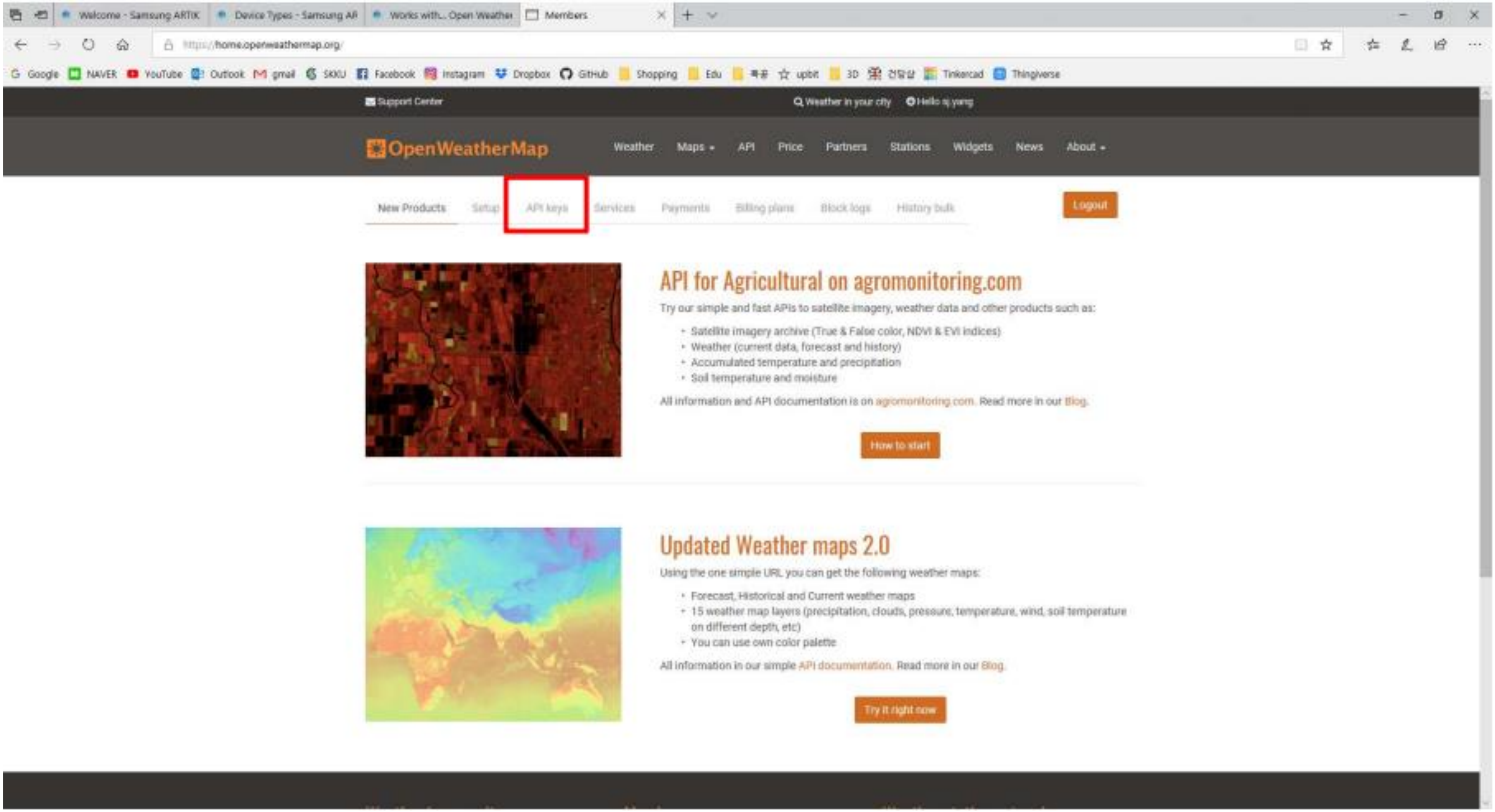
Login to Open Weather Map

After Login copy the API key



API for Agricultural on agromonitoring.com

Try our simple and fast APIs to satellite imagery, weather data and other products such as:

- Satellite imagery archive (True & False color, NDVI & EVI indices)
- Weather (current data, forecast and history)
- Accumulated temperature and precipitation
- Soil temperature and moisture

All information and API documentation is on agromonitoring.com. Read more in our Blog.

Updated Weather maps 2.0

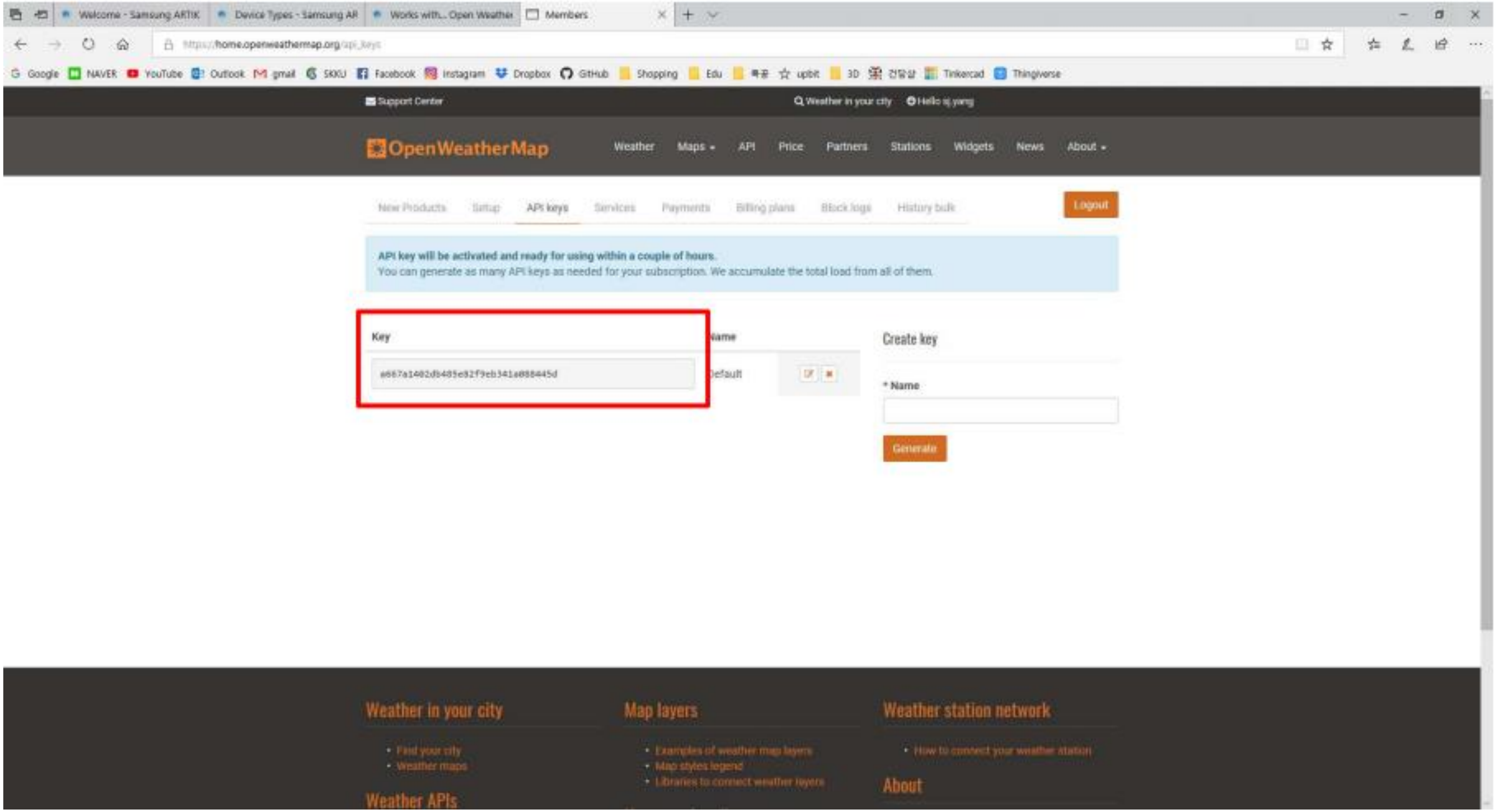
Using the one simple URL you can get the following weather maps:

- Forecast, Historical and Current weather maps
- 15 weather map layers (precipitation, clouds, pressure, temperature, wind, soil temperature on different depth, etc)
- You can use own color palette

All information in our simple API documentation. Read more in our Blog.

Login to Open Weather Map

The API key will be used on the code



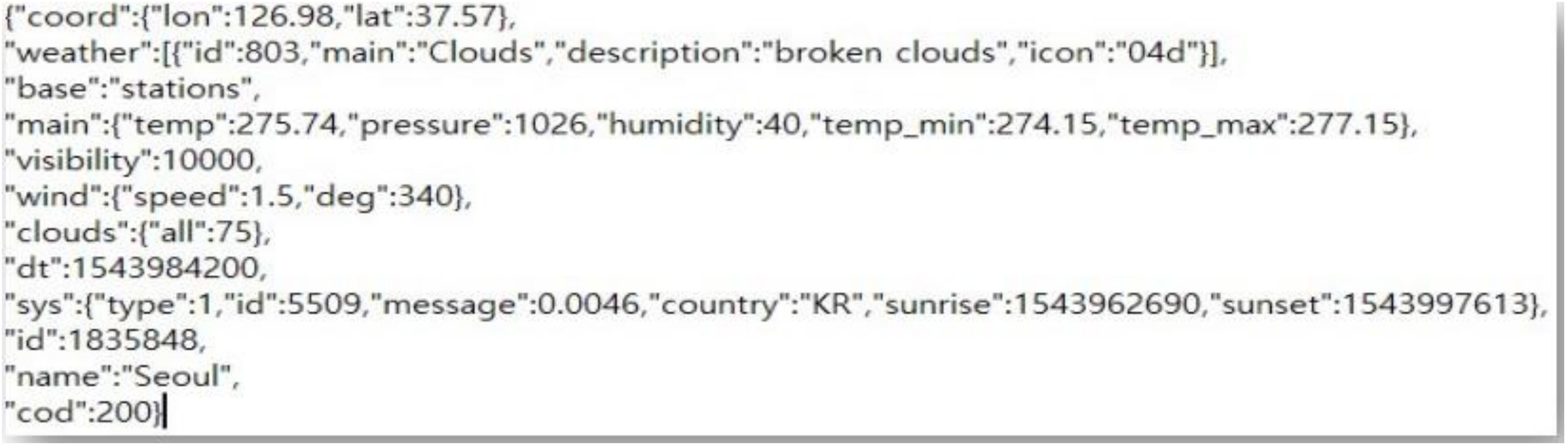
API key will be activated and ready for using within a couple of hours.
You can generate as many API keys as needed for your subscription. We accumulate the total load from all of them.

Key	Name
a667a1402db485e82f9eb341a088445d	Default

Create key

* Name

Weather Information Vocabulary



```
{"coord":{"lon":126.98,"lat":37.57},
"weather":[{"id":803,"main":"Clouds","description":"broken clouds","icon":"04d"}],
"base":"stations",
"main":{"temp":275.74,"pressure":1026,"humidity":40,"temp_min":274.15,"temp_max":277.15},
"visibility":10000,
"wind":{"speed":1.5,"deg":340},
"clouds":{"all":75},
"dt":1543984200,
"sys":{"type":1,"id":5509,"message":0.0046,"country":"KR","sunrise":1543962690,"sunset":1543997613},
"id":1835848,
"name":"Seoul",
"cod":200}
```

Coord(좌표) lon : 경도, lat : 위도

Weather

Base

Main(main정보) temp : 온도, pressure : 기압

Wind(바람 speed : 바람 세기, deg : 바람 방향

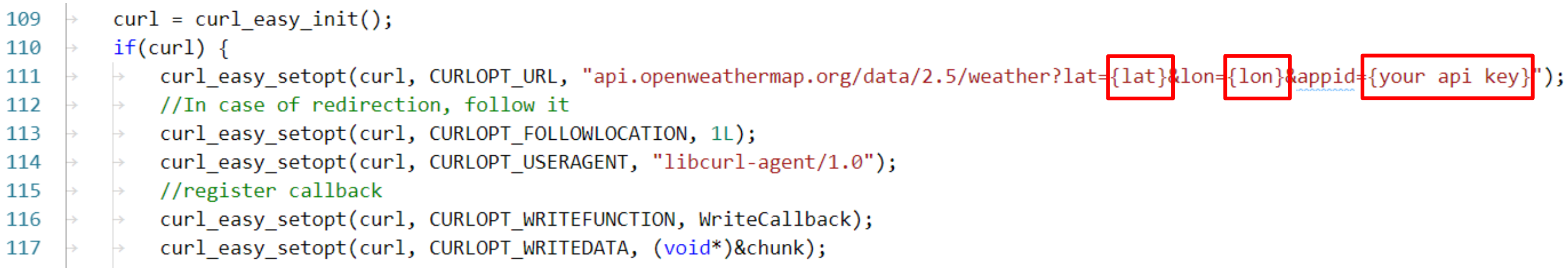
Clouds(구름)

Dt(시간)

Name(도시 이름)

Calling the API

- Copy and paste your api key
- Use internet maps to find the latitude and longitude of your desired location
- Update the code and compile



```
curl = curl_easy_init();
if(curl) {
    curl_easy_setopt(curl, CURLOPT_URL, "api.openweathermap.org/data/2.5/weather?lat={lat}&lon={lon}&appid={your api key}");
    //In case of redirection, follow it
    curl_easy_setopt(curl, CURLOPT_FOLLOWLOCATION, 1L);
    curl_easy_setopt(curl, CURLOPT_USERAGENT, "libcurl-agent/1.0");
    //register callback
    curl_easy_setopt(curl, CURLOPT_WRITEFUNCTION, WriteCallback);
    curl_easy_setopt(curl, CURLOPT_WRITEDATA, (void*)&chunk);
```

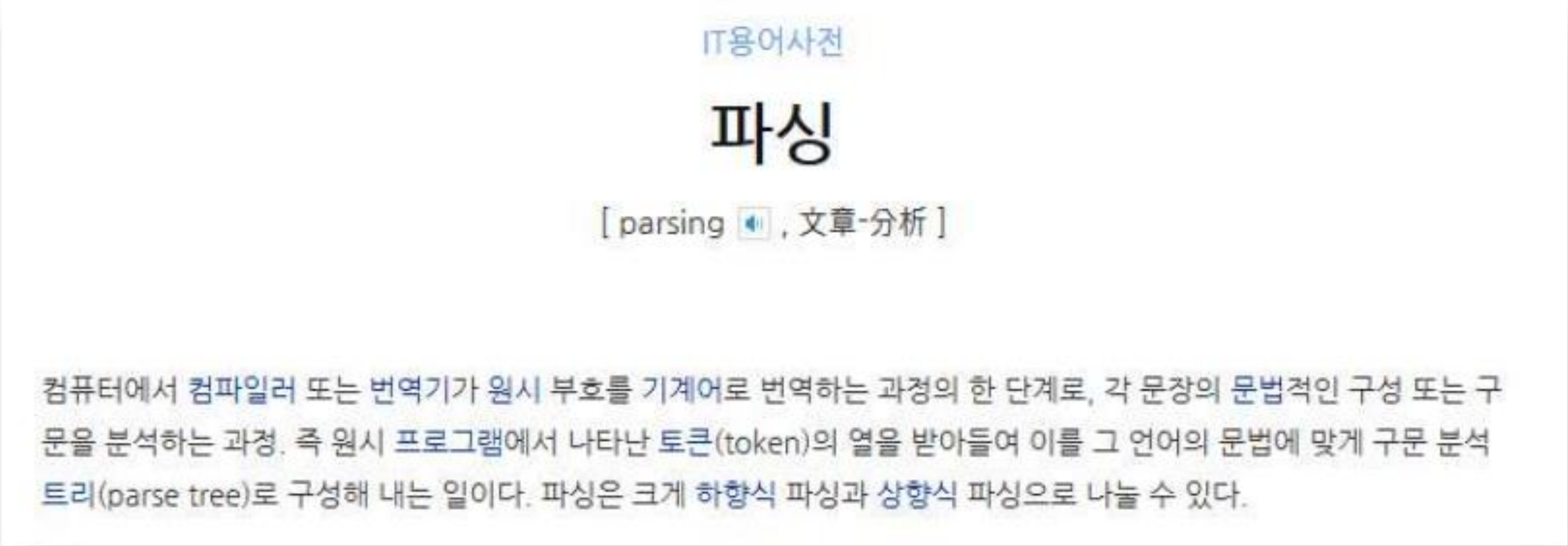
- On terminal:

- Compile:
  - gcc -Wall callApi.c -o callApi –lcurl

- Run:
  - ./callApi

Parsing the response data

Parsing?



IT용어사전

파싱

[parsing 🔈 , 文章-分析]

컴퓨터에서 컴파일러 또는 번역기가 원시 부호를 기계어로 번역하는 과정의 한 단계로, 각 문장의 문법적인 구성 또는 구문을 분석하는 과정. 즉 원시 프로그램에서 나타난 토큰(token)의 열을 받아들여 이를 그 언어의 문법에 맞게 구문 분석 트리(parse tree)로 구성해 내는 일이다. 파싱은 크게 하향식 파싱과 상향식 파싱으로 나눌 수 있다.

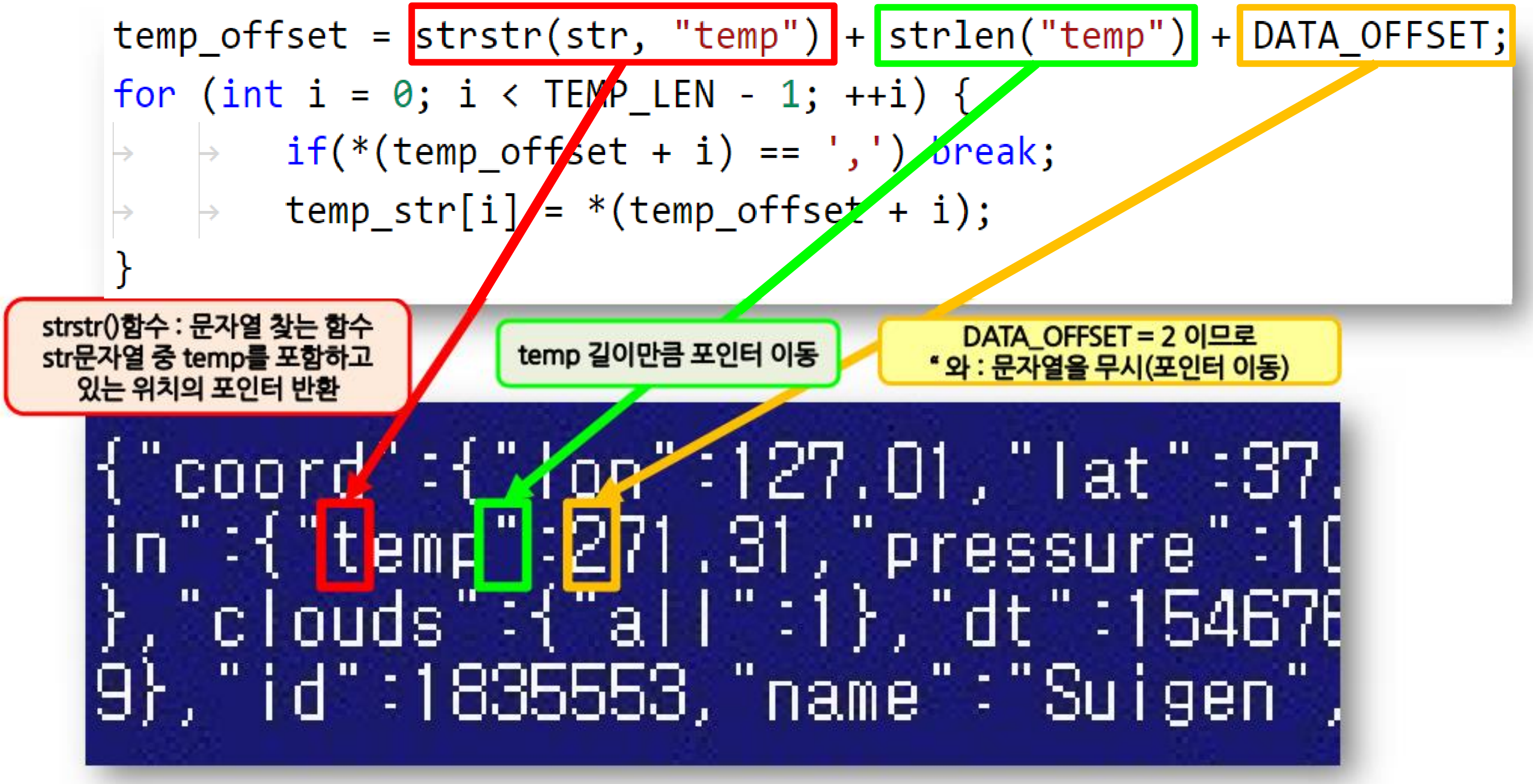
[출처] https://terms.naver.com/entry.nhn?docId=2454969&cid=42346&categoryId=42346

여러 개의 데이터 중 필요한 데이터만 골라 내는 것

현재기온, 최고기온, 최저기온, 습도 데이터만 파싱

Parsing

Parsing algorithm



```
temp_offset = strstr(str, "temp") + strlen("temp") + DATA_OFFSET;
for (int i = 0; i < TEMP_LEN - 1; ++i) {
        if(*(temp_offset + i) == ',') break;
        temp_str[i] = *(temp_offset + i);
}
```

strstr()함수 : 문자열 찾는 함수
str문자열 중 temp를 포함하고
있는 위치의 포인터 반환

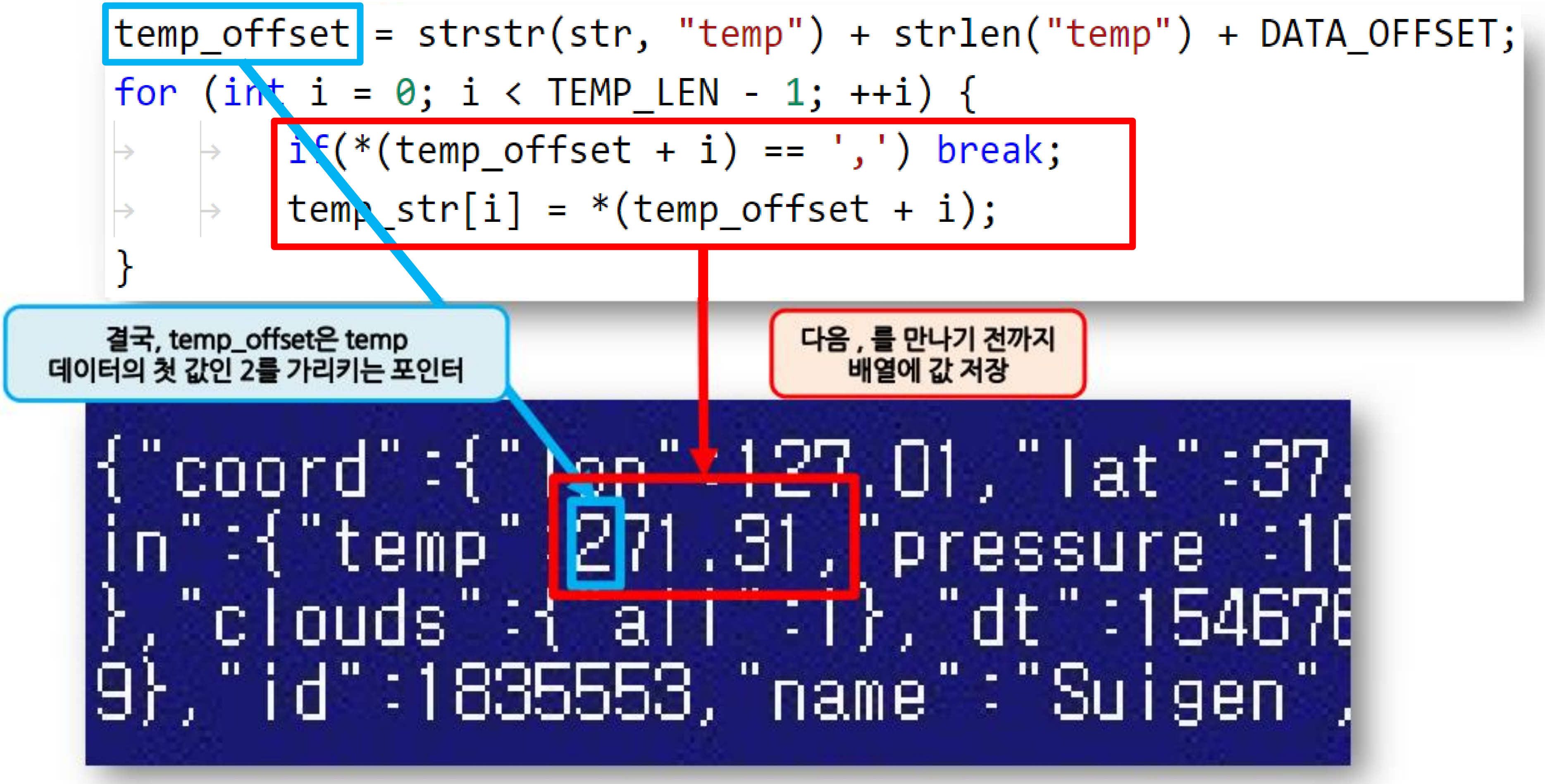
temp 길이만큼 포인터 이동

DATA_OFFSET = 2 이므로
" 와 : 문자열을 무시(포인터 이동)

```
{"coord":{"lon":127.01,"lat":37.
in":{"temp":271.31,"pressure":10
},"clouds":{"all":1},"dt":154676
9},"id":1835553,"name":"Suigen",
```

Parsing

Parsing algorithm



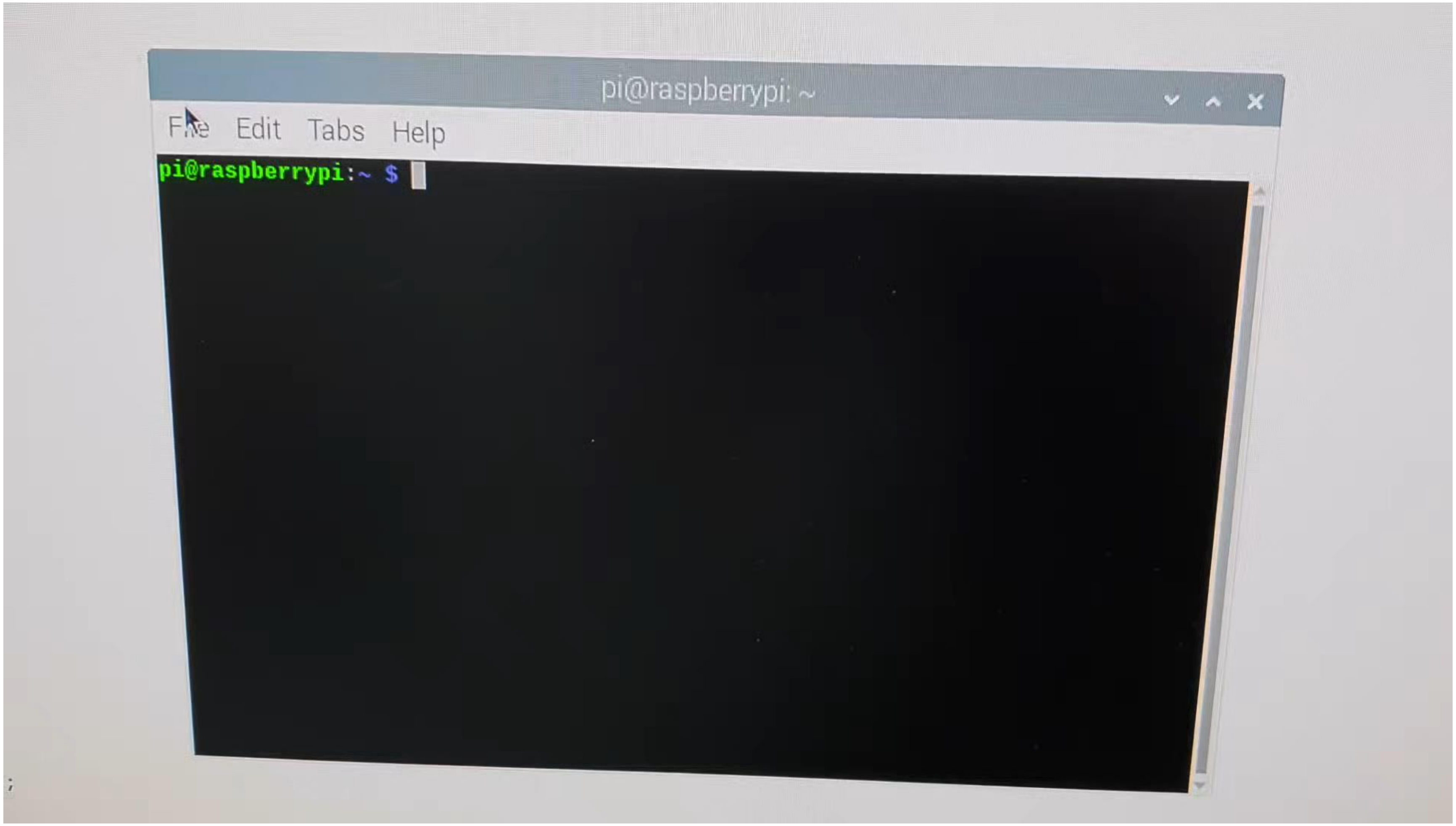
```
temp_offset = strstr(str, "temp") + strlen("temp") + DATA_OFFSET;
for (int i = 0; i < TEMP_LEN - 1; ++i) {
        if(*(temp_offset + i) == ',') break;
        temp_str[i] = *(temp_offset + i);
}
```

결국, temp_offset은 temp 데이터의 첫 값인 2를 가리키는 포인터

다음 , 를 만나기 전까지 배열에 값 저장

```
{"coord":{"lon":127.01,"lat":37.
in":{"temp":271.31,"pressure":10
},"clouds":{"all":1},"dt":154676
9},"id":1835553,"name":"Suigen",
```

Calling the API



```
pi@raspberrypi:~ $
```

Part 3 - Project

Small Project

- **Create a small project integrating GPIO and API calling**

- **Example APIs:**
  - https://openweathermap.org (Weather Information)
  - https://sunrise-sunset.org/api (Sunset and Sunrise times in UTC, need to convert after receiving)
  - https://ip-api.com/docs/api:json (Get IP location)
  - https://www.boredapi.com/ (Get random activity suggestion)

감사합니다.

Q & A