Oide

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Supporting the Professional Learning of School Leaders and Teachers

Raspberry Pi and Astro Pi

Session 2

Skills Workshop

OIDE and ESERO

Session Overview

PART 1. Physical Sense HAT setup

PART 2. Programming the Sense HAT

PART 3. Internet of Things (IoT) and ThingSpeak

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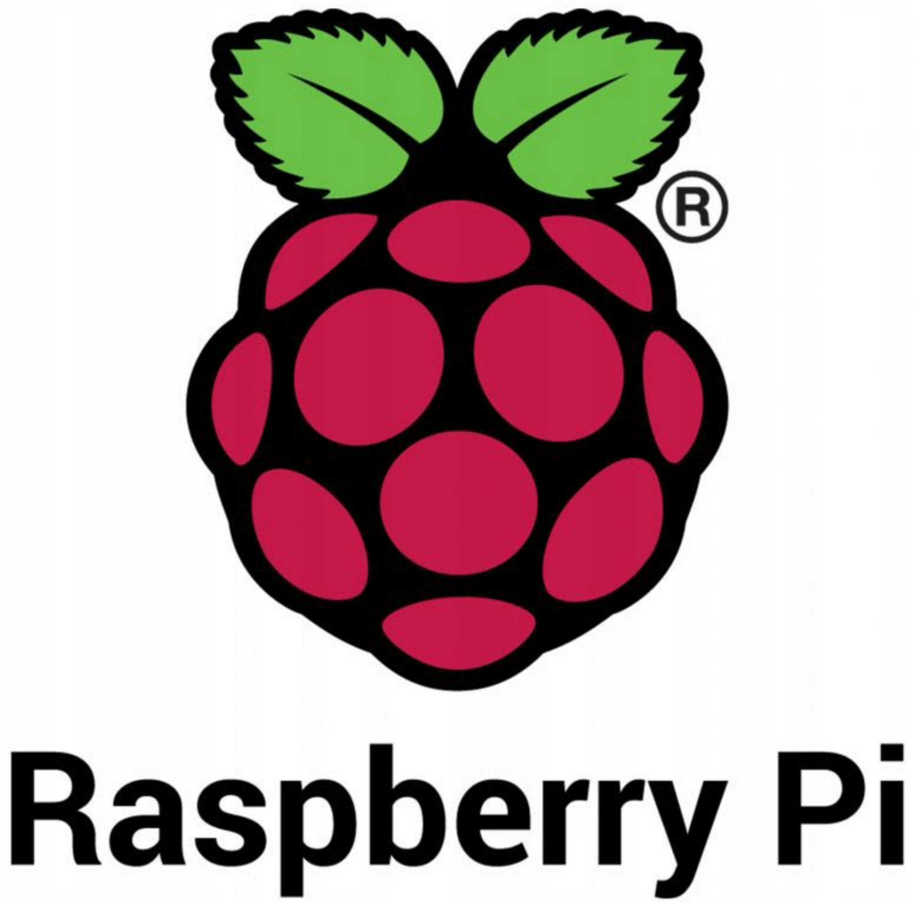
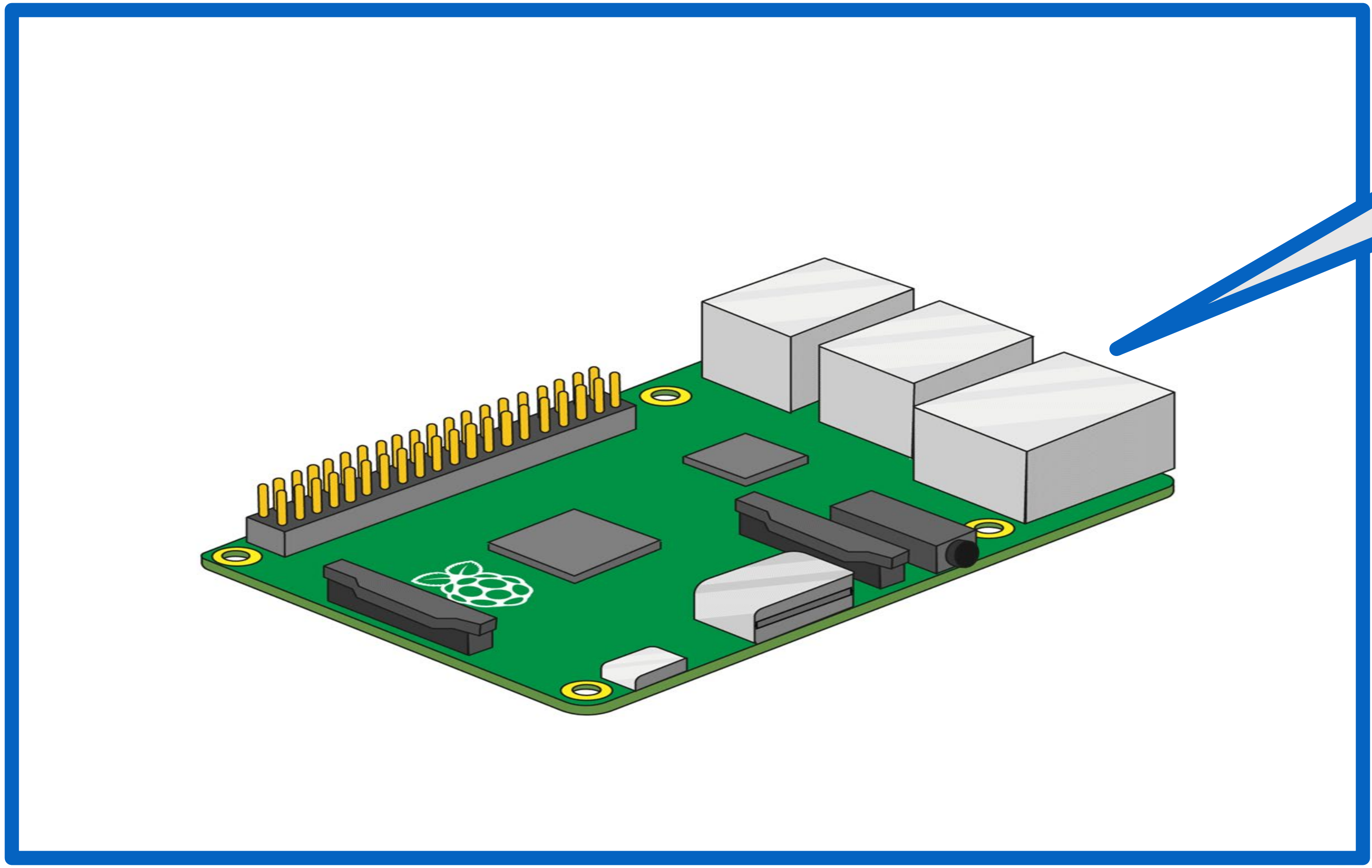
PART 1

Sense HAT Setup

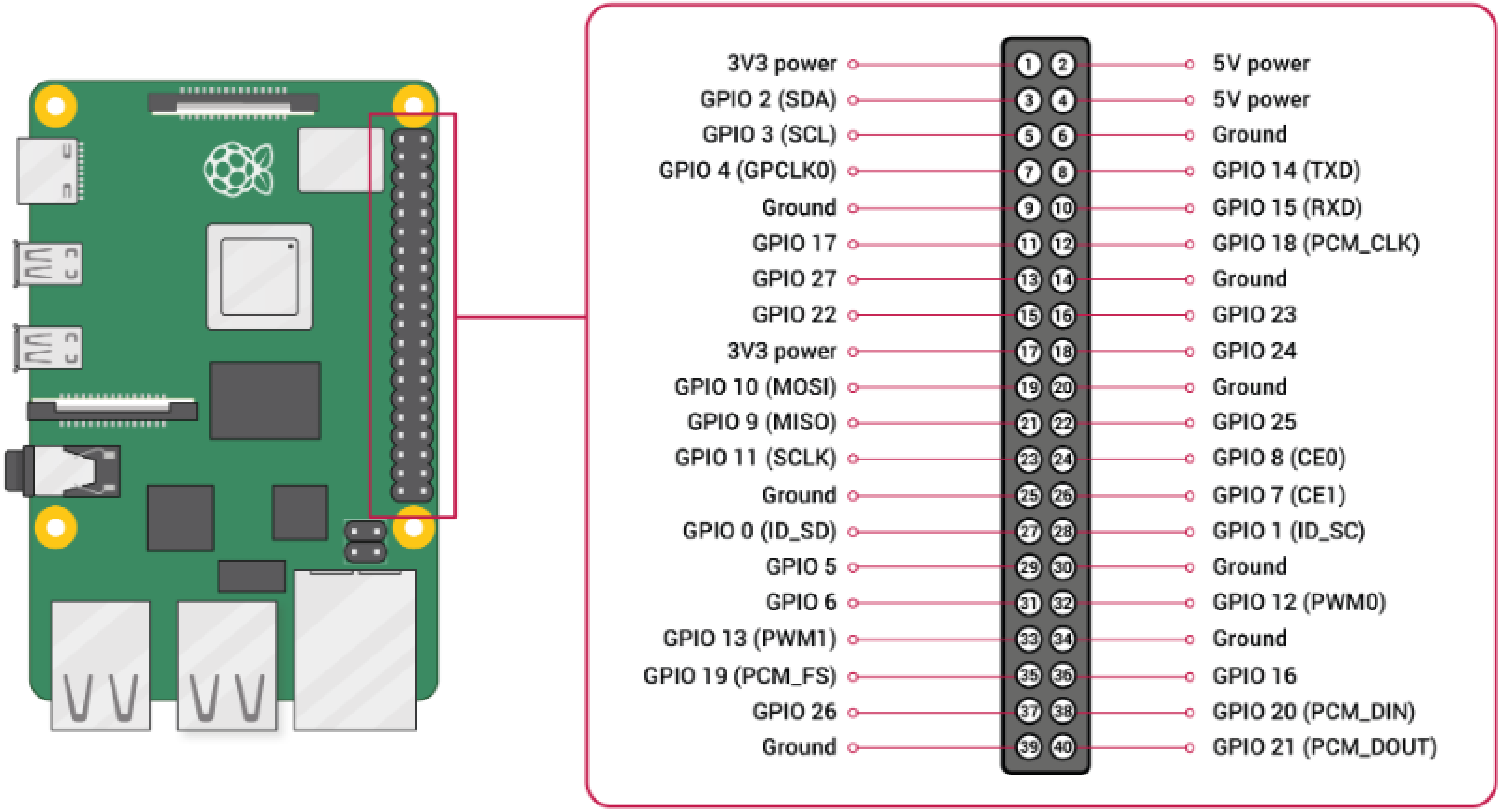


Attaching the Sense Hat



Turn off RPi first !

GPIO and the 40-pin header



3V3 power	1	2	5V power
GPIO 2 (SDA)	3	4	5V power
GPIO 3 (SCL)	5	6	Ground
GPIO 4 (GPCLK0)	7	8	GPIO 14 (TXD)
Ground	9	10	GPIO 15 (RXD)
GPIO 17	11	12	GPIO 18 (PCM_CLK)
GPIO 27	13	14	Ground
GPIO 22	15	16	GPIO 23
3V3 power	17	18	GPIO 24
GPIO 10 (MOSI)	19	20	Ground
GPIO 9 (MISO)	21	22	GPIO 25
GPIO 11 (SCLK)	23	24	GPIO 8 (CE0)
Ground	25	26	GPIO 7 (CE1)
GPIO 0 (ID_SD)	27	28	GPIO 1 (ID_SC)
GPIO 5	29	30	Ground
GPIO 6	31	32	GPIO 12 (PWM0)
GPIO 13 (PWM1)	33	34	Ground
GPIO 19 (PCM_FS)	35	36	GPIO 16
GPIO 26	37	38	GPIO 20 (PCM_DIN)
Ground	39	40	GPIO 21 (PCM_DOUT)

Any of the GPIO pins can be designated (in software) as an input or output pin and used for a wide range of purposes

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Change this image from the Master slide

The Raspberry Pi and Astro Pi

PART 2

Programming the Sense HAT

Programming Activity

Task:

Make one of the emulator programs you worked on before the break work on the physical sense HAT

Code Along:

- Open one of the programs you were working on earlier
- Make a copy of the line: from *sense_emu* import SenseHat
- Comment out the line: #from *sense_emu* import SenseHat
- Change the copied line: sense_emu → sense_hat
- Program to animate a pixel so that it appears to be moving around the 8x8 LED

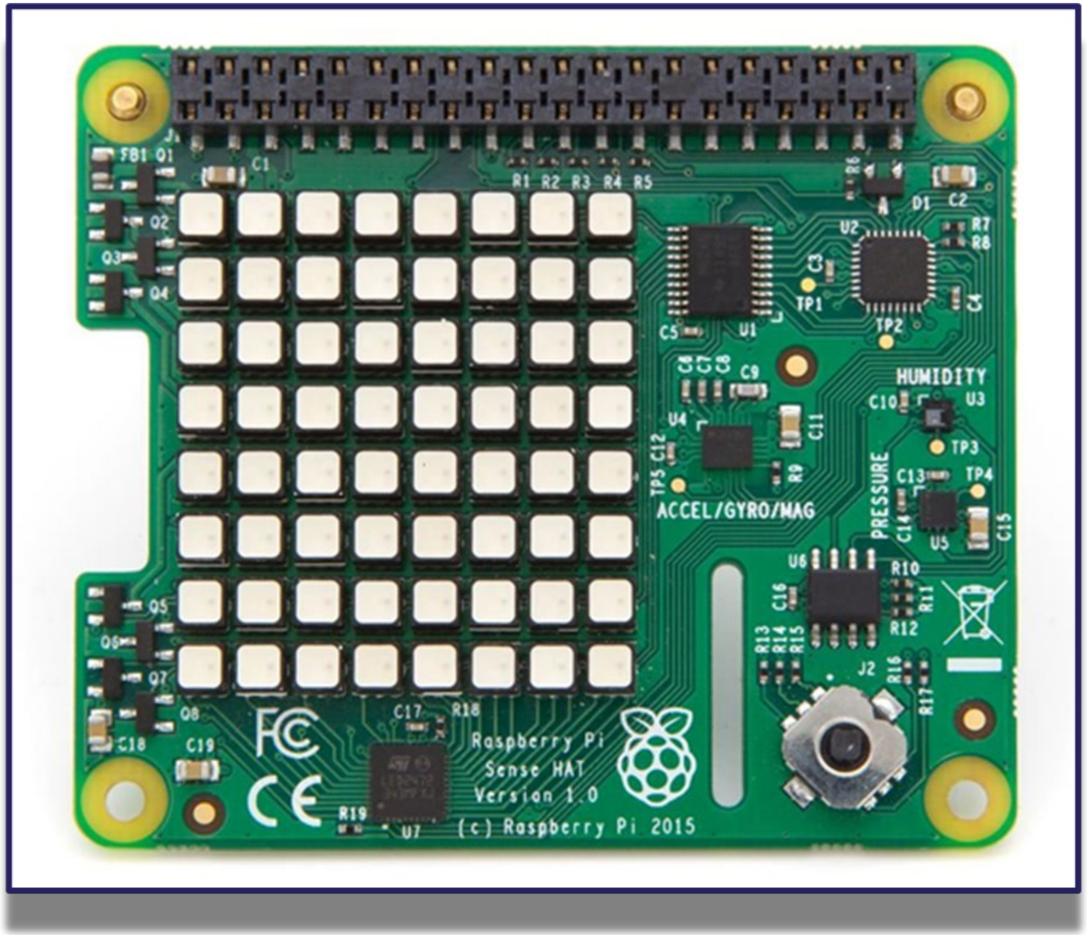
Programming Activity

Challenge

Sparkling LED: Animate the LED so that it appears to sparkle!

https://projects.raspberrypi.org/en/projects/sense-hat-random-sparkles

Built in Sensors

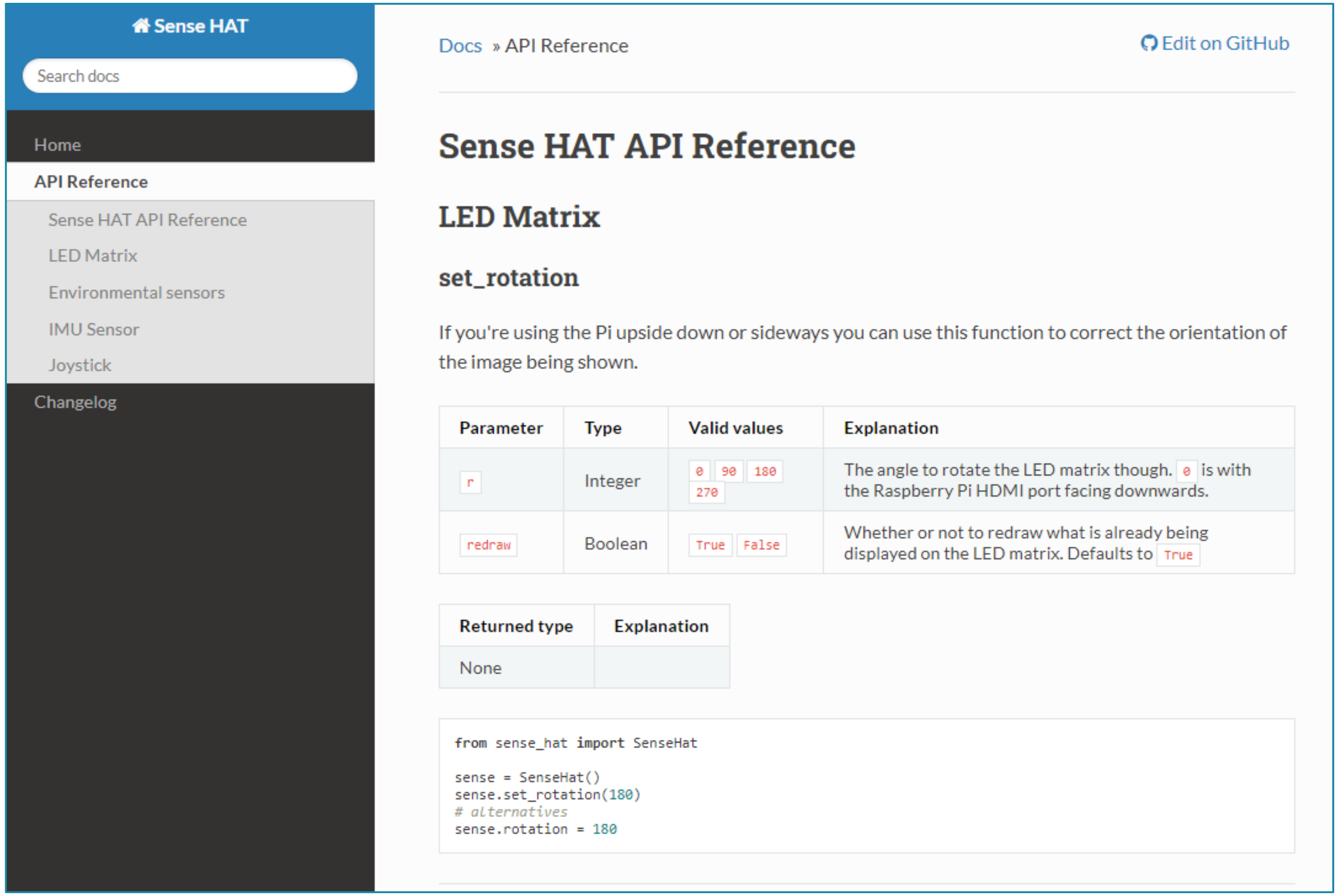


- Temperature sensor
- Humidity sensor
- Pressure sensor
- Accelerometer
- Gyroscope
- Magnetometer
- Light sensor

Activity – Collecting Sensor Data

```
temperature = sense.get_temperature()
```

Sense HAT API Reference



Sense HAT API Reference

LED Matrix

set_rotation

If you're using the Pi upside down or sideways you can use this function to correct the orientation of the image being shown.

Parameter	Type	Valid values	Explanation
`r`	Integer	`0` `90` `180` `270`	The angle to rotate the LED matrix though. `0` is with the Raspberry Pi HDMI port facing downwards.
`redraw`	Boolean	`True` `False`	Whether or not to redraw what is already being displayed on the LED matrix. Defaults to `True`

Returned type	Explanation
None	

```
from sense_hat import SenseHat

sense = SenseHat()
sense.set_rotation(180)
# alternatives
sense.rotation = 180
```

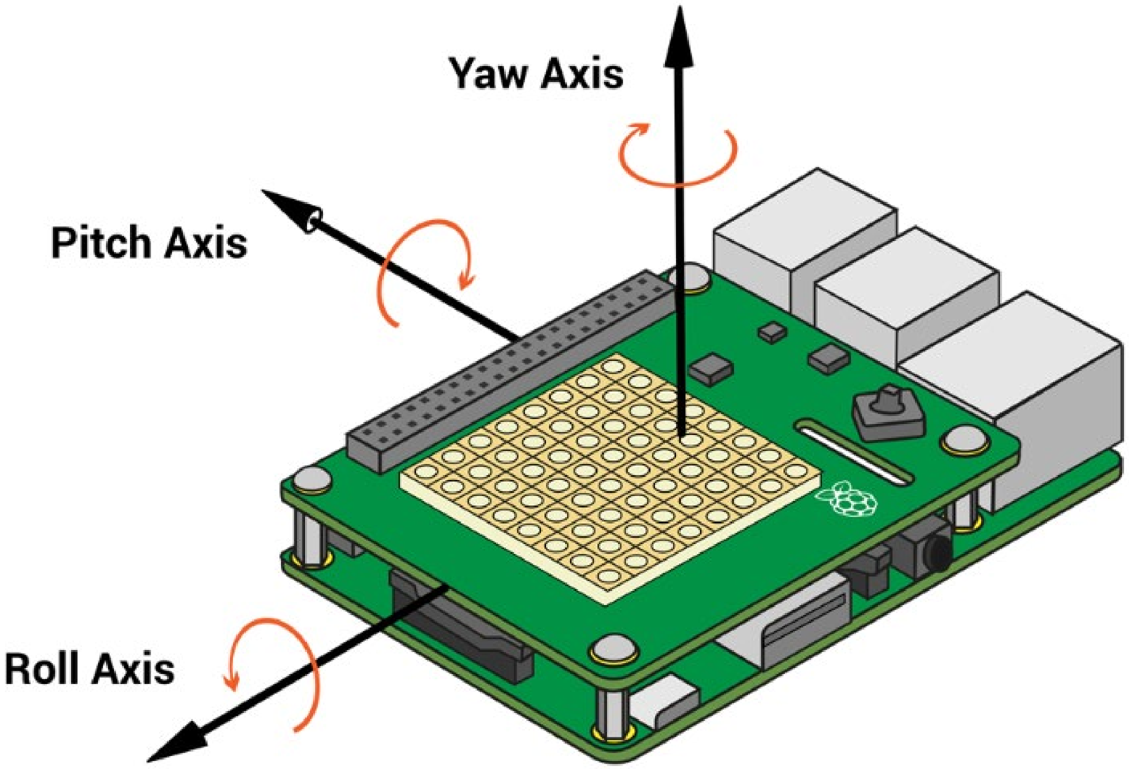
https://pythonhosted.org/sense-hat/api/

Programming Activity

Write a program to read and display the air pressure (or humidity)

Tracking Movement with the Sense HAT

Inertial Measurement Unit (IMU)
Combination of gyroscopic sensor, accelerometer, and magnetometer



Pitch — imagine a plane taking off

Roll — imagine a plane doing a victory roll

Yaw — imagine steering a plane like a car

Orientation

```
from sense_hat import SenseHat

sense = SenseHat()
sense.clear()

o = sense.get_orientation()
pitch = o["pitch"]
roll = o["roll"]
yaw = o["yaw"]

print("pitch {0} roll {1} yaw {2}".format(pitch, roll, yaw))
```

Accelerometer

```
from sense_hat import SenseHat
sense = SenseHat()

while True:
        acceleration = sense.get_accelerometer_raw()
        x = acceleration['x’]
        y = acceleration[‘y’]
        z = acceleration['z’]

        x=round(x, 0)
        y=round(y, 0)
        z=round(z, 0)

        print("x={0}, y={1}, z={2}".format(x, y, z))
```

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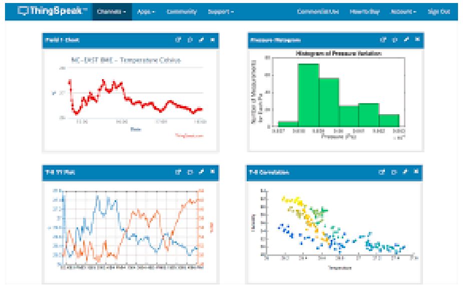
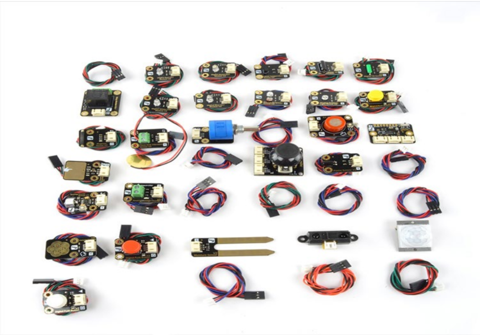
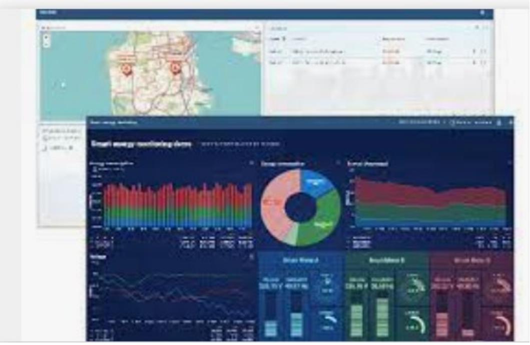
PART 3

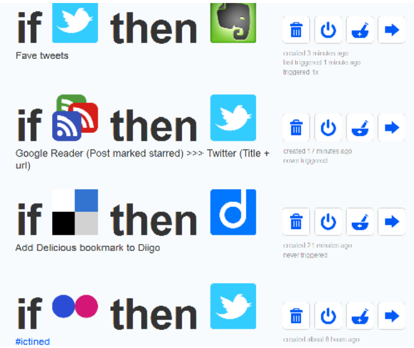
Internet of Things (IoT) and ThingSpeak

An overview of IoT Platforms and Dashboards








if then
Fave tweets
created 3 minutes ago
last triggered 1 minute ago
triggered 1x

if then
Google Reader (Post marked starred) >>> Twitter (Title + url)
created 1 / minutes ago
never triggered

if then
Add Delicious bookmark to Diigo
created 21 minutes ago
never triggered

if then
#ictined
created about 8 hours ago

ThingSpeak:

Easiest to get going for beginners. Does all the heavy lifting such as graphing and animation for you.

Has MATLAB analytics.

Firebase:

Industry level database.
Works great with webpages on Glitch.
A little bit more complicated!
Does not graph that data for you.

Thingsboard:

Like ThingSpeak but better looking and with more features.
No free version though! (€10 p/m)

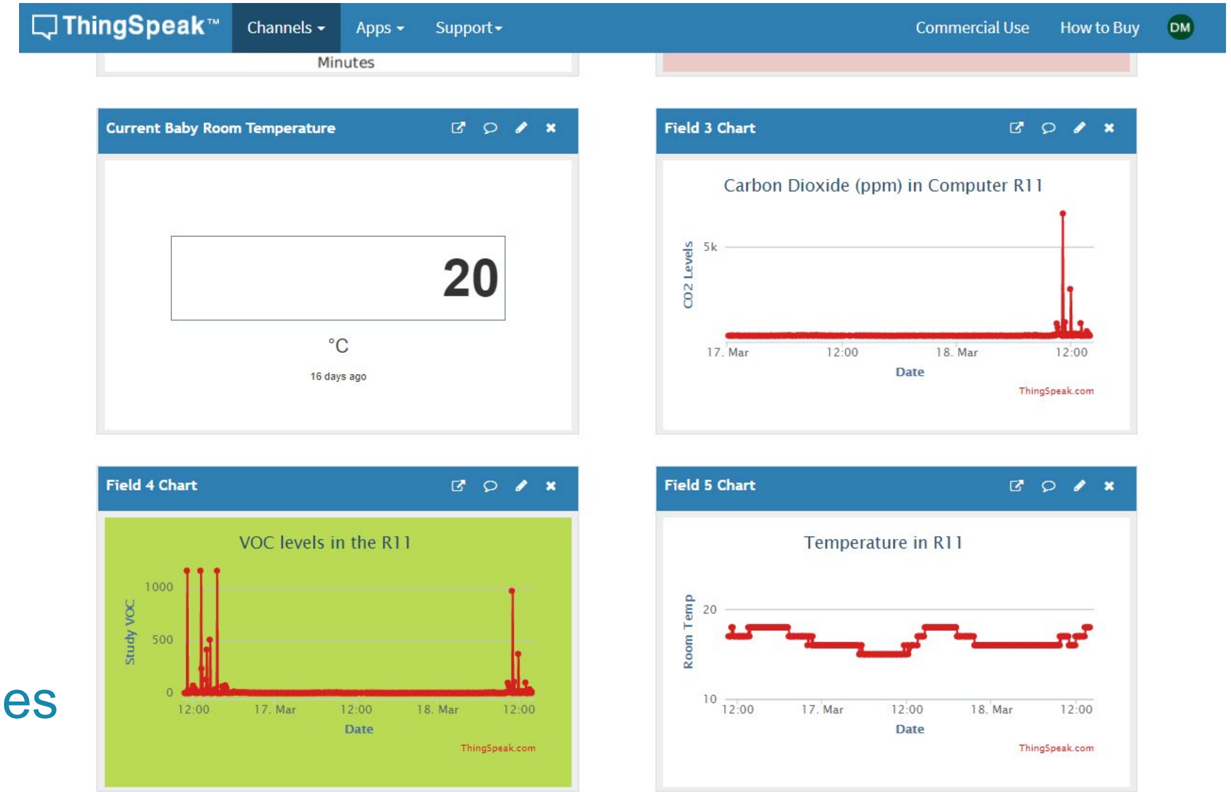
IFTTT

If This Then That lets your programs link up with Phillips Hue, Alexa, Google Assistant and other Home IoT devices

ThingSpeak Advantages & Limitations

ThingSpeak Advantages:

- **Free** to use (8 data sources)
- Can both **read** and **write**
- Quick & **easy sensor to graph**
- Quick & **easy share**/publish



ThingSpeak Limitations:

More like a spreadsheet with 8 columns, data does not have branches or leaf nodes like Firebase.

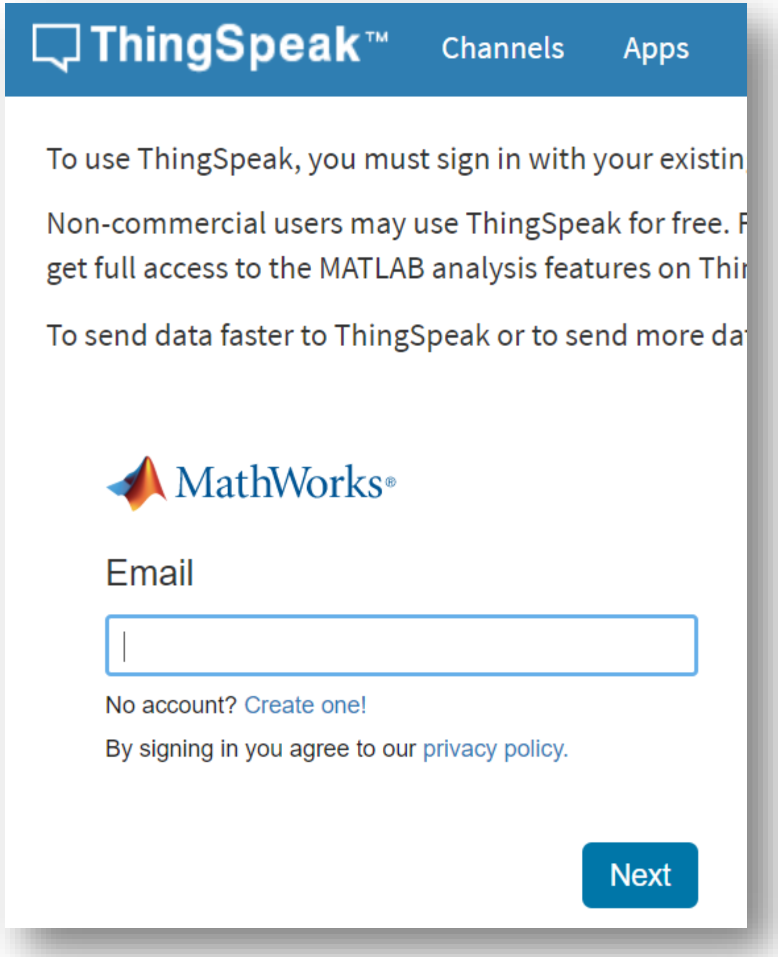
Let’s make a ThingSpeak project!

ThingSpeak™

IoT Analytics
with MATLAB®

We’ll do this as a LIVE CODING session!

1. Go to ThingSpeak.com and create a MathWorks account.



To use ThingSpeak, you must sign in with your existin

Non-commercial users may use ThingSpeak for free. F get full access to the MATLAB analysis features on Thi

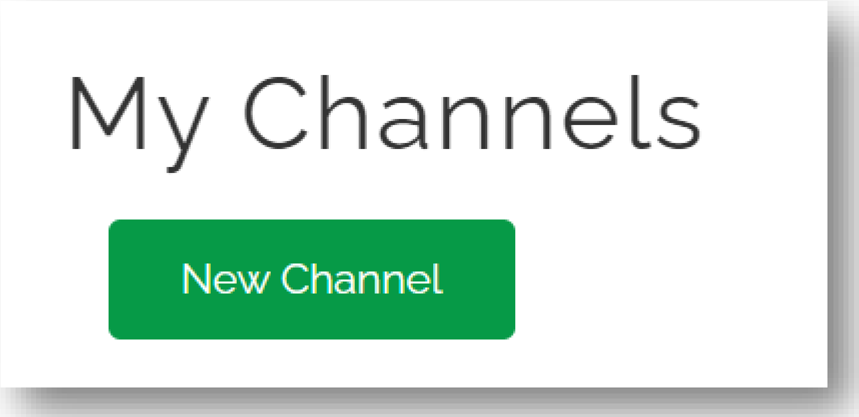
To send data faster to ThingSpeak or to send more da

Email

No account? Create one!

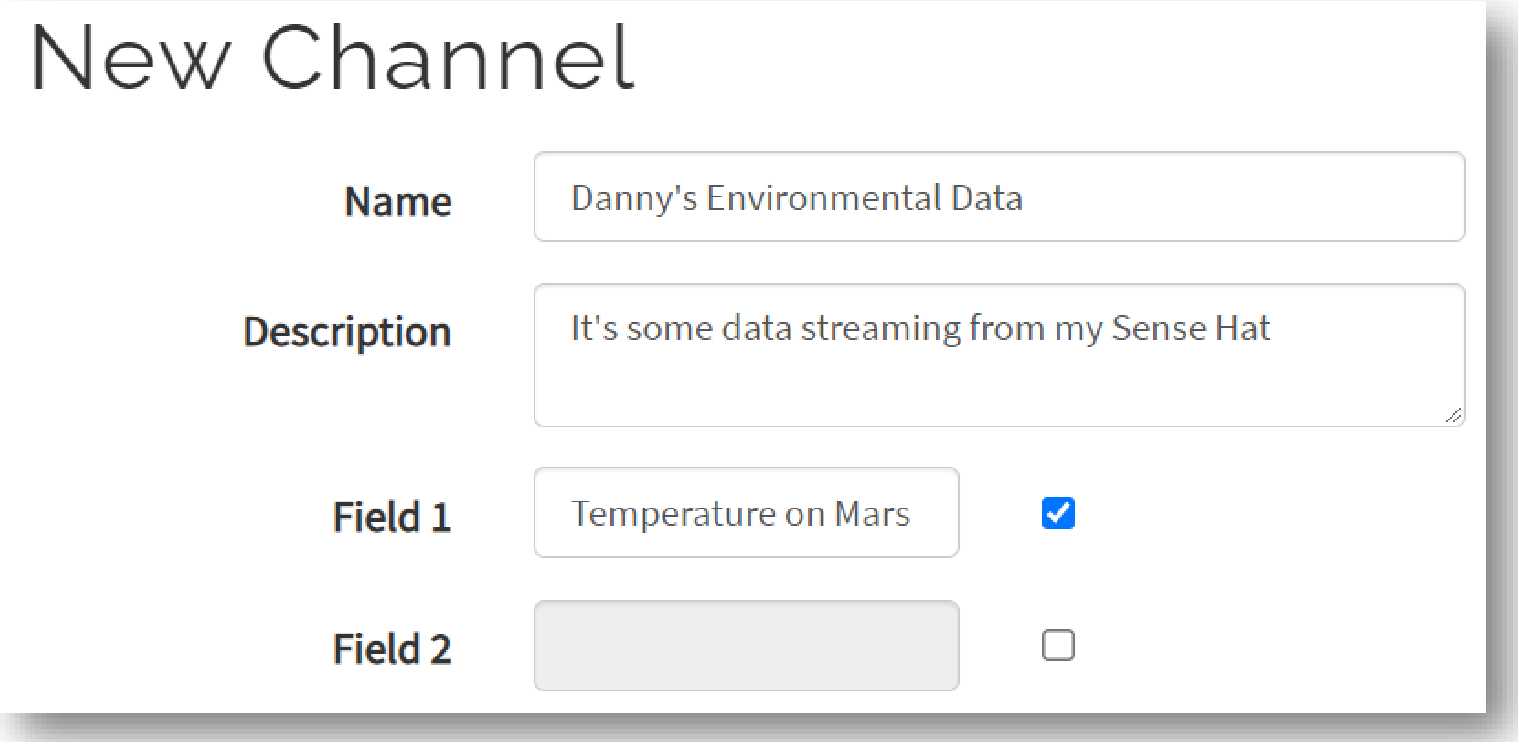
By signing in you agree to our privacy policy.

Create a New Channel.



2. Give your channel a name.

Say what you're recording in Field 1.



New Channel

Name: Danny's Environmental Data

Description: It's some data streaming from my Sense Hat

Field 1: Temperature on Mars ☑

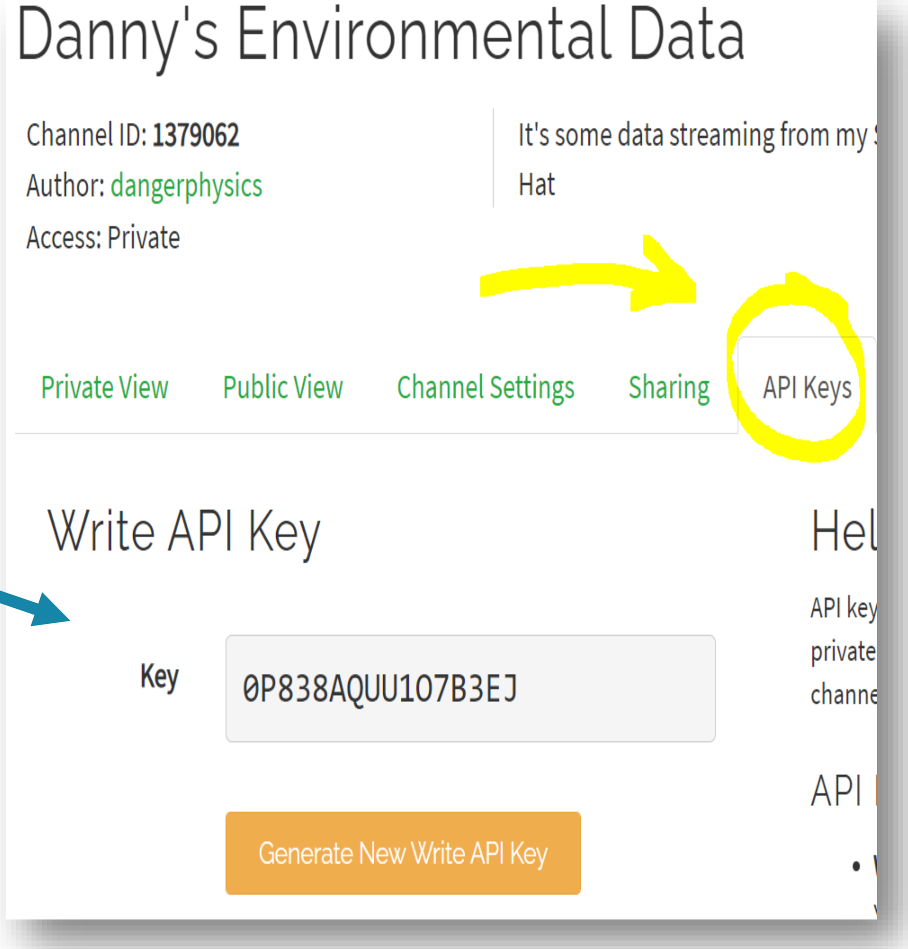
Field 2: □

Scroll down to the bottom of the page and click on Save Channel

Save Channel

3. After saving, go back into your channel and copy the *Write API Key*.

Make a note of this Key.



Danny's Environmental Data

Channel ID: 1379062
Author: dangerphysics
Access: Private

It's some data streaming from my S
Hat

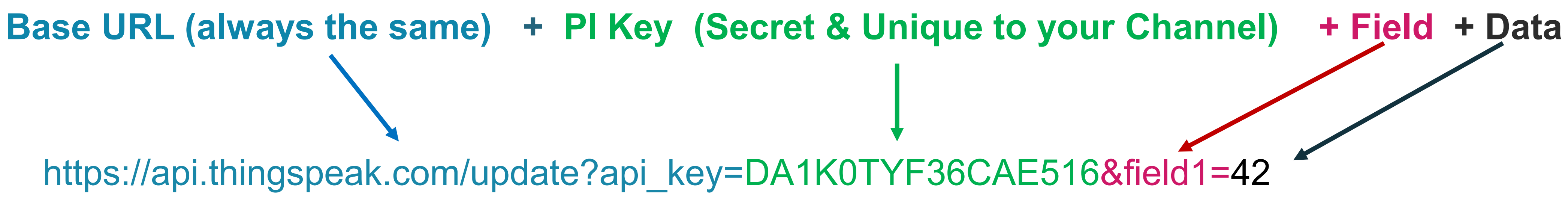
Write API Key

Key: 0P838AQUU107B3EJ

This is the secret password that allows ANYONE to write to your database

4. Writing to your Database is so simple you could theoretically add a data point without Python!

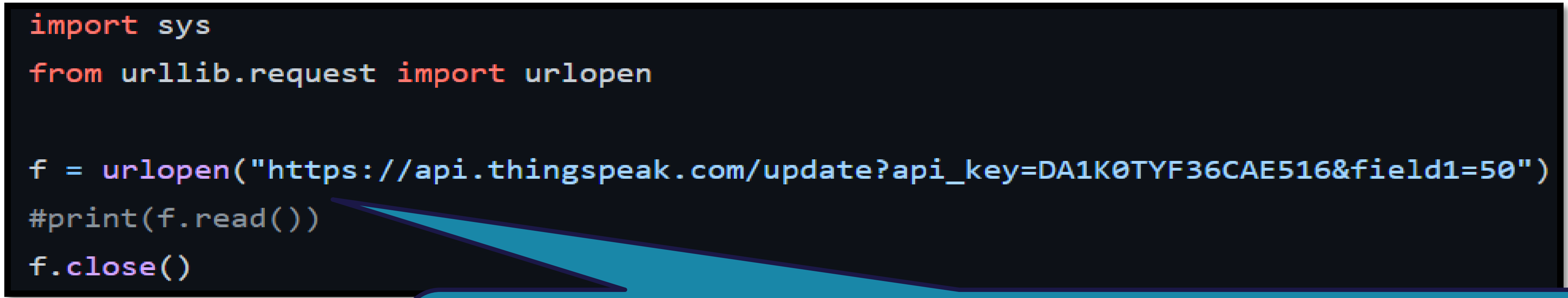
In fact, all the Python program does is open one webpage. Opening that URL once adds a data point. Opening it again will add it again.



Base URL (always the same) + PI Key (Secret & Unique to your Channel) + Field + Data

https://api.thingspeak.com/update?api_key=DA1K0TYF36CAE516&field1=42

5. Test using this 5 line python program that opens a webpage.



```
import sys
from urllib.request import urlopen


f = urlopen("https://api.thingspeak.com/update?api_key=DA1K0TYF36CAE516&field1=50")
#print(f.read())
f.close()
```

Uncomment this line to check if your code works.
It should return something in the format
b'11907' (I've added 11907 data points but your number may be much smaller)

Base URL (always the same) + API Key (Secret & Unique to your Channel)+ Field + Data

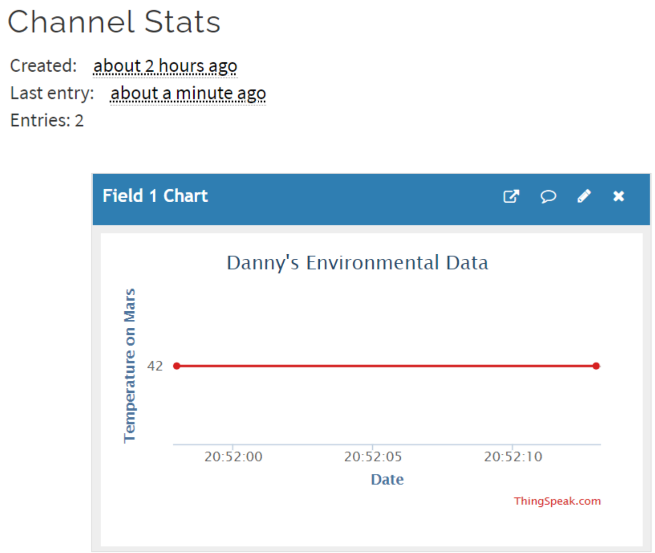
https://api.thingspeak.com/update?api_key=DA1K0TYF36CAE516&field1=42

Change this GREEN PART to YOUR API Key

6. Run the previous code twice and then check to see if your graph!

If it’s not working, ensure that:

- Your device has an internet connection
- You’ve used the correct API key for the channel you are viewing. (Not my API)
- You’re not viewing a channel that is being spammed by 50 people right now. There is a limit on how quickly you can send data. (15 seconds for the free version)



Channel Stats

Created: about 2 hours ago

Last entry: about a minute ago

Entries: 2

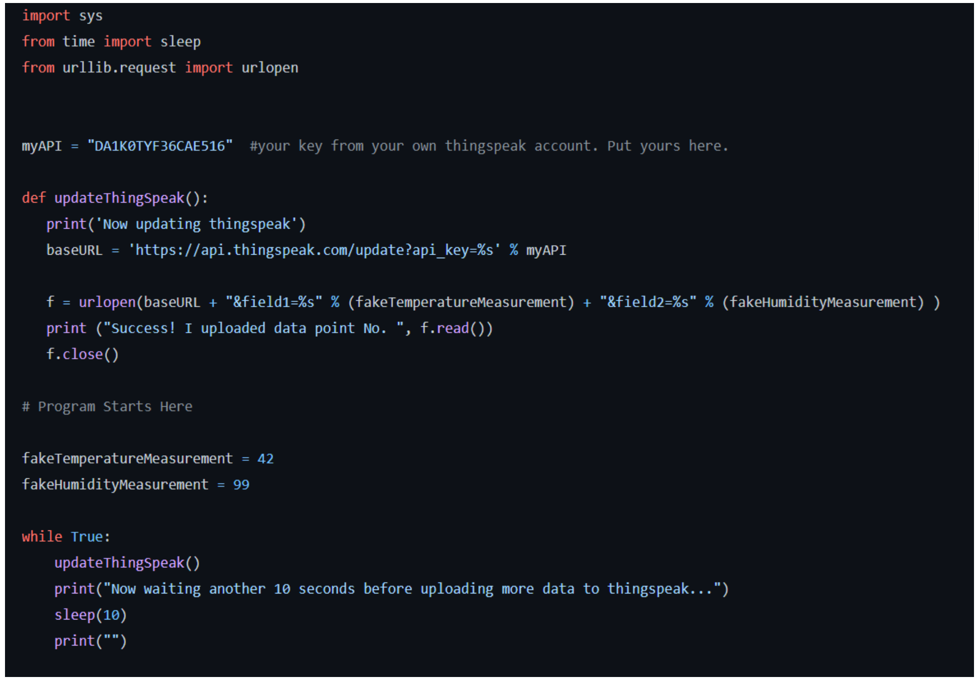
Base URL (always the same) **+API Key (Secret & Unique to your Channel)** **+ Field** **+ Data**

https://api.thingspeak.com/update?api_key=DA1K0TYF36CAE516&field1=42

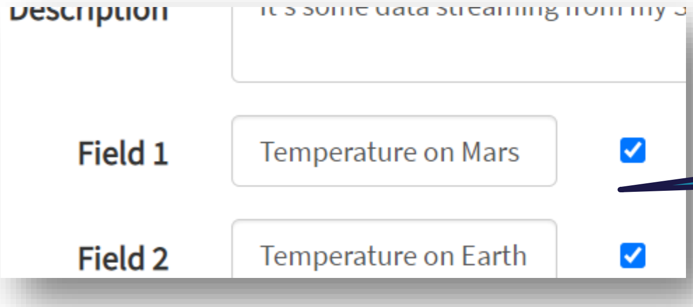
7. Try this Longer example with two fields. We’re nearly ready for sensors.

This code has placeholder variables for each sensor e.g. *fakeTemperature = 42*

You will need to add *Field 2* on your Thingspeak Channel in Chrome.



```python
import sys
from time import sleep
from urllib.request import urlopen


myAPI = "DA1K0TYF36CAE516"  #your key from your own thingspeak account. Put yours here.

def updateThingSpeak():
   print('Now updating thingspeak')
   baseURL = 'https://api.thingspeak.com/update?api_key=%s' % myAPI

   f = urlopen(baseURL + "&field1=%s" % (fakeTemperatureMeasurement) + "&field2=%s" % (fakeHumidityMeasurement) )
   print ("Success! I uploaded data point No. ", f.read())
   f.close()

# Program Starts Here

fakeTemperatureMeasurement = 42
fakeHumidityMeasurement = 99

while True:
    updateThingSpeak()
    print("Now waiting another 10 seconds before uploading more data to thingspeak...")
    sleep(10)
    print("")
```



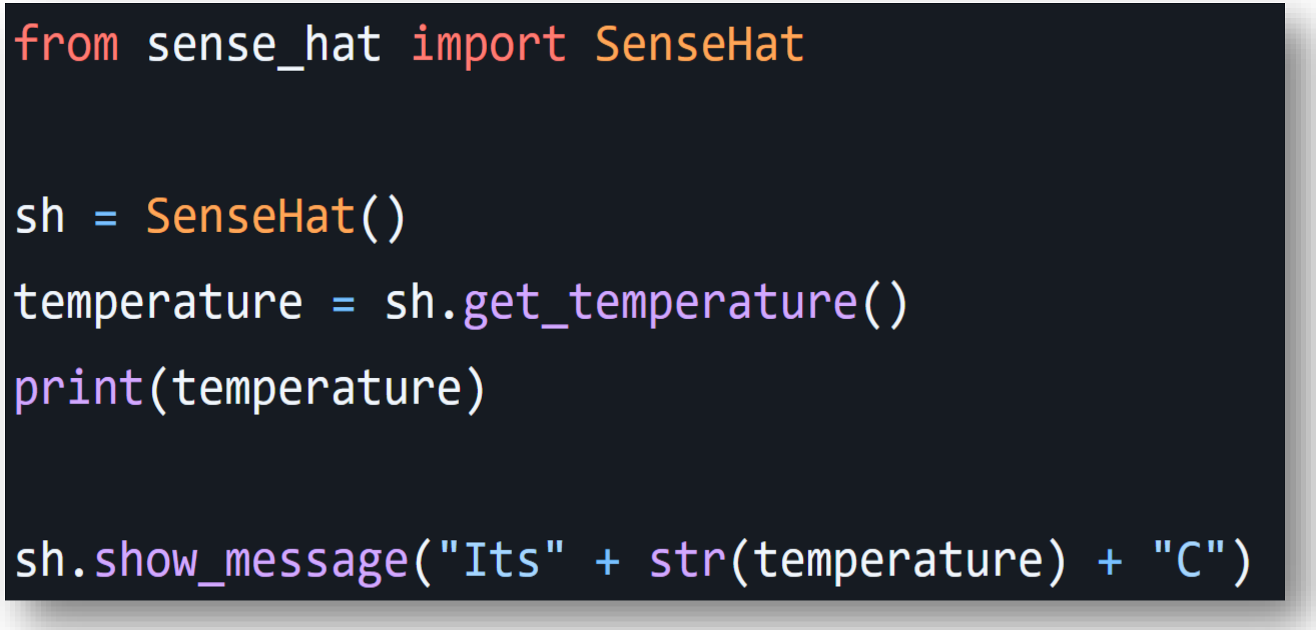
Description It's some data streaming from my s

Field 1 Temperature on Mars ☑

Field 2 Temperature on Earth ☑

These Field names only decorate your Webpage Graph and will not affect your python Data coming in

8. Now try stream Temperature Data from your Sense Hat!



```python
from sense_hat import SenseHat

sh = SenseHat()
temperature = sh.get_temperature()
print(temperature)

sh.show_message("Its" + str(temperature) + "C")
```

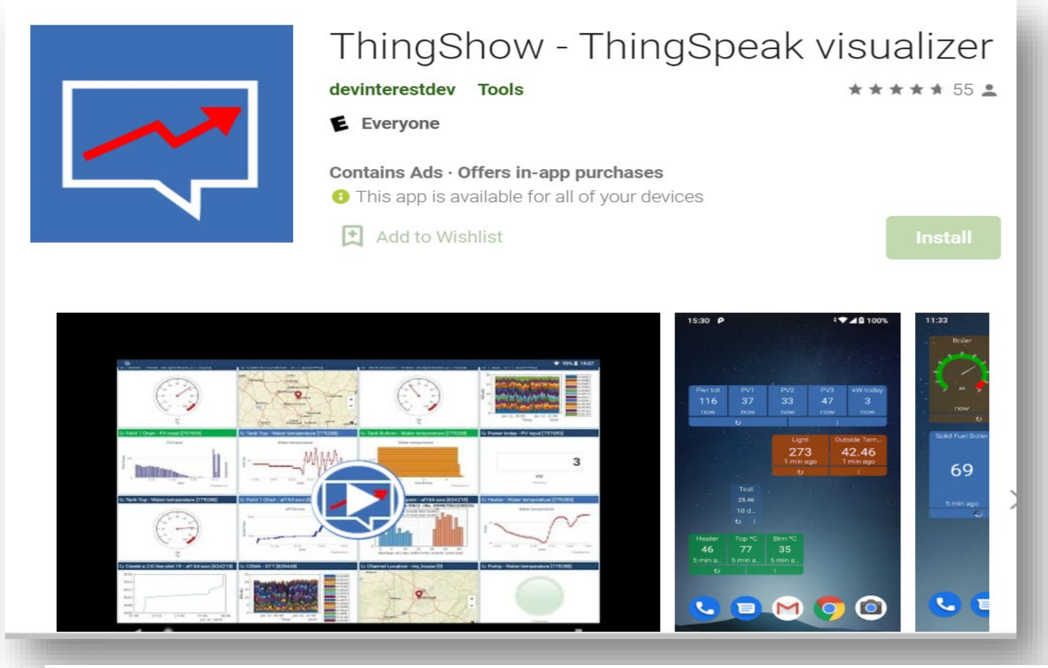
9. Download a ThingSpeak Mobile App and connect your Public channel using your own Channel ID under Channel Settings.

Examples of

Thingspeak Apps:

- **ThingShow** (Android)

- **Thingview** (iOS)



ThingShow - ThingSpeak visualizer

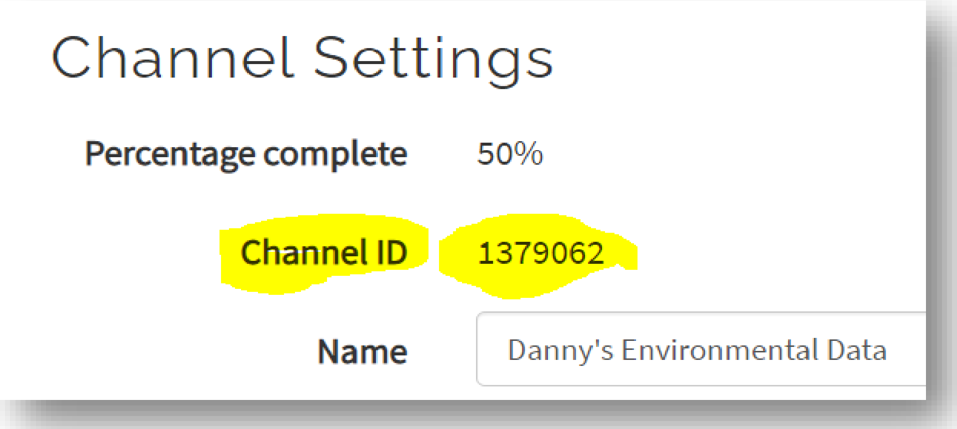
devinterestdev Tools

★★★★★ 55

Everyone

Contains Ads · Offers in-app purchases

This app is available for all of your devices

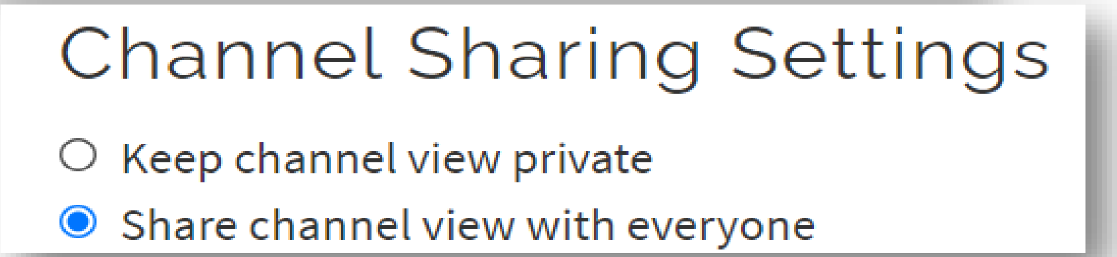


Channel Settings

Percentage complete 50%

Channel ID 1379062

Name Danny's Environmental Data



Channel Sharing Settings

○ Keep channel view private

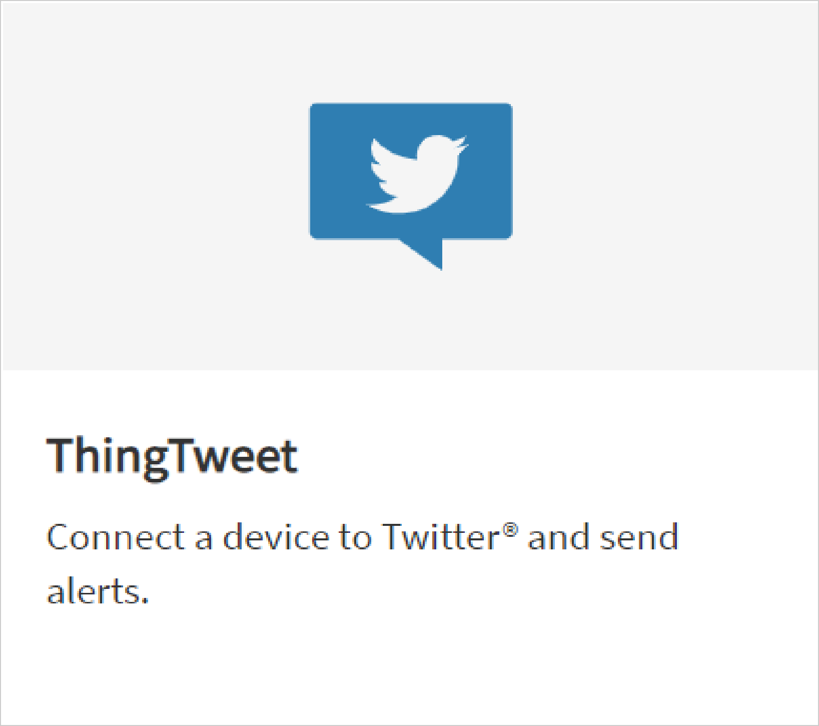
● Share channel view with everyone

Other cool stuff to try later:

Tweet Control! Send a Tweet if things get too hot or if your cookie has gone missing!

Or control your Raspberry Pi Motor, Light or Servo by Tweeting!

It's under ThingSpeak.com/apps



ThingTweet

Connect a device to Twitter® and send alerts.

https://community.thingspeak.com/documentation/apps/tweetcontrol/

Lunch Break

An Roinn Oideachais
Department of Education