

Maker Lab

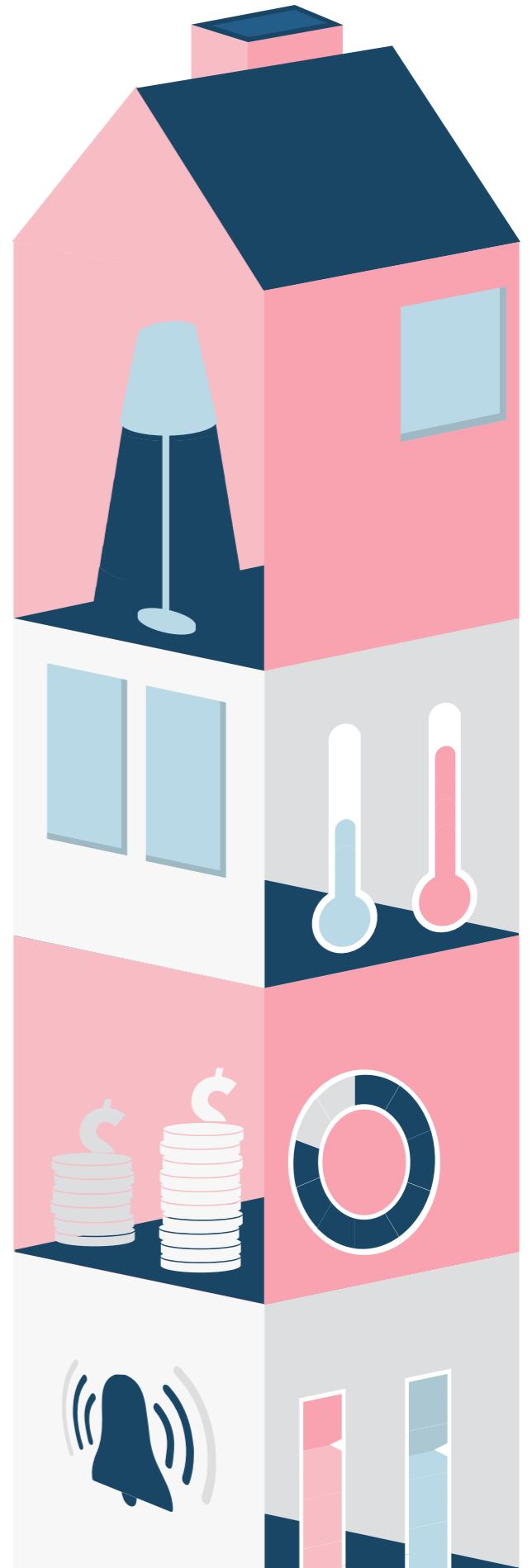
Adafruit IOT, Files and Hats

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www.inf.unibz.it/~gennari/makerlab.html



Outline

File handling

Exceptions

Explorer Hat and Sense Emu "simulation"

Explorer Hat posts data to Adafruit IOT feeds and dashboards

Explorer Hat gets data from Adafruit IOT feeds and dashboards

(postponed to next week)

Assignments: from Explorer Hat with Adafruit IOT to Sense Emu with Adafruit IOT

WHAT FILES

Files can be text or binary files.

Text files have an End-Of-Line (EOL) character to indicate each line's termination; in Python, this is '\n'.

Binary, such as images or exe, have no EOL character.

We will be mainly focussing on text files.

Opening and Closing

```
# Open a file  
fo = open(filename, mode)
```

FIRST COMES FILE OPENING

To process a file, we need to open it. This is done through the **open()** function, whose result is stored in a variable for performing operations on the file, e.g., **fo**.

Modes can be different, e.g., '**r**' for reading (this is the default mode, if none is given), '**w**' for writing and erasing, '**r+**' for reading and writing, '**a**' for appending at the end of file, '**a+**' for appending and reading. See <https://www.tutorialspoint.com/python3/python_files_io.htm>.

file

```
This is line 1  
This is line 2
```

```
# Open a file  
fo = open("test.txt", "r")
```

FIRST COMES FILE OPENING

For instance, create a file with the above text in the box, and save it as 'test.txt'. Then create a Python 3 script as above.

file

```
This is line 1  
This is line 2
```

```
# Open a file  
fo = open("test.txt", "r")
```

```
# Close the file  
fo.close()
```

LAST COMES FILE CLOSING

To stop processing a file, we need to close it, e.g., with the **close()** function.

Reading

file

This is line 1
This is line 2

what's printed

This is line 1
This is line 2

```
# Open a file
fo = open("test.txt", "r")
string = fo.read(10) #nr of bytes to read from
print(string)
```

```
# Close opened file
fo.close()
```

READING

The **read()** method reads, line by line, the **entire** file; you can also specify the number of bytes to read as argument, and hence limit it.

file

```
This is line 1  
This is line 2
```

what's printed

```
Ahead? y  
This is line 1  
Ahead? y  
This is line 2
```

```
# Open a file  
fo = open("test.txt", "r")  
for line in fo:  
    if input('Ahead?\t') == 'y':  
        print(line,end=' ') #end=' ' for avoiding extra \n
```

```
# Close opened file  
fo.close()
```

READING

For **reading lines** from a file **iteratively**, you can use a for-loop over the file object as in the example script above.

file

```
This is line 1  
This is line 2
```

what's printed

```
This is line 1
```

```
# Open a file  
fo = open("test.txt", "r")  
string = fo.readline()  
print(string)
```

```
# Close opened file  
fo.close()
```

READING

The **readline()** reads a **single line** from the file; you can also specify the number of bytes to read, as argument, and hence limit it.

file

```
This is line 1  
This is line 2
```

what's printed

```
[ 'This is line 1\n', 'This is line 2' ]
```

```
# Open a file  
fo = open("test.txt", "r")  
slist = fo.readlines()  
print(slist)
```

```
# Close opened file  
fo.close()
```

READING

The **readlines()** method maintains a **list** of **each line** in the file.

Writing

file before writing

This is line 1
This is line 2

file after writing

This is line 3
This is line 4

```
# Open a file
fo = open("test.txt", "w")
fo.write("This is line 3.\nThis is line 4\n")
```

```
# Close file
fo.close()
```

WRITING

The **write()** method writes any string at the start of a file, opened in '**w**' mode.

The **write()** method does not add a newline character ('\n') to the end of the string.

file before writing

This is line 1
This is line 2

file after writing

This is line 1
This is line 2
This is line 3
This is line 4

```
# Open a file
fo = open("test.txt", "a")
fo.write("\nThis is line 3.\nThis is line 4\n")
```

```
# Close file
fo.close()
```

WRITING

The **write()** method appends any string at the end of a file, opened in 'a' mode.

The **write()** method does not add a newline character ('\n') to the end of the string.

file before writing

This is line 1
This is line 2

file after writing

This is line 3
This is line 4

```
# Open a file
fo = open("test.txt", "w")
slist = ['This is line 3.\n', 'This is line 4.\n']
fo.writelines(slist)

# Close file
fo.close()
```

WRITING

The **writelines()** method writes a list (or appends it, depending on the opening mode) as a string to an open file.

file before writing

This is line 1
This is line 2

file after writing

This is line 3
This is line 4

```
fo = open("test.txt", "w")
slist_no_line = ['This is line 3.', 'This is line 4.']
for element in slist_no_line:
    fo.write(element+'\n')
fo.close()
```

WRITING

You can iteratively write elements of a list in a file, line by line, as above.

Furthermore...

file before writing

```
This is line 1  
This is line 2
```

file after writing

```
This is line 3  
This is line 4
```

```
fo = open("test.txt", "r+")
slist = ['This is line 3','This is line 4']
for element in slist:
    fo.write(element+'\n')
print("The cursor is at",fo.tell())
fo.seek(0)
for line in fo:
    print(line,end=' ')
fo.close()
```

OTHER USEFUL METHODS: SEEK AND TELL

After reading a file, the cursor is at the End Of File (EOF). The **seek(offset, reference_point)** method sets the cursor at different positions: 0 (the beginning of the file, as default), 1 (the current position) and 2 (EOF).

The **tell()** method tells where the cursor is.

```
with open('insults.csv', 'r') as fo:
    ...
```

ALTERNATIVE CLOSURE WITH "WITH"

It is also common to use the **with** keyword to avoid explicitly closing; it ensures that files are always cleaned up promptly and correctly.

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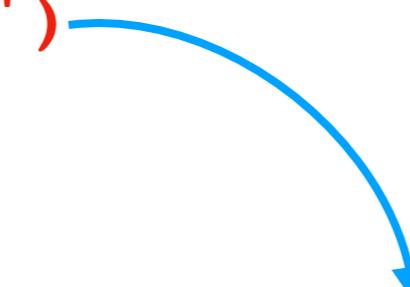
TRY...EXCEPT

```
import sys

try:
    # a file not in your folder or without reading
    permissions
        f = open('integers.txt')
        s = f.readline()
        i = int(s.strip())
    except IOError as e:
        print(e)

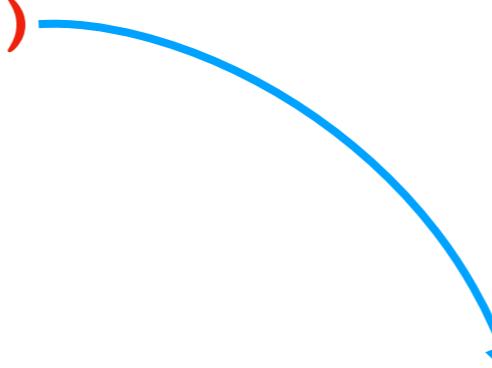
    except ValueError:
        print("No valid integer in line.")

    except:
        print("Unexpected error:", sys.exc_info()[0])
```



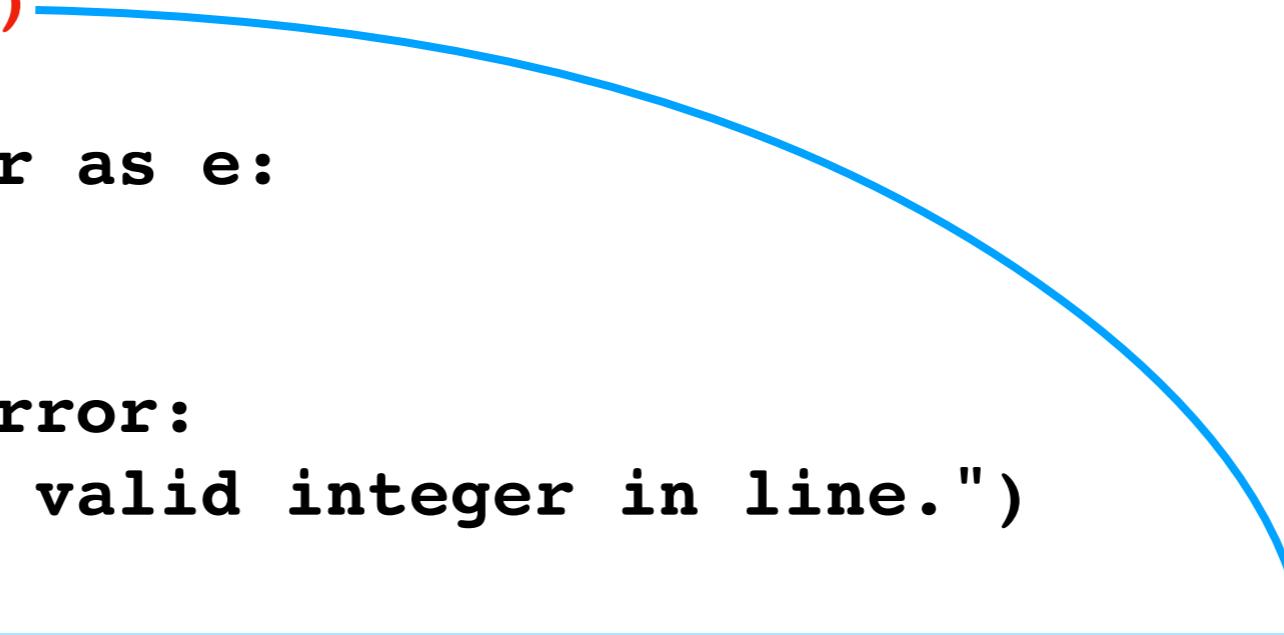
TRY...EXCEPT

```
import sys\n\ntry:\n    # a file without integer strings\n    f = open('insults.csv')\n    s = f.readline()\n    i = int(s.strip())  
  
except IOError as e:\n    print(e)  
  
except ValueError:  
    print("No valid integer in line.")  
  
except:  
    print("Unexpected error:", sys.exc_info()[0])
```



TRY...EXCEPT

```
import sys\n\ntry:\n    # an unexpected error...\n    f = open('insults.csv')\n    s = f.readline()\n    print(s+3)\n\nexcept IOError as e:\n    print(e)\n\nexcept ValueError:\n    print("No valid integer in line.")\n\nexcept:\n    print("Unexpected error:", sys.exc_info()[0])
```



TRY...EXCEPT

```
from Adafruit_IO import Client, Data, Feed, RequestError
```

```
#----ACCESS OR CREATE FEED
```

```
# access or create a feed with a given key or name
```

```
try: # try accessing the feed
```

```
    feed = aio.feeds('bgcolor')
```

```
except RequestError: # if request error create the feed
```

```
    feed = aio.create_feed(Feed(name='bgcolor',
```

```
key='bgcolor', history=True))
```



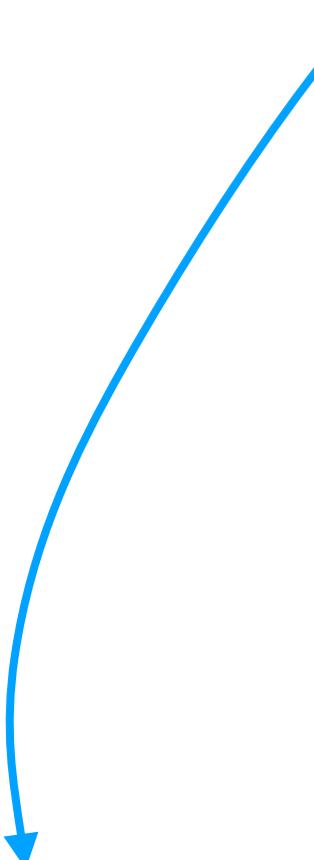
TRY...EXCEPT

```
-----CONTINUE FOREVER UNTIL STOP THEN EXIT GRACEFULLY

try:

    while True:
        # receive latest data value from feed.key
        latest_data = aio.receive('bgcolor').value
        if color_string != received_color_string:
            color_string = received_color_string
            generate_html(color_string)
            print('color received:', color_string)
        time.sleep(2)

except KeyboardInterrupt:
    pass
```



Outline

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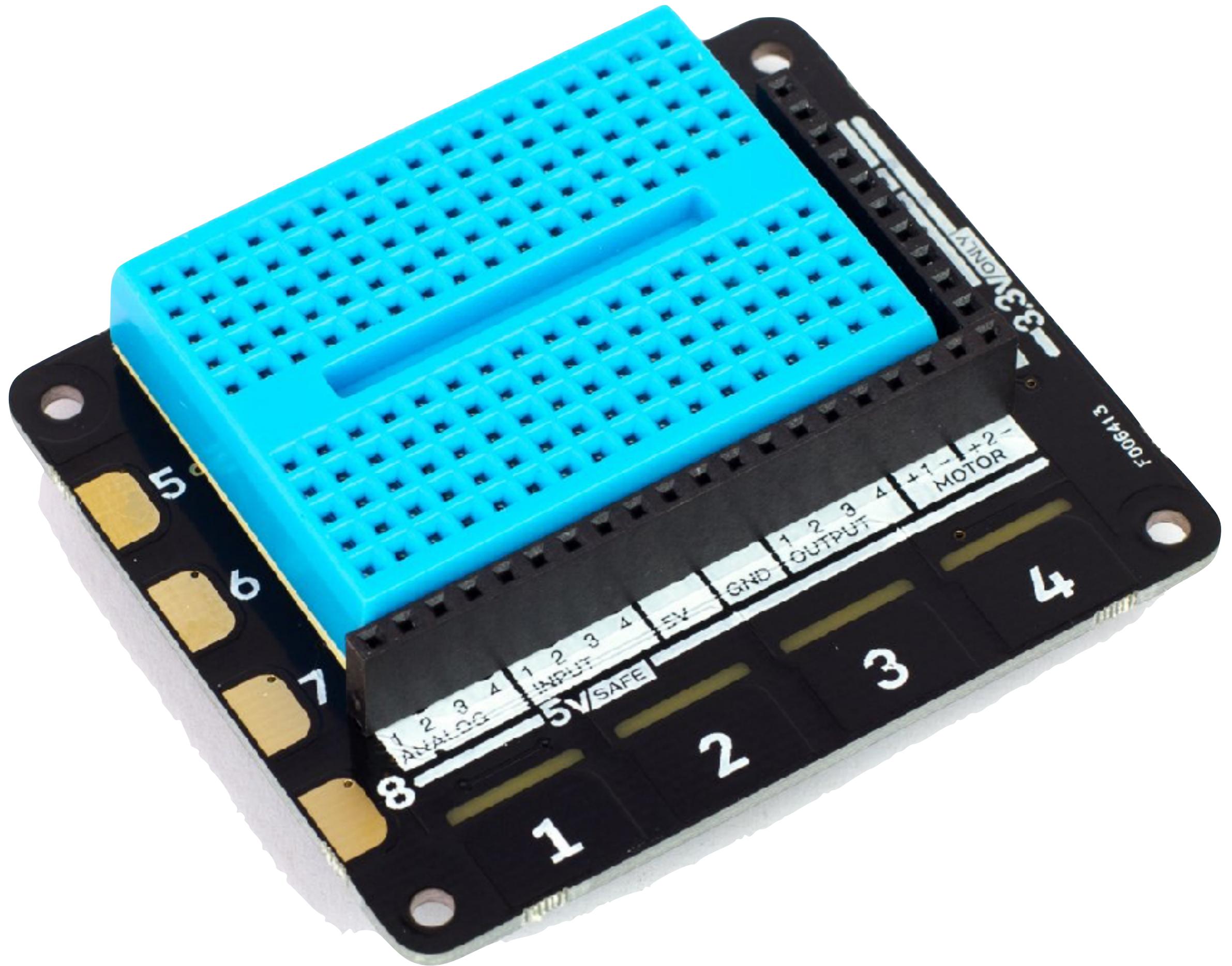
Explorer Hat and Sense Emu "simulation"

Explorer Hat posts data to Adafruit IOT feeds and dashboards

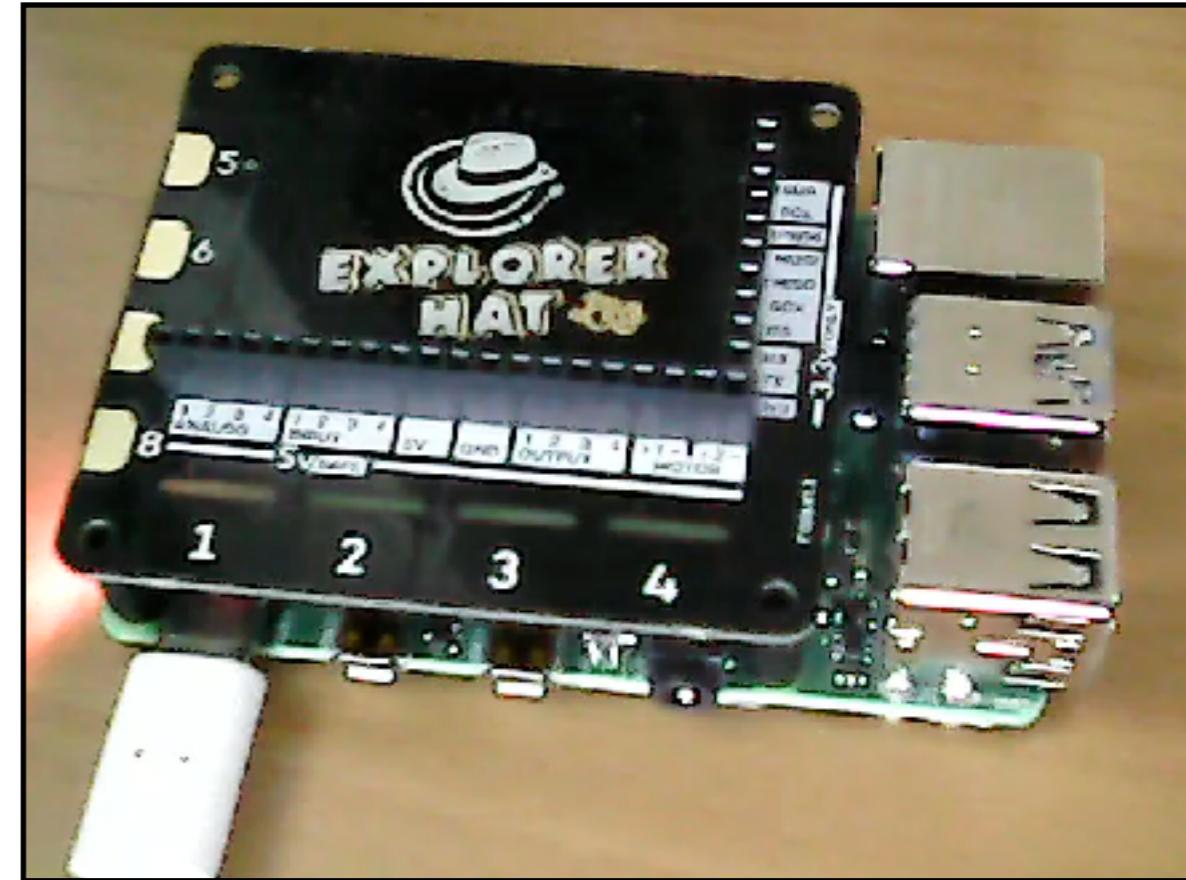
Explorer Hat gets data from Adafruit IOT feeds and dashboards

(postponed to next week)

Assignments: from Explorer Hat with Adafruit IOT to Sense Emu with Adafruit IOT



```
import explorerhat as eh  
import time  
  
# switch off all lights  
eh.light.off()  
  
# switch on red light, for 1 sec,  
# then off  
eh.light['red'].on()  
time.sleep(1)  
eh.light['red'].off()
```



LEDs: ON, OFF, PULSE

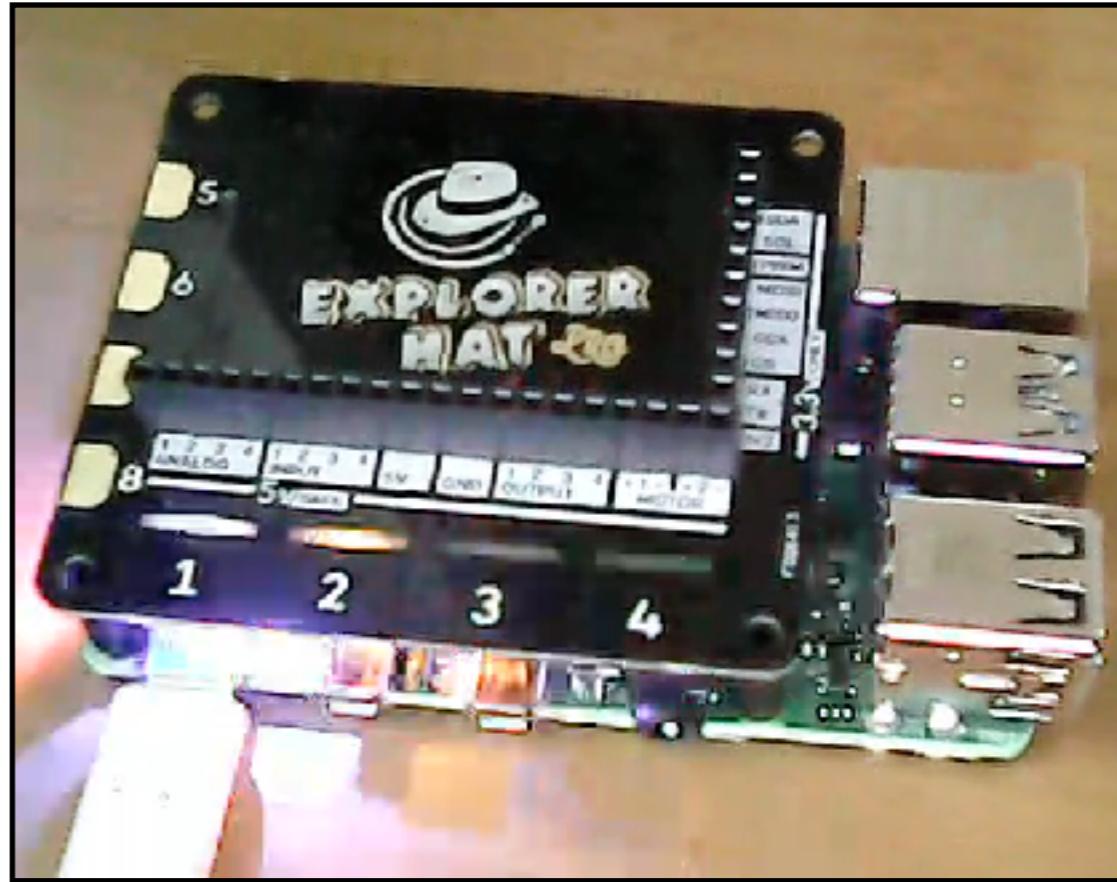
See above how to switch **on, off** lights.

```
import explorerhat as eh
import time

colorleds = [ 'blue' , 'yellow' ,
'red' , 'green' ]

try:
    while True:
        for color in colorleds:
            # switch on/off color
            eh.light[color].on()
            time.sleep(0.1)
            eh.light[color].off()
            time.sleep(0.01)

except KeyboardInterrupt:
    pass
```



LEDs: ON, OFF, PULSE

See above how to switch **on**, **off** and **pulse** lights.

```
import explorerhat as eh  
import time
```

```
# switch off all lights  
eh.light.off()
```

```
# Create a dictionary mapping integers:
```

```
# color for each color of eh
```

```
# where color is a valid string for eh colours
```

```
# and integer is its touchpad
```

```
eh_color_dict = { 1: 'blue', 2: 'yellow', 3: 'red' , 4: 'green' }
```

```
def light_on(touchpad, event):
```

```
    if touchpad > 4:
```

```
        return
```

```
    if event == 'press':
```

```
        color = eh_color_dict[touchpad]
```

```
        eh.light[color].on()
```

```
def light_off(touchpad, event):
```

```
    if touchpad > 4:
```

```
        return
```

```
    if event == 'release':
```

```
        color = eh_color_dict[touchpad]
```

```
        eh.light[color].off()
```

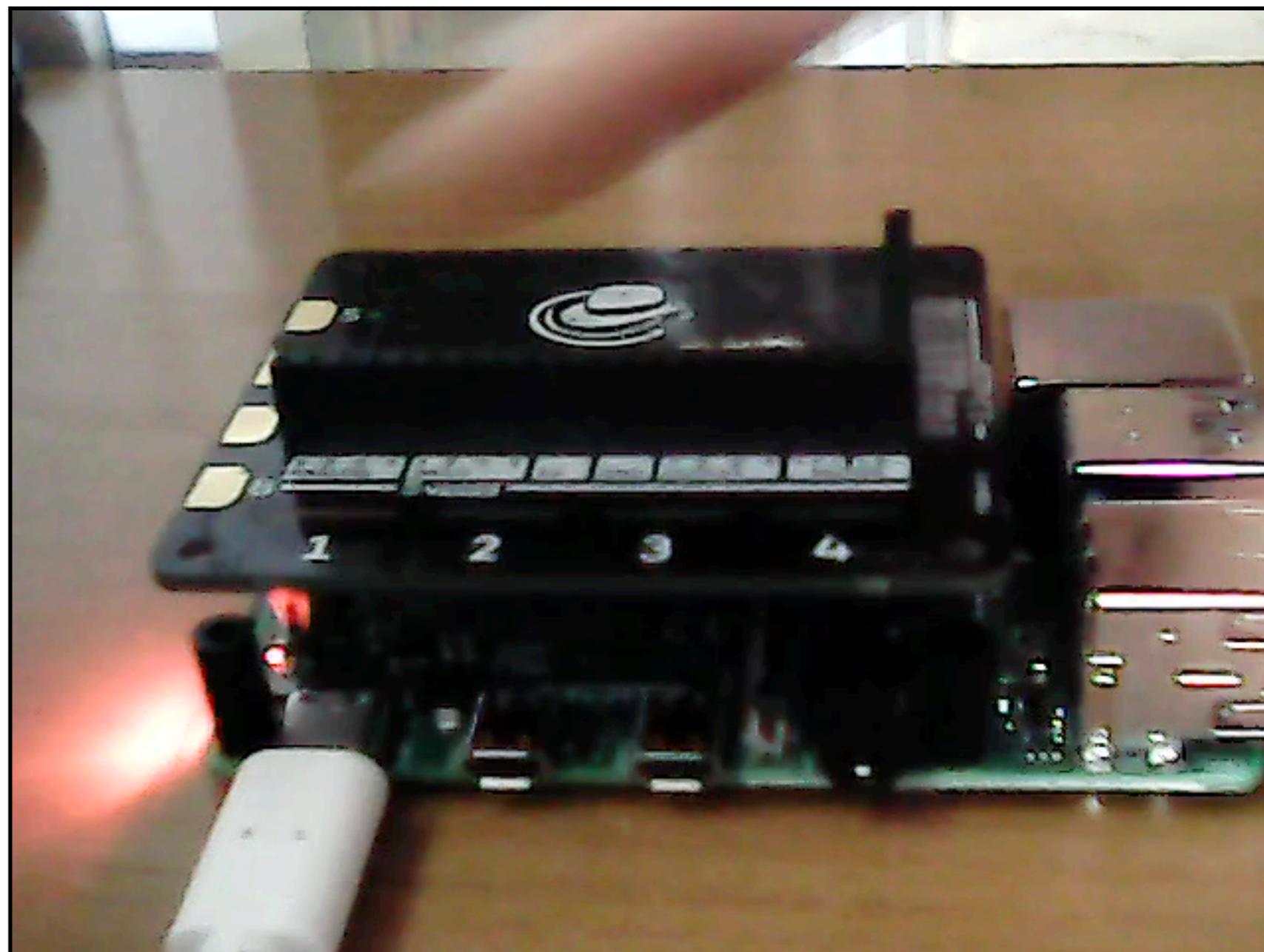
LEDS: ON AND OFF ON TOUCH (OF) PADS (1/2)

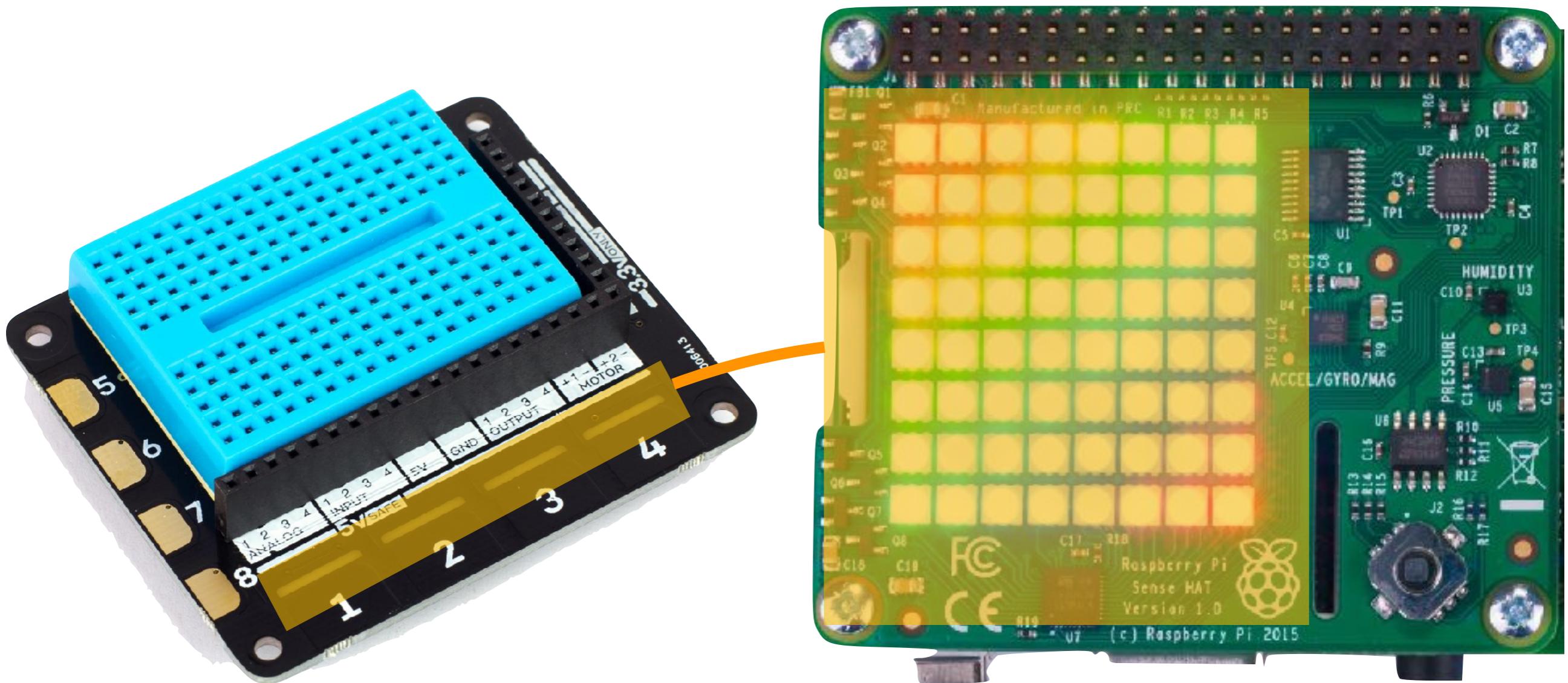
Call a function on a touchpad event pressed, another function on a touchpad event release.

```
# light on/off  
# according to touchpad event  
try:  
    while True:  
        eh.touch.pressed(light_on)  
        time.sleep(.3)  
        eh.touch.released(light_off)  
        time.sleep(.3)  
  
except KeyboardInterrupt:  
    pass
```

LEDS: ON AND OFF ON TOUCH (OF) PADS (2/2)

Call a function on a touchpad event pressed, another function on a touchpad event release.





```

from sense_emu import SenseHat
from time import sleep

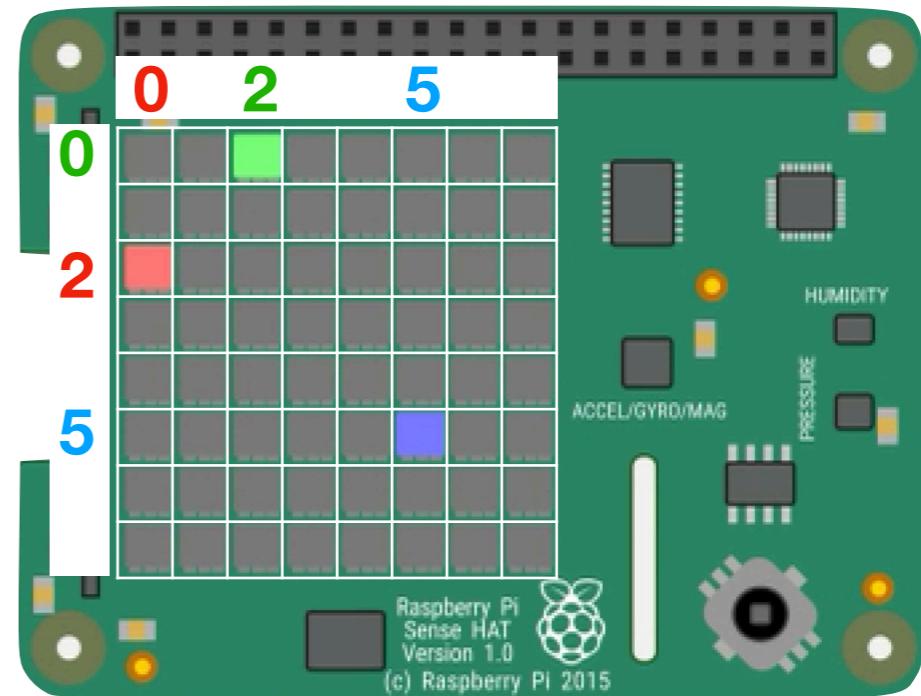
sense = SenseHat()

red = (255,0,0)
green = (0,255,0)
blue = (0,0,255)

sense.set_pixel(0,2,red)
sense.set_pixel(2,0,green)
sense.set_pixel(5,5,blue)

sleep(2)
sense.clear()

```



LED MATRIX REMINDER: SET_PIXEL VS SET_PIXELS

See above.

```

from sense_emu import SenseHat
from time import sleep

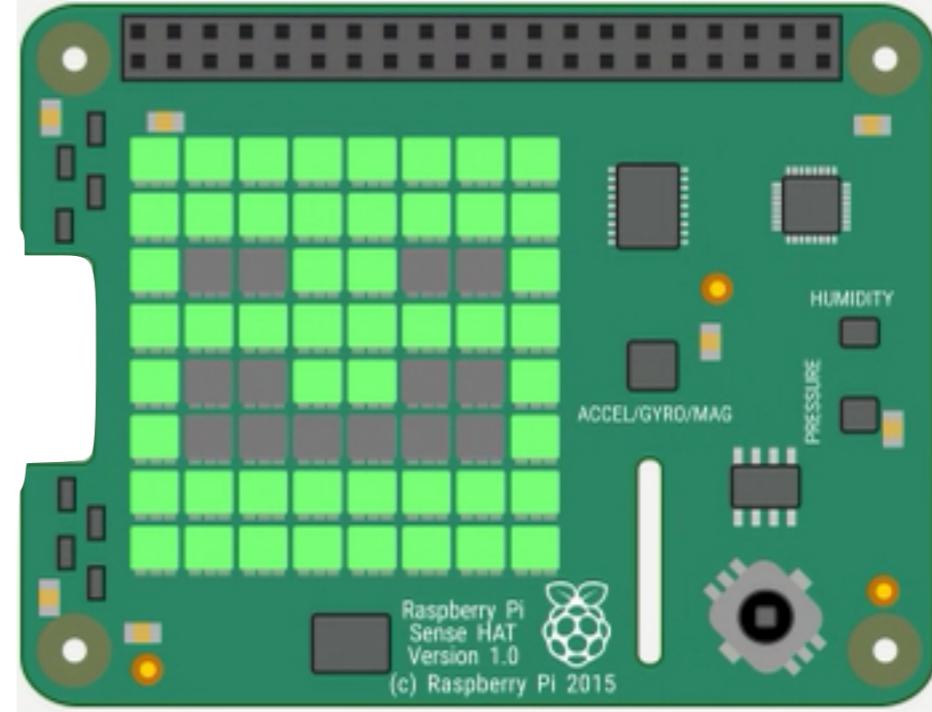
sense = SenseHat()

red = (255,0,0)
green = (0,255,0)
black = (0,0,0)

pattern = [
    #0,      #1,      #2,      #3,      #4,      #5,      #6,      #7
    green,   green,   green,   green,   green,   green,   green,   green,   #0
    green,   green,   green,   green,   green,   green,   green,   green,   #1
    green,   black,   black,   green,   green,   black,   black,   green,   #2
    green,   green,   green,   green,   green,   green,   green,   green,   #3
    green,   black,   black,   green,   green,   black,   black,   green,   #4
    green,   black,   black,   black,   black,   black,   black,   green,   #5
    green,   green,   green,   green,   green,   green,   green,   green,   #6
    green,   green,   green,   green,   green,   green,   green,   green,   #7
]
sense.set_pixels(pattern)

sleep(2)
sense.clear()

```



LED MATRIX REMINDER: SET_PIXEL VS SET_PIXELS

See above.

```

from sense_emu import SenseHat
from time import sleep

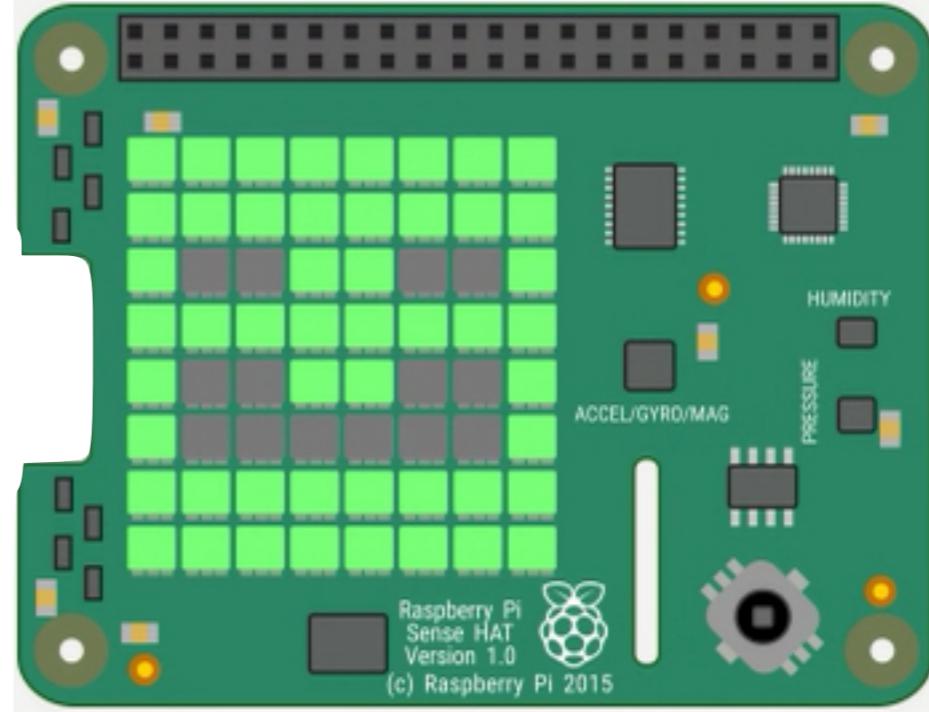
sense = SenseHat()
sense.clear()

red = (255,0,0)
green = (0,255,0)
black = (0,0,0)

greenmatrix = [ green for i in range(0,64) ]
sense.set_pixels(greenmatrix)
for j in range(2,6):
    if (j == 2 or j == 4):
        for i in range(1,7):
            sense.set_pixel(1,j, black) # only those
            sense.set_pixel(2,j, black) # only those
            sense.set_pixel(5,j, black) # only those
            sense.set_pixel(6,j, black) # only those
    elif j == 5:
        for i in range(1,7):
            sense.set_pixel(i,j, black) # all (1,5), ..., (6,5)
    else:
        pass

sleep(12)
sense.clear()

```



LED MATRIX REMINDER: SET_PIXEL VS SET_PIXELS

See above.

```

from sense_emu import SenseHat
from time import sleep

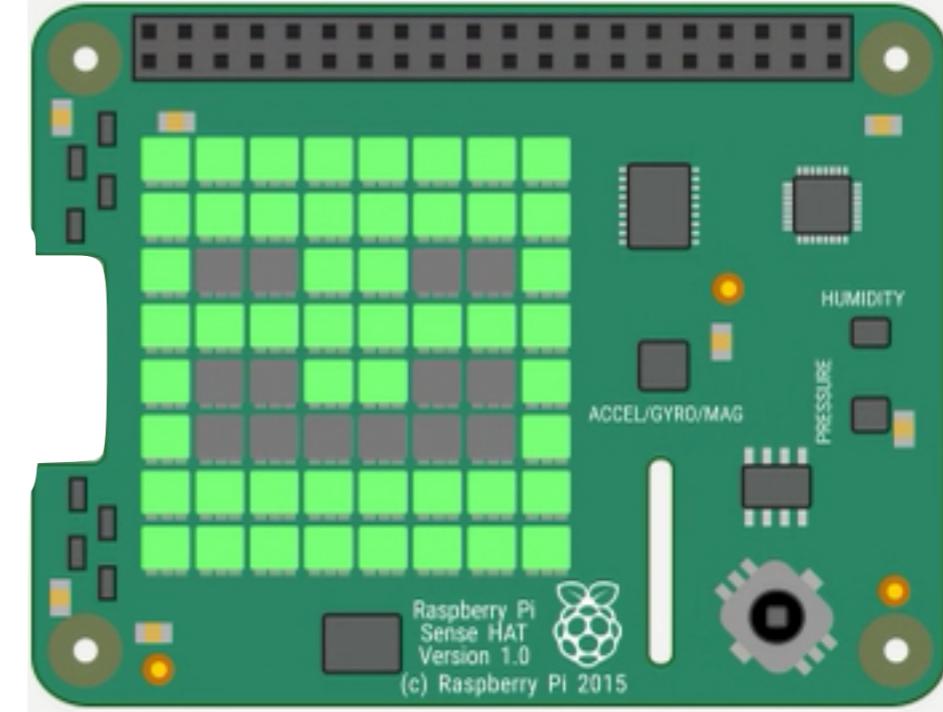
sense = SenseHat()
sense.clear()

red = (255,0,0)
green = (0,255,0)
black = (0,0,0)

sense.clear(green)
for j in range(2,6):
    if (j == 2 or j == 4):
        for i in range(1,7):
            sense.set_pixel(1,j, black) # only those
            sense.set_pixel(2,j, black) # only those
            sense.set_pixel(5,j, black) # only those
            sense.set_pixel(6,j, black) # only those
    elif j == 5:
        for i in range(1,7):
            sense.set_pixel(i,j, black) # all (1,5), ..., (6,5)
    else:
        pass

sleep(12)
sense.clear()

```



LED MATRIX REMINDER: SET_PIXEL VS SET_PIXELS

See above.

```
from sense_emu import SenseHat
from time import sleep

sense = SenseHat()

red = (255, 0, 0)
green = (0, 255, 0)
blue = (0, 0, 255)
yellow = (0, 255, 255)

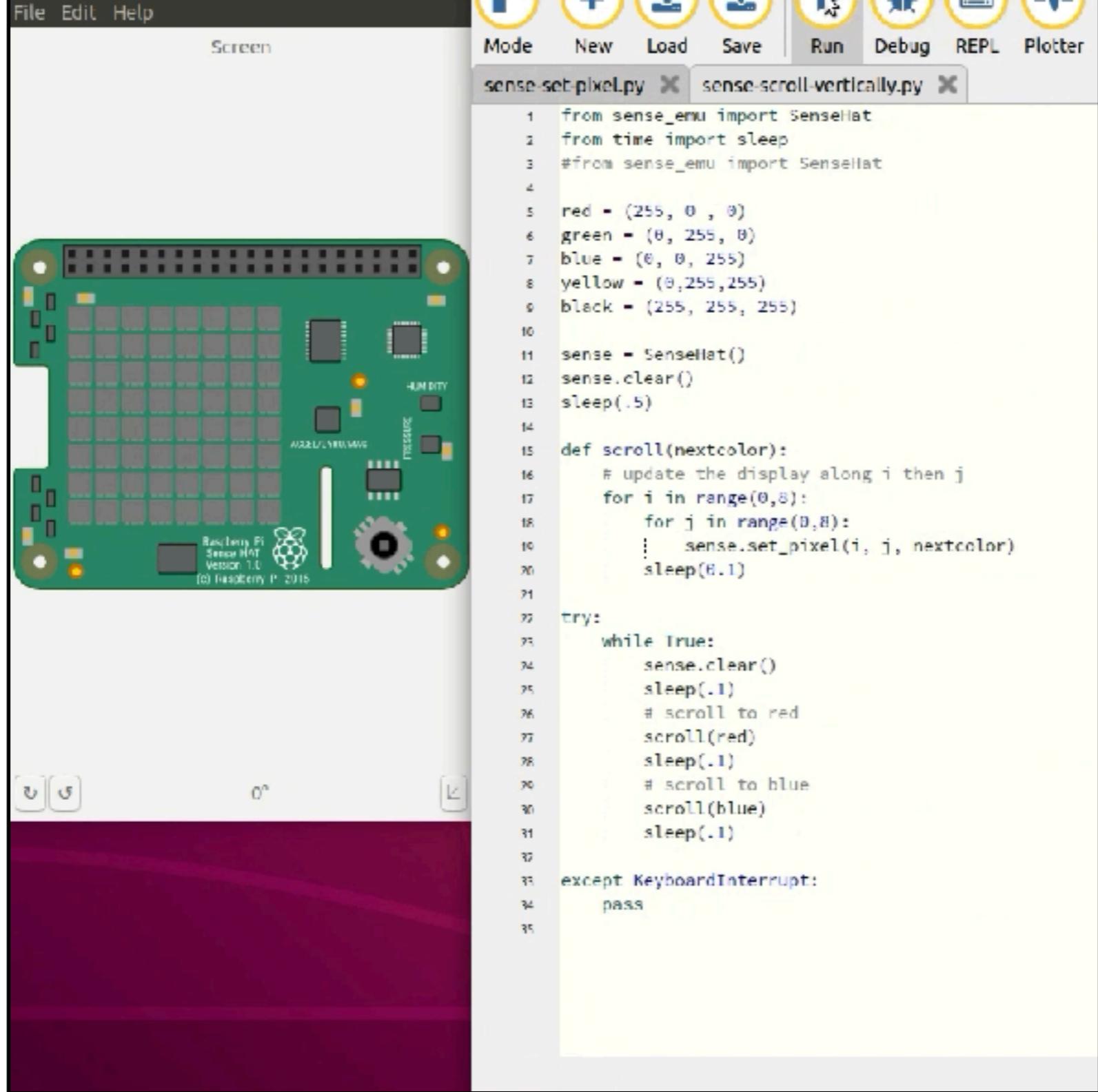
def scroll(RGBvalue):
    # clear the LED matrix
    sense.clear()
    sleep(.1)
    for i in range(0,8):
        # update the LED matrix along i
        for j in range(0,8):
            sense.set_pixel(i, j, RGBvalue)
        sleep(0.1)

try:
    while True:
        # scroll to red
        scroll(red)
        sleep(.1)
        # scroll to blue
        scroll(blue)
        sleep(.1)

except KeyboardInterrupt:
    pass
```

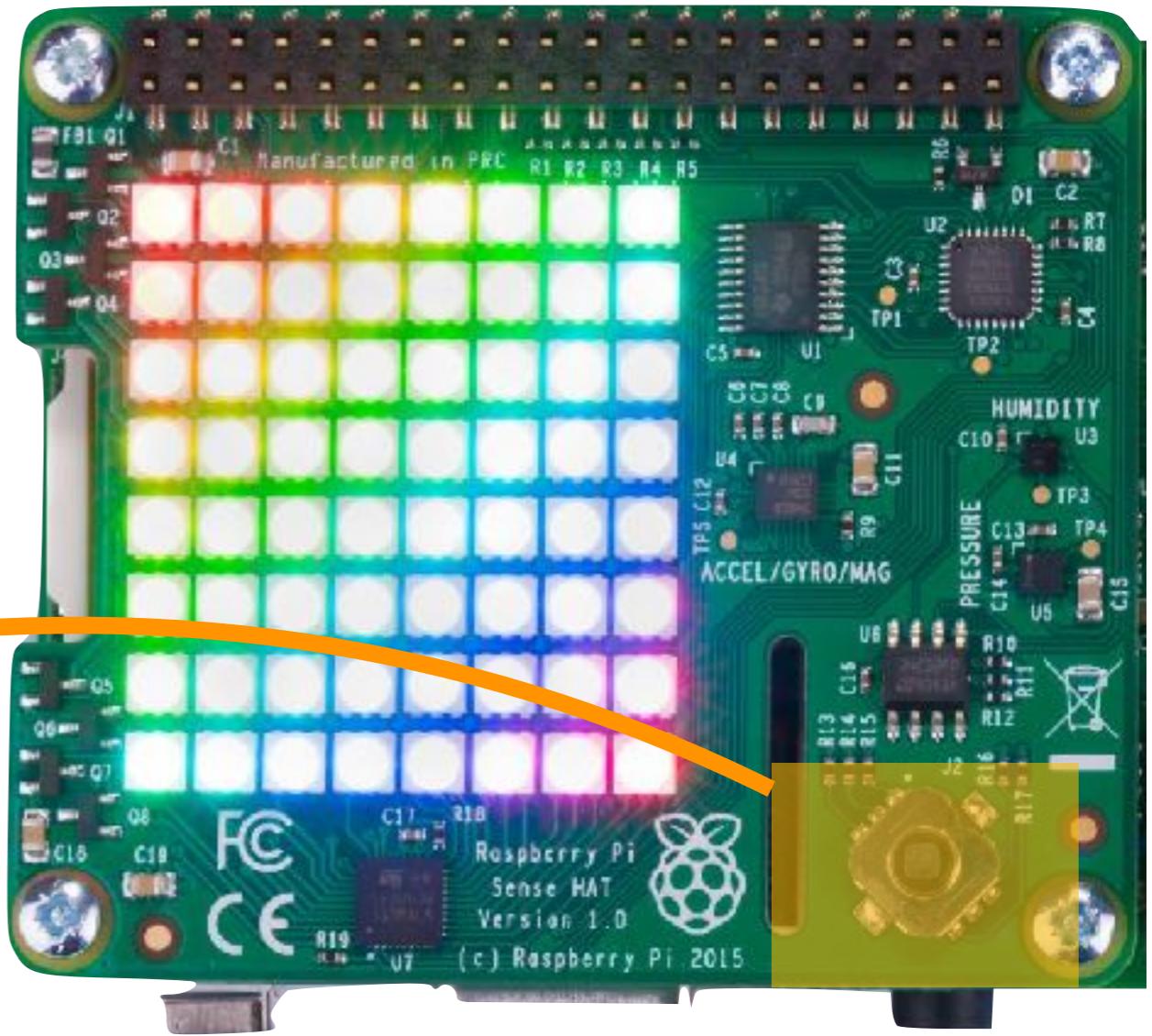
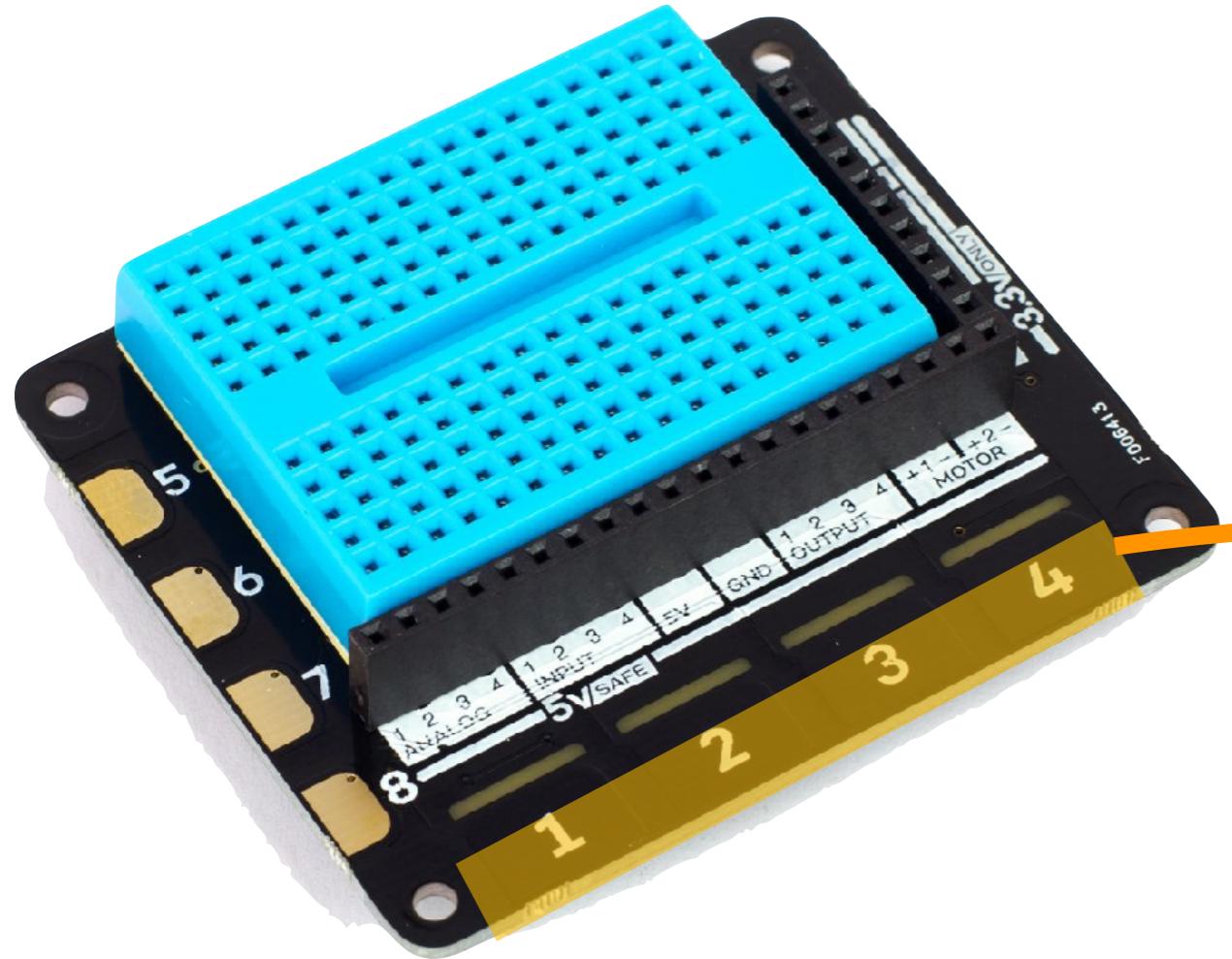
SCROLLING COLOURS ON SENSE EMU LED MATRIX

We have a single LED matrix with 64 individual LEDs in Sense Hat (emu). We can use them all and scroll colours, e.g., **vertically**.



SCROLLING COLOURS ON SENSE EMU LED MATRIX

We have a single LED matrix with 64 individual LEDs in Sense Hat (emu). We can use them all and scroll colours, e.g., **vertically**.



```
from sense_emu import SenseHat
from time import sleep
sense = SenseHat()

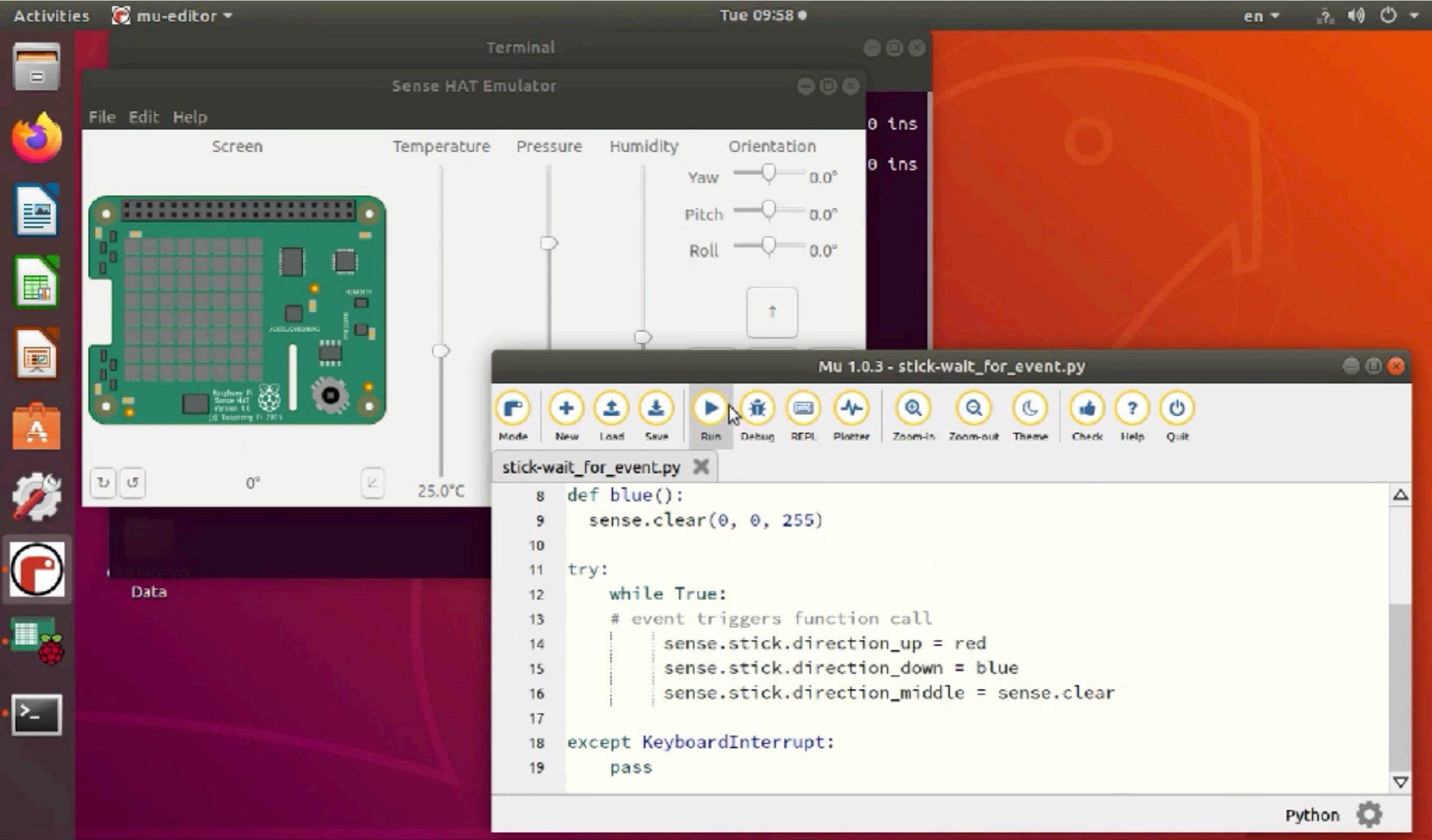
# Define functions
def red():
    sense.clear(255, 0, 0)
def blue():
    sense.clear(0, 0, 255)

try:
    while True:
        # event triggers function call
        sense.stick.direction_up = red
        sense.stick.direction_down = blue
        sense.stick.direction_middle = sense.clear

except KeyboardInterrupt:
    pass
```

JOYSTICK REMINDER: ON EVENT CALL A FUNCTION AND TOGGLE COLORS ON THE SENSE-EMU LED MATRIX

The `.direction_any()` methods or the above methods can either take one parameter (the `InputEvent` tuple that has occurred), or no parameters at all.



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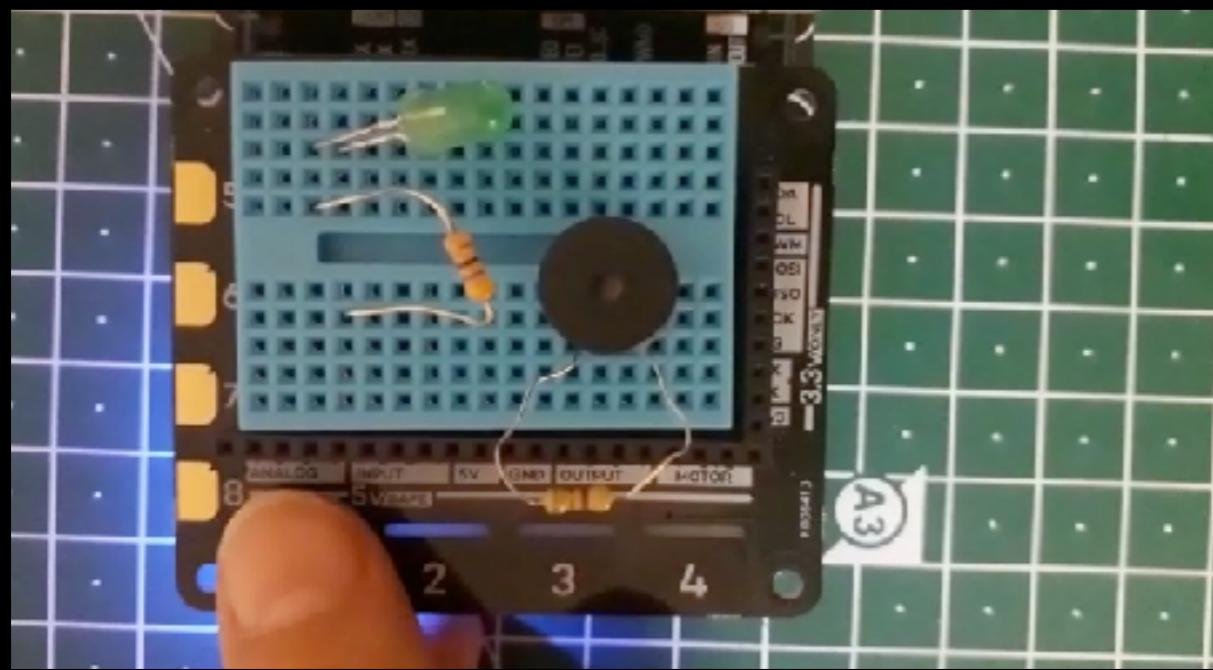
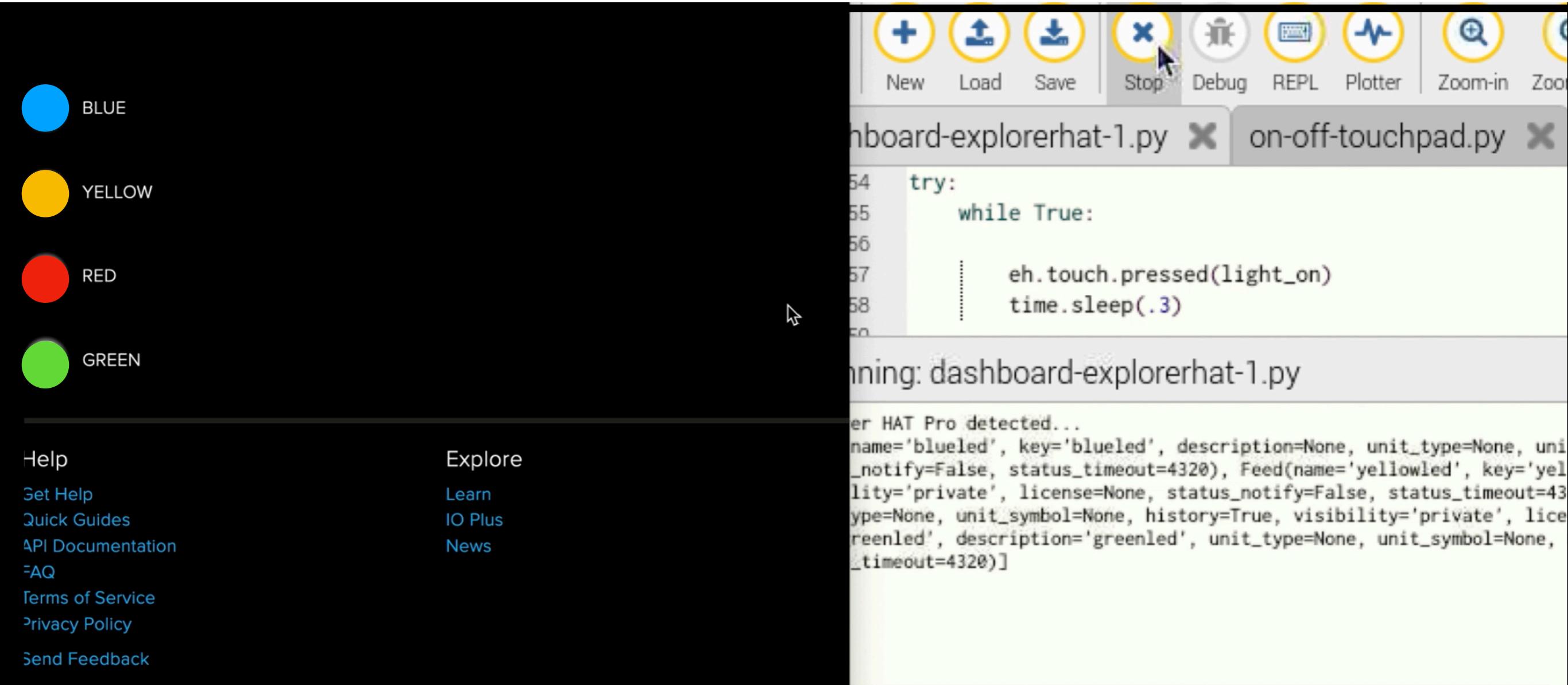
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Adafruit IOT



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News

```
54     try:
55         while True:
56             if eh.touch.pressed(light_on):
57                 time.sleep(.3)
58             else:
59                 print("Light off")
60
61             if eh.touch.pressed(blue_on):
62                 time.sleep(.3)
63             else:
64                 print("Blue LED off")
65
66             if eh.touch.pressed(yellow_on):
67                 time.sleep(.3)
68             else:
69                 print("Yellow LED off")
70
71             if eh.touch.pressed(red_on):
72                 time.sleep(.3)
73             else:
74                 print("Red LED off")
75
76             if eh.touch.pressed(green_on):
77                 time.sleep(.3)
78             else:
79                 print("Green LED off")
80
81             if eh.touch.pressed(blueled):
82                 time.sleep(.3)
83             else:
84                 print("Blue LED on")
85
86             if eh.touch.pressed(yellowled):
87                 time.sleep(.3)
88             else:
89                 print("Yellow LED on")
90
91             if eh.touch.pressed(redled):
92                 time.sleep(.3)
93             else:
94                 print("Red LED on")
95
96             if eh.touch.pressed(greenled):
97                 time.sleep(.3)
98             else:
99                 print("Green LED on")
100
101
102             if blueled == 1:
103                 print("Blue HAT Pro detected...")
104                 blueled = 0
105             if yellowled == 1:
106                 print("Yellow HAT Pro detected...")
107                 yellowled = 0
108             if redled == 1:
109                 print("Red HAT Pro detected...")
110                 redled = 0
111             if greenled == 1:
112                 print("Green HAT Pro detected...")
113                 greenled = 0
114
115
116             if blueled == 0:
117                 print("Blue LED on")
118                 blueled = 1
119             if yellowled == 0:
120                 print("Yellow LED on")
121                 yellowled = 1
122             if redled == 0:
123                 print("Red LED on")
124                 redled = 1
125             if greenled == 0:
126                 print("Green LED on")
127                 greenled = 1
128
129
130             if blueled == 1:
131                 print("Blue LED off")
132                 blueled = 0
133             if yellowled == 1:
134                 print("Yellow LED off")
135                 yellowled = 0
136             if redled == 1:
137                 print("Red LED off")
138                 redled = 0
139             if greenled == 1:
140                 print("Green LED off")
141                 greenled = 0
142
143
144             if blueled == 0:
145                 print("Blue LED off")
146                 blueled = 1
147             if yellowled == 0:
148                 print("Yellow LED off")
149                 yellowled = 1
150             if redled == 0:
151                 print("Red LED off")
152                 redled = 1
153             if greenled == 0:
154                 print("Green LED off")
155                 greenled = 1
156
157
158             if blueled == 1:
159                 print("Blue LED on")
160                 blueled = 0
161             if yellowled == 1:
162                 print("Yellow LED on")
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944                 blueled = 0
945             if yellowled == 1:
946                 print("Yellow LED on")
947                 yellowled = 0
948             if red
```



INTERACTION

See the interaction with the RPi, the feeds passed and how they are displayed in the dashboard.

Next we see the script together, step by step.



skybit / Dashboards

Actions ▾

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DASHBOARD CREATION

See how to create
such a dashboard

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*"Elegance is not a
dispensable luxury
but a quality that
decides between
success and failure" -
Edsger Dijkstra*



```
# Import explorerhat as eh
import explorerhat as eh
# Import time for avoiding too many requests
import time
# import Adafruit IO REST client
from Adafruit_IO import Client, Feed, Data, RequestError
# Import my_username, my_key
from username_key import my_username, my_key

# create an instance of the REST client
# with your key and username
aio = Client( my_username, my_key )
```

```
# Create a dictionary mapping integers: color for each color of eh
# where color is a valid string for eh colours
# and integer is its touchpad
eh_color_dict = { 1: 'blue', 2: 'yellow', 3: 'red' , 4: 'green' }

# Create the feeds_keys list for keys of feeds from Adafruit
feeds_keys = [ 'blueled','yellowled','redled','greenled' ]

# For each colorled in feeds_keys access its feed in IO Adafruit else create it;
# add color:feed to the dictionary feeds
feeds = {}
for color_key in feeds_keys:
    # cut 'led' from color_key for matching the eh string names of colours
    color = color_key[:-3]
    try: # access a feed and store in feeds dictionary
        feeds[color] = aio.feeds(color_key)
    except RequestError:
        feeds[color] = aio.create_feed(Feed(name=color_key, key=color_key,
history=True))

# test
print(feeds)
```

```
# def function that
# on touch press of a touchpad for a colored
# switches it on and sends 1 to AIOT
#
def light_on(touchpad, event):
    if touchpad > 4:
        return
    if event == 'press':
        color = eh_color_dict[touchpad]
        eh.light[color].on()
        aio.send_data(feeds[color].key, 1)
```

```
# def function that
# on touch release of a touchpad for a colored
# switches it off and sends 0 to AIOT
#
def light_off(touchpad, event):
    if touchpad > 4:
        return
    if event == 'release':
        color = eh_color_dict[touchpad]
        eh.light[color].off()
        aio.send_data(feeds[color].key, 0)
```

```
# add the data value of the LED status to the feed, identified by its key  
try:  
    while True:
```

```
        eh.touch.pressed(light_on)  
        time.sleep(.3)
```

```
        eh.touch.released(light_off)  
        time.sleep(.3)
```

```
except KeyboardInterrupt:  
    # on interrupt, switch off all led-colours  
    eh.light.off()  
    pass
```

Outline

File handling

Exceptions

Explorer Hat and Sense Emu "simulation"

Explorer Hat posts data to Adafruit IOT feeds and dashboards

Explorer Hat gets data from Adafruit IOT feeds and dashboards
(postponed to next week)

Assignments: from Explorer Hat with Adafruit IOT to Sense Emu with
Adafruit IOT

Outline

File handling

Exceptions

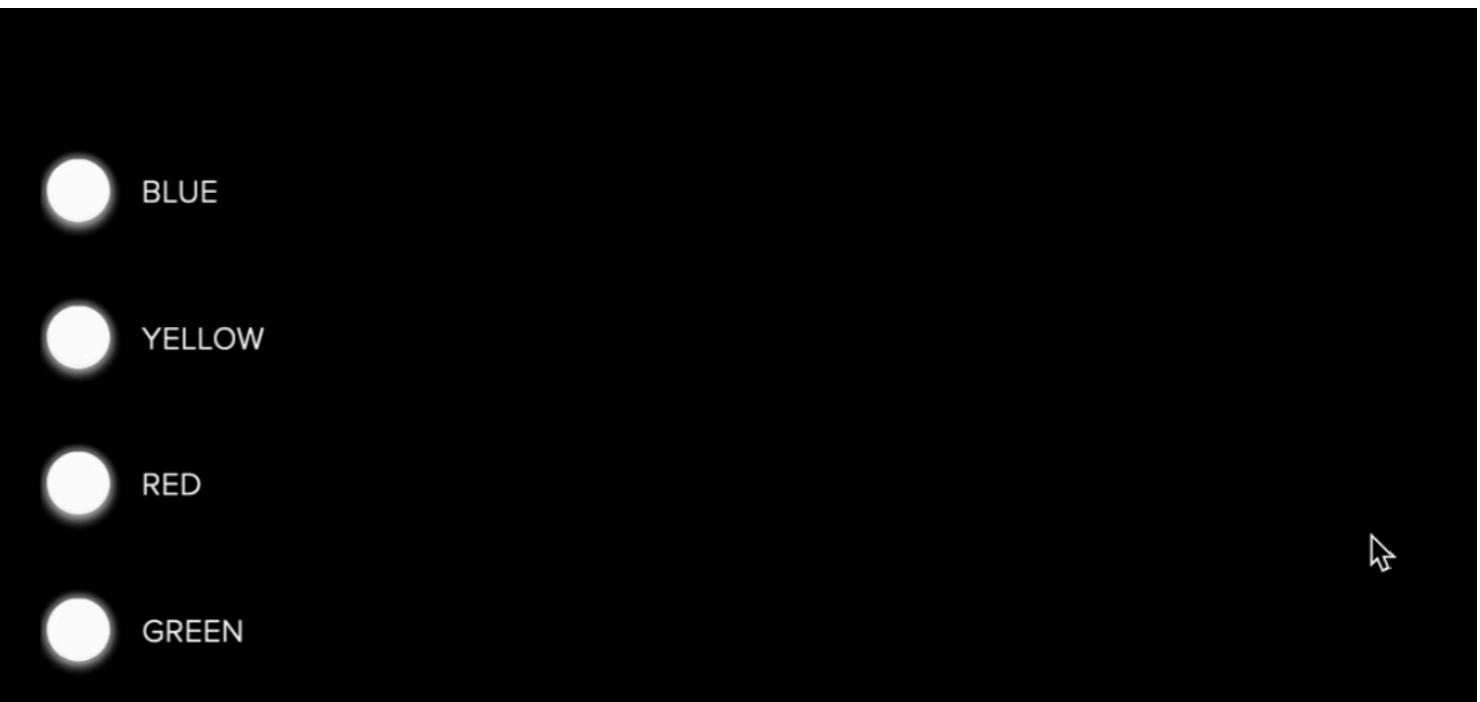
Explorer Hat and Sense Emu "simulation"

Explorer Hat posts data to Adafruit IOT feeds and dashboards

Explorer Hat gets data from Adafruit IOT feeds and dashboards

(postponed to next week)

Assignments: from Explorer Hat with Adafruit IOT to Sense Emu with Adafruit IOT



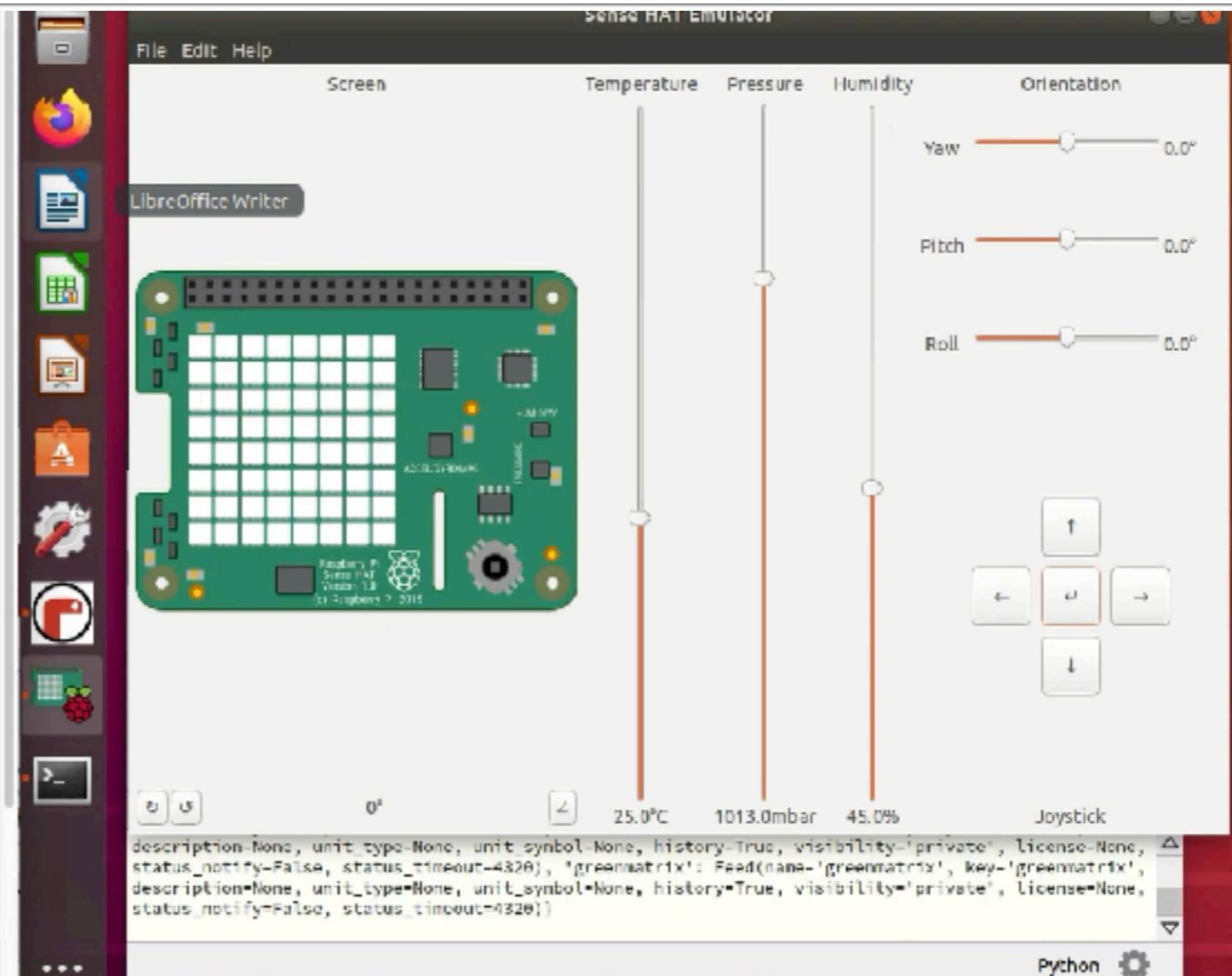
Assignment 12

Start from the relevant code in slides for Explorer Hat and Adafruit IOT.

Then create a script which continuously does as follows:

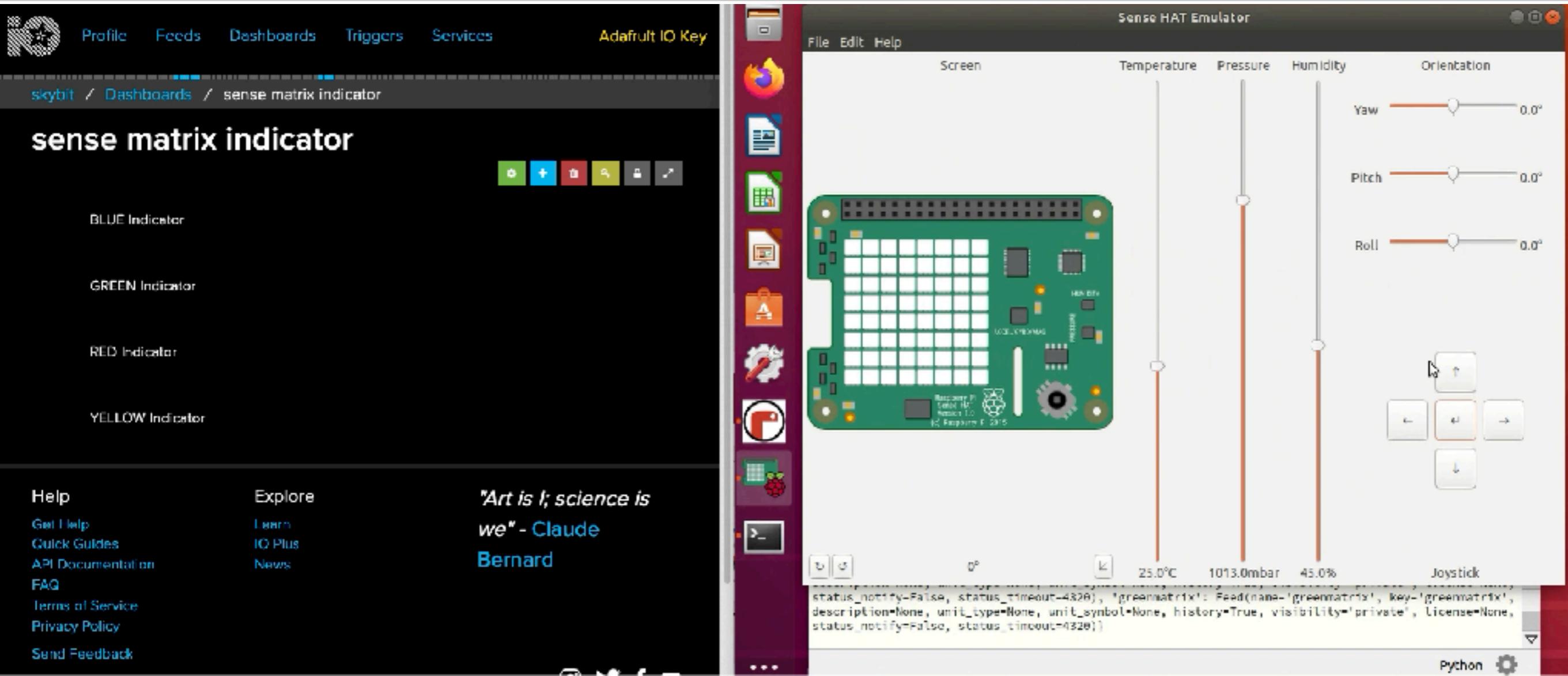
- on the SenseHat LED matrix, it displays blue when the joystick is pressed with direction "up", no colour otherwise or the middle button is pressed; similarly for yellow and "down", red and "right", green and "left";
- it has one feed per colour of the form **colormatrix** (e.g., 'bluematrix'), which registers whether **color** (e.g., blue) is displayed or not on the matrix;
- for each feed **colormatrix**, it has an indicator dashboard; these dashboards are grouped together for indicating the color being displayed on the LED matrix.

The screenshot shows the Adafruit IO dashboard interface. At the top, there are navigation links: Profile, Feeds, Dashboards, Triggers, Services, and an Adafruit IO Key. Below these are sections for 'Actions' and 'skybit / Dashboards'. The 'Actions' section lists several items with checkboxes: Name, colorpicker, graph, LED switch, ledtoggle, rhyme, servo_speed, single edindicator, and todayrhymes. A note at the bottom says 'Loaded in 0.22 seconds'. At the bottom left are 'Help' and 'Explore' sections with links to Get Help, Quick Guides, API Documentation, FAQ, Terms of Service, and Privacy Policy. On the right, there's a quote: "'Art is I; science is we'" - Claude Bernard.



Assignment 12: dashboard creation

Create the dashboard as above. See also <https://www.dropbox.com/s/ajg3tutewmxj92n/assignment12.mov?dl=0>



Assignment 12: run the script

The script you create, when run, should indicate what you see above in the dashboard. See also <https://www.dropbox.com/s/ajg3tutewmxj92n/assignment12.mov?dl=0>

Summary

File handling

Exceptions

Explorer Hat and Sense Emu "simulation"

Explorer Hat posts data to Adafruit IOT feeds and dashboards

Explorer Hat gets data from Adafruit IOT feeds and dashboards

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