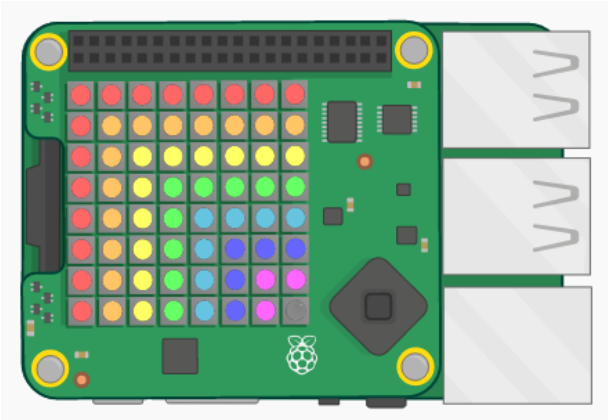
Raspberry Pi Projects

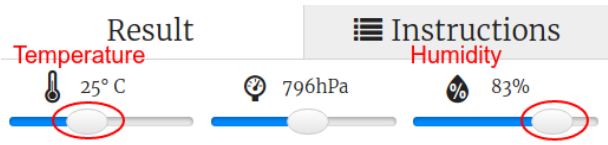
Rainbow Predictor

Introduction:

In this project you will use the temperature and humidity sensors on the Sense HAT to predict when there's a good chance of spotting a rainbow. When the right conditions are detected you will display a rainbow on the Sense HAT LED Matrix.



In the Trinket emulator you can move the sliders to change the temperature and humidity, they look like this:



You'll get a rainbow if the temperature is over 20 degrees C and the humidity is over 80 percent. Try experimenting to find the weather conditions for sunshine (yellow) and snow (white).

Additional information for club leaders

If you need to print this project, please use the Printer friendly version (https://projects.raspberrypi.org/en/projects/rainbow-predictor/print).

Club leader notes

Introduction:

In this project, children will learn how to use the Sense HAT sensors to detect the weather, and display a rainbow using the LED matrix when it's warm and humid.

Online Resources

This project uses Python 3. We recommend using Trinket (https://trinket.io/) to write Python online. This project contains the following Trinkets:

- 'Rainbow Predictor' Starter Trinket – jumpto.cc/rainbow-go (http://jumpto.cc/rainbow-go)

There is also a trinket containing the completed project:

- 'Rainbow Predictor' Finished – trinket.io/python/eaea4cb76c (https://trinket.io/python/eaea4cb76c)

Offline Resources

This project can also be completed offline (https://www.codeclubprojects.org/en-GB/https://projects-static.raspberrypi.org/projects/rainbow-predictor/66e273f8ae0b1c72ce26a83bcd714010ae0bc202/en/resources/physical-sense-hat/) on a Raspberry Pi computer with a Sense HAT. You can access the project resources by clicking the 'Project Materials' link for this project. This link contains a 'Project Resources' section, which includes resources that children will need to complete this project offline. Make sure that each child has access to a copy of these resources. This section includes the following files:

- rainbow/rainbow.py

You can also find a completed version of this project in the 'Volunteer Resources' section, which contains:

- rainbow-finished/rainbow.py

(All of the resources above are also downloadable as project and volunteer `.zip` files.)

Learning Objectives

- Physical computing - sensors;
- Boolean AND;
- RGB Colours;
- Sense HAT display;

This project covers elements from the following strands of the Raspberry Pi Digital Making Curriculum (http://rpf.io/curriculum):

- Combine programming constructs to solve a problem. (https://www.raspberrypi.org/curriculum/programming/builder)

Challenges

- More Weather - display different images under different weather conditions.

Project materials

Project resources

- .zip file containing all project resources (https://projects-static.raspberrypi.org/projects/rainbow-predictor/66e273f8ae0b1c72ce26a83bcd714010ae0bc202/en/resources/rainbow-project-resources.zip)
- Starter project (http://jumpto.cc/rainbow-go)
- Offline starter Python file (https://projects-static.raspberrypi.org/projects/rainbow-predictor/66e273f8ae0b1c72ce26a83bcd714010ae0bc202/en/resources/rainbow-rainbow.py)

Club leader resources

- .zip file containing all completed project resources (https://projects-static.raspberrypi.org/projects/rainbow-predictor/66e273f8ae0b1c72ce26a83bcd714010ae0bc202/en/resources/rainbow-volunteer-resources.zip)
- Online completed Trinket project (https://trinket.io/python/eaea4cb76c)
- rainbow-finished/rainbow.py (https://projects-static.raspberrypi.org/projects/rainbow-predictor/66e273f8ae0b1c72ce26a83bcd714010ae0bc202/en/resources/rainbow-finished-rainbow.py)

Drawing a rainbow

First let's draw a rainbow using the LED Matrix on the Sense HAT. The colours are Red, Orange, Yellow, Green, Blue, Indigo and Violet.

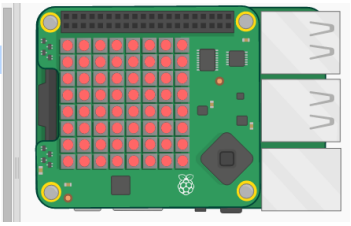
To set the colour of an individual LED we need to say how much red, green and blue it should have from 0 to 255.

- Open the Rainbow Predictor Starter Trinket: jumpto.cc/rainbow-go (http://jumpto.cc/rainbow-go).

  The code to set up the Sense HAT has been included for you.

- Add the highlighted code to set up a variable for the colour Red and then turn all the pixels red using `sense.clear(R)`:

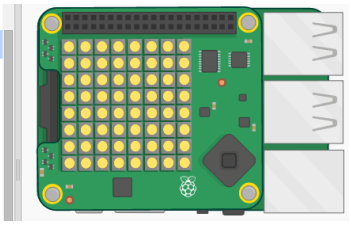
```
sense = SenseHat()
sense.clear()

R = [255, 0, 0]

sense.clear(R)
```



  Make sure you use a capital letter `R`.

- Orange is next. Orange is red mixed with green. You can adjust the numbers until you get an orange that you like. Use `sense.clear(O)` this time to test the new colour, making sure to use a capital letter `O` in the brackets.

```
R = [255, 0, 0]
O = [255, 165, 0]

sense.clear(O)
```



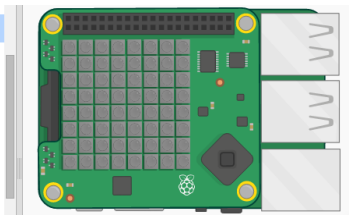
- Now add variables `Y`, `G`, `B`, `I`, `V` so that you have the seven colours of the rainbow. You can look up RGB colours at jumpto.cc/colours (http://jumpto.cc/colours)

  You can test your colours using `sense.clear()`.

```
R = [255, 0, 0]
O = [255, 165, 0]
Y =
G =     Fill in the missing colours
B =
I =
V =       Test your colours with sense.clear()

sense.clear(V)
```

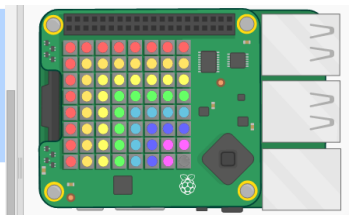
- Add a variable `X` for setting pixels to off (no red, green or blue):

```
X = [0, 0, 0]

sense.clear(X)
```



- Now it's time to draw a rainbow. You need to set up a list containing the colour of each pixel and then call `set_pixels` with the list of colours. To save typing you can copy the rainbow from `snippets.py` in your project.

```
rainbow = [
R, R, R, R, R, R, R, R,
R, O, O, O, O, O, O, O,
R, O, Y, Y, Y, Y, Y, Y,
R, O, Y, G, G, G, G, G,
R, O, Y, G, B, B, B, B,
R, O, Y, G, B, I, I, I,
R, O, Y, G, B, I, V, V,
R, O, Y, G, B, I, V, X
]

sense.set_pixels(rainbow)
```

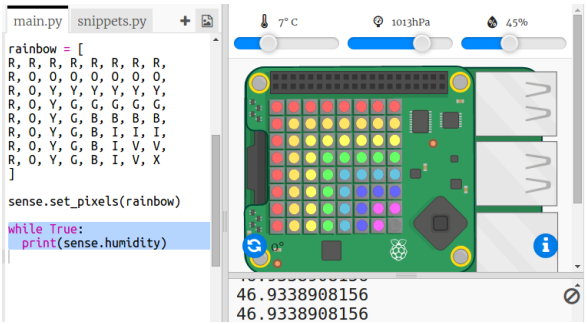


Reading the sensor data

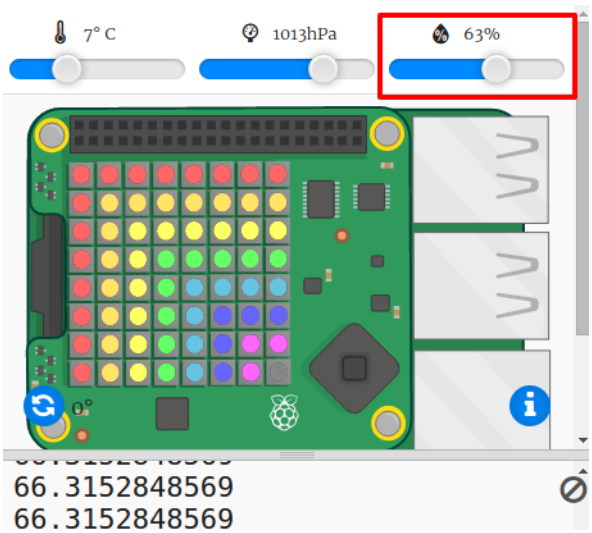
The Sense HAT has a range of sensors that provide real world data on a Raspberry Pi computer. The Sense HAT Emulator in Trinket allows you write and test projects for the Sense HAT in your web browser.

The humidity sensor reports the amount of moisture in the air. Humidity is high when it rains.

- Let's read from the humidity sensor and print out the result. Add the highlighted code to the bottom of your script.



- Test your program by moving the humidity slider to different values.

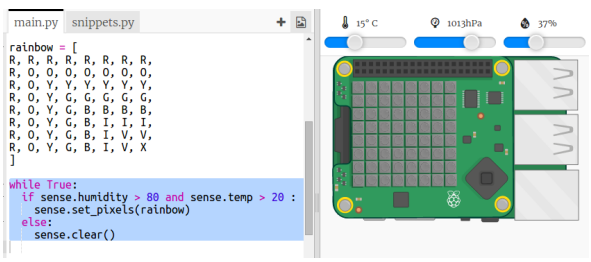


Notice that the value you get back from the humidity sensor isn't exactly the same as the value on the slider. This is because the sensors aren't perfectly accurate.

Predicting a rainbow

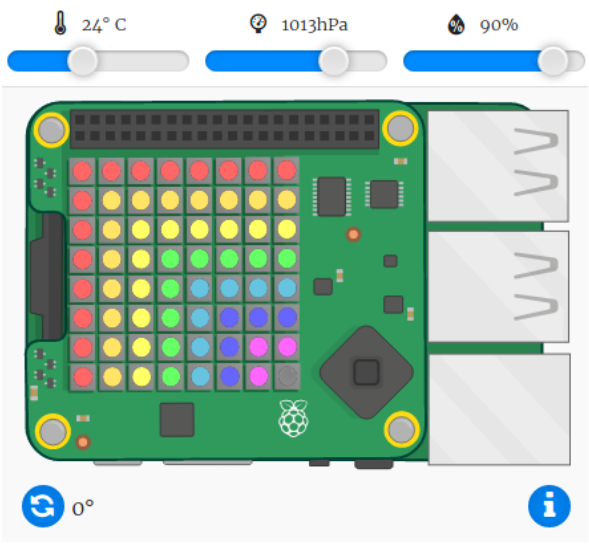
Rainbows happen when the sun shines through water droplets at the right angle (usually in the afternoon.) If it's warm and the humidity is high then it's worth checking to see if there's a rainbow.

- Now let's only show the rainbow if the conditions are right. Change your code to look like this:



You can't be sure there's a rainbow when these conditions are met, but it's worth a look.

- Try changing the values on the slider until you see the rainbow.



Remember that the values reported won't be exactly the same as those shown on the sliders.

- A *threshold* is a number that indicates an important change. 20 degrees C and 80% humidity are thresholds for the rainbow detector.

  Try changing the thresholds and then moving the sliders to trigger a rainbow.

  If you're working with a physical Sense HAT then you can test your code by setting the thresholds to low values.

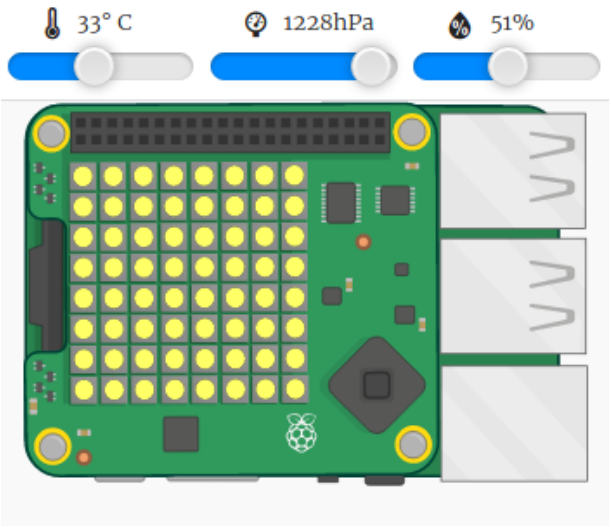
Challenge: More Weather

Can you display a sun image when the temperature is above 20 and the humidity is below 80%.

Tip: Use `elif` to check for other kinds of weather. For each kind of weather you'll need to include a condition to check for a kind of weather and then code to set the display on the Sense HAT.

```
if sense.humidity > 80 and sense.temp > 20:
    sense.set_pixels(rainbow)
elif          it's sunny                    :
    turn the Sense HAT display yellow
else:
    sense.clear()
```

Tip: You can create a simple sun by setting all the pixels to yellow with `clear()`. Or you can try creating a pixel image like you did with the rainbow.



How about a snow image if the humidity is above 80% and the temperature is below zero.

Tip: Set red, green and blue to the maximum of 255 to create white.