adafruit learning system

PyPortal Smart Thermometer with Analog Devices ADT7410, Adafruit IO and CircuitPython

Created by Brent Rubell

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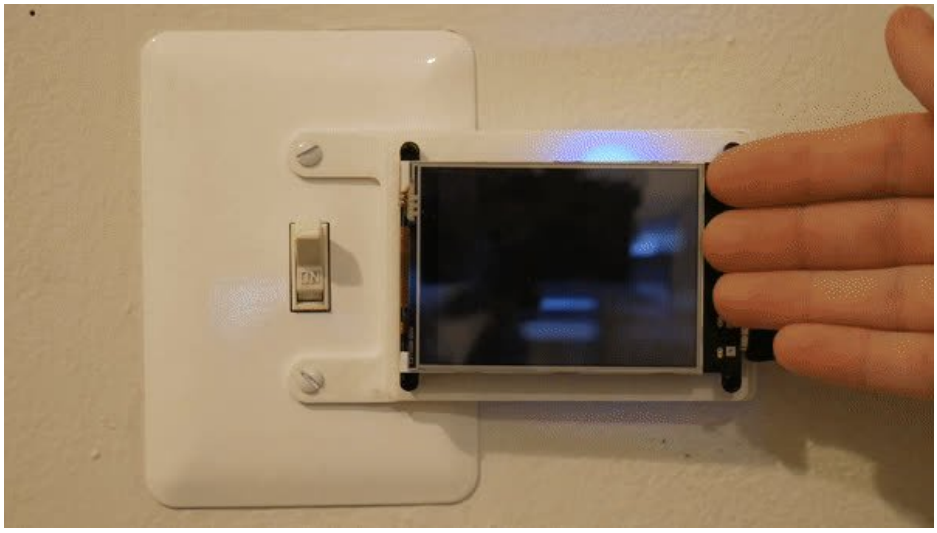
Overview

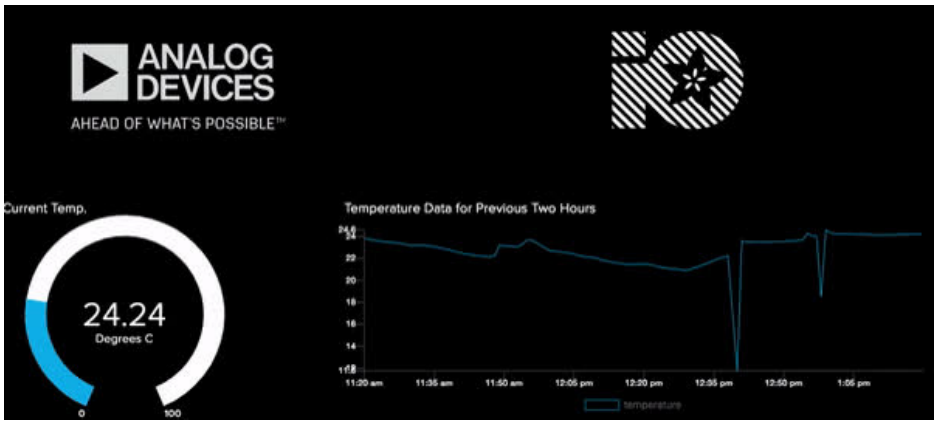


*Connected your PyPortal to the internet and want to do more with **data**?*

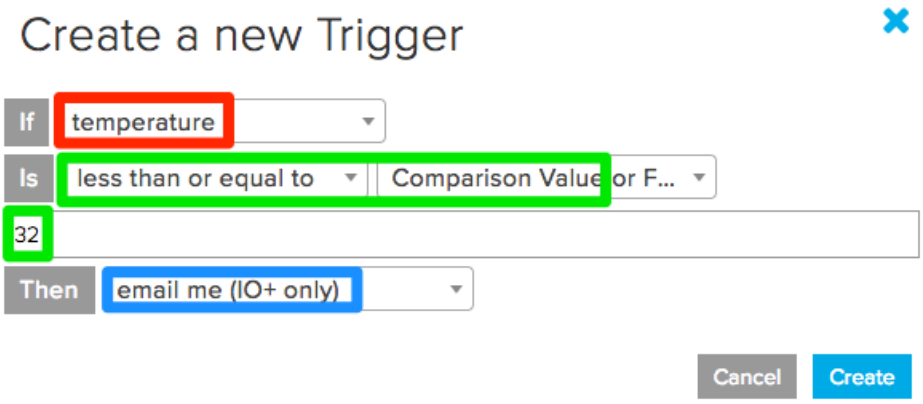
You'll be using the Analog Devices ADT7410 (https://adafru.it/EgN) built-into your PyPortal as a thermometer to measure the ambient temperature over I2C.

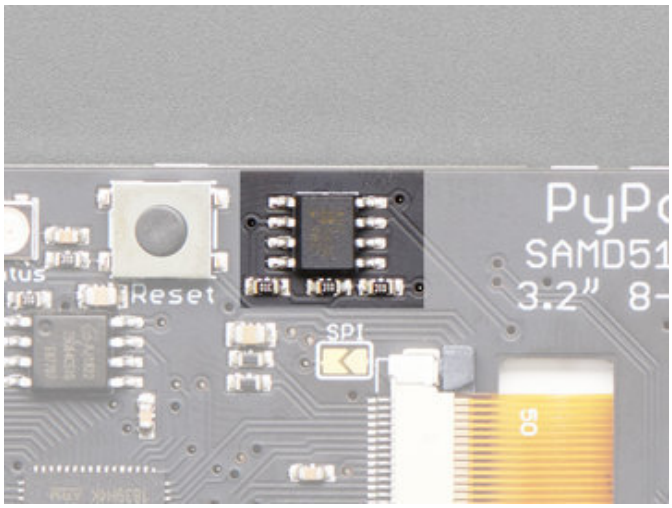
But what makes this thermometer particularly ***smart?***

You'll be sending temperature data to the internet - using *the best data service in the world* - Adafruit IO (https://adafru.it/fH9) - for **real-time data visualization** and **long-term data logging**.



Want to give your PyPortal Thermometer *more intelligence*? set up a Trigger on Adafruit IO to email you if the PyPortal Thermometer dips below (or goes above!) a certain temperature threshold value.



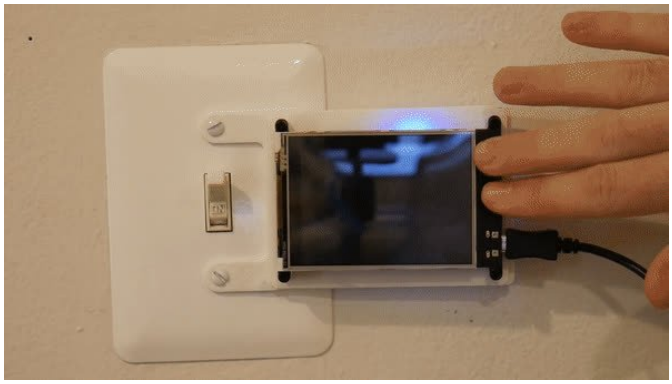


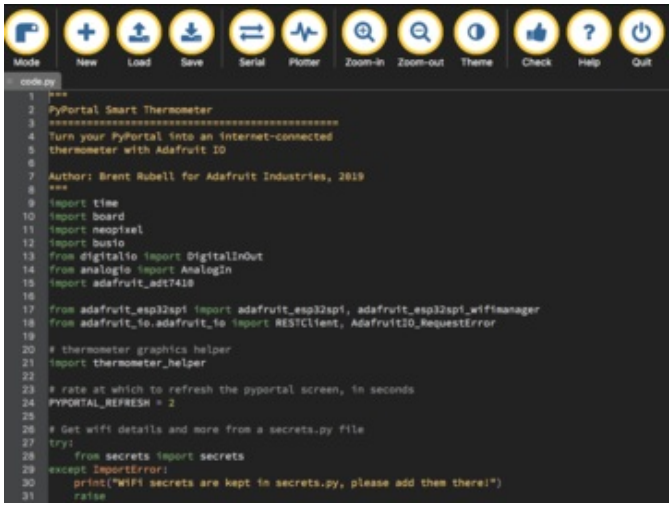
We'll be using the Analog Devices ADT7410 (https://adafru.it/EaC) built into the PyPortal to measure the ambient temperature over I2C

You'll also be using the ambient light sensor, which points through the front of the PyPortal, to turn on the PyPortal's display.

Wave at the PyPortal to display the temperature along with the current date and time.

The date and time are obtained from Adafruit IO and are based on your PyPortal's IP address - you don't need to add an RTC (https://adafru.it/sd6) or fiddle with time zones!





CircuitPython Code

CircuitPython is great for building Internet-of-Things projects. Using the Adafruit IO CircuitPython module (https://adafru.it/Ean), you can easily send data to Adafruit IO, receive data from Adafruit IO, and easily manipulate data with the powerful Adafruit IO API.

You can rapidly update your code without having to compile and store WiFi and API secret keys on the device. This means that there's no editing code and re-uploading whenever you move the PyPortal to another network - just update a file and you're set.

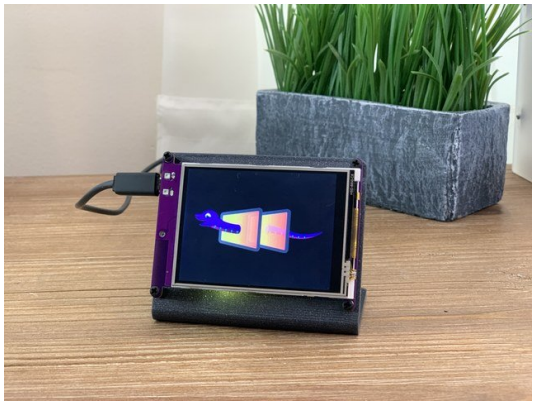
Prerequisite Guides

If you're new to Adafruit IO or CircuitPython, take a moment to walk through the following guides to get you started and up-to-speed:

- Welcome to Adafruit IO (https://adafru.it/DZd)
- Welcome to CircuitPython (https://adafru.it/cpy-welcome)

Parts

You only need a PyPortal for this guide - you'll be using the temperature and light sensors included with the PyPortal. No other sensors or external circuitry required!



Adafruit PyPortal - CircuitPython Powered Internet Display

$54.95
IN STOCK

Add To Cart

---

1 x USB Cable

USB cable - USB A to Micro-B - 3 ft

Add To Cart

Install CircuitPython

CircuitPython (https://adafru.it/tB7) is a derivative of MicroPython (https://adafru.it/BeZ) designed to simplify experimentation and education on low-cost microcontrollers. It makes it easier than ever to get prototyping by requiring no upfront desktop software downloads. Simply copy and edit files on the **CIRCUITPY** "flash" drive to iterate.

The following instructions will show you how to install CircuitPython. If you've already installed CircuitPython but are looking to update it or reinstall it, the same steps work for that as well!

Set up CircuitPython Quick Start!

Follow this quick step-by-step for super-fast Python power :)

https://adafru.it/Egk

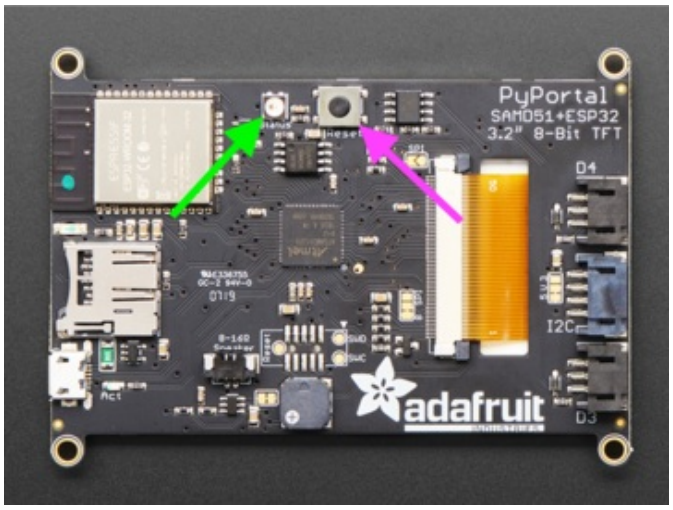
https://adafru.it/Egk

https://adafru.it/HFd

https://adafru.it/HFd

Click the link above to download the latest version of CircuitPython for the PyPortal.

Download and save it to your desktop (or wherever is handy).

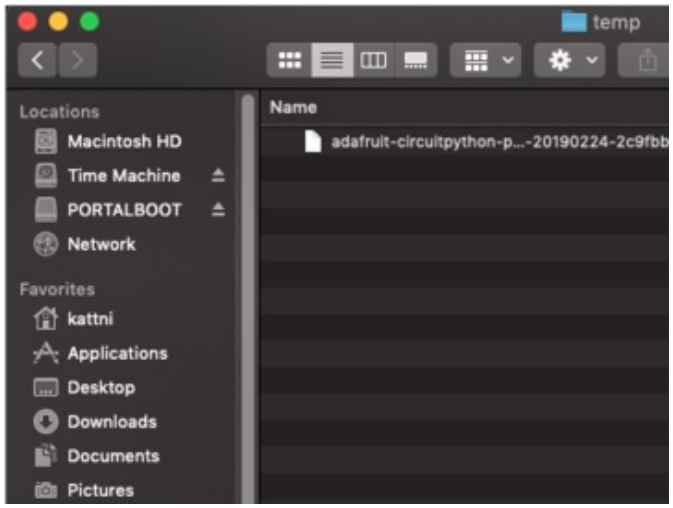


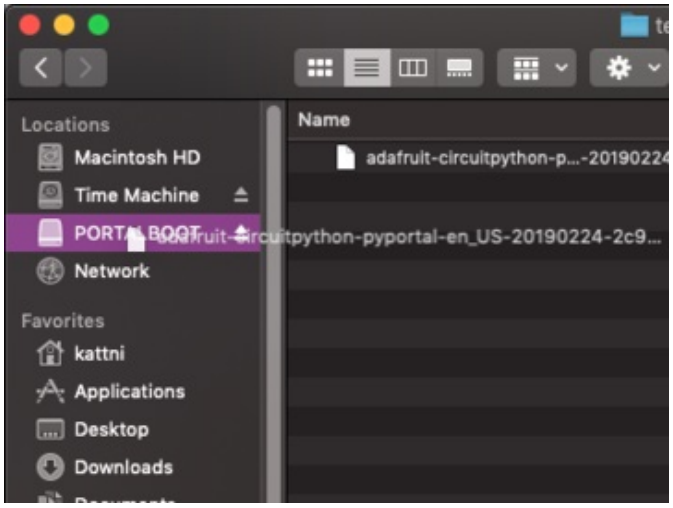
Plug your PyPortal into your computer using a known-good USB cable.

A lot of people end up using charge-only USB cables and it is very frustrating! So make sure you have a USB cable you know is good for data sync.

Double-click the **Reset** button on the top in the middle (magenta arrow) on your board, and you will see the NeoPixel RGB LED (green arrow) turn green. If it turns red, check the USB cable, try another USB port, etc. **Note:** The little red LED next to the USB connector will pulse red. That's ok!

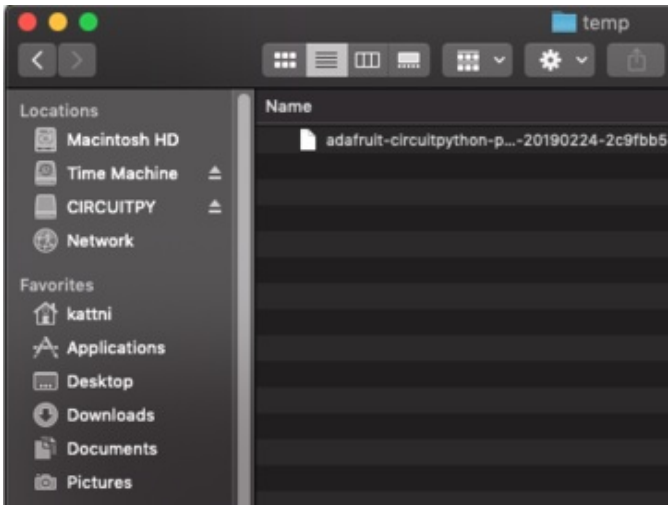
If double-clicking doesn't work the first time, try again. Sometimes it can take a few tries to get the rhythm right!





You will see a new disk drive appear called **PORTALBOOT**.

Drag the **adafruit-circuitpython-pyportal-<whatever>.uf2** file to **PORTALBOOT.**



The LED will flash. Then, the **PORTALBOOT** drive will disappear and a new disk drive called **CIRCUITPY** will appear.

If you haven't added any code to your board, the only file that will be present is **boot_out.txt**. This is absolutely normal! It's time for you to add your **code.py** and get started!

That's it, you're done! :)

PyPortal Default Files

Click below to download a zip of the files that shipped on the PyPortal or PyPortal Pynt.

https://adafru.it/Env

https://adafru.it/Env

https://adafru.it/HFf

https://adafru.it/HFf

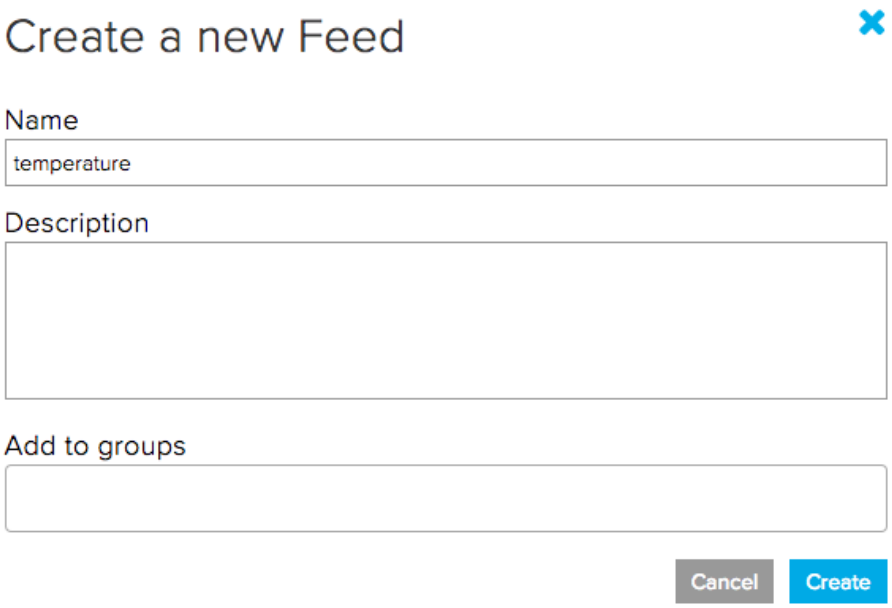
Adafruit IO Setup

Feed Setup

If you do not already have an Adafruit IO account set up, head over to io.adafruit.com (https://adafru.it/fH9) to link your Adafruit.com account to Adafruit IO.

The first step is to create a new Adafruit IO feed to hold the data from the PyPortal's temperature sensor. Navigate to the feeds page (https://adafru.it/mxC) on Adafruit IO. Then click **Actions -> Create New Feed**, and name this feed **temperature**.

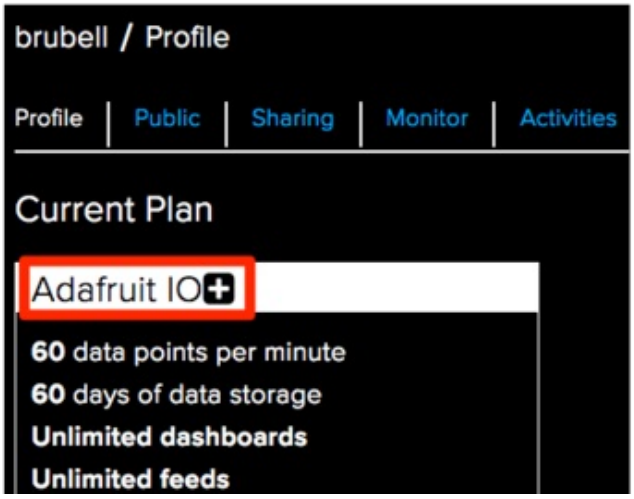
- If you do not already know how to create a feed, head over to Adafruit IO Basics: Feeds (https://adafru.it/ioA).



Adafruit IO Trigger Setup

This optional step requires an active Adafruit IO Plus (IO+) account.

While you can remotely monitor your PyPortal thermometer using an Adafruit IO Dashboard, if you want to be alerted of a specific high temperature reading when you're away from your keyboard. You can set up Adafruit IO Triggers to monitor a feed for predefined conditions.



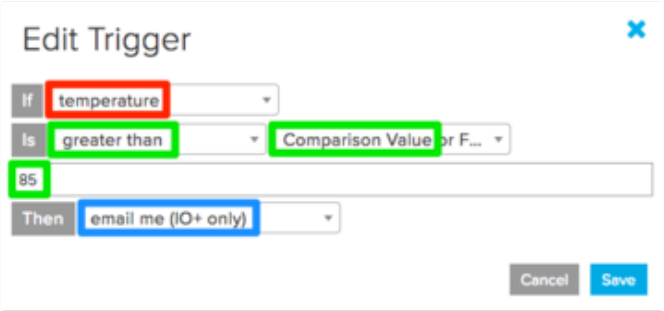
Adafruit IO Email Triggers are a feature of Adafruit IO Plus, and require an active Adafruit IO Plus subscription.

To check if you have an Adafruit IO Plus subscription: Navigate to your Adafruit IO Profile page (https://adafru.it/BmD) and **check your *Current Plan***.

- **Interested in upgrading to IO Plus?** Learn more about the upgraded, all systems go version of the Adafruit IO service here... (https://adafru.it/Eg3)

Navigate to the Adafruit IO trigger page (https://adafru.it/Em3). From the **Actions** dropdown, click **Create a New Trigger**.

To set up the trigger, you'll need to define a condition and an action to perform when the condition occurs.

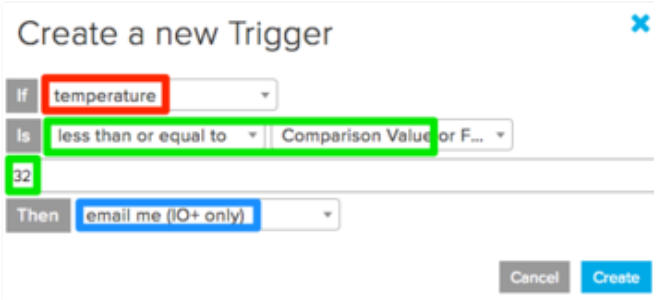


Set the feed to *temperature*

Define the trigger to fire only when the feed value is *greater than 85*.

Set the trigger action to *email me*

Next, you'll **set up a *second* trigger to email you if the temperature feed dips below freezing** (in degrees Fahrenheit).



Set the feed to *temperature*

Define the trigger to fire only when the feed value is *less than or equal to 32*.

Set the trigger action to *email me*

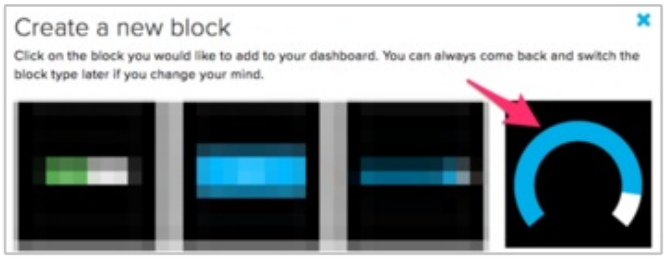
Note that 85 is a *value* on the feed and does not include the unit - it can be 85 degrees Celsius, Fahrenheit or even Kelvin. The code in this project supports converting the raw value before sending it to Adafruit IO.

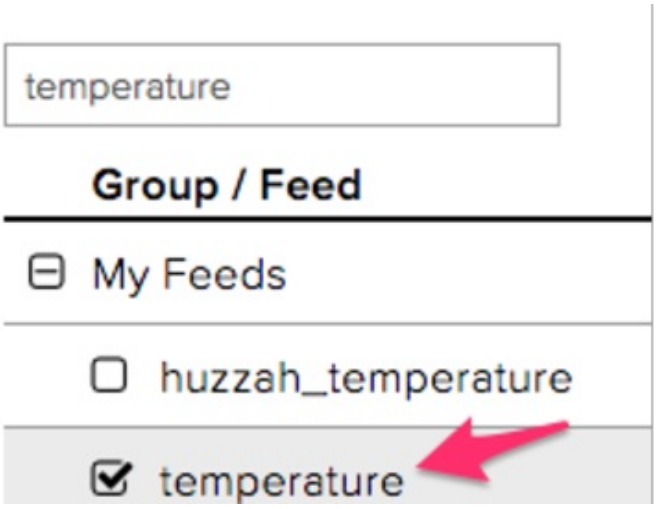
Build an Adafruit IO Dashboard

Next, you'll create a dashboard to display the values from the feed you created.

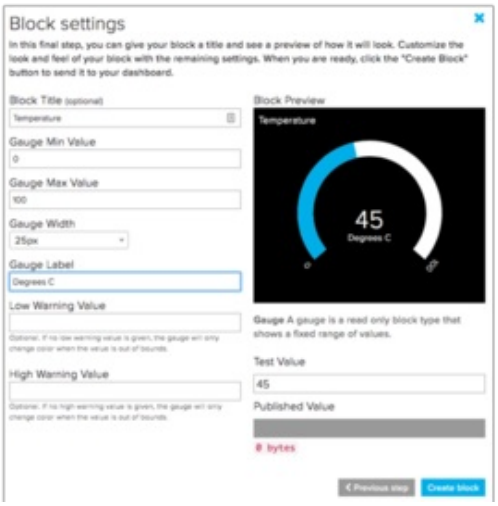
- If you do not know how to create or use Dashboards in Adafruit IO, head over to the Adafruit IO Basics: Dashboards (https://adafru.it/f5m) guide.

From your dashboard, **select the Gauge block.**





Select the *temperature* feed



In the Block Settings step, set the **Block Title** to**Temperature**, set the **Gauge Min/Max Values** to the upper and lower temperature thresholds you want to measure.

You can label the gauge by setting the **Gauge Label** - this example assumes temperature is to be measured in Degrees C.

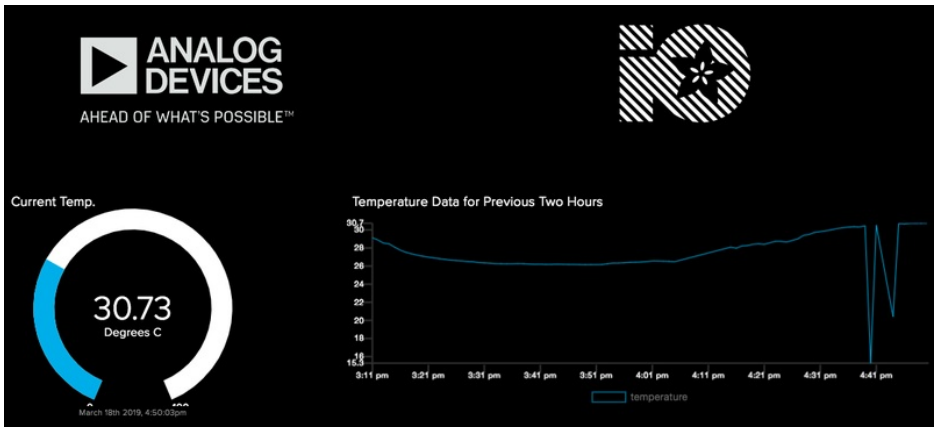
Uncomfortably hot or cold? You can optionally set the gauge change color to warn you if the temperature goes above (or below) a certain value.

While displaying the current values of the temperature is useful, Adafruit IO stores data so you can monitor how it changes a long period of time.

To do this, we'll use the **Line Chart** block and set it up to display the light value over a period of time.

Create a new block, and link the temperature feed to the line chart block. You can configure it to show the thermostat's history from one hour to thirty days.

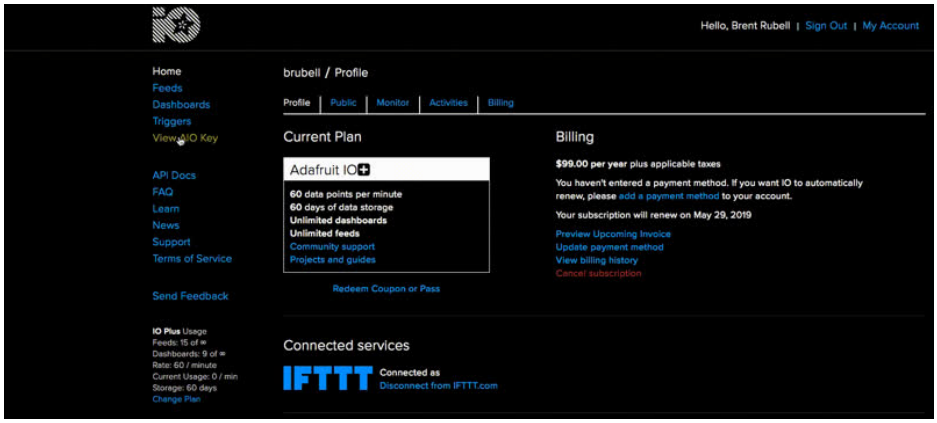
Your final dashboard should look like the following:



Obtain Adafruit IO Key

You are also going to need your Adafruit IO username and secret API key.

Navigate to your profile and click the View AIO Key button to retrieve them. Write them down in a safe place, you'll need them for the next step.



Internet Connect!

Once you have CircuitPython setup and libraries installed we can get your board connected to the Internet. Note that access to enterprise level secured WiFi networks is not currently supported, only WiFi networks that require SSID and password.

To get connected, you will need to start by creating a *secrets file*.

What's a secrets file?

We expect people to share tons of projects as they build CircuitPython WiFi widgets. What we want to avoid is people accidentally sharing their passwords or secret tokens and API keys. So, we designed all our examples to use a `secrets.py` file, that is in your **CIRCUITPY** drive, to hold secret/private/custom data. That way you can share your main project without worrying about accidentally sharing private stuff.

Your **secrets.py** file should look like this:

```
# This file is where you keep secret settings, passwords, and tokens!
# If you put them in the code you risk committing that info or sharing it

secrets = {
    'ssid' : 'home ssid',
    'password' : 'my password',
    'timezone' : "America/New_York", # http://worldtimeapi.org/timezones
    'github_token' : 'fawfj23rakjnfawiefa',
    'hackaday_token' : 'h4xx0rs3kret',
    }
```

Inside is a python dictionary named secrets with a line for each entry. Each entry has an entry name (say `'ssid'`) and then a colon to separate it from the entry key `'home ssid'` and finally a comma ,

At a minimum you'll need the `ssid` and `password` for your local WiFi setup. As you make projects you may need more tokens and keys, just add them one line at a time. See for example other tokens such as one for accessing github or the hackaday API. Other non-secret data like your timezone can also go here, just cause it's called secrets doesn't mean you can't have general customization data in there!

For the correct time zone string, look at http://worldtimeapi.org/timezones (https://adafru.it/EcP) and remember that if your city is not listed, look for a city in the same time zone, for example Boston, New York, Philadelphia, Washington DC, and Miami are all on the same time as New York.

Of course, don't share your **secrets.py** - keep that out of GitHub, Discord or other project-sharing sites.

Connect to WiFi

OK now you have your secrets setup - you can connect to the Internet. Lets use the ESP32SPI and the Requests libraries - you'll need to visit the CircuitPython bundle and install (https://adafru.it/ENC):

- **adafruit_bus_device**
- **adafruit_esp32spi**
- **adafruit_requests**
- **neopixel**

Into your `lib` folder. Once that's done, load up the following example using Mu or your favorite editor:

This first connection example doesn't use a secrets file - you'll hand-enter your SSID/password to verify connectivity first! See the detailed instructions after the code below.

```
# SPDX-FileCopyrightText: 2019 ladyada for Adafruit Industries
# SPDX-License-Identifier: MIT

import board
import busio
from digitalio import DigitalInOut
import adafruit_requests as requests
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi

# Get wifi details and more from a secrets.py file
try:
    from secrets import secrets
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

print("ESP32 SPI webclient test")

TEXT_URL = "http://wifitest.adafruit.com/testwifi/index.html"
JSON_URL = "http://api.coindesk.com/v1/bpi/currentprice/USD.json"


# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an AirLift Shield:
# esp32_cs = DigitalInOut(board.D10)
# esp32_ready = DigitalInOut(board.D7)
# esp32_reset = DigitalInOut(board.D5)

# If you have an AirLift Featherwing or ItsyBitsy Airlift:
# esp32_cs = DigitalInOut(board.D13)
# esp32_ready = DigitalInOut(board.D11)
# esp32_reset = DigitalInOut(board.D12)

# If you have an externally connected ESP32:
# NOTE: You may need to change the pins to reflect your wiring
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

requests.set_socket(socket, esp)

if esp.status == adafruit_esp32spi.WL_IDLE_STATUS:
    print("ESP32 found and in idle mode")
```

```
print("Firmware vers.", esp.firmware_version)
print("MAC addr:", [hex(i) for i in esp.MAC_address])

for ap in esp.scan_networks():
    print("\t%s\t\tRSSI: %d" % (str(ap["ssid"], "utf-8"), ap["rssi"]))

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(secrets["ssid"], secrets["password"])
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)
print("My IP address is", esp.pretty_ip(esp.ip_address))
print(
    "IP lookup adafruit.com: %s" % esp.pretty_ip(esp.get_host_by_name("adafruit.com"))
)
print("Ping google.com: %d ms" % esp.ping("google.com"))

# esp._debug = True
print("Fetching text from", TEXT_URL)
r = requests.get(TEXT_URL)
print("-" * 40)
print(r.text)
print("-" * 40)
r.close()

print()
print("Fetching json from", JSON_URL)
r = requests.get(JSON_URL)
print("-" * 40)
print(r.json())
print("-" * 40)
r.close()

print("Done!")
```

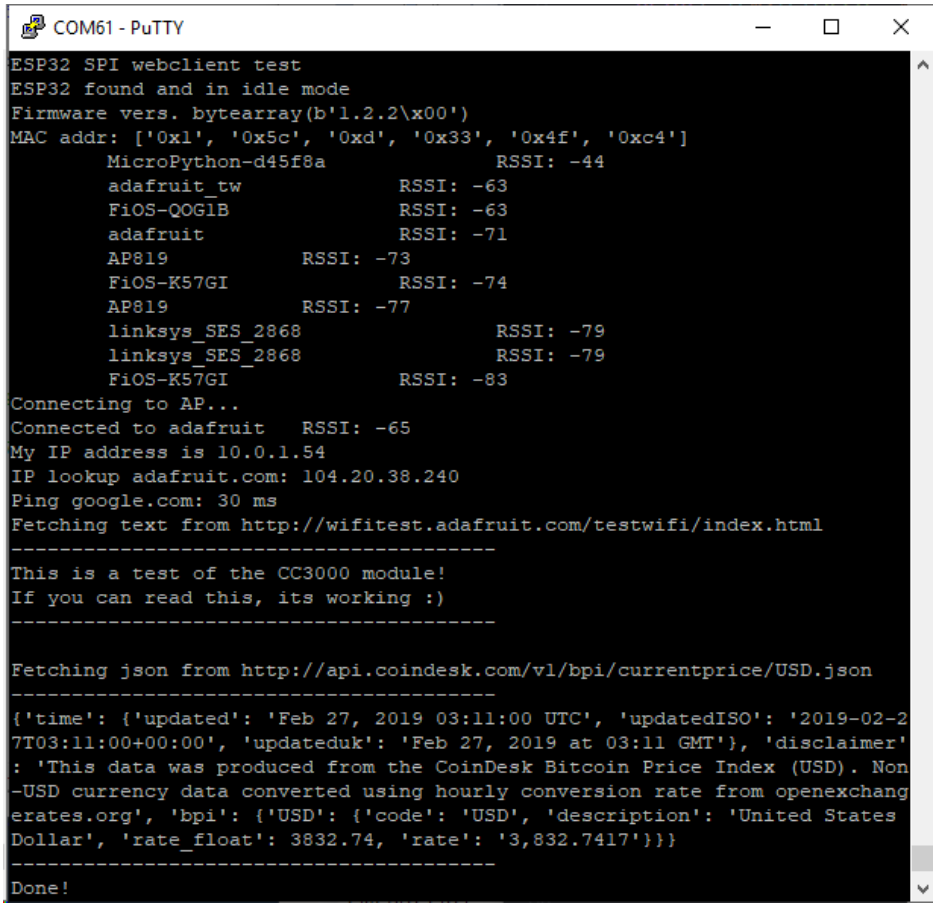
And save it to your board, with the name `code.py`.

As mentioned, this first connection example doesn't use a secrets file - you'll hand-enter your SSID/password to verify connectivity first!

Then go down to this line

`esp.connect_AP(b'MY_SSID_NAME', b'MY_SSID_PASSWORD')`

and change `MY_SSID_NAME` and `MY_SSID_PASSWORD` to your access point name and password, keeping them within the '' quotes. (This example doesn't use the secrets' file, but it's also very stand-alone so if other things seem to not work you can always re-load this to verify basic connectivity.) You should get something like the following:



In order, the example code...

Initializes the ESP32 over SPI using the SPI port and 3 control pins:

```
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)
```

Tells our `requests` library the type of socket we're using (socket type varies by connectivity type - we'll be using the `adafruit_esp32spi_socket` for this example). We'll also set the interface to an `esp` object. This is a little bit of a hack, but it lets us use `requests` like CPython does.

```
requests.set_socket(socket, esp)
```

Verifies an ESP32 is found, checks the firmware and MAC address

```
if esp.status == adafruit_esp32spi.WL_IDLE_STATUS:
    print("ESP32 found and in idle mode")
print("Firmware vers.", esp.firmware_version)
print("MAC addr:", [hex(i) for i in esp.MAC_address])
```

Performs a scan of all access points it can see and prints out the name and signal strength:

```
for ap in esp.scan_networks():
    print("\t%s\t\tRSSI: %d" % (str(ap['ssid'], 'utf-8'), ap['rssi']))
```

Connects to the AP we've defined here, then prints out the local IP address, attempts to do a domain name lookup and ping google.com to check network connectivity (note sometimes the ping fails or takes a while, this isn't a big deal)

```
    print("Connecting to AP...")
esp.connect_AP(b'MY_SSID_NAME', b'MY_SSID_PASSWORD')
print("Connected to", str(esp.ssid, 'utf-8'), "\tRSSI:", esp.rssi)
print("My IP address is", esp.pretty_ip(esp.ip_address))
print("IP lookup adafruit.com: %s" % esp.pretty_ip(esp.get_host_by_name("adafruit.com")))
print("Ping google.com: %d ms" % esp.ping("google.com"))
```

OK now we're getting to the really interesting part. With a SAMD51 or other large-RAM (well, over 32 KB) device, we can do a lot of neat tricks. Like for example we can implement an interface a lot like requests (https://adafru.it/E9o) - which makes getting data *really really easy*

To read in all the text from a web URL call `requests.get` - you can pass in `https` URLs for SSL connectivity

```
TEXT_URL = "http://wifitest.adafruit.com/testwifi/index.html"
print("Fetching text from", TEXT_URL)
r = requests.get(TEXT_URL)
print('-'*40)
print(r.text)
print('-'*40)
r.close()
```

Or, if the data is in structured JSON, you can get the json pre-parsed into a Python dictionary that can be easily queried or traversed. (Again, only for nRF52840, M4 and other high-RAM boards)

```
JSON_URL = "http://api.coindesk.com/v1/bpi/currentprice/USD.json"
print("Fetching json from", JSON_URL)
r = requests.get(JSON_URL)
print('-'*40)
print(r.json())
print('-'*40)
r.close()
```

Requests

We've written a requests-like (https://adafru.it/Kpa) library for web interfacing named Adafruit_CircuitPython_Requests (https://adafru.it/FpW). This library allows you to send HTTP/1.1 requests without "crafting" them and provides helpful methods for parsing the response from the server.

```
# adafruit_requests usage with an esp32spi_socket
import board
import busio
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
```

```
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(b"MY_SSID_NAME", b"MY_SSID_PASSWORD")
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)

# Initialize a requests object with a socket and esp32spi interface
requests.set_socket(socket, esp)

TEXT_URL = "http://wifitest.adafruit.com/testwifi/index.html"
JSON_GET_URL = "http://httpbin.org/get"
JSON_POST_URL = "http://httpbin.org/post"

print("Fetching text from %s" % TEXT_URL)
response = requests.get(TEXT_URL)
print("-" * 40)

print("Text Response: ", response.text)
print("-" * 40)
response.close()

print("Fetching JSON data from %s" % JSON_GET_URL)
response = requests.get(JSON_GET_URL)
print("-" * 40)

print("JSON Response: ", response.json())
print("-" * 40)
response.close()

data = "31F"
print("POSTing data to {0}: {1}".format(JSON_POST_URL, data))
response = requests.post(JSON_POST_URL, data=data)
print("-" * 40)

json_resp = response.json()
# Parse out the 'data' key from json_resp dict.
print("Data received from server:", json_resp["data"])
print("-" * 40)
response.close()
```

```
json_data = {"Date": "July 25, 2019"}
print("POSTing data to {0}: {1}".format(JSON_POST_URL, json_data))
response = requests.post(JSON_POST_URL, json=json_data)
print("-" * 40)

json_resp = response.json()
# Parse out the 'json' key from json_resp dict.
print("JSON Data received from server:", json_resp["json"])
print("-" * 40)
response.close()
```

The code first sets up the ESP32SPI interface. Then, it initializes a `request` object using an ESP32 `socket` and the `esp` object.

```
import board
import busio
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(b'MY_SSID_NAME', b'MY_SSID_PASSWORD')
    except RuntimeError as e:
        print("could not connect to AP, retrying: ",e)
        continue
print("Connected to", str(esp.ssid, 'utf-8'), "\tRSSI:", esp.rssi)

# Initialize a requests object with a socket and esp32spi interface
requests.set_socket(socket, esp)
```

HTTP GET with Requests

The code makes a HTTP GET request to Adafruit's WiFi testing website - http://wifitest.adafruit.com/testwifi/index.html (https://adafru.it/FpZ).

To do this, we'll pass the URL into `requests.get()`. We're also going to save the response *from* the server into a variable named `response`.

While we requested data from the server, we'd what the server responded with. Since we already saved the

server's `response`, we can read it back. Luckily for us, **requests automatically decodes the server's response into human-readable text,** you can read it back by calling `response.text`.

Lastly, we'll perform a bit of cleanup by calling `response.close()`. This closes, deletes, and collect's the response's data.

```
print("Fetching text from %s"%TEXT_URL)
response = requests.get(TEXT_URL)
print('-'*40)

print("Text Response: ", response.text)
print('-'*40)
response.close()
```

While some servers respond with text, some respond with json-formatted data consisting of attribute–value pairs.

CircuitPython_Requests can convert a JSON-formatted response from a server into a CPython `dict.` object.

We can also fetch and parse **json** data. We'll send a HTTP get to a url we know returns a json-formatted response (instead of text data).

Then, the code calls `response.json()` to convert the response to a CPython `dict`.

```
print("Fetching JSON data from %s"%JSON_GET_URL)
response = requests.get(JSON_GET_URL)
print('-'*40)

print("JSON Response: ", response.json())
print('-'*40)
response.close()
```

HTTP POST with Requests

Requests can also **POST data to a server by calling the `requests.post` method, passing it a `data` value.**

```
data = '31F'
print("POSTing data to {0}: {1}".format(JSON_POST_URL, data))
response = requests.post(JSON_POST_URL, data=data)
print('-'*40)

json_resp = response.json()
# Parse out the 'data' key from json_resp dict.
print("Data received from server:", json_resp['data'])
print('-'*40)
response.close()
```

You can also post json-formatted data to a server by passing `json_data` into the `requests.post` method.

```
    json_data = {"Date" : "July 25, 2019"}
print("POSTing data to {0}: {1}".format(JSON_POST_URL, json_data))
response = requests.post(JSON_POST_URL, json=json_data)
print('-'*40)

json_resp = response.json()
# Parse out the 'json' key from json_resp dict.
print("JSON Data received from server:", json_resp['json'])
print('-'*40)
response.close()
```

Advanced Requests Usage

Want to send custom HTTP headers, parse the response as raw bytes, or handle a response's http status code in your CircuitPython code?

We've written an example to show advanced usage of the requests module below.

```
import board
import busio
from digitalio import DigitalInOut
import adafruit_esp32spi.adafruit_esp32spi_socket as socket
from adafruit_esp32spi import adafruit_esp32spi
import adafruit_requests as requests

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)

print("Connecting to AP...")
while not esp.is_connected:
    try:
        esp.connect_AP(b"MY_SSID_NAME", b"MY_SSID_PASSWORD")
    except RuntimeError as e:
        print("could not connect to AP, retrying: ", e)
        continue
print("Connected to", str(esp.ssid, "utf-8"), "\tRSSI:", esp.rssi)

# Initialize a requests object with a socket and esp32spi interface
requests.set_socket(socket, esp)

JSON_GET_URL = "http://httpbin.org/get"

# Define a custom header as a dict.
headers = {"user-agent": "blinka/1.0.0"}

print("Fetching JSON data from %s..." % JSON_GET_URL)
response = requests.get(JSON_GET_URL, headers=headers)
print("-" * 60)

json_data = response.json()
headers = json_data["headers"]
print("Response's Custom User-Agent Header: {0}".format(headers["User-Agent"]))
print("-" * 60)

# Read Response's HTTP status code
print("Response HTTP Status Code: ", response.status_code)
print("-" * 60)

# Read Response, as raw bytes instead of pretty text
print("Raw Response: ", response.content)

# Close, delete and collect the response data
response.close()
```

WiFi Manager

That simpletest example works but it's a little finicky - you need to constantly check WiFi status and have many loops to manage connections and disconnections. For more advanced uses, we recommend using the WiFiManager object. It will wrap the connection/status/requests loop for you - reconnecting if WiFi drops, resetting the ESP32 if it gets into a bad state, etc.

Here's a more advanced example that shows the WiFi manager and also how to POST data with some extra headers:

```
# SPDX-FileCopyrightText: 2019 ladyada for Adafruit Industries
# SPDX-License-Identifier: MIT

import time
import board
import busio
from digitalio import DigitalInOut
import neopixel
from adafruit_esp32spi import adafruit_esp32spi
from adafruit_esp32spi import adafruit_esp32spi_wifimanager

print("ESP32 SPI webclient test")

# Get wifi details and more from a secrets.py file
try:
    from secrets import secrets
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

# If you are using a board with pre-defined ESP32 Pins:
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)

# If you have an externally connected ESP32:
# esp32_cs = DigitalInOut(board.D9)
# esp32_ready = DigitalInOut(board.D10)
# esp32_reset = DigitalInOut(board.D5)

spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)
"""Use below for Most Boards"""
status_light = neopixel.NeoPixel(
    board.NEOPIXEL, 1, brightness=0.2
)  # Uncomment for Most Boards
"""Uncomment below for ItsyBitsy M4"""
# status_light = dotstar.DotStar(board.APA102_SCK, board.APA102_MOSI, 1, brightness=0.2)
# Uncomment below for an externally defined RGB LED
# import adafruit_rgbled
# from adafruit_esp32spi import PWMOut
# RED_LED = PWMOut.PWMOut(esp, 26)
# GREEN_LED = PWMOut.PWMOut(esp, 27)
# BLUE_LED = PWMOut.PWMOut(esp, 25)
# status_light = adafruit_rgbled.RGBLED(RED_LED, BLUE_LED, GREEN_LED)
wifi = adafruit_esp32spi_wifimanager.ESPSPI_WiFiManager(esp, secrets, status_light)

counter = 0

while True:
    try:
```

```
    try:
        print("Posting data...", end="")
        data = counter
        feed = "test"
        payload = {"value": data}
        response = wifi.post(
            "https://io.adafruit.com/api/v2/"
            + secrets["aio_username"]
            + "/feeds/"
            + feed
            + "/data",
            json=payload,
            headers={"X-AIO-KEY": secrets["aio_key"]},
        )
        print(response.json())
        response.close()
        counter = counter + 1
        print("OK")
    except (ValueError, RuntimeError) as e:
        print("Failed to get data, retrying\n", e)
        wifi.reset()
        continue
    response = None
    time.sleep(15)
```

You'll note here we use a secrets.py file to manage our SSID info. The wifimanager is given the ESP32 object, secrets and a neopixel for status indication.

Note, you'll need to add a some additional information to your secrets file so that the code can query the Adafruit IO API:

- `aio_username`
- `aio_key`

You can go to your adafruit.io View AIO Key link to get those two values and add them to the secrets file, which will now look something like this:

```
# This file is where you keep secret settings, passwords, and tokens!
# If you put them in the code you risk committing that info or sharing it

secrets = {
    'ssid' : '_your_ssid_',
    'password' : '_your_wifi_password_',
    'timezone' : "America/Los_Angeles", # http://worldtimeapi.org/timezones
    'aio_username' : '_your_aio_username_',
    'aio_key' : '_your_aio_key_',
    }
```

Next, **set up an Adafruit IO feed named `test`**

- If you do not know how to set up a feed, follow this page and come back when you've set up a feed named `test`. (https://adafru.it/f5k)

We can then have a simple loop for posting data to Adafruit IO without having to deal with connecting or initializing the hardware!

Take a look at your **test** feed on Adafruit.io and you'll see the value increase each time the CircuitPython board posts data to it!

Secrets File Setup

If you have not yet set up a **secrets.py** file in your CIRCUITPY drive and connected to the internet using it, follow this guide and come back when you've successfully connected to the internet (https://adafru.it/Eao).

Adafruit IO username, and **Adafruit IO key**. Head to io.adafruit.com (https://adafru.it/fsU) and simply click the **View AIO Key** link on the left hand side of the Adafruit IO page to get this information.

Then, add them to the **secrets.py** file:

```
secrets = {
    'ssid' : '_your_wifi_ssid',
    'password : '_your_wifi_password',
    'aio_username' : '_your_adafruit_io_username',
    'aio_key' : '_your_big_huge_super_long_aio_key_'
    }
```

Add CircuitPython Code and Project Assets

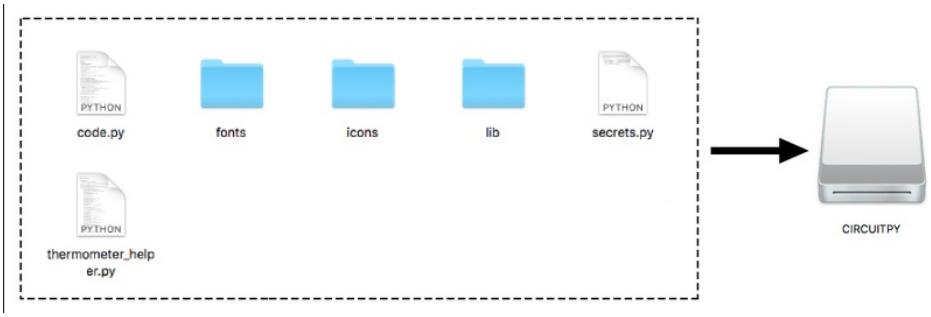
In the embedded code element below, click on the **Download: Project Zip** link, and save the .zip archive file to your computer.

Then, **uncompress the .zip file**, it will unpack to a folder named **PyPortal_Smart_Thermometer**.

Copy the contents of the **PyPortal_Smart_Thermometer** directory to your PyPortal's **CIRCUITPY** drive.

Make sure to **save the fonts (Ninito-Black-17.bdf and Ninito-Light-75.bdf) into the *fonts* folder** on the **CIRCUITPY** volume and **save pyportal_splash.bmp into the *icons* folder**.

Rename the thermometer.py file to code.py so it will automatically run when the PyPortal restarts.

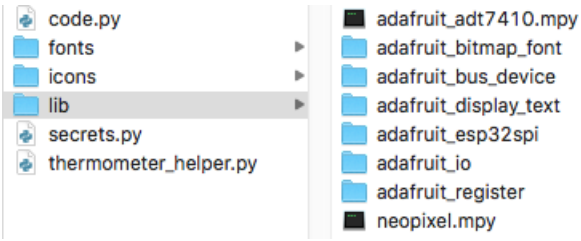



```
"""
PyPortal Smart Thermometer
==========================================
Turn your PyPortal into an internet-connected
thermometer with Adafruit IO

Author: Brent Rubell for Adafruit Industries, 2019
"""
import time
import board
```

```
import board
import neopixel
import busio
from digitalio import DigitalInOut
from analogio import AnalogIn
import adafruit_adt7410

from adafruit_esp32spi import adafruit_esp32spi, adafruit_esp32spi_wifimanager
from adafruit_io.adafruit_io import IO_HTTP, AdafruitIO_RequestError

# thermometer graphics helper
import thermometer_helper

# rate at which to refresh the pyportal screen, in seconds
PYPORTAL_REFRESH = 2

# Get wifi details and more from a secrets.py file
try:
    from secrets import secrets
except ImportError:
    print("WiFi secrets are kept in secrets.py, please add them there!")
    raise

# PyPortal ESP32 Setup
esp32_cs = DigitalInOut(board.ESP_CS)
esp32_ready = DigitalInOut(board.ESP_BUSY)
esp32_reset = DigitalInOut(board.ESP_RESET)
spi = busio.SPI(board.SCK, board.MOSI, board.MISO)
esp = adafruit_esp32spi.ESP_SPIcontrol(spi, esp32_cs, esp32_ready, esp32_reset)
status_light = neopixel.NeoPixel(board.NEOPIXEL, 1, brightness=0.2)
wifi = adafruit_esp32spi_wifimanager.ESPSPI_WiFiManager(esp, secrets, status_light)

# Set your Adafruit IO Username and Key in secrets.py
# (visit io.adafruit.com if you need to create an account,
# or if you need your Adafruit IO key.)
try:
    ADAFRUIT_IO_USER = secrets['aio_username']
    ADAFRUIT_IO_KEY = secrets['aio_key']
except KeyError:
    raise KeyError('To use this code, you need to include your Adafruit IO username \
and password in a secrets.py file on the CIRCUITPY drive.')

# Create an instance of the IO_HTTP client
io = IO_HTTP(ADAFRUIT_IO_USER, ADAFRUIT_IO_KEY, wifi)

# Get the temperature feed from Adafruit IO
temperature_feed = io.get_feed('temperature')

# init. graphics helper
gfx = thermometer_helper.Thermometer_GFX(celsius=False)

# init. adt7410
i2c_bus = busio.I2C(board.SCL, board.SDA)
adt = adafruit_adt7410.ADT7410(i2c_bus, address=0x48)
adt.high_resolution = True

# init. the light sensor
light_sensor = AnalogIn(board.LIGHT)

def set_backlight(val):
```

```
    """Adjust the TFT backlight.
    :param val: The backlight brightness. Use a value between ``0`` and ``1``, where ``0`` is
                off, and ``1`` is 100% brightness.
    """
    val = max(0, min(1.0, val))
    board.DISPLAY.auto_brightness = False
    board.DISPLAY.brightness = val

while True:
    # read the light sensor
    light_value = light_sensor.value
    print('Light Value: ', light_value)
    # read the temperature sensor
    temperature = adt.temperature
    try: # WiFi Connection
        if light_value < 1000: # turn on the backlight
            set_backlight(1)
            print('displaying temperature...')
            gfx.display_temp(temperature)
            # Get and display date and time form Adafruit IO
            print('Getting time from Adafruit IO...')
            datetime = io.receive_time()
            print('displaying time...')
            gfx.display_date_time(datetime)
        else: # turn off the backlight
            set_backlight(0)
        try: # send temperature data to IO
            gfx.display_io_status('Sending data...')
            print('Sending data to Adafruit IO...')
            io.send_data(temperature_feed['key'], temperature)
            print('Data sent!')
            gfx.display_io_status('Data sent!')
        except AdafruitIO_RequestError as e:
            raise AdafruitIO_RequestError('IO Error: ', e)
    except (ValueError, RuntimeError) as e: # WiFi Connection Failure
        print("Failed to get data, retrying\n", e)
        wifi.reset()
        continue
    time.sleep(PYPORTAL_REFRESH)
```

This is what the final contents of the **CIRCUITPY** drive will look like:



If you run into any errors, such as "ImportError: no module named `adafruit_display_text.label`" be sure to update your libraries to the latest release bundle!

Code Usage

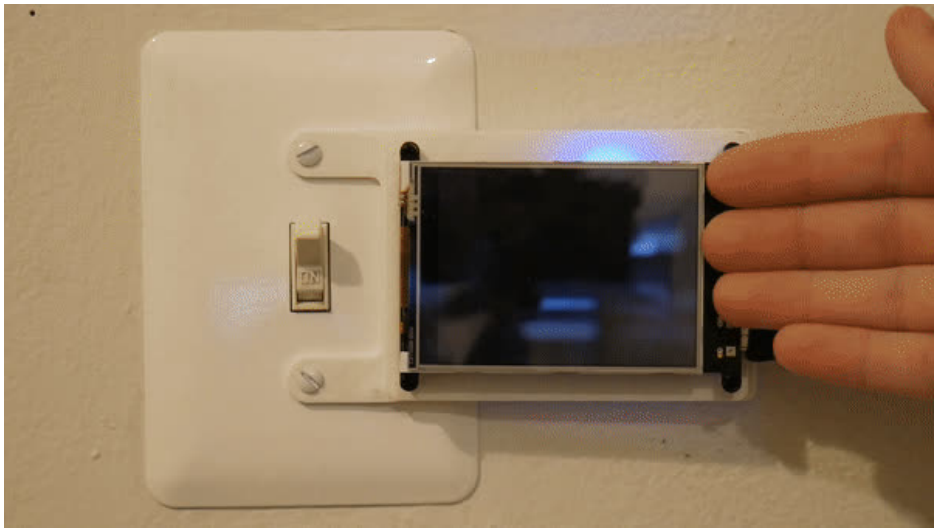
Your PyPortal will boot up to a splash screen displaying the PyPortal logo along with the Analog Devices and Adafruit IO logos.

While the PyPortal *seems* like it's just displaying a splash screen - it is doing a lot of work behind the scenes! The PyPortal is loads in the two fonts this project requires and sets up labels for displaying text.

Wave your hand in front of the PyPortal's light sensor to turn on the display's backlight!

Your PyPortal Thermometer will display the current temperature reading, pull in the date and time from Adafruit IO (based off of your IP address), and send the data to Adafruit IO.

When it finishes sending data, it'll turn the display back off but continue to send data to Adafruit IO.



Why is the backlight off by default?

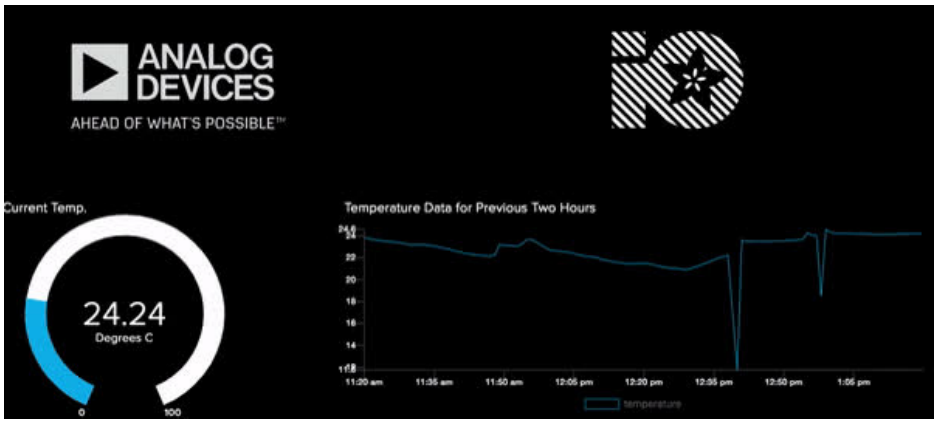
When the backlight is turned on, it produces heat. This interferes with the ADT7410's ambient temperature readings.

Adafruit IO Usage

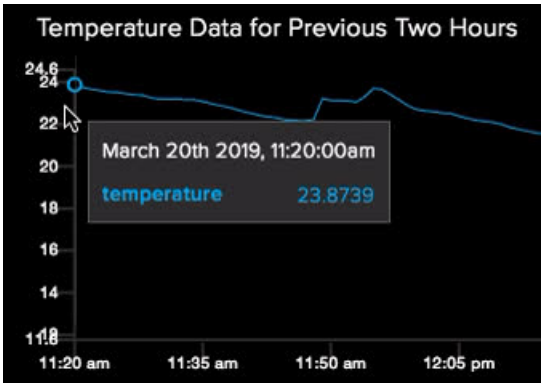
While the PyPortal thermostat can display its temperature along with the current date/time on its screen - what if you're physically away from the thermostat?

How do we know that the temperature data is being sent from the thermostat to Adafruit IO?

Open the Adafruit IO Dashboard you created earlier. Notice that the fill and values of the gauge changes as values are sent from your PyPortal to Adafruit IO.



Then, leave the PyPortal running for a while and come back later to see new data appear on the line graph.



PyPortal Customization

Displaying temperature in Fahrenheit

Live in a region where Fahrenheit is the standard? The `thermometer_helper` can handle displaying the temperature as either Fahrenheit or Celsius.

To display the temperature in Fahrenheit, modify the following line in `code.py` from:

```
gfx = thermometer_helper.Thermometer_GFX()
```

to

```
gfx = thermometer_helper.Thermometer_GFX(celsius=False)
```

Changing fonts

Want to use a different font? The fonts for this project are referenced at the top of the **thermometer_helper.py** file as `info_font` and `temperature_font`.

The PyPortal reads **.BDF** (bitmap distribution format) fonts, so you'll need to convert a font into this format, and then modify the code to use the new font.

For more information about converting fonts, read the learning guide here... (https://adafru.it/Em4)

Custom Wall Mount

The wall mount used in this project PyPortal was created by the Ruiz Brothers. For detailed instructions about how to print your own, check out the learning system guide here (https://adafru.it/Ek0).