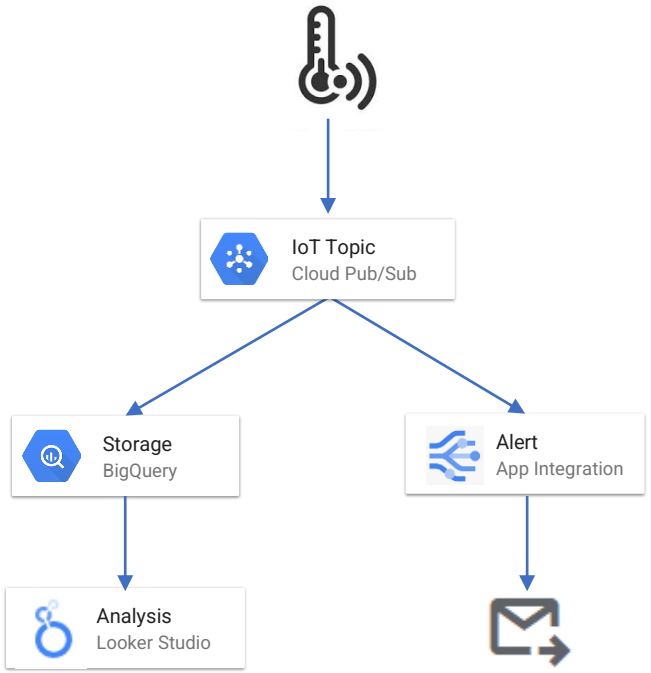
IoT & The Cloud

Faculty Workshop

March 28, 2024

WAKE TECH COMMUNITY COLLEGE

IoT & The Cloud



DOWNLOAD THE SLIDES HERE TO FOLLOW ALONG:

http://tinyurl.com/48khunrk

AGENDA

- Welcome & Intros
- Goals for the Day
- IoT Overview
- Raspberry Pi Hardware Setup
- Google Cloud Platform (GCP)
- Ingesting Telemetry Data
- Storing the Data
- Alerting & Reporting on the Data
- Futures

CHECKPOINT

Logistics Discussion

Everyone on the same page?

Help each other out!

Links exist throughout the deck to dive more deeply into some of the topics we cover

Great for followup after the workshop!

Priyanka Vergadia

#GCPSketchnote

@PVERGADIA
THECLOUDGIRL.DEV
8.13.2020

How to build a scalable DATA ANALYTICS PIPELINE

CAPTURE
Data ingestion at any scale

PROCESS
Reliable streaming data pipeline

STORE
Data lake and data warehousing

ANALYZE
Data warehousing

USE
Advanced analytics

CLOUD PUB/SUB
Scaled messaging platform

DATA TRANSFER SERVICE
Fast data migration from saas apps

STORAGE TRANSFER SERVICE
Data migration from other cloud or on-prem

CLOUD IoT CORE
Stream events from IoT devices

CLOUD DATAFLOW
Stream and batch processing

CLOUD DATAPROC
Managed Hadoop & Spark platform

CLOUD DATAPREP
Data prep using visual tool

CLOUD STORAGE
Use as your data lake for structured and unstructured data

BIGQUERY STORAGE
Cloud-native, highly scalable serverless data warehouse

BIGQUERY
Analysis engine

CLOUD AI PLATFORM
For machine learning

TENSORFLOW
For machine learning

LOOKER
For your analysis

SHEETS
For your analysis

CLOUD DATA FUSION
Fully managed, code-free data integration service to manage ETL/ELT pipelines and also track lineage of that data.

DATA CATALOG
Unified view of all datasets

CLOUD COMPOSER
Fully managed, workflow orchestration built on Apache Airflow

IoT

RPI

GCP

Internet of Things Overview

Number of humans? – **8.1B**

Number of cell phones? – **7B**

Number of IoT devices? – **24.4 B**

Examples

Consumer – locks, doorbells, lightbulbs, cars

Commercial – healthcare, monitoring, security

Industrial – digital control sys, agribiz

Infrastructure – smart cities

aws Azure Google Cloud

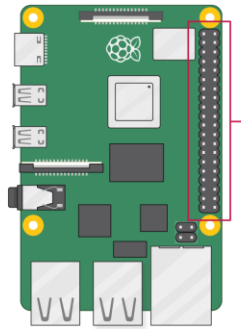
Challenges:

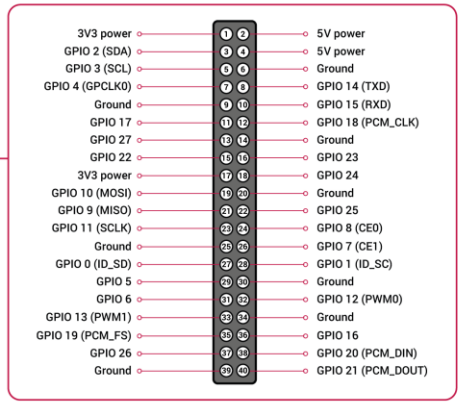
1. Updating & Managing Devices
2. Managing Telemetry
3. Managing Data

Raspberry Pi Overview

Pi 3 Model B (circa 2016)

- Single Board Computer (SBC)
- 1.2 GHz 64-bit quad core ARM Cortex-A53 processor
- 1 GB RAM
- HDMI output
- 802.11n Wi-Fi & Bluetooth
- 8G SD card w/64-bit Debian (bookworm)
- GPIO – General Purpose I/O





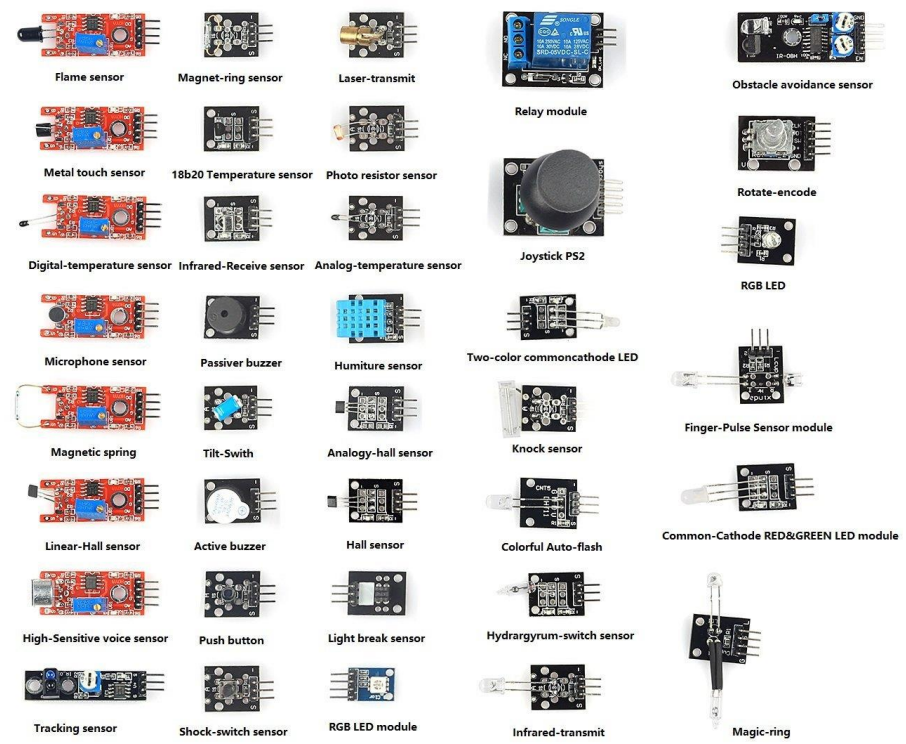
History of Raspberry Pi

Raspberry Pi Model Comparison

Raspberry Pi Overview

Many popular IoT type sensors can be connected to GPIO:

- Temp
- Humidity
- Light
- Fire
- Sound
- Motion
- IR
- Joystick, etc.

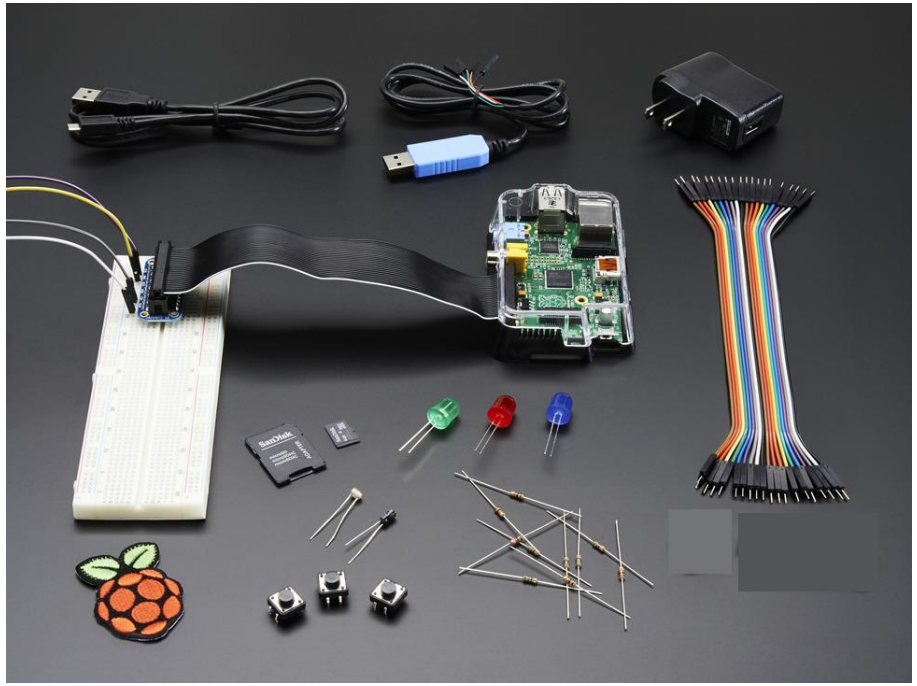


Raspberry Pi Setup

- Raspberry Pi 3 Model B
- SD Card with Raspbian OS
- Pi Case
- 5v Power Supply
- Breadboard and Jumper wires
- Leds & Resistors
- GPIO breakout ribbon cable
- USB jumper (not used)
- Raspberry Pi patch
- DS18B20 Temp Sensor

Raspberry Pi®

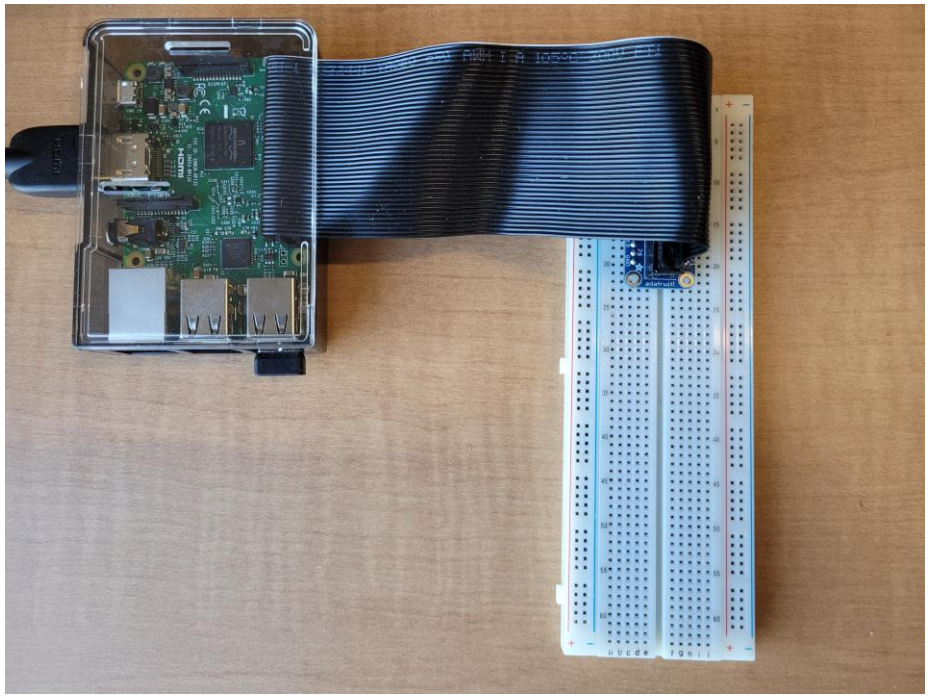
What's in the box??



Raspberry Pi Setup

Cable it up:

1. Insert pi board into case
2. Insert SD Card
3. Connect HDMI monitor
4. Connect Keyboard
5. Connect Mouse
6. Cable GPIO to Breadboard
7. 5v Power supply ***(do this last!)***



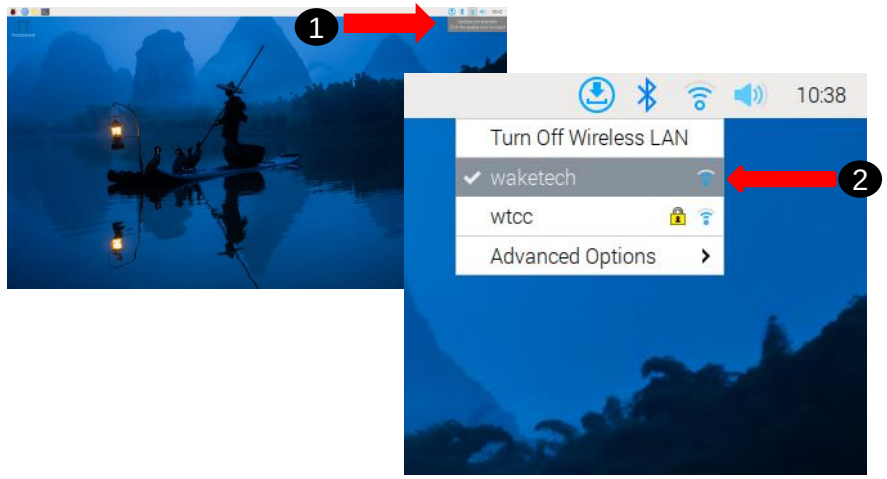
- Orient the pi breakout board with the “Pi Cobbler” text at the top and plugged in to columns c & g and rows 1 thru 20 on the breadboard – it will be tight when you plug it in the first time, and you may have to use some force to get it seated properly.
- Orient the ribbon cable with the white stripe at the top – there is a notch on the ribbon connectors that will help you to position it correctly – the notch faces in (left) on pi side and fits into a slot on the left side of the pi breakout board.

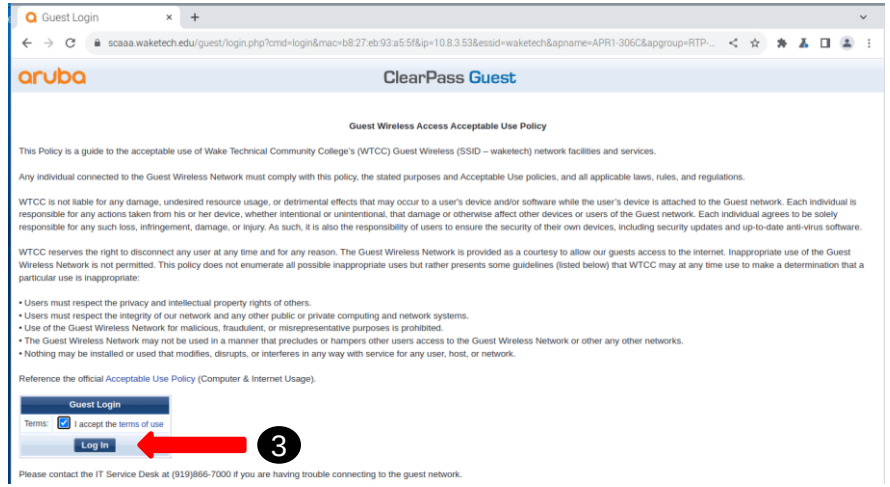
Raspberry Pi Setup

Raspberry Pi®

Initial Startup – *Be patient – it's a bit slow!*

1. Check that your machine has joined the wireless network (waketech)
   - *Click the wireless icon in upper right*
2. Launch a web browser by clicking the small globe icon in the upper left of the screen (be patient – it's slow!)
3. Accept the Aruba guest logon screen agreement in order to use the wireless connection





Raspberry Pi Setup

Raspberry Pi

Initial Startup – *Be patient – it's a bit slow!*

1. Test the logoff / logon process

- Click the raspberry icon in upper left &

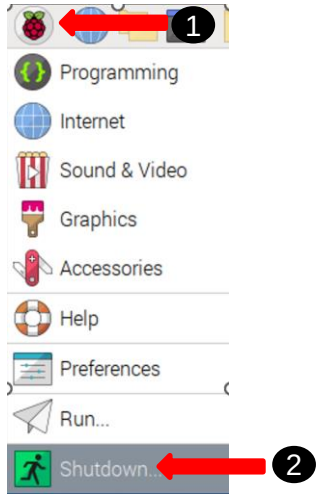
  select the *Shutdown* menu choice and

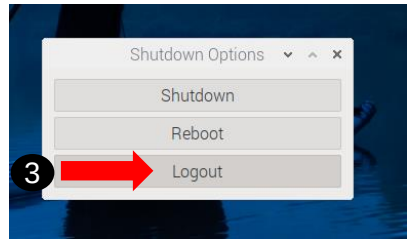
  select *Logout*

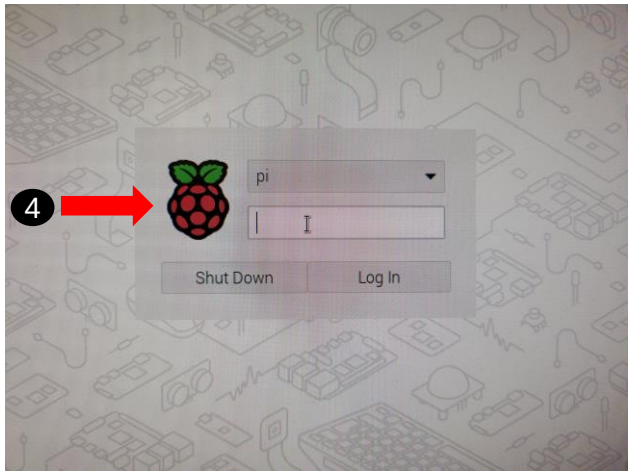
- Log back on with:

  username = `pi`

  password = `raspberry`







CHECKPOINT

Raspberry Pi rebooted, connected to the network and showing the desktop

IoT RPI GCP

Raspberry Pi Setup

Raspberry Pi

<u>Config tweak needed for our project:</u>

Launch terminal and run this command

```
sudo nano /boot/config.txt
```

Then add these 2 lines at the bottom just

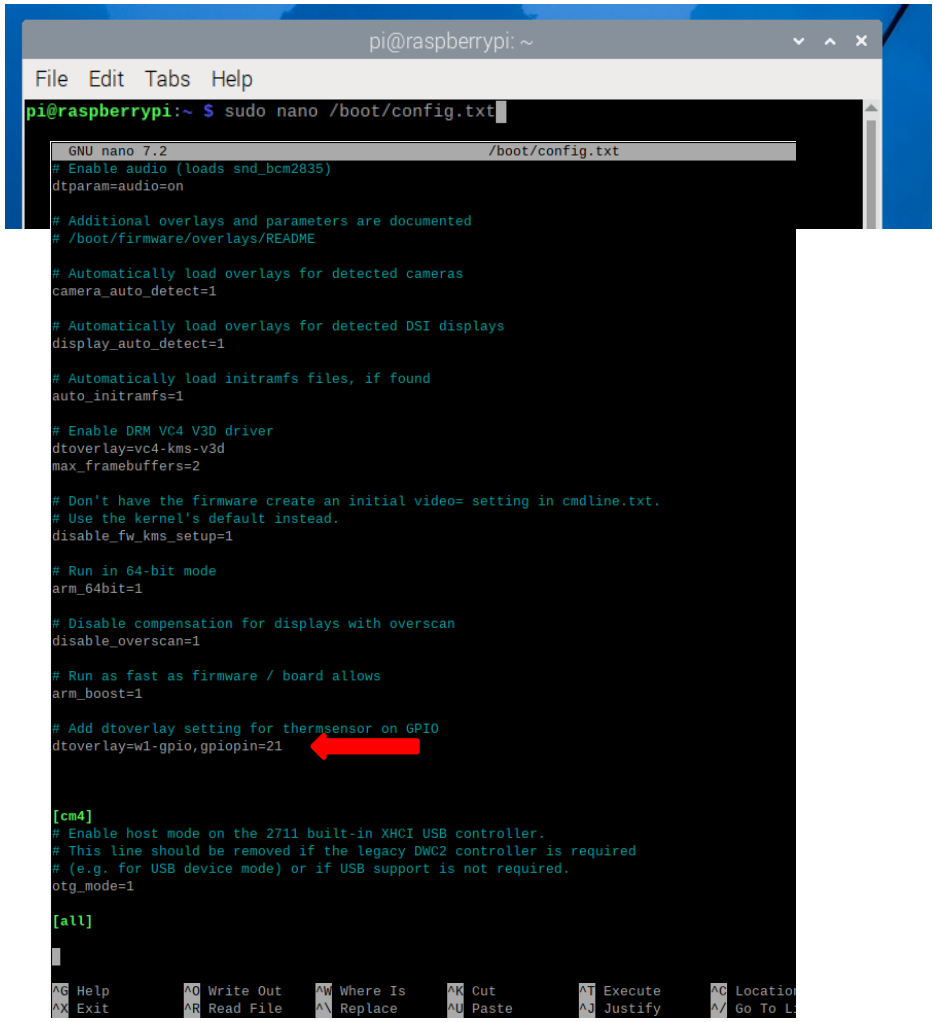
before the [cm4] section:

```
# Add dtoveraly setting for thermsensor on GPIO
```

```
dtoverlay=w1-gpio,gpiopin=21
```

Type CTRL+O to write then CTRL+X to exit

Then reboot (pi menu – choose Shutdown)



Raspberry Pi Code

1. Launch terminal and run this command:

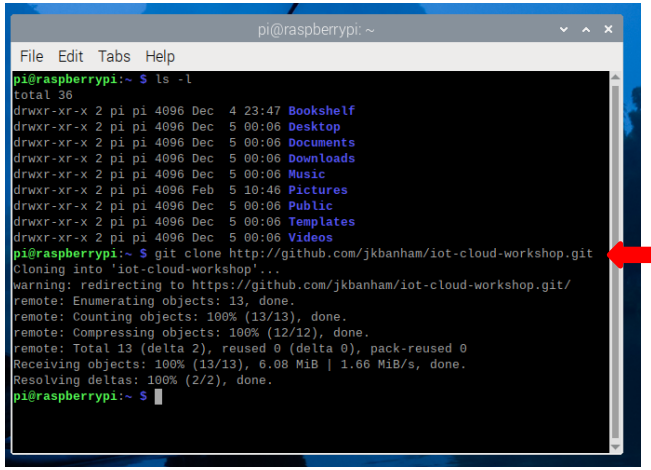
```
git clone http://github.com/jkbanham/iot-cloud-workshop.git
```

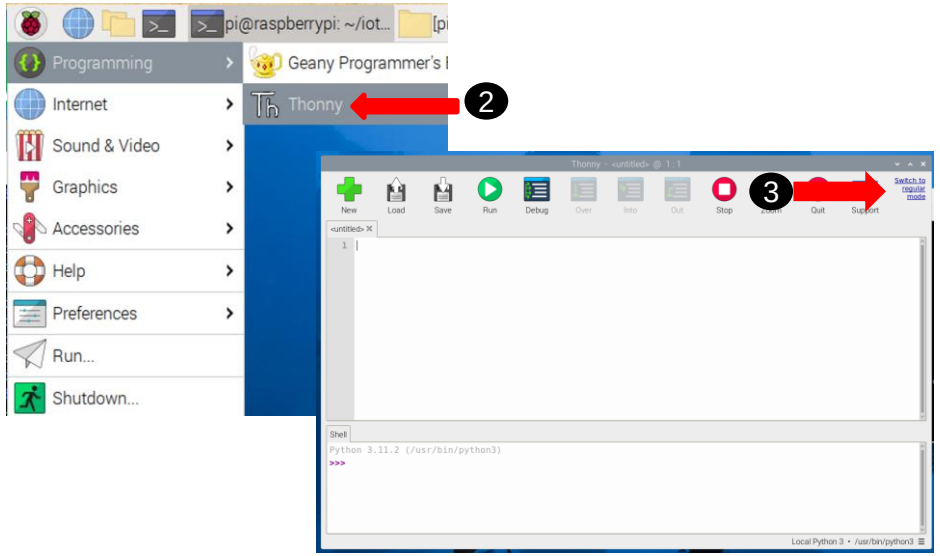
2. Note that you should now have a new directory with files we use for this project:

```
/home/pi/iot-cloud-workshop/
```

3. Launch the Thonny IDE from the Pi menu under Programming. Click on the ‘Switch to regular mode’ link in the upper right

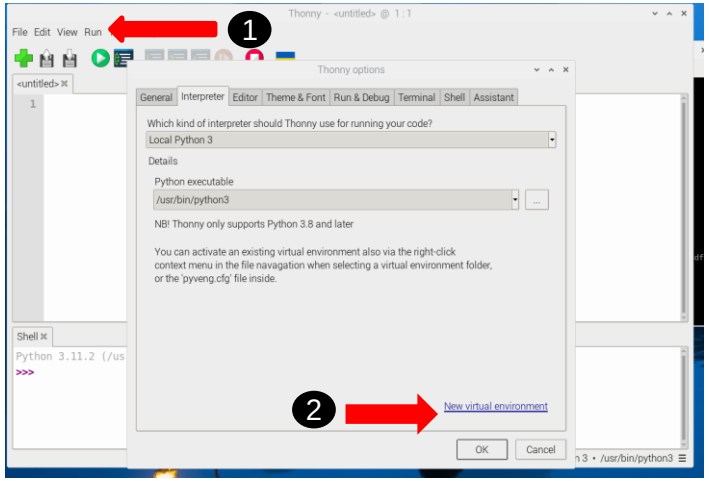
4. Close Thonny and then re-launch it

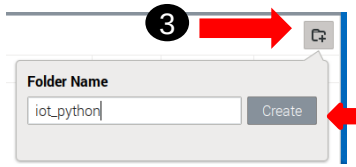


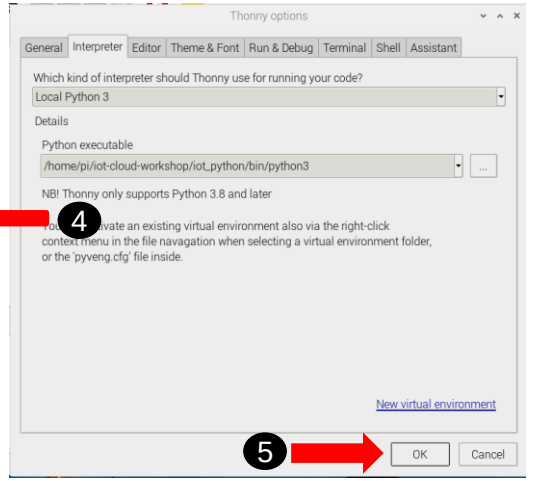


Raspberry Pi Code

1. From the ‘Run’ menu, select ‘Configure Interpreter’ and then click the ‘New virtual environment’ link in the lower right
2. In the dialog box to “Select empty directory for new virtual environment”, browse to the `/home/pi/iot-cloud-workshop` folder and click the ‘Create Folder’ icon in the upper right. Type *iot_python* and click ‘Create’.
3. Click ‘OK’ at the bottom and the new virtual python environment will be created.





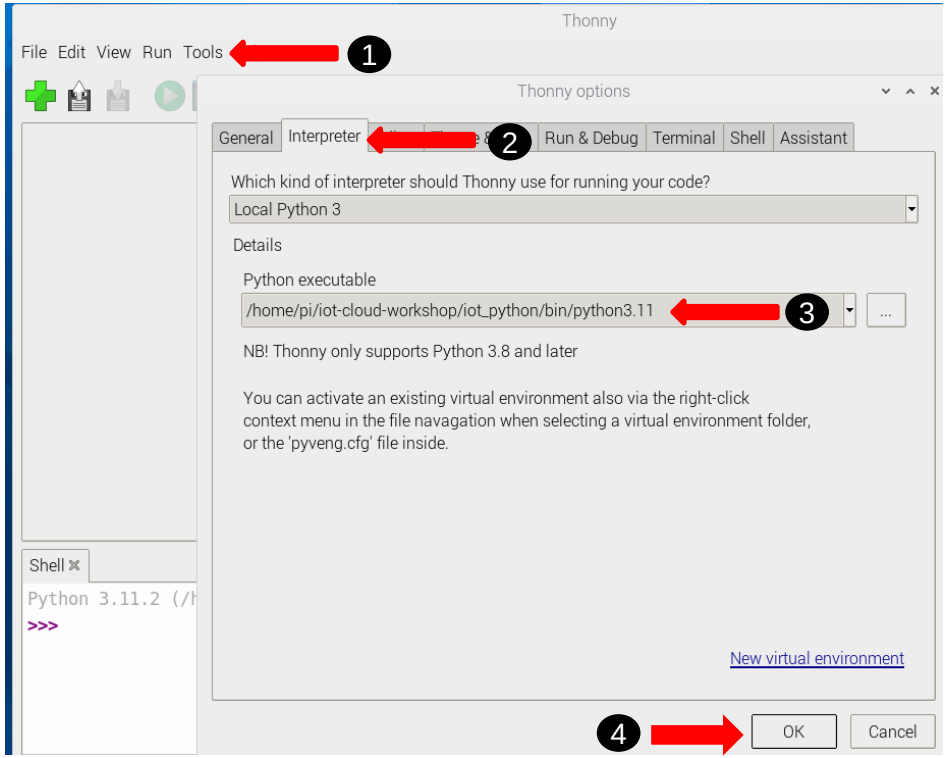


Raspberry Pi Code

Set the new virtual environment as the default

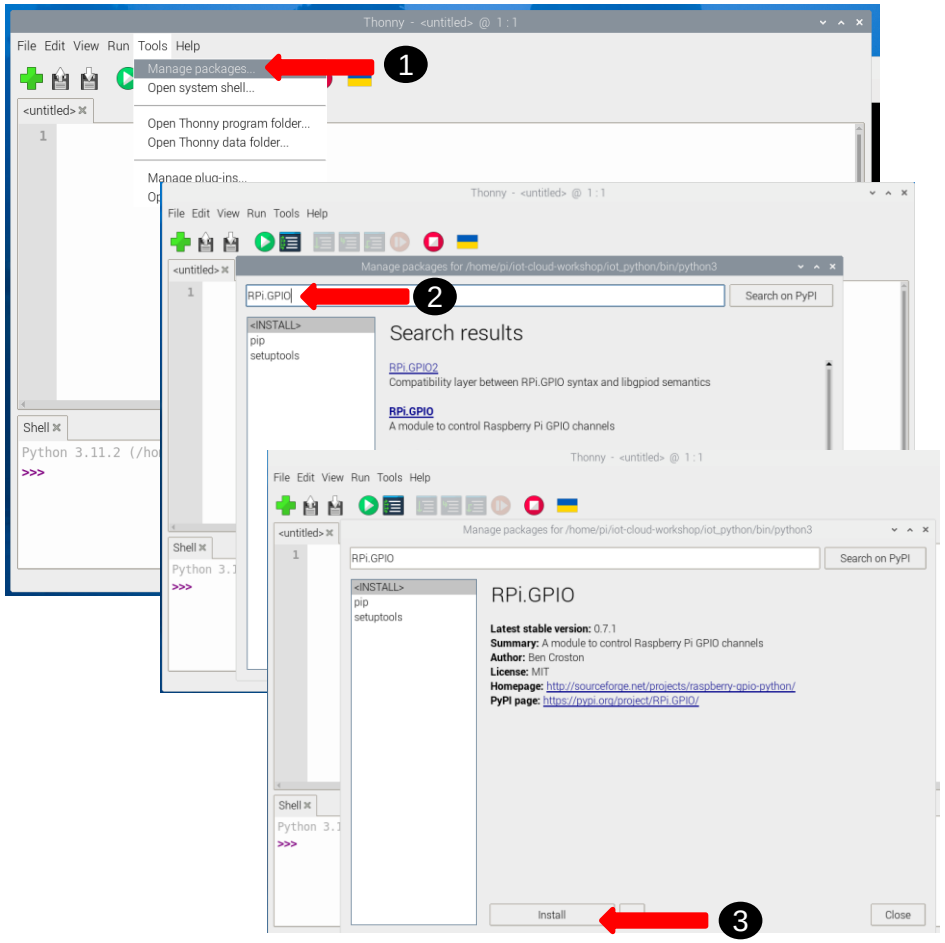
interpreter in the Thonny IDE application:

1. Open the *Tools -> Options* menu and select the *Interpreter* tab
2. Select the python version 3.11 executable file from the new virtual environment that you created (`/home/pi/iot-cloud-workshop/iot_python/bin/python3.11`)
3. Click OK to save



Raspberry Pi Code

1. Open the *Tools -> Manage Packages* menu
2. Type `RPi.GPIO` (note lowercase ‘i’) in the ‘Search on PyPI’ box and then click the module when it appears and then click Install button in lower left
3. Repeat the same process described above for the `W1thermsensor` module and the `google-cloud-pubsub` module



CHECKPOINT

Git repo cloned, Thonny launched, Python virtual environment created, Python modules installed

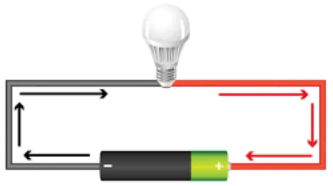
Check & Compare with Instructor’s Screen View

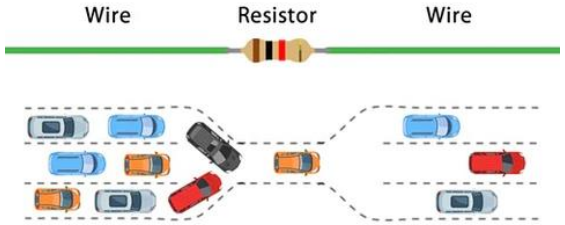
Raspberry Pi Sensor

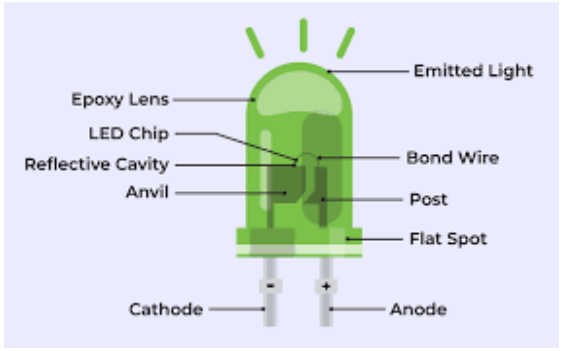
Raspberry Pi

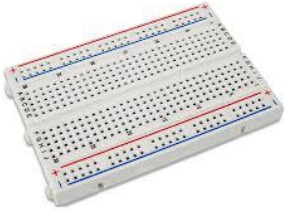
Some key concepts:

- Voltage
- Polarity
- Resistors
- LEDs
- Breadboard









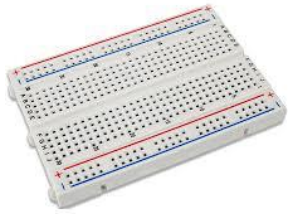
More info about circuits

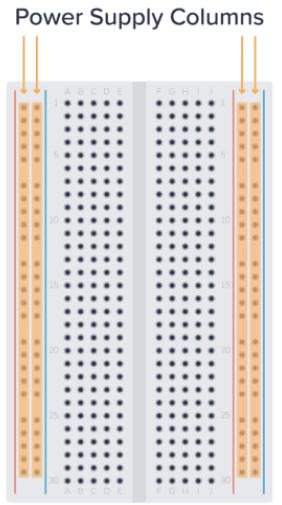
Raspberry Pi Sensor

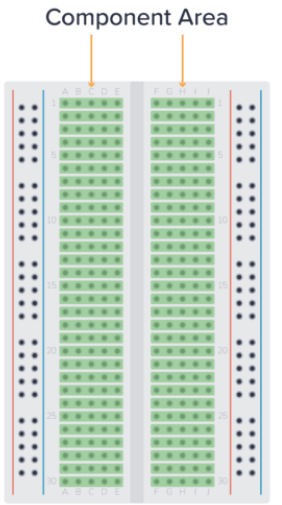
Raspberry Pi

What is a breadboard?

- Used for easy electronic circuit prototyping – no soldering required
- The story is that a vacuum tube engineer drove nails into his kitchen bread cutting board and connected them with wires
- Power supply columns are common (red/pos & blue/neg) Numbered rows in component area are common (on each side only – no commonality across middle gap)



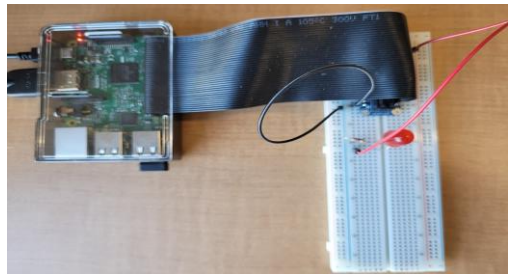




More info about breadboards

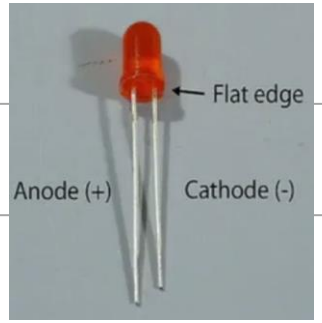
Raspberry Pi Sensor

Raspberry Pi

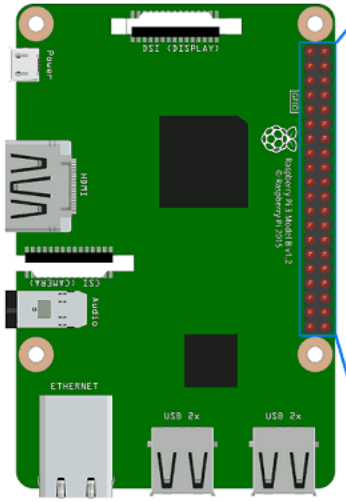


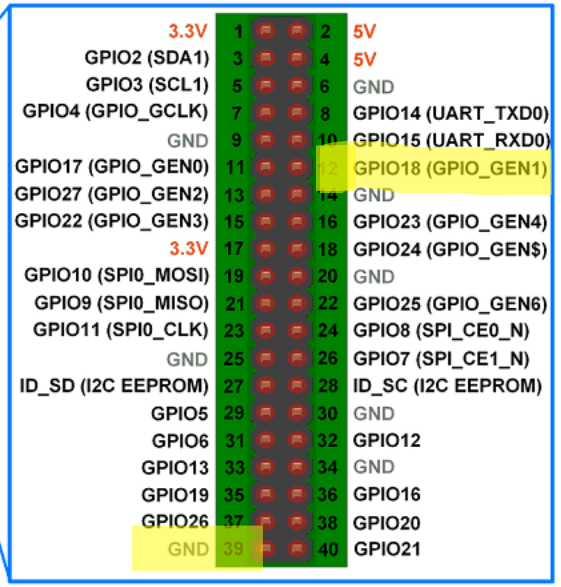
Make the following connections on your breadboard:

- Plug the red LED into the breadboard with the short leg (cathode (-)) in row 30 column c and the long leg (anode (+)) in row 32 column c



- Plug a resistor between row 30 column a and the negative (blue) rail
- Plug a jumper wire from pi pin 39 (GND - row 20, col a) to the blue rail
- Plug a jumper wire from pi pin 12 (GPIO18 – row 6, col j) on the raspberry pi breakout board to row 32 column a





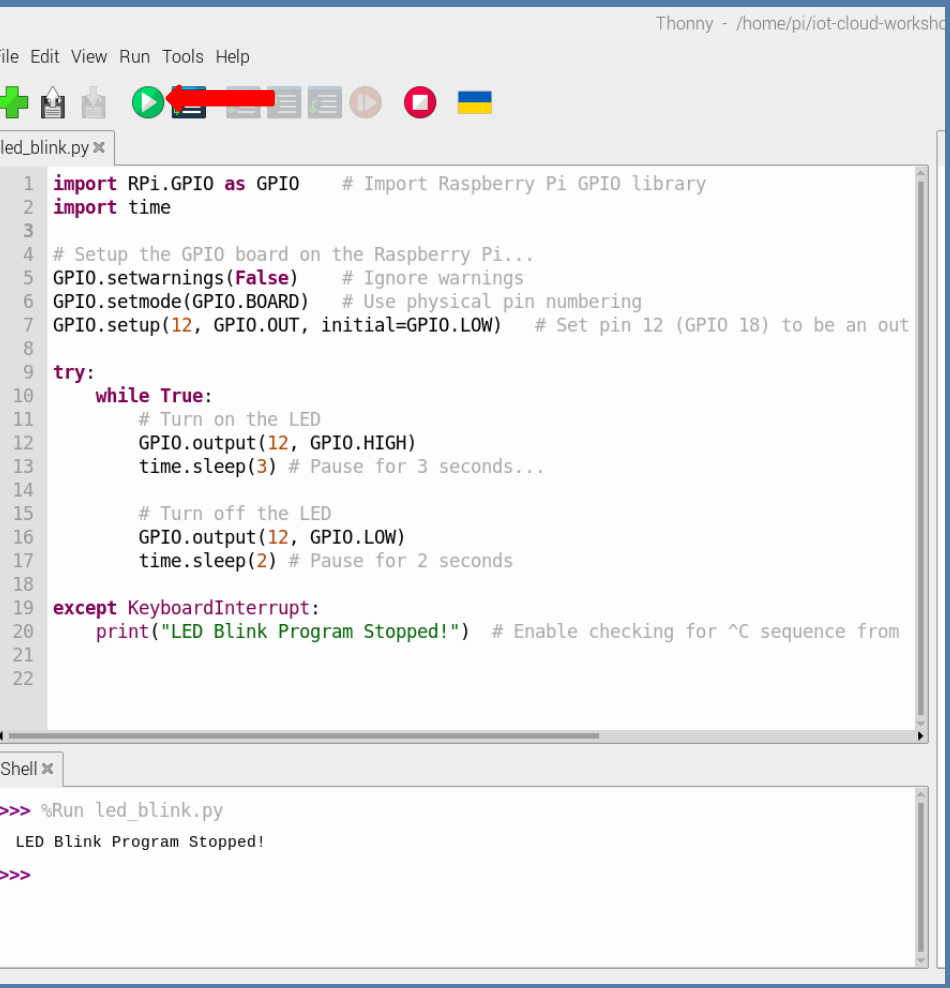
How does an LED work?

Using GPIO pins with LEDs

IoT RPI GCP

Raspberry Pi Code

1. In the Thonny IDE, open the file named `/home/pi/iot-cloud-workshop/led_blink.py`
2. Read through the code and ask any questions you might have
3. Click the ▶ button and check to see if your LED starts to blink
4. Press CTRL+C to stop the program



CHECKPOINT

Code runs successfully to

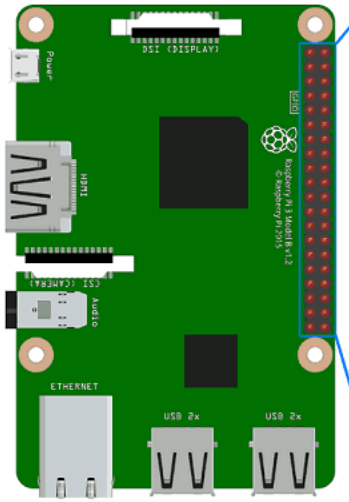
blink the LED

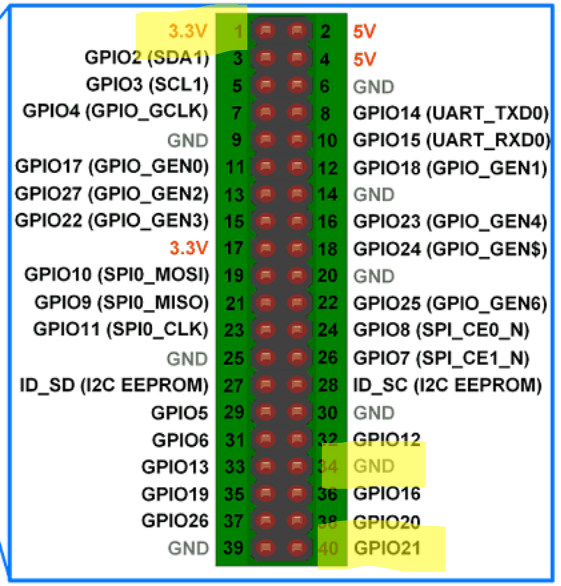
Raspberry Pi Sensor

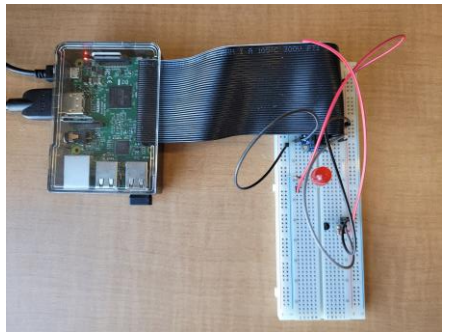
Make the following connections on your breadboard:

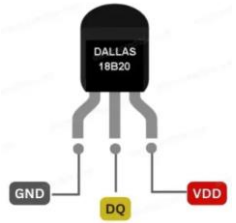
- Plug your DS18B20 sensor into the board with pin 1(GND) in row 40 column f, pin 2(DATA) in row 41 column f, and pin 3 (voltage) in row 42 column f on the breadboard
- Plug a resistor between rows 41 & 42 in column h
- Plug a jumper wire from row 40 col j to pi pin 34 (GND – row 17, col j) on the breadboard
- Plug a jumper wire from row 41 col j to pi pin 40 (GPIO21 – row 20, col j) on the breadboard
- Plug a jumper wire from row 42 col j to pi pin 1 (3v – row 1, col a) on the breadboard

Raspberry Pi









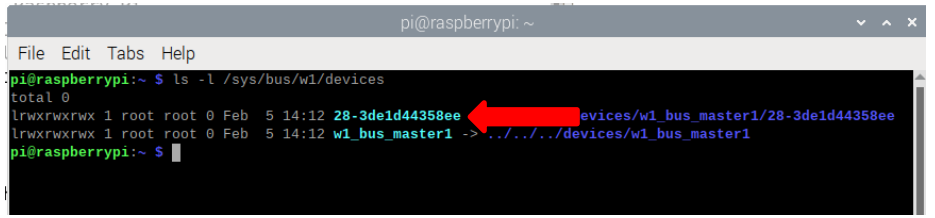
How does the DS18B20 work?

Raspberry Pi Sensor

Open a terminal and type:

```
ls -l /sys/bus/w1/devices
```

If you see an output line starting with "28-“ then you have set things up correctly and there is an active temp sensor connected to your Pi! (*If you don’t see it then something is wrong and troubleshooting is needed!)*



**** Note that the DS18B20 will get very hot if it is wired incorrectly (reverse polarity)***

CHECKPOINT

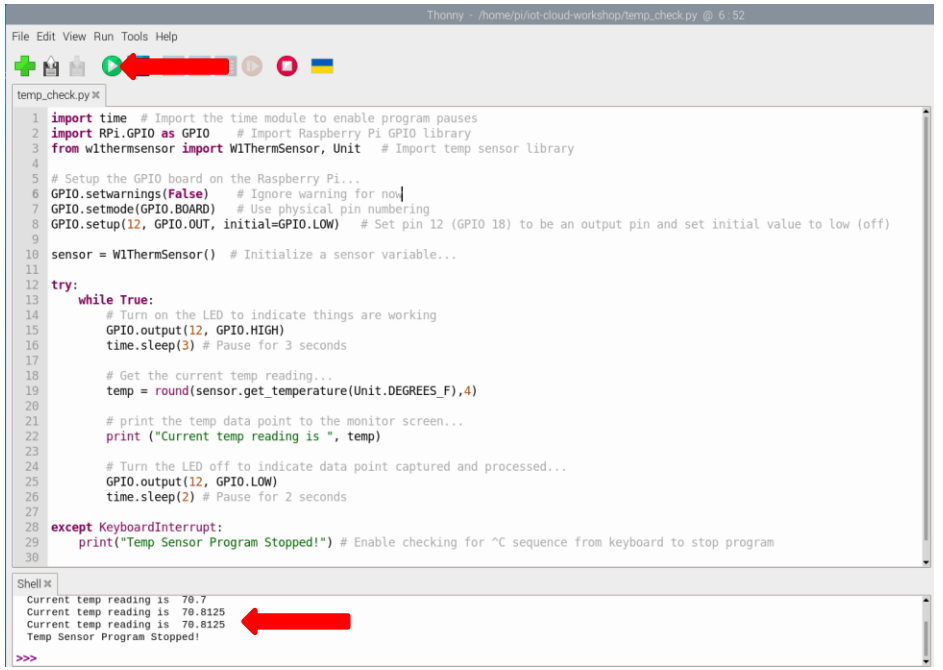
Everyone can see the sensor

in the /sys/bus/w1/devices

folder

Raspberry Pi Code

1. In the Thonny IDE, open the file named `/home/pi/iot-cloud-workshop/temp_check.py`
2. Read through the code and ask any questions you might have
3. Click the  button and check to see if temp readings print to the program output shell tab
4. Press CTRL+C to stop the program



CHECKPOINT

Code runs successfully to blink the LED and print the temp reading to the screen

Test putting your fingers on the temp sensor to watch the readings change

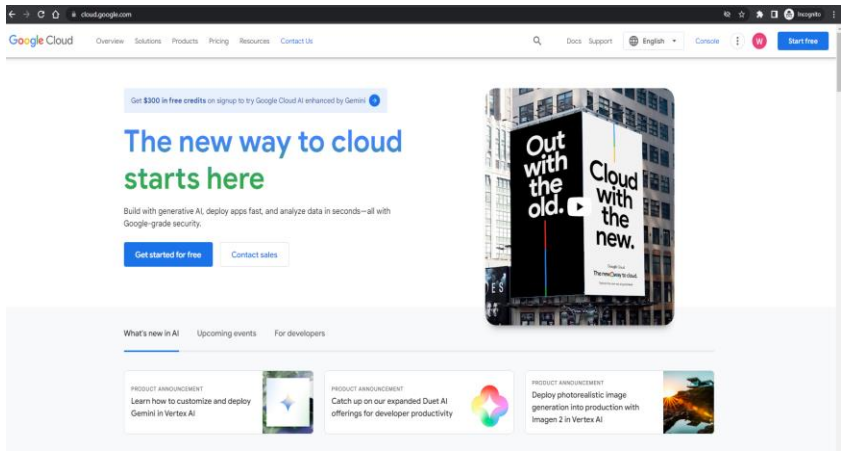
LUNCH BREAK

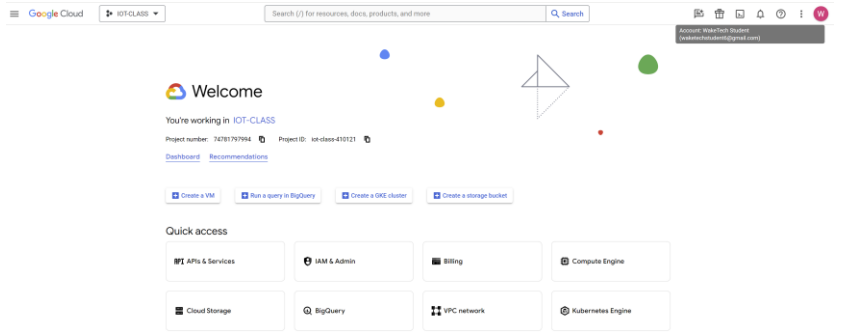
IoT | RPI | GCP

Google Cloud Platform (GCP)

STEP 1: Create a GCP Account

This step was completed prior to the workshop - confirm that you can log in to console.cloud.google.com in a browser window



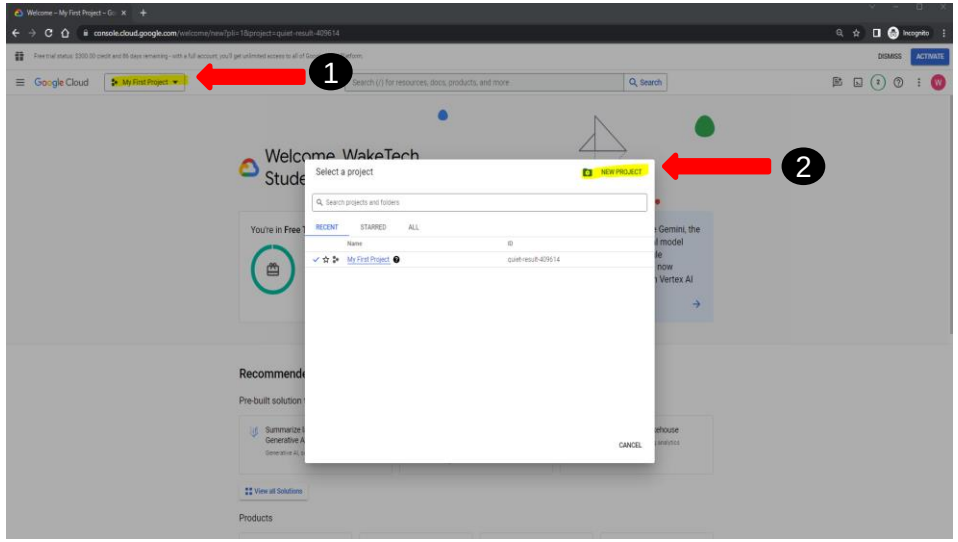


Google Cloud Platform (GCP)

Google Cloud

STEP 2: Create a New Project

Once you are logged in to console.cloud.google.com, click on the active project name in the upper left. Then click the NEW PROJECT button



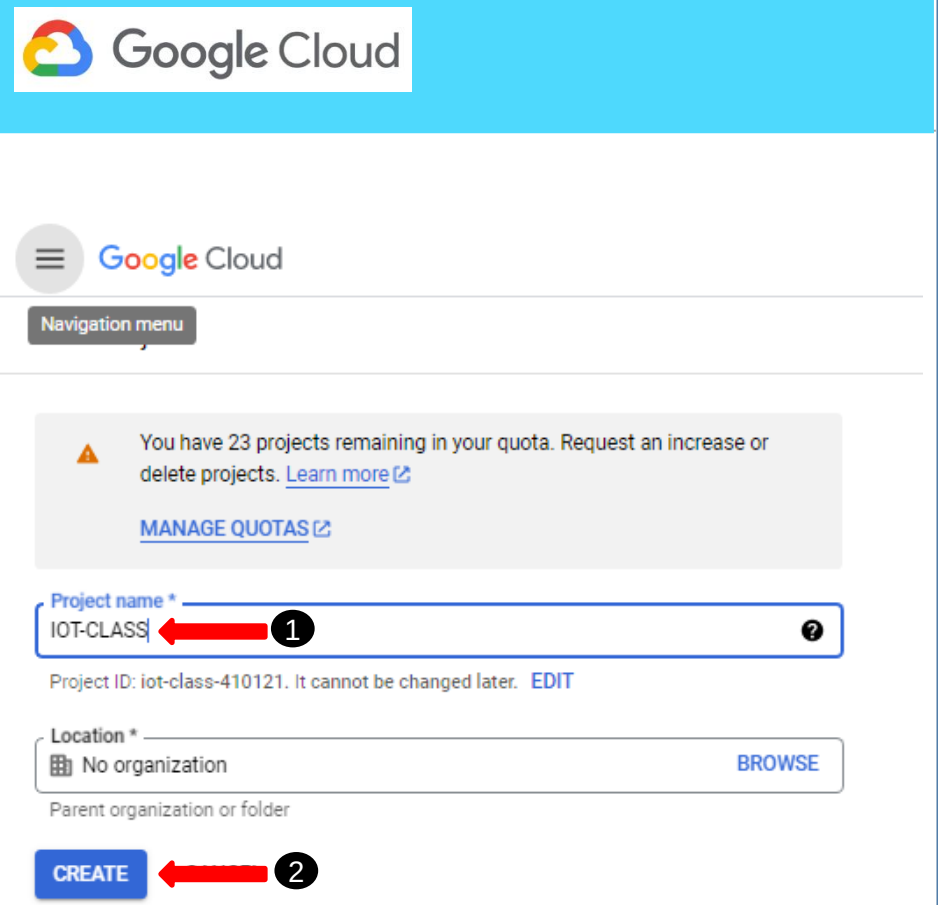
IoT RPI GCP

Google Cloud Platform (GCP)

STEP 2: Create a New Project

Name the new project ‘IOT-CLASS’

and then click the CREATE button



Google Cloud Platform (GCP)

Google Cloud

STEP 2: Create a New Project

Click the project list in upper left

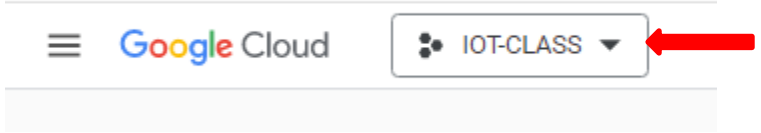
again and then select the new IOT-

CLASS project – it should now show

as your active project while you are

working in the GCP console

--



CHECKPOINT

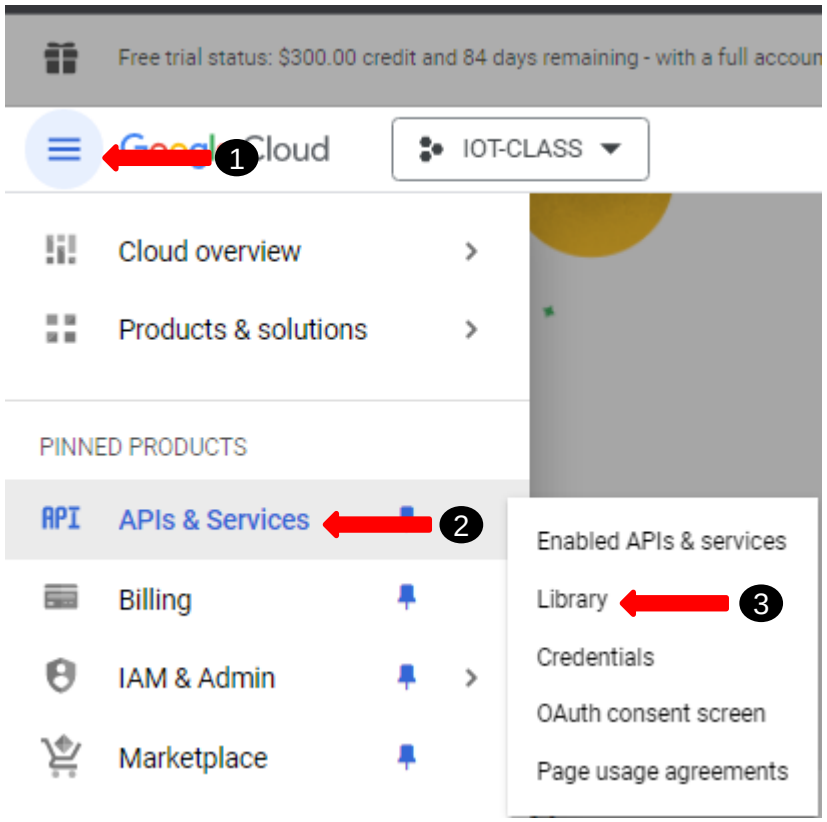
Everyone has a new project

created named IOT-CLASS

Google Cloud Platform (GCP)

STEP 3: Enable APIs

From the navigation menu on the left-hand side (often referred to as the ‘hamburger’ menu), select APIs & Services | Library



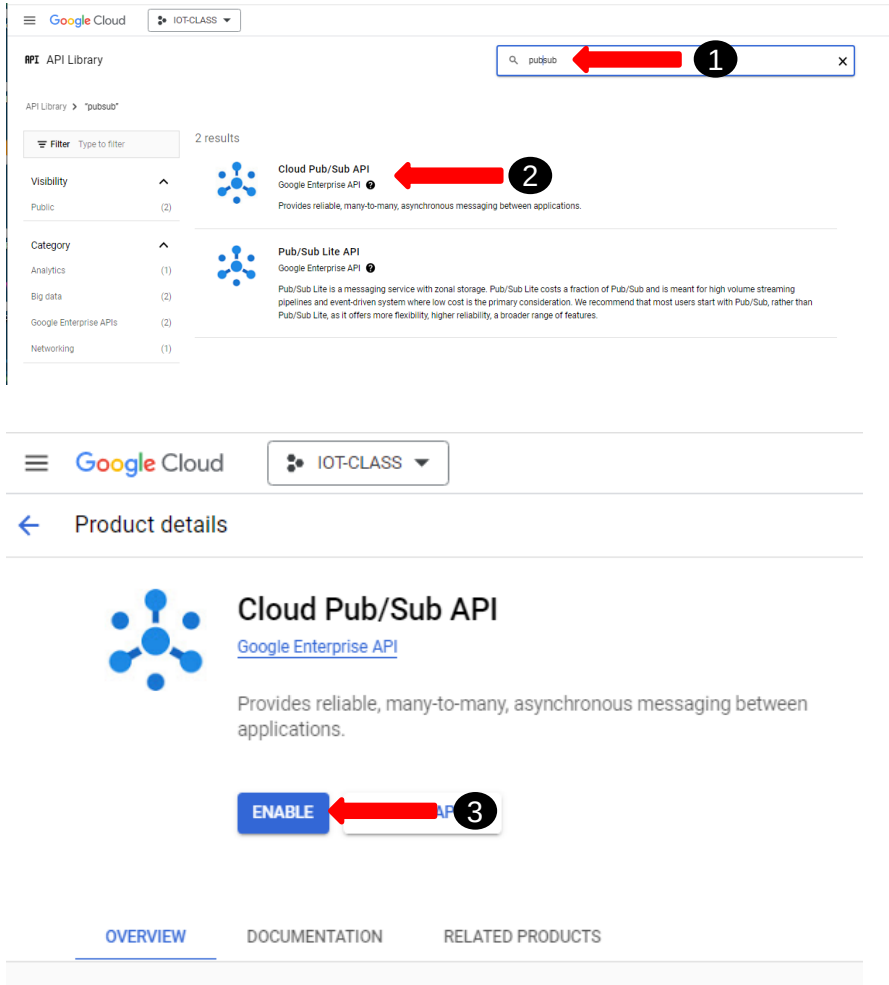
I WANT TO KNOW MORE

What is an API

Google Cloud Platform (GCP)

STEP 3: Enable APIs

1. On the next screen, type ‘pubsub’ in the search box and then click the Cloud Pub/Sub API from the results
2. On the next screen, click the ENABLE button
3. Repeat this same process to enable the Application Integration API



IoT | RPI | GCP

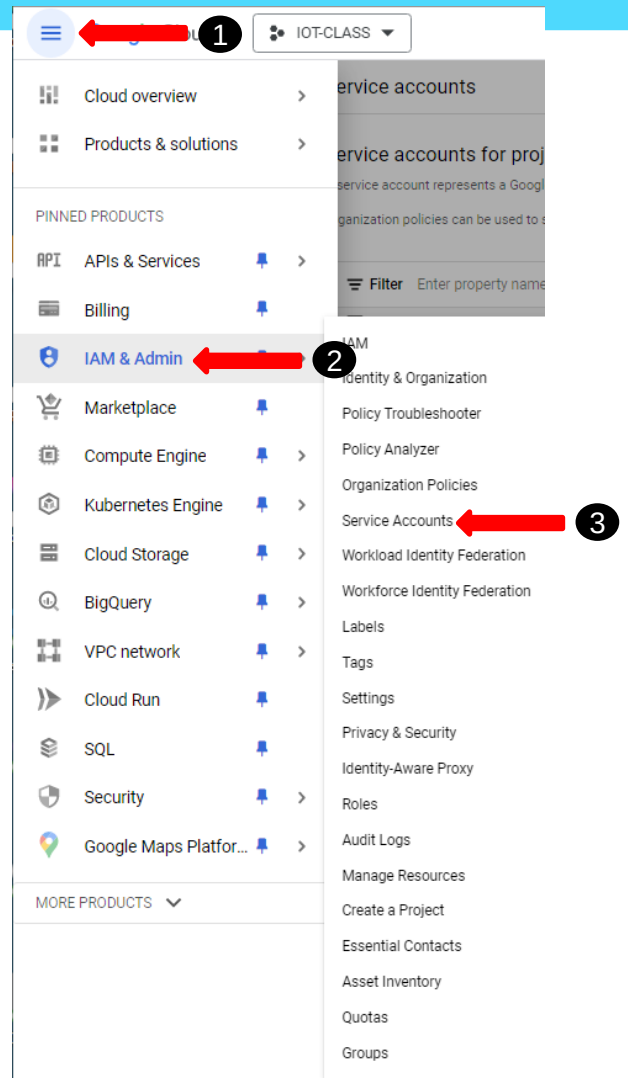
Google Cloud Platform (GCP)

STEP 4: Create a Service Account

From the navigation menu on the left-hand side, select IAM & Admin | Service Accounts

I WANT TO KNOW MORE

What is a Google Service Account



IoT | RPI | GCP

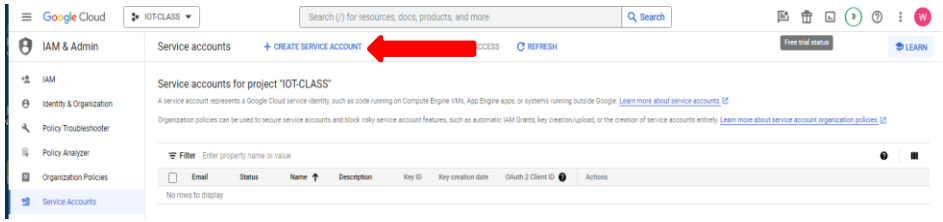
Google Cloud Platform (GCP)

STEP 4: Create a Service Account

On the next screen, click the

+ CREATE SERVICE ACCOUNT button near the

top left of the screen

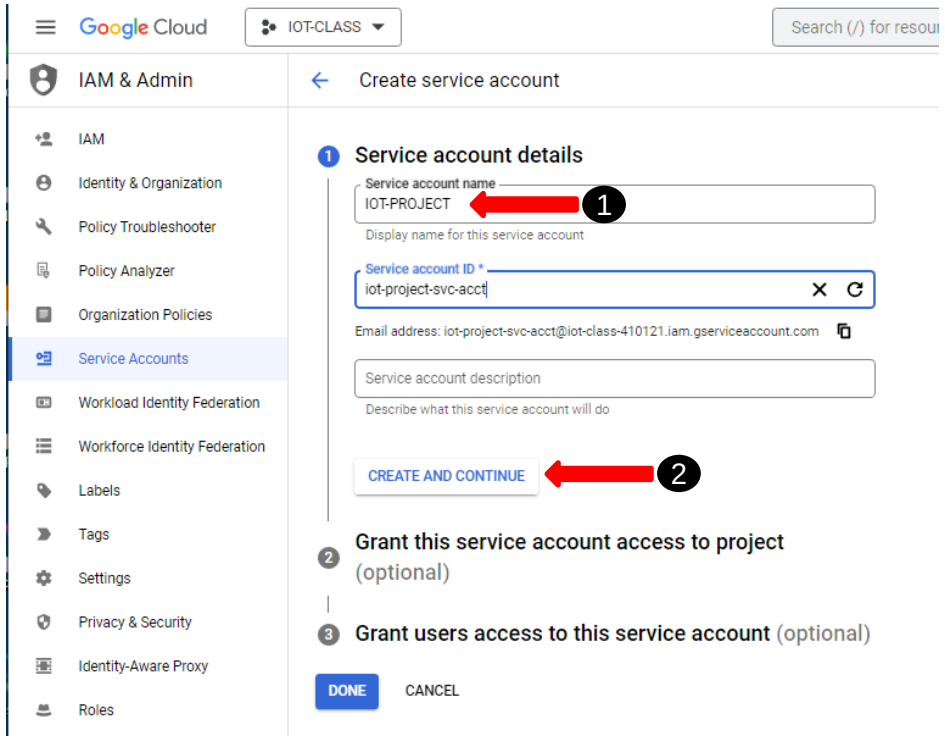


IoT | RPI | GCP

Google Cloud Platform (GCP)

STEP 4: Create a Service Account

Give the new service account a name of “IOT-PROJECT” and then click CREATE AND CONTINUE

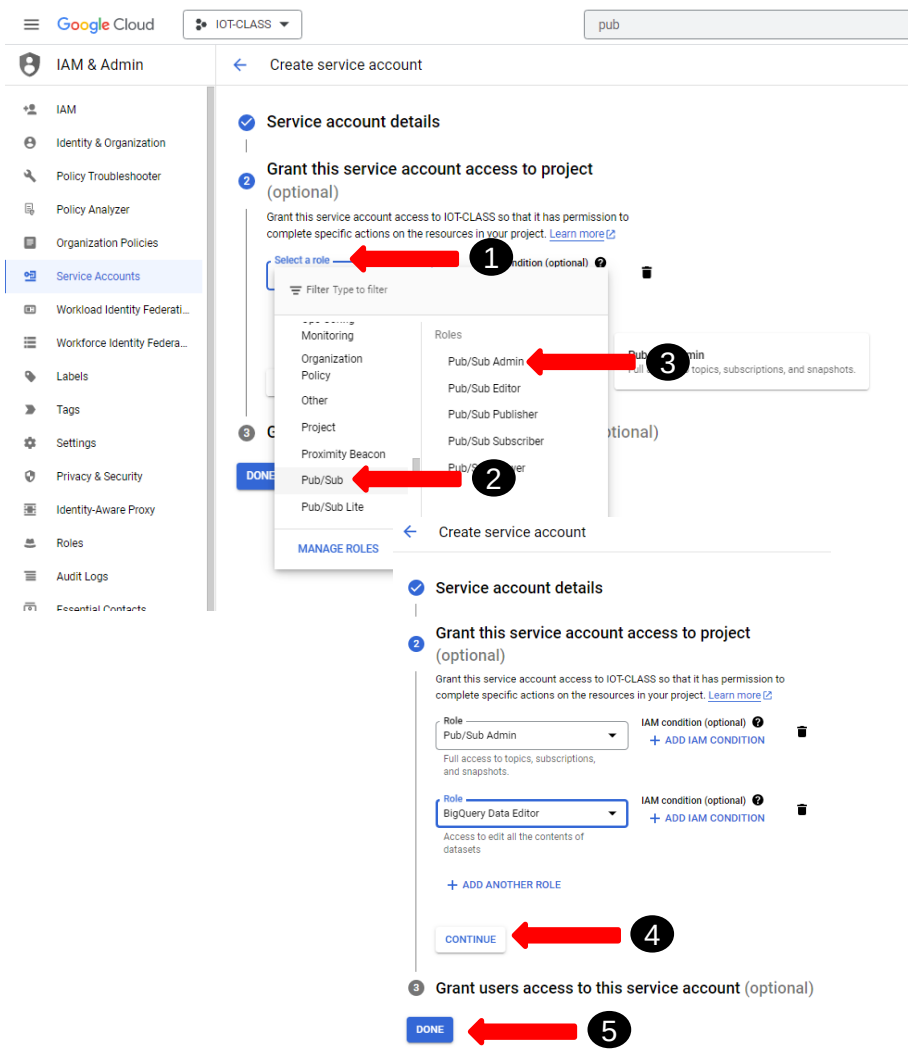


IoT | RPI | GCP

Google Cloud Platform (GCP)

STEP 4: Create a Service Account

1. In the ‘Select a role’ drop-down list, scroll down and select the ‘Pub/Sub Admin’ role
2. Repeat this process to also add the ‘BigQuery Data Editor’ role
3. Click CONTINUE and then the DONE button at the bottom.



CHECKPOINT

Everyone has a new service account named IOT-PROJECT created and has granted it roles for Pub/Sub & BigQuery

IoT | RPI | GCP

Google Cloud Platform (GCP)

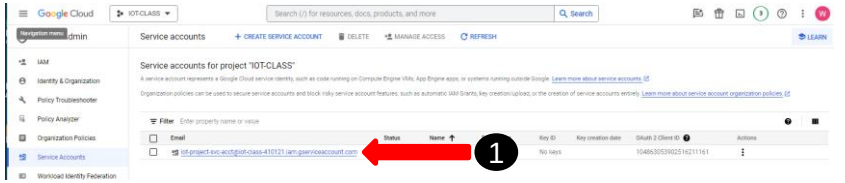
Google Cloud

STEP 5: GET API CREDENTIALS

1. While on the service accounts page,

   Click your newly created service account

   to open it's details page:

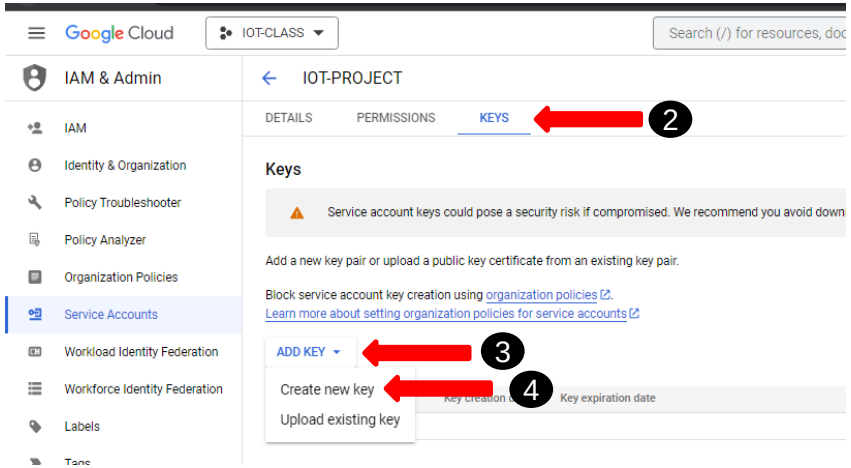


2. On the Service Account details page,

   click the 'KEYS' tab, and then click the

   ADD KEY button, and select the 'Create

   new key' option.



Google Cloud Platform (GCP)

STEP 5: GET API CREDENTIALS

1. Select JSON for the key type and then

   click the CREATE button

2. A new public/private key pair is generated

   and the private key file is downloaded to

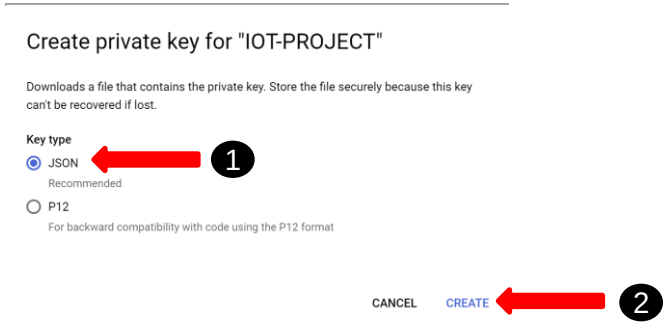
   your computer. Save it to a USB thumb

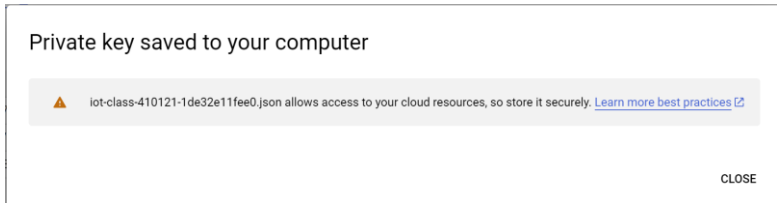
   drive with the name `credentials.json`

3. Swap your thumb drive over to the pi and

   copy the file to:

`/home/pi/iot-cloud-workshop/credentials.json`





What is a JSON file

CHECKPOINT

Everyone has the `credentials.json` file saved locally in the `iot-cloud-workshop` folder on their Raspberry Pi

Google Cloud Platform (GCP)

STEP 6: BIGQUERY TABLE

From the service navigation menu,

choose BigQuery | BigQuery Studio –

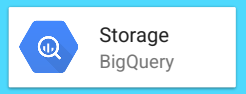
click the 3 dots to the left of your

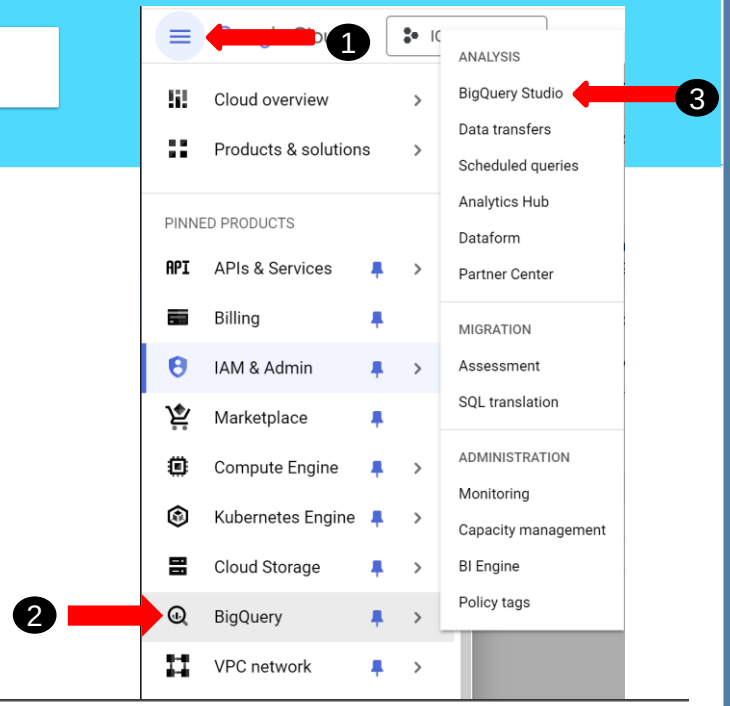
project name in the explorer pane and

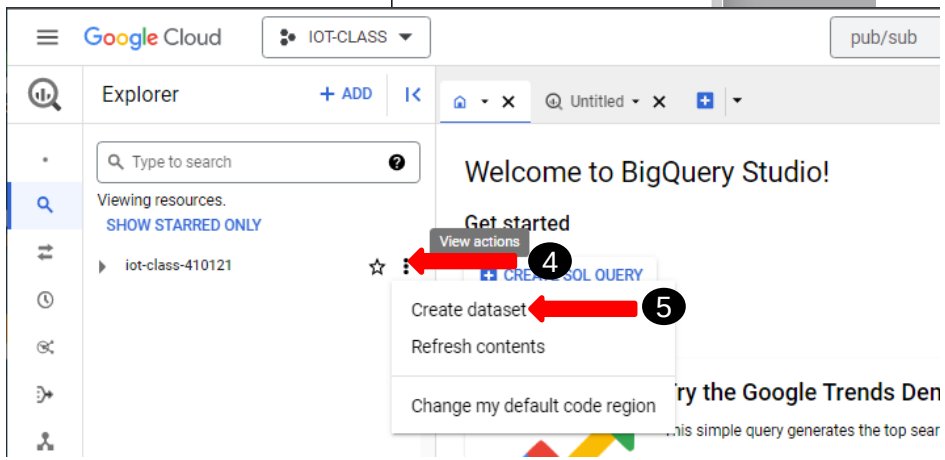
select ‘Create dataset’

I WANT TO KNOW MORE

Google BigQuery





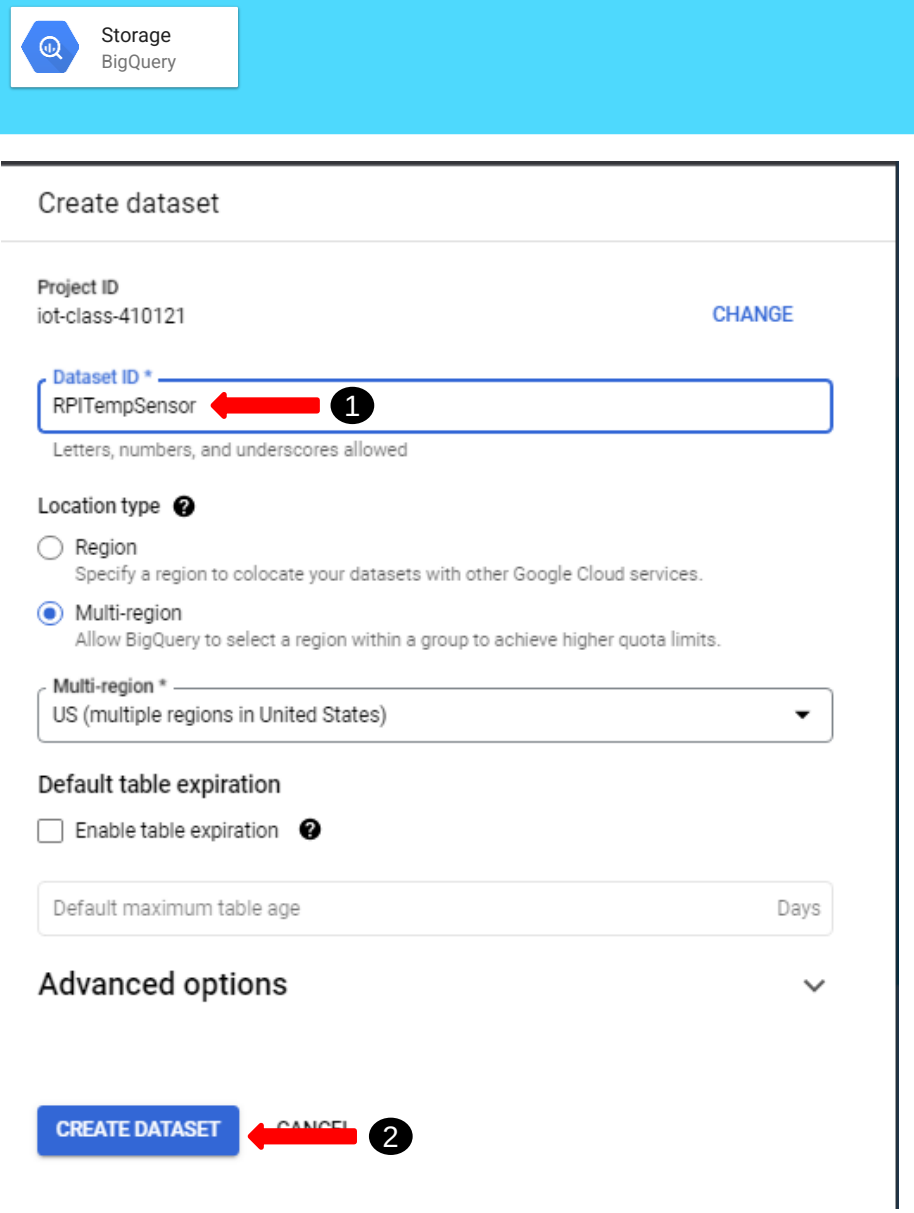


IoT | RPI | GCP

Google Cloud Platform (GCP)

STEP 6: BIGQUERY TABLE

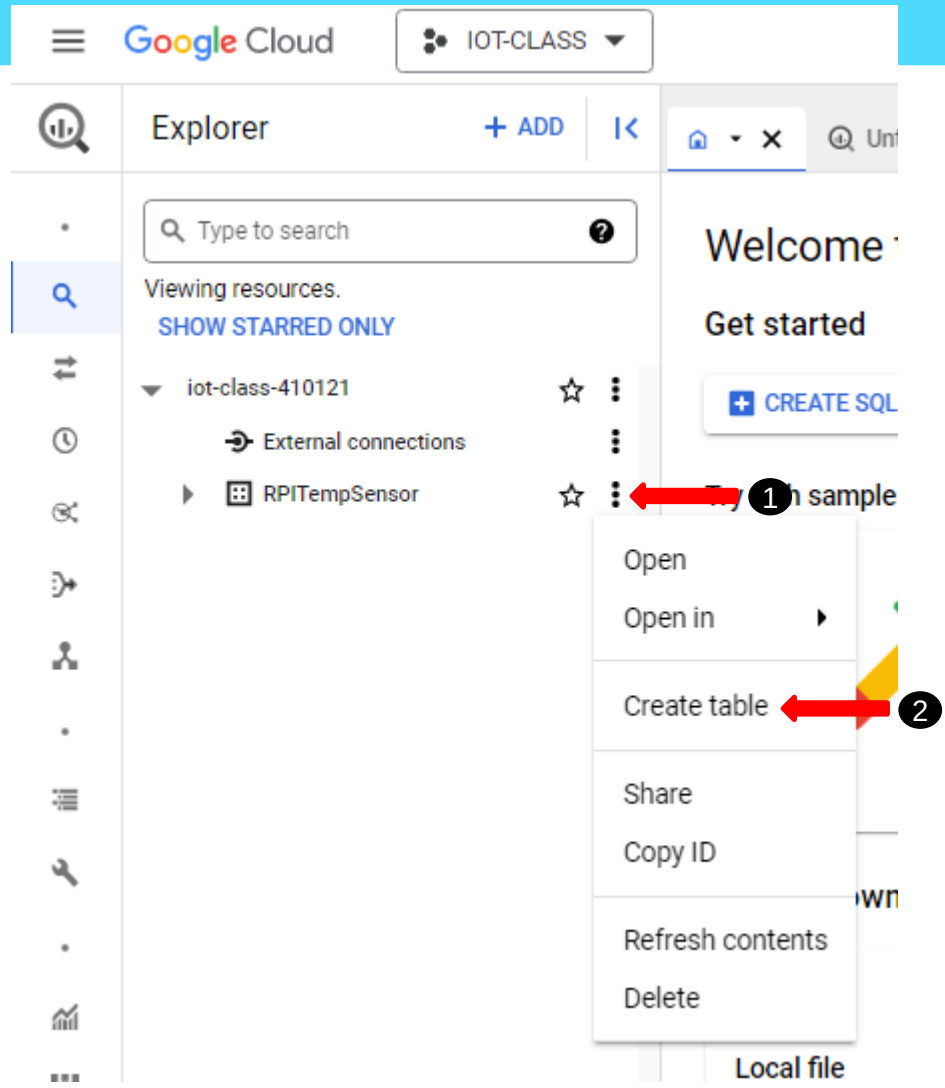
Type ‘RPITempSensor’ in the Dataset ID field and click the CREATE DATASET button at the bottom



Google Cloud Platform (GCP)

STEP 6: BIGQUERY TABLE

You'll see the new data set appear at the bottom of your BQ Explorer window – click the 3 dots to the right of the dataset name and select 'Create table'



IoT RPI GCP

Google Cloud Platform (GCP)

Storage
BigQuery

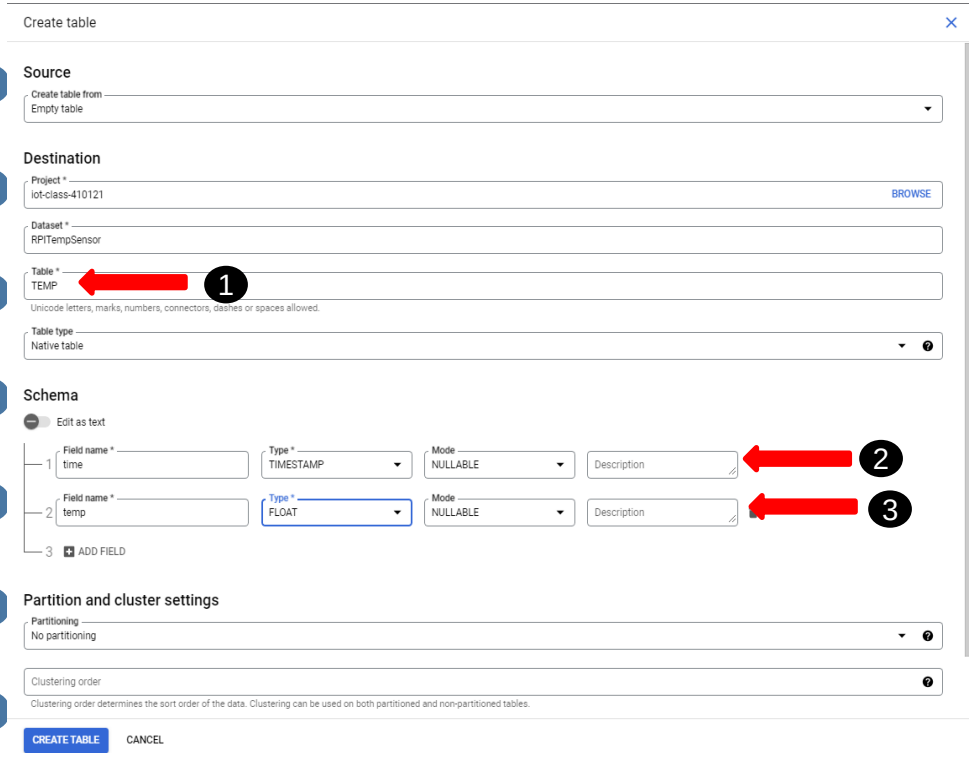
STEP 6: BIGQUERY TABLE

In the ‘Create table’ window, set the Table name to TEMP and then click the plus sign under the Schema section to add fields. Add the following fields:

time – type=TIMESTAMP

temp – type=FLOAT

Then click the CREATE TABLE button at the bottom

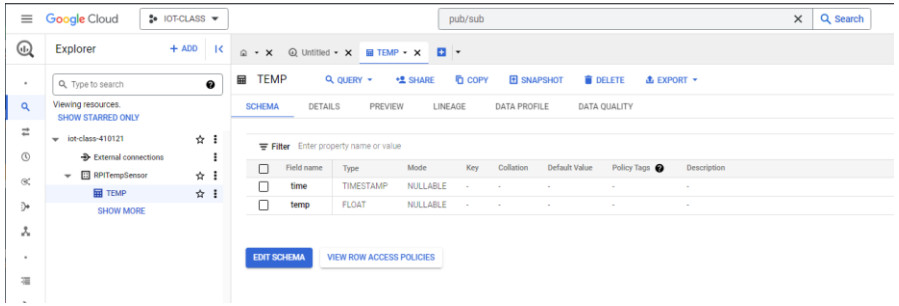


Google Cloud Platform (GCP)

Storage
BigQuery

STEP 6: BIGQUERY TABLE

You should now see the new table at the bottom of your BQ Explorer window.



CHECKPOINT

Everyone has a new BigQuery dataset and table created

IoT | RPI | GCP

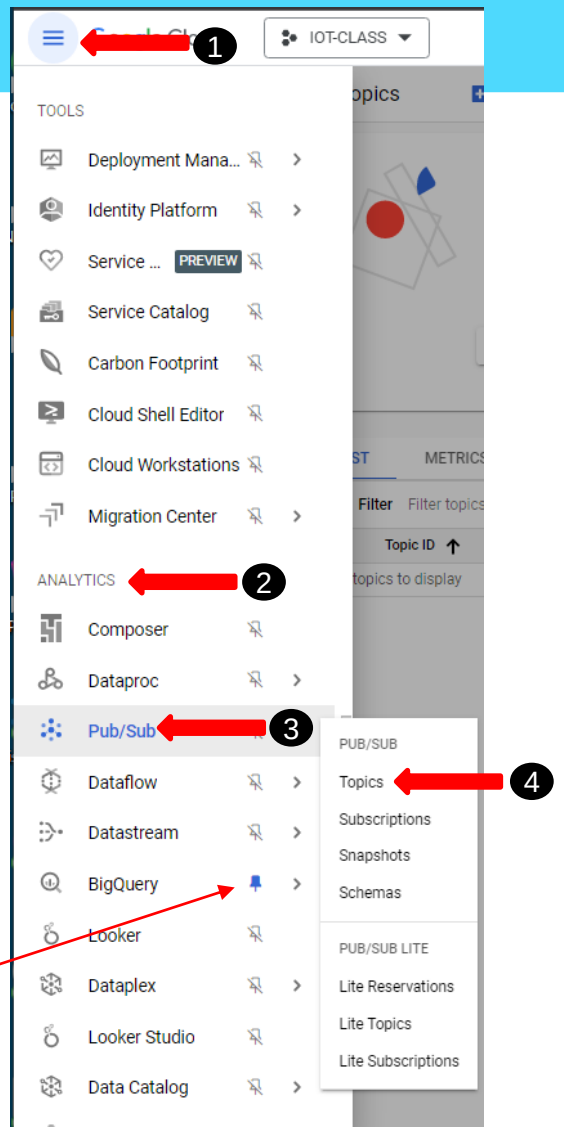
Google Cloud Platform (GCP)

STEP 7: CREATE PUB/SUB TOPIC

From the navigation menu on the left-hand side, expand the ‘More Products’ section and scroll down to ‘ANALYTICS’ and then select Pub/Sub | Topics as shown (or you can just type pub/sub in the top search menu and select the Pub/Sub product)

***TIP**: Click the pin icon next to a service name in the nav menu to keep it ‘pinned’ to the top section of your menu*

Cloud Pub/Sub



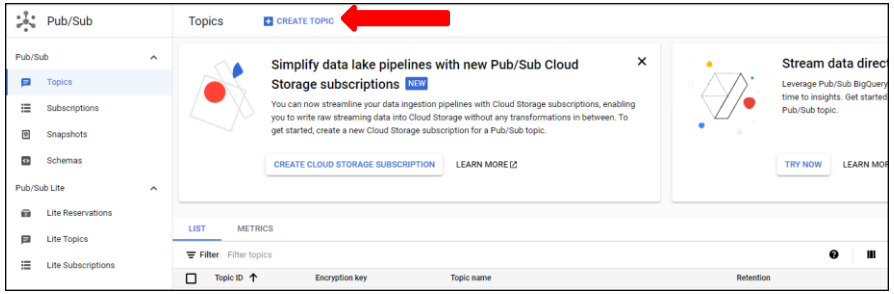
Google Cloud Platform (GCP)

IoT Topic
Cloud Pub/Sub

STEP 7: CREATE PUB/SUB TOPIC

We'll now create a new Pub/Sub Topic which will be used to collect the telemetry data coming in from the temp sensors.

Click the + CREATE TOPIC button

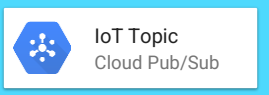


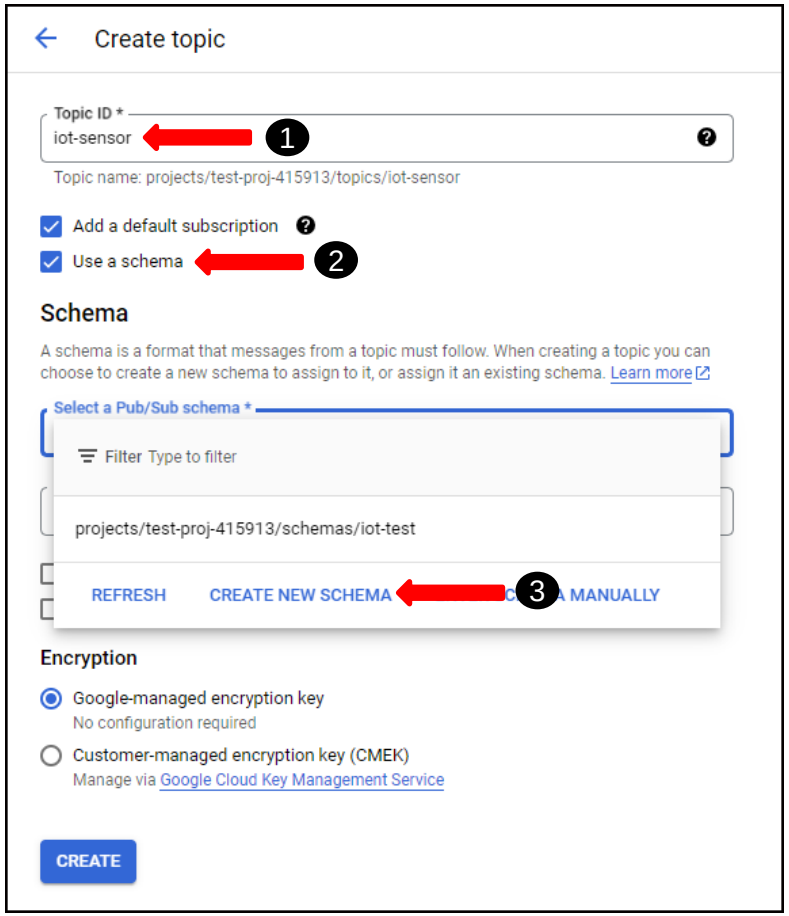
Google Cloud Platform (GCP)

STEP 7: CREATE PUB/SUB TOPIC

1. Type ‘iot-sensor’ for the Topic ID
2. Click the Use a schema check box
3. Click in the ‘Select a Pub/Sub schema filter box and select

CREATE NEW SCHEMA





More about Pub/Sub

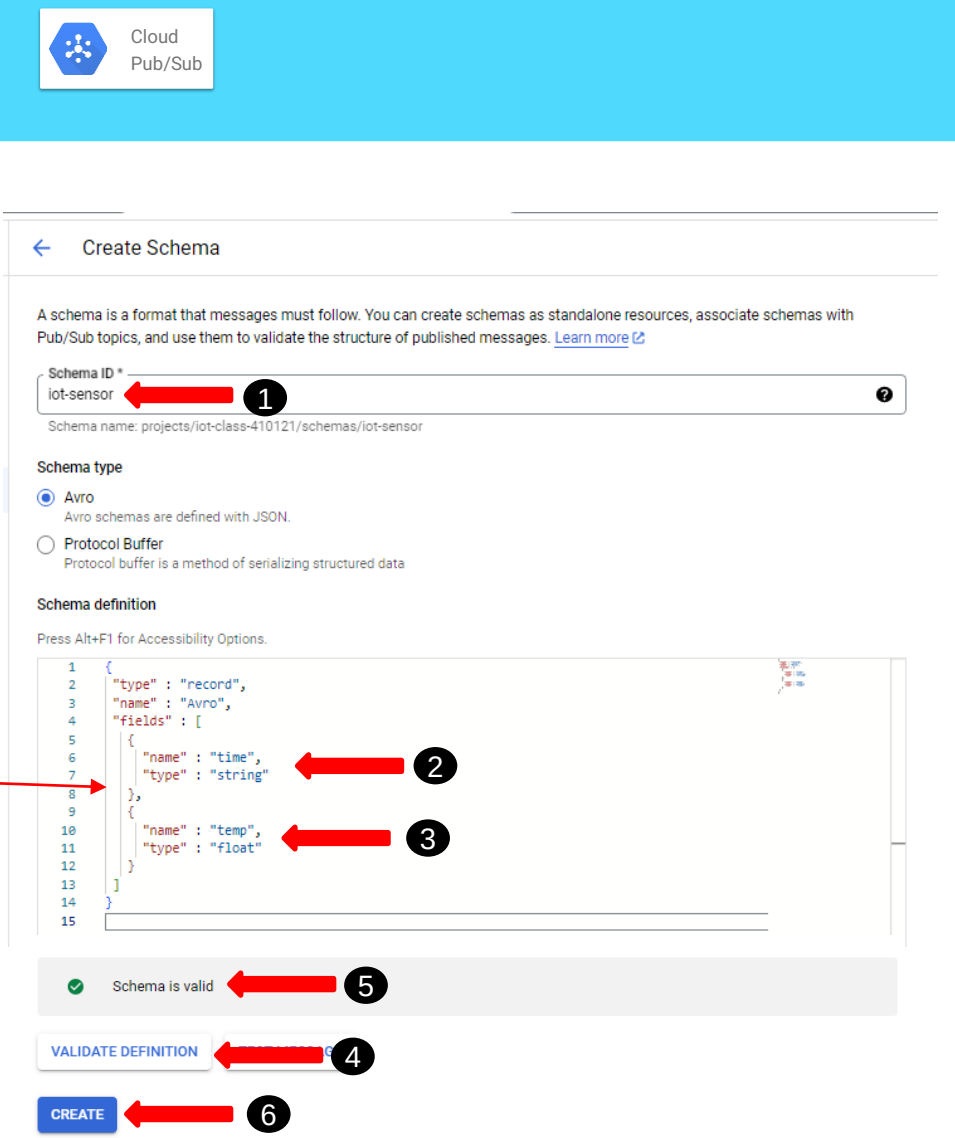
IoT | RPI | GCP

Google Cloud Platform (GCP)

STEP 7: CREATE PUB/SUB TOPIC

A new 'Create Schema' browser tab will open.

1. Type 'iot-sensor' in the Schema ID field
2. Edit the Schema definition to match the screenshot
3. Click the VALIDATE DEFINITION button at the bottom left
4. Make sure you see Schema is valid
5. Click CREATE



IoT RPI GCP

Google Cloud Platform (GCP)

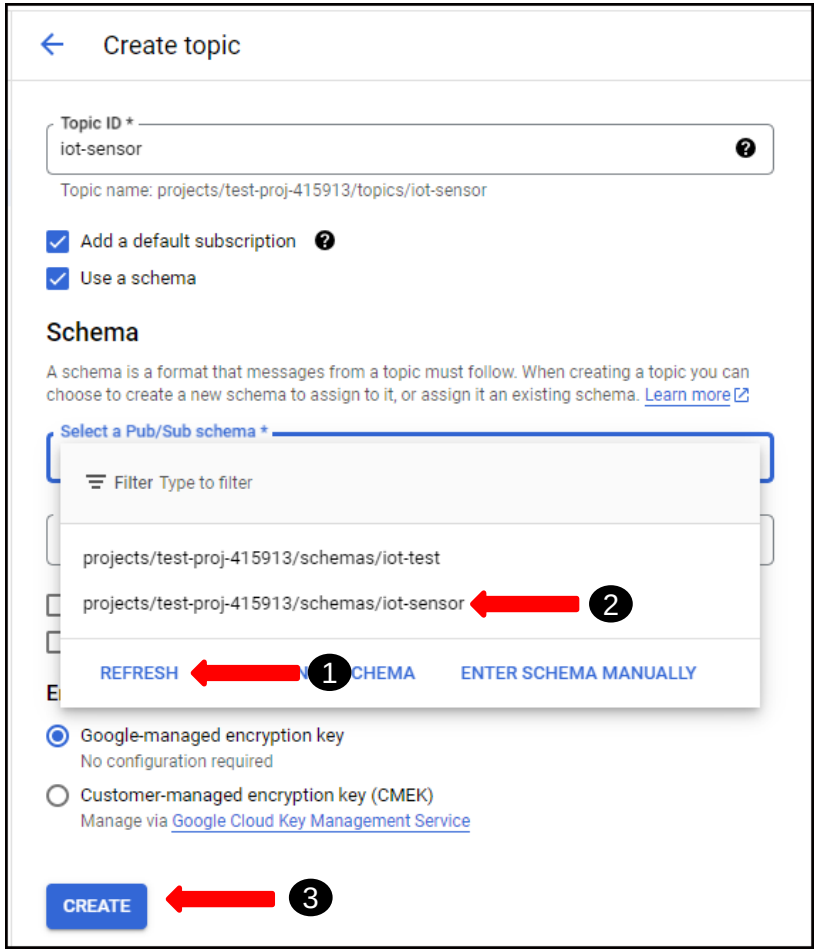
Cloud Pub/Sub

STEP 7: CREATE PUB/SUB TOPIC

Now switch back to the 'Pub/Sub

'Create Topic' browser tab

1. Click the REFRESH link in the Schema filter and you should see the new schema in the list
2. Select the newly created schema
3. Click the CREATE button at the bottom left



IoT | RPI | GCP

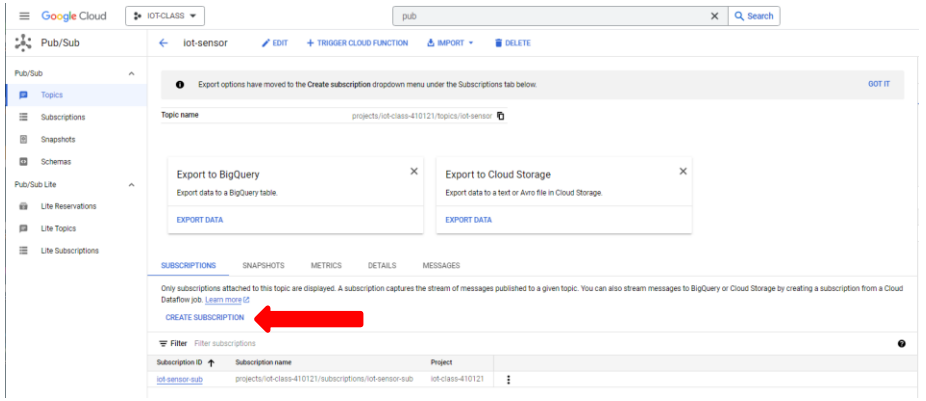
Google Cloud Platform (GCP)

IoT Topic
Cloud Pub/Sub

STEP 7: CREATE PUB/SUB TOPIC

You will now see the details screen for the newly created *iot-sensor* Topic.

Click the CREATE SUBSCRIPTION link in the middle of the page.



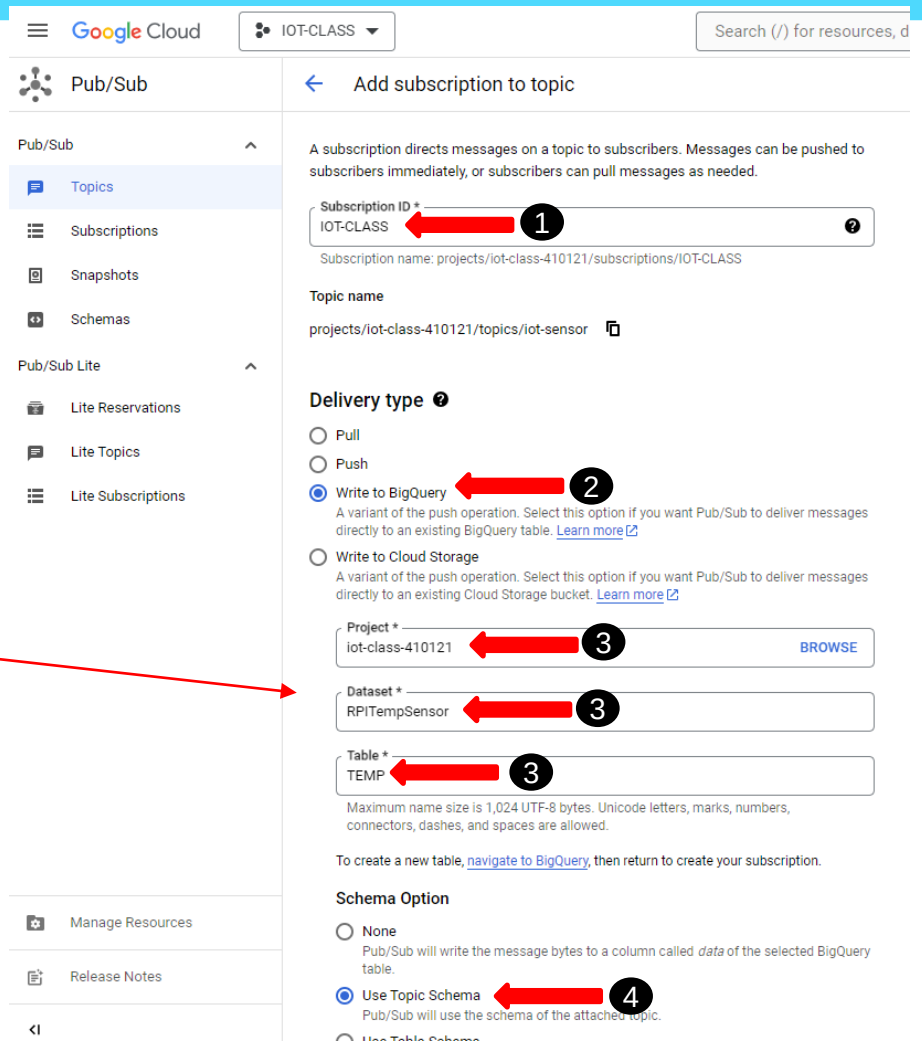
IoT | RPI | GCP

Google Cloud Platform (GCP)

STEP 7: CREATE PUB/SUB TOPIC

We'll now create a Pub/Sub 'subscription' to enable real-time ingestion of the IoT temp sensor data into the BigQuery database.

1. Type 'IOT-CLASS' for the Subscription ID
2. Select 'Write to BigQuery' for the Delivery type
3. Select the Project, Dataset, and Table as shown
4. Select the 'Use Topic Schema' choice for Schema Option
5. Scroll to the bottom of the page and click the CREATE button (not shown in screenshot)



IoT | RPI | GCP

Raspberry Pi Code

1. In the Thonny IDE, open the file named

   `/home/pi/iot-cloud-workshop/sensor_cloud.py`

2. Read through the code and ask questions

3. Edit the values of the

   `GOOGLE_APPLICATION_CREDENTIALS` & `project_id`

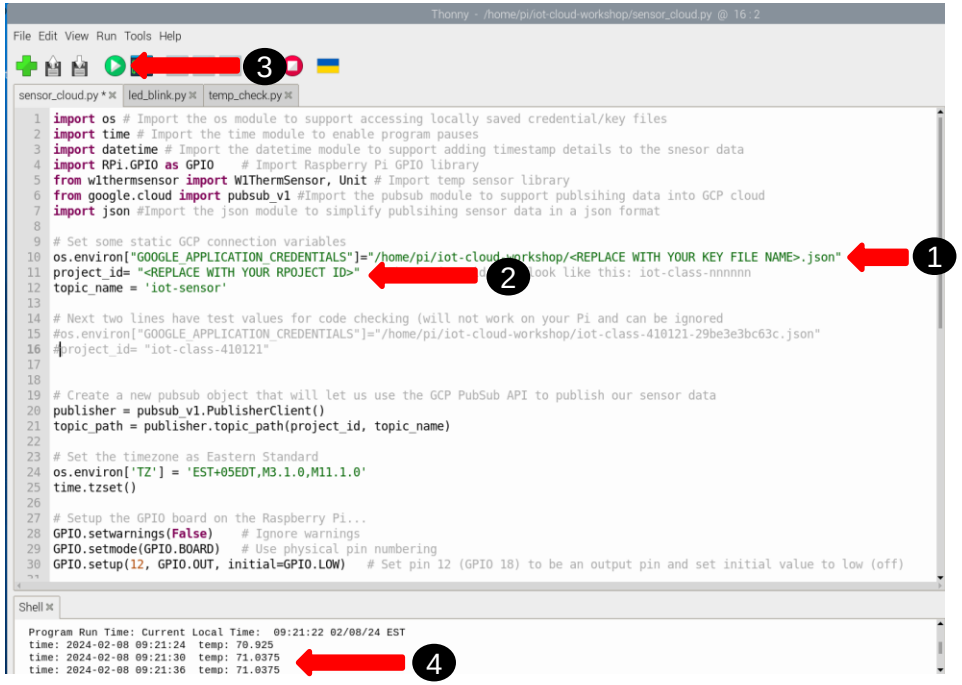
   variables to match your environment

4. Click the ▶ button and check to see if temp

   readings print to the screen

5. Press CTRL+C to stop the program

Raspberry Pi®

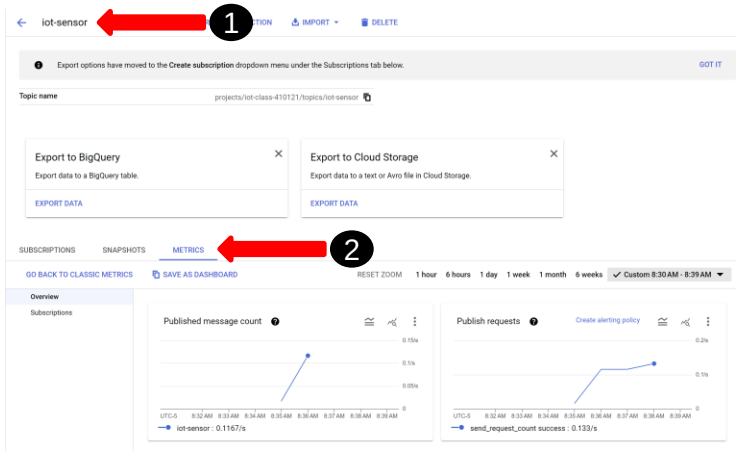


IoT RPI GCP

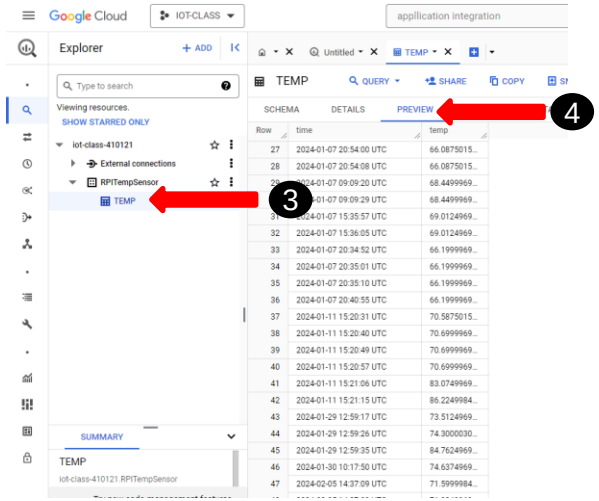
Google Cloud Platform (GCP)

STEP 7: CREATE PUB/SUB TOPIC

1. Open your iot-sensor Pub/Sub topic and click the METRICS tab to ensure messages are being published to the topic



2. Open BigQuery Studio and verify that data is being collected in your TEMP table via the subscription (click the PREVIEW tab)



CHECKPOINT

Everyone has successfully streamed temperature data from the Raspberry Pi into GCP

(*Pub/Sub Stats & BigQuery table contents show successful publishing of data*)

IoT | RPI | GCP

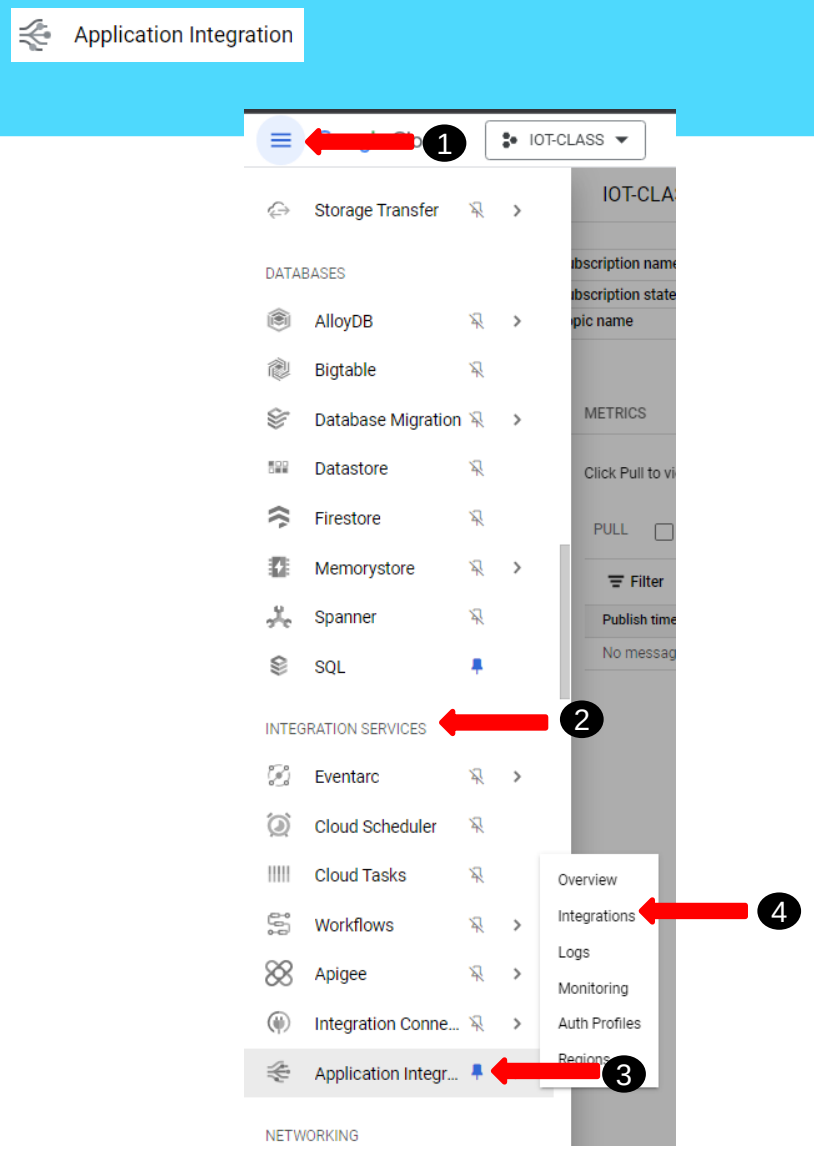
Google Cloud Platform (GCP)

STEP 8: Alerting

We will use the GCP Application Integration tool to create an email alert when the temperature from our IoT sensor exceeds a certain value.

From the nav menu, expand ‘MORE PRODUCTS’ at the bottom and scroll down to ‘INTEGRATION SERVICES”.

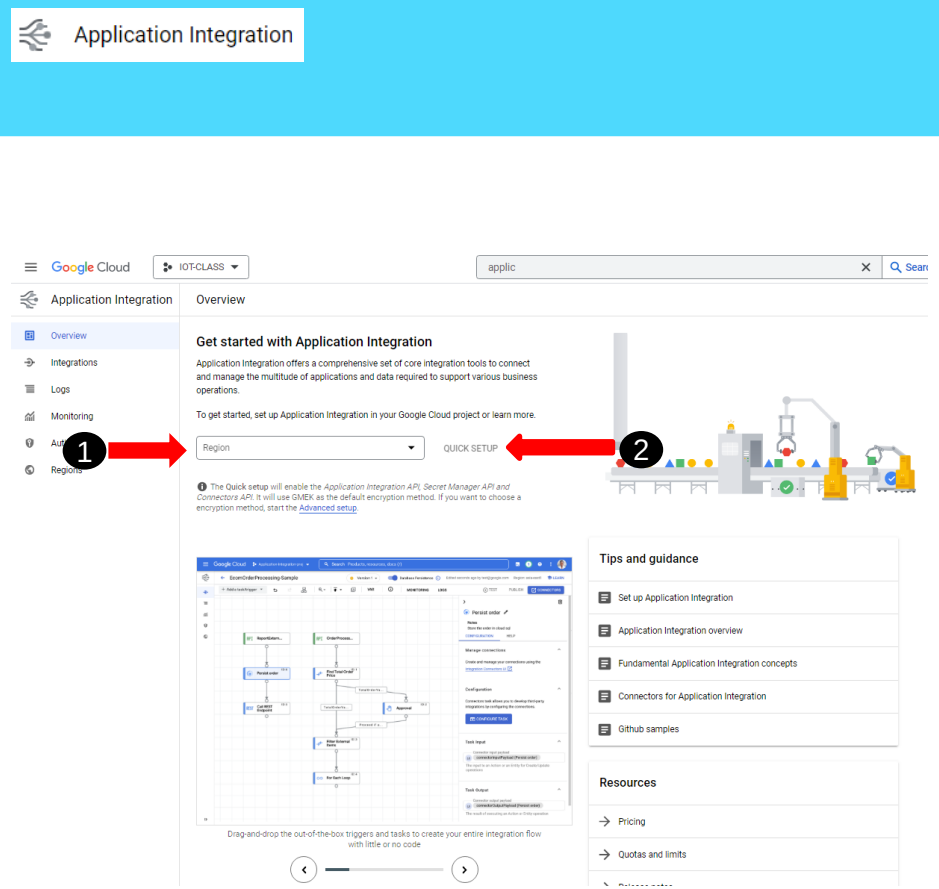
Select ‘Application Integration’ and then ‘Integrations’.



Google Cloud Platform (GCP)

STEP 8: ALERTING

You will see the App Integrations overview page. Select the '*us-east1*' region from the pick-list and then click the QUICK SETUP link.



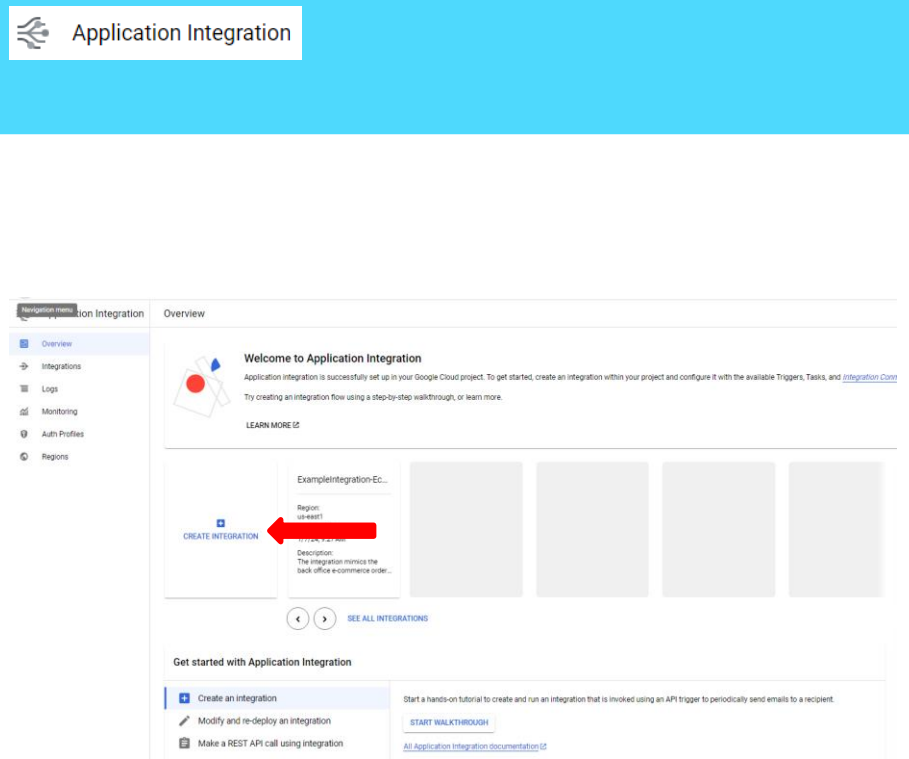
IoT RPI GCP

Google Cloud Platform (GCP)

STEP 8: ALERTING

It will take a few moments while the App Integration service gets deployed and then you will see this screen.

Click the + CREATE INTEGRATION button

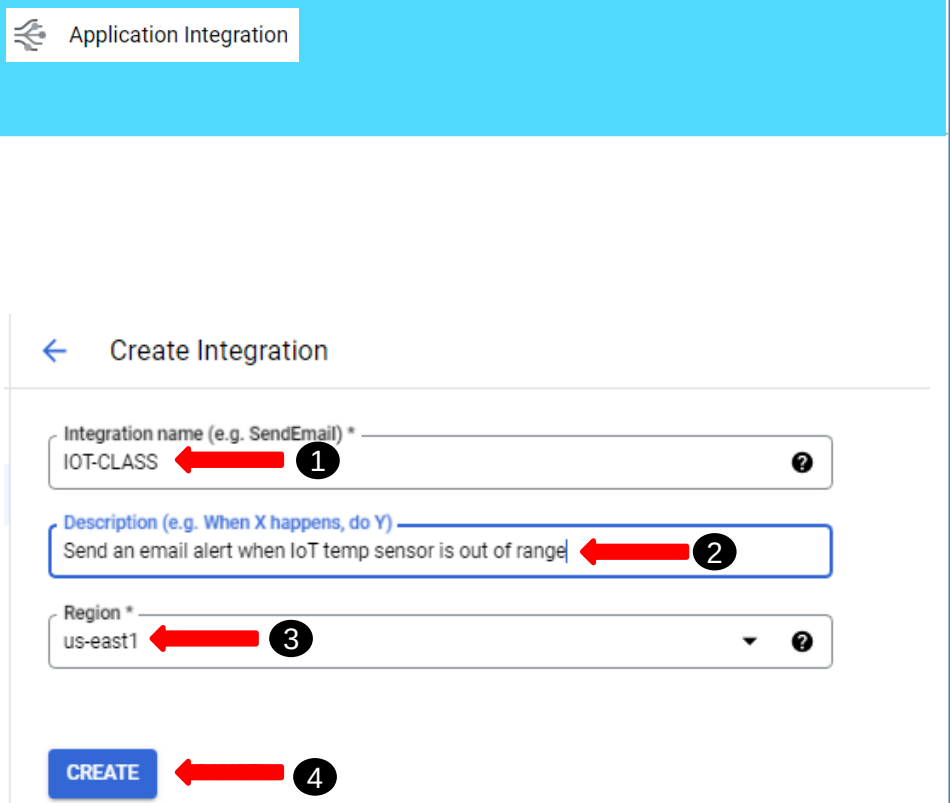


IoT | RPI | GCP

Google Cloud Platform (GCP)

STEP 8: ALERTING

1. Type '*IOT-CLASS*' for the Integration name
2. Enter a description like the one in the screen shot
3. Ensure that the Region is set to '*us-east1*'
4. Click the CREATE button

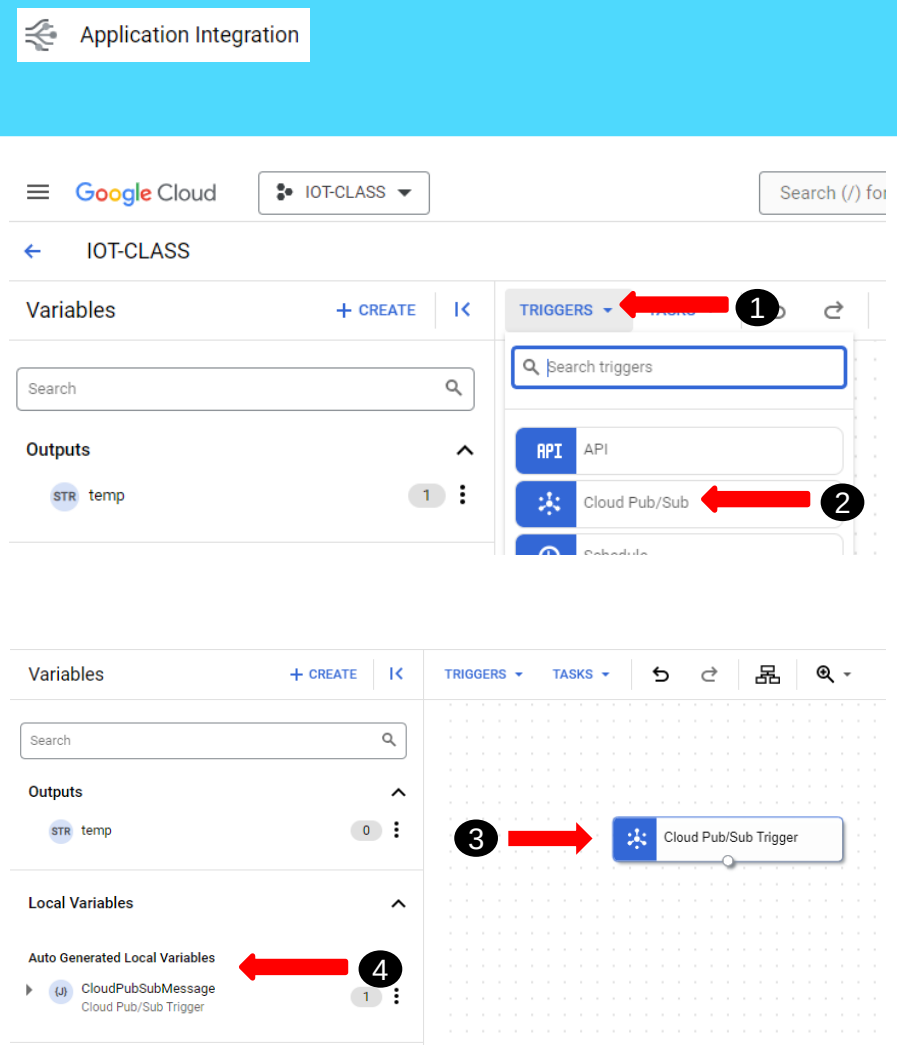


Google Cloud Platform (GCP)

STEP 8: ALERTING

1. Select the TRIGGERS pick-list and choose Cloud Pub/Sub

2. Drag and drop the Cloud Pub/Sub Trigger trigger widget onto the App Integration workflow editor screen. You will see new Auto-Generated Local Variables appear in the left-hand pane

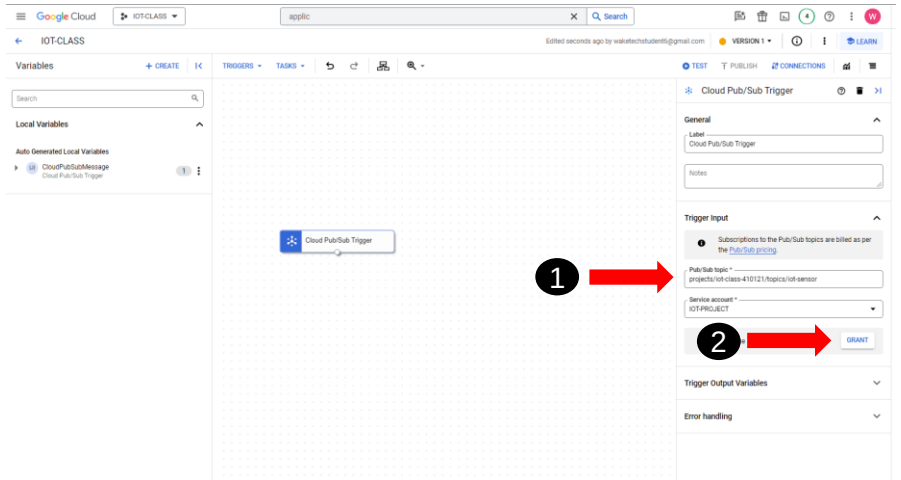


Google Cloud Platform (GCP)

Application Integration

STEP 8: ALERTING

1. In the right-hand details pane, type the Pub/Sub topic name that you created in a prior step into the Trigger input field. *(It will look something like* `projects/iot-class-410121/topics/iot-sensor` *you can open another browser tab and bring up the pub/sub topic details screen to easily copy the name value if needed)*



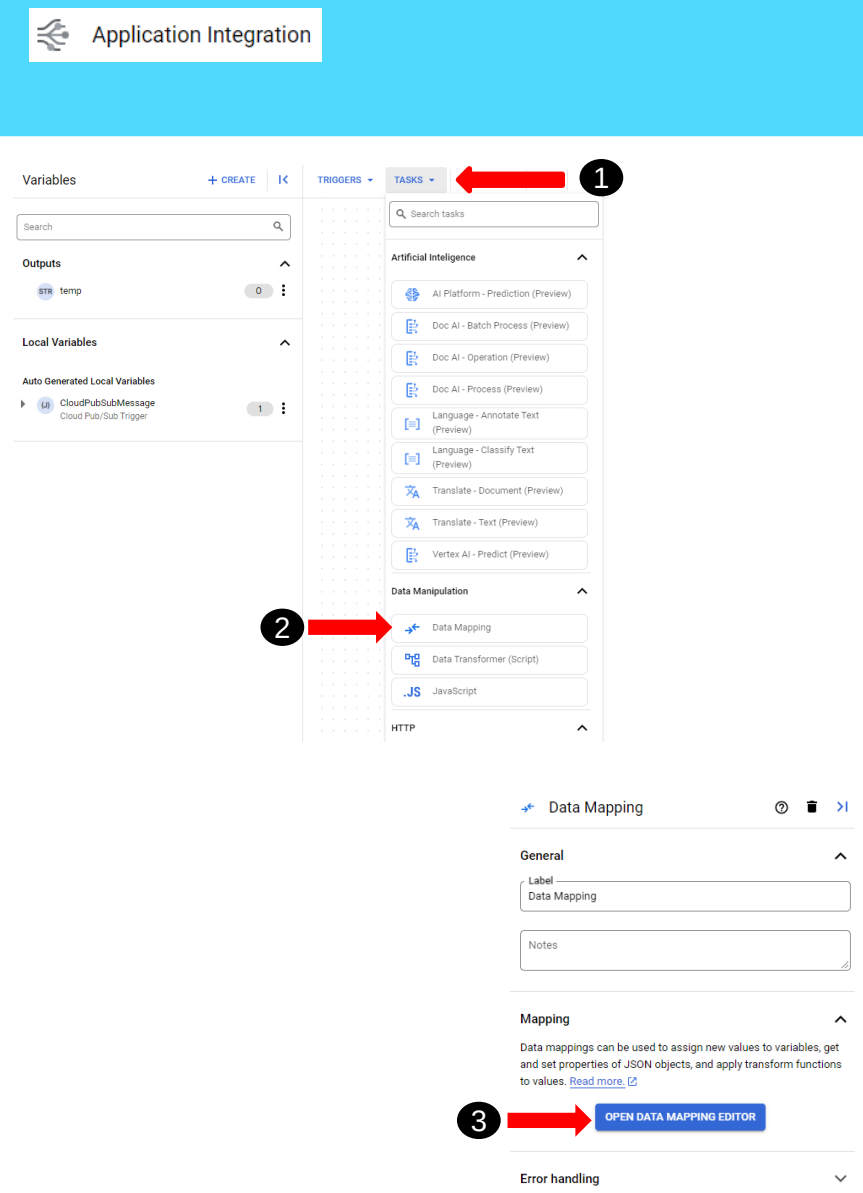
2. Select the 'IOT-PROJECT' service account and click the GRANT button to assign the relevant IAM role.

IoT | RPI | GCP

Google Cloud Platform (GCP)

STEP 8: ALERTING

1. Select the TASKS pick-list, scroll to the ‘Data Manipulation’ section and choose Data Mapping
2. Drop the Data Mapping ID: 1 widget onto the App Integration editor screen.
3. The Data Mapping details pane will appear on the right - Click on the OPEN DATA MAPPING EDITOR button

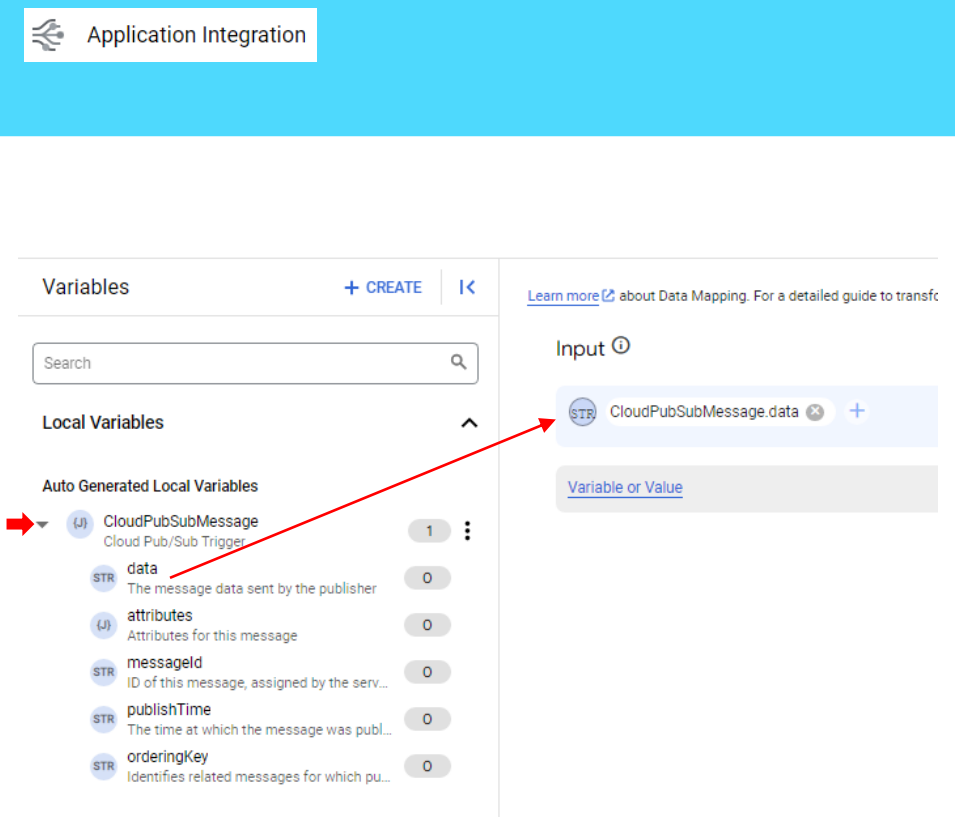


IoT RPI GCP

Google Cloud Platform (GCP)

STEP 8: ALERTING

1. In the left panel under ‘Local Variables’ click the down-arrow to expand the CloudPubSubMessage variable and then click and drag the ‘data’ variable into the ‘Input’ section of the Data Mapping Task Editor



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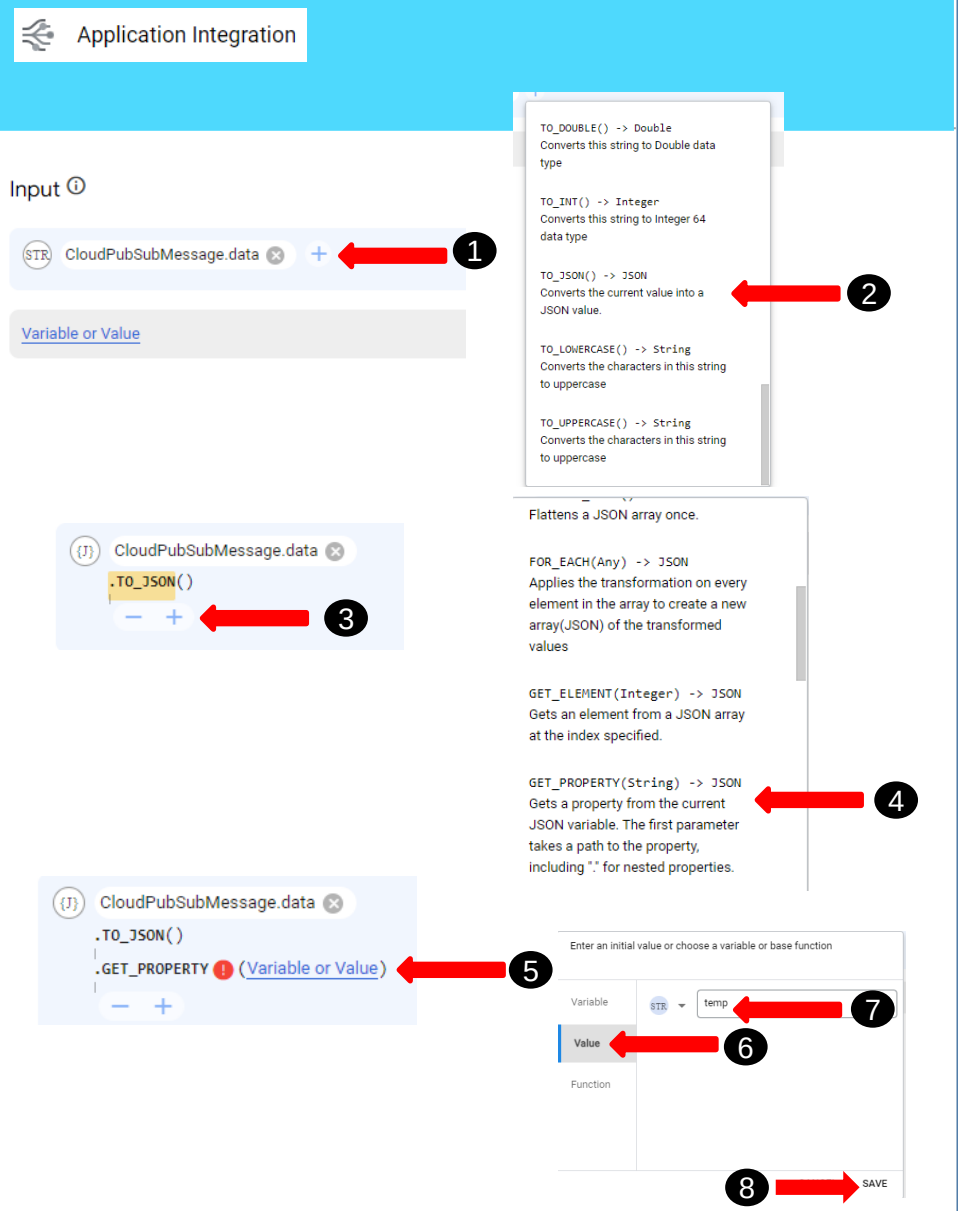
Google Cloud Platform (GCP)

STEP 8: ALERTING

1. Click the + button to the right of the CloudPubSubMessage.data variable to add a function.
2. Scroll down and choose the ".TO_JSON" function.
3. Click the + button again to add another function and choose ".GET_PROPERTY(string)".
4. Click the "(Variable or Value) link and select 'Value' in the left column. Name the value 'temp' and click 'Save'



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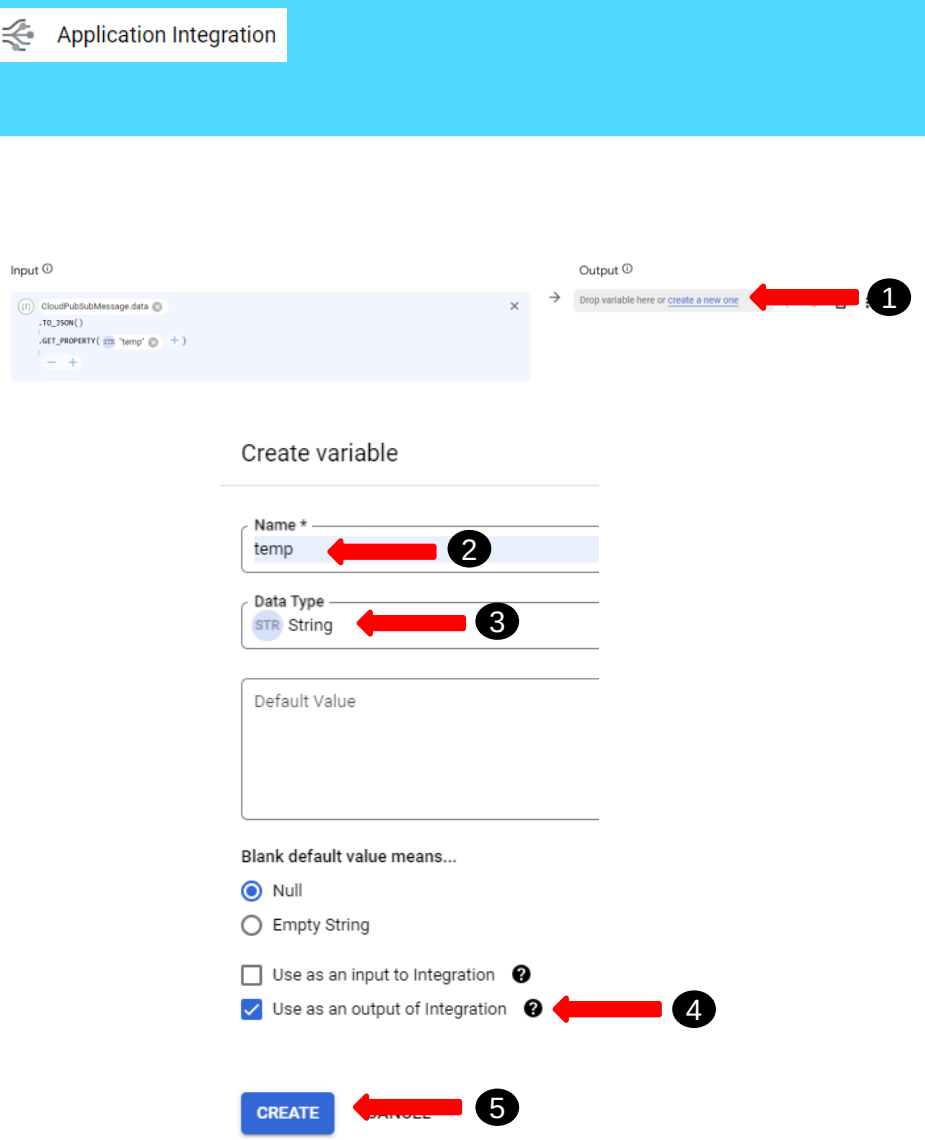
Google Cloud Platform (GCP)

STEP 8: ALERTING

1. Click on the ‘create a new one’ link under the Output section of the data mapping editor
2. In the ‘Create variable’ window that opens, name it ‘temp’, set the Data Type to ‘String’, and check the ‘Use as an ouput of integration’ box
3. Click the CREATE button



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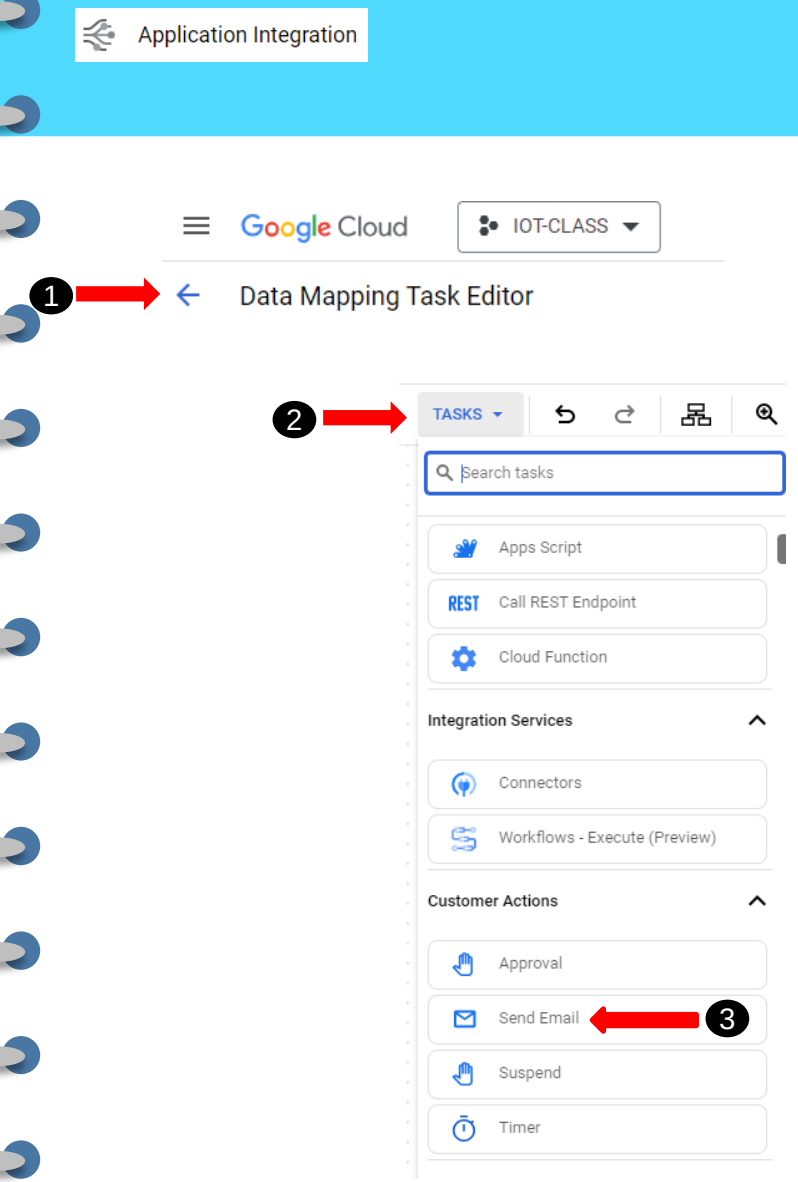
Google Cloud Platform (GCP)

STEP 8: ALERTING

1. Click the left-pointing arrow in the upper left of the screen to exit the Data Mapping Task Editor back to the main Application Integration Workflow Editor screen
2. Click the TASKS widget once more, scroll down to the ‘Customer Actions’ section and select the Send Email task and drop it into the workflow.



IoT | RPI | GCP

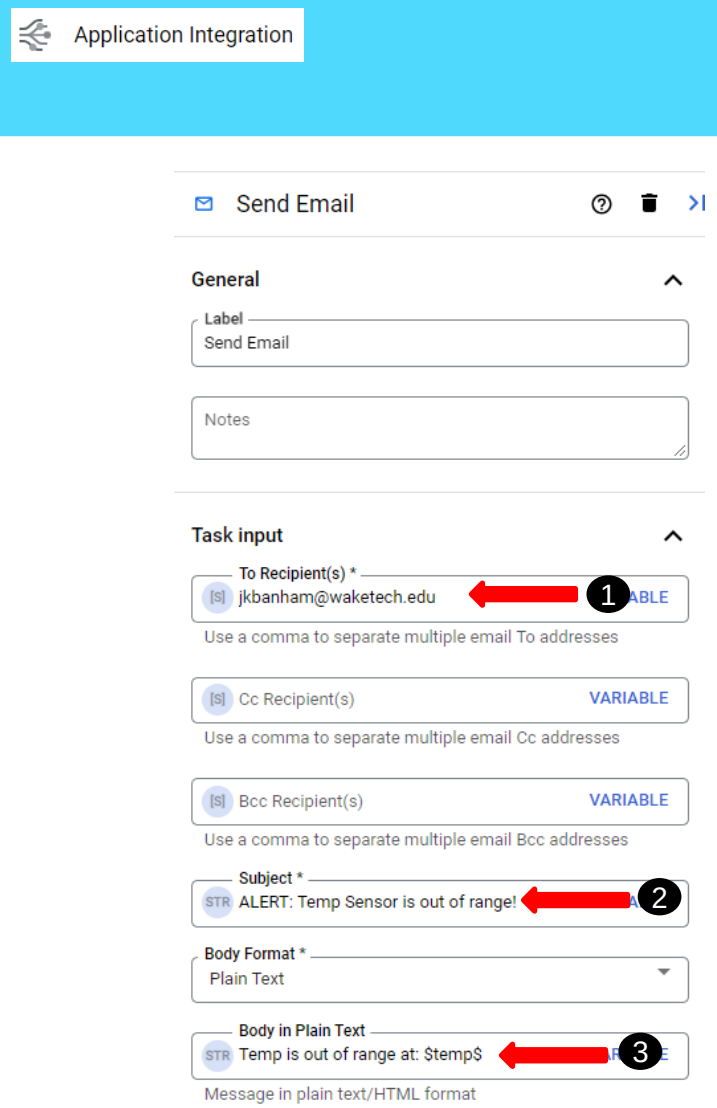
Google Cloud Platform (GCP)

STEP 8: ALERTING

1. In the Send Email detail panel that appears on the right – complete the fields as shown in the screenshot. Note the following:

- Use your own email address as the recipient
- Be sure to include the variable name in the Body variable enclosed in dollar sign characters: `$temp$`

** Note that you can get fancy with an HTML formatted message if desired!*



IoT RPI GCP

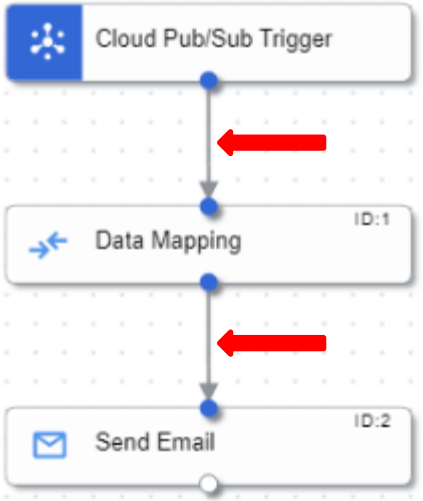
Google Cloud Platform (GCP)

STEP 8: ALERTING

Now link the tasks to build the workflow by clicking on the circle at the bottom of the Cloud Pub/Sub Trigger task and drag the connector down to the Data Mapping Task. Do the same thing to connect the Data Mapping task to the Send Email task.

These arrows are referred to as 'Edge Connectors' between the workflow elements

Application Integration



IoT RPI GCP

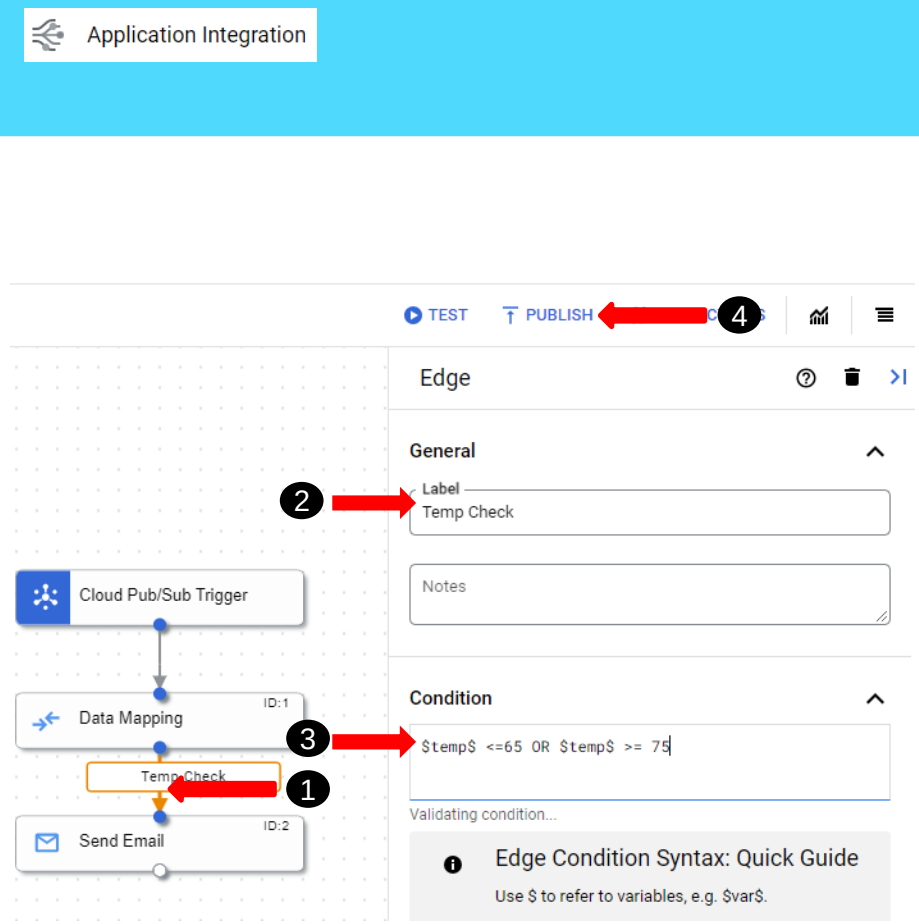
Google Cloud Platform (GCP)

STEP 8: ALERTING

1. Click on the Edge connector line between the Data Mapping and Send Email widgets and its properties pane will appear on the right
2. Set the Label value to ‘Temp Check’
3. Set the Condition value to:

```
$temp$ <= 65 OR $temp$ >= 75
```

4. Click the PUBLISH button to activate the workflow.



IoT RPI GCP

Raspberry Pi Code

1. In the Thonny IDE, if it's not already open, open the file named

   `/home/pi/iot-cloud-workshop/sensor_cloud.py`

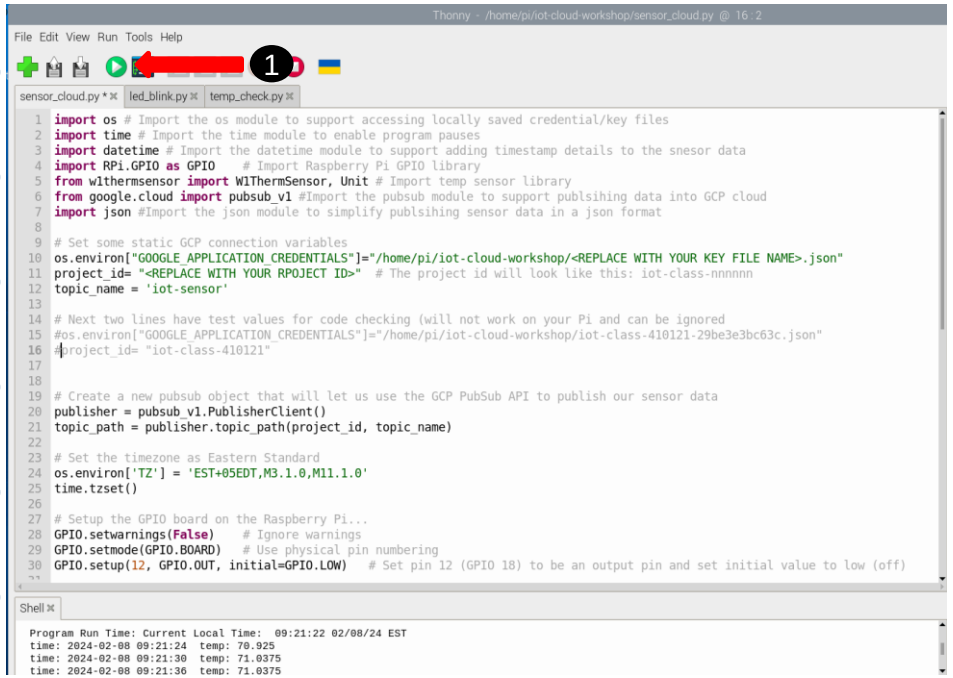
2. Click the ▶ button

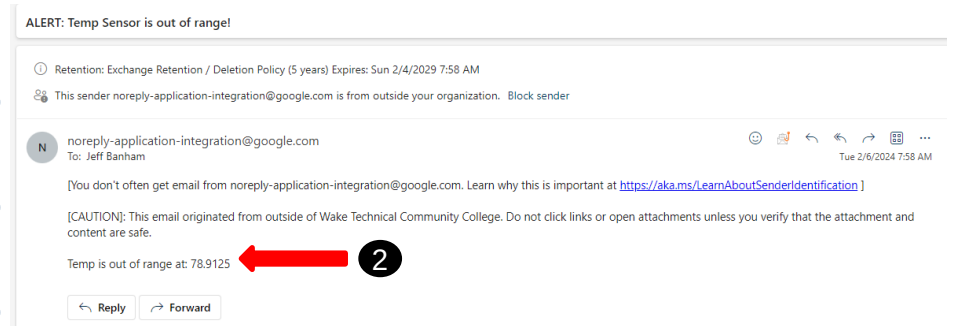
3. Try raising the temp (by holding your fingers on the sensor)

4. Check if you are receiving the email alerts when temp exceeds limit

5. Press CTRL+C to stop the program

Raspberry Pi®





CHECKPOINT

Everyone can successfully generate an email alert when temp exceeds coded limit

IoT | RPI | GCP

Google Cloud Platform (GCP)

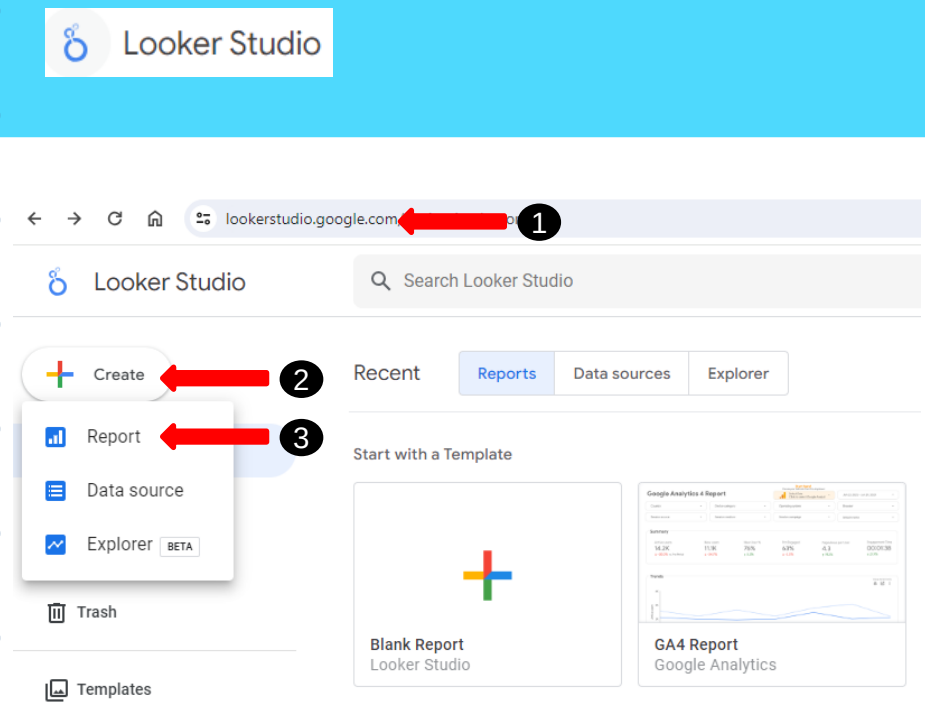
STEP 10: REPORTING

1. In a new browser tab, open

   https://lookerstudio.google.com

2. Click the Create button and

then select Report



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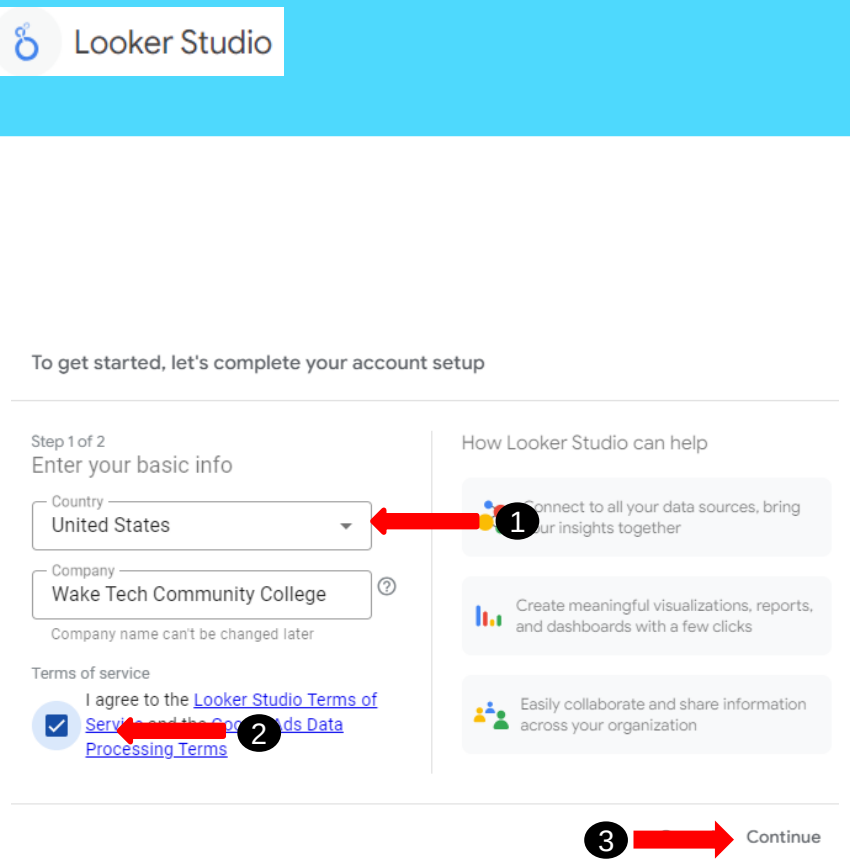
Google Cloud Platform (GCP)

STEP 10: REPORTING

You'll be prompted to complete setting up your Looker Studio account. Fill in the form and agree to the service terms, and click 'Continue' – On the following screen (not shown), answer the 3 questions and click 'Continue' again



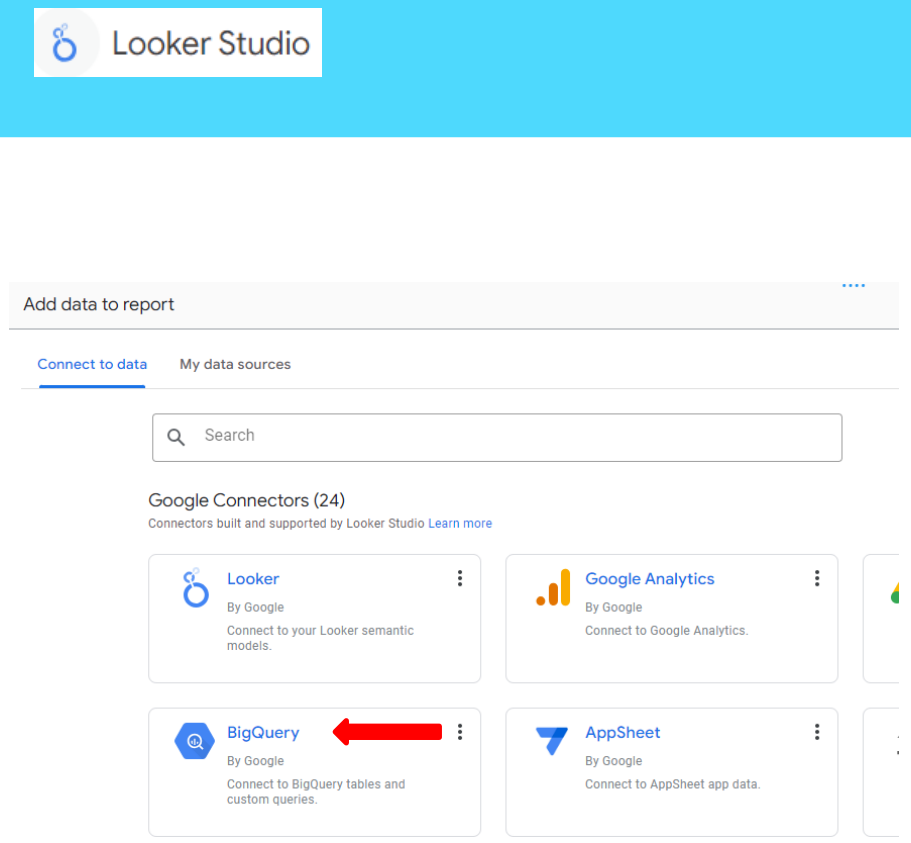
IoT RPI GCP

Google Cloud Platform (GCP)

STEP 10: REPORTING

On the ‘Add data to report’ screen,

select the BigQuery connector



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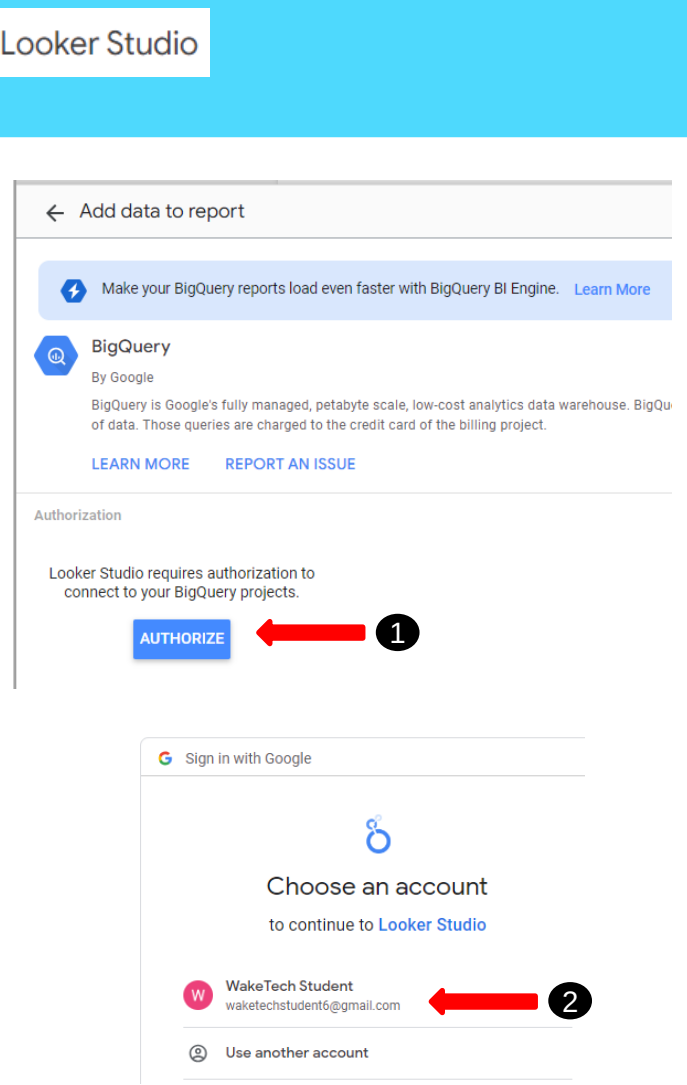
Google Cloud Platform (GCP)

STEP 10: REPORTING

Click the ‘Authorize’ button to allow Looker Studio to connect to BQ and then select your account



IoT RPI GCP

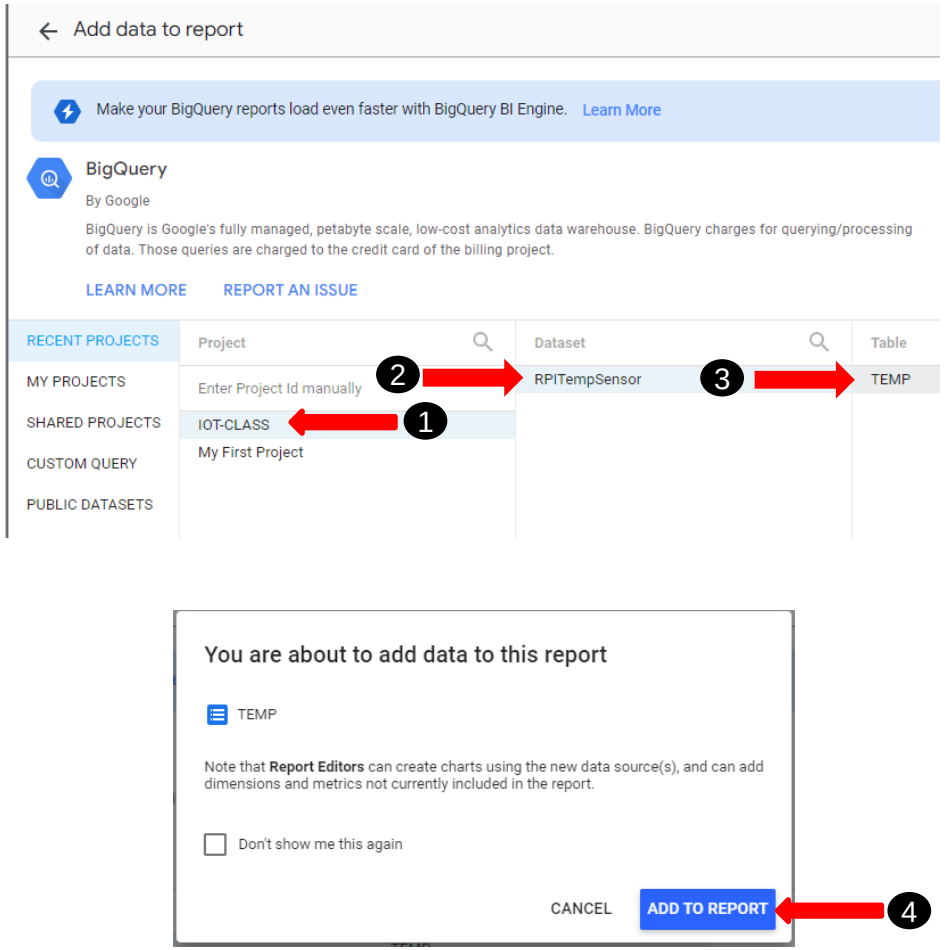
Google Cloud Platform (GCP)

STEP 10: REPORTING

Select your ‘IOT-CLASS’ project, RPITempSensor Dataset, and TEMP table and then click the Add button in the lower right (not shown in screen shot)

On the next screen, click the ADD TO REPORT button

Looker Studio



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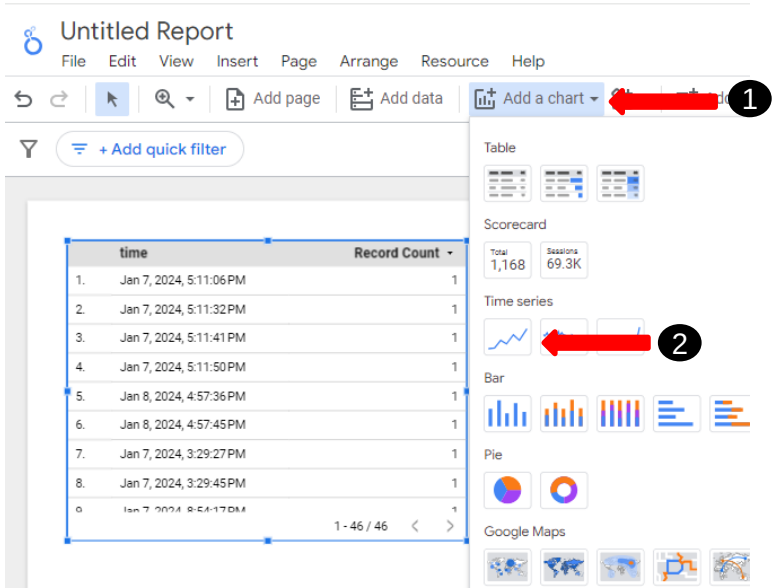
Looker Studio

STEP 10: REPORTING

Click the ‘Add a chart’ button and then

select the first time series chart type



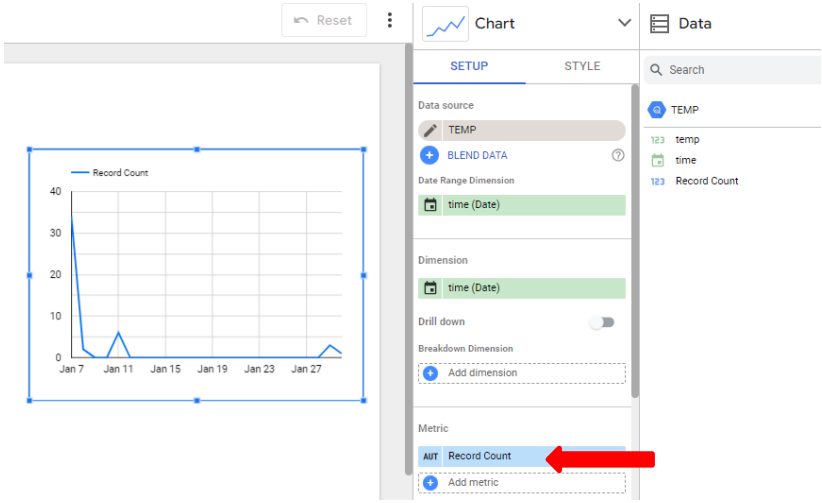
IoT RPI GCP

Google Cloud Platform (GCP)

STEP 10: REPORTING

Note that the default chart settings just map the record count metric over time.

Looker Studio



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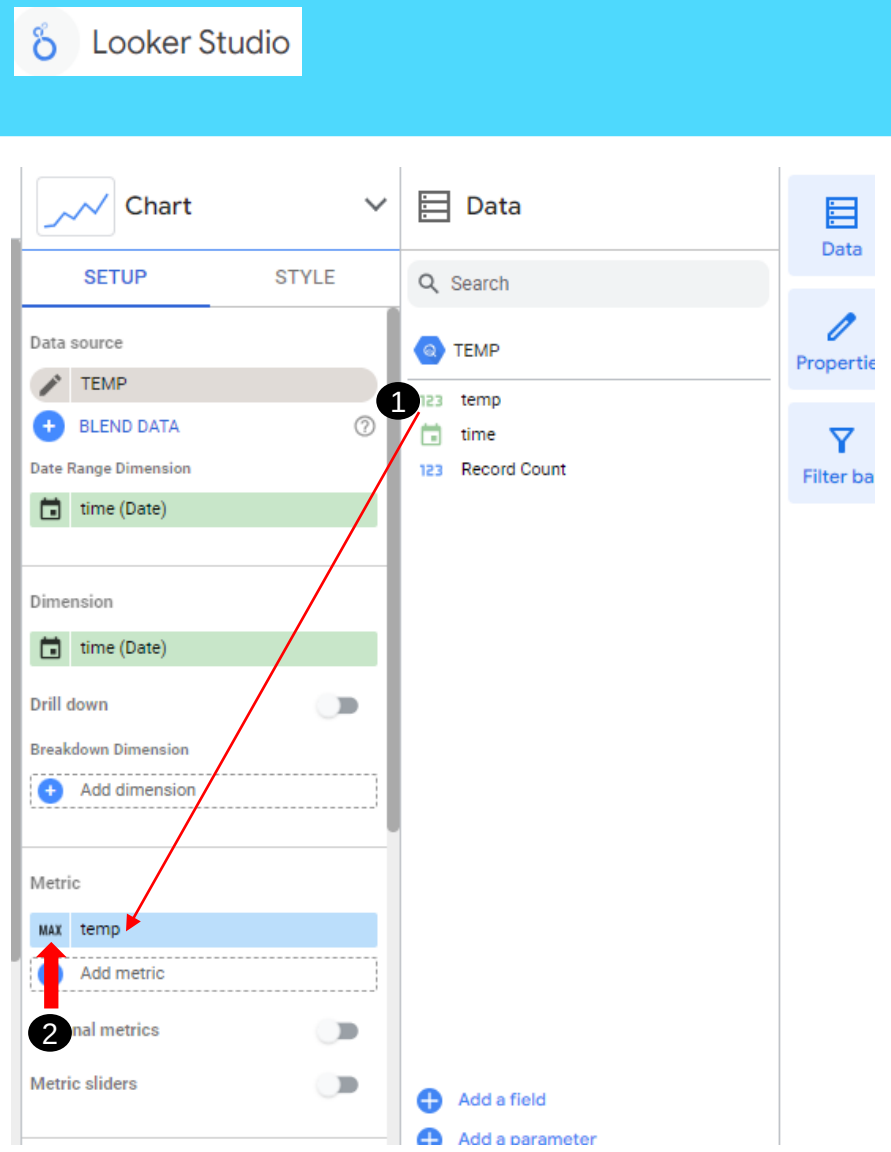
Google Cloud Platform (GCP)

STEP 10: REPORTING

Drag the ‘temp’ field from the ‘Data’ column into the ‘Metric’ section of the Chart column. Click on the metric type field and change the value from ‘Sum’ to ‘Max’. Click the ‘X’ next to the ‘Record Count’ field under Metric to remove it (not shown in screen shot)



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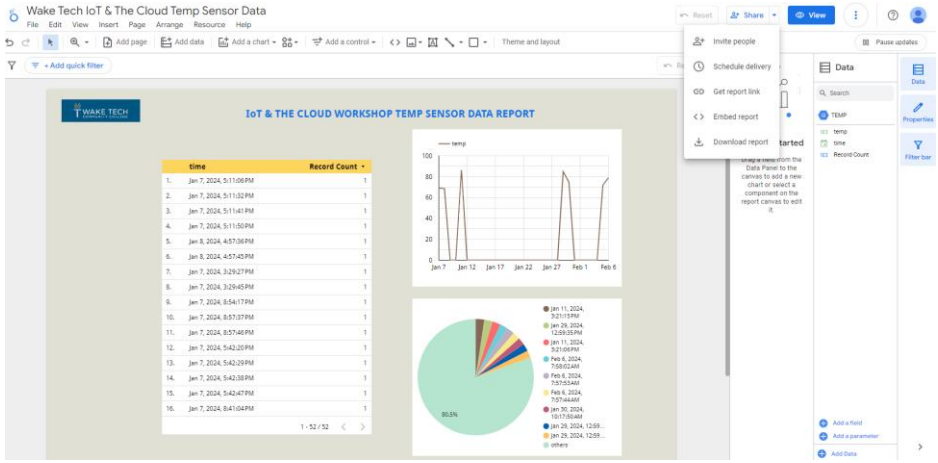
Google Cloud Platform (GCP)

Looker Studio

STEP 10: REPORTING

Depending on available time, play around with the various settings and see what you can come up with for a report.

Note the options for sharing it also!



WHAT'S NEXT?

- Take your kit home!
- Try other sensors
- Check out AWS & Azure
- Check out sample projects on the internet:
  - Tom's Hardware
  - PC Magazine
  - Raspberry Pi Forums

KEEP LEARNING

COLLABORATE

STAY IN TOUCH!

Please take a moment to complete this short feedback form – it will help us to improve the workshop for future students!

https://forms.office.com/r/UKRPBbb81X

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The opinions, findings, and conclusions or recommendations expressed are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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