Azure IoT Academy Month Two Day One

1. Introduction

Video: https://youtu.be/lJK0h1f7avY

This hands on lab seeks to introduce the student to the following Azure Services and Technologies:

- Visual Studio Code
- Azure IoT Hub
- Azure Device Provisioning Service (DPS)
- Azure Virtual Machines
- Azure Edge for Linux on Windows (EFLOW)
- Azure IoT Edge Routing
- Azure IoT Edge Stream Analytics (ASA) Module
- Azure Logic Apps
- Azure Monitor & Azure Log Analytics

These services are explored as they're often part of overall IoT solutions. A simplistic approach is taken with this lab to allow to reach many audiences of varying technical experience.

Ideally students taking this course will have:

- Familiarity with the Azure Portal. https://portal.azure.com
- Completed IoT Academy Month One Content

A good way to become familiar with Azure IoT is to follow Azure IoT Developer Specialty certification path. You can read more at the following link: https://docs.microsoft.com/en-us/learn/certifications/exams/az-220

Course Content

2. Prerequisites

2.1. Install VS Code

Visual Studio Code Download

2.2. Install VS Code Extensions

1. Click extensions
2. Search for `azure iot`
3. Click install for the `Azure IoT Tools` extension pack
4. Search for `bicep`
5. Click install for the `Bicep`

2.3. Please ensure you cloned the IoT Academy Repo locally to your machine

2.4. Install Azure CLI

- https://docs.microsoft.com/en-us/cli/azure/install-azure-cli

2.5. Install Azure CLI Bicep Extension

2.6. Supporting Materials

- https://docs.microsoft.com/en-us/azure/azure-resource-manager/bicep/install

Open your terminal in VS Code and run the following commands Terminal -> New Terminal if not open yet

```
az bicep install
az bicep upgrade
az bicep version
```

3. Exercise: Deploy Azure Lab Resources with Bicep

Video: https://youtu.be/TMgfs9Eh2xY

3.1. Resources

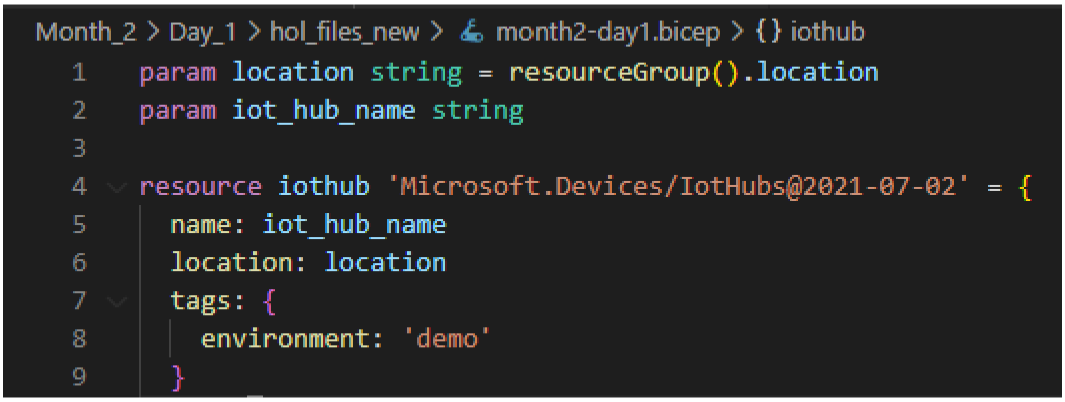
https://docs.microsoft.com/en-us/azure/azure-resource-manager/bicep/overview?tabs=bicep
https://docs.microsoft.com/en-us/azure/azure-resource-manager/bicep/parameters
https://docs.microsoft.com/en-us/azure/azure-resource-manager/templates/

3.2. Review the Bicep file

1. Within the github repo: (https://github.com/AzureIoTGBB/iot-academy-april-2022-internal/tree/main/Month_2/Day_1/hol_files)
2. Locate the file at the following location and review the contents.`Month_2/Day_1/hol_files/month2_day1.bicep`

You'll see in the file:

- two resources
- two accepted parameters for iot_hub_name and location

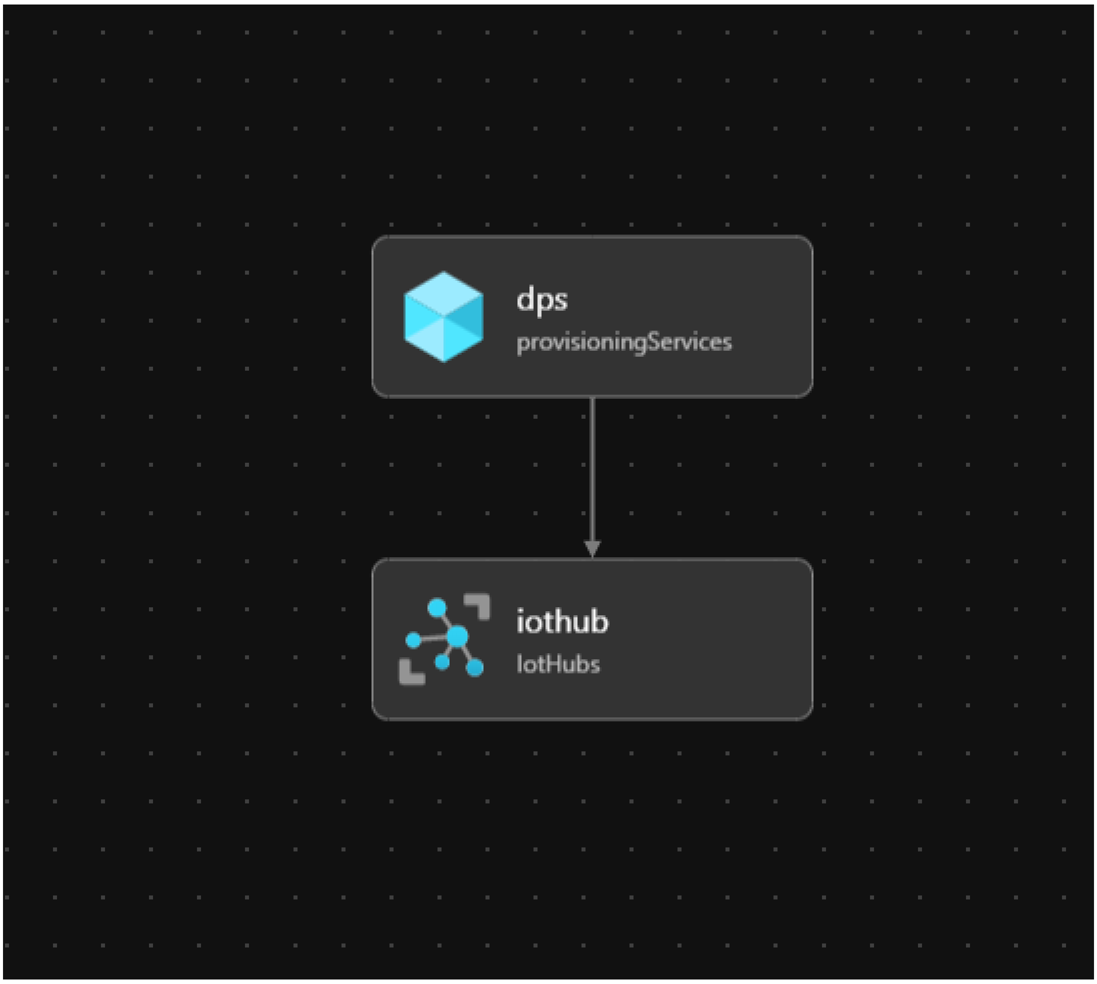


Month_2 > Day_1 > hol_files_new > month2-day1.bicep > {} iothub

```
param location string = resourceGroup().location
param iot_hub_name string

resource iothub 'Microsoft.Devices/IotHubs@2021-07-02' = {
  name: iot_hub_name
  location: location
  tags: {
    environment: 'demo'
  }
```

3.3. Use the Bicep visualizer to review the resources

1. Within VS Code trigger the command pallette Ctrl+Shift+P, or click View, command pallette from the menu.
2. Type `visual` and select the `Bicep: Open Bicep Visualizer to the Side` entry, press enter.
3. Select your Bicep file located at `Month_2/Day_1/hol_files/month2_day1.bicep`
4. Review the diagram as seen below



3.4. Edit your bicep parameters file

1. Look for the `Month_2/Day_1/hol_files/month2_day1_params.json` file and open it
2. Edit the following values:
    1. first_name
    2. last_name
    3. favorite_animal: this could be any random string value. This is used in the Bicep template to ensure unique resource names are achieved

3.5. Ensure you've selected your subscription and correct tenant

1. Run the following command to ensure your subscription is currently default

    ```
    az account show
    ```

2. If the correct subscription is selected skip this step

    1. If your subscription is listed but not default run this step

    ```
    az account set -s "YourSubscriptionIdGoesHere"
    ```

    2. Skip the following steps if you subscription is already set correctly. If not, continue.
    3. If your subscription is not listed you've logged into the wrong tenant. Run the following command to logout and login to the correct tenant.

    ```
    az logout
    az login
    ```

    4. List all of your subscriptions to find the right subscriptionId

    ```
    az account show
    ```

    5. Find your SubscriptionId and run step 1 to make it default

3. Save your SubscriptionId in your notepad. When running `az account show` your SubscriptionID is the `"id"` field

3.6. Create an Azure Resource Group

In your terminal run the following command. Ensure you replace the location with the correct value. After the command is run `"provisioningState": "Succeeded"` can be observed in the result

```
az group create --name rg-iot-academy --location northcentralus
```

3.7. Deploy Lab resources with an Azure Resource Manager Deployment

The resources deployed are:

- IoT Hub
- DPS
- Logic App: used in a later part of the lab

1. Change your terminal to the hol_files directory

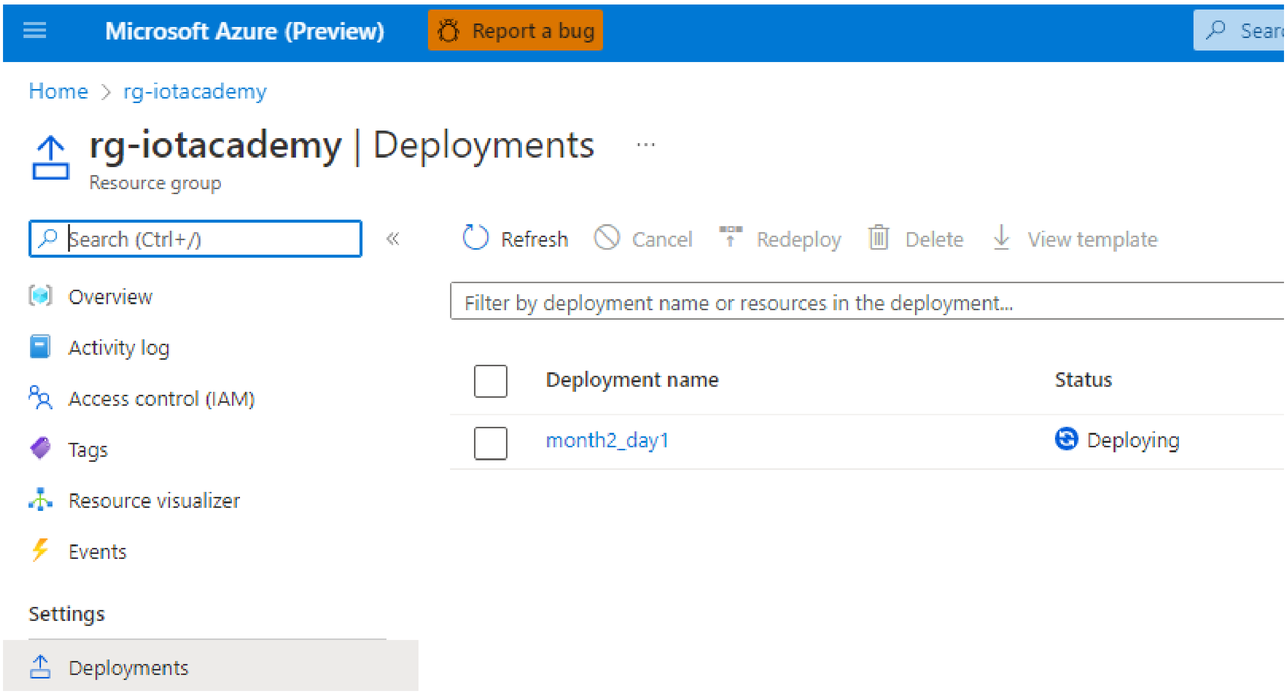
```
cd Month_2/Day_1/hol_files
```

2. Run the following command in your terminal in VS Code

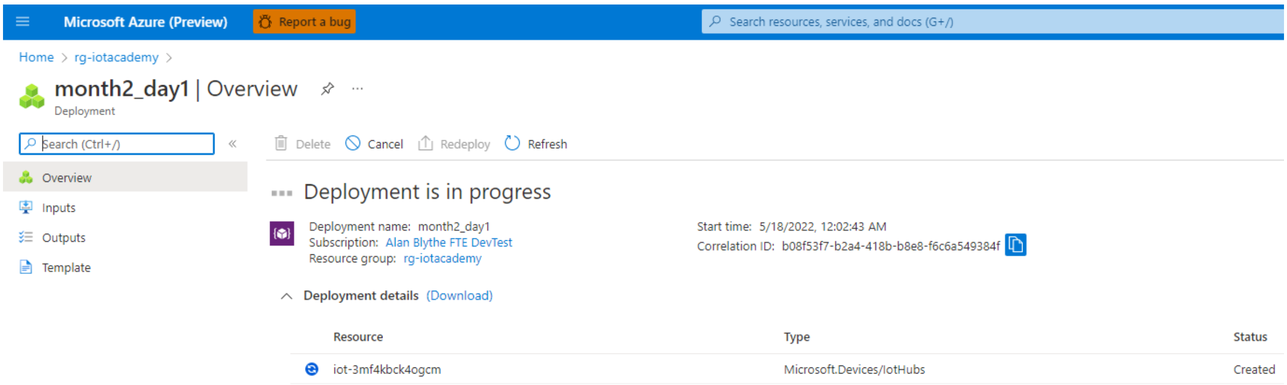
```
az deployment group create --resource-group rg-iot-academy --template-file
month2_day1.bicep --parameters month2_day1_params.json
```

3. Go to the Azure Portal, find an open the `rg-iot-academy` resource group.

4. Click Deployments, and click the first your deployment in the list. Review the following screenshots for what to expect



☐	Deployment name	Status
☐	month2_day1	Deploying



month2_day1 | Overview
Deployment

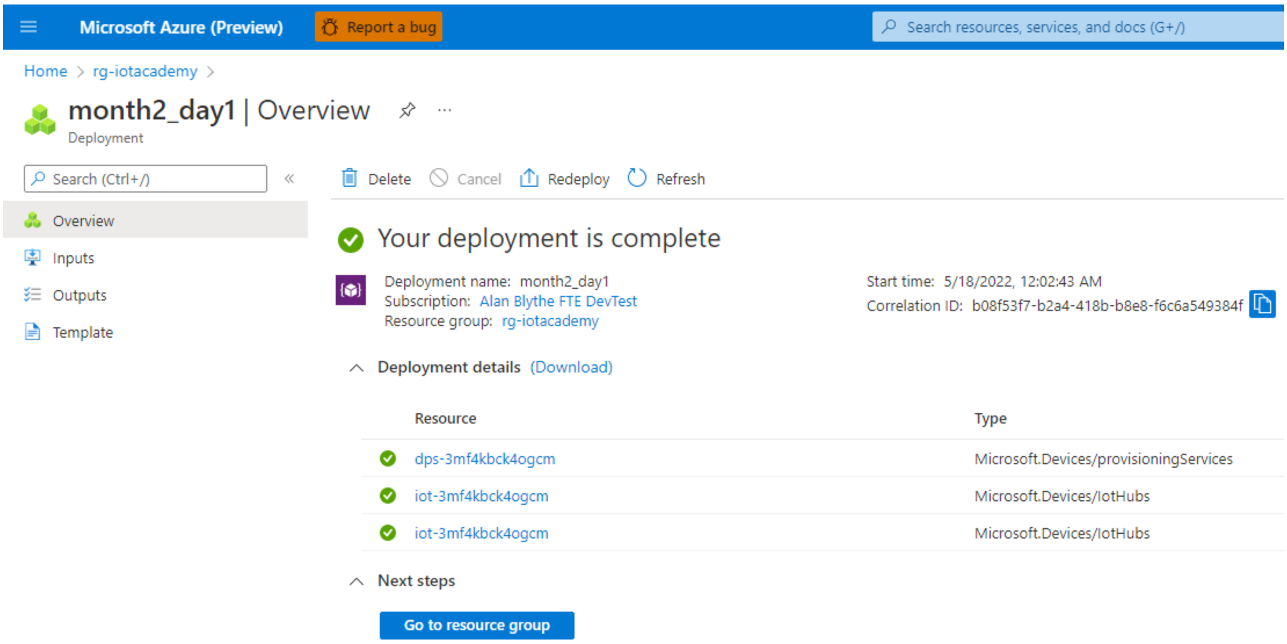
Deployment is in progress

Deployment name: month2_day1
Subscription: Alan Blythe FTE DevTest
Resource group: rg-iotacademy

Start time: 5/18/2022, 12:02:43 AM
Correlation ID: b08f53f7-b2a4-418b-b8e8-f6c6a549384f

Deployment details (Download)

Resource	Type	Status
iot-3mf4kbck4ogcm	Microsoft.Devices/IotHubs	Created



month2_day1 | Overview
Deployment

Your deployment is complete

Deployment name: month2_day1
Subscription: Alan Blythe FTE DevTest
Resource group: rg-iotacademy

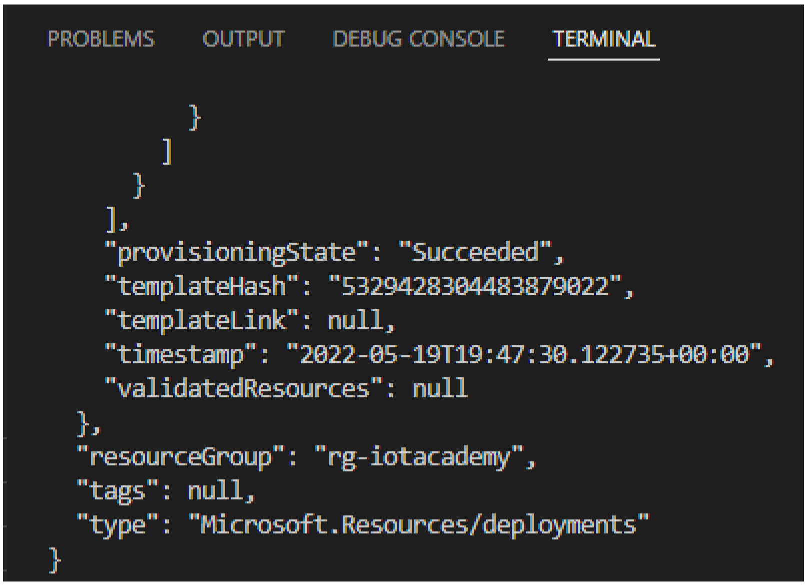
Start time: 5/18/2022, 12:02:43 AM
Correlation ID: b08f53f7-b2a4-418b-b8e8-f6c6a549384f

Deployment details (Download)

Resource	Type
dps-3mf4kbck4ogcm	Microsoft.Devices/provisioningServices
iot-3mf4kbck4ogcm	Microsoft.Devices/IotHubs
iot-3mf4kbck4ogcm	Microsoft.Devices/IotHubs

Next steps

5. When the command is done running expect the following in your terminal



```
          }
        ]
      }
    ],
    "provisioningState": "Succeeded",
    "templateHash": "5329428304483879022",
    "templateLink": null,
    "timestamp": "2022-05-19T19:47:30.122735+00:00",
    "validatedResources": null
  },
  "resourceGroup": "rg-iotacademy",
  "tags": null,
  "type": "Microsoft.Resources/deployments"
}
```

4. Exercise: Deploy a Windows 10 Azure VM

Video: https://youtu.be/JffdKqj1kGA

Next, let's:

- Deploy an Azure Windows 10 VM using Bicep

- Add an IoT Edge Device
- Retrieve Device Credentials for the Edge Device
- RDP to the Windows 10 VM to install and configure EFLOW

Some links that cover EFLOW and the steps in this section https://docs.microsoft.com/en-us/azure/iot-edge/iot-edge-for-linux-on-windows?view=iotedge-2020-11 https://docs.microsoft.com/en-us/azure/iot-edge/quickstart?view=iotedge-2020-11#code-try-0

4.1. Deploy another bicep template to create the VM

Note: when picking the vm_size it the VM has to support Nested Virtualization. Some good options are: Standard_D2_v3 Standard_D2_v4 Standard_D2s_v3 Standard_D2s_v4

All the VM SKUs can be reviewed at the following link: https://docs.microsoft.com/en-us/azure/virtual-machines/sizes-general

1. Open the `Month_2/Day_1/hol_files/createvm.bicep` file and review the contents. Notice many resources in this file and the time savings this provides.

2. Open the `Month_2/Day_1/hol_files/createvm_params.json` file

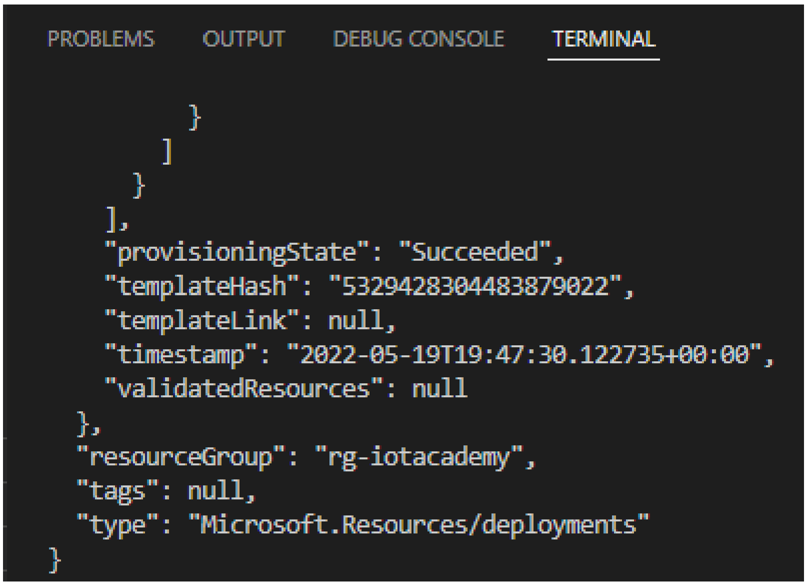
3. Set the values of the fields similarly to the previous Bicep deployment

   1. vm_size: you may need to find an available size in your selected location. This could be done by using the Azure Portal to create a VM and cancelling the process before **Review and Create**
   2. vm_admin_password: change the value to your preference or leave default.
   3. client_ipaddress: as in Month 1. Use bing and search for `what is my ip`, replace with the found value
   4. first_name: ensure you use the same value from your other Bicep params file
   5. last_name: ensure you use the same value from your other Bicep params file
   6. favorite_animal: ensure you use the same value from your other Bicep params file

4. Create your deployment group to Deploy your VM Bicep template

```
az deployment group create --resource-group rg-iot-academy --template-file
createvm.bicep --parameters createvm_params.json
```

When you complete you'll see Succeeded



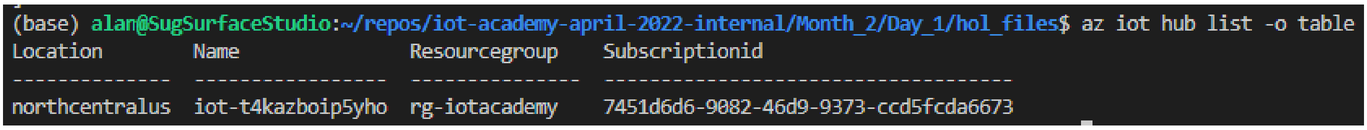
```
            }
          ]
        }
      ],
      "provisioningState": "Succeeded",
      "templateHash": "5329428304483879022",
      "templateLink": null,
      "timestamp": "2022-05-19T19:47:30.122735+00:00",
      "validatedResources": null
    },
    "resourceGroup": "rg-iotacademy",
    "tags": null,
    "type": "Microsoft.Resources/deployments"
  }
```

4.2. Create an Azure IoT DPS Enrollment

Resources https://docs.microsoft.com/en-us/cli/azure/iot/dps/enrollment?view=azure-cli-latest#az-iot-dps-enrollment-create

1. Find your Azure IoT DPS name with the following command. Take note of your DPS resource name

```
az iot dps list -o table
```



```
(base) alan@SugSurfaceStudio:~/repos/iot-academy-april-2022-internal/Month_2/Day_1/hol_files$ az iot hub list -o table
Location        Name              Resourcegroup    SubscriptionId
-------------   ----------------  ---------------  ------------------------------------
northcentralus  iot-t4kazboip5yho  rg-iotacademy    7451d6d6-9082-46d9-9373-ccd5fcda6673
```

2. Run the following command after replace your dps_name with yours found in the previous command

```
az iot dps enrollment create -g rg-iot-academy --dps-name {dps_name} --
enrollment-id iot-academy-edge-device --edge-enabled true --tags "
{'environment':'dev'}" --attestation-type symmetrickey
e.g. az iot dps enrollment create -g rg-iot-academy --dps-name dps-
qdiyctqfomakk --enrollment-id iot-academy-edge-device --edge-enabled true -
-tags "{'environment':'dev'}" --attestation-type symmetrickey
```

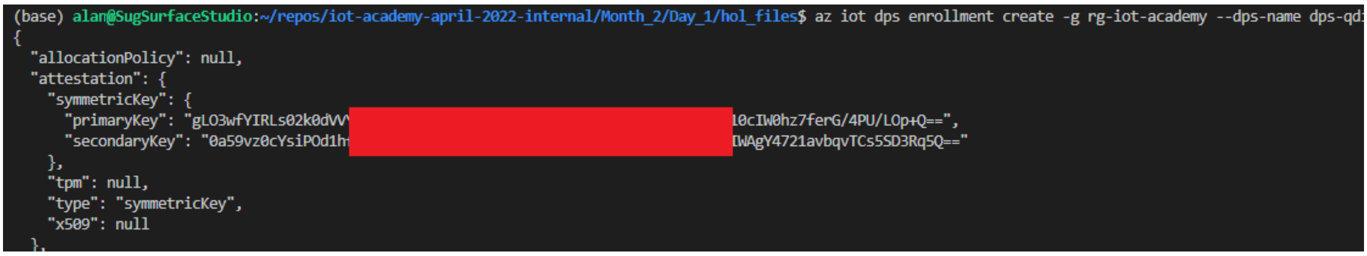
3. Copy the primaryKey and save it to your notepad

4. Run the following command to retrieve the scopeId for your DPS instance. Replace the {name} with your value found in step 1 of this section

```
az iot dps show --name {name}
```

5. find idScope and note the value in your notepad e.g. "idScope": "0ne00600B86"

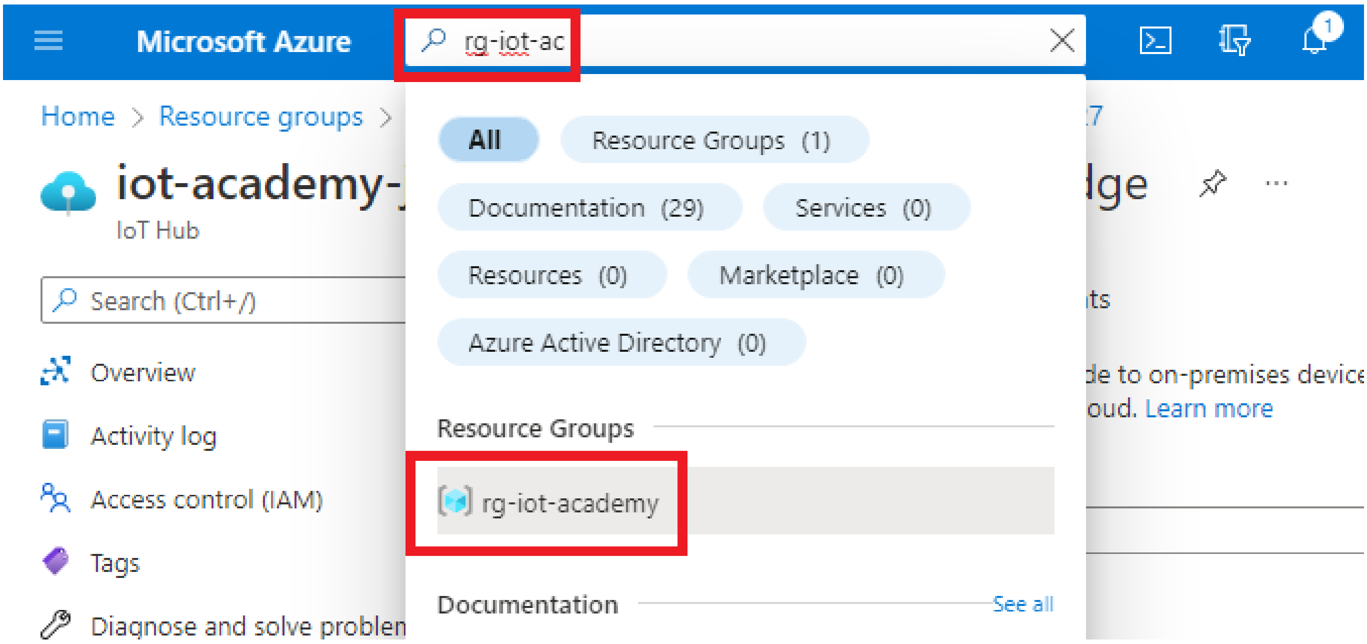
You'll then see results as follows



```
(base) alan@SugSurfaceStudio:~/repos/iot-academy-april-2022-internal/Month_2/Day_1/hol_files$ az iot dps enrollment create -g rg-iot-academy --dps-name dps-qd
{
  "allocationPolicy": null,
  "attestation": {
    "symmetricKey": {
      "primaryKey": "gLO3wfYIRLs02k0dVV[redacted]l0cIW0hz7ferG/4PU/LOp+Q==",
      "secondaryKey": "0a59vz0cYsiPOd1hIWAgY4721avbqvTCs5SD3Rq5Q=="
    },
    "tpm": null,
    "type": "symmetricKey",
    "x509": null
  },
```

4.3. Login to your Windows 10 VM

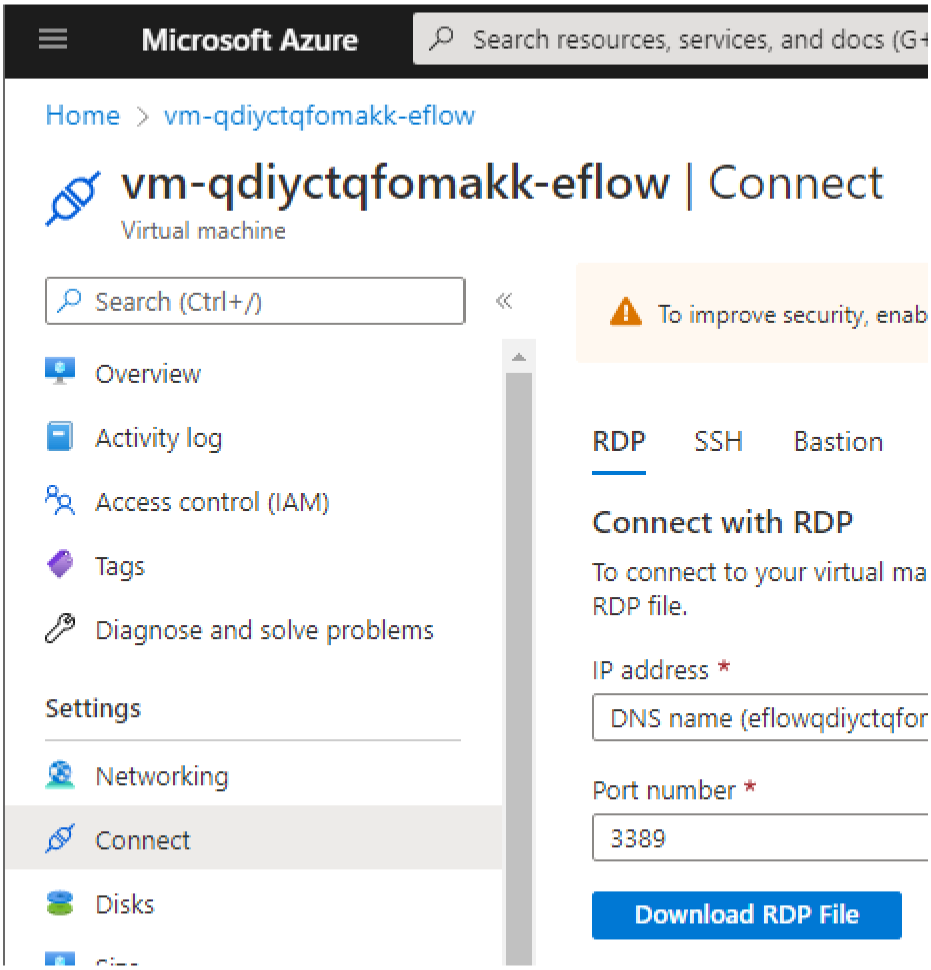
1. Browse to the Azure Portal and search for your resource group



2. Find your VM in the list of resources, prefixed with `vm-`, and click it

3. Click `Connect` and then `RDP`

4. Click `Download RDP File`



vm-qdiyctqfomakk-eflow | Connect

Virtual machine

To improve security, enab

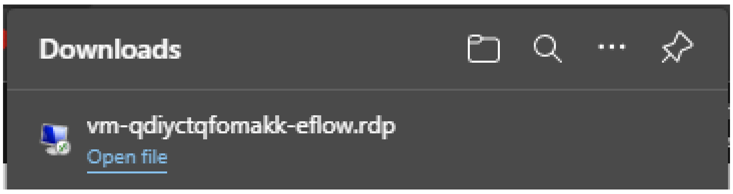
Connect with RDP

To connect to your virtual ma
RDP file.

IP address *: DNS name (eflowqdiyctqfor

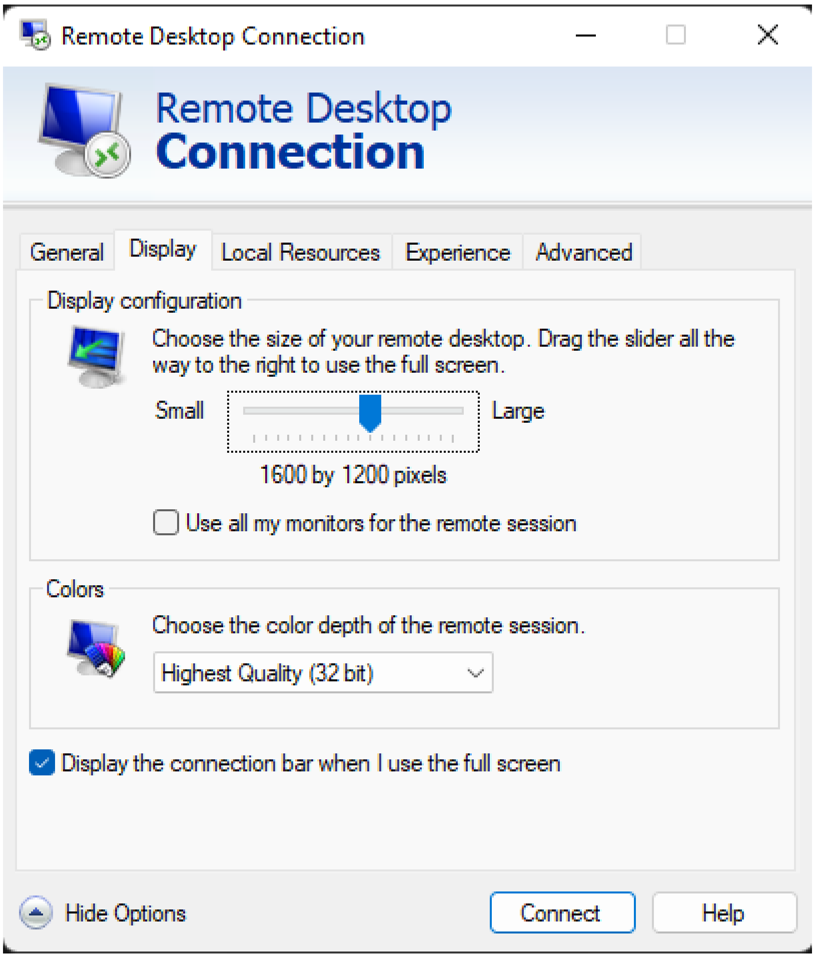
Port number *: 3389

Notice the download in your browser



vm-qdiyctqfomakk-eflow.rdp

5. Optional Step: You can also edit the RDP file, from Windows Explorer, to change settings such as resolution, the RDP session will default to full screen.



Display configuration

Choose the size of your remote desktop. Drag the slider all the way to the right to use the full screen.

Small Large

1600 by 1200 pixels

□ Use all my monitors for the remote session

Colors

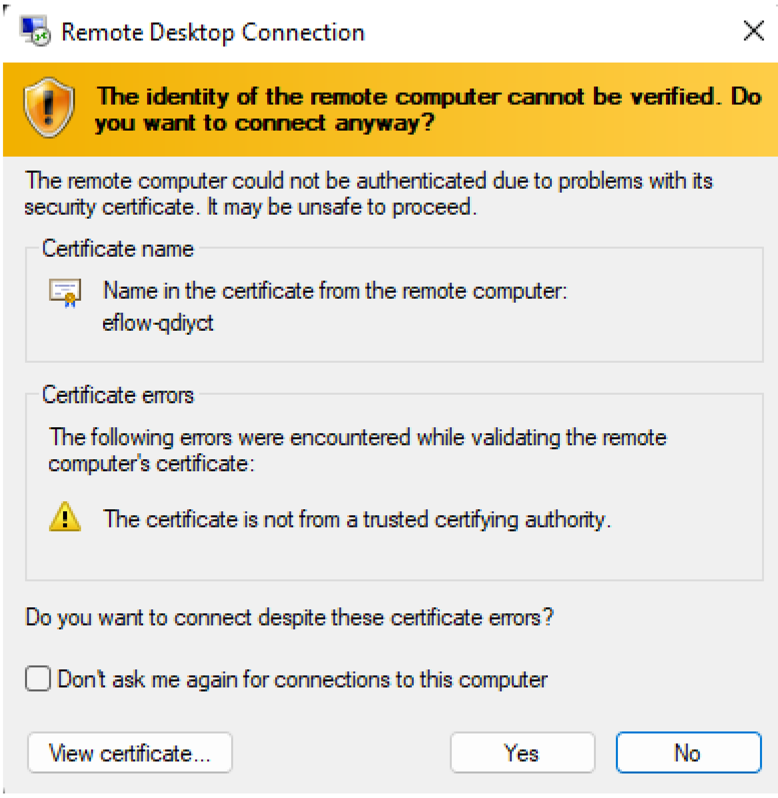
Choose the color depth of the remote session.

Highest Quality (32 bit)

☑ Display the connection bar when I use the full screen

6. Open the RDP file

7. If presented with a confirmation for if you would like to connect due to a certificate issue, click yes



The identity of the remote computer cannot be verified. Do you want to connect anyway?

The remote computer could not be authenticated due to problems with its security certificate. It may be unsafe to proceed.

Certificate name

Name in the certificate from the remote computer:
eflow-qdiyct

Certificate errors

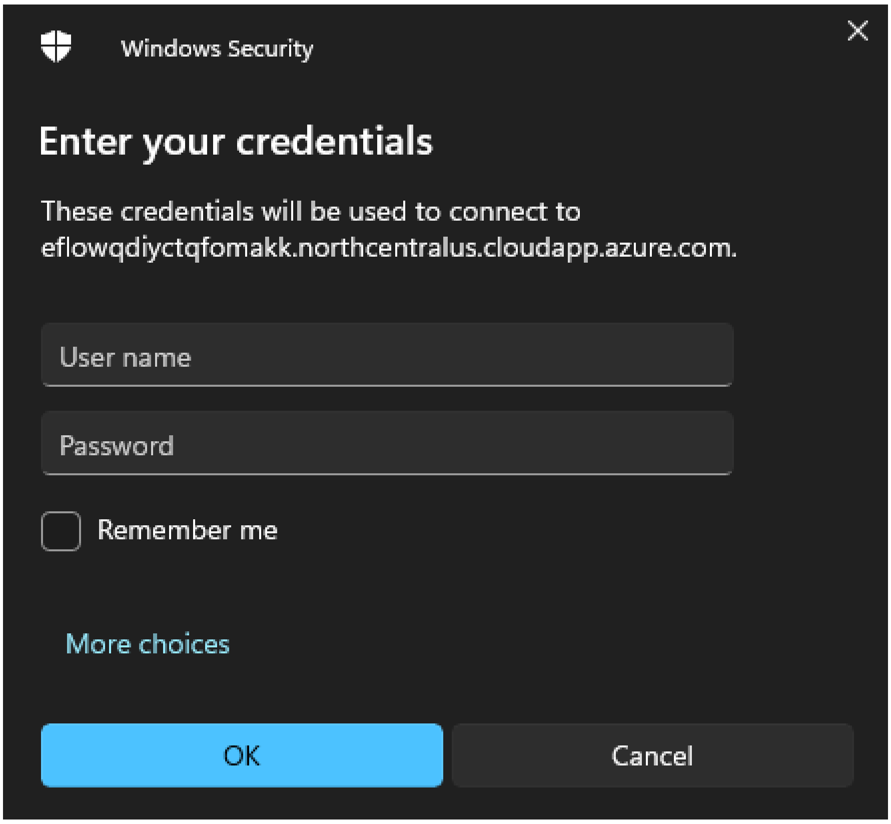
The following errors were encountered while validating the remote computer's certificate:

The certificate is not from a trusted certifying authority.

Do you want to connect despite these certificate errors?

□ Don't ask me again for connections to this computer

8. Enter your credentials, you can find this in the `Month_2/Day_1/hol_files/createvm.bicep` file

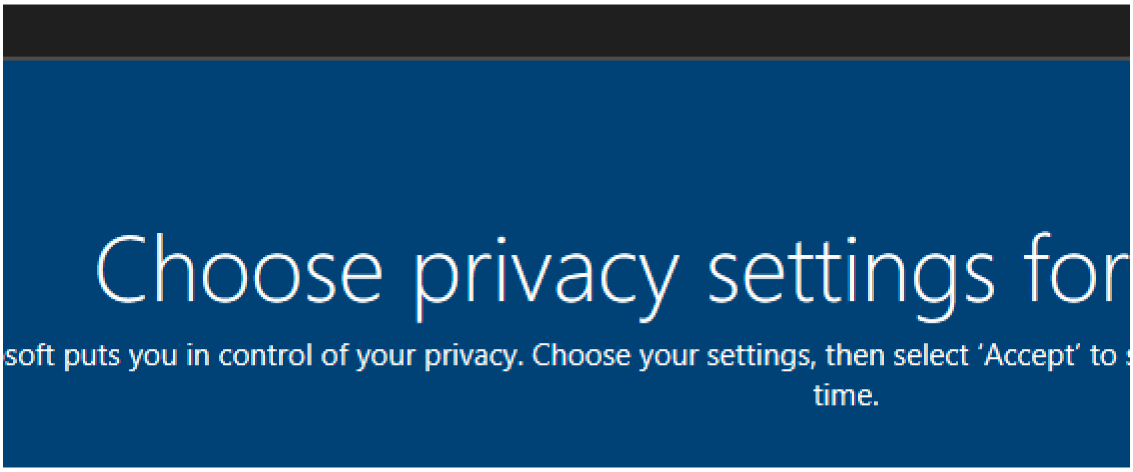


Windows Security

Enter your credentials

These credentials will be used to connect to eflowqdiyctqfomakk.northcentralus.cloudapp.azure.com.

9. After logging in confirm privacy settings and click `Accept`



Choose privacy settings for

soft puts you in control of your privacy. Choose your settings, then select 'Accept' to
time.

5. Exercise: Install Azure IoT Edge for Linux on Windows (EFLOW)

Video: https://youtu.be/AlFSLh7ihAw

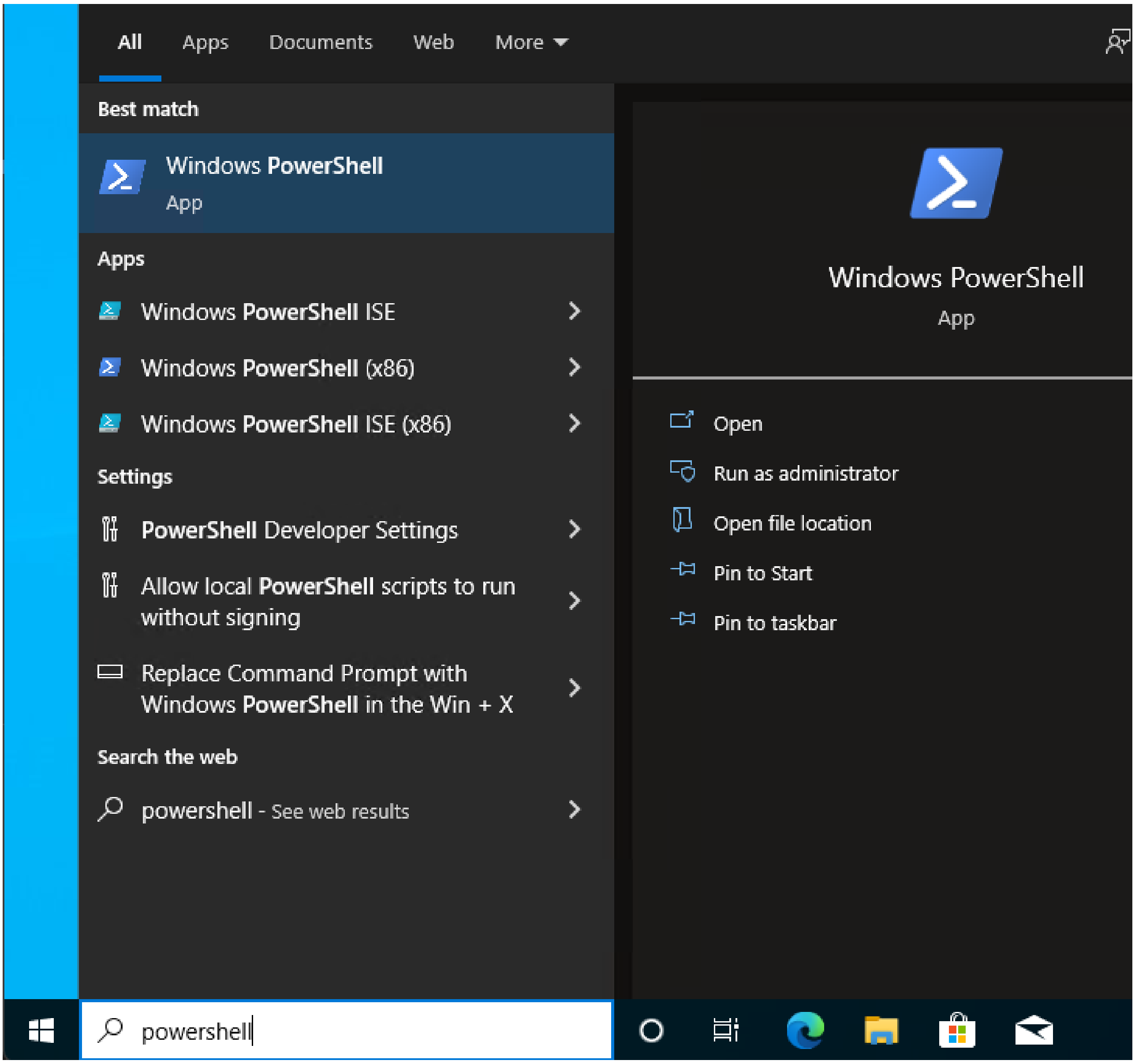
5.1. Install EFLOW

5.2. Resources

https://docs.microsoft.com/en-us/azure/iot-edge/how-to-provision-single-device-linux-on-windows-symmetric?view=iotedge-2020-11&tabs=azure-portal%2Cpowershell https://docs.microsoft.com/en-us/azure/iot-edge/nested-virtualization?view=iotedge-2020-11 https://docs.microsoft.com/en-us/azure/iotedge/troubleshoot?view=iotedge-2020-11 https://docs.microsoft.com/en-us/azure/iot-edge/reference-iot-edge-for-linux-on-windows-functions?view=iotedge-2020-11

Now that you're logged into the VM

1. Run PowerShell, click into the search box on the bottom left, and search for `powershell`, Click `Open`



2. Run the following scripts

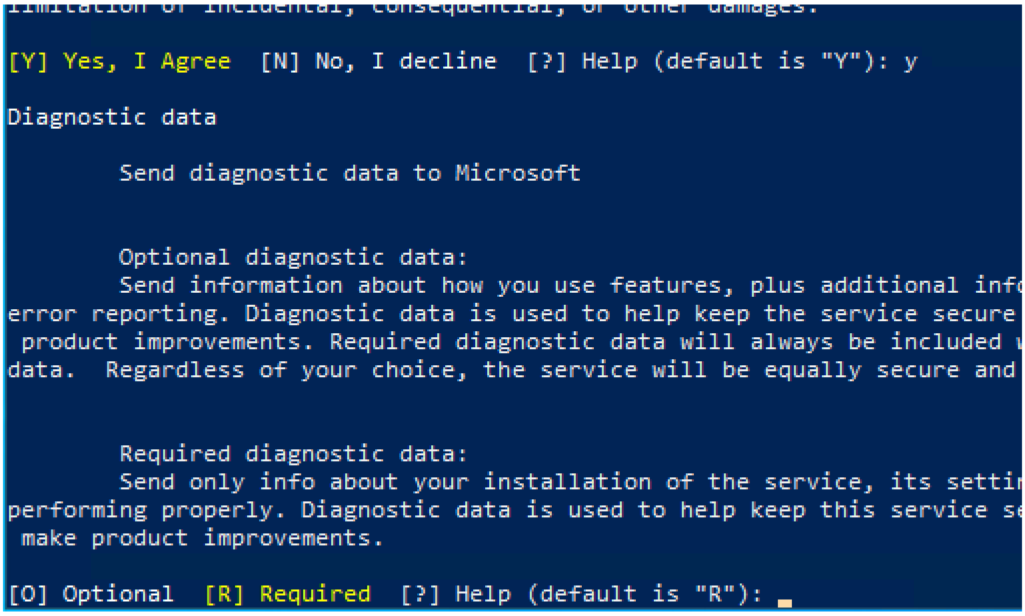
```
$msiPath = $([io.Path]::Combine($env:TEMP, 'AzureIoTEdge.msi'))
$ProgressPreference = 'SilentlyContinue'
Invoke-WebRequest "https://aka.ms/AzEflowMSI" -OutFile $msiPath
```

```
Start-Process -Wait msiexec -ArgumentList
"/i","$([io.Path]::Combine($env:TEMP, 'AzureIoTEdge.msi'))","/qn"
```

3. Run the following script

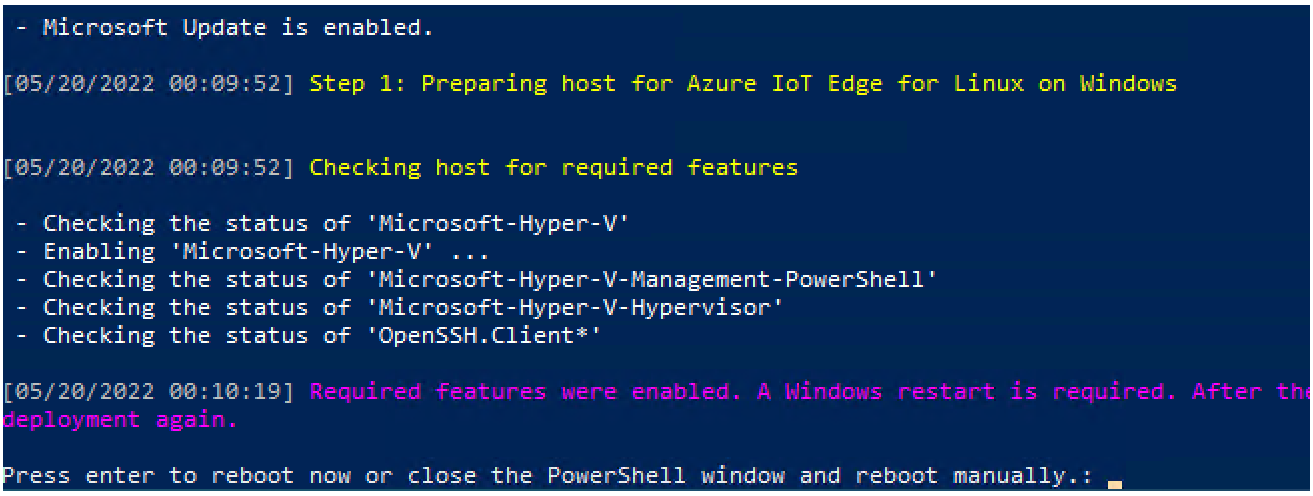
```
Deploy-Eflow
```

4. Accept the agreement and the next question



```
limitation of incidental, consequential, or other damages.

[Y] Yes, I Agree  [N] No, I decline  [?] Help (default is "Y"): y

Diagnostic data

        Send diagnostic data to Microsoft


        Optional diagnostic data:
        Send information about how you use features, plus additional info
error reporting. Diagnostic data is used to help keep the service secure
 product improvements. Required diagnostic data will always be included w
data.  Regardless of your choice, the service will be equally secure and


        Required diagnostic data:
        Send only info about your installation of the service, its settin
performing properly. Diagnostic data is used to help keep this service se
 make product improvements.

[O] Optional  [R] Required  [?] Help (default is "R"):
```

5. When prompted allow the VM to restart. Wait a few minutes before moving on to the next step.



```
 - Microsoft Update is enabled.

[05/20/2022 00:09:52] Step 1: Preparing host for Azure IoT Edge for Linux on Windows


[05/20/2022 00:09:52] Checking host for required features

 - Checking the status of 'Microsoft-Hyper-V'
 - Enabling 'Microsoft-Hyper-V' ...
 - Checking the status of 'Microsoft-Hyper-V-Management-PowerShell'
 - Checking the status of 'Microsoft-Hyper-V-Hypervisor'
 - Checking the status of 'OpenSSH.Client*'

[05/20/2022 00:10:19] Required features were enabled. A Windows restart is required. After the
deployment again.

Press enter to reboot now or close the PowerShell window and reboot manually.:
```

6. After the VM restarts, reconnect your RDP session as in the earlier step. You may need to wait a few minutes for it to restart.

7. Open PowerShell and run the `Deploy-Eflow` command again

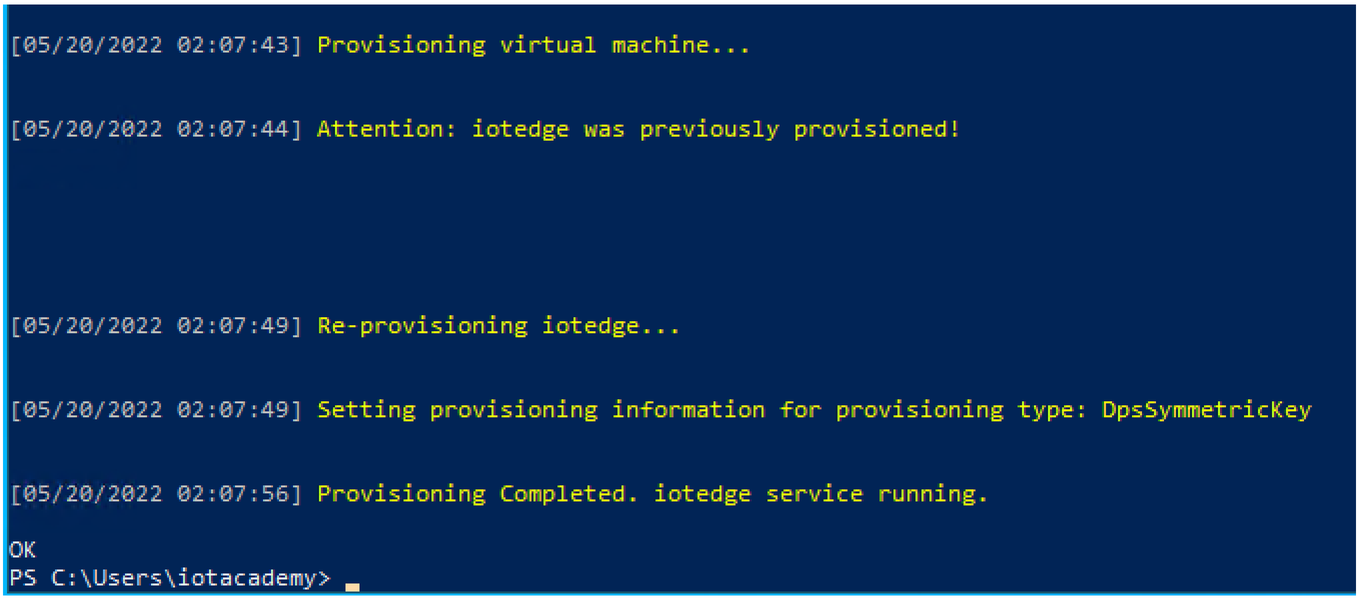
```
Deploy-Eflow -memoryInMB 2048 -acceptEula Yes -acceptOptionalTelemetry Yes
```

After some time, maybe 5 minutes, you should a success message as seen in the screenshot below.

8. Replace the `{primaryKey}` and {scopeId} values that you took note of in earlier and then run the following command

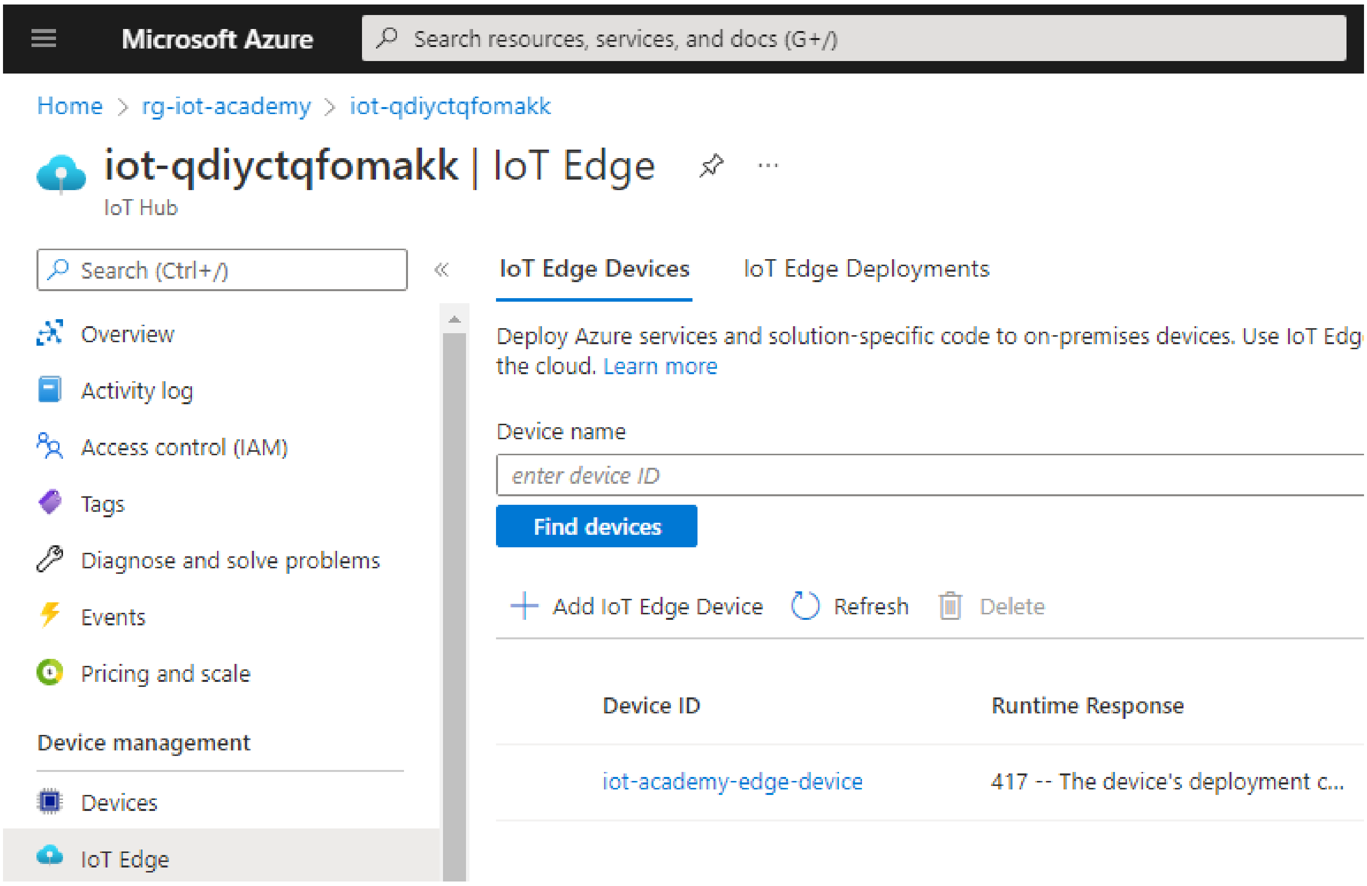
```
Provision-EflowVm -provisioningType DpsSymmetricKey -scopeId {scopeId} -registrationId iot-academy-edge-device -symmKey {primaryKey}
e.g. Provision-EflowVm -provisioningType DpsSymmetricKey -scopeId 0ne00600B86 -registrationId iot-academy-edge-device -symmKey Yh1Y5pVwuo1Kroa7yZWmD42CTNpB5aTcJvFl1mu5E=
```

After running the command you will see a success message as follows.



```
[05/20/2022 02:07:43] Provisioning virtual machine...

[05/20/2022 02:07:44] Attention: iotedge was previously provisioned!



[05/20/2022 02:07:49] Re-provisioning iotedge...

[05/20/2022 02:07:49] Setting provisioning information for provisioning type: DpsSymmetricKey

[05/20/2022 02:07:56] Provisioning Completed. iotedge service running.

OK
PS C:\Users\iotacademy> _
```

9. Now navigate back to the Azure Portal and find your resource group and navigate to it
10. Find your IoT Hub resource in the list prefixed with `iot-`. Click it
11. Click IoT Edge. Click your device `iot-academy-edge-device`

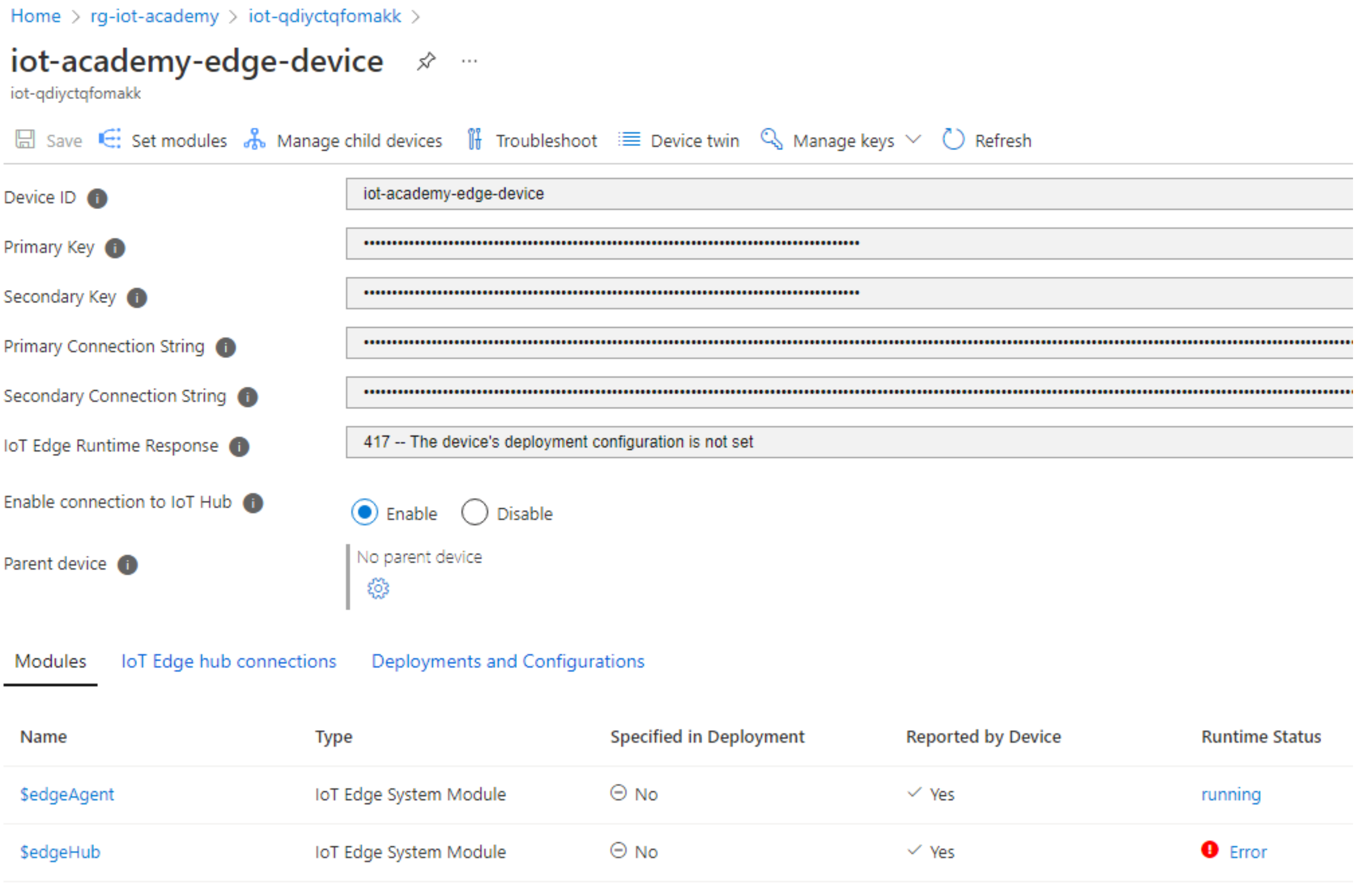


Deploy Azure services and solution-specific code to on-premises devices. Use IoT Edg the cloud. Learn more

Device name: enter device ID

Device ID	Runtime Response
iot-academy-edge-device	417 -- The device's deployment c...

12. After some time you'll notice the edgeAgent running and a normal condition for edgeHub to be in error state since we have not provided configuration



Device ID	iot-academy-edge-device
Primary Key	••
Secondary Key	••
Primary Connection String	••
Secondary Connection String	••
IoT Edge Runtime Response	417 -- The device's deployment configuration is not set
Enable connection to IoT Hub	● Enable ○ Disable
Parent device	No parent device

Name	Type	Specified in Deployment	Reported by Device	Runtime Status
$edgeAgent	IoT Edge System Module	⊖ No	✓ Yes	running
$edgeHub	IoT Edge System Module	⊖ No	✓ Yes	● Error

6. Exercise: Create a Azure Stream Analytics Job

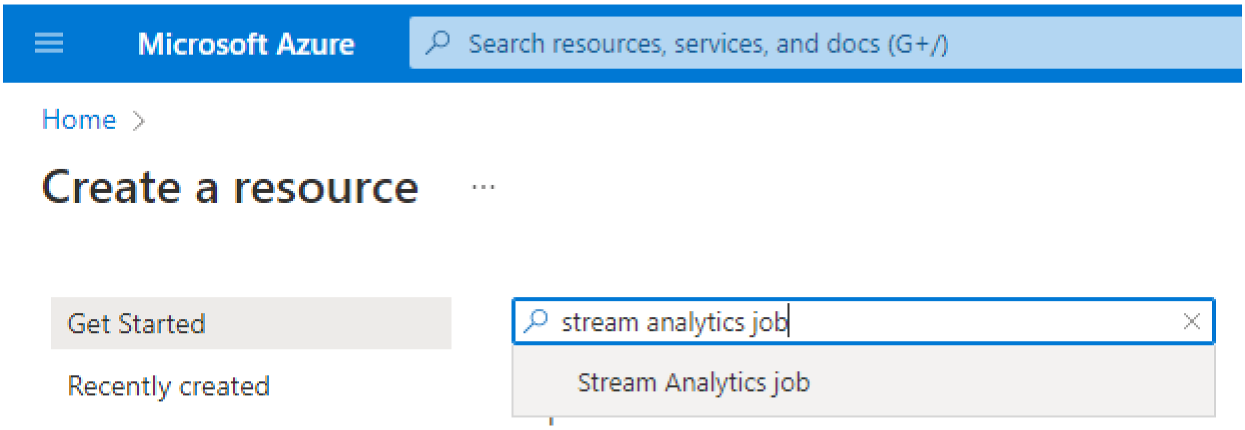
Video: https://youtu.be/1T64Xnu0m3U

6.1. Resources

https://docs.microsoft.com/en-us/azure/iot-edge/reference-iot-edge-for-linux-on-windows-functions?view=iotedge-2020-11

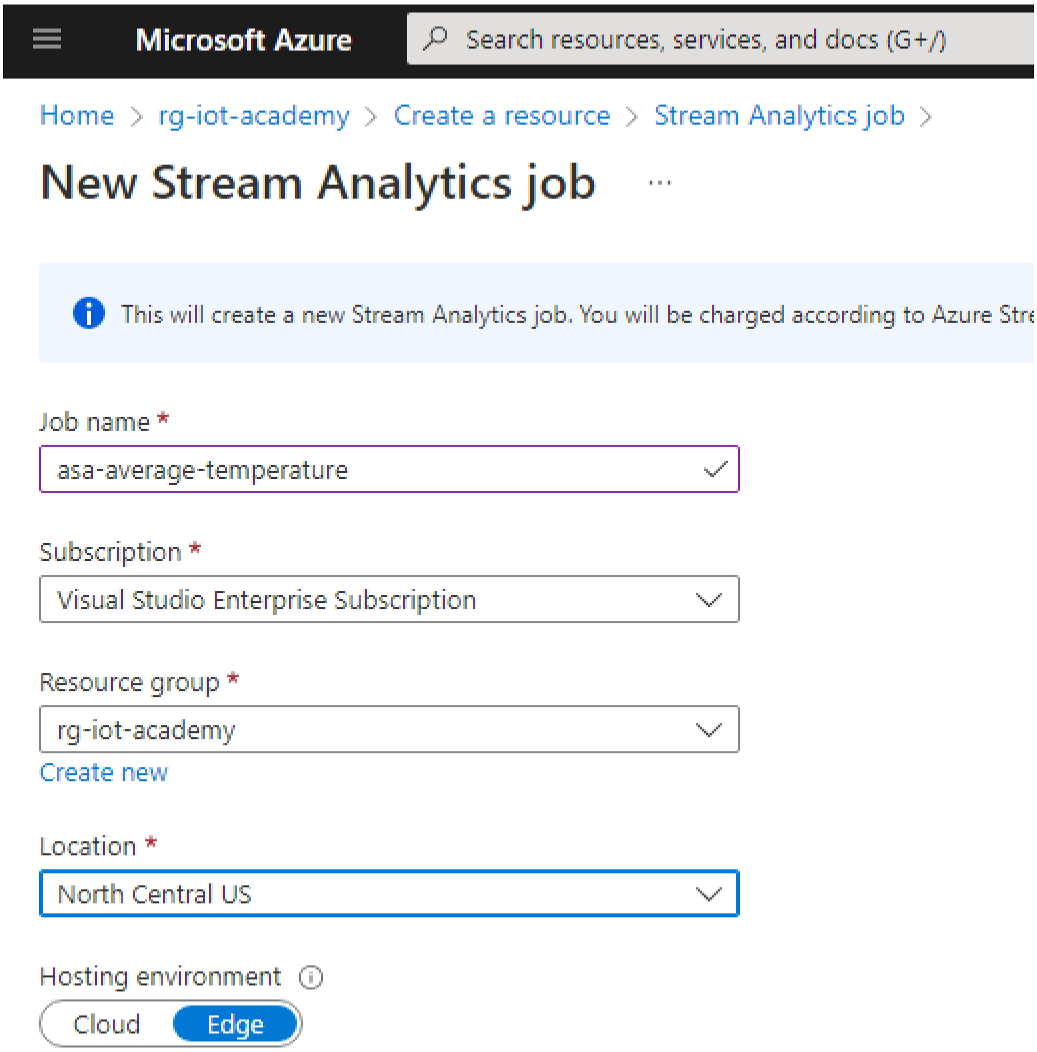
6.2. Create a new ASA Job

1. Go to the Azure Portal home page
2. Click **Create a resource**
3. Search for `stream analytics job`



4. Click **Stream Analytics job**
5. Click **Create**
6. Enter the details for the job:

- Job name: `asa-average-temperature`
- Resource group: `rg-iot-academy`
- Location: your region e.g. `East US 2`
- Hosting environment: `Edge`


Microsoft Azure
Search resources, services, and docs (G+/)
Home > rg-iot-academy > Create a resource > Stream Analytics job >

New Stream Analytics job

This will create a new Stream Analytics job. You will be charged according to Azure Stre

Job name * asa-average-temperature

Subscription * Visual Studio Enterprise Subscription

Resource group * rg-iot-academy

Create new

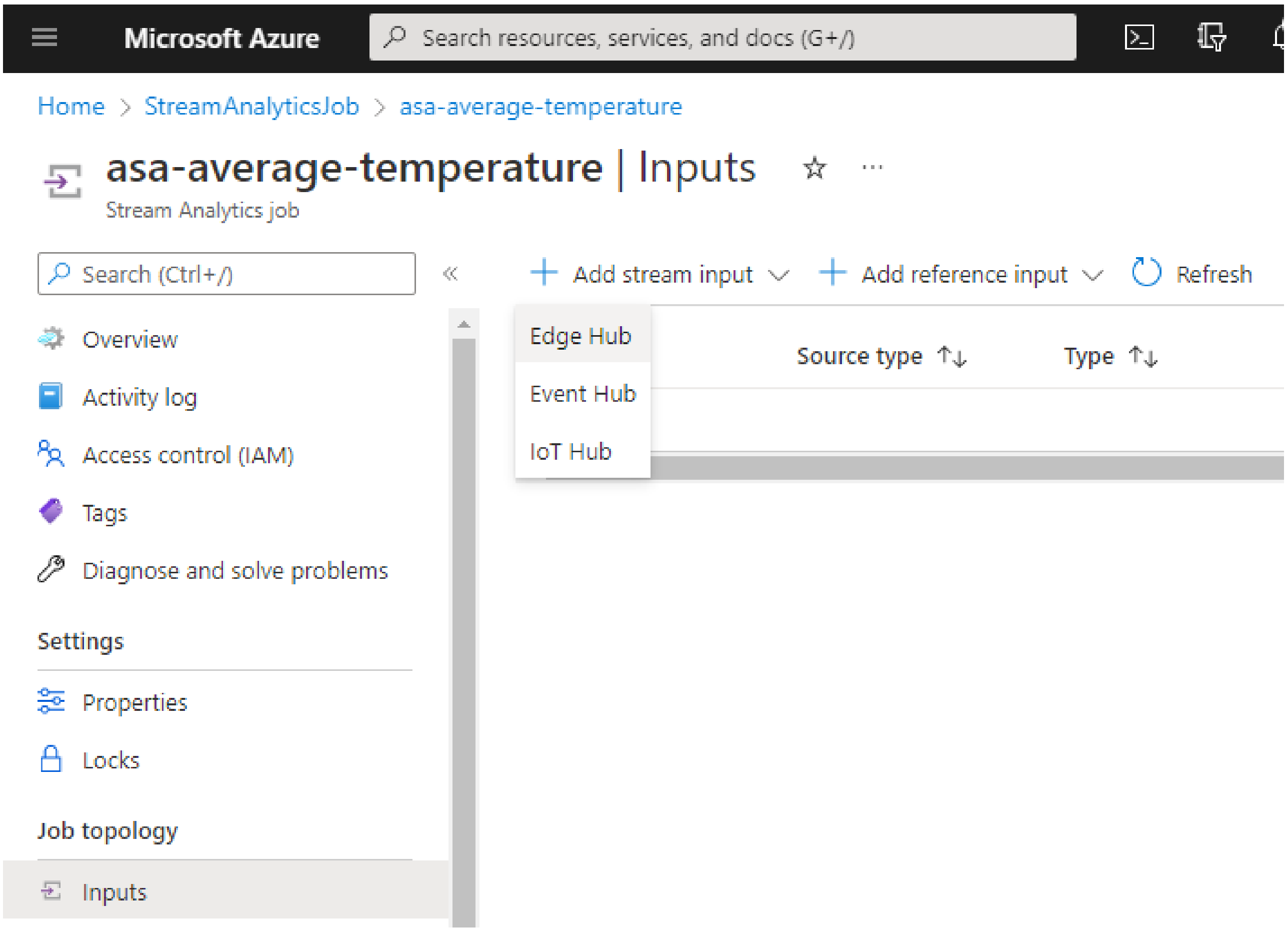
Location * North Central US

Hosting environment: Cloud [✓ Edge]

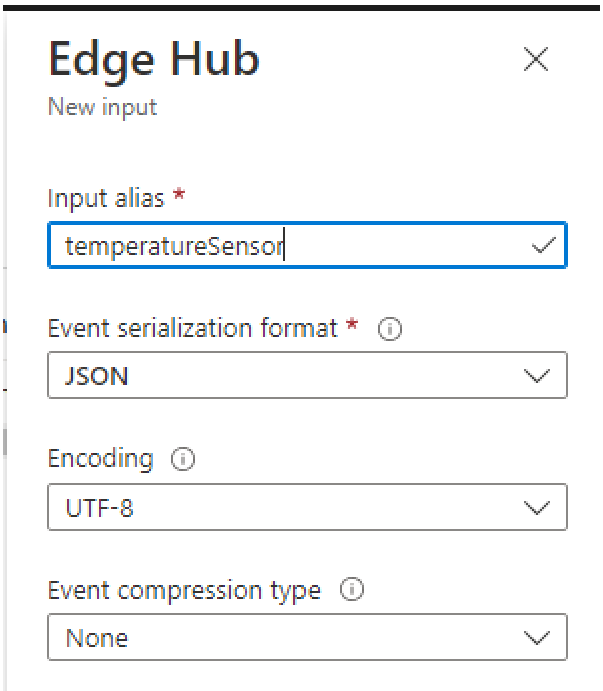
7. When the deployment is complete click **Go to resource**

6.3. Creating an ASA Input

- Click **Inputs**, Click **Add stream input**, Click **Edge Hub**



- Enter the input details:
  - Input alias: `temperatureSensor`
  - All other values: default



Edge Hub

New input

Input alias * temperatureSensor

Event serialization format * JSON

Encoding UTF-8

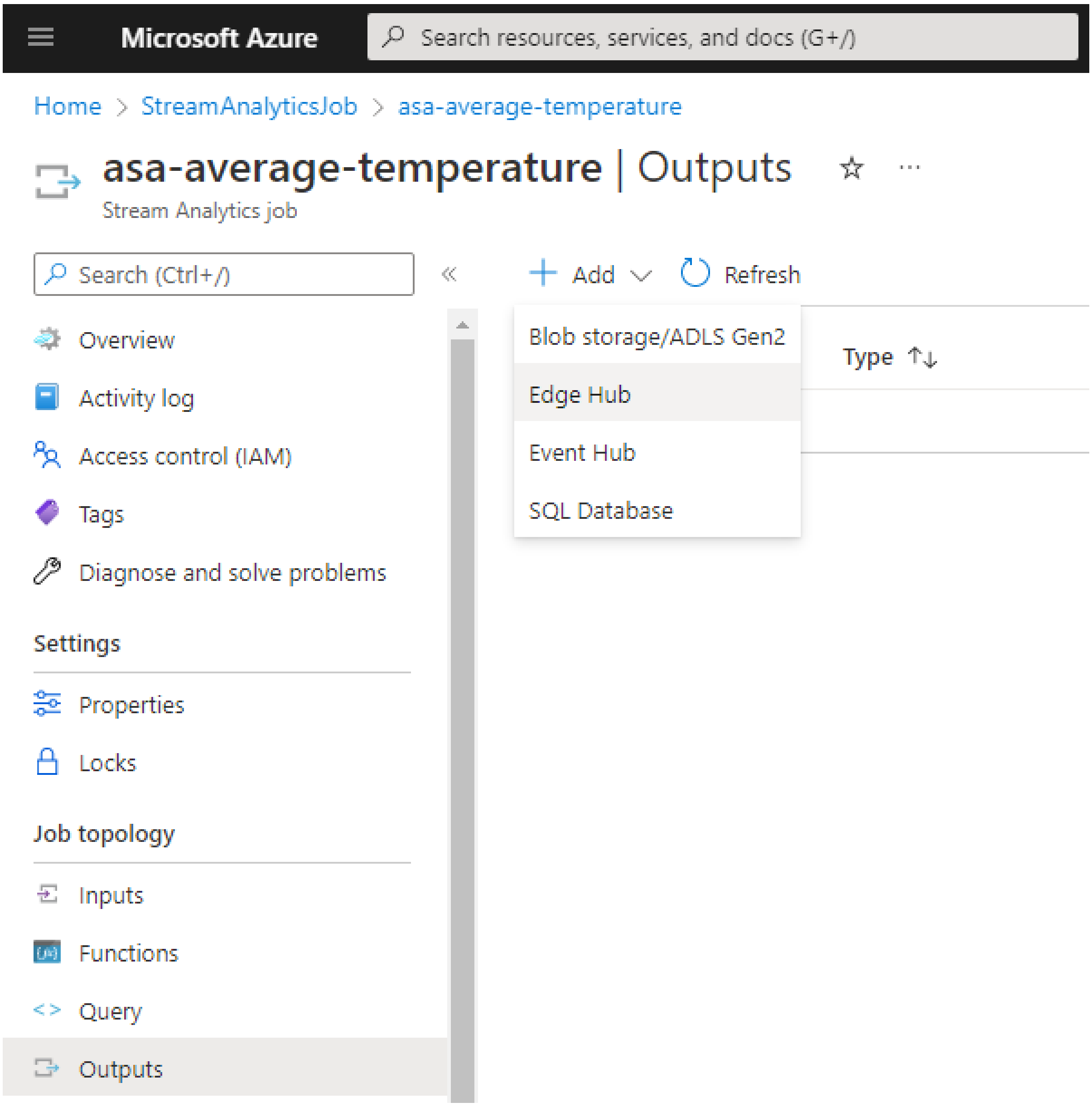
Event compression type None

- Click **Save**

6.4. Creating an ASA Output

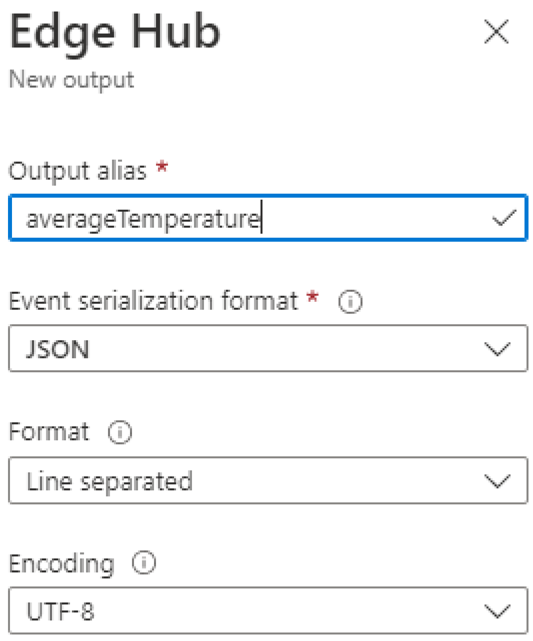
1. Click **Outputs**

2. Click **Add**, then click **Edge Hub**



3. Enter the details as shown below:

- Output alias: `averageTemperature`
- All other values: default



Edge Hub

New output

Output alias *

averageTemperature

Event serialization format *

JSON

Format

Line separated

Encoding

UTF-8

4. Click **Save**

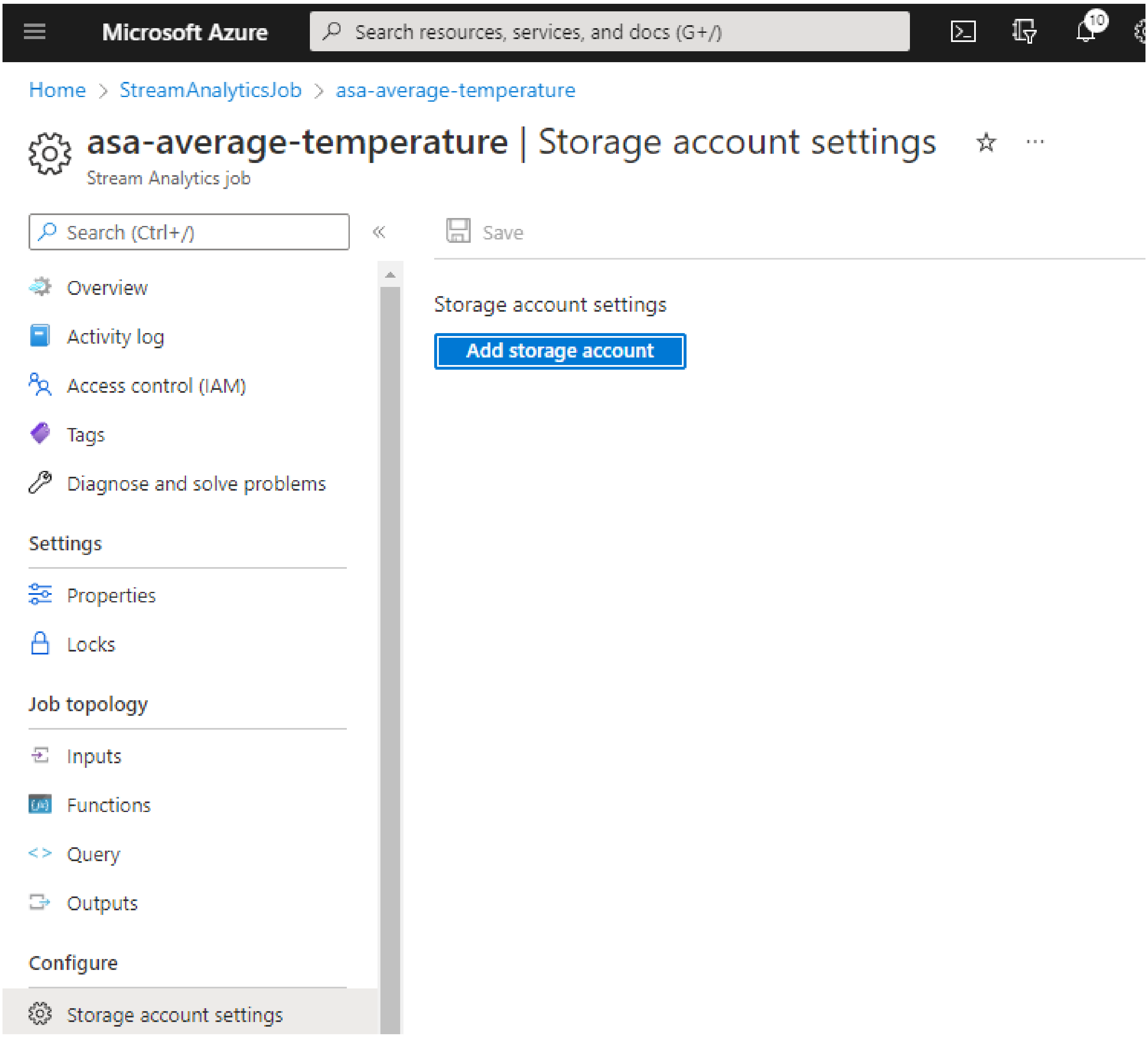
6.5. Writing an ASA Query

1. Click **Query**
2. Copy and paste the query below into the query window

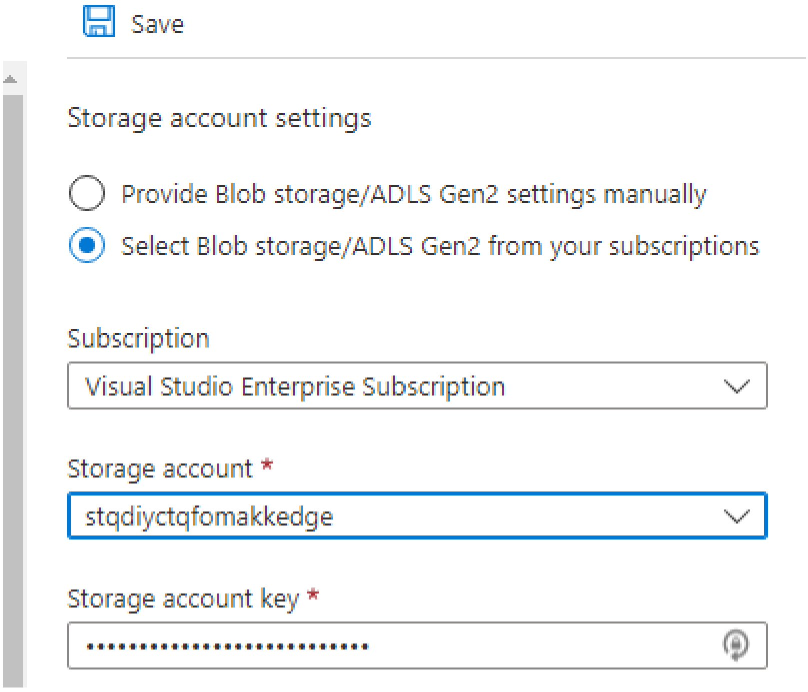
```
SELECT
    System.Timestamp() AS WindowEnd, avg(ambient.temperature)
AverageTemperature
INTO
    averageTemperature
FROM
    temperatureSensor
GROUP BY TumblingWindow(Duration(minute, 1))
```

3. Click **Save query**

4. Click Publish, Click **Storage account settings**, then click **Add storage account**



5. Select your subscription, then select the storage account formed such as `st******edge`. Your common student prefix will be in place of the ******.



Storage account settings

○ Provide Blob storage/ADLS Gen2 settings manually

● Select Blob storage/ADLS Gen2 from your subscriptions

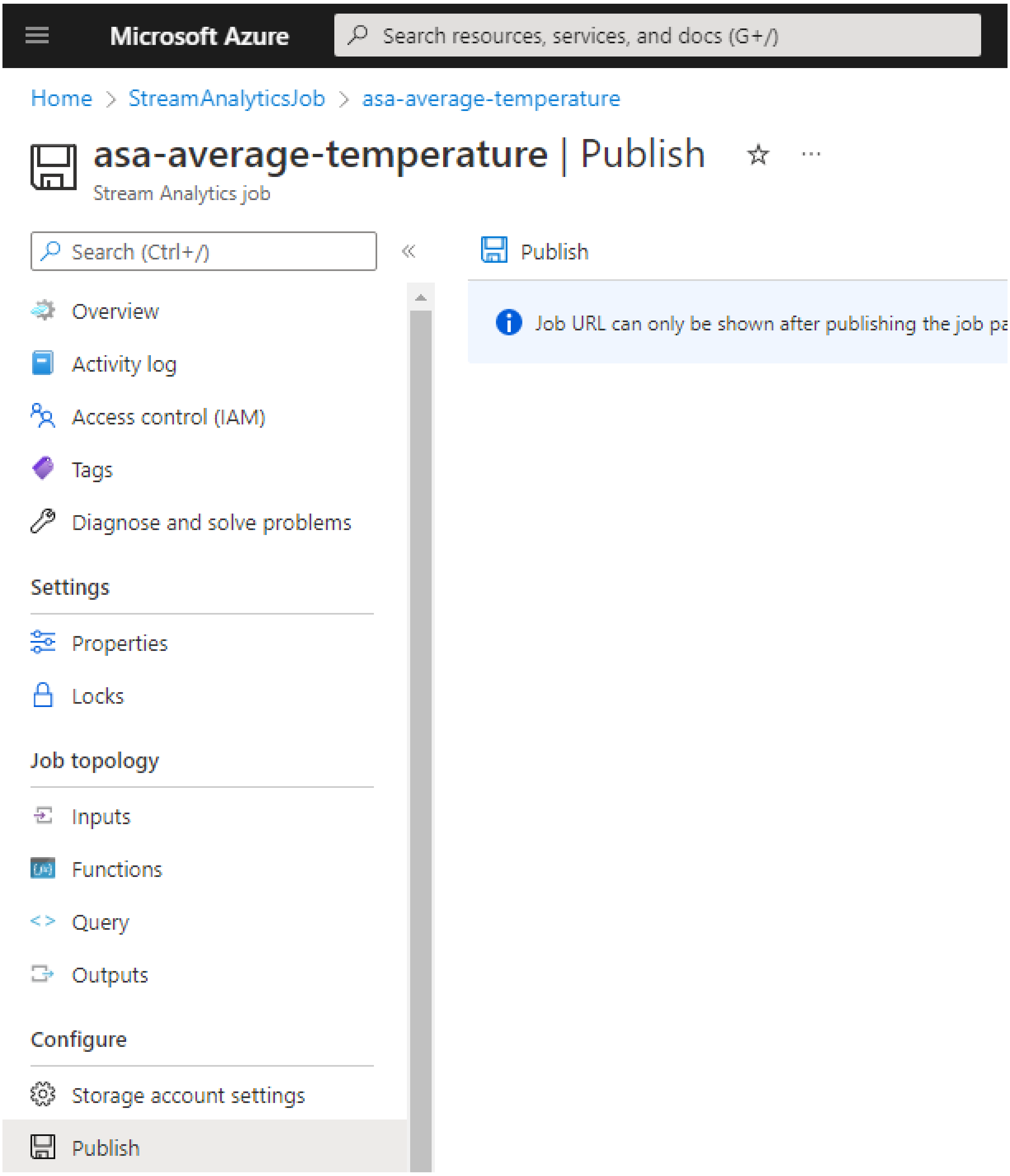
Subscription: Visual Studio Enterprise Subscription

Storage account *: stqdiyctqfomakkedge

Storage account key *: ••••••••••••••••••••••••••••

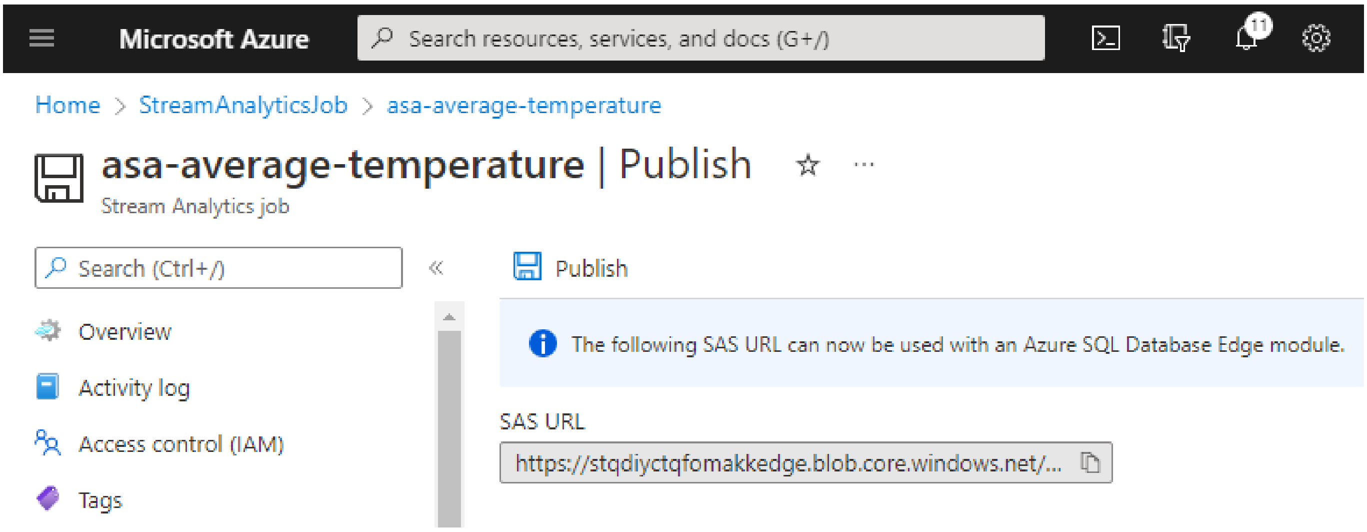
6. Click **Save**

7. Click **Publish**. Then, click **Yes**



Job URL can only be shown after publishing the job pa

8. Copy the SAS URL to your notepad for later



Microsoft Azure
Search resources, services, and docs (G+/)
Home > StreamAnalyticsJob > asa-average-temperature
asa-average-temperature | Publish
Stream Analytics job
Search (Ctrl+/)
Overview
Activity log
Access control (IAM)
Tags
Publish

The following SAS URL can now be used with an Azure SQL Database Edge module.

SAS URL

https://stqdiyctqfomakkedge.blob.core.windows.net/...

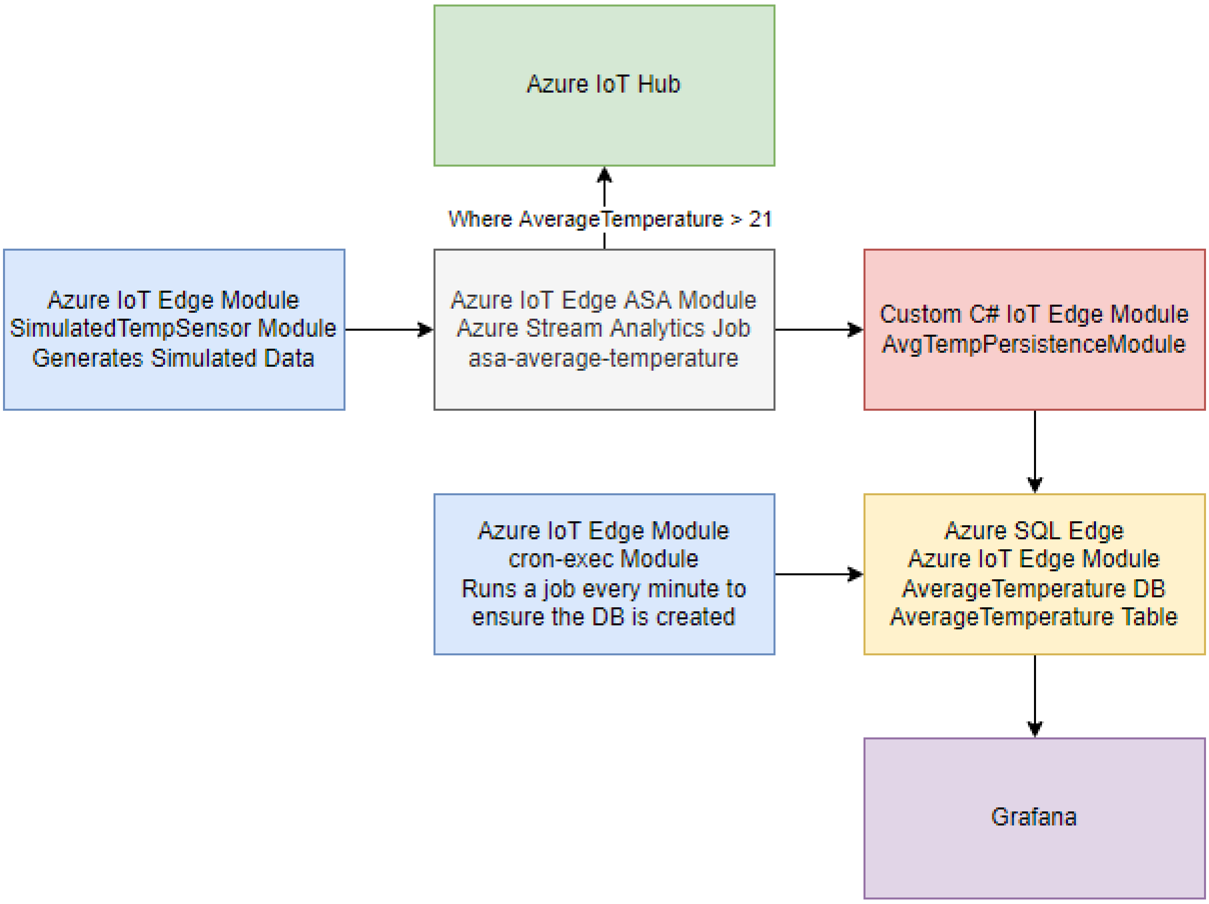
7. Exercise: Update the Azure IoT Edge manifest to add modules and routes

Video: https://youtu.be/UbGhG7gxmnU

7.1. Intro and Edge Architecture

This section of the lab focuses on deploying Azure IoT Edge Modules and configuring routes.

The diagram below shows how the data flows between each step.



A quick review of the components:

- Simulated Temperature Sensor Module
  - Generates a message every 5 seconds, for 2000, messages. The payload includes temperature and humidity data.
  - Distributed by Microsoft on the Azure Marketplace
- Azure IoT Edge ASA Module
  - Provides the capability to run stream analytics jobs at the edge
  - Distributed by Microsoft on the Azure Marketplace
- Average Temperature Persistence Module
  - A custom module, written for this lab, which gives example for how to implement the Azure IoT Edge Module SDK. This module inserts records into an Azure SQL Edge database.
  - `Month_2/Day_1/hol_files/avg_temp_persistence_module`
- Azure SQL Edge Module
  - A module designed to run SQL Server.
  - Distributed by Microsoft on the Azure Marketplace
- cron-exec Module
  - A module that runs a custom docker container for running cron jobs. The only cron job in this implementation connects to AzureSqlEdge and creates the database and table for this PoC if it does not exist.
  - `Month_2/Day_1/hol_files/cron_exec`
- Grafana
  - runs a container image that provides Grafana for telemetry visualization. This PoC pulls telemetry from the Azure SQL Edge AverageTemperature database.
  - `Month_2/Day_1/hol_files/grafana_average_temp`

Some alternatives to this approach would be to use the following. This current architecture was chosen for exposure and example to different approaches.

1. An Azure Function in place of the custom module
   1. https://docs.microsoft.com/en-us/azure/iot-edge/tutorial-deploy-function?view=iotedge-2020-11
2. Use Azure SQL Edge Data streaming
   1. https://docs.microsoft.com/en-us/azure/azure-sql-edge/stream-data
   2. https://docs.microsoft.com/en-us/azure/azure-sql-edge/create-stream-analytics-job

7.2. Resources

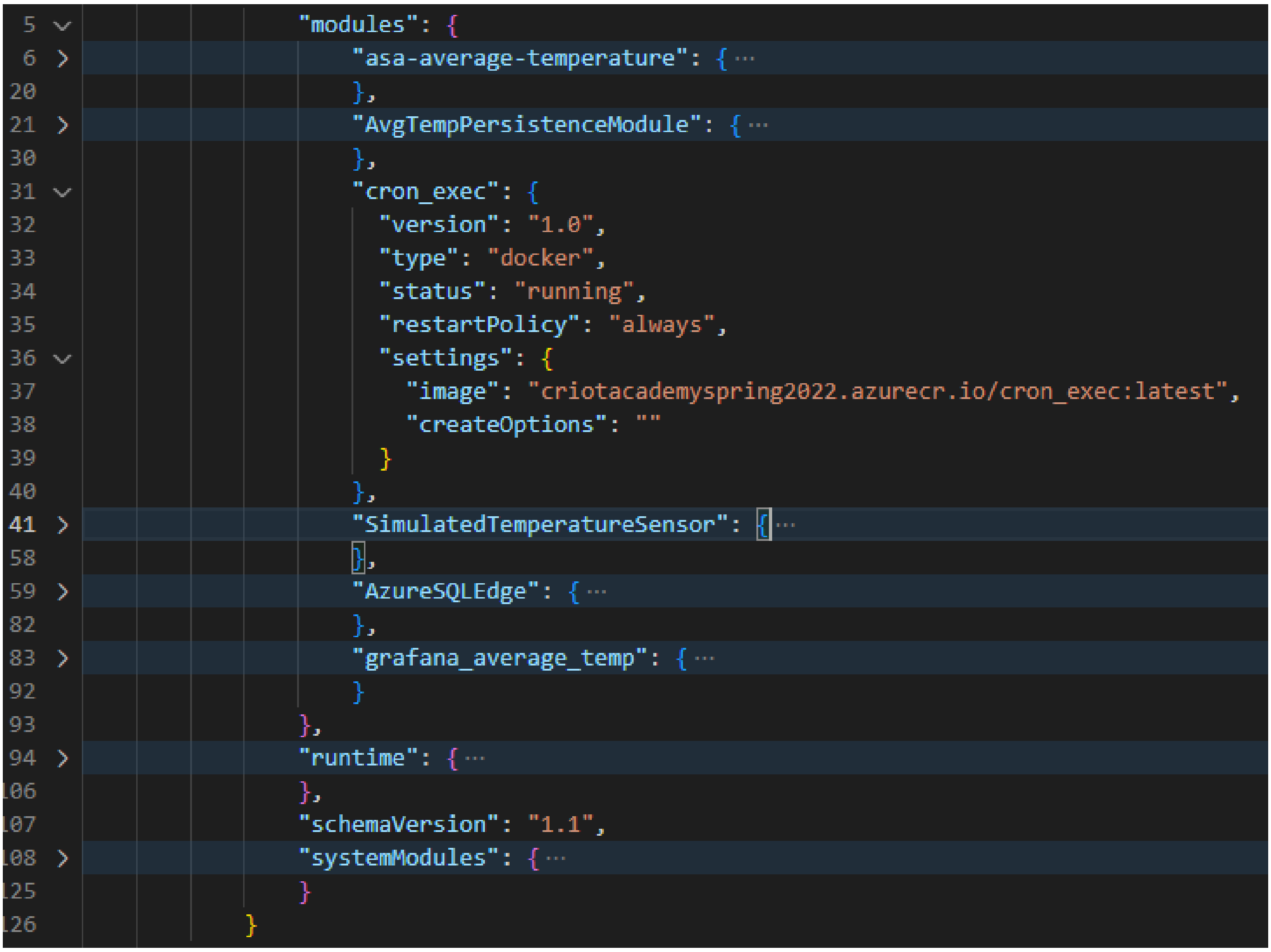
https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-devguide-messages-d2c https://docs.microsoft.com/en-us/azure/iot-edge/module-composition?view=iotedge-2020-11 https://docs.microsoft.com/en-us/azure/stream-analytics/stream-analytics-edge https://docs.microsoft.com/en-us/azure/iot-edge/how-to-vs-code-develop-module?view=iotedge-2020-11 https://docs.microsoft.com/en-us/azure/azure-sql-edge/tutorial-set-up-iot-edge-modules https://docs.microsoft.com/en-us/azure/iot-edge/how-to-use-create-options?view=iotedge-2020-11 https://docs.docker.com/engine/api/v1.32/#operation/ContainerCreate https://github.com/marvin-garcia/AzureSqlEdge

7.3. Review the deployment manifest

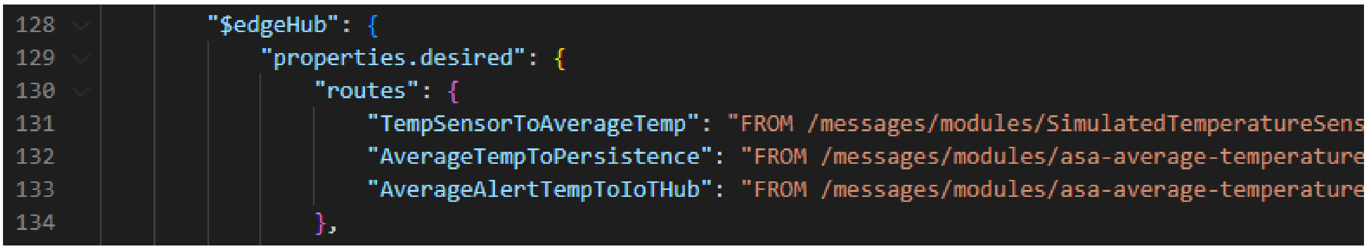
Now, we'll review the details for the how the integration of all the components is orchestrated with Azure IoT Edge.

Open the `Month_2/Day_1/hol_files/edge_manifest_modules.json` file to review the contents

Notice the modules and routes sections
The following screenshots shows the configured routes. You can use the line numbers to navigate the actual file.



```
5                   "modules": {
6                       "asa-average-temperature": {…
20                      },
21                      "AvgTempPersistenceModule": {…
30                      },
31                      "cron_exec": {
32                        "version": "1.0",
33                        "type": "docker",
34                        "status": "running",
35                        "restartPolicy": "always",
36                        "settings": {
37                          "image": "criotacademyspring2022.azurecr.io/cron_exec:latest",
38                          "createOptions": ""
39                        }
40                      },
41                      "SimulatedTemperatureSensor": {…
58                      },
59                      "AzureSQLEdge": {…
82                      },
83                      "grafana_average_temp": {…
92                      }
93                  },
94                  "runtime": {…
106                 },
107                 "schemaVersion": "1.1",
108                 "systemModules": {…
125                 }
126             }
```



```
128         "$edgeHub": {
129             "properties.desired": {
130                 "routes": {
131                     "TempSensorToAverageTemp": "FROM /messages/modules/SimulatedTemperatureSens
132                     "AverageTempToPersistence": "FROM /messages/modules/asa-average-temperature
133                     "AverageAlertTempToIoTHub": "FROM /messages/modules/asa-average-temperature
134                 },
```

```
FROM /messages/modules/SimulatedTemperatureSensor/* INTO
BrokeredEndpoint("/modules/asa-average-temperature/inputs/temperatureSensor
FROM /messages/modules/asa-average-temperature/* INTO
BrokeredEndpoint("/modules/AvgTempPersistenceModule/inputs/input1
FROM /messages/modules/asa-average-temperature/* WHERE
$body.Weather.Temperature > 21 INTO
BrokeredEndpoint("/modules/AvgTempPersistenceModule/inputs/input1")
```

7.4. Create the an IoT Edge deployment using the CLI

In the previous steps you successfully deployed an Azure IoT Edge device using EFLOW.
In this step you'll be configured your Edge device to run Azure IoT Edge Modules.

1. List your iot hubs to get the name

```
az iot hub list -o table
```

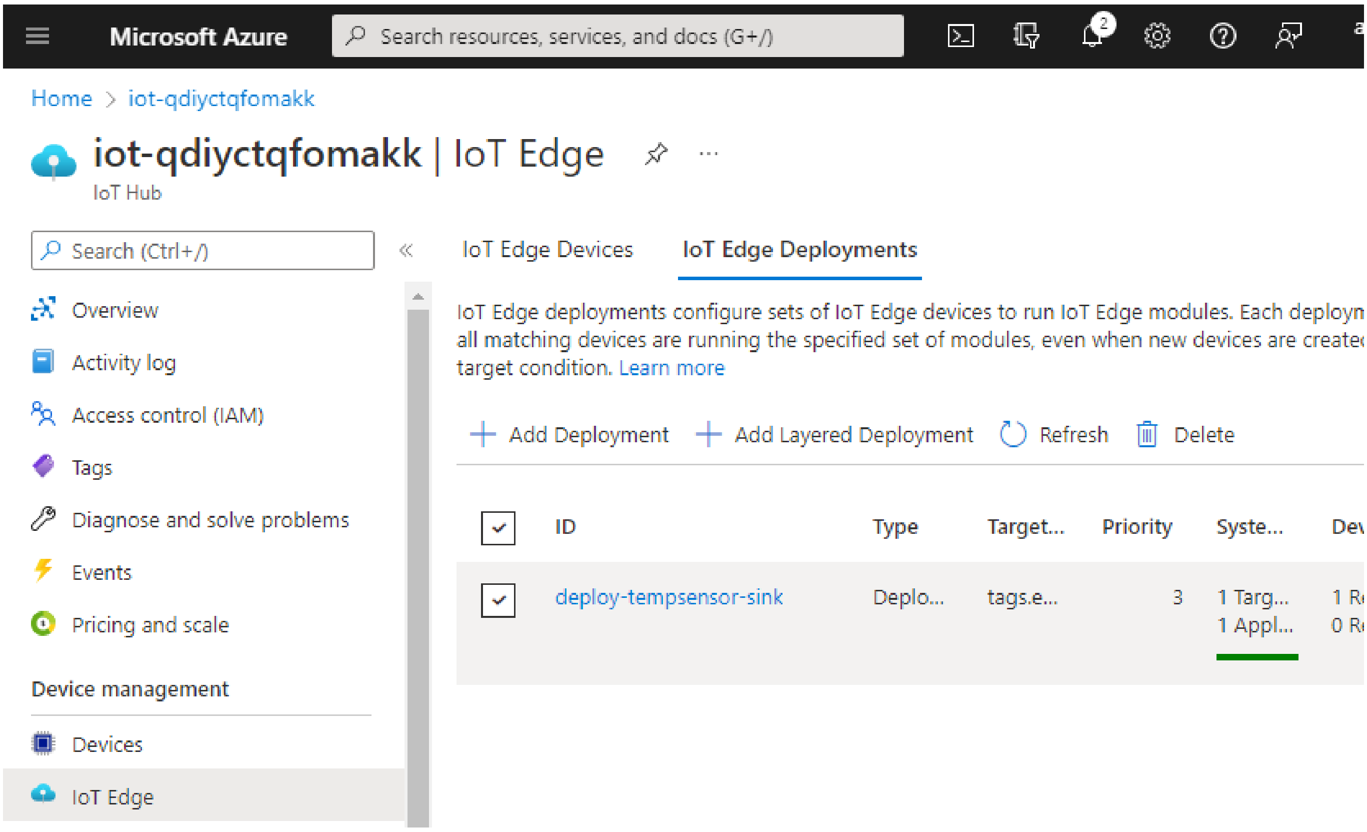
2. Edit the `Month_2/Day_1/hol_files/edge_manifest_modules.json`
3. Replace `{sas_url}` with your SAS URL saved in notepad earlier
4. Replace `{subscription_id}` with your SubscriptionID that you saved in notepad earlier
5. Run the command below after replacing `{hub_name}` below

Notice the **target-condition** this is what is going to target your Edge device since it does in fact have the **dev** tag as follows: **tags.environment='dev'**.

```
az iot edge deployment create -d deploy-tempsensor-sink -n {hub_name} --
content edge_manifest_modules.json --target-condition
"tags.environment='dev'" --priority 3

Some Examples
e.g. az iot edge deployment create -d deploy-tempsensor-sink -n iot-
qdiyctqfomakk --content edge_manifest_modules.json --target-condition
"tags.environment='dev'" --priority 3
e.g. to delete, az iot edge deployment delete -d deploy-tempsensor-sink -n
iot-qdiyctqfomakk
```

7.5. Review the IoT Edge deployment in the Azure Portal

1. Visit the Azure Portal, view your IoT Hub, click IoT Edge, then click IoT Edge Deployments



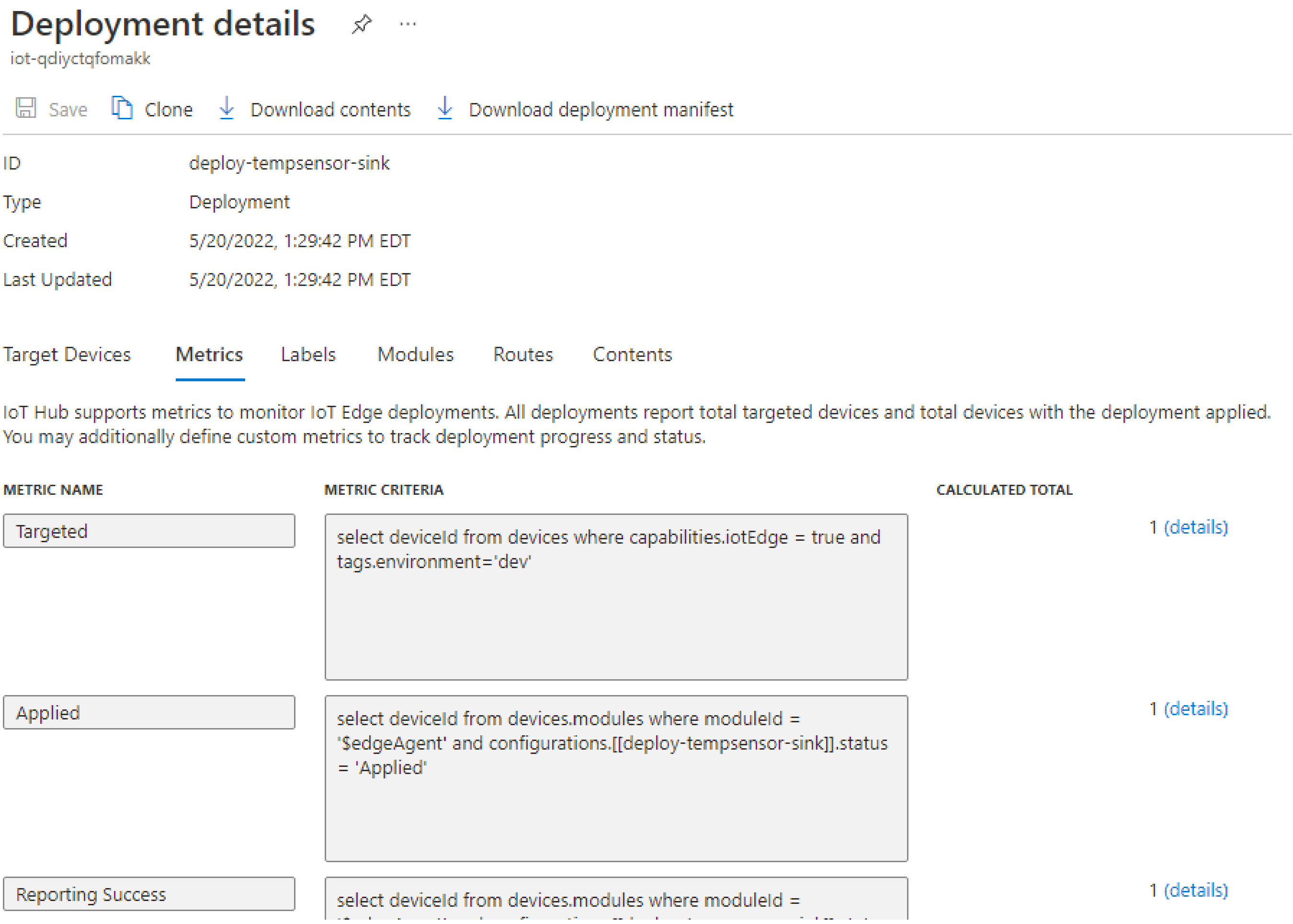
iot-qdiyctqfomakk | IoT Edge

IoT Hub

IoT Edge deployments configure sets of IoT Edge devices to run IoT Edge modules. Each deploym all matching devices are running the specified set of modules, even when new devices are create target condition. Learn more

☑	ID	Type	Target...	Priority	Syste...	Dev
☑	deploy-tempsensor-sink	Deplo...	tags.e...	3	1 Targ... 1 Appl...	1 R 0 R

2. Click your deployment, the details of your deployment can be viewed here: modules, routes, and rollout metrics for your deployment


Deployment details

iot-qdiyctqfomakk

ID	deploy-tempsensor-sink
Type	Deployment
Created	5/20/2022, 1:29:42 PM EDT
Last Updated	5/20/2022, 1:29:42 PM EDT

IoT Hub supports metrics to monitor IoT Edge deployments. All deployments report total targeted devices and total devices with the deployment applied. You may additionally define custom metrics to track deployment progress and status.

METRIC NAME	METRIC CRITERIA	CALCULATED TOTAL
Targeted	select deviceId from devices where capabilities.iotEdge = true and tags.environment='dev'	1 (details)
Applied	select deviceId from devices.modules where moduleId = '$edgeAgent' and configurations.[[deploy-tempsensor-sink]].status = 'Applied'	1 (details)
Reporting Success	select deviceId from devices.modules where moduleId =	1 (details)

3. Wait for your deployment to rollout to your device and then move on to the next section. This could take a bit of time for the deployment to roll out.

   If you go back to the page used on step 1. You can use the refresh button until System Metrics states `1 Targeted, 1 Applied`

8. Exercise: Review the data being sent to Grafana

Video: https://youtu.be/TvzvFG79spE

8.1. Login to your Windows 10 VM

You should still have your RDP session from earlier. If you closed it or it ended, follow the steps in section `Login to your Windows 10 VM` once again

8.2. Get the IP address of the EFLOW VM

1. Go to, or open, the PowerShell window
2. Run the following command to get the IP address of the EFlow VM

```
Get-EflowVmAddr
```

You'll get a result such as `172.20.126.50` Replace `{eflow_vm_ip}` below with the value

8.3. Login to Grafana

1. In the VM open Edge browser and navigate to http://{eflow_vm_ip}:3000

2. After the page loads, login with:

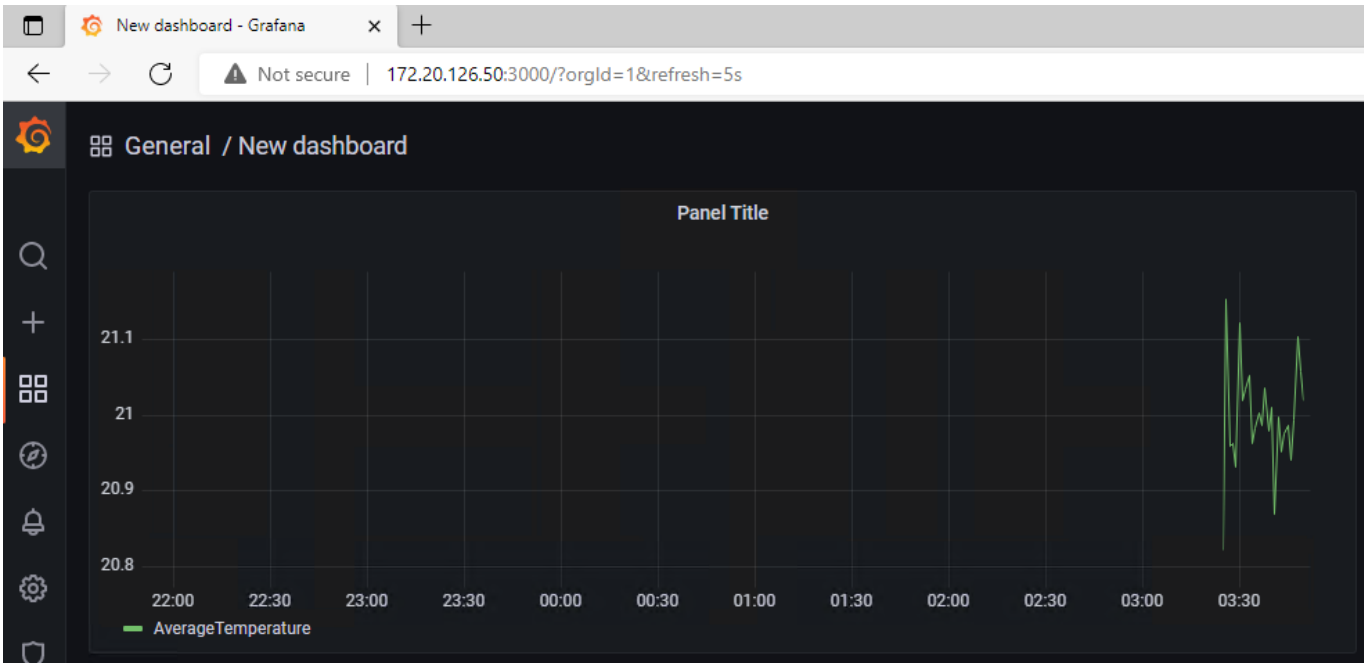
- username: `admin`
- password: `admin`

3. When prompted to change your password use `password1!` in password and confirmation boxes and click ok.

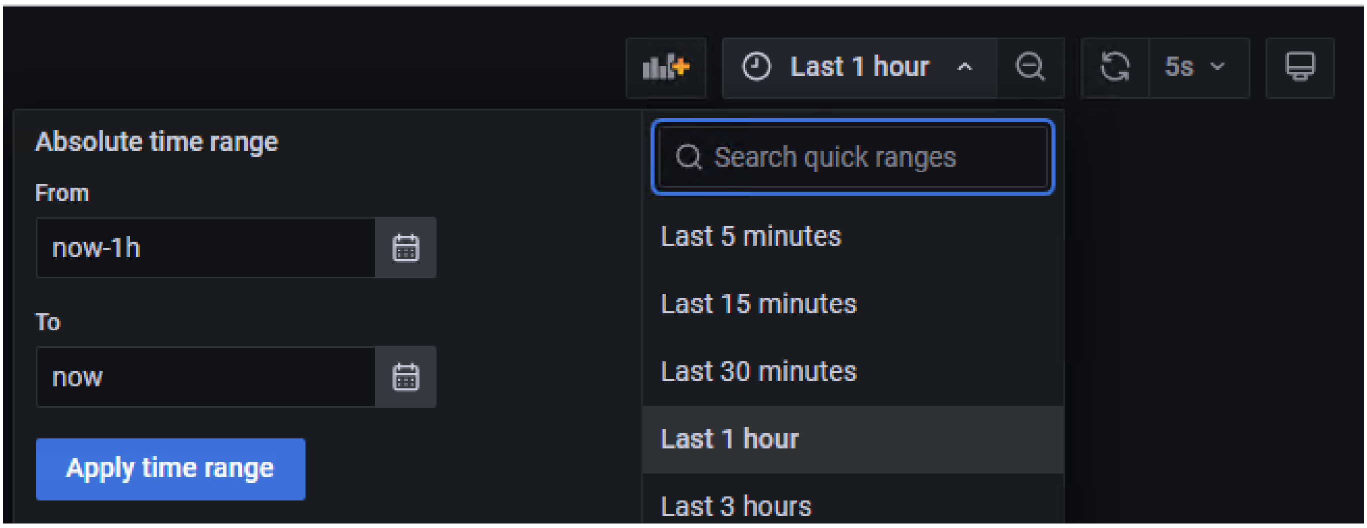
8.4. Review the provided dashboard and chart provided by this hands on lab

1. Review the data on the provided chart.

You may need to allow some time to pass for a lot of data to show on the graph



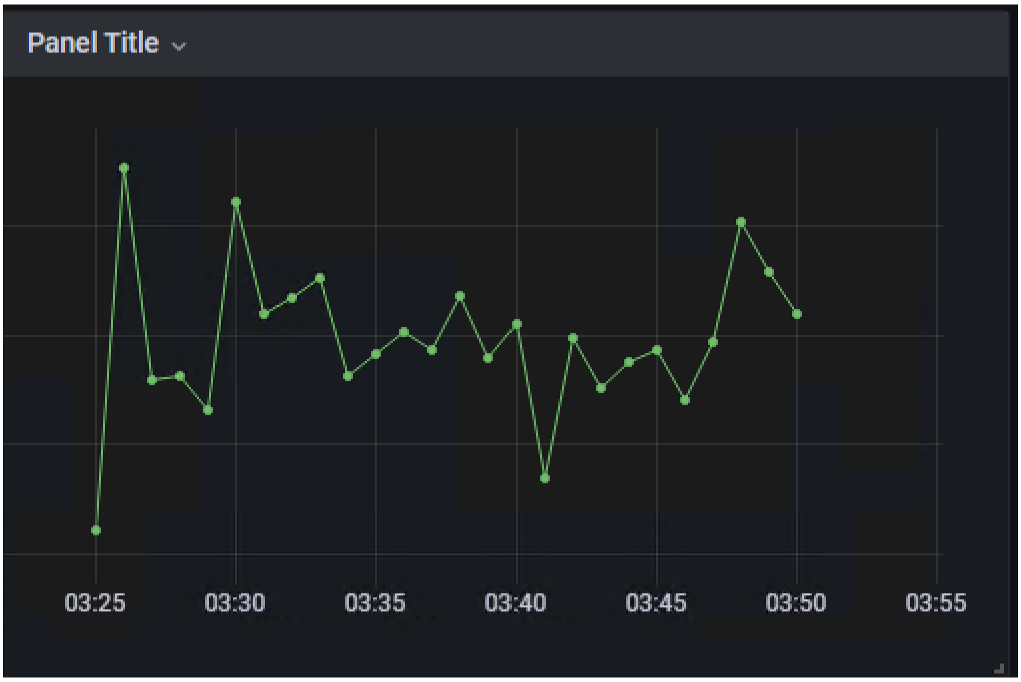
You can also change the time range to a shorter time and see a bit better graph. There is also an auto-refresh option available.



Absolute time range

From: now-1h

To: now



2. After seeing data, move on to the next Exercise

9. Exercise: Monitor IoT Hub Events

Video: https://youtu.be/cWtMkYIblI0

9.1. Resources

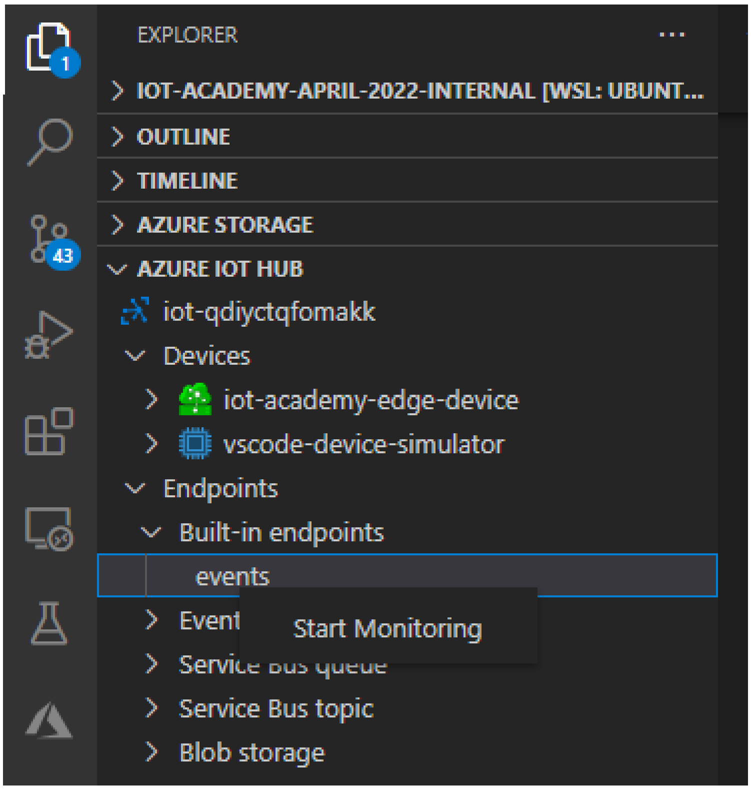
https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-vscode-iot-toolkit-cloud-device-messaging

9.2. Sign in and select the correct IoT Hub

1. Open VSCode
2. Use the command pallette, View -> Command Pallette
3. Type `select iot` and press enter after selecting `Azure IoT Hub: Select IoT Hub`
4. Select your subscription. If successful skip to step 6
5. If it's not visible you'll need to sign in with the correct account
    1. Command Pallette: `Azure: Sign Out`
    2. Command Pallette: `Azure: Sign In to Azure Cloud`
6. Select your IoT Hub created for this lab`

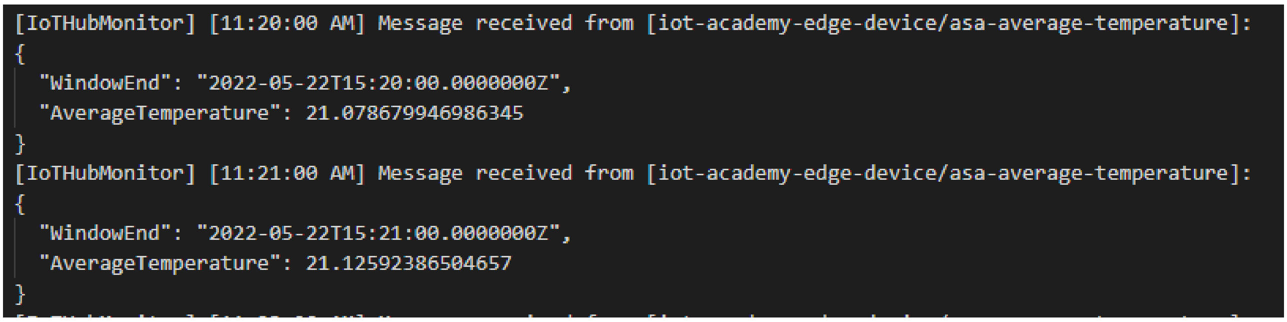
9.3. Start monitoring the IoT Hub built-in event endpoint

1. Right click `Explorer -> Azure IoT Hub -> Your Hub -> Built-in endpoints -> events` and click `Start Monitoring`



2. Average Temperature telemetry is produced once a minute. As not all averages temperatures meet the criteria for `AverageTemperature > 21`, it may take some time to see events flowing. You'll events in

your output window when they arrive.



```
[IoTHubMonitor] [11:20:00 AM] Message received from [iot-academy-edge-device/asa-average-temperature]:
{
  "WindowEnd": "2022-05-22T15:20:00.0000000Z",
  "AverageTemperature": 21.078679946986345
}
[IoTHubMonitor] [11:21:00 AM] Message received from [iot-academy-edge-device/asa-average-temperature]:
{
  "WindowEnd": "2022-05-22T15:21:00.0000000Z",
  "AverageTemperature": 21.12592386504657
}
```

10. Exercise: Create an Azure Logic App to Monitor Events from IoT Hub

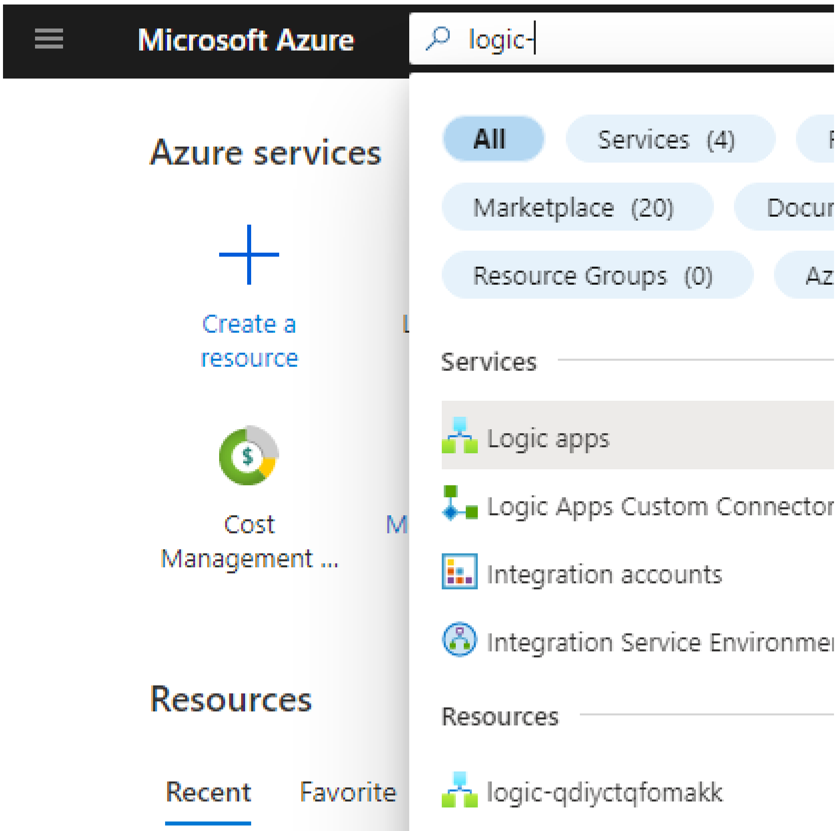
Video: https://youtu.be/n0ATDWwxfRg

10.1. Resources

https://docs.microsoft.com/en-us/azure/event-grid/publish-iot-hub-events-to-logic-apps
https://docs.microsoft.com/en-us/connectors/azureloganalyticsdatacollector/#creating-a-connection

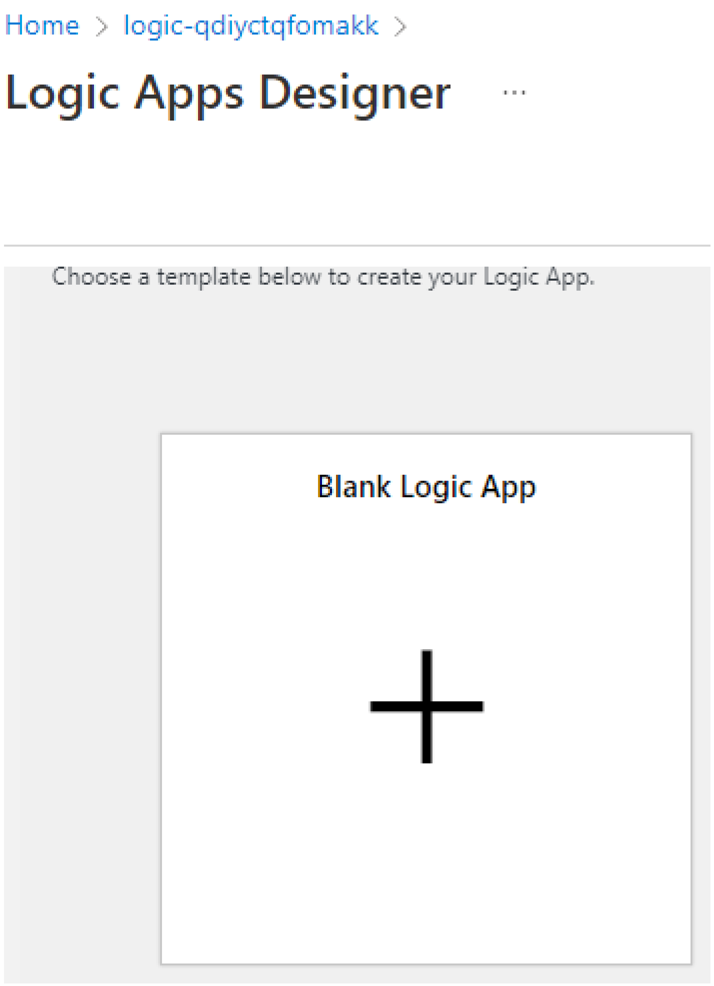
10.2. Open your pre-created Logic App in the portal

Go to the Azure Portal, search for `logic-`, search for `Logic App` and select it



10.3. Add a HTTP Request Trigger to your Logic App

1. Click `Blank Logic App`



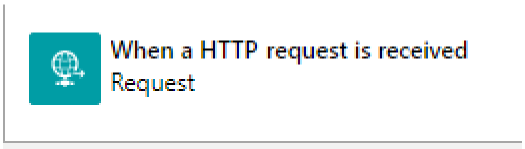
Home > logic-qdiyctqfomakk >

Logic Apps Designer ...

Choose a template below to create your Logic App.

Blank Logic App

2. Search for `http request` and click `When a HTTP request is received`

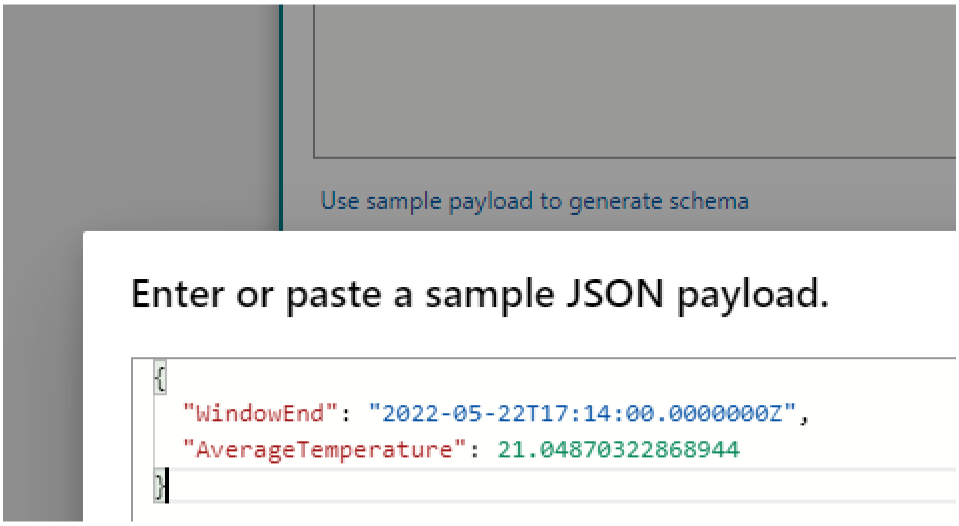


When a HTTP request is received
Request

4. Click `Use sample payload to generate schema` Copy the json to your clipboard

```
[
        {
            "id": "5749a230-6ebf-950f-3d26-53cc8315a4ad",
            "topic": "/SUBSCRIPTIONS/7451D6D6-9082-46D9-9373-CCD5FCDA6673/RESOURCEGROUPS/RG-IOT-ACADEMY/PROVIDERS/MICROSOFT.DEVICES/IOTHUBS/IOT-QDIYCTQFOMAKK",
            "subject": "devices/iot-academy-edge-device/asa-average-temperature",
            "eventType": "Microsoft.Devices.DeviceTelemetry",
            "data": {
                "properties": {},
                "systemProperties": {
                    "iothub-content-type": "application/json",
                    "iothub-content-encoding": "utf-8",
                    "iothub-connection-device-id": "iot-academy-edge-device",
                    "iothub-connection-module-id": "asa-average-
temperature",
                    "iothub-connection-auth-method": "
{\"scope\":\"module\",\"type\":\"sas\",\"issuer\":\"iothub\",\"acceptingIpF
ilterRule\":null}",
                    "iothub-connection-auth-generation-id":
"637886649142604368",
                    "iothub-enqueuedtime": "2022-05-22T20:19:00.3160000Z",
                    "iothub-message-source": "Telemetry"
                },
                "body": {
                    "WindowEnd": "2022-05-22T20:19:00.0000000Z",
                    "AverageTemperature": 21.038353595978126
                }
            },
            "dataVersion": "",
            "metadataVersion": "1",
            "eventTime": "2022-05-22T20:19:00.316Z"
        }
    ]
```

5. Paste in your json
6. Click `Done`



Use sample payload to generate schema

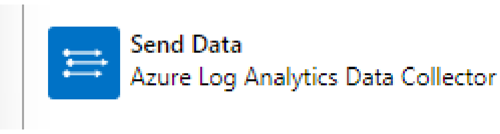
Enter or paste a sample JSON payload.

```
{
  "WindowEnd": "2022-05-22T17:14:00.0000000Z",
  "AverageTemperature": 21.04870322868944
}
```

7. Click `Save`
8. Copy the `HTTP Post URL` to your clipboard, save in your notepad

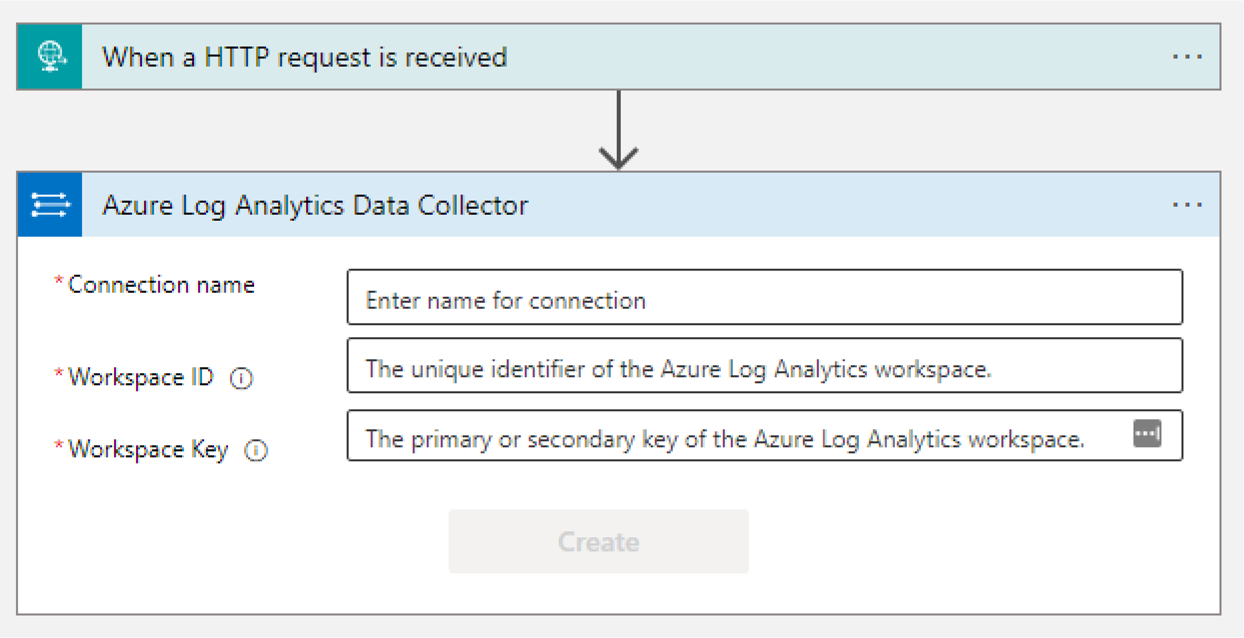
10.4. Add a Step for sending data to an Azure Log Analytics workspace

1. Click `New step`
2. Search for `Send data`. Look for and select `Send Data: Azure Log Analytics Data Collector`



Send Data
Azure Log Analytics Data Collector

3. Next you'll notice that connection information for your Log Analytics Workspace is needed.



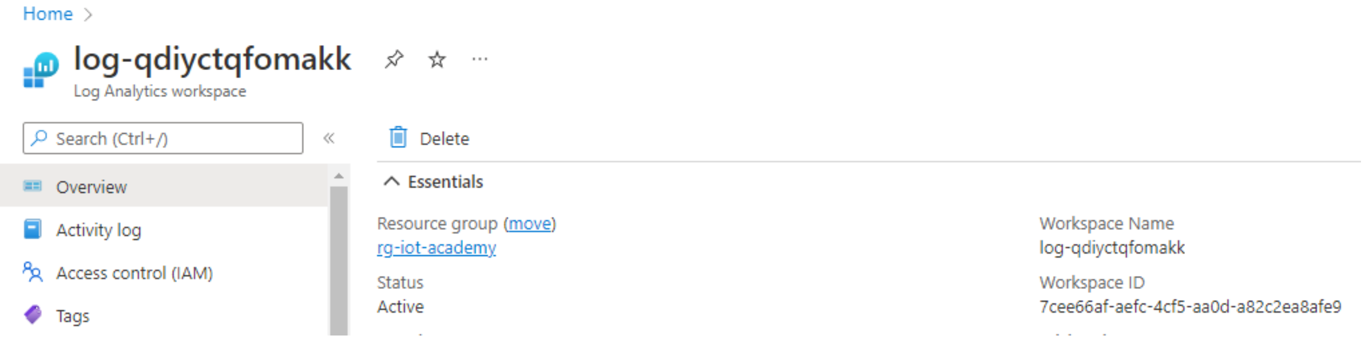
When a HTTP request is received
Azure Log Analytics Data Collector
Create

* Connection name: Enter name for connection

* Workspace ID: The unique identifier of the Azure Log Analytics workspace.

* Workspace Key: The primary or secondary key of the Azure Log Analytics workspace.

4. Name: `log-analytics`
5. In another browser tab go to the Azure Portal. Search for `log-`. Click your Log Analytics resource.
6. Copy the `Workspace ID` to your clipboard, such as `7cee66af-aefc-4cf5-aa0d-a82c2ea8afe9`



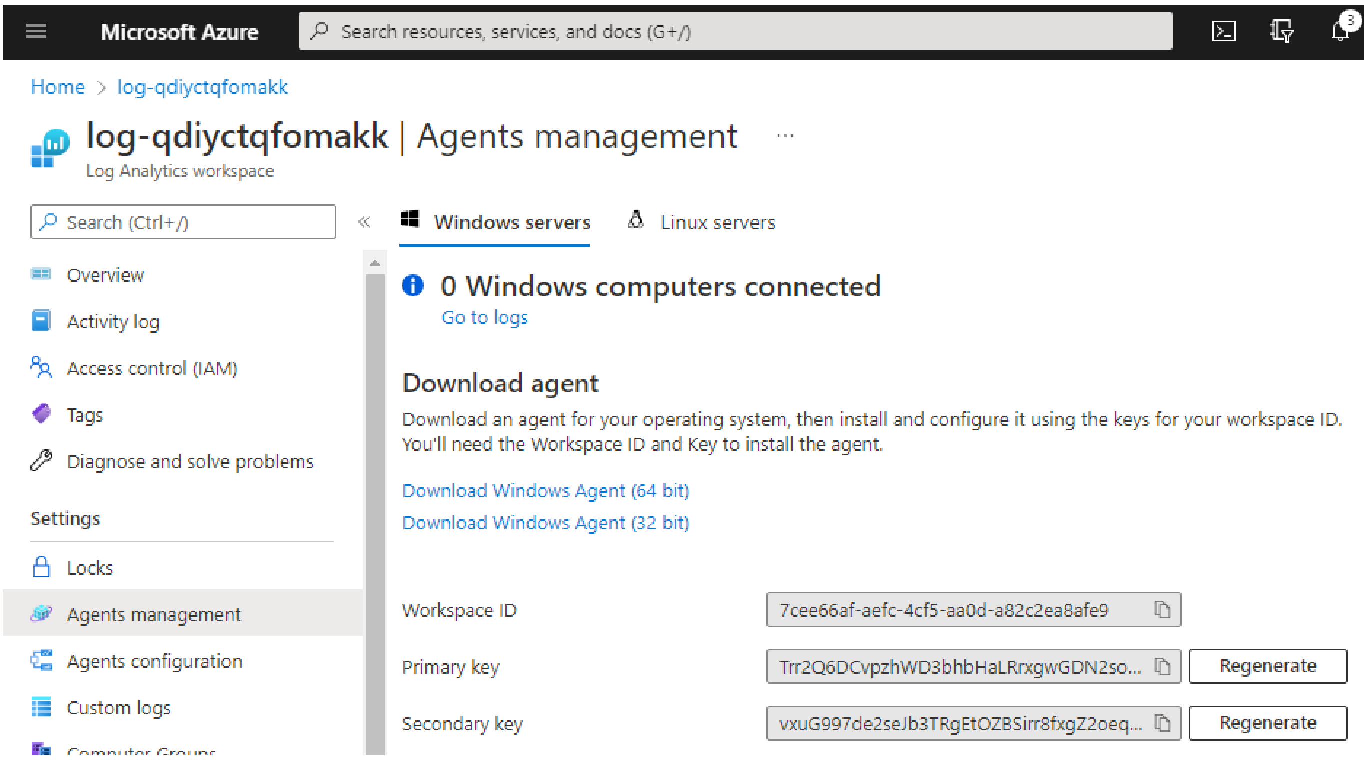
Resource group (move)
rg-iot-academy

Status
Active

Workspace Name
log-qdiyctqfomakk

Workspace ID
7cee66af-aefc-4cf5-aa0d-a82c2ea8afe9

7. Back to your Logic App browser tab. Paste your `Workspace ID` in the appropriate box
8. Back to your Log Analytics tab. Click `Agents Management`. Copy the `Primary Key` to your clipboard



log-qdiyctqfomakk | Agents management

Log Analytics workspace

0 Windows computers connected

Download agent

Download an agent for your operating system, then install and configure it using the keys for your workspace ID. You'll need the Workspace ID and Key to install the agent.

Workspace ID 7cee66af-aefc-4cf5-aa0d-a82c2ea8afe9

Primary key Trr2Q6DCvpzhWD3bhbHaLRrxgwGDN2so...

Secondary key vxuG997de2seJb3TRgEtOZBSirr8fxgZ2oeq...

9. Back to your Logic App browser tab. Paste your `Primary Key`. Click Ok.

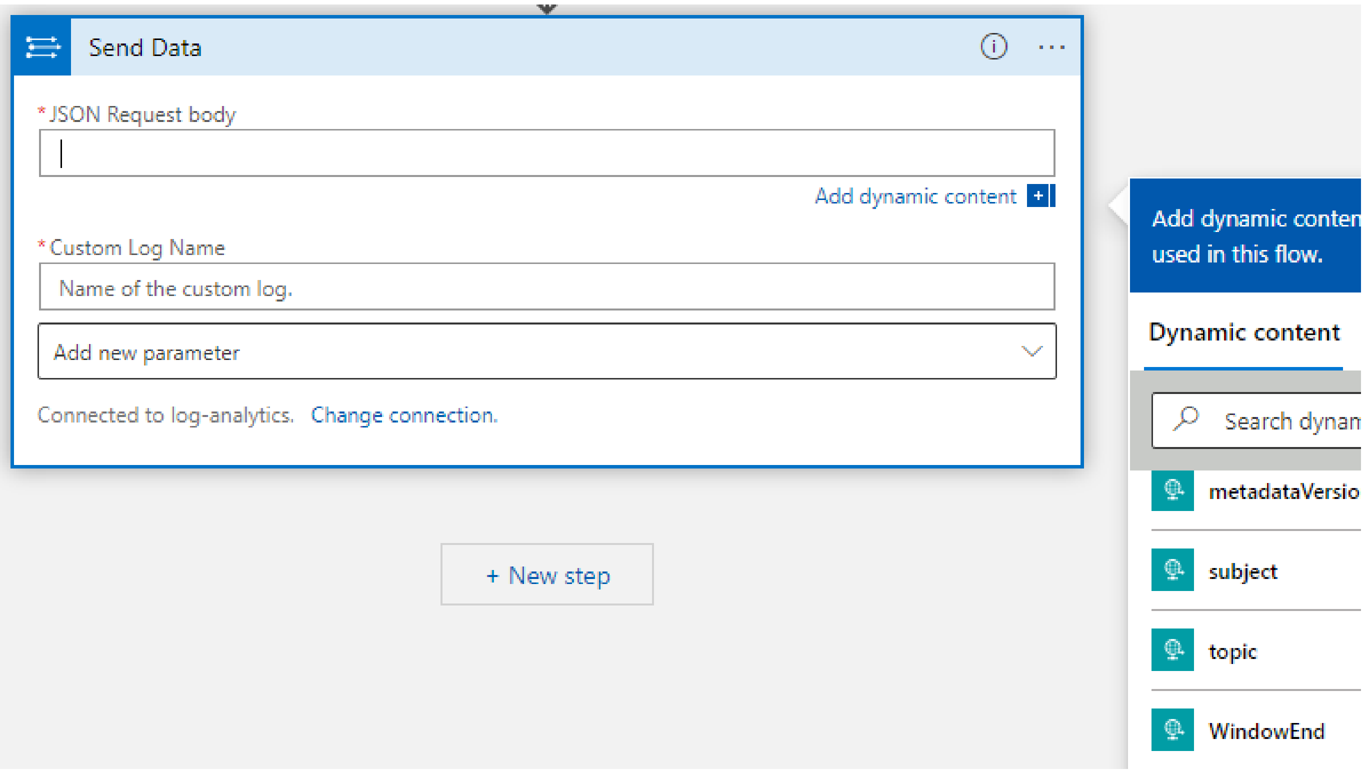
10. Click `Create`

11. Click `Save`

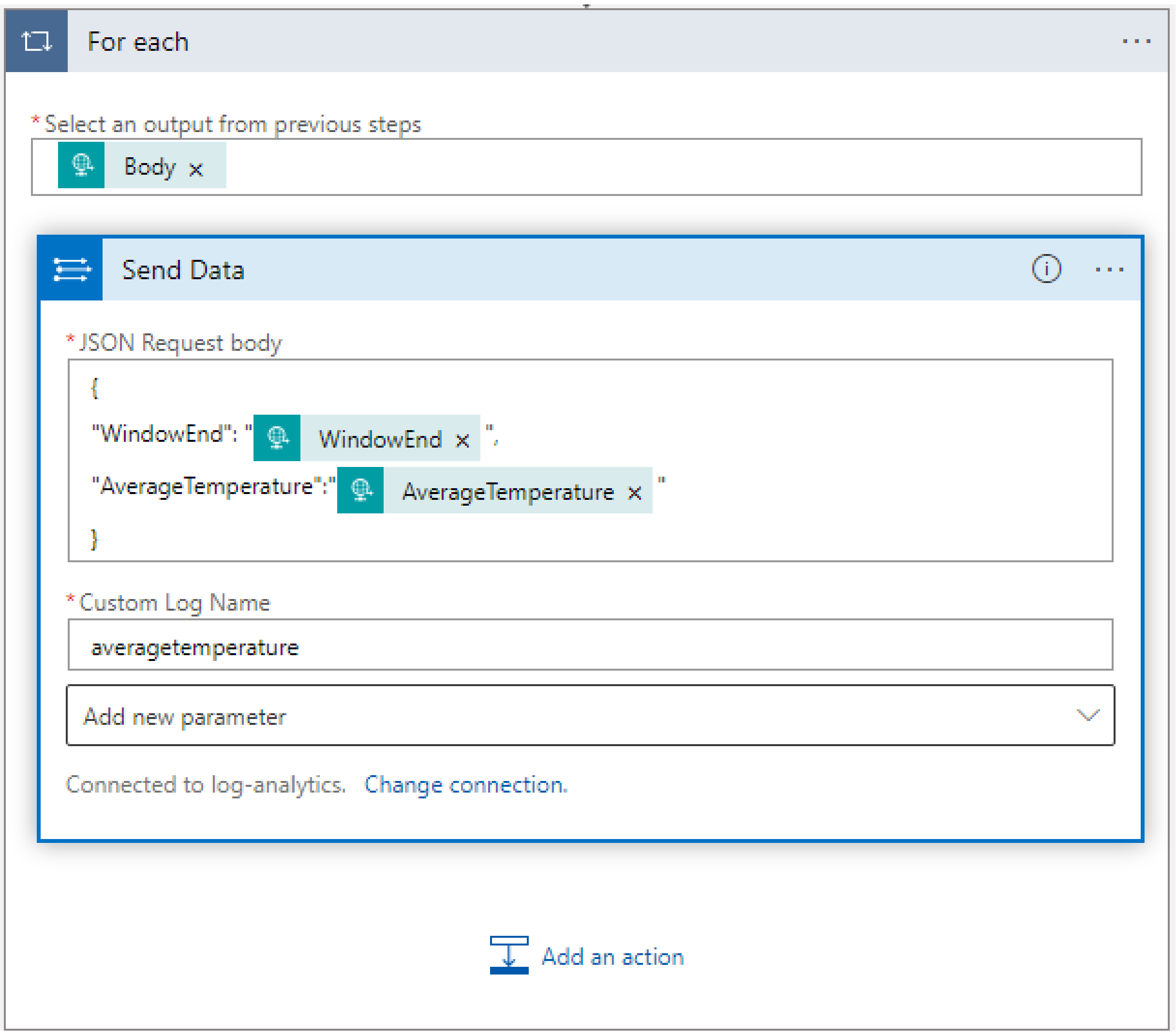
12. Paste the following json into the `JSON Request body` box

```
{
"WindowEnd": "@{items('For_each')?['data']?['body']?['WindowEnd']}",
"AverageTemperature":"@{items('For_each')?['data']?['body']?
['AverageTemperature']}"
}
```

13. Click in the JSON Request Body field and select `WindowEnd` in the Dynamic Content box.



14. Notice, the Logic App designer automatically inserts a foreach for you, due to the nesting of the json.

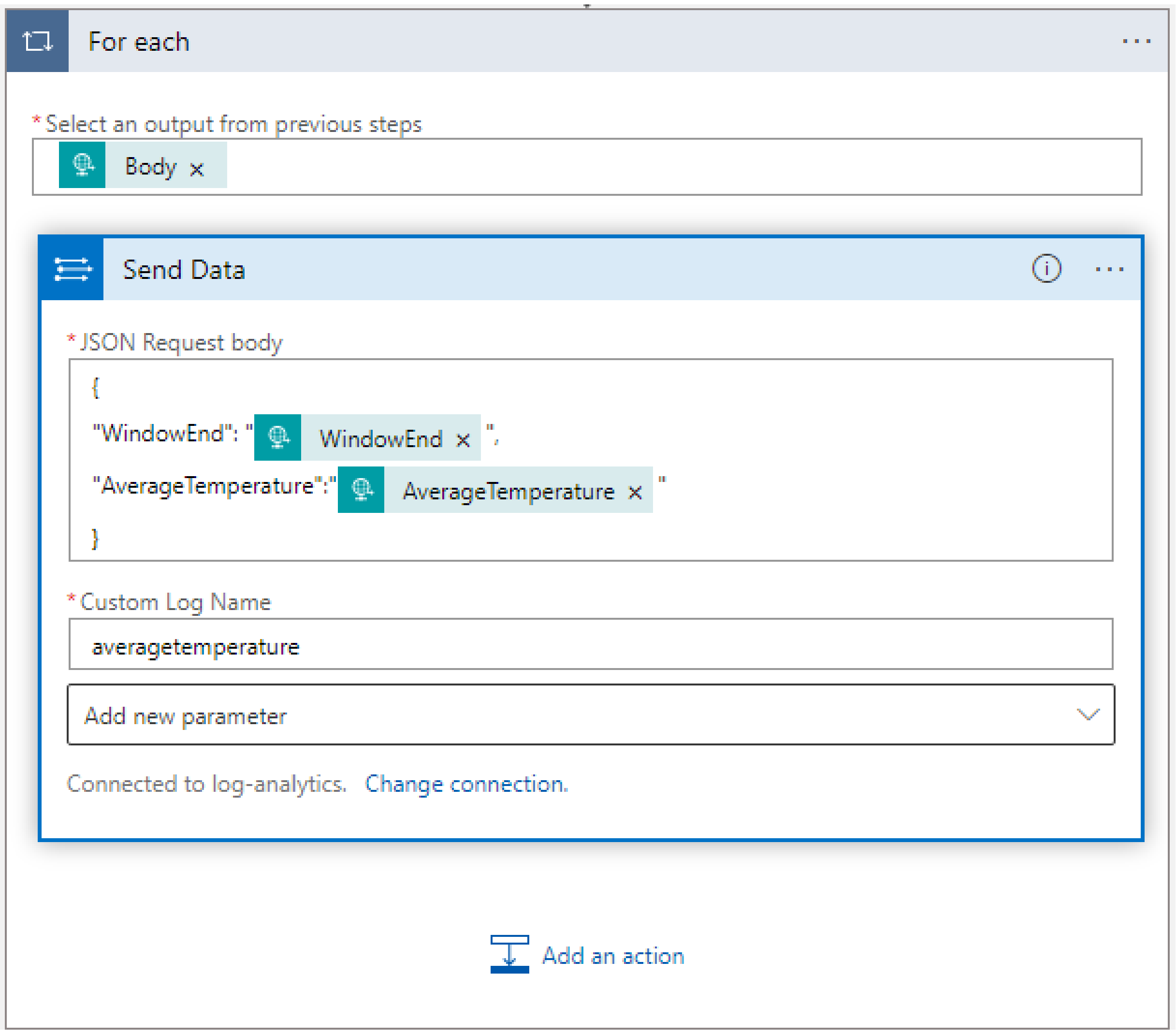


```
{
"WindowEnd": "WindowEnd",
"AverageTemperature":"AverageTemperature"
}
```

averagetemperature

15. Click the x on the WindowEnd field. Place your cursor between the two "". Look on the right panel dynamic fields and click WindowEnd.

16. Enter the details the click Save



For each

* Select an output from previous steps: Body

Send Data

* JSON Request body

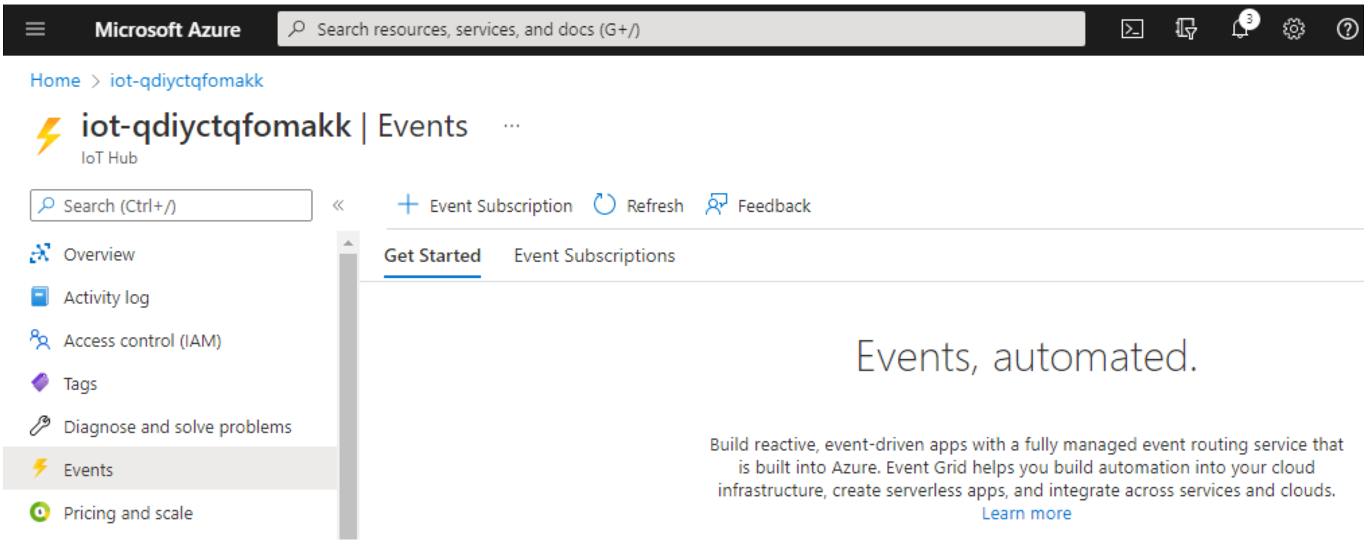
```
{
"WindowEnd": "WindowEnd",
"AverageTemperature":"AverageTemperature"
}
```

* Custom Log Name: averagetemperature

10.5. Configure IoT Hub to send events to your logic app

1. In a new browser tab, search for `iot-`. Click your IoT Hub instance.

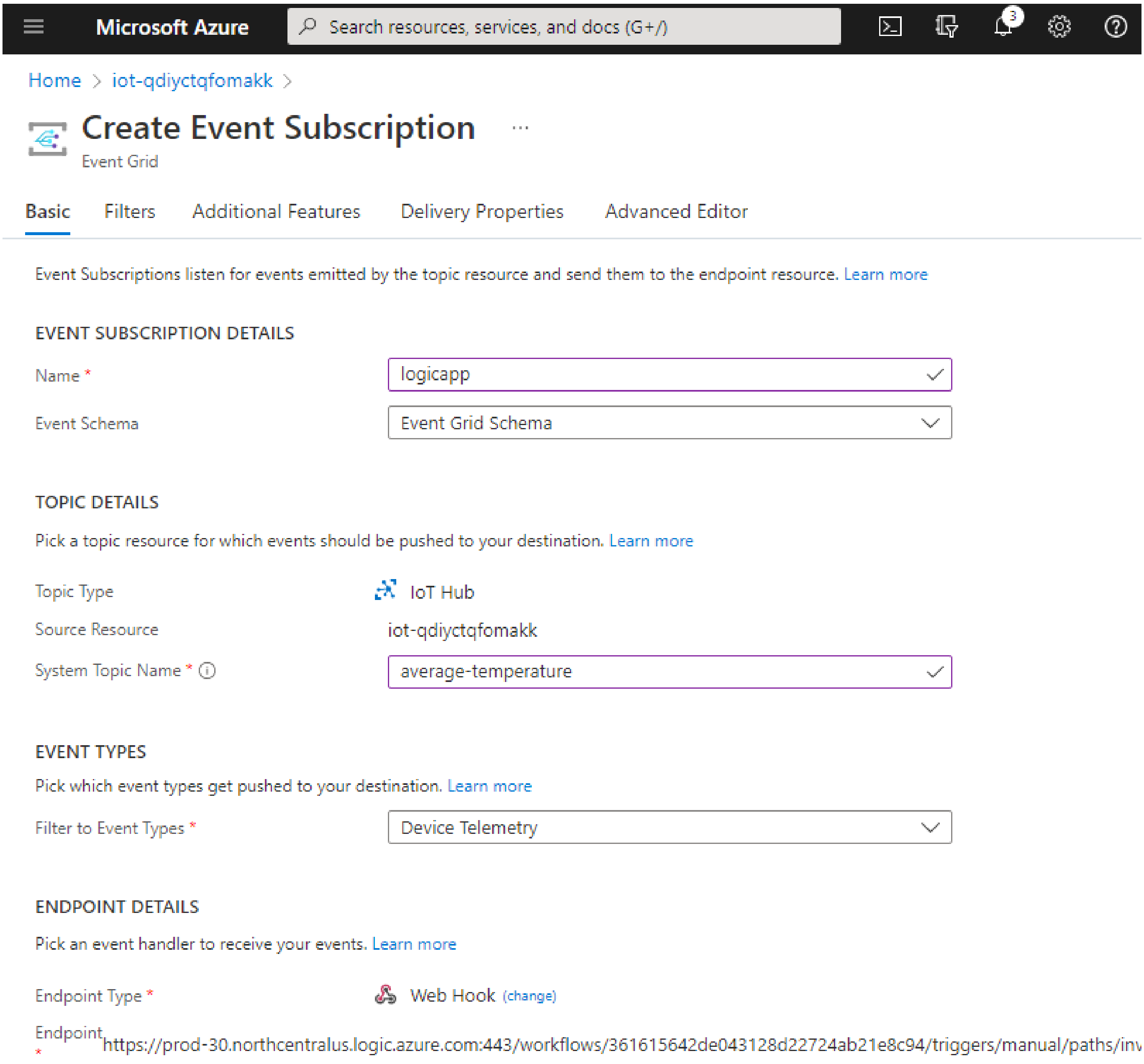
2. Click Events. Click `+ Event Subscription`



Build reactive, event-driven apps with a fully managed event routing service that is built into Azure. Event Grid helps you build automation into your cloud infrastructure, create serverless apps, and integrate across services and clouds.

3. Enter the following details

- Name: logicapp
- Event Grid Schema
- Filter to Event Types: Only Device Telemetry
- Endpoint: The `HTTP Post URL` you saved to your notepad



Microsoft Azure
Search resources, services, and docs (G+/)
Home > iot-qdiyctqfomakk >

Create Event Subscription

Event Grid

Event Subscriptions listen for events emitted by the topic resource and send them to the endpoint resource. Learn more

EVENT SUBSCRIPTION DETAILS

Name * logicapp

Event Schema Event Grid Schema

TOPIC DETAILS

Pick a topic resource for which events should be pushed to your destination. Learn more

Topic Type IoT Hub

Source Resource iot-qdiyctqfomakk

System Topic Name * average-temperature

EVENT TYPES

Pick which event types get pushed to your destination. Learn more

Filter to Event Types * Device Telemetry

ENDPOINT DETAILS

Pick an event handler to receive your events. Learn more

Endpoint Type * Web Hook (change)

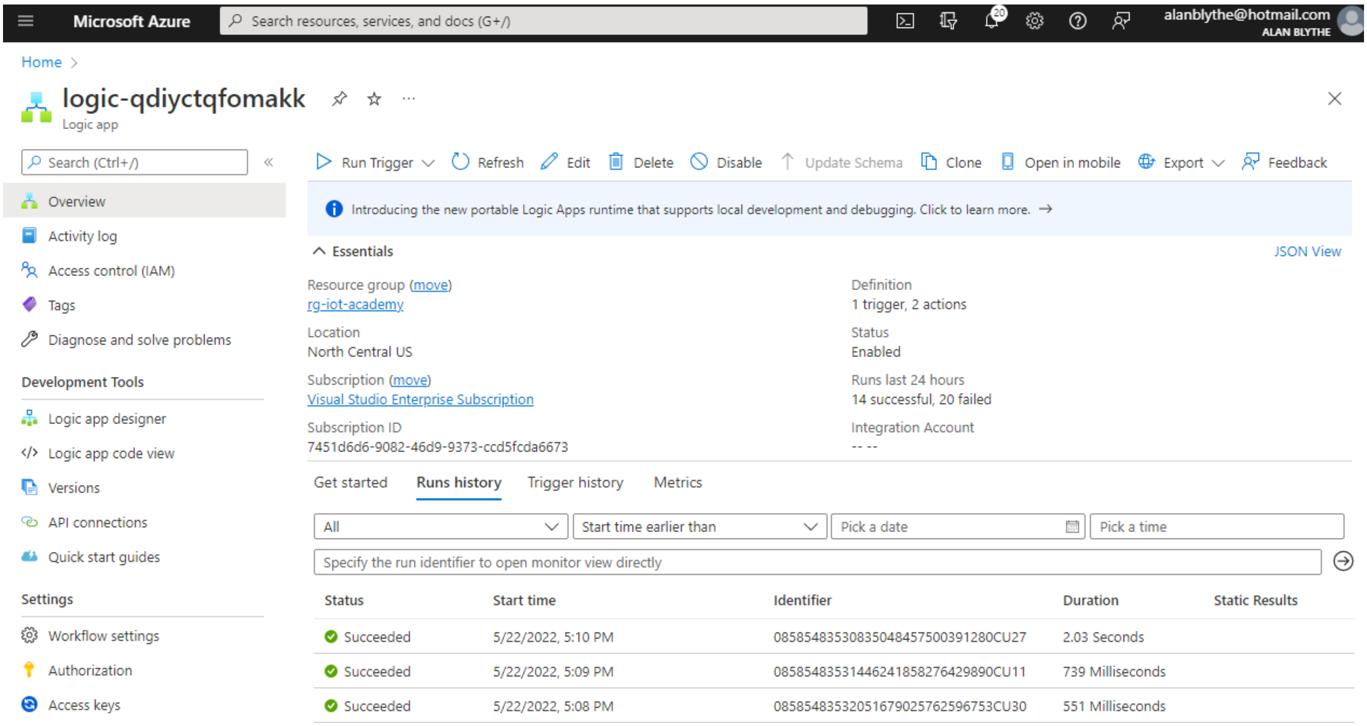
Endpoint * https://prod-30.northcentralus.logic.azure.com:443/workflows/361615642de043128d22724ab21e8c94/triggers/manual/paths/inv

4. Click `Create`

Note: Filters can also be added here similar to how we filtered telemetry for > 21 earlier in the lab.

10.6. Ensure your Logic is receiving the webhook and succeeding

1. Navigate back to your browser tab where you have the Logic App open
2. Review the execution history on the Overview page. If you don't see any runs, give it a few minutes to show up. Use the refresh button if necessary.



Introducing the new portable Logic Apps runtime that supports local development and debugging. Click to learn more. →

Resource group (move)
rg-iot-academy

Location
North Central US

Subscription (move)
Visual Studio Enterprise Subscription

Subscription ID
7451d6d6-9082-46d9-9373-ccd5fcda6673

Definition
1 trigger, 2 actions

Status
Enabled

Runs last 24 hours
14 successful, 20 failed

Integration Account
-- --

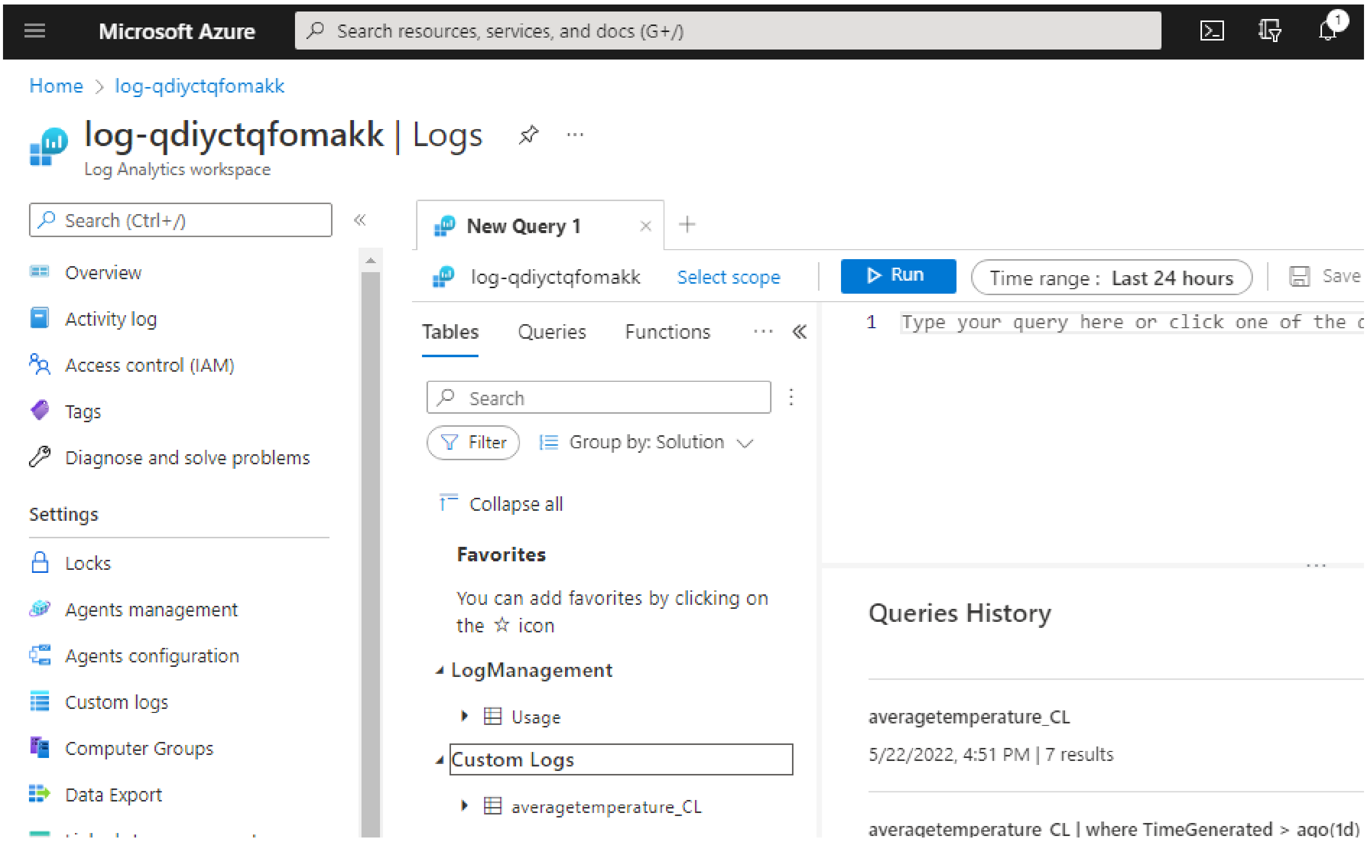
Status	Start time	Identifier	Duration	Static Results
✓ Succeeded	5/22/2022, 5:10 PM	08585483530835048457500391280CU27	2.03 Seconds	
✓ Succeeded	5/22/2022, 5:09 PM	08585483531446241858276429890CU11	739 Milliseconds	
✓ Succeeded	5/22/2022, 5:08 PM	08585483532051679025762596753CU30	551 Milliseconds	

11. Exercise: View Log Analytics data and setup an alert

Video: https://youtu.be/GhwsPXFdye0

11.1. Query the Log Analytics Data

1. Go back to your browser tab where Log Analytics is open. If you can't find it search for `iot-`
2. Click `Logs` and close the `Queries` window that pops up.



```
Type your query here or click one of the q
```

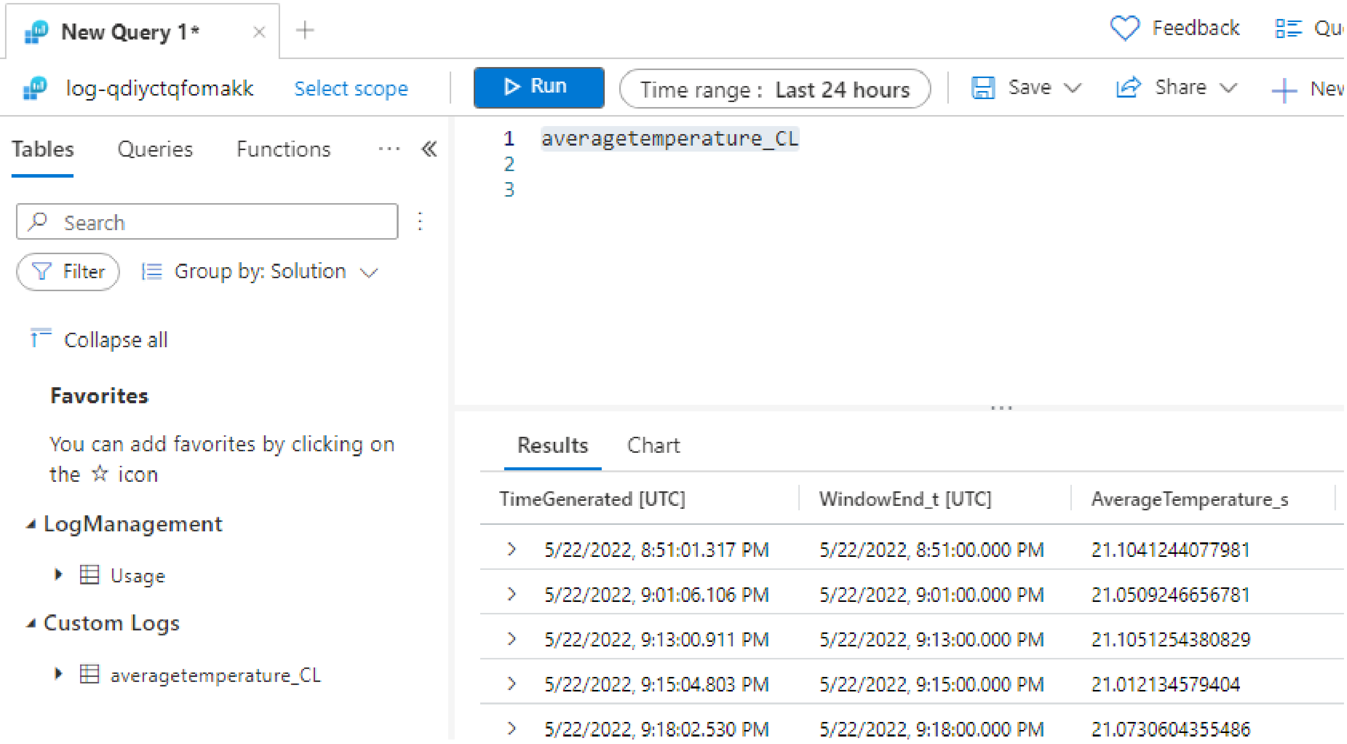
averagetemperature_CL

5/22/2022, 4:51 PM | 7 results

averagetemperature_CL | where TimeGenerated > ago(1d)

3. Ensure you see the `averagetemperature_CL` table. If not, it may take some time to show up

4. Paste `averagetemperature_CL` into the query window and click the `Run button`



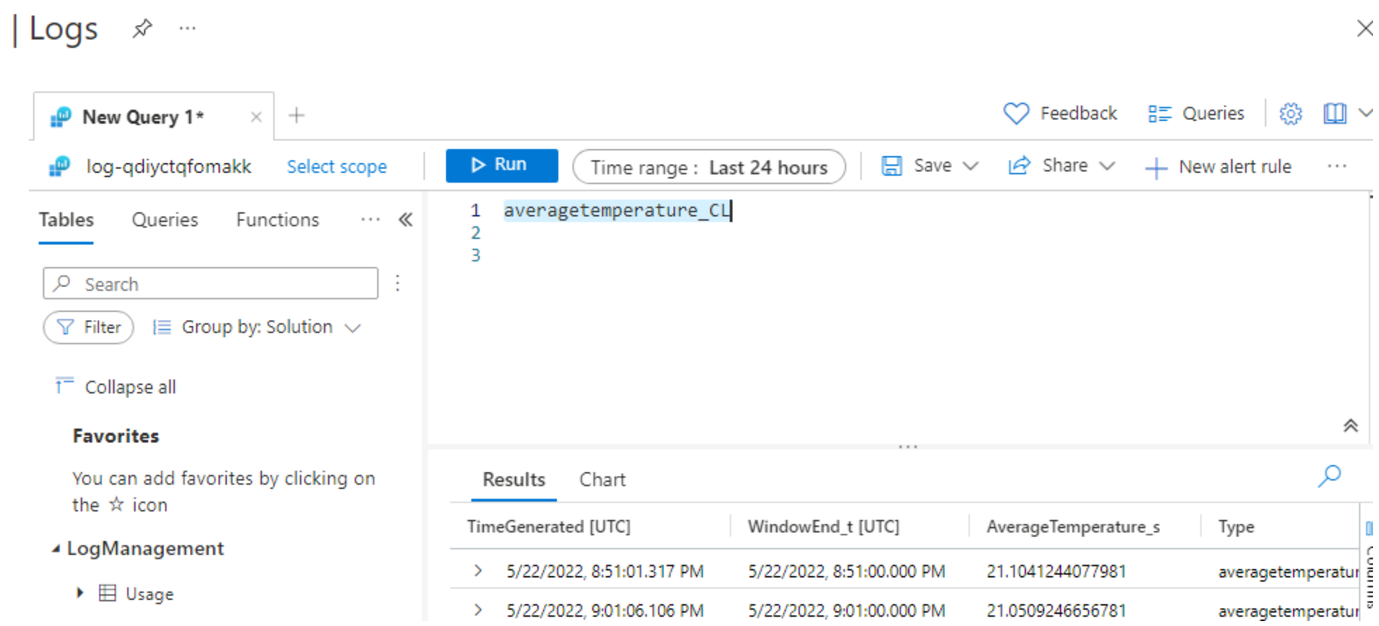
```
averagetemperature_CL
```

TimeGenerated [UTC]	WindowEnd_t [UTC]	AverageTemperature_s
5/22/2022, 8:51:01.317 PM	5/22/2022, 8:51:00.000 PM	21.1041244077981
5/22/2022, 9:01:06.106 PM	5/22/2022, 9:01:00.000 PM	21.0509246656781
5/22/2022, 9:13:00.911 PM	5/22/2022, 9:13:00.000 PM	21.1051254380829
5/22/2022, 9:15:04.803 PM	5/22/2022, 9:15:00.000 PM	21.012134579404
5/22/2022, 9:18:02.530 PM	5/22/2022, 9:18:00.000 PM	21.0730604355486

5. Once you see logs move onto the next section

11.2. Create an Azure Monitor Alert

1. On the upper right click `New alert rule`



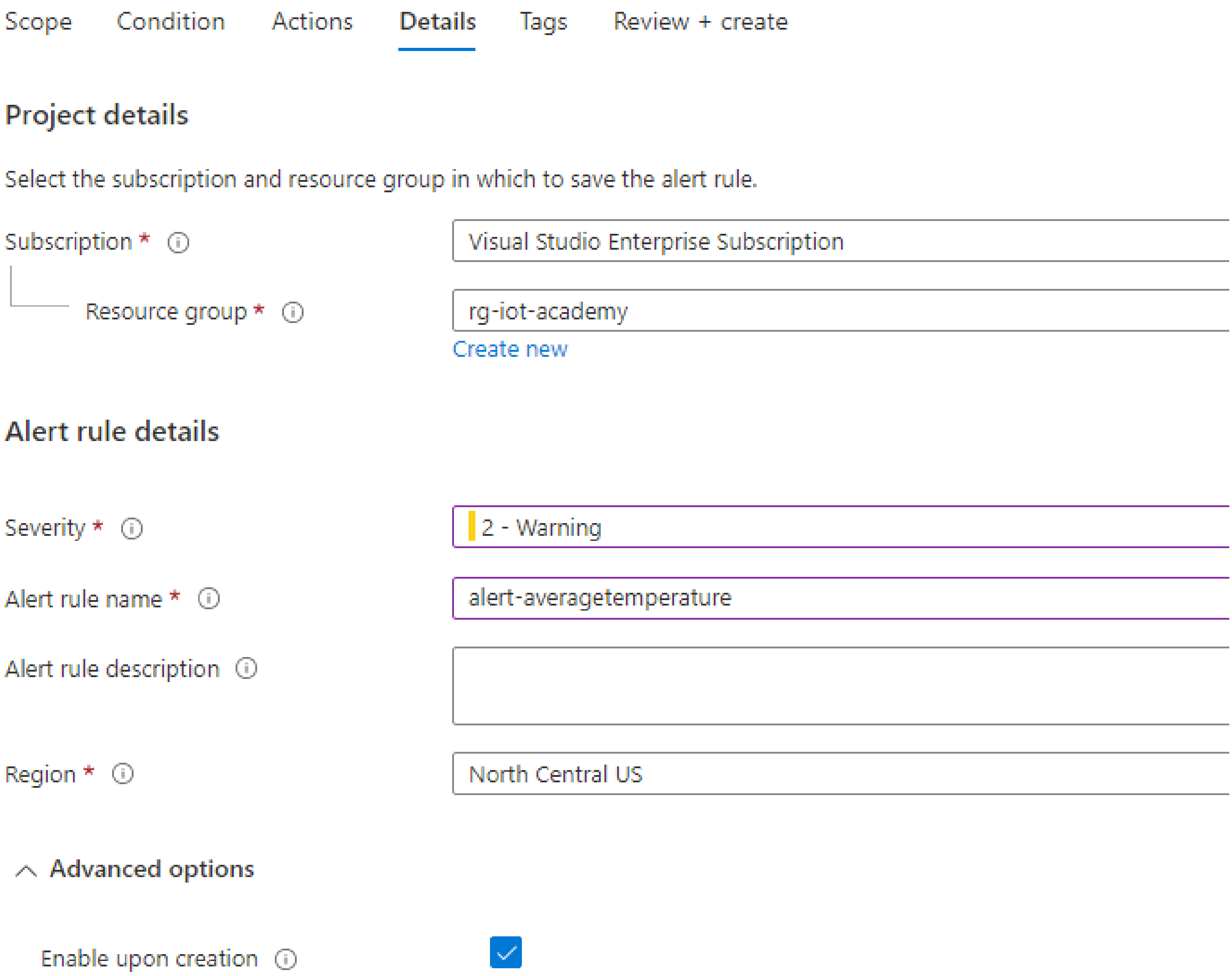
```
averagetemperature_CL
```

TimeGenerated [UTC]	WindowEnd_t [UTC]	AverageTemperature_s	Type
5/22/2022, 8:51:01.317 PM	5/22/2022, 8:51:00.000 PM	21.1041244077981	averagetemperatur
5/22/2022, 9:01:06.106 PM	5/22/2022, 9:01:00.000 PM	21.0509246656781	averagetemperatur

2. Now on the `Condition` tab. Enter the following

- Search Query: `averagetemperature_CL`
- Measure: `Table Rows`
- Aggregation Type: `Count`
- Aggregation Granularity: `5 minutes`
- Operator: `Greater than`
- Threshold Value: 2
- Frequency of Evaluation: `5 minutes`

3. Click `Next`. Review the `Actions` tab. Here you can configure emails or SMS to be sent.
4. Click `Next: Details`
5. Enter a name: `alert-averagetemperature`
6. Change Severity to: `Warning`
7. Region: Default or your region
8. Leave the result default, ensure it's enabled



Project details

Select the subscription and resource group in which to save the alert rule.

Subscription * : Visual Studio Enterprise Subscription

Resource group * : rg-iot-academy

Create new

Alert rule details

Severity * : 2 - Warning

Alert rule name * : alert-averagetemperature

Alert rule description :

Region * : North Central US

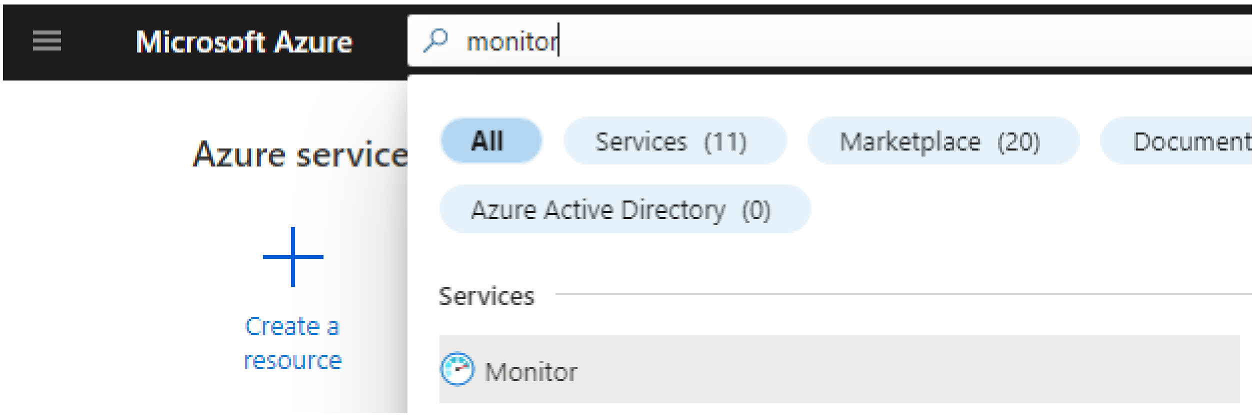
Advanced options

Enable upon creation ☑

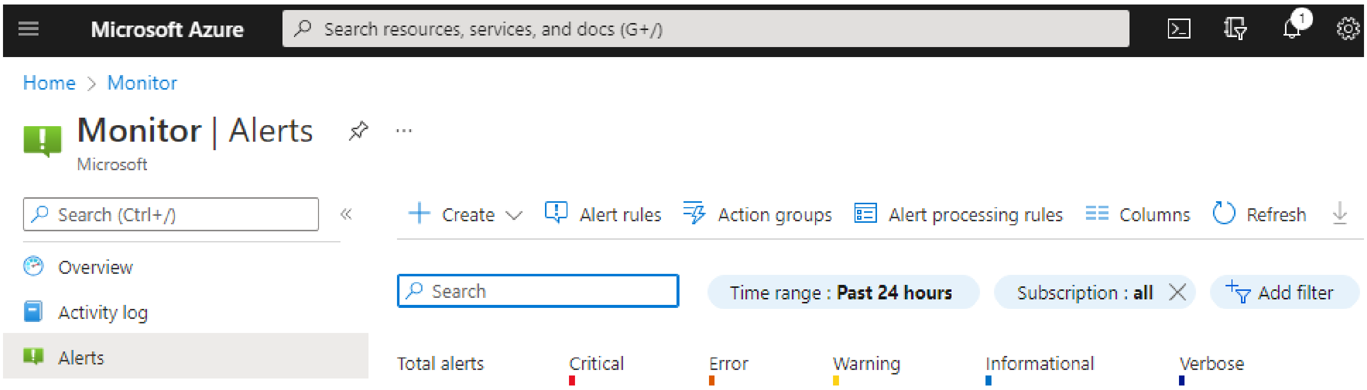
9. Click `Review and Create`
10. Click `Create`

11.3. Review your Alert in Azure Monitor

1. Open a new browser tab to https://portal.azure.com and search for Monitor. Click Monitor



2. Click `Alerts`. Review the Alerts page



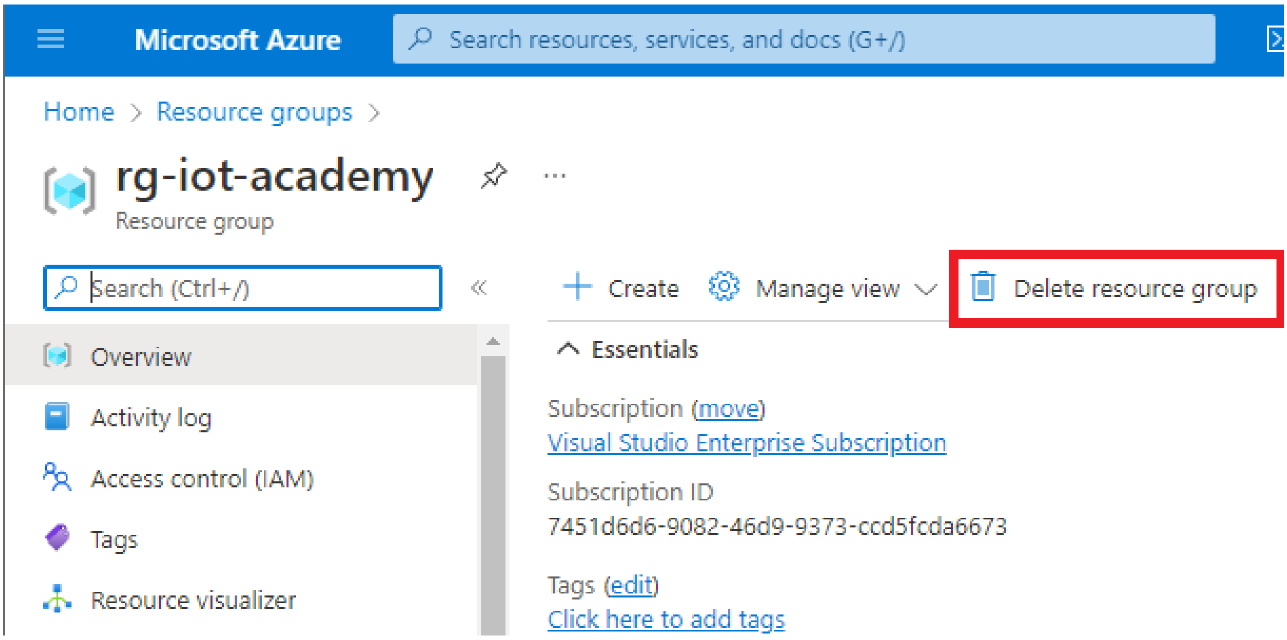
3. Wait some time, after a while an alert should trigger based on the temperature simulator data being sent. The `Refresh` button will need to be used to see new alerts arrive.

12. Cleanup

Note: If you are continuing to Month 2 Day 2, this should be done after Day 2 is complete, as the IoT Hub resource is re-used.

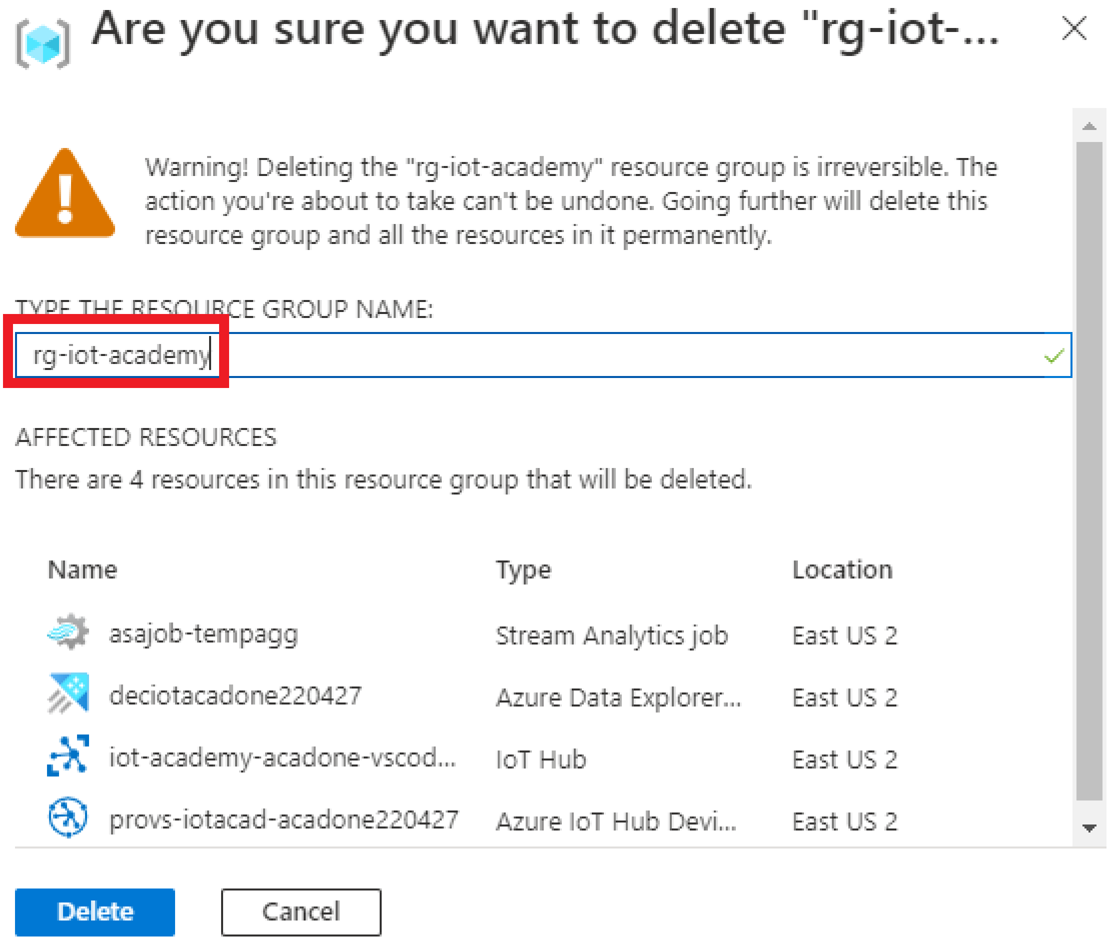
It's important to not leave your Azure resources provisioned until the next Azure IoT Academy session as there may not be enough Azure credit for the next sessions.

1. Navigate to the Azure Portal home page
2. Click **Resource groups**
3. Click **rg-iot-academy**
4. Click **Delete resource group**



Subscription (move)
Visual Studio Enterprise Subscription
Subscription ID
7451d6d6-9082-46d9-9373-ccd5fcda6673
Tags (edit)
Click here to add tags

5. Type the type the name of your resource group and click **Delete**



Are you sure you want to delete "rg-iot-...

Warning! Deleting the "rg-iot-academy" resource group is irreversible. The action you're about to take can't be undone. Going further will delete this resource group and all the resources in it permanently.

TYPE THE RESOURCE GROUP NAME:

rg-iot-academy ✓

AFFECTED RESOURCES

There are 4 resources in this resource group that will be deleted.

Name	Type	Location
asajob-tempagg	Stream Analytics job	East US 2
deciotacadone220427	Azure Data Explorer...	East US 2
iot-academy-acadone-vscod...	IoT Hub	East US 2
provs-iotacad-acadone220427	Azure IoT Hub Devi...	East US 2