

Azure Digital Twins End-To-End Sample

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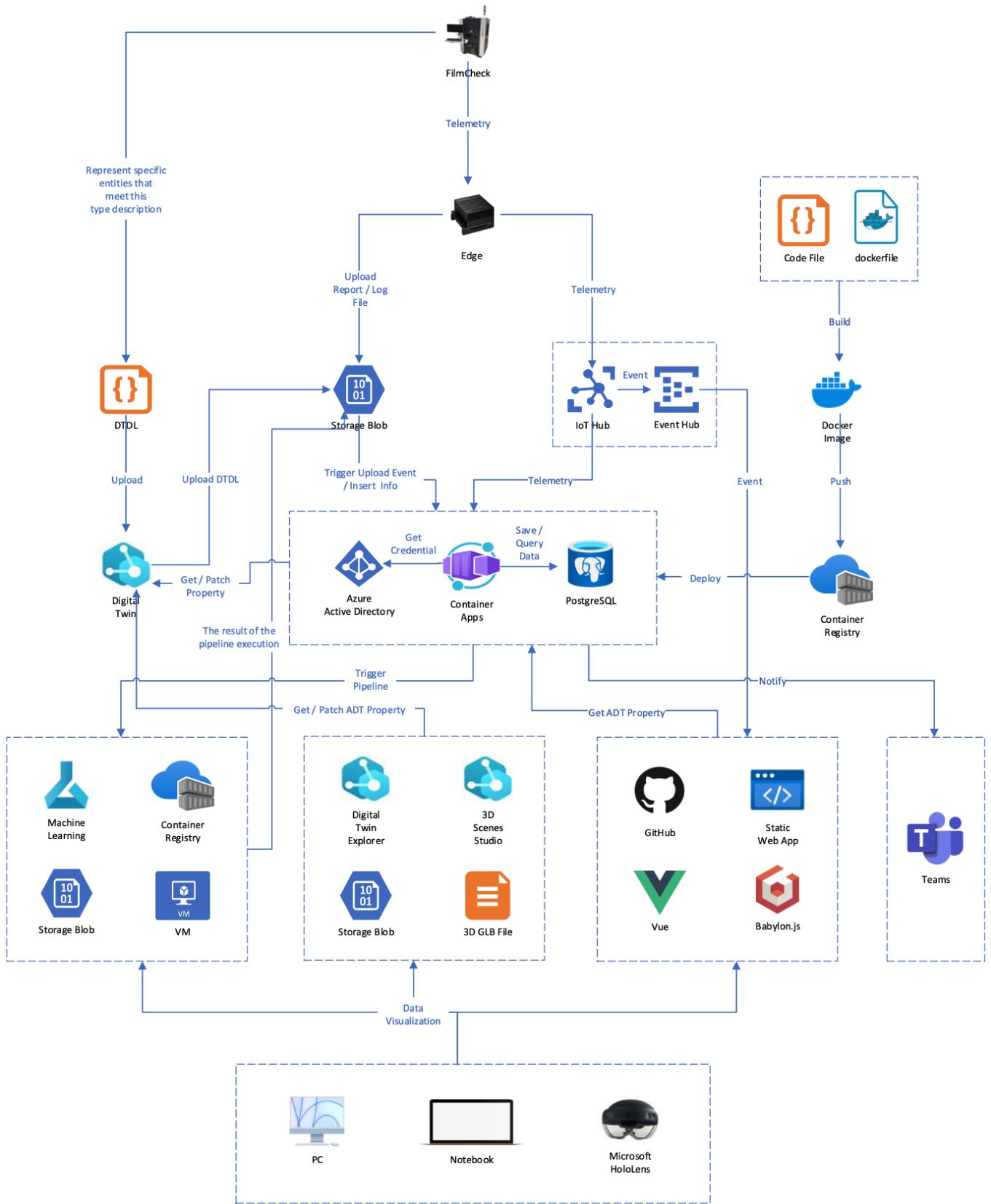
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Flow

This project contains a sample for working with Azure Digital Twins :

- A building scenario sample written in Vue, Node.js, and Python. The sample can be used to set up and a full end-to-end scenario with Azure Digital Twins.
- The designed flow and architecture is showed as following :
 - Upload the corresponding status and measurement results of the Semiconductor Film Thickness Measurement System (FilmCheck AS300) in **DTDL** format to Azure Digital Twins.
 - Sending the status and measurement results of the Semiconductor Film Thickness Measurement System (FilmCheck AS300) to the edge for analysis and serialization, and then transmitting to Azure IoT Hub.
 - After analyzing the relevant data received from Azure IoT Hub, the program deployed in the Azure Container App writes it into the corresponding property in Azure Digital Twin.
 - Retrieve the corresponding properties from Azure Digital Twins and display them in Azure 3D Scenes Studio.
 - Use Microsoft HoloLens to understand the current status and measurement results of the Semiconductor Film Thickness Measurement System (FilmCheck AS300) through the dashboard deployed in Azure Static Web App.
 - When an error occurs in the Semiconductor Film Thickness Measurement System (FilmCheck AS300), send an alert message to the administrator group in real-time via Microsoft Teams.
 - Upload the logs and reports received from the Semiconductor Film Thickness Measurement System (FilmCheck AS300) on Edge to Azure Blob. When Azure Blob receives the upload event of the report, trigger the Azure Machine Learning pipeline to perform data analysis and generate results, then upload them to Azure Blob and Job Metrics/Images.
 - Keyword :
 - Azure IoT Hub, Docker, Azure Container Registry, Azure Container Apps, Azure Digital Twins, Digital Twins Definition Language (DTDL), Azure 3D Scenes Studio, Azure Digital Twins Explorer, Azure App Service, Microsoft HoloLens, Creating a 3D model of a physical object, Babylon.js, Azure Machine Learning, Azure Static Web App, Vue, Azure storage account, Azure Database for PostgreSQL, GitHub, Azure Active Directory and Microsoft Teams.



Semiconductor Film Thickness Measurement System - FilmCheck AS300

Spectral reflectometer (SR) is a method of characterizing unknown properties of a sample by measuring the reflection of electromagnetic radiation. The reflected light is collected onto the spectrometer and transferred into spectrum signals. After the theoretical analysis and signature fitting, the parameters of the sample can be obtained. In our system, it can measure the parameters of film thickness, (n, k) value, and TSV (through silicon via) depth (option).

- Features
 - Extra film thickness range up to 150 µm
 - Fast alignment with high reliability R - Θ stage
 - Precise measurement location for patterned film
 - Generate map recipe in seconds
 - Double check measurement location by preview color camera
 - Auto focusing for precise measurement
- Specifications
 - Oxide, Nitride, PR, PI film on Si, GaAs, glass, metals substrate
 - Excellent for patterned film with auto mapping
 - Mapping size up to 300 mm wafer
 - Absolute reflectivity measurements
 - Film thickness range: 200 Å ~ 150 µm
 - Repeatability:
 10 Å @ 5000 Å Oxide on Si substrate
 - Measurement Spot Size: φ40 µm (available others)
 - Wafer size compatibility: 4", 6", 8", 12"
 - SEMI S2 compliance
- Infomation

Edge Computing Hardware

- [NVIDIA® Jetson AGX Xavier™](#)

Azure Cloud service used

- [Azure IoT Hub](#)
- [Azure Event Hub](#)
- [Azure Active Directory](#)
- [Azure Digital Twins](#)
- [Azure Digital Twins Explorer](#)
- [3D Scenes Studio for Azure Digital Twins](#)
- [Azure Container Registry](#)
- [Azure Container Apps](#)
- [Azure Machine Learning Studio](#)
- [Azure Static Web Apps](#)
- [Azure Storage Account](#)
- [Azure Database for PostgreSQL](#)

Development Environment

Application	Development Environment - Hardware / OS	Language
Edge	NVIDIA Jetson AGX Xavier	Python 3.6
Cloud	MacBook Pro M1 Max (macOS: Ventura 13.0.1) You can also use an Azure Ubuntu VM to perform the following operations.	Node v18.13.0 (LTS)

Prerequisites

- Sign in to the Azure portal
- Install the Azure CLI
- Sign in with Azure CLI
- Install the Visual Studio Code
- Install the Docker CLI
- Install the pgAdmin
- Sign in to GitHub
- Install Node.js
- Install Git and Sign in to GitHub

Digital Twins Definition Language

The DTDL model is defined as following 2 sections:

- Lab

```
{  
    "@id": "dtmi:itri:Lab;1",  
    "@type": "Interface",  
    "@context": "dtmi:dtdl:context;2",  
    "displayName": "Lab",  
    "contents": [  
        {  
            "@type": "Relationship",  
            "name": "contains",  
            "properties": [  
                {  
                    "@type": "Property",  
                    "name": "targetModel",  
                    "schema": "string"  
                }  
            ],  
            "target": "dtmi:itri:cms:filmcheck;1"  
        }  
    ]  
}
```

- Semiconductor Film Thickness Measurement System (FilmCheck AS300)

Type Error	Machine Status	Color	Annotation
-1	Shutdown	Default Color	The program for FilmCheck AS300 has been closed.
0	Idle	Green	The program for FilmCheck AS300 has been opened.

Type Error	Machine Status	Color	Annotation
1	inOperation	Orange	The program for FilmCheck AS300 is currently performing wafer inspection.
2	Error	Red	An error occurred during wafer inspection in the program for FilmCheck AS300.

```
{
  "@context": [
    "dtmi:dtdl:context;2"
  ],
  "@id": "dtmi:itri:cms:filmcheck;1",
  "@type": "Interface",
  "displayName": "FilmCheck Device",
  "description": "FilmCheck Device",
  "contents": [
    {
      "@type": "Property",
      "name": "statusDate",
      "displayName": "status date",
      "description": "status date",
      "schema": "string"
    },
    {
      "@type": "Property",
      "name": "statusTime",
      "displayName": "status time",
      "description": "status time",
      "schema": "string"
    },
    {
      "@type": "Property",
      "name": "typeError",
      "displayName": "status type",
      "description": "status type",
      "schema": "integer"
    },
    {
      "@type": "Property",
      "name": "statusMessage",
      "displayName": "status message",
      "description": "status message",
      "schema": "string"
    },
    {
      "@type": "Property",
      "name": "statisticsDate",
      "displayName": "statistics date",
      "description": "statistics date",
      "schema": "string"
    }
  ]
}
```

```

},
{
  "@type": "Property",
  "name": "statisticsTime",
  "displayName": "statistics time",
  "description": "statistics time",
  "schema": "string"
},
{
  "@type": "Property",
  "name": "statisticsStandardDeviation",
  "displayName": "statistics standard deviation",
  "description": "statistics standard deviation",
  "schema": "double"
},
{
  "@type": "Property",
  "name": "statisticsAverage",
  "displayName": "statistics average",
  "description": "statistics average",
  "schema": "double"
},
{
  "@type": "Property",
  "name": "statisticsUniformity",
  "displayName": "statistics uniformity",
  "description": "statistics uniformity",
  "schema": "double"
},
{
  "@type": "Property",
  "name": "statisticsMax",
  "displayName": "statistics max",
  "description": "statistics max",
  "schema": "double"
},
{
  "@type": "Property",
  "name": "statisticsMin",
  "displayName": "statistics min",
  "description": "statistics min",
  "schema": "double"
},
{
  "@type": "Property",
  "name": "statisticsMaxMin",
  "displayName": "statistics max min",
  "description": "statistics max min",
  "schema": "double"
}
]
}

```

Data transmission format

- Transferring data from the Semiconductor Film Thickness Measurement System to the Edge

- Shutdown

```
{  
    "date": "2023/02/23",  
    "time": "13:43:34",  
    "message": "Shutdown: The program is preparing to close."  
}
```

- Idle

```
{  
    "date": "2023/02/23",  
    "time": "13:43:34",  
    "message": "Idle: The program is already open but wafer  
inspection has not yet started."  
}
```

- inOperation

```
{  
    "date": "2023/02/23",  
    "time": "13:43:34",  
    "message": "inOperation: The wafer inspection is in progress."  
}
```

- Error

```
{  
    "date": "2023/02/23",  
    "time": "13:43:34",  
    "message": "Error: OpenSensor() : Sensor usb device list failed  
or no sensor present : 0x1"  
}
```

- Transferring data from the Edge to Azure IoT Hub

Type	Machine Status (type)	Color	Annotation
Error			

Type Error	Machine Status (type)	Color	Annotation
-1	Shutdown	Default Color	The program for FilmCheck AS300 has been closed.
0	Idle	Green	The program for FilmCheck AS300 has been opened.
1	inOperation	Orange	The program for FilmCheck AS300 is currently performing wafer inspection.
2	Error	Red	An error occurred during wafer inspection in the program for FilmCheck AS300.

```
{
  "status": {
    "date": "2023/01/11",
    "time": "09:18:50",
    "type": "Error",
    "message": "-999 Failed to load the configuration file."
  },
  "statistics": {
    "date": "2023/01/11",
    "time": "09:18:50",
    "standardDeviation": 769.93,
    "average": 54954.8,
    "uniformity": 98.599,
    "max": 54954.8,
    "min": 54954.8,
    "maxMin": 54954.8,
    "fileName": "20230220-011029.csv",
  }
}
```

The path of the Log & Report & Image in Azure Blob

Type	Name	Azure Blob
Log	L20230218.log	adt3dstorageaccount/adt/Log
Report	20230220-011029.csv	adt3dstorageaccount/adt/Report
Image	20230220-011029.png	adt3dstorageaccount/adt/Image

The file structure in the Github repository

```

  └── 3D-Scenes
      └── semi-v1.glb
  └── AzureContainerApp
      └── Blob_Trigger

```

```
    config
        config.json
    docker-manifests
        Dockerfile
    index.js
    migrations
        20230219235350-create-log.js
    models
        index.js
        log.js
    package-lock.json
    package.json
    tokenService.js
DB_Ops
    config
        config.json
    docker-manifests
        Dockerfile
    index.js
    migrations
        20230219235350-create-log.js
        20230220012714-create-report.js
        20230309235001-create-status.js
    models
        index.js
        log.js
        report.js
        status.js
    package-lock.json
    package.json
IoTHub_To_ADT_Notify
    adtService.js
    config
        config.json
    docker-manifests
        Dockerfile
    index.js
    migrations
        20230220012714-create-report.js
        20230309234114-create-status.js
    models
        index.js
        report.js
        status.js
    package-lock.json
    package.json
Query_ADT
    adtService.js
    docker-manifests
        Dockerfile
    index.js
    package-lock.json
    package.json
AzureML
```

```
    └── pipeline-python
        └── go.py
    └── run_pipeline.ipynb
└── DM
    └── FilmChek_AS300.png
└── DTDL
    ├── 3D-FilmCheck-v1.json
    └── Lab.json
└── Edge
    ├── Datas
    │   ├── L20230301-Error.log
    │   ├── L20230301-Idle.log
    │   ├── L20230301-Shutdown.log
    │   ├── L20230301-inOperation.log
    │   └── L20230301.log
    ├── Excel
    │   └── 20230305-144311.xlsx
    ├── Log
    ├── Report
    │   └── 20230313-140020.csv
    ├── edge.py
    ├── publisher-test
    │   ├── pubLog.py
    │   └── pubReport.py
    ├── requirements.txt
    └── uploadFileToBlob
        ├── Log
        │   └── L20230301.log
        ├── Report
        │   └── 20230313-140020.csv
        ├── app.py
        └── requirements.txt
└── Frontend
    ├── README.md
    ├── babel.config.js
    ├── jsconfig.json
    ├── package-lock.json
    ├── package.json
    └── public
        ├── assets
        │   └── semi-v1.glb
        ├── favicon.ico
        ├── index.html
        └── itri-64.ico
└── src
    ├── App.vue
    ├── assets
    │   └── logo.png
    ├── components
    │   ├── InfoModal.vue
    │   └── SpinnerModal.vue
    ├── main.js
    ├── router
    └── index.js
```

```
└── scenes
    └── Scene.js
    └── store
        └── index.js
    └── views
        └── IndoorView.vue
    └── vue.config.js
    └── README.md
    └── Script
        └── install-docker.sh
```

Step-by-step Guide

0. If the prerequisite for the environment is to use Azure Ubuntu VM

- Log in to Azure Ubuntu VM

```
ssh Account@Azure-Ubuntu-VM-IP
```

- Download the zip file of the source code

```
git clone https://github.com/ArcherHuang/Azure-Digital-Twins-End-To-End-Sample.git
```

```
mmosconii@adt-vm:~$ git clone https://github.com/ArcherHuang/Azure-Digital-Twins-End-To-End-Sample.git
Cloning into 'Azure-Digital-Twins-End-To-End-Sample'...
remote: Enumerating objects: 404, done.
remote: Counting objects: 100% (3/3), done.
remote: Total 404 (delta 0), reused 3 (delta 0), pack-reused 401
Receiving objects: 100% (404/404), 53.96 MiB | 23.18 MiB/s, done.
Resolving deltas: 100% (20/20), done.
mmosconii@adt-vm:~$
```

- Install Docker Engine

- Switch the working directory

```
cd ./Azure-Digital-Twins-End-To-End-Sample/Script
```

```
mmosconii@adt-vm:~$ cd ./Azure-Digital-Twins-End-To-End-Sample/Script
mmosconii@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/Script$
```

- Change file permissions

```
chmod 777 install-docker.sh
```

```
archer -- mmosconii@adt-vm: ~/Azure-Digital-Twins-End-To-End-Sample/Script -- ssh mmosconii@20.78.16.33 - 121x25
mmosconii@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/Script$ chmod 777 install-docker.sh
mmosconii@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/Script$
```

- o Install Docker

```
sudo ./install-docker.sh
```

```

● ● ● archer - mosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/Script - ssh mosconi@20.78.16.33 — 152x139
mosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/Script$ sudo ./install-docker.sh
Hit:1 http://azure.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://azure.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://azure.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Get:4 http://azure.archive.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Get:5 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 Packages [8628 kB]
0% [5 Packages 515 kB/8628 kB 6%]
Get:6 http://azure.archive.ubuntu.com/ubuntu focal/universe Translation-en [5124 kB]
Get:7 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 c-n-f Metadata [265 kB]
Get:8 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 Packages [144 kB]
Get:9 http://azure.archive.ubuntu.com/ubuntu focal/multiverse Translation-en [104 kB]
Get:10 http://azure.archive.ubuntu.com/ubuntu focal/multiverse amd64 c-n-f Metadata [9136 kB]
Get:11 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [2425 kB]
Get:12 http://azure.archive.ubuntu.com/ubuntu focal-updates/main Translation-en [418 kB]
Get:13 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 c-n-f Metadata [16.3 kB]
Get:14 http://azure.archive.ubuntu.com/ubuntu focal-updates/restricted amd64 Packages [1666 kB]
Get:15 http://azure.archive.ubuntu.com/ubuntu focal-updates/restricted Translation-en [234 kB]
Get:16 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 Packages [1038 kB]
Get:17 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe Translation-en [243 kB]
Get:18 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 c-n-f Metadata [23.8 kB]
Get:19 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 Packages [25.1 kB]
Get:20 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse Translation-en [7408 kB]
Get:21 http://azure.archive.ubuntu.com/ubuntu focal-updates/multiverse amd64 c-n-f Metadata [592 kB]
Get:22 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 Packages [45.7 kB]
Get:23 http://azure.archive.ubuntu.com/ubuntu focal-backports/main Translation-en [16.3 kB]
Get:24 http://azure.archive.ubuntu.com/ubuntu focal-backports/main amd64 c-n-f Metadata [1420 kB]
Get:25 http://azure.archive.ubuntu.com/ubuntu focal-backports/restricted amd64 c-n-f Metadata [116 kB]
Get:26 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 Packages [25.0 kB]
Get:27 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe Translation-en [16.3 kB]
Get:28 http://azure.archive.ubuntu.com/ubuntu focal-backports/universe amd64 c-n-f Metadata [880 kB]
Get:29 http://azure.archive.ubuntu.com/ubuntu focal-backports/multiverse amd64 c-n-f Metadata [116 kB]
Get:30 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 Packages [2046 kB]
Get:31 http://azure.archive.ubuntu.com/ubuntu focal-security/main Translation-en [333 kB]
Get:32 http://azure.archive.ubuntu.com/ubuntu focal-security/main amd64 c-n-f Metadata [12.3 kB]
Get:33 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 Packages [812 kB]
Get:34 http://azure.archive.ubuntu.com/ubuntu focal-security/universe Translation-en [161 kB]
Get:35 http://azure.archive.ubuntu.com/ubuntu focal-security/universe amd64 c-n-f Metadata [17.2 kB]
Get:36 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 Packages [22.9 kB]
Get:37 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse Translation-en [5488 kB]
Get:38 http://azure.archive.ubuntu.com/ubuntu focal-security/multiverse amd64 c-n-f Metadata [528 kB]
Fetched 24.2 MB in 4s (6081 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
lsb-release is already the newest version (11.1.0ubuntu2).
lsb-release set to manually installed.
ca-certificates is already the newest version (20211016ubuntu0.20.04.1).
ca-certificates set to manually installed.
curl is already the newest version (7.68.0-1ubuntu2.16).
curl set to manually installed.
gnupg is already the newest version (2.2.19-3ubuntu2.2).
gnupg set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 25 not upgraded.
Hit:1 http://azure.archive.ubuntu.com/ubuntu focal InRelease
Hit:2 http://azure.archive.ubuntu.com/ubuntu focal-updates InRelease
Hit:3 http://azure.archive.ubuntu.com/ubuntu focal-backports InRelease
Hit:4 http://azure.archive.ubuntu.com/ubuntu focal-security InRelease
Get:5 https://download.docker.com/linux/ubuntu focal InRelease [57.7 kB]
Get:6 https://download.docker.com/linux/ubuntu focal/stable amd64 Packages [24.7 kB]
Fetched 82.4 kB in 1s (144 kB/s)
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  docker-buildx-plugin docker-ce-rootless-extras docker-scan-plugin pigz slirp4netns
Suggested packages:
  aufs-tools cgroups-mount | cgroup-lite
The following NEW packages will be installed:
  containerd.io docker-buildx-plugin docker-ce cli docker-ce-rootless-extras docker-compose-plugin
  docker-scan-plugin pigz slirp4netns
0 upgraded, 9 newly installed, 0 to remove and 25 not upgraded.
Need to get 112 MB of archives.
After this operation, 401 MB of additional disk space will be used.
Get:1 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 pigz amd64 2.4-1 [57.4 kB]
Get:2 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 slirp4netns amd64 0.4.3-1 [74.3 kB]
Get:3 https://download.docker.com/linux/ubuntu focal/stable amd64 containerd.io amd64 1.6.18-1 [28.2 MB]
Get:4 https://download.docker.com/linux/ubuntu focal/stable amd64 docker-buildx-plugin amd64 0.10.2-1~ubuntu.20.04-focal [25.9 MB]
Get:5 https://download.docker.com/linux/ubuntu focal/stable amd64 docker-ce cli amd64 5:23.0.1-1~ubuntu.20.04-focal [13.2 MB]
Get:6 https://download.docker.com/linux/ubuntu focal/stable amd64 docker-ce amd64 5:23.0.1-1~ubuntu.20.04-focal [22.0 MB]
Get:7 https://download.docker.com/linux/ubuntu focal/stable amd64 docker-ce-rootless-extras amd64 5:23.0.1-1~ubuntu.20.04-focal [8765 kB]
Get:8 https://download.docker.com/linux/ubuntu focal/stable amd64 docker-compose-plugin amd64 2.16.0-1~ubuntu.20.04-focal [10.2 MB]
Get:9 https://download.docker.com/linux/ubuntu focal/stable amd64 docker-scan-plugin amd64 0.23.0~ubuntu-focal [3622 kB]
Fetched 112 MB in 1s (94.2 MB/s)
Selecting previously unselected package pigz.
(Reading database ... 58667 files and directories currently installed.)
Preparing to unpack .../0-pigz_2.4-1_amd64.deb ...
Unpacking pigz (2.4-1) ...
Selecting previously unselected package containerd.io.
Preparing to unpack .../1-containerd.io_1.6.18-1_amd64.deb ...
Unpacking containerd.io (1.6.18-1) ...
Selecting previously unselected package docker-buildx-plugin.
Preparing to unpack .../2-docker-buildx-plugin_0.10.2-1~ubuntu.20.04-focal_amd64.deb ...
Unpacking docker-buildx-plugin (0.10.2-1~ubuntu.20.04-focal) ...
Selecting previously unselected package docker-ce-cli.
Preparing to unpack .../3-docker-ce-cli_5%3a23.0.1-1~ubuntu.20.04-focal_amd64.deb ...
Unpacking docker-ce-cli (5:23.0.1-1~ubuntu.20.04-focal) ...
Selecting previously unselected package docker-ce.
Preparing to unpack .../4-docker-ce_5%3a23.0.1-1~ubuntu.20.04-focal_amd64.deb ...
Unpacking docker-ce (5:23.0.1-1~ubuntu.20.04-focal) ...
Selecting previously unselected package docker-ce-rootless-extras.
Preparing to unpack .../5-docker-ce-rootless-extras_5%3a23.0.1-1~ubuntu.20.04-focal_amd64.deb ...
Unpacking docker-ce-rootless-extras (5:23.0.1-1~ubuntu.20.04-focal) ...
Selecting previously unselected package docker-compose-plugin.
Preparing to unpack .../6-docker-compose-plugin_2.16.0-1~ubuntu.20.04-focal_amd64.deb ...
Unpacking docker-compose-plugin (2.16.0-1~ubuntu.20.04-focal) ...
Selecting previously unselected package docker-scan-plugin.
Preparing to unpack .../7-docker-scan-plugin_0.23.0~ubuntu-focal_amd64.deb ...
Unpacking docker-scan-plugin (0.23.0~ubuntu-focal) ...
Selecting previously unselected package slirp4netns.
Preparing to unpack .../8-slirp4netns_0.4.3-1_amd64.deb ...
Unpacking slirp4netns (0.4.3-1) ...
Setting up slirp4netns (0.4.3-1) ...
Setting up docker-scan-plugin (0.23.0~ubuntu-focal) ...
Setting up docker-buildx-plugin (0.10.2-1~ubuntu.20.04-focal) ...
Setting up containerd.io (1.6.18-1) ...
Created symlink /etc/systemd/system/multi-user.target.wants/containerd.service → /lib/systemd/system/containerd.service.
Setting up docker-compose-plugin (2.16.0-1~ubuntu.20.04-focal) ...
Setting up docker-ce-cli (5:23.0.1-1~ubuntu.20.04-focal) ...
Setting up pigz (2.4-1) ...
Setting up docker-ce-rootless-extras (5:23.0.1-1~ubuntu.20.04-focal) ...
Setting up docker-ce (5:23.0.1-1~ubuntu.20.04-focal) ...
Created symlink /etc/systemd/system/multi-user.target.wants/docker.service → /lib/systemd/system/docker.service.
Created symlink /etc/systemd/system/sockets.target.wants/docker.socket → /lib/systemd/system/docker.socket.
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for systemd (245.4-4ubuntu3.19) ...
mosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/Script$ 

```

- Install Buildx

```
sudo apt-get install qemu qemu-user-static qemu-user

mkdir -p ~/.docker/cli-plugins

sudo docker version --format '{{.Server.Experimental}}' | grep -q
'true' && DOCKER_BUILDKIT=1 || DOCKER_BUILDKIT=0

curl -SL
https://github.com/docker/buildx/releases/download/v0.6.1/buildx-
v0.6.1.linux-amd64 -o ~/.docker/cli-plugins/docker-buildx

chmod a+x ~/.docker/cli-plugins/docker-buildx

docker buildx install

docker buildx version
```

```
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample$ sudo apt-get install qemu qemu-user-static qemu-user
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  binfmt-support
The following NEW packages will be installed:
  binfmt-support qemu qemu-user qemu-user-static
0 upgraded, 4 newly installed, 0 to remove and 25 not upgraded.
Need to get 37.4 MB of archives.
After this operation, 380 kB of additional disk space will be used.
Do you want to continue? [Y/n]
Get:1 http://azure.archive.ubuntu.com/ubuntu focal/universe amd64 binfmt-support amd64 2.2.0-2 [58.2 kB]
Get:2 http://azure.archive.ubuntu.com/ubuntu focal-updates/main amd64 qemu amd64 1:4.2-3ubuntu6.24 [15.0 kB]
Get:3 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 qemu-user amd64 1:4.2-3ubuntu6.24 [16.1 kB]
Get:4 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 qemu-user-static amd64 1:4.2-3ubuntu6.24 [21.3 kB]
Fetched 37.4 MB in 2s (19.6 MB/s)
Selecting previously unselected package binfmt-support.
(Reading database ... 58925 files and directories currently installed.)
Preparing to unpack .../binfmt-support_2.2.0-2_amd64.deb ...
Unpacking binfmt-support (2.2.0-2) ...
Selecting previously unselected package qemu.
Preparing to unpack .../qemu_1%3a4.2-3ubuntu6.24_amd64.deb ...
Unpacking qemu (1:4.2-3ubuntu6.24) ...
Selecting previously unselected package qemu-user.
Preparing to unpack .../qemu-user_1%3a4.2-3ubuntu6.24_amd64.deb ...
Unpacking qemu-user (1:4.2-3ubuntu6.24) ...
Selecting previously unselected package qemu-user-static.
Preparing to unpack .../qemu-user-static_1%3a4.2-3ubuntu6.24_amd64.deb ...
Unpacking qemu-user-static (1:4.2-3ubuntu6.24) ...
Setting up qemu (1:4.2-3ubuntu6.24) ...
Setting up qemu-user-static (1:4.2-3ubuntu6.24) ...
Setting up qemu-user (1:4.2-3ubuntu6.24) ...
Setting up binfmt-support (2.2.0-2) ...
Created symlink /etc/systemd/system/multi-user.target.wants/binfmt-support.service → /lib/systemd/system/binfmt-support.service.
Processing triggers for man-db (2.9.1-1) ...
Processing triggers for systemd (245.4-4ubuntu3.19) ...
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample$ mkdir -p ~/.docker/cli-plugins
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample$ sudo docker version --format '{{.Server.Experimental}}' | grep -q 'true' && DOCKER_BUILDKIT=1 ||
| DOCKER_BUILDKIT=0
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample$ curl -SL https://github.com/docker/buildx/releases/download/v0.6.1/buildx-v0.6.1.linux-amd64 -o
~/docker/cli-plugins/docker-buildx
% Total    % Received % Xferd  Average Speed   Time     Time      Current
          Dload  Upload   Total Spent    Left  Speed
 0     0    0     0    0     0  --:--:-- --:--:-- --:--:-- 0
100 58.4M  100 58.4M  0     0  21.8M  0  0:00:02  0:00:02  0:00:02  30.0M
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample$ chmod a+x ~/.docker/cli-plugins/docker-buildx
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample$ docker buildx install
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample$ docker buildx version
github.com/docker/buildx v0.6.1 26dd07a9a19b03df969787496419a0888a27ac61
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample$
```

- Install Azure CLI

```
curl -sL https://aka.ms/InstallAzureCLIDeb | sudo bash

az --version
```

```
Need to get 1704 B of archives.  
After this operation, 162 kB of additional disk space will be used.  
Get:1 http://azure.archive.ubuntu.com/ubuntu focal-updates/universe amd64 apt-transport-https all 2.0.9 [1704 B]  
Fetched 1704 B in 0s (95.3 kB/s)  
Selecting previously unselected package apt-transport-https.  
Preparing to unpack .../apt-transport-https_2.0.9_all.deb ...  
Unpacking apt-transport-https (2.0.9) ...  
Setting up apt-transport-https (2.0.9) ...  
Hit:1 http://azure.archive.ubuntu.com/ubuntu focal InRelease  
Hit:2 http://azure.archive.ubuntu.com/ubuntu focal-updates InRelease  
Hit:3 http://azure.archive.ubuntu.com/ubuntu focal-backports InRelease  
Hit:4 http://azure.archive.ubuntu.com/ubuntu focal-security InRelease  
Hit:5 https://download.docker.com/linux/ubuntu focal InRelease  
Get:6 https://packages.microsoft.com/repos/azure-cli focal InRelease [3029 B]  
Get:7 https://packages.microsoft.com/repos/azure-cli focal/main all Packages [4106 B]  
Get:8 https://packages.microsoft.com/repos/azure-cli focal/main amd64 Packages [484 B]  
Fetched 7619 B in 1s (10.1 kB/s)  
Reading package lists... Done  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following NEW packages will be installed:  
  azure-cli  
0 upgraded, 1 newly installed, 0 to remove and 25 not upgraded.  
Need to get 65.3 MB of archives.  
After this operation, 1197 MB of additional disk space will be used.  
Get:1 https://packages.microsoft.com/repos/azure-cli focal/main amd64 azure-cli amd64 2.46.0-1-focal [65.3 MB]  
Fetched 65.3 MB in 2s (38.2 MB/s)  
Selecting previously unselected package azure-cli.  
(Reading database ... 59126 files and directories currently installed.)  
Preparing to unpack .../azure-cli_2.46.0-1-focal_amd64.deb ...  
Unpacking azure-cli (2.46.0-1-focal) ...  
Setting up azure-cli (2.46.0-1-focal) ...  
Processing triggers for libc-bin (2.31-0ubuntu9.9) ...  
[mmosconii@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/Script$ az --version  
azure-cli                         2.46.0  
  
core                               2.46.0  
telemetry                          1.0.8  
  
Dependencies:  
msal                               1.20.0  
azure-mgmt-resource                21.1.0b1  
  
Python location '/opt/az/bin/python3'  
Extensions directory '/home/mmosconii/.azure/cliextensions'  
  
Python (Linux) 3.10.10 (main, Mar 6 2023, 09:39:55) [GCC 9.4.0]  
  
Legal docs and information: aka.ms/AzureCliLegal  
  
Your CLI is up-to-date.  
[mmosconii@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/Script$ ]
```

- Sign in to Azure via AZ CLI

az login

- Get subscription ID

az account subscription list

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az account subscription list
Command group 'account subscription' is experimental and under development. Reference and support levels: https://aka.ms/CLI_refstatus
[
  {
    "authorizationSource": "Legacy",
    "displayName": "Azure in Open",
    "id": "/subscriptions/[REDACTED]",
    "state": "Enabled",
    "subscriptionId": "[REDACTED]",
    "subscriptionPolicies": {
      "locationPlacementId": "Public_2014-09-01",
      "quotaId": "AzureInOpen_2014-09-01",
      "spendingLimit": "On"
    }
  },
  {
    "authorizationSource": "RoleBased",
    "displayName": "Azure [REDACTED]",
    "id": "/subscriptions/[REDACTED]",
    "state": "Enabled",
    "subscriptionId": "[REDACTED]",  
    "subscriptionPolicies": {
      "locationPlacementId": "Public_2014-09-01",
      "quotaId": "CSP_2015-05-01",
      "spendingLimit": "Off"
    }
  }
]
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

- Switch to the subscription to be used

```
az account set --subscription "SUBSCRIPTION-ID"
```

- Install Node.js

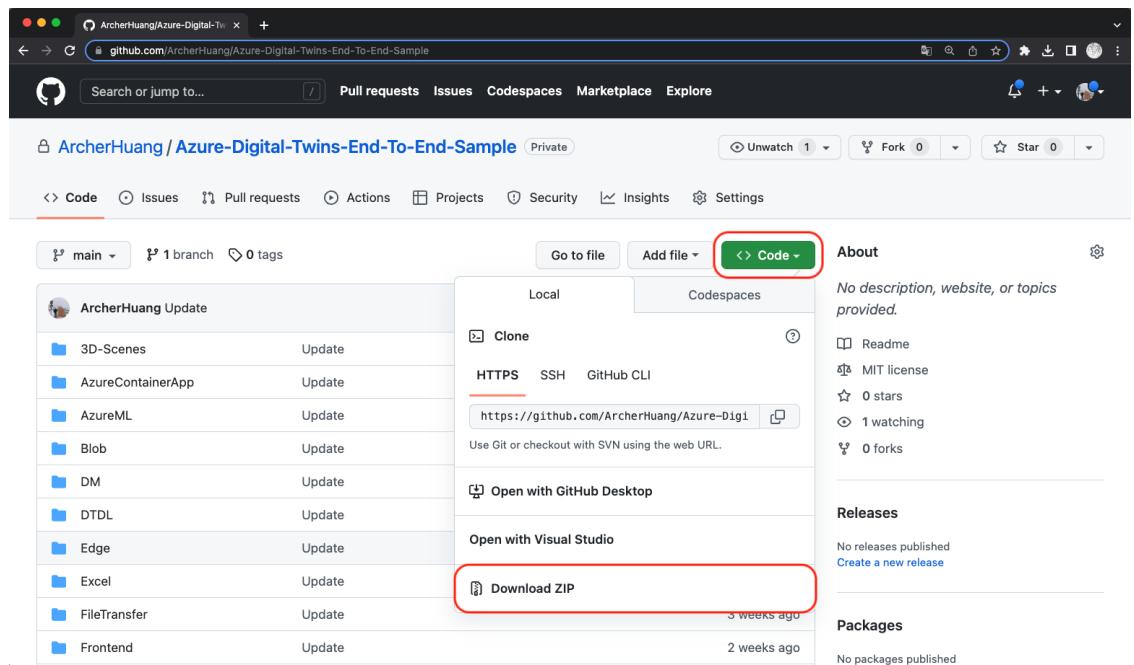
```
curl -s https://deb.nodesource.com/setup_16.x | sudo bash  
  
sudo apt install nodejs -y  
  
node -v
```

```
mmosconii@adt-vm:~$ curl -s https://deb.nodesource.com/setup_16.x | sudo bash  
## Installing the NodeSource Node.js 16.x repo...  
  
## Populating apt-get cache...  
  
+ apt-get update  
Hit:1 http://azure.archive.ubuntu.com/ubuntu focal InRelease  
Hit:2 http://azure.archive.ubuntu.com/ubuntu focal-updates InRelease  
Hit:3 http://azure.archive.ubuntu.com/ubuntu focal-backports InRelease  
Hit:4 http://azure.archive.ubuntu.com/ubuntu focal-security InRelease  
Hit:5 https://download.docker.com/linux/ubuntu focal InRelease  
Hit:6 https://packages.microsoft.com/repos/azure-cli focal InRelease  
Reading package lists... Done  
  
## Confirming "focal" is supported...  
  
+ curl -sLF -o /dev/null 'https://deb.nodesource.com/node_16.x/dists/focal/Release'  
## Adding the NodeSource signing key to your keyring...  
  
+ curl -s https://deb.nodesource.com/gpgkey/nodesource.gpg.key | gpg --dearmor | tee /usr/share/keyrings/nodesource.gpg >/dev/null  
## Creating apt sources list file for the NodeSource Node.js 16.x repo...  
  
+ echo 'deb [signed-by=/usr/share/keyrings/nodesource.gpg] https://deb.nodesource.com/node_16.x focal main' > /etc/apt/sources.list.d/nodesource.list  
+ echo 'deb-src [signed-by=/usr/share/keyrings/nodesource.gpg] https://deb.nodesource.com/node_16.x focal main' >> /etc/apt/sources.list.d/nodesource.list  
  
## Running `apt-get update` for you...  
  
+ apt-get update  
Hit:1 http://azure.archive.ubuntu.com/ubuntu focal InRelease  
Hit:2 http://azure.archive.ubuntu.com/ubuntu focal-updates InRelease  
Hit:3 http://azure.archive.ubuntu.com/ubuntu focal-backports InRelease  
Hit:4 http://azure.archive.ubuntu.com/ubuntu focal-security InRelease  
Hit:5 https://download.docker.com/linux/ubuntu focal InRelease  
Get:6 https://deb.nodesource.com/node_16.x focal InRelease [4583 B]  
Hit:7 https://packages.microsoft.com/repos/azure-cli focal InRelease  
Get:8 https://deb.nodesource.com/node_16.x focal/main amd64 Packages [777 B]  
Fetched 5360 B in 0s (7479 B/s)  
Reading package lists... Done  
  
## Run `sudo apt-get install -y nodejs` to install Node.js 16.x and npm  
## You may also need development tools to build native addons:  
  sudo apt-get install gcc g++ make  
## To install the Yarn package manager, run:  
  curl -sL https://dl.yarnpkg.com/debian/pubkey.gpg | gpg --dearmor | sudo tee /usr/share/keyrings/yarnkey.gpg >/dev/null  
  echo "deb [signed-by=/usr/share/keyrings/yarnkey.gpg] https://dl.yarnpkg.com/debian stable main" | sudo tee /etc/apt/sources.list.d/yarn.list  
  sudo apt-get update && sudo apt-get install yarn  
  
mmosconii@adt-vm:~$ sudo apt install nodejs -y  
Reading package lists... Done  
Building dependency tree  
Reading state information... Done  
The following NEW packages will be installed:  
  nodejs  
0 upgraded, 1 newly installed, 0 to remove and 25 not upgraded.  
Need to get 27.2 MB of archives.  
After this operation, 128 MB of additional disk space will be used.  
Get:1 https://deb.nodesource.com/node_16.x focal/main amd64 nodejs amd64 16.19.1-deb-1nodesource1 [27.2 MB]  
Fetched 27.2 MB in 0s (67.8 MB/s)  
Selecting previously unselected package nodejs.  
(Reading database ... 115143 files and directories currently installed.)  
Preparing to unpack .../nodejs_16.19.1-deb-1nodesource1_amd64.deb ...  
Unpacking nodejs (16.19.1-deb-1nodesource1) ...  
Setting up nodejs (16.19.1-deb-1nodesource1) ...  
Processing triggers for man-db (2.9.1-1) ...  
mmosconii@adt-vm:~$ node -v  
v16.19.1  
mmosconii@adt-vm:~$
```

1. Preparing the operating environment

- Commands for macOS environment
 - Download the zip file of the source code

- Click the **Code** button > Click the **Download ZIP** button



- Unzip the zip file and Switch the working directory to the folder that has been extracted

```
cd ./Azure-Digital-Twins-End-To-End-Sample-main
```

- Please remember to log in to Azure using Azure CLI.

2. Set Environment Variable

- Commands for macOS and Ubuntu environment

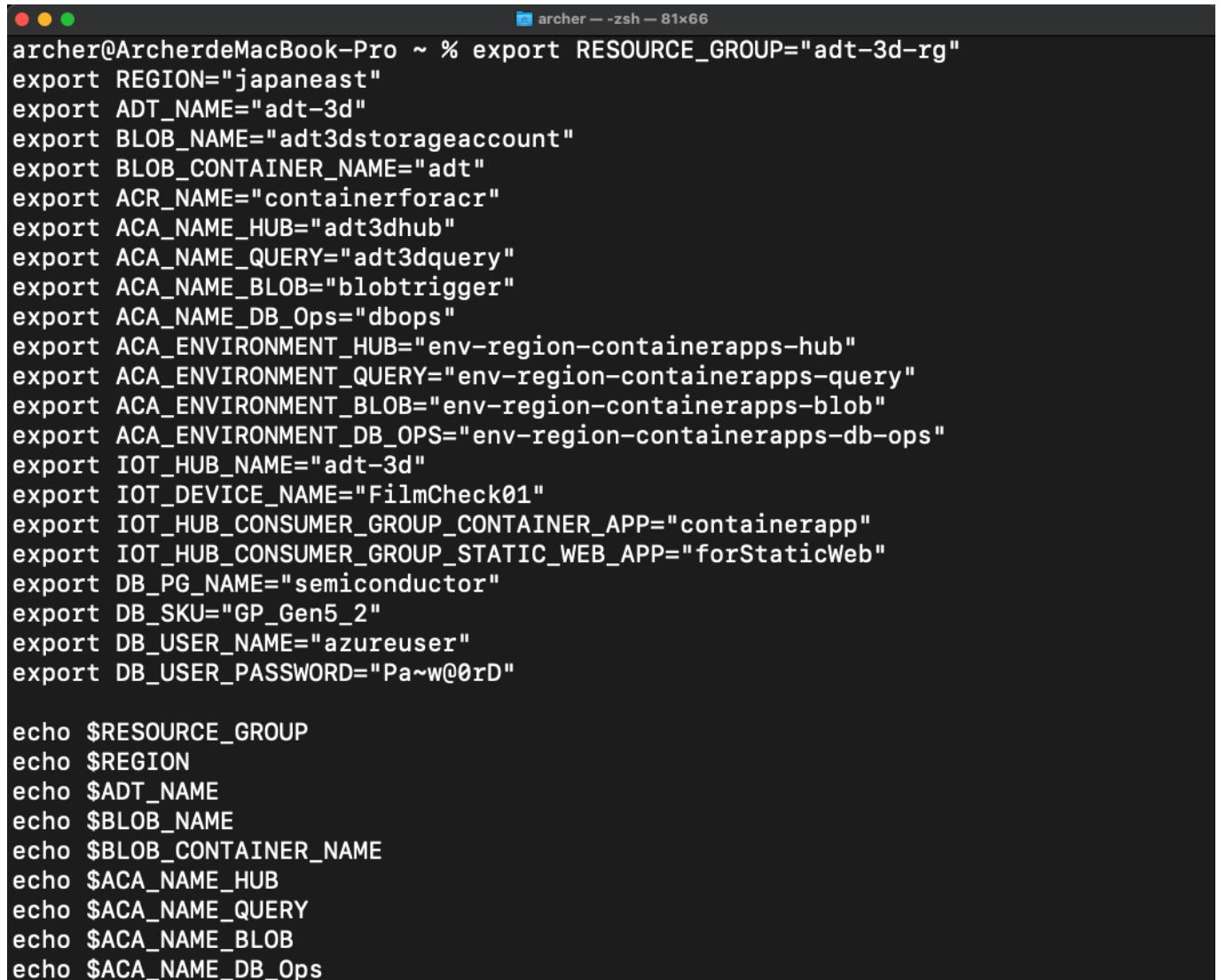
```
export RESOURCE_GROUP="adt-3d-rg"
export REGION="japaneast"
export ADT_NAME="adt-3d"
export BL0B_NAME="adt3dstorageaccount"
export BLOB_CONTAINER_NAME="adt"
export ACR_NAME="containerforacr"
export ACA_NAME_HUB="adt3dhub"
export ACA_NAME_QUERY="adt3dquery"
export ACA_NAME_BLOB="blobtrigger"
export ACA_NAME_DB_Ops="dbops"
export ACA_ENVIRONMENT_HUB="env-region-containerapps-hub"
export ACA_ENVIRONMENT_QUERY="env-region-containerapps-query"
export ACA_ENVIRONMENT_BLOB="env-region-containerapps-blob"
export ACA_ENVIRONMENT_DB_OPS="env-region-containerapps-db-ops"
export IOT_HUB_NAME="adt-3d"
export IOT_DEVICE_NAME="FilmCheck01"
export IOT_HUB_CONSUMER_GROUP_CONTAINER_APP="containerapp"
export IOT_HUB_CONSUMER_GROUP_STATIC_WEB_APP="forStaticWeb"
export DB_PG_NAME="semiconductor"
export DB_SKU="GP_Gen5_2"
export DB_USER_NAME="azureuser"
```

```

export DB_USER_PASSWORD="Pa~w@0rD"

echo $RESOURCE_GROUP
echo $REGION
echo $ADT_NAME
echo $BLOB_NAME
echo $BLOB_CONTAINER_NAME
echo $ACA_NAME_HUB
echo $ACA_NAME_QUERY
echo $ACA_NAME_BLOB
echo $ACA_NAME_DB_Ops
echo $ACA_ENVIRONMENT_HUB
echo $ACA_ENVIRONMENT_QUERY
echo $ACA_ENVIRONMENT_BLOB
echo $ACA_ENVIRONMENT_DB_OPS
echo $IOT_HUB_NAME
echo $IOT_DEVICE_NAME
echo $IOT_HUB_CONSUMER_GROUP_CONTAINER_APP
echo $IOT_HUB_CONSUMER_GROUP_STATIC_WEB_APP
echo $DB_PG_NAME
echo $DB_SKU
echo $DB_USER_NAME
echo $DB_USER_PASSWORD

```



The screenshot shows a terminal window titled "archer -- zsh -- 81x66" running on a Mac. The command "export RESOURCE_GROUP='adt-3d-rg'" is entered at the prompt. Subsequent lines show the expansion of various environment variables defined in the script, such as REGION, ADT_NAME, BLOB_NAME, etc., with their values being the corresponding Azure service names.

```

archer@ArcherdeMacBook-Pro ~ % export RESOURCE_GROUP="adt-3d-rg"
export REGION="japaneast"
export ADT_NAME="adt-3d"
export BLOB_NAME="adt3dstorageaccount"
export BLOB_CONTAINER_NAME="adt"
export ACR_NAME="containerforacr"
export ACA_NAME_HUB="adt3dhub"
export ACA_NAME_QUERY="adt3dqquery"
export ACA_NAME_BLOB="blobtrigger"
export ACA_NAME_DB_Ops="dbops"
export ACA_ENVIRONMENT_HUB="env-region-containerapps-hub"
export ACA_ENVIRONMENT_QUERY="env-region-containerapps-query"
export ACA_ENVIRONMENT_BLOB="env-region-containerapps-blob"
export ACA_ENVIRONMENT_DB_OPS="env-region-containerapps-db-ops"
export IOT_HUB_NAME="adt-3d"
export IOT_DEVICE_NAME="FilmCheck01"
export IOT_HUB_CONSUMER_GROUP_CONTAINER_APP="containerapp"
export IOT_HUB_CONSUMER_GROUP_STATIC_WEB_APP="forStaticWeb"
export DB_PG_NAME="semiconductor"
export DB_SKU="GP_Gen5_2"
export DB_USER_NAME="azureuser"
export DB_USER_PASSWORD="Pa~w@0rD"

echo $RESOURCE_GROUP
echo $REGION
echo $ADT_NAME
echo $BLOB_NAME
echo $BLOB_CONTAINER_NAME
echo $ACA_NAME_HUB
echo $ACA_NAME_QUERY
echo $ACA_NAME_BLOB
echo $ACA_NAME_DB_Ops

```

```
echo $ACA_ENVIRONMENT_HUB
echo $ACA_ENVIRONMENT_QUERY
echo $ACA_ENVIRONMENT_BLOB
echo $ACA_ENVIRONMENT_DB_OPS
echo $IOT_HUB_NAME
echo $IOT_DEVICE_NAME
echo $IOT_HUB_CONSUMER_GROUP_CONTAINER_APP
echo $IOT_HUB_CONSUMER_GROUP_STATIC_WEB_APP
echo $DB_PG_NAME
echo $DB_SKU
echo $DB_USER_NAME
echo $DB_USER_PASSWORD
adt-3d-rg
japaneast
adt-3d
adt3dstorageaccount
adt
adt3dhub
adt3dquery
blobtrigger
dbops
env-region-containerapps-hub
env-region-containerapps-query
env-region-containerapps-blob
env-region-containerapps-db-ops
adt-3d
FilmCheck01
containerapp
forStaticWeb
semiconductor
GP_Gen5_2
azureuser
Pa~w@0rD
```

3. Create a resource group

- Commands for macOS and Ubuntu environment

```
az group create --name $RESOURCE_GROUP --location $REGION
```

```
archer@ArcherdeMacBook-Pro ~ % az group create --name $RESOURCE_GROUP --location $REGION
{
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg",
  "location": "japaneast",
  "managedBy": null,
  "name": "adt-3d-rg",
  "properties": {
    "provisioningState": "Succeeded"
  },
  "tags": null,
  "type": "Microsoft.Resources/resourceGroups"
}
```

4. Deploying Azure Digital Twin

- Create an Azure Digital Twin
 - Commands for macOS and Ubuntu environment

```
az dt create -n $ADT_NAME -g $RESOURCE_GROUP -l $REGION
```

```
archer@ArcherdeMacBook-Pro ~ % az dt create -n $ADT_NAME -g $RESOURCE_GROUP -l $REGION
{
  "createdTime": "2023-03-09T00:28:53.259190+00:00",
  "hostName": "adt-3d.api.jpe.digitaltwins.azure.net",
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.DigitalTwins/digitalTwinsInstances/adt-3d",
  "identity": null,
  "lastUpdatedTime": "2023-03-09T00:29:30.257846+00:00",
  "location": "japaneast",
  "name": "adt-3d",
  "privateEndpointConnections": [],
  "provisioningState": "Succeeded",
  "publicNetworkAccess": "Enabled",
  "resourceGroup": "adt-3d-rg",
  "systemData": {
    "createdAt": "2023-03-09T00:28:53.097720+00:00",
    "createdBy": "mmosconii@gmail.com",
    "createdByType": "User",
    "lastModifiedAt": "2023-03-09T00:28:53.097720+00:00",
    "lastModifiedBy": "mmosconii@gmail.com",
    "lastModifiedByType": "User"
  },
  "tags": null,
  "type": "Microsoft.DigitalTwins/digitalTwinsInstances"
}
```

- Get Azure Digital Twin Host URL

- Commands for macOS and Ubuntu environment

```
export ADT_Host_Name=`az dt show --dt-name $ADT_NAME --resource-group $RESOURCE_GROUP --query hostName`  
echo $ADT_Host_Name
```

```
archer@ArcherdeMacBook-Pro ~ % export ADT_Host_Name=`az dt show --dt-name $ADT_NAME --resource-group $RESOURCE_GROUP --query hostName`  
archer@ArcherdeMacBook-Pro ~ % echo $ADT_Host_Name  
"adt-3d.api.jpe.digitaltwins.azure.net"  
archer@ArcherdeMacBook-Pro ~ %
```

- Get User Principal Name

```
az ad user list
```

```
archer@ArcherdeMacBook-Pro ~ % az ad user list
{
  "businessPhones": [],
  "displayName": "Archer Huang",
  "givenName": null,
  "id": "[REDACTED]",
  "jobTitle": null,
  "mail": "mmosconii@gmail.com",
  "mobilePhone": null,
  "officeLocation": null,
  "preferredLanguage": null,
  "surname": null,
  "userPrincipalName": "mmosconii_gmail.com#EXT#@[REDACTED].onmicrosoft.com"
}
archer@ArcherdeMacBook-Pro ~ %
```

- Set parameter

- Commands for macOS and Ubuntu environment

```
export USER_PRINCIPAL_NAME="Change it to the userPrincipalName obtained in the previous step."  
echo $USER_PRINCIPAL_NAME
```

- Set Role Assignment

- Commands for macOS and Ubuntu environment

```
az dt role-assignment create -n $ADT_NAME --assignee
$USER_PRINCIPAL_NAME --role "Azure Digital Twins Data Owner" -g
$RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az dt role-assignment create -n $ADT_NAME --assignee $USER_PRINCIPAL_NAME --role "Azure Digital Twins Data Owner" -g $RESOURCE_GROUP
{
  "canDelegate": null,
  "condition": null,
  "conditionVersion": null,
  "description": null,
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.DigitalTwins/digitalTwinsInstances/adt-3d/providers/Microsoft.Authorization/roleAssignments/[REDACTED]",
  "name": "[REDACTED]",
  "principalId": "[REDACTED]",
  "principalType": "User",
  "resourceDefinitionId": "adt-3d-rg",
  "roleDefinitionId": "/subscriptions/[REDACTED]/providers/Microsoft.Authorization/roleDefinitions/[REDACTED]",
  "scope": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.DigitalTwins/digitalTwinsInstances/adt-3d",
  "type": "Microsoft.Authorization/roleAssignments"
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

- Check Role Assignment

- Commands for macOS and Ubuntu environment

```
az dt role-assignment list -n $ADT_NAME -g $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro ~ % az dt role-assignment list -n $ADT_NAME -g $RESOURCE_GROUP
[
  {
    "canDelegate": null,
    "condition": null,
    "conditionVersion": null,
    "description": null,
    "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.DigitalTwins/digitalTwinsInstances/adt-3d/providers/Microsoft.Authorization/roleAssignments/[REDACTED]",
    "name": "[REDACTED]",
    "principalId": "[REDACTED]",
    "principalName": "mosconii_gmail.com#EXT#@[REDACTED].onmicrosoft.com",
    "principalType": "User",
    "resourceGroup": "adt-3d-rg",
    "roleDefinitionId": "/subscriptions/[REDACTED]/providers/Microsoft.Authorization/roleDefinitions/[REDACTED]",
    "roleDefinitionName": "Azure Digital Twins Data Owner",
    "scope": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.DigitalTwins/digitalTwinsInstances/adt-3d",
    "type": "Microsoft.Authorization/roleAssignments"
  }
]
archer@ArcherdeMacBook-Pro ~ %
```

- Upload DTDL Model

- Commands for macOS and Ubuntu environment

```
az dt model create -n $ADT_NAME --from-directory ./DTDL -g
$RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az dt model create -n $ADT_NAME --from-directory ./DTDL -g $RESOURCE_GROUP
[
  {
    "decommissioned": false,
    "description": {},
    "displayName": {
      "en": "Lab"
    },
    "id": "dtmi:itri:Lab;1",
    "uploadTime": "2023-03-09T01:00:16.8914566+00:00"
  },
  {
    "decommissioned": false,
    "description": {
      "en": "FilmCheck Device"
    },
    "displayName": {
      "en": "FilmCheck Device"
    },
    "id": "dtmi:itri:cms:filmcheck;1",
    "uploadTime": "2023-03-09T01:00:16.8915255+00:00"
  }
]
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

- Create the Twins

- Lab

- Commands for macOS and Ubuntu environment

```
az dt twin create -n $ADT_NAME --dtmi "dtmi:itri:Lab;1" --twin-id DistCtr -g $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az dt twin create -n $ADT_NAME --dtmi "dtmi:itri:Lab;1" --twin-id DistCtr -g $RESOURCE_GROUP
{
  "$id": "DistCtr",
  "$etag": "W/\"34f253f-2cab-4140-98a8-7c4475de8410\"",
  "$metadata": {
    "$lastUpdateTime": "2023-03-09T01:04:35.525074Z",
    "$model": "dtmi:itri:Lab;1"
  }
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

- Semiconductor Film Thickness Measurement System (FilmCheck AS300)

- Commands for macOS and Ubuntu environment

```
az dt twin create -n $ADT_NAME --dtmi "dtmi:itri:cms:filmcheck;1" --twin-id FilmCheck01 -g $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az dt twin create -n $ADT_NAME --dtmi "dtmi:itri:cms:filmcheck;1" --twin-id FilmCheck01 -g $RESOURCE_GROUP
{
  "$id": "FilmCheck01",
  "$etag": "W/\"b6894e15-f80c-42d6-ab77-feb4d21f60bd\"",
  "$metadata": {
    "$lastUpdateTime": "2023-03-09T01:06:06.9250218Z",
    "$model": "dtmi:itri:cms:filmcheck;1"
  }
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

- Initial Property

- Commands for macOS and Ubuntu environment

```
az dt twin update -n $ADT_NAME --twin-id FilmCheck01 --json-patch
>[
  {"op": "add", "path": "/statusDate", "value": "0"}, {"op": "add", "path": "/statusTime", "value": "0"}, {"op": "add", "path": "/typeError", "value": -1}, {"op": "add", "path": "/statusMessage", "value": "0"}, {"op": "add", "path": "/statisticsDate", "value": "0"}, {"op": "add", "path": "/statisticsTime", "value": "0"}, {"op": "add", "path": "/statisticsStandardDeviation", "value": 0.0}, {"op": "add", "path": "/statisticsAverage", "value": 0.0}, {"op": "add", "path": "/statisticsUniformity", "value": 0.0}, {"op": "add", "path": "/statisticsMax", "value": 0.0}, {"op": "add", "path": "/statisticsMin", "value": 0.0}, {"op": "add", "path": "/statisticsMaxMin", "value": 0.0}
] -g $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az dt twin update -n $ADT_NAME --twin-id FilmCheck01 --json-patch '[{"op": "add", "path": "/statusDate", "value": "0"}, {"op": "add", "path": "/statusTime", "value": "0"}, {"op": "add", "path": "/typeError", "value": "-1"}, {"op": "add", "path": "/statusMessage", "value": ""}, {"op": "add", "path": "/statisticsLastUpdateDate", "value": "0"}, {"op": "add", "path": "/statisticsTime", "value": "0"}, {"op": "add", "path": "/statisticsStandardDeviation", "value": "0.0"}, {"op": "add", "path": "/statisticsAverage", "value": "0.0"}, {"op": "add", "path": "/statisticsUniformity", "value": "0.0"}, {"op": "add", "path": "/statisticsMax", "value": "0.0"}, {"op": "add", "path": "/statisticsMin", "value": "0.0"}, {"op": "add", "path": "/statisticsMaxMin", "value": "0.0"}]' -g $RESOURCE_GROUP
{
    "$id": "FilmCheck01",
    "$etag": "W/\\"9cf951dd-c5ce-487a-8688-0ed6216c6424\\\"",
    "$metadata": {},
    "$lastUpdateTime": "2023-03-09T01:09:40.4348713Z",
    "$modelName": "dtmi:litri:ms:filmcheck;1",
    "statisticsAverage": {},
    "statisticsLastUpdate": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "statisticsDate": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "statisticsMax": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "statisticsMaxMin": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "statisticsMin": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "statisticsStandardDeviation": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "statisticsTime": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "statisticsUniformity": {},
    "statusDate": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "statusMessage": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "statusTime": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    },
    "typeError": {
        "lastUpdateTime": "2023-03-09T01:09:40.4348713Z"
    }
},
"statisticsAverage": 0.0,
"statisticsDate": "0",
"statisticsMax": "0",
"statisticsMaxMin": 0.0,
"statisticsMin": "0",
"statisticsStandardDeviation": 0.0,
"statisticsTime": "0",
"statisticsUniformity": 0.0,
"statusDate": "0",
"statusMessage": "0",
"statusTime": "0",
"typeError": -1
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- Create Relationship

- Commands for macOS and Ubuntu environment

```
az dt twin relationship create -n $ADT_NAME --relationship-id DistCtr_contains_Relationship_FilmCheck01 --relationship contains --twin-id DistCtr --target FilmCheck01 -g $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az dt twin relationship create -n $ADT_NAME --relationship-id DistCtr_contains_Relationship_FilmCheck01 --relationship contains --twin-id DistCtr --target FilmCheck01 -g $RESOURCE_GROUP
{
    "$id": "DistCtr_contains_Relationship_FilmCheck01",
    "$modelName": "dtmi:litri:ms:relationship;1",
    "sourceId": "DistCtr",
    "targetId": "FilmCheck01"
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- List Relationship

- Commands for macOS and Ubuntu environment

```
az dt twin relationship list -n $ADT_NAME --twin-id DistCtr -g $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az dt twin relationship list -n $ADT_NAME --twin-id DistCtr -g $RESOURCE_GROUP
[
    {
        "$id": "DistCtr_contains_Relationship_FilmCheck01",
        "$modelName": "dtmi:litri:ms:relationship;1",
        "sourceId": "DistCtr",
        "targetId": "FilmCheck01"
    }
]
```

- Check from Azure Digital Twins Explorer

- Click the Open Azure Digital Twins Explorer (preview) button

The screenshot shows the Microsoft Azure portal interface. At the top, there's a search bar and a user profile icon. Below it, the 'Azure Digital Twins' blade for a resource named 'adt-3d' is displayed. On the left, there's a sidebar with options like 'Overview', 'Activity log', 'Access control (IAM)', 'Tags', 'Diagnose and solve problems', 'Settings', and 'Identity'. The main area shows 'Essentials' details: Resource group (adt-3d-rg), Location (Japan East), Subscription (adt-3d-rg), Host name (adt-3d.api.jpe.digitaltwins.azure.net). A note at the top right says: 'Dear ADT user - We are going to retire Azure Digital Twins preview control plane APIs, 2020-03-01-preview and 2021-06-30-preview on 2nd May 2023. If you use these APIs, please [click here](#) to know how to migrate to a stable API version before the retirement date. Your portal and ADT instance will not be impacted and will continue to operate as-is.' A 'JSON View' link is also present.

- After clicking on Run Query in the upper right corner, you will see the results.

The screenshot shows the 'Azure Digital Twins Explorer Preview' interface. It features a 'QUERY EXPLORER' section with a 'Saved Queries' dropdown and a text input field containing 'SELECT * FROM digitaltwins'. To the right is a 'TWIN GRAPH' section showing a network of nodes: 'DistCtr' (blue circle) and 'FilmGhe...' (pink circle), connected by a purple edge labeled 'hasChild'. Below the graph is a toolbar with icons for copy, paste, and refresh. To the right is a 'TWIN PROPERTIES' panel displaying JSON data for a twin with \$dtId: 'FilmCheck01'. The JSON includes fields like statistics average, max, min, standard deviation, and status type. The entire interface has a dark theme.

5. Create Azure IoT Hub and Create IoT Device

- Create Azure IoT Hub

- Commands for macOS and Ubuntu environment

```
az iot hub create --resource-group $RESOURCE_GROUP --name
$IOT_HUB_NAME --sku S1 --location $REGION
```

```

archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az iot hub create --resource-group $RESOURCE_GROUP --name $IOT_HUB_NAME --sku S1 --location $REGION
{
  "etag": "AAAAADHzuycM=",
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.Devices/IotHubs/adt-3d",
  "identity": {
    "principalId": null,
    "tenantId": null,
    "type": "None",
    "userAssignedidentities": null
  },
  "location": "japaneast",
  "name": "adt-3d",
  "properties": {
    "allowedFqdnList": [],
    "authorizationPolicies": null,
    "cloudToDevice": {
      "defaultTtlAsIso8601": "1:00:00",
      "feedback": {
        "lockDurationAsIso8601": "0:00:05",
        "maxDeliveryCount": 10,
        "ttlAsIso8601": "1:00:00"
      },
      "maxDeliveryCount": 10
    },
    "comments": null,
    "deviceStreams": null,
    "disableDeviceSas": null,
    "disableLocalAuth": null,
    "disableModuleSas": null,
    "enableDataResidency": null,
    "enableFileUploadNotifications": false,
    "encryption": null,
    "eventHubEndpoints": {
      "events": {
        "endpoint": "sb://iothub-ns-adt-3d-24776508-ea89d22d36.servicebus.windows.net/",
        "partitionCount": 4,
        "partitionIds": [
          "0",
          "1",
          "2",
          "3"
        ],
        "path": "adt-3d",
        "retentionTimeInDays": 1
      }
    },
    "features": "None",
    "hostName": "adt-3d.azure-devices.net",
    "ipFilterRules": [],
    "locations": [
      {
        "location": "Japan East",
        "role": "primary"
      },
      {
        "location": "Japan West",
        "role": "secondary"
      }
    ],
    "messagingEndpoints": {
      "fileNotifications": {
        "lockDurationAsIso8601": "0:00:05",
        "maxDeliveryCount": 10,
        "ttlAsIso8601": "1:00:00"
      }
    },
    "minTlsVersion": null,
    "networkRuleSets": null,
    "privateEndpointConnections": null,
    "provisioningState": "Succeeded",
    "publicNetworkAccess": null,
    "restrictOutboundNetworkAccess": null,
    "rootCertificate": null,
    "routing": {
      "endpoints": {
        "cosmosDbSqlCollections": [],
        "eventHubs": [],
        "serviceBusQueues": [],
        "serviceBusTopics": [],
        "storageContainers": []
      },
      "enrichments": null,
      "fallbackRoute": {
        "condition": "true",
        "endpointNames": [
          "events"
        ],
        "isEnabled": true,
        "name": "$fallback",
        "source": "DeviceMessages"
      },
      "routes": []
    },
    "state": "Active",
    "storageEndpoints": {
      "$default": {
        "authenticationType": null,
        "connectionString": "",
        "containerName": "",
        "identity": null,
        "sasTtlAsIso8601": "1:00:00"
      }
    },
    "resourcegroup": "adt-3d-rg",
    "sku": {
      "capacity": 1,
      "name": "S1",
      "tier": "Standard"
    },
    "subscriptionId": "[REDACTED]",
    "systemData": {
      "createdAt": "2023-03-09T01:19:16.846666+00:00",
      "createdBy": null,
      "createdByType": null,
      "lastModifiedAt": null,
      "lastModifiedBy": null,
      "lastModifiedByType": null
    },
    "tags": {},
    "type": "Microsoft.Devices/IotHubs"
  }
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- Create IoT Device
 - Commands for macOS and Ubuntu environment

```
az iot hub device-identity create --hub-name $IOT_HUB_NAME --device-id $IOT_DEVICE_NAME --resource-group $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az iot hub device-identity create --hub-name $IOT_HUB_NAME --device-id $IOT_DEVICE_NAME --resource-group $RESOURCE_GROUP
{
  "authentication": {
    "symmetricKey": {
      "primaryKey": "KbdZnkGMSdNH5zDSliosaAcm4Xz49Xu0eqBOD9kpE=",
      "secondaryKey": "H+ZEwy+Es+xOubby6GxfNk1TdeWvVJbm/pWGEn0/J8="
    }
  },
  "type": "sas",
  "x509Thumbprint": {
    "primaryThumbprint": null,
    "secondaryThumbprint": null
  }
},
"capabilities": {
  "iotEdge": false
},
"cloudToDeviceMessageCount": 0,
"connectionState": "Disconnected",
"connectionUpdatedTime": "0001-01-01T00:00:00",
"deviceId": "FilmCheck01",
"deviceScope": null,
"etag": "NTQ4MTc4MDIx",
"generationId": "638139220020285965",
"lastActivityTime": "0001-01-01T00:00:00",
"ownerScope": null,
"status": "enabled",
"statusReason": null,
"statusUpdateTime": "0001-01-01T00:00:00"
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

- Create 2 event hub consumer groups
 - Commands for macOS and Ubuntu environment

```
az iot hub consumer-group create --hub-name $IOT_HUB_NAME --name $IOT_HUB_CONSUMER_GROUP_CONTAINER_APP --resource-group $RESOURCE_GROUP
```

```
az iot hub consumer-group create --hub-name $IOT_HUB_NAME --name $IOT_HUB_CONSUMER_GROUP_STATIC_WEB_APP --resource-group $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az iot hub consumer-group create --hub-name $IOT_HUB_NAME --name $IOT_HUB_CONSUMER_GROUP_CONTAINER_APP --resource-group $RESOURCE_GROUP
{
  "etag": null,
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.Devices/IotHubs/adt-3d/eventHubEndpoints/events/ConsumerGroups/containerapp",
  "properties": {
    "created": "Thu, 09 Mar 2023 01:28:37 GMT",
    "properties": {
      "name": "containerapp"
    }
  },
  "resourceGroup": "adt-3d-rg",
  "type": "Microsoft.Devices/IotHubs/EventHubEndpoints/ConsumerGroups"
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az iot hub consumer-group create --hub-name $IOT_HUB_NAME --name $IOT_HUB_CONSUMER_GROUP_STATIC_WEB_APP --resource-group $RESOURCE_GROUP
{
  "etag": null,
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.Devices/IotHubs/adt-3d/eventHubEndpoints/events/ConsumerGroups/forStaticWeb",
  "properties": {
    "created": "Thu, 09 Mar 2023 01:28:47 GMT",
    "properties": {
      "name": "forStaticWeb"
    }
  },
  "resourceGroup": "adt-3d-rg",
  "type": "Microsoft.Devices/IotHubs/EventHubEndpoints/ConsumerGroups"
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

- Get **FilmCheck01** IoT Device Connection String
 - Commands for macOS and Ubuntu environment

```
az iot hub device-identity connection-string show --hub-name $IOT_HUB_NAME --device-id $IOT_DEVICE_NAME --output table --resource-group $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az iot hub device-identity connection-string show --hub-name $IOT_HUB_NAME --device-id $IOT_DEVICE_NAME --output table --resource-group $RESOURCE_GROUP
ConnectionString
HostNames=adt-3d.azure-devices.net/deviceId=filmCheck01;sharedAccessKey=KbdZnkGMSdNH5zDSliosaAcm4Xz49Xu0eqBOD9kpE=
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

6. Build Azure 3D Scenes Studio

- Create Storage Accounts & Container

- Create Storage Account

- Commands for macOS and Ubuntu environment

```
az storage account create -n $BL0B_NAME -g $RESOURCE_GROUP -l $REGION --sku Standard_LRS
```

```
{
  "accessTier": "Hot",
  "allowBlobPublicAccess": true,
  "allowCrossTenantReplication": null,
  "allowSharedKeyAccess": null,
  "allowScopedAccess": null,
  "azureFilesIdentityBasedAuthentication": null,
  "blobRestoreStatus": null,
  "creationTime": "2023-03-09T01:48:57.797427+00:00",
  "customDomain": null,
  "defaultToAuthAuthentication": null,
  "dnsEndpointType": null,
  "enableHttpsTrafficOnly": true,
  "enableNfs3": null,
  "encryption": {
    "encryptionIdentity": null,
    "keySource": "Microsoft.Storage",
    "keyVaultProperties": null,
    "requireInfrastructureEncryption": null,
    "services": {
      "blob": {
        "enabled": true,
        "keyType": "Account",
        "lastEnabledTime": "2023-03-09T01:48:57.891176+00:00"
      },
      "file": {
        "enabled": true,
        "keyType": "Account",
        "lastEnabledTime": "2023-03-09T01:48:57.891176+00:00"
      },
      "queue": null,
      "table": null
    }
  },
  "extendedLocation": null,
  "failoverInProgress": null,
  "geoReplicationStats": null,
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.Storage/storageAccounts/adt3dstorageaccount",
  "identity": null,
  "immutableStorageWithVersioning": null,
  "isHnsEnabled": null,
  "isLocalUserEnabled": null,
  "isSftpEnabled": null,
  "keyCreationTime": {
    "key1": "2023-03-09T01:48:57.875566+00:00",
    "key2": "2023-03-09T01:48:57.875566+00:00"
  },
  "keyPolicy": null,
  "kind": "StorageV2",
  "largeFileSharesState": null,
  "lastGeoFailoverTime": null,
  "location": "japaneast",
  "minimumLsVersion": "LSI_9",
  "name": "adt3dstorageaccount",
  "networkRuleSet": {
    "bypass": "AzureServices",
    "defaultAction": "Allow",
    "ipRules": [],
    "resourceAccessRules": null,
    "virtualNetworkRules": []
  },
  "primaryEndpoints": {
    "blob": "https://adt3dstorageaccount.blob.core.windows.net/",
    "dfs": "https://adt3dstorageaccount.dfs.core.windows.net/",
    "file": "https://adt3dstorageaccount.file.core.windows.net/",
    "internetEndpoints": null,
    "microsoftEndpoints": null,
    "queue": "https://adt3dstorageaccount.queue.core.windows.net/",
    "table": "https://adt3dstorageaccount.table.core.windows.net/",
    "web": "https://adt3dstorageaccount.z11.web.core.windows.net/"
  },
  "primaryLocation": "japaneast",
  "privateEndpointConnections": [],
  "provisioningState": "Succeeded",
  "publicNetworkAccess": null,
  "resourceGroup": "adt-3d-rg",
  "routingPreference": null,
  "sasPolicy": null,
  "secondaryEndpoints": null,
  "secondaryLocation": null,
  "sku": {
    "name": "Standard_LRS",
    "tier": "Standard"
  },
  "statusOfPrimary": "available",
  "statusOfSecondary": null,
  "storageAccountsSkuConversionStatus": null,
  "tags": {},
  "type": "Microsoft.Storage/storageAccounts"
}
```

- Create Container

- Commands for macOS and Ubuntu environment

```
az storage container create -n $BL0B_CONTAINER_NAME --account-name $BL0B_NAME --resource-group $RESOURCE_GROUP
```

```

archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az storage container create -n $BLOB_CONTAINER_NAME --account-name $BLOB_NAME --resource-group $RESOURCE_GROUP
Argument 'resource_group_name' has been removed and will be removed in a future release.
There are no credentials provided in your command and environment, we will query for account key for your storage account.
It is recommended to provide --connection-string, --account-key or --sas-token in your command as credentials.
You also can add '--auth-mode login' in your command to use Azure Active Directory (Azure AD) for authorization if your login account is assigned required RBAC roles.
For more information about RBAC roles in storage, visit https://docs.microsoft.com/azure/storage/common/storage-auth-aad-rbac-cli.

In addition, setting the corresponding environment variables can avoid inputting credentials in your command. Please use --help to get more information about environment variable usage.

{
  "created": true
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- Change access level

- Commands for macOS and Ubuntu environment

```

az storage container set-permission --name
$BLOB_CONTAINER_NAME --public-access blob --account-name
$BLOB_NAME

```

```

archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az storage container set-permission --name $BLOB_CONTAINER_NAME --public-access blob --account-name $BLOB_NAME
Argument 'resource_group_name' has been removed and will be removed in a future release.
There are no credentials provided in your command and environment, we will query for account key for your storage account.
It is recommended to provide --connection-string, --account-key or --sas-token in your command as credentials.
You also can add '--auth-mode login' in your command to use Azure Active Directory (Azure AD) for authorization if your login account is assigned required RBAC roles.
For more information about RBAC roles in storage, visit https://docs.microsoft.com/azure/storage/common/storage-auth-aad-rbac-cli.

In addition, setting the corresponding environment variables can avoid inputting credentials in your command. Please use --help to get more information about environment variable usage.

{
  "client_request_id": "6c66dc94-be1d-11ed-9b9e-0e34b01520ae",
  "date": "2023-03-09T01:55:10+00:00",
  "etag": "0x8D53E80000000000",
  "last_modified": "2023-03-09T01:55:10+00:00",
  "request_id": "46513f65-601e-002a-312a-52a385000000",
  "version": "2021-06-08"
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- Add Storage Blob Data Owner

- Retrieve the **subscriptionId** from the results.

```

az account subscription list

```

```

archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az account subscription list
Command group 'account subscription' is experimental and under development. Reference and support levels: https://aka.ms/CLI_refstatus
[
  {
    "authorizationSource": "Legacy",
    "displayName": "Azure in Open",
    "id": "/subscriptions/[REDACTED]",
    "state": "Enabled",
    "subscriptionId": "[REDACTED]",
    "subscriptionPolicies": {
      "locationPlacementId": "Public_2014-09-01",
      "quotaId": "AzureInOpen_2014-09-01",
      "spendingLimit": "On"
    }
  },
  {
    "authorizationSource": "RoleBased",
    "displayName": "Azure [REDACTED]",
    "id": "/subscriptions/[REDACTED]",
    "state": "Enabled",
    "subscriptionId": "[REDACTED]", highlighted
    "subscriptionPolicies": {
      "locationPlacementId": "Public_2014-09-01",
      "quotaId": "CSP_2015-05-01",
      "spendingLimit": "Off"
    }
  }
]
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- Set parameter

- Commands for macOS and Ubuntu environment

```

export SUBSCRIPTION_ID="Enter the subscriptionId
obtained in the previous step."
echo $SUBSCRIPTION_ID

```

- Create a role assignment.

- Commands for macOS and Ubuntu environment

```
az role assignment create \
    --role "Storage Blob Data Owner" \
    --assignee $USER_PRINCIPAL_NAME \
    --scope
"/subscriptions/$SUBSCRIPTION_ID/resourceGroups/$RESOURCE_GROUP/providers/Microsoft.Storage/storageAccounts/$BLOB_NAME"
```

```
archer@ArcherdeMacBook-Pro ~ % az role assignment create \
--role "Storage Blob Data Owner" \
--assignee $USER_PRINCIPAL_NAME \
--scope
"/subscriptions/$SUBSCRIPTION_ID/resourceGroups/$RESOURCE_GROUP/providers/Microsoft.Storage/storageAccounts/$BLOB_NAME"
{
  "canDelegate": null,
  "condition": null,
  "conditionVersion": null,
  "description": null,
  "descriptionLocalization": null,
  "name": "Storage Blob Data Owner",
  "principalId": "msconii@gmail.com#EXT#@itrcms.onmicrosoft.com",
  "principalType": "User",
  "resourceDefinitionId": "/subscriptions/$SUBSCRIPTION_ID/resourceGroups/$RESOURCE_GROUP/providers/Microsoft.Authorization/roleDefinitions/b7edaddf-1e83-8833-af276bb8955b",
  "roleDefinitionName": "Storage Blob Data Owner",
  "scope": "/subscriptions/$SUBSCRIPTION_ID/resourceGroups/adt-3d-rg/providers/Microsoft.Storage/storageAccounts/adt3dstorageaccount",
  "type": "Microsoft.Authorization/roleAssignments"
}
archer@ArcherdeMacBook-Pro ~ %
```

- Upload 3D Scenes to Studio & Create Twin

- Enable Cross-Origin Resource Sharing (CORS) for storage account

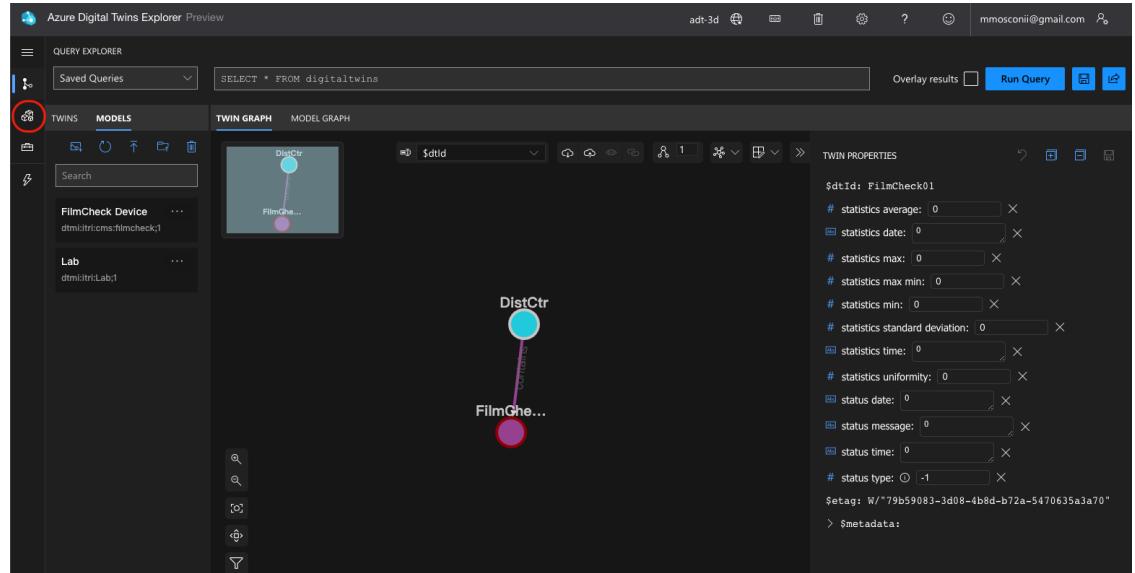
- Commands for macOS and Ubuntu environment

```
az storage cors add --services b --methods GET OPTIONS POST
PUT --origins https://explorer.digitaltwins.azure.net --
allowed-headers Authorization x-ms-version x-ms-blob-type --
account-name $BLOB_NAME
```

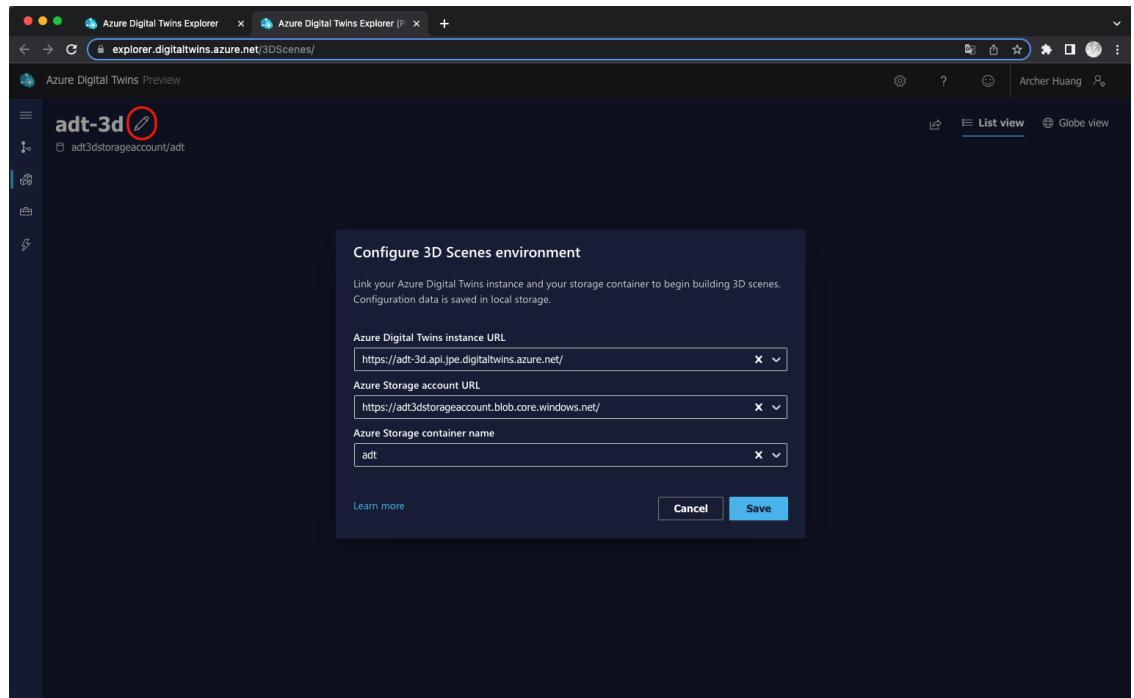
```
archer@ArcherdeMacBook-Pro ~ % az storage cors add --services b --methods GET OPTIONS POST
PUT --origins https://explorer.digitaltwins.azure.net --
allowed-headers Authorization x-ms-version x-ms-blob-type --
account-name $BLOB_NAME
There are no credentials provided in your command and environment, we will query for account key for your storage account.
It is recommended to provide --connection-string, --account-key or --as-token in your command as credentials.
In addition, setting the corresponding environment variables can avoid inputting credentials in your command. Please use --help to get more information about environment variable usage.
archer@ArcherdeMacBook-Pro ~ %
```

- 3D Scenes Studio

- Click the 3D Scenes button

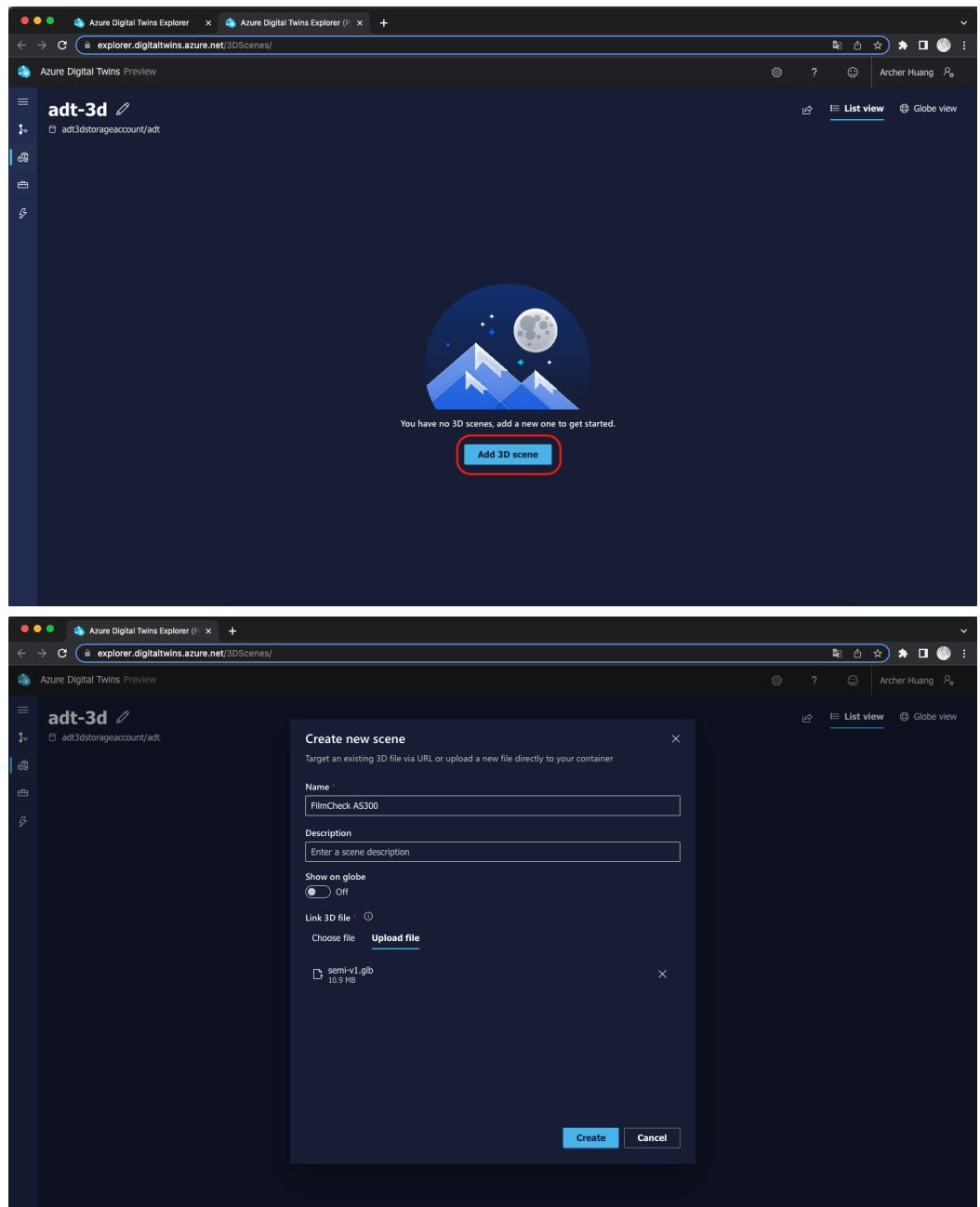


- Click on the pencil icon and Configure the instance and storage container details



- Add a new 3D scene

- Enter a Name and Description for your scene, and select the **/3D-Scenes/semi-v1.glb** file for uploading.



- After the file upload is completed, relevant information can also be viewed in the created blob.

Microsoft Azure mmosconi@gmail.com

Home > Resource groups > adt-3d-rg > adt3dstorageaccount | Containers >

adt Container

Upload Change access level Refresh Delete Change tier Acquire lease

Overview Diagnose and solve problems Access Control (IAM)

Authentication method: Access key ([Switch to Azure AD User Account](#))
Location: adt

Show deleted blobs

Add filter

Name	Modified	Access tier	Archive status
3DScenesConfiguration.json	3/15/2023, 10:52:59 ...	Hot (Inferred)	
semi-v1.glb	3/15/2023, 10:52:58 ...	Hot (Inferred)	

- Once the file is uploaded, you'll see it listed back on the main screen of 3D Scenes Studio

Azure Digital Twins Preview

adt-3d

Name Description 3D file blob URL Actions

FilmCheck AS300

<https://adt3dstorageaccount.blob.core.windows.net/>

- Select the scene to open and view it. The scene will open in Build mode

Azure Digital Twins Preview

FilmCheck AS300

Elements Behaviors

No elements created yet. Select an object in the scene to create an element

New element

- Create a scene element - Create the element for the **Red** color of the tri-color light
 - Select the floor in the scene visualization. This will bring up the possible element actions. Select **+ Create new element** - Create the element for the **Red** color of the tri-color light

Azure Digital Twins Preview

FilmCheck AS300

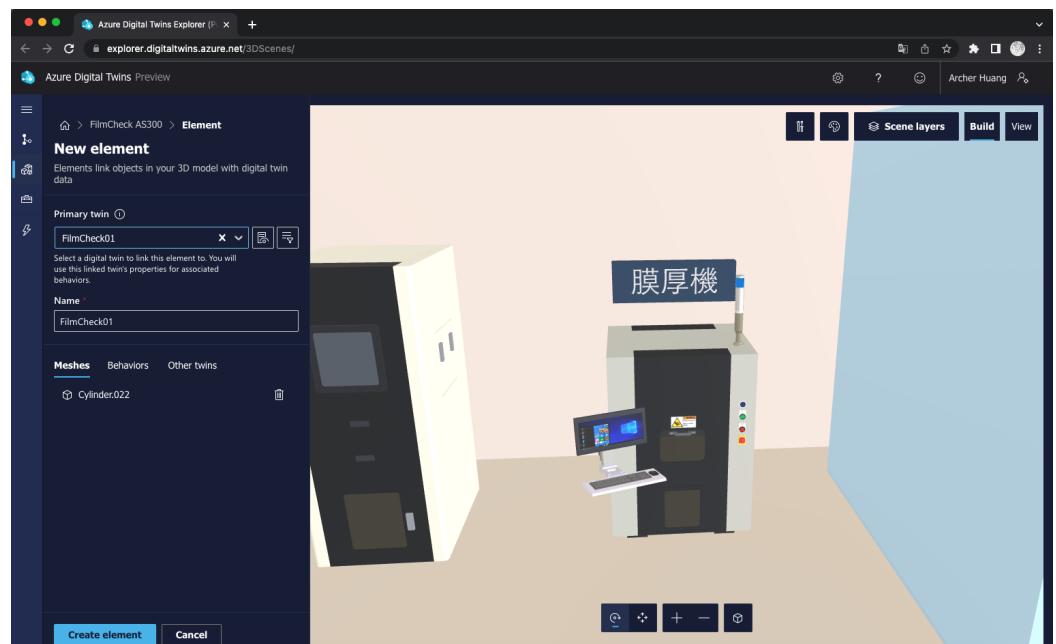
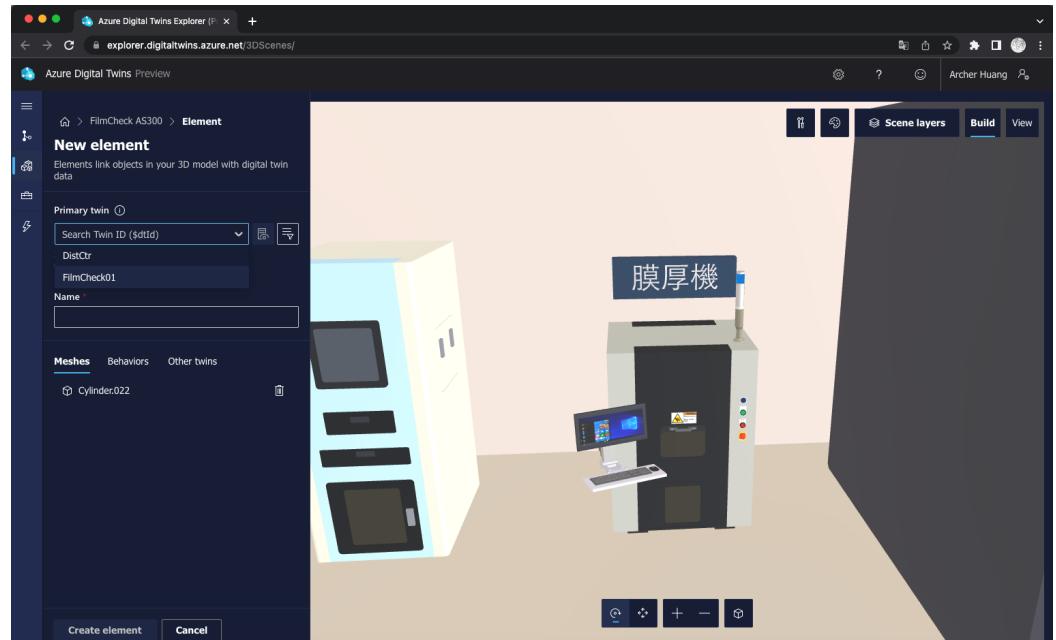
Elements Behaviors

No elements created yet. Select an object in the scene to create an element

New element

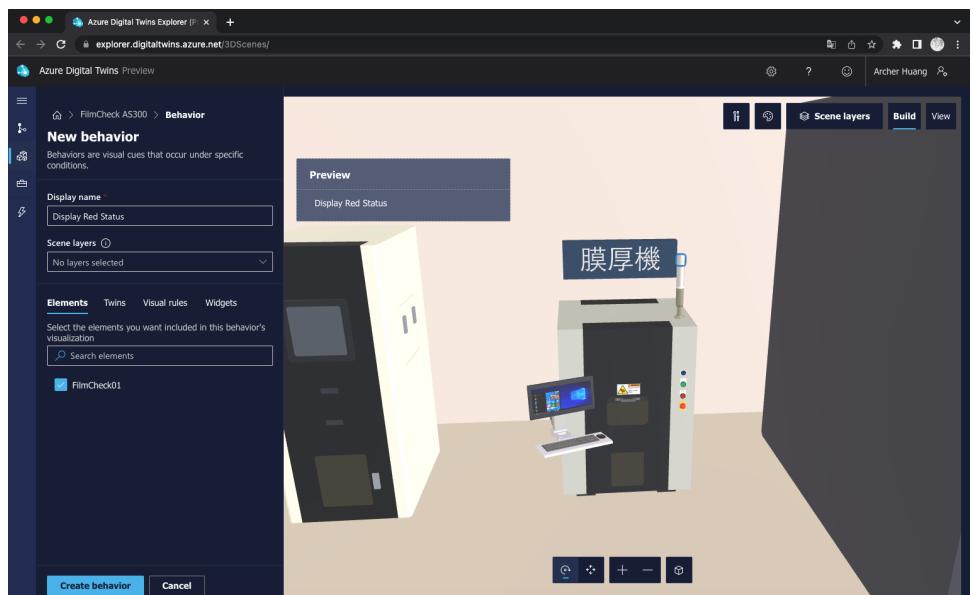
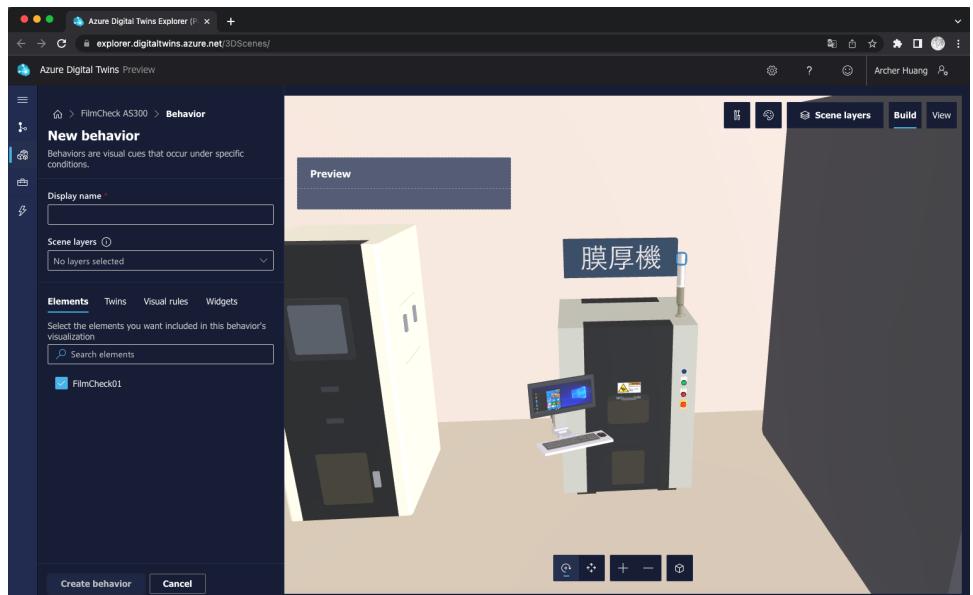
Element actions

+ Create new element

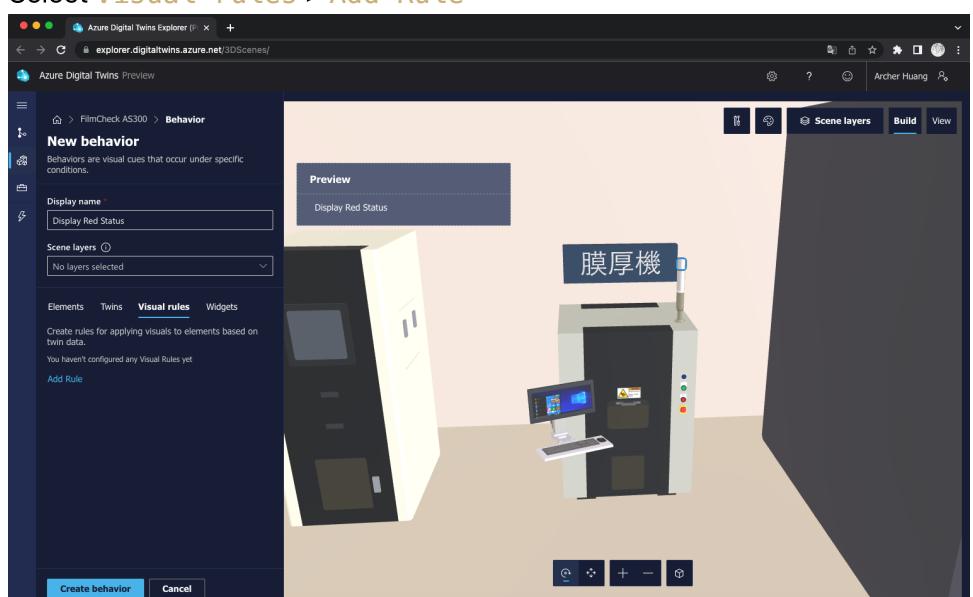




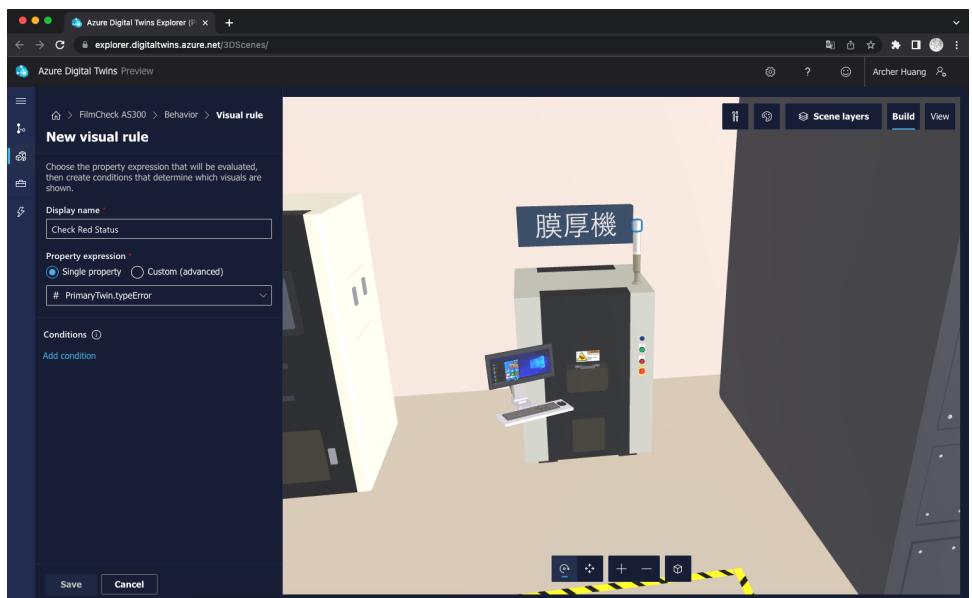
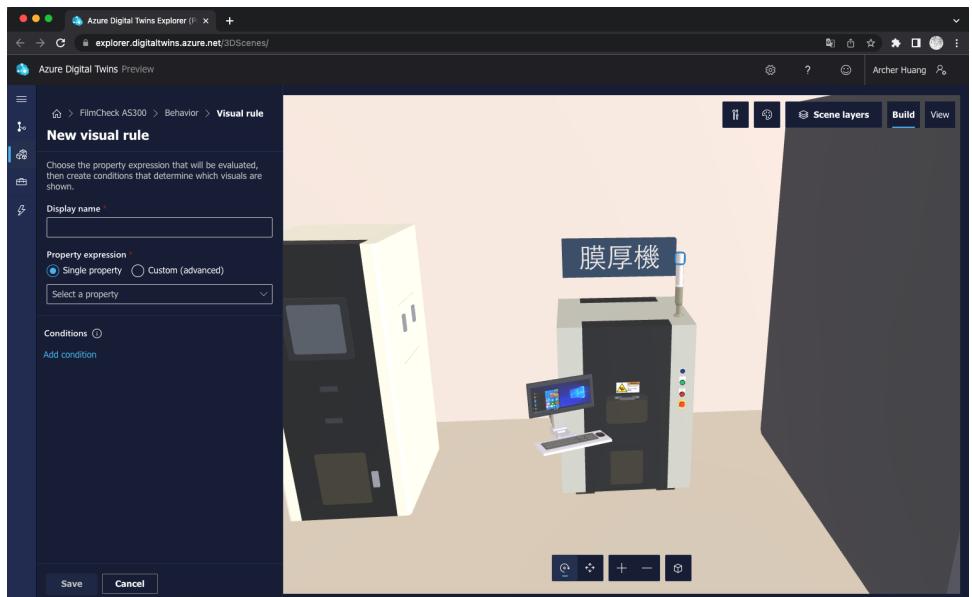
- Display name, enter **Display Red Status**. Under Elements, select Floors.



- Select **Visual rules > Add Rule**

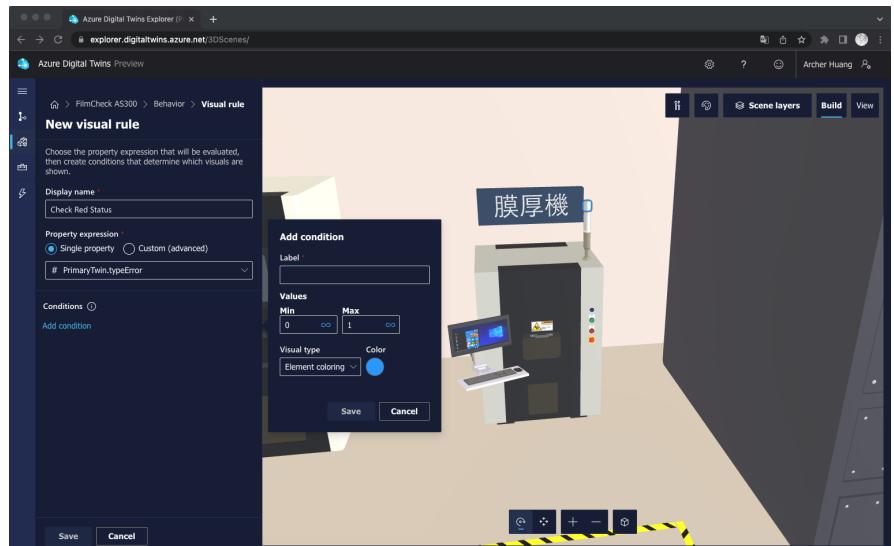


- Enter a Display name of **Check Red Status**. Leave the Property expression on **Single property** and open the property dropdown list. It contains names of all the properties on the primary twin for the Floor element. Select **typeError**. Then, select **Add condition**.



■ Add check **typeError** condition

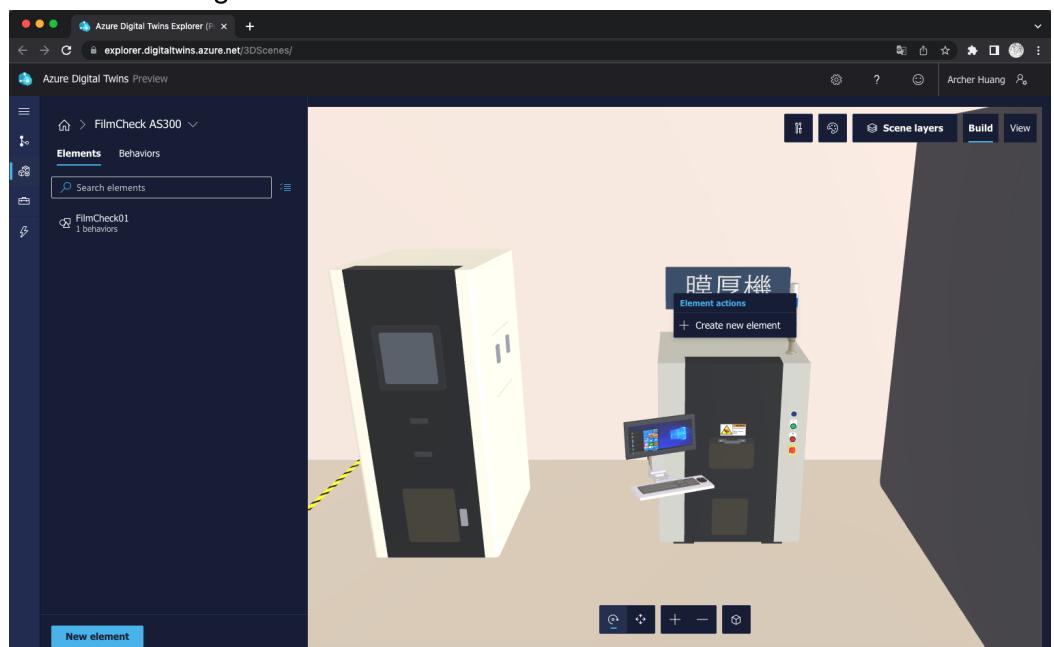
- **Label name**, enter **Red**.
- **Values** Fields, Define a value range between **2** and **3** (the min range value is inclusive, and the max value is exclusive), and assign an **Element coloring of Red**. Select **Save**.

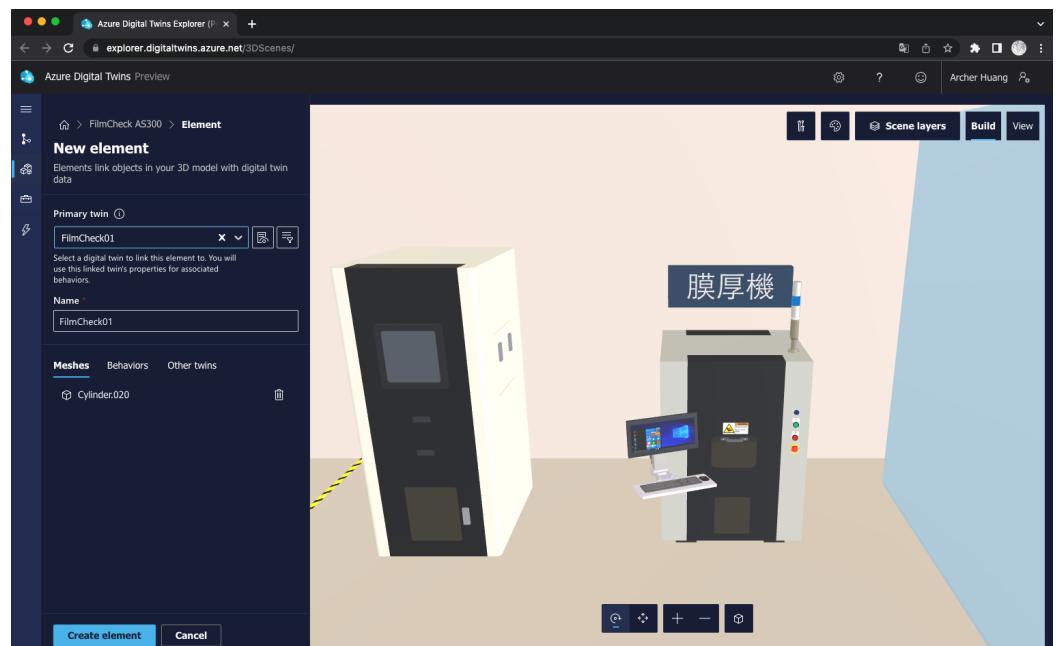
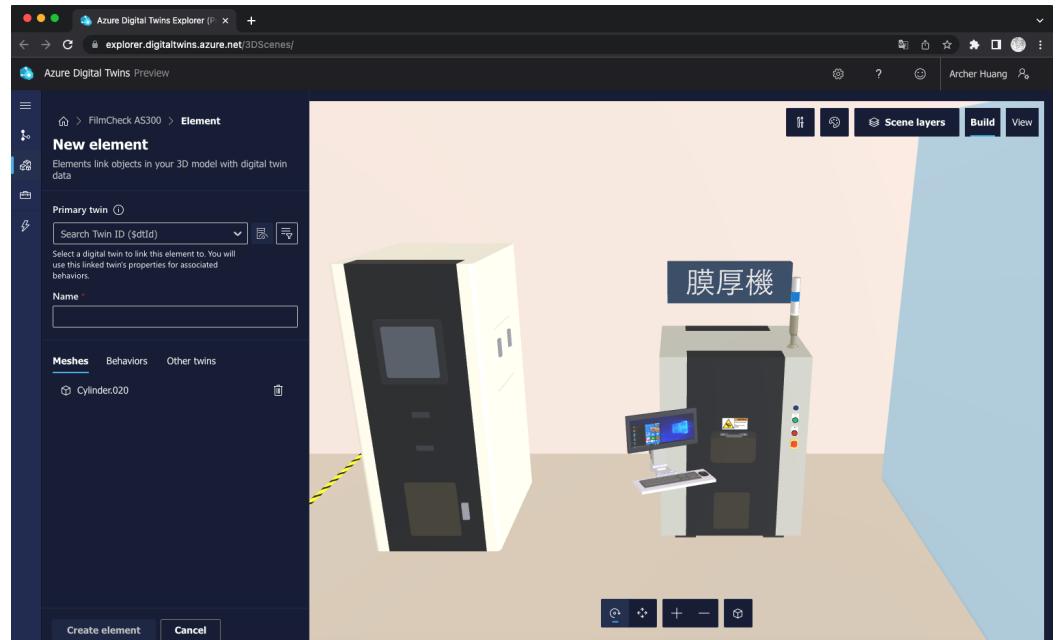






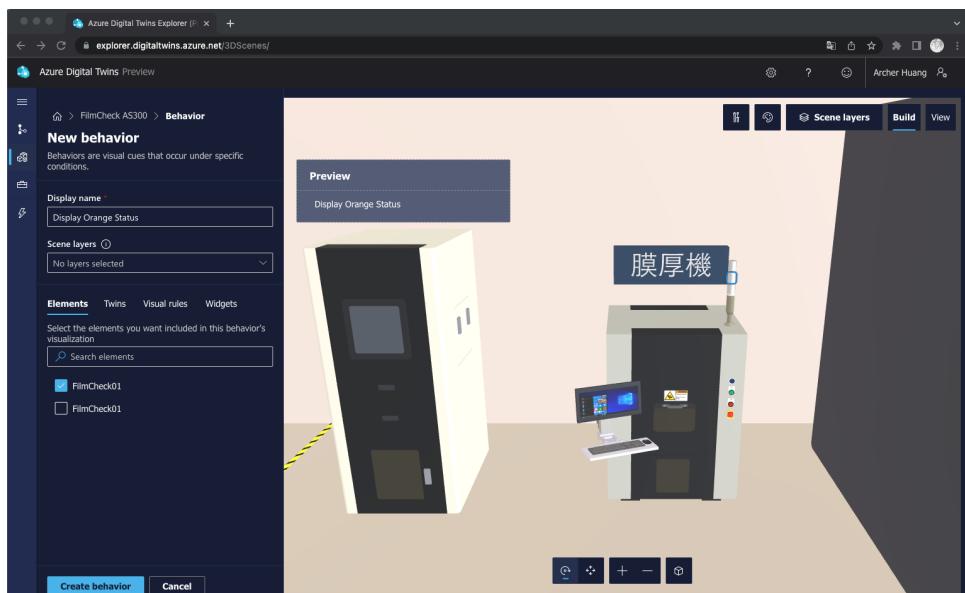
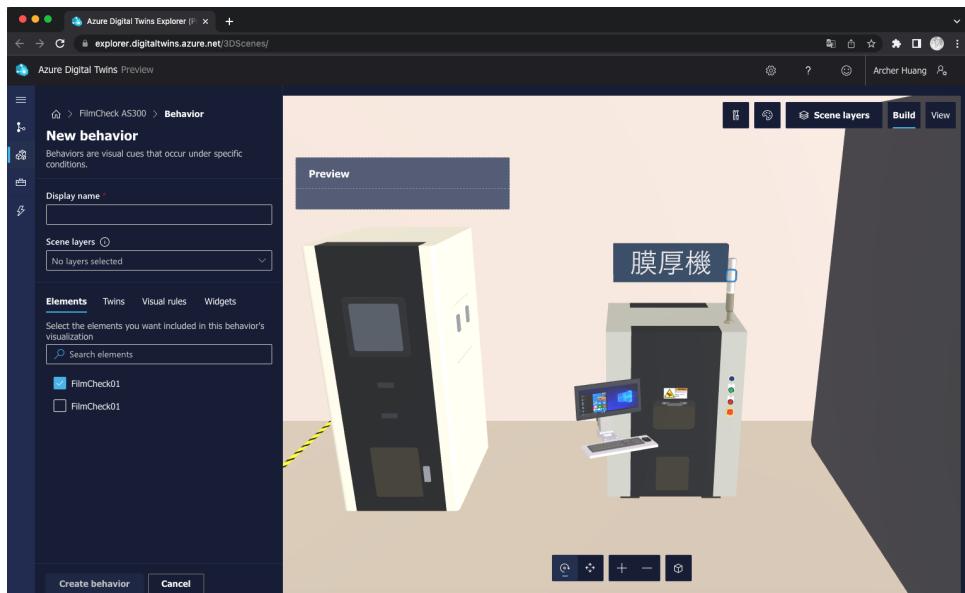
- Create a scene element - Create the element for the **Orange** color of the tri-color light
 - Select the floor in the scene visualization. This will bring up the possible element actions. Select **+** Create new element - Create the element for the **Orange** color of the tri-color light



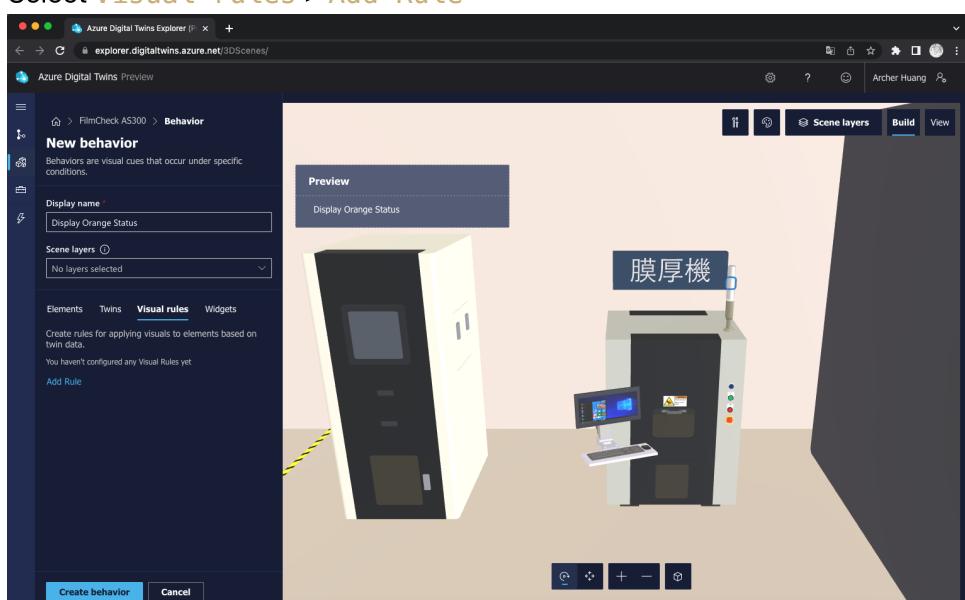




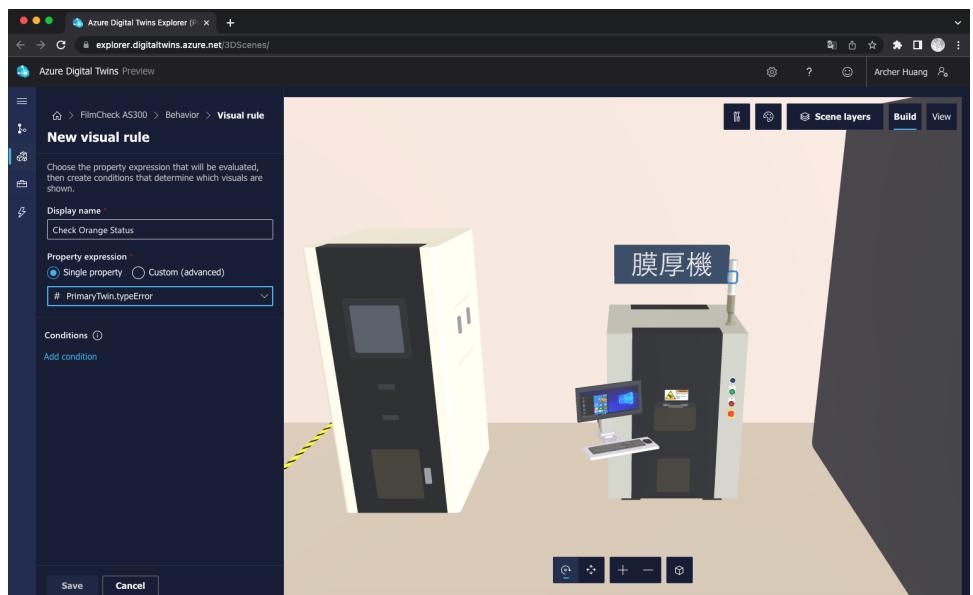
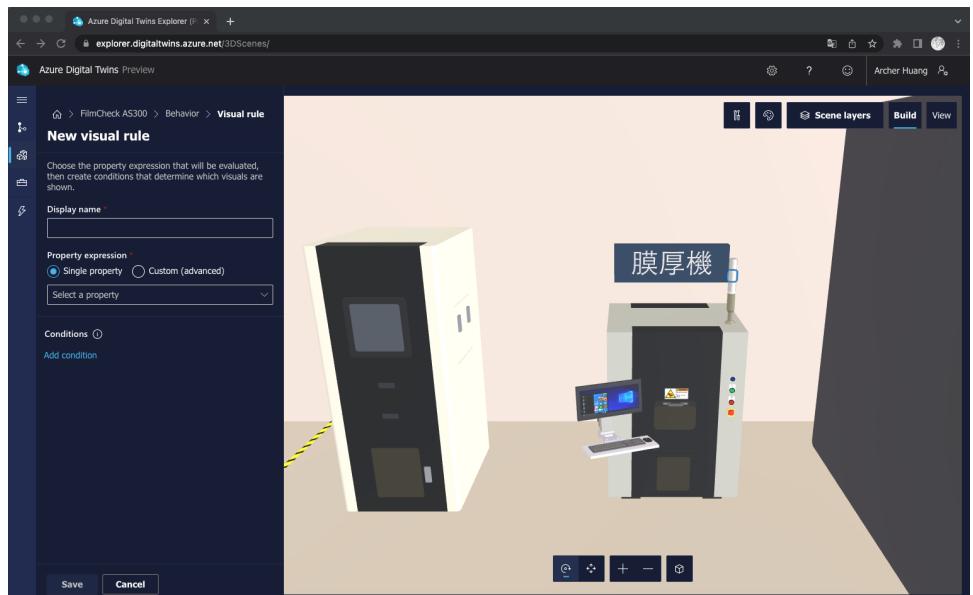
- Display name, enter **Display Orange Status**. Under Elements, select Floors.



■ Select **Visual rules > Add Rule**

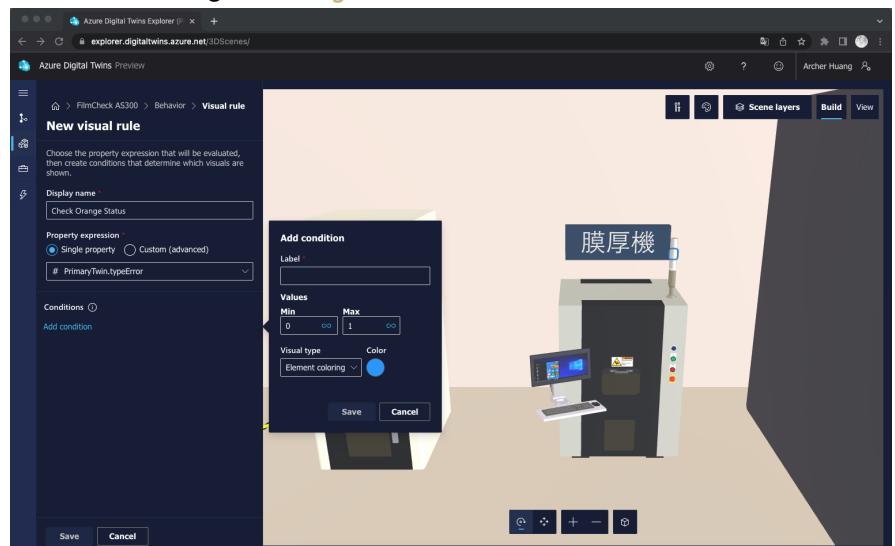


- Enter a Display name of **Check Orange Status**. Leave the Property expression on **Single property** and open the property dropdown list. It contains names of all the properties on the primary twin for the Floor element. Select **typeError**. Then, select **Add condition**.



■ Add check **typeError** condition

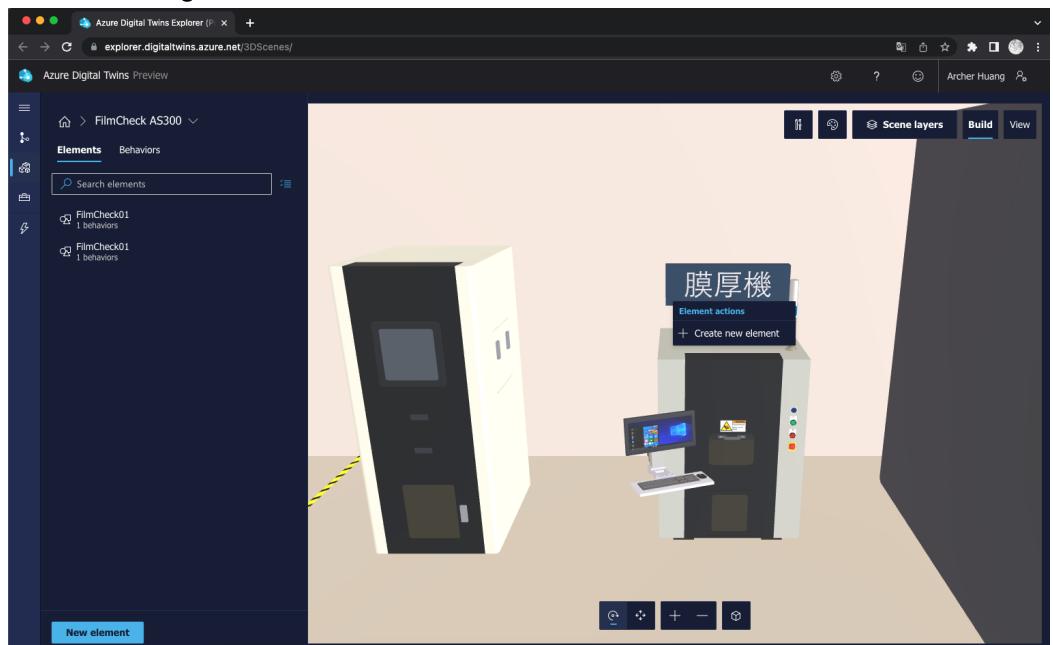
- **Label name**, enter **Orange**.
- **Values** Fields, Define a value range between **1** and **2** (the min range value is inclusive, and the max value is exclusive), and assign an **Element coloring of Orange**. Select **Save**.

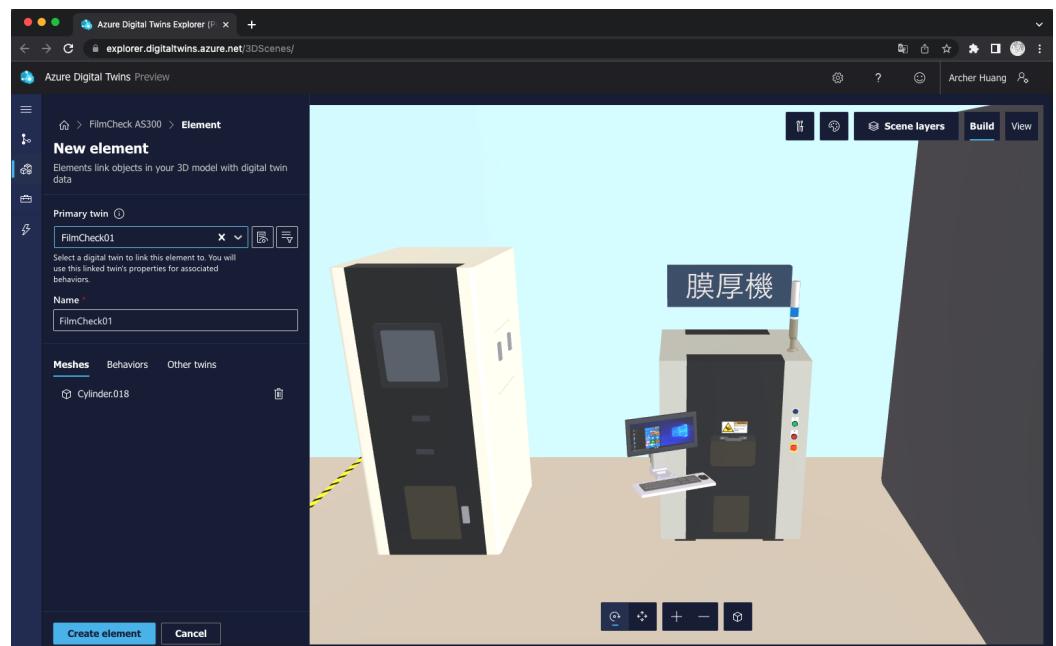
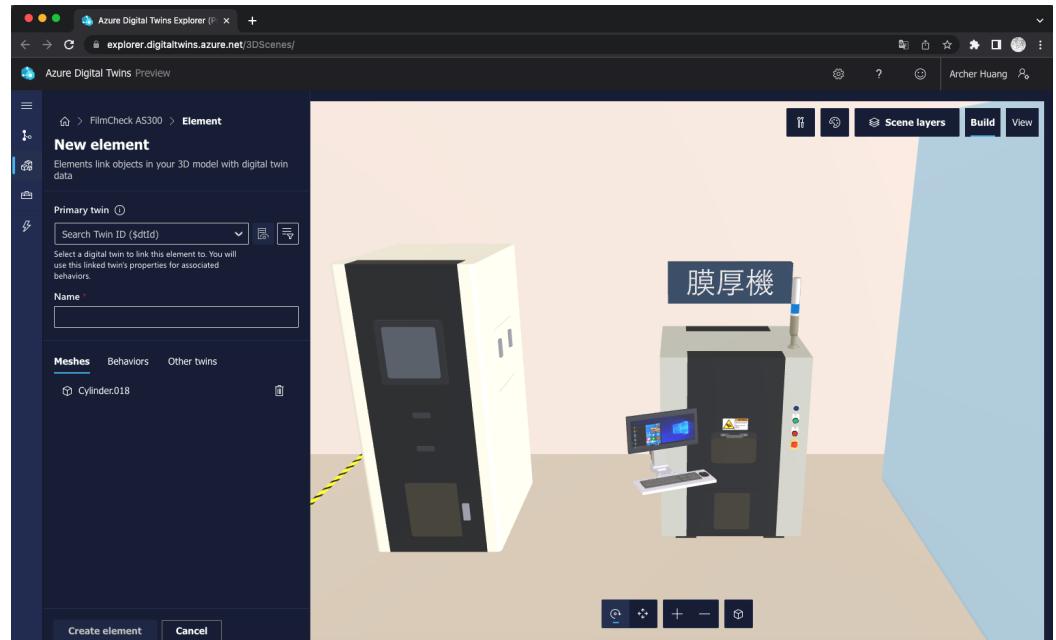


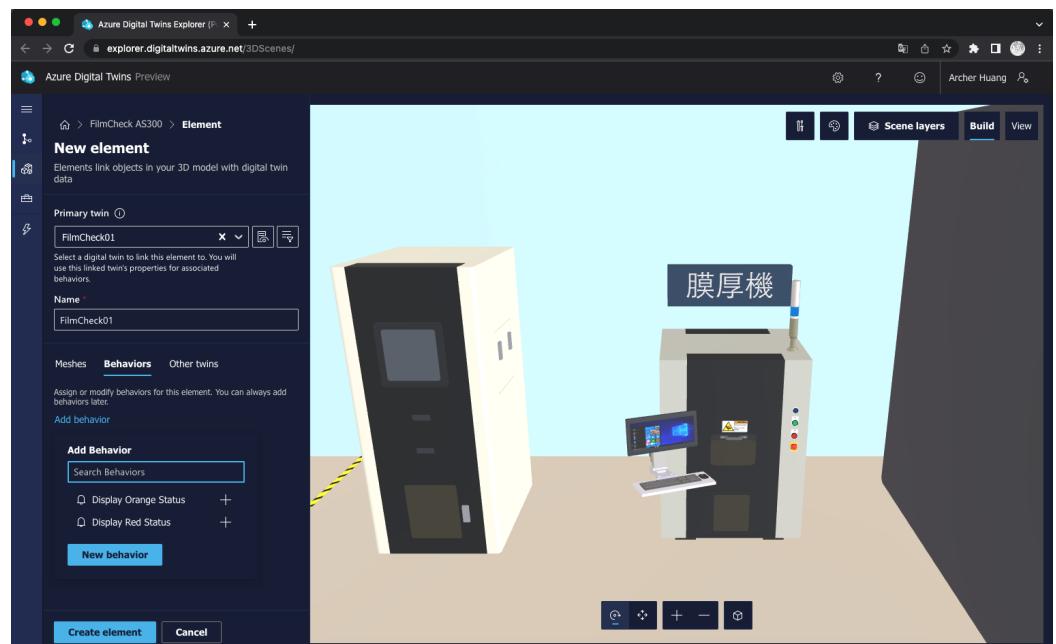
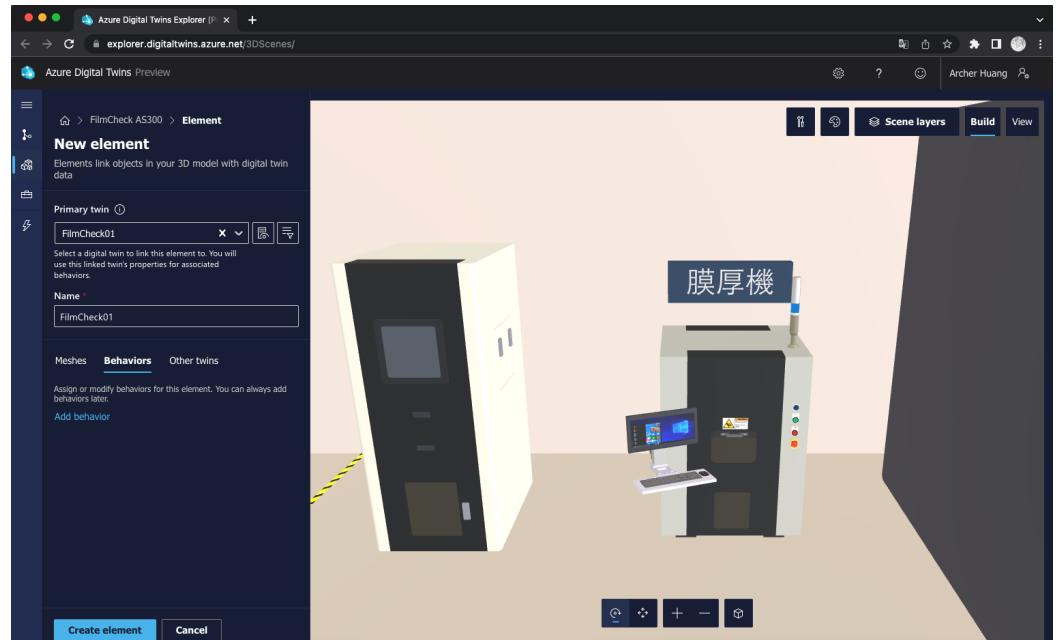




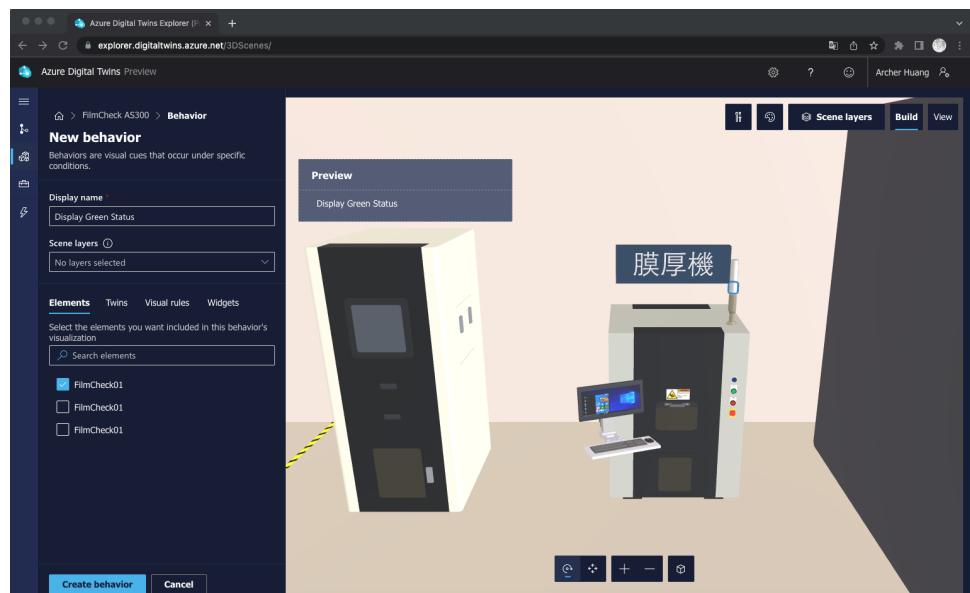
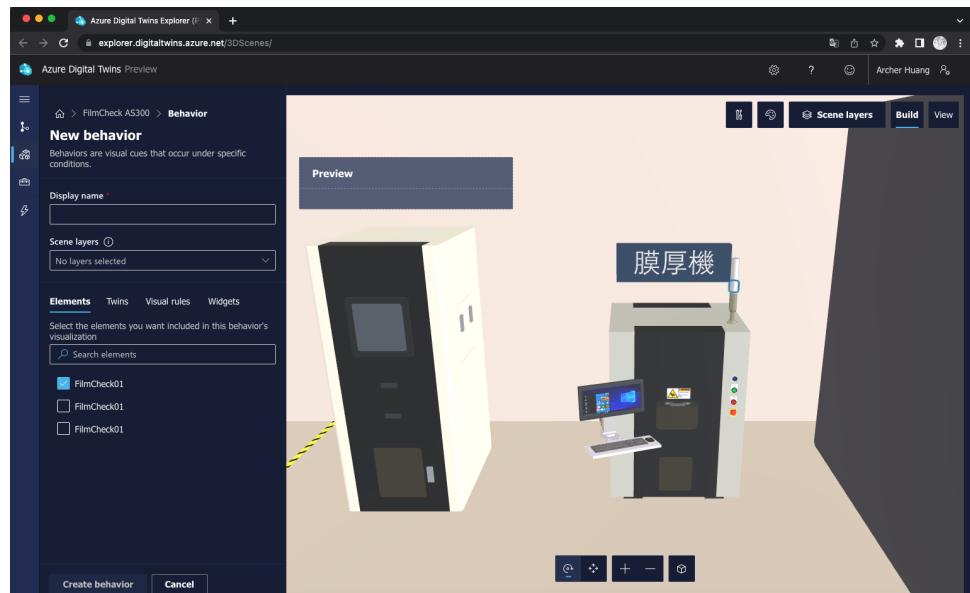
- Create a scene element - Create the element for the **Green** color of the tri-color light
 - Select the floor in the scene visualization. This will bring up the possible element actions. Select **+** Create new element - Create the element for the **Green** color of the tri-color light



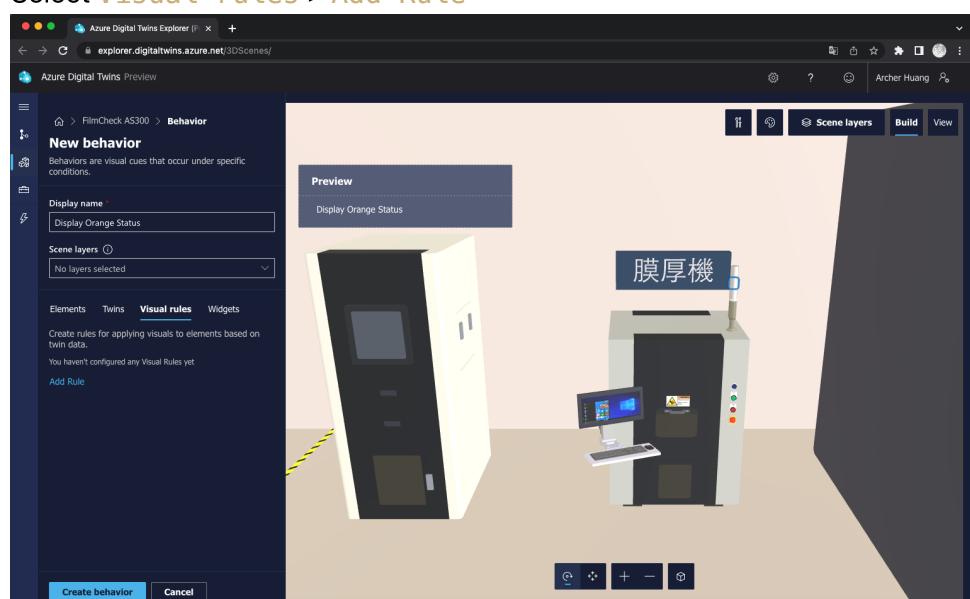




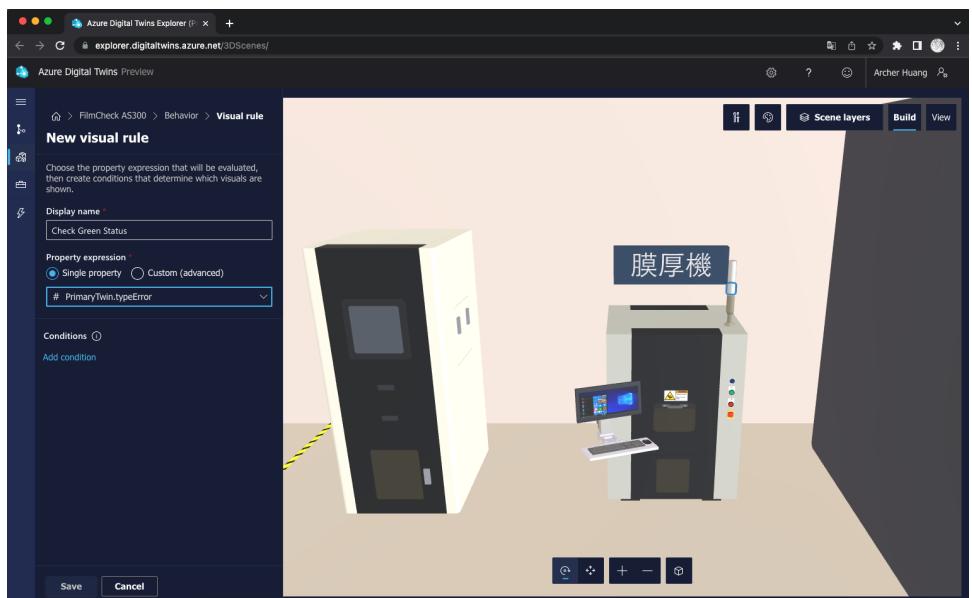
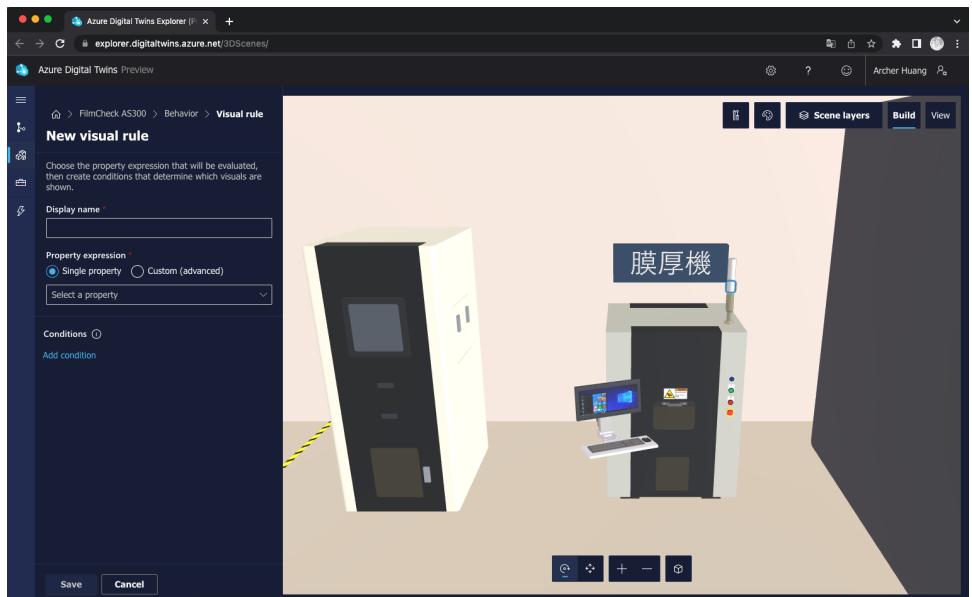
- Display name, enter **Display Green Status**. Under Elements, select Floors.



■ Select Visual rules > Add Rule

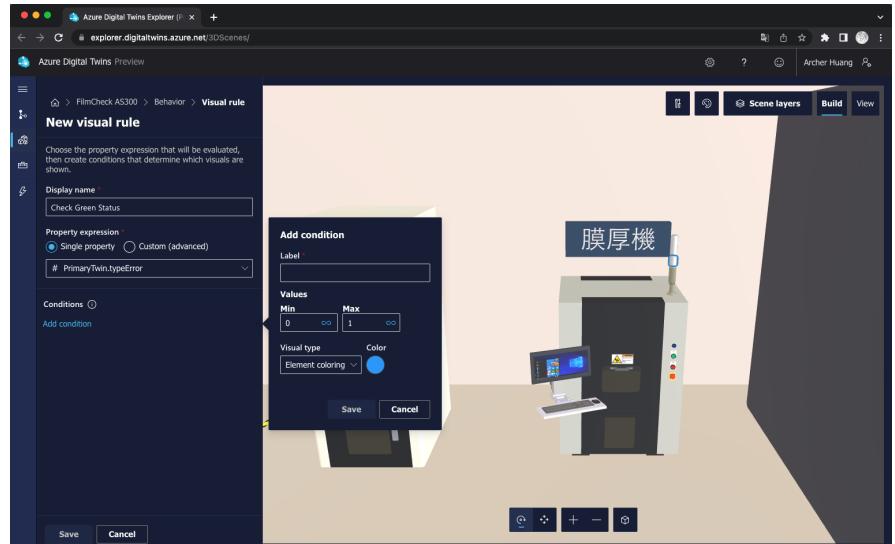


- Enter a Display name of **Check Green Status**. Leave the Property expression on **Single property** and open the property dropdown list. It contains names of all the properties on the primary twin for the Floor element. Select **typeError**. Then, select **Add condition**.



- Add check **typeError** condition

- **Label name**, enter **Green**.
- **Values** Fields, Define a value range between **0** and **1** (the min range value is inclusive, and the max value is exclusive), and assign an **Element coloring** of **Green**. Select **Save**.

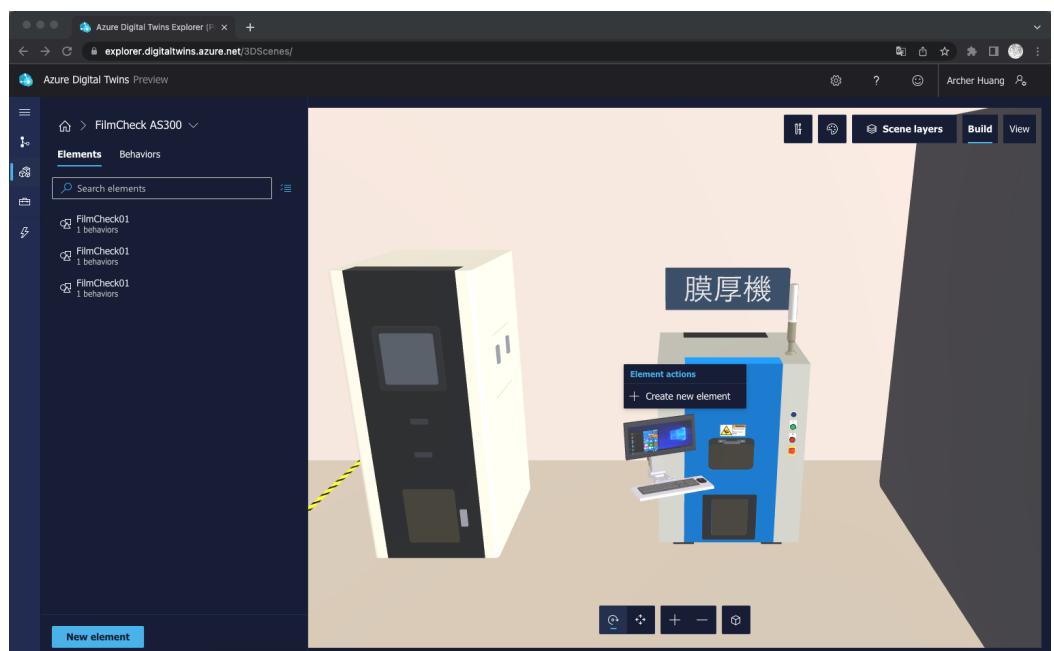


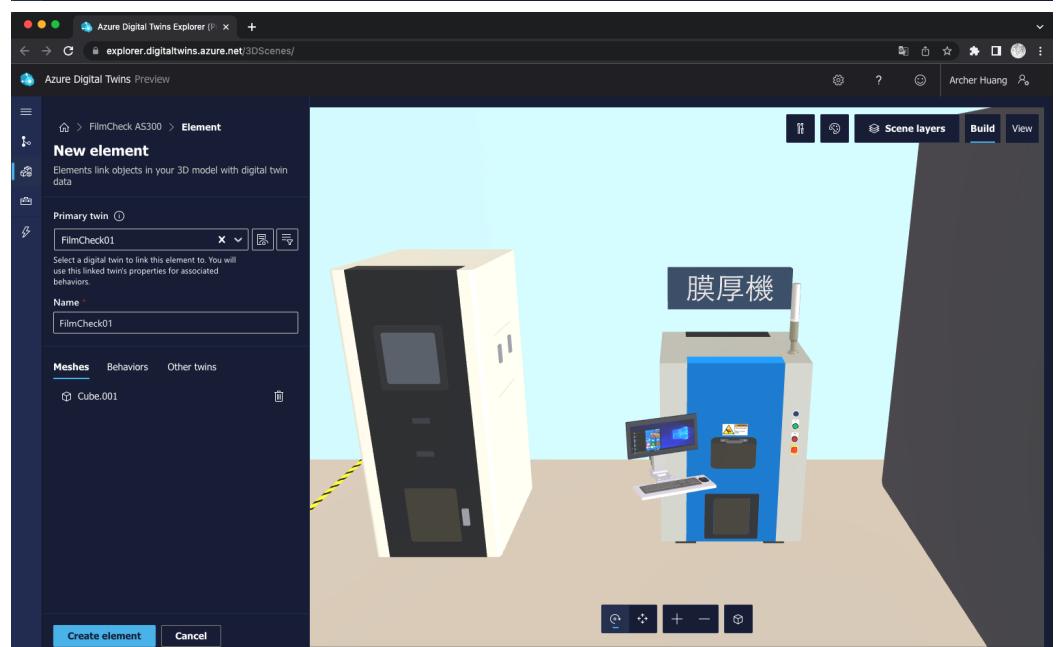
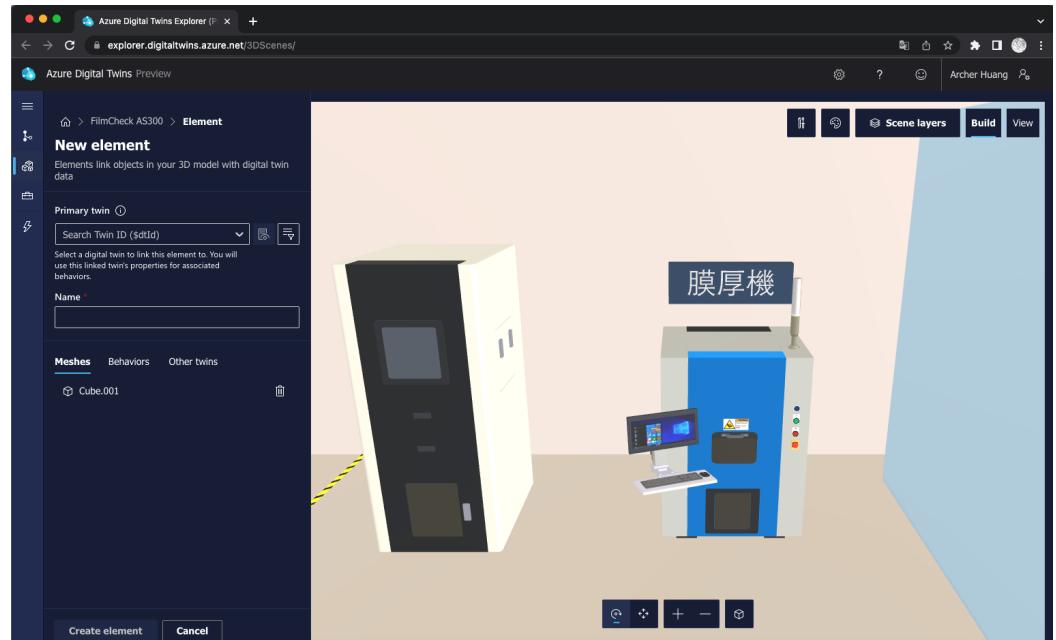


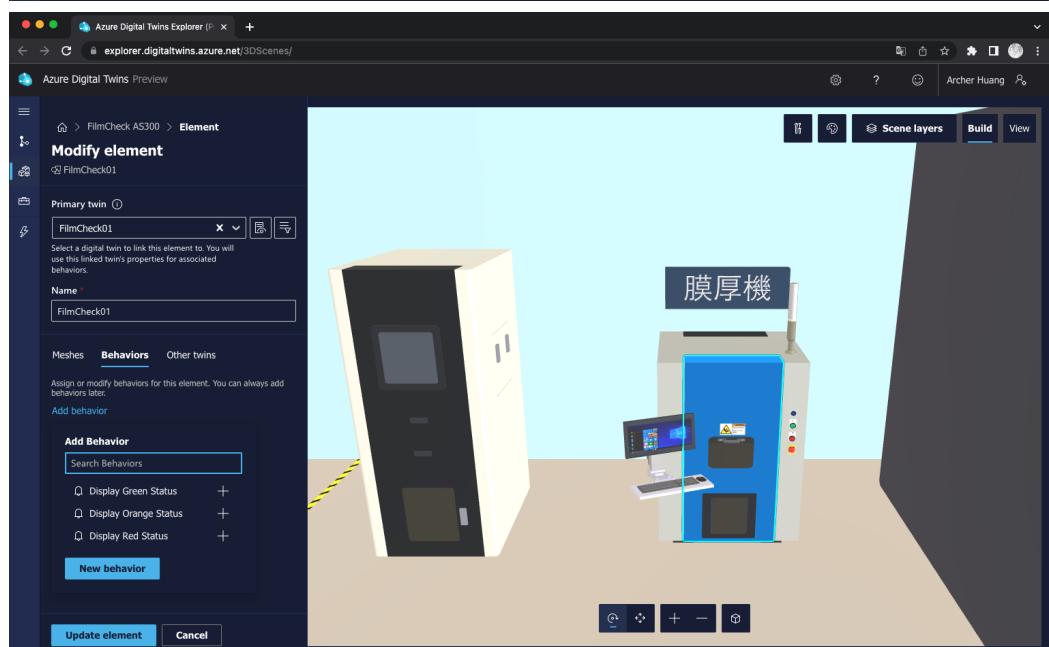
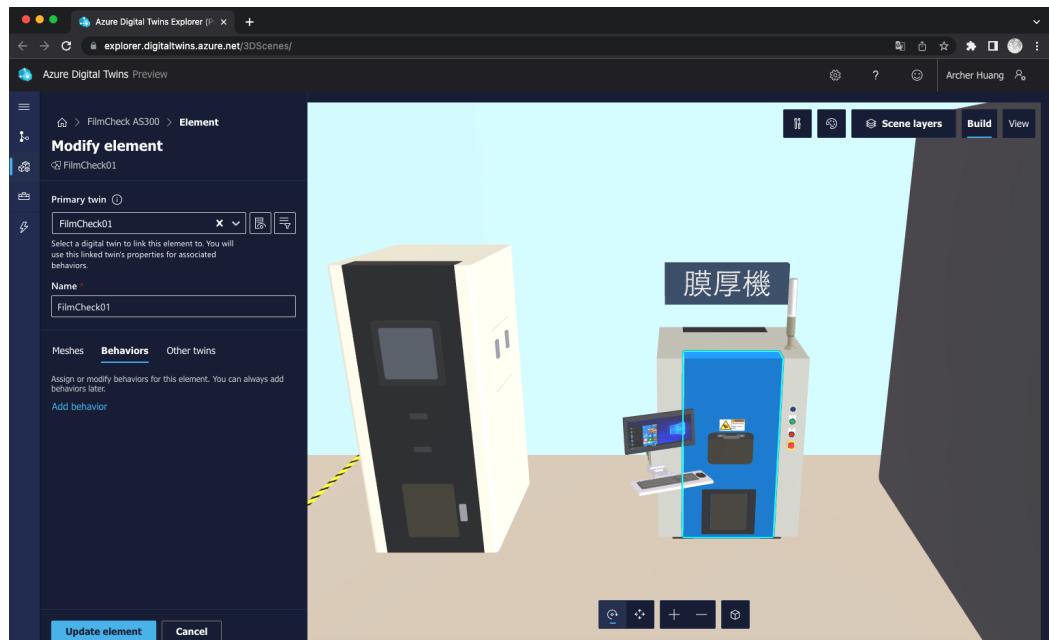


- Create new element for display Statistics

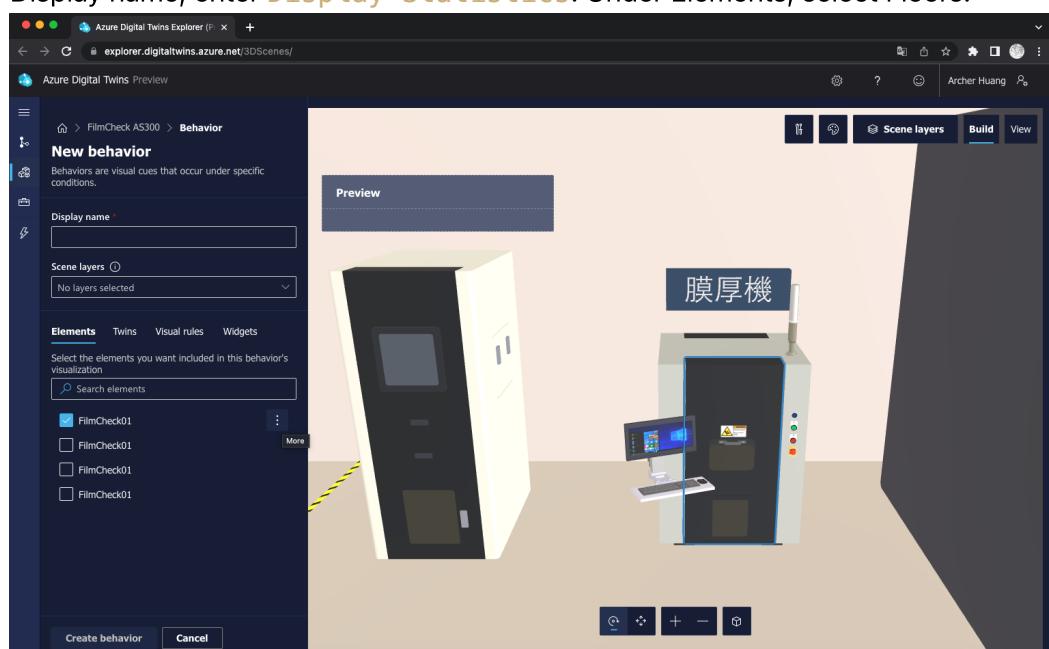
- Select the floor in the scene visualization. This will bring up the possible element actions. Select + Create new element

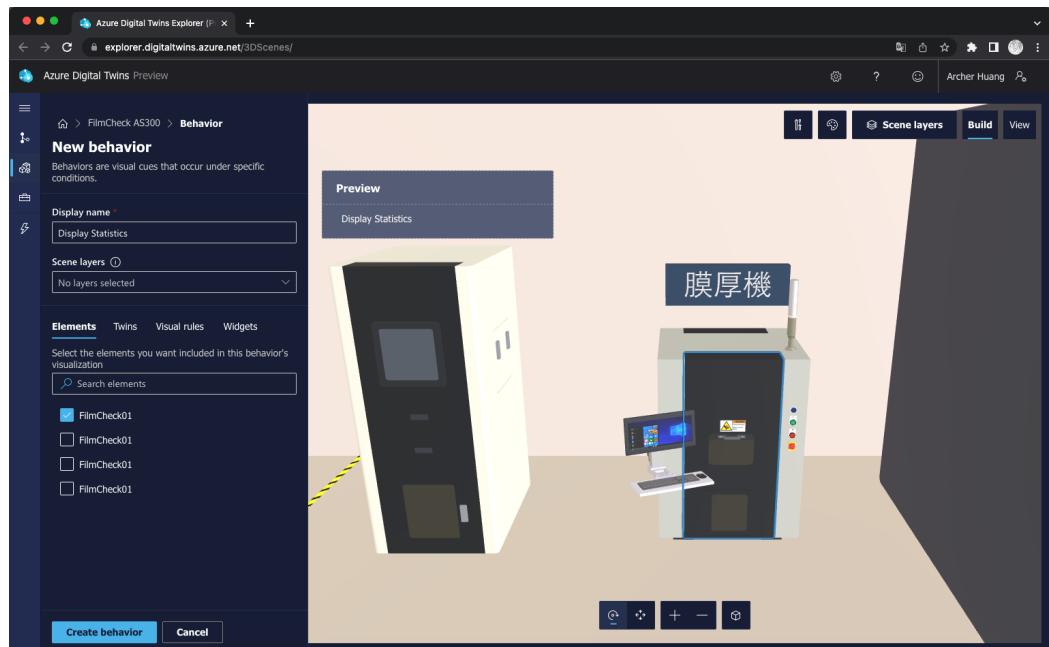






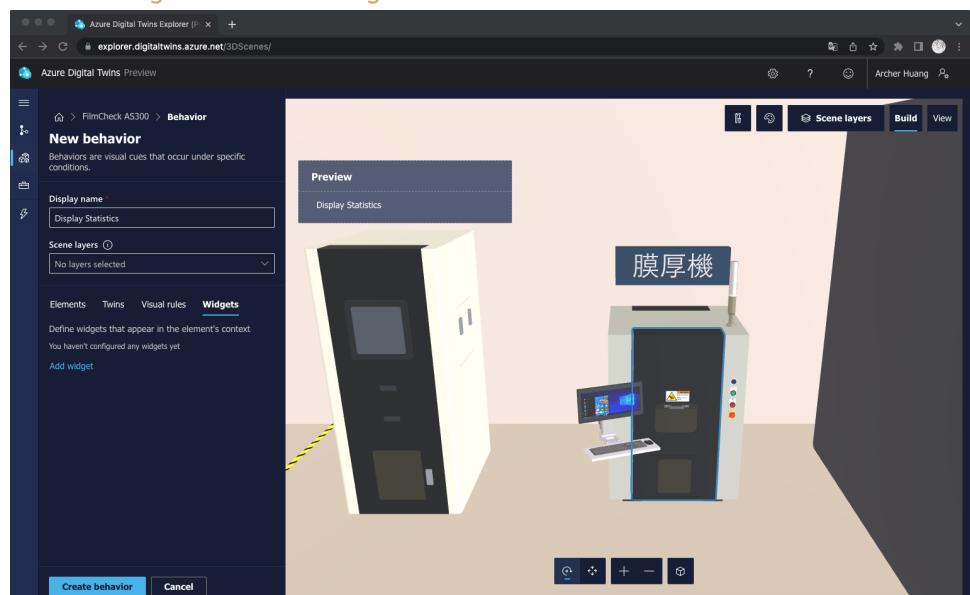
- Display name, enter **Display Statistics**. Under Elements, select Floors.



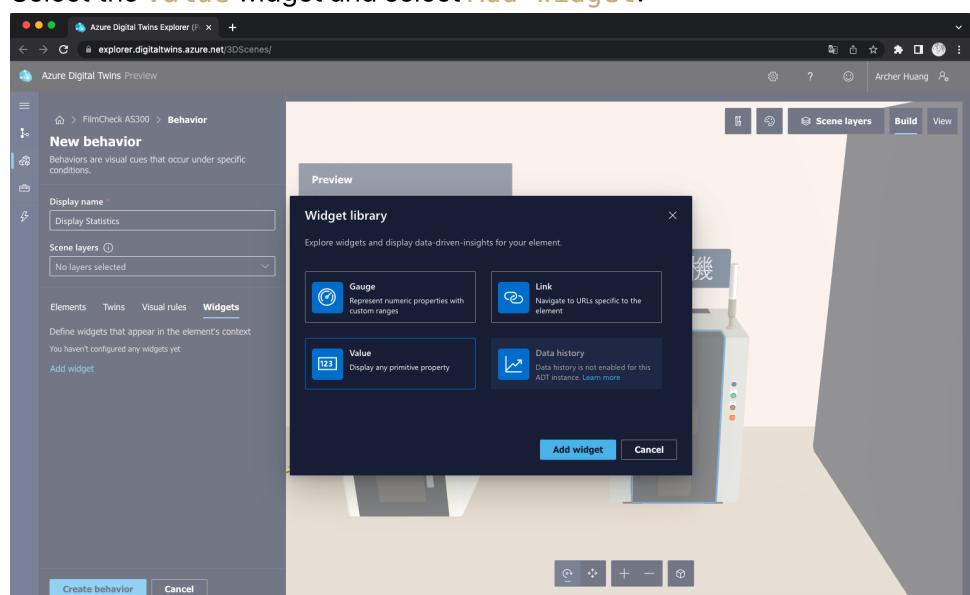


■ Add **Status** widget

■ Select **Widgets** > **Add widget**



■ Select the **Value** widget and select **Add widget**.

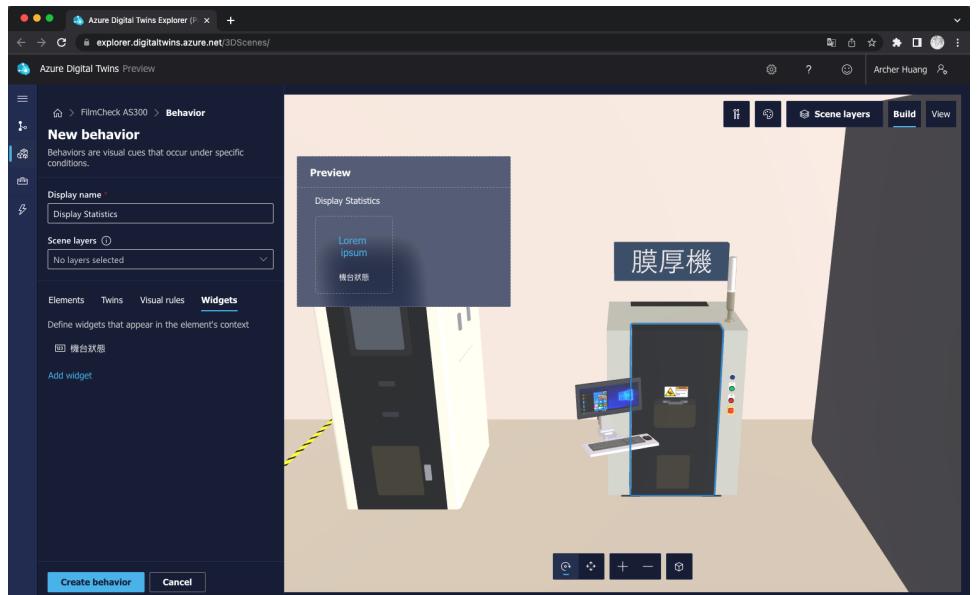


- In the New widget options, add a Display name of 機台狀態 and a Custom (advanced) Property expression of PrimaryTwin.typeError == 2 ? 目前機台發生錯誤, \${PrimaryTwin.statusMessage}: '目前機台正常運作', Type is string

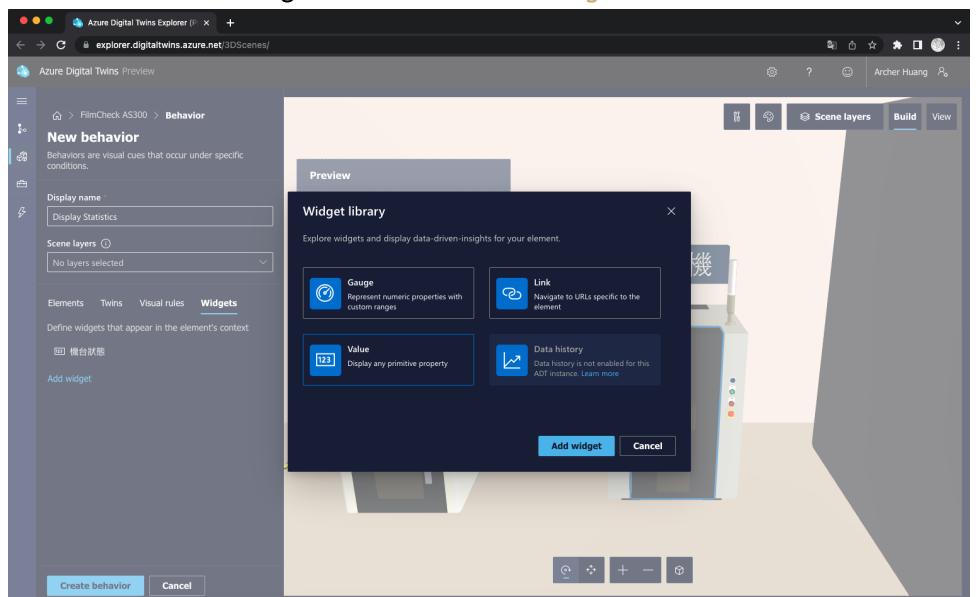


- Add Standard Deviation widget

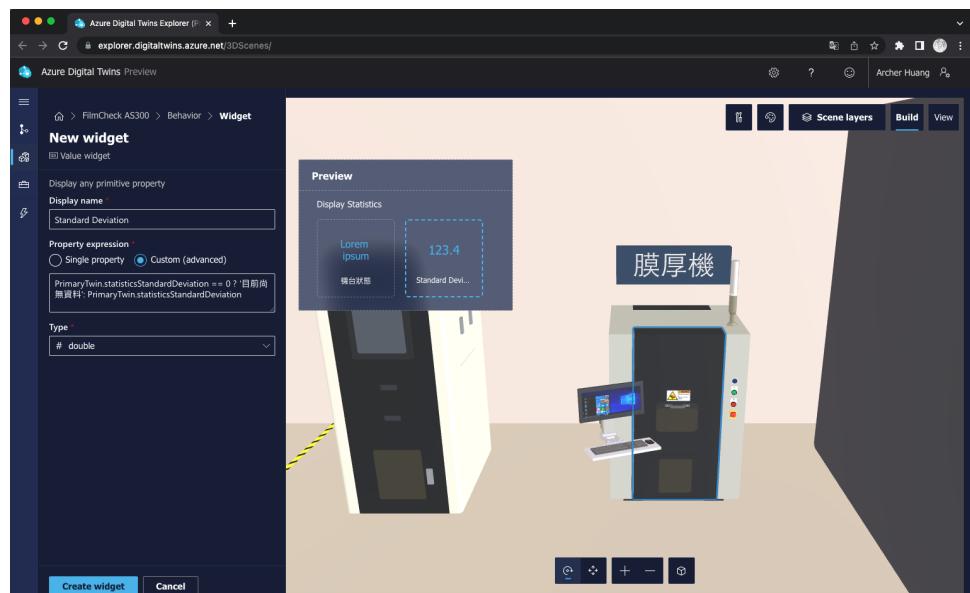
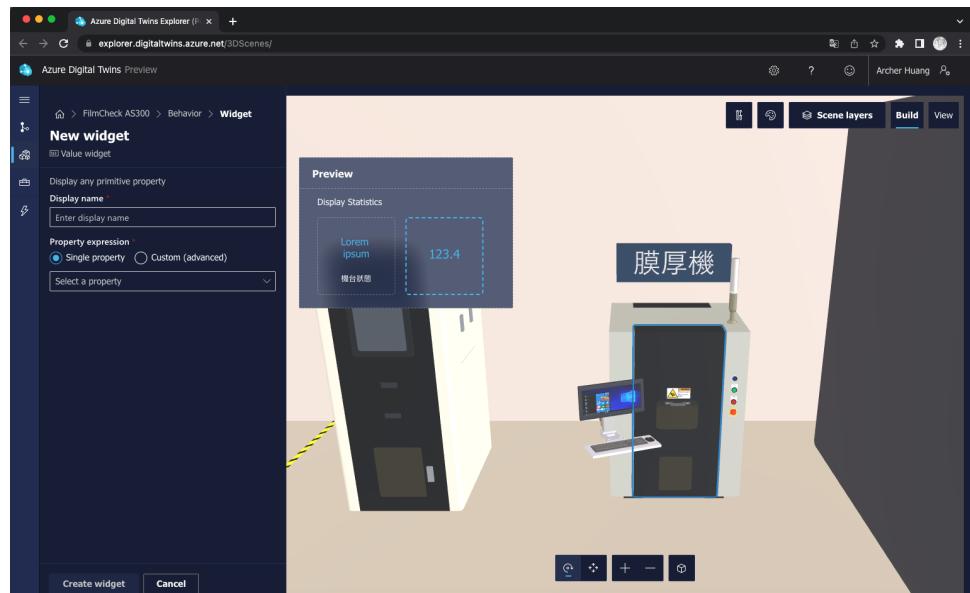
- select Add widget.



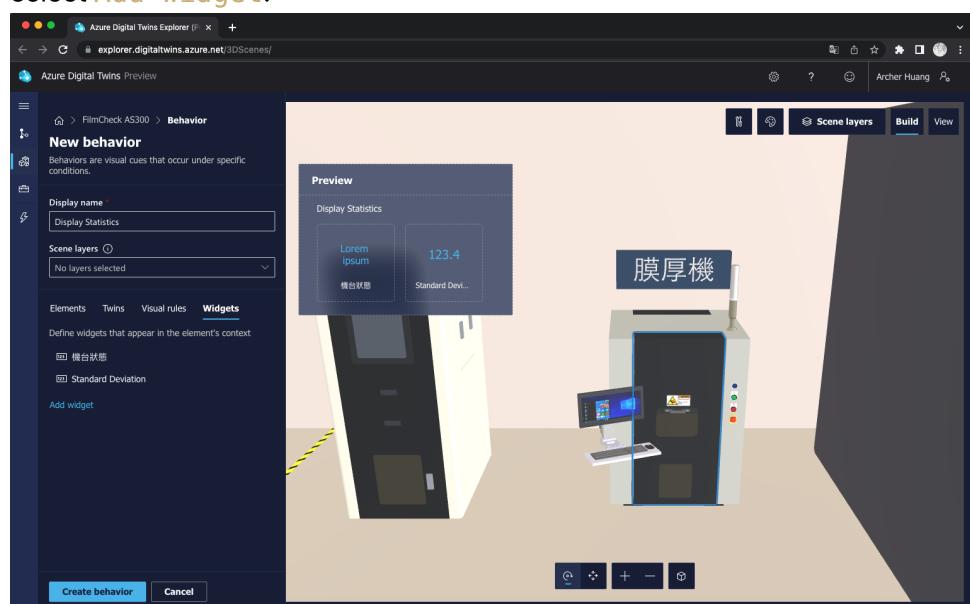
- Select the Value widget and select Add widget.



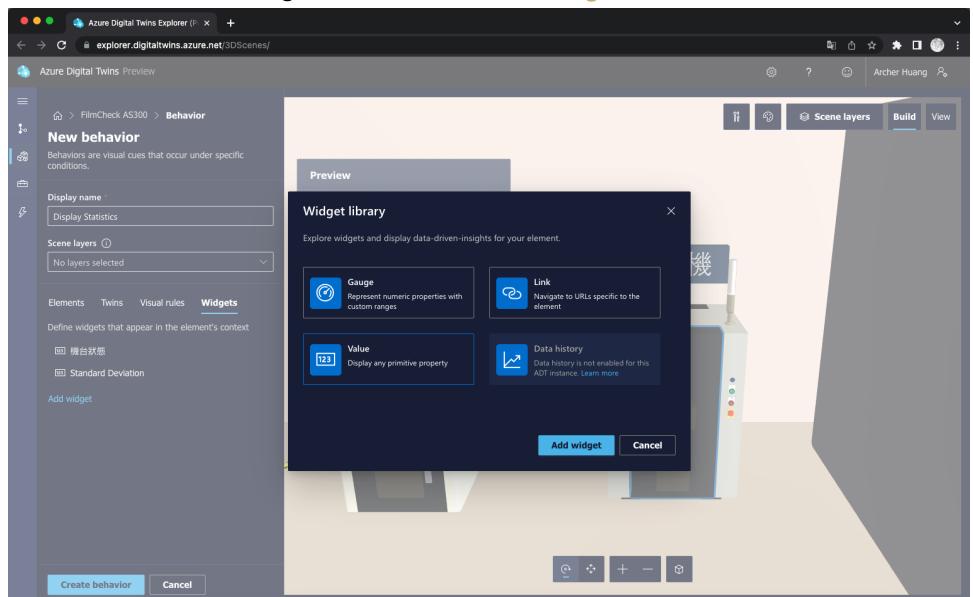
- In the New widget options, add a Display name of Standard Deviation and a Custom (advanced) Property expression of PrimaryTwin.statisticsStandardDeviation == 0 ? '目前尚無資料': PrimaryTwin.statisticsStandardDeviation, Type is double



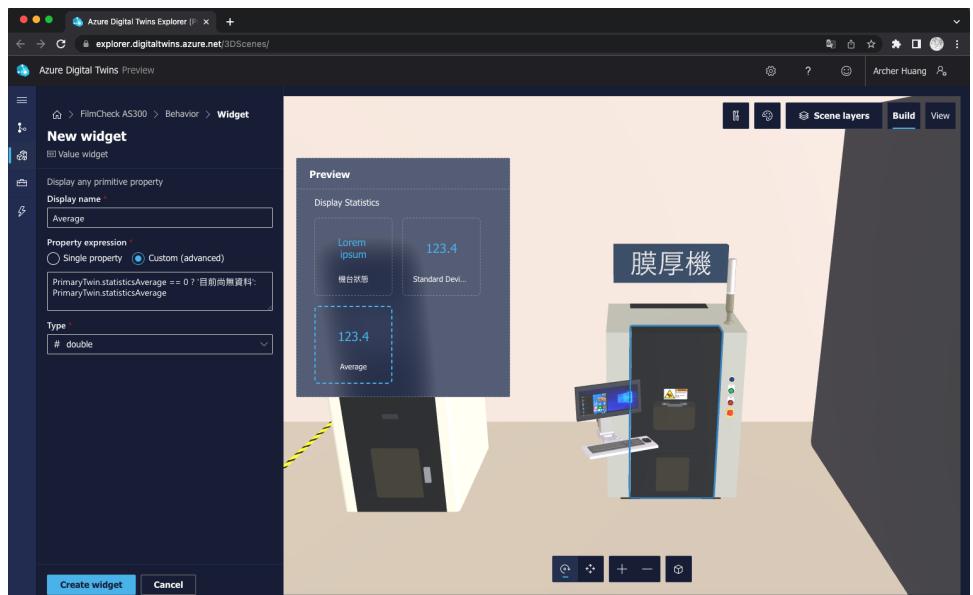
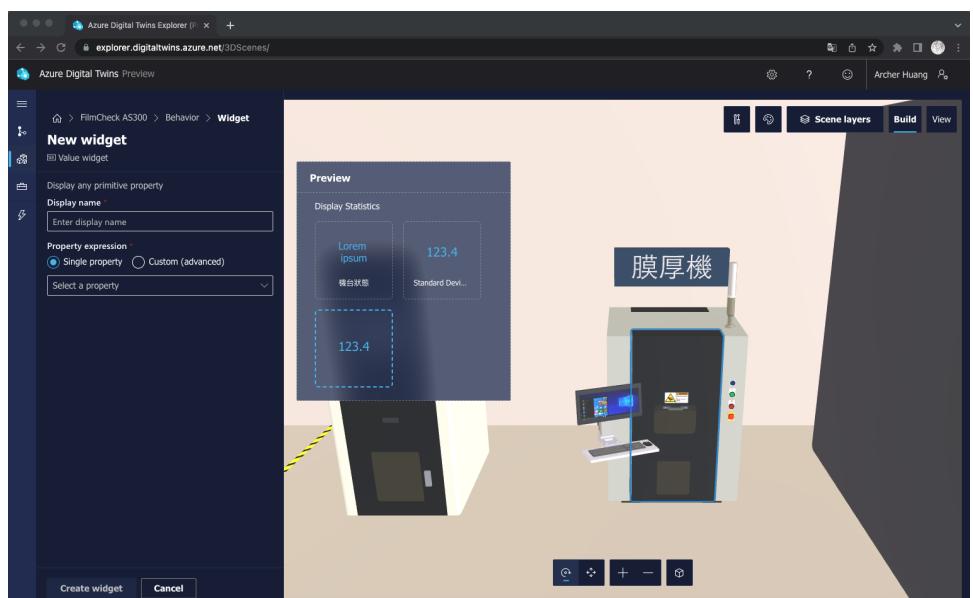
- Add **Average** widget
- select **Add widget.**



- Select the **Value** widget and select **Add widget**.

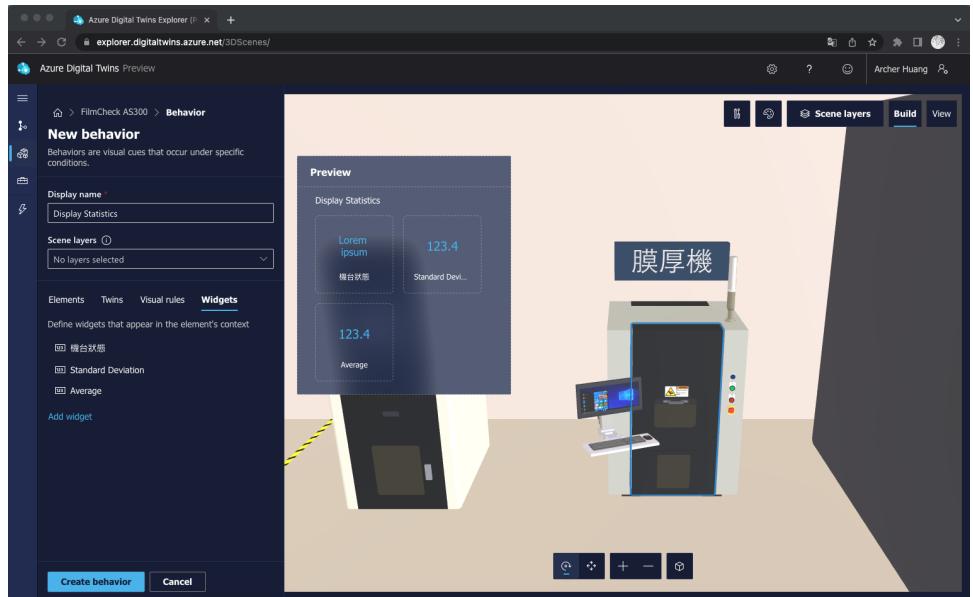


- In the New widget options, add a Display name of **Average** and a **Custom (advanced)** Property expression of **PrimaryTwin.statisticsAverage == 0 ? '目前尚無資料' : PrimaryTwin.statisticsAverage**, Type is **double**

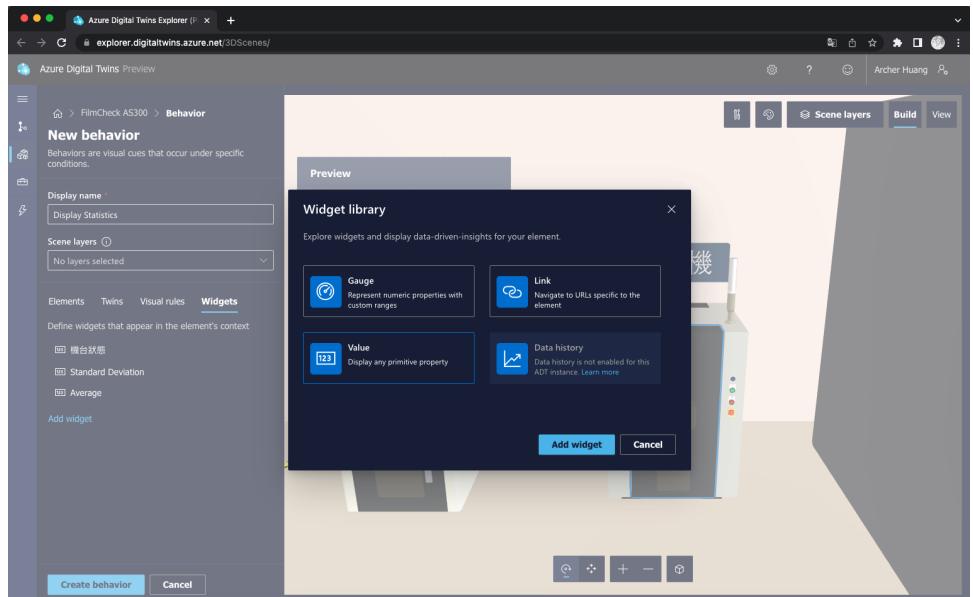


- Add **Uniformity** widget

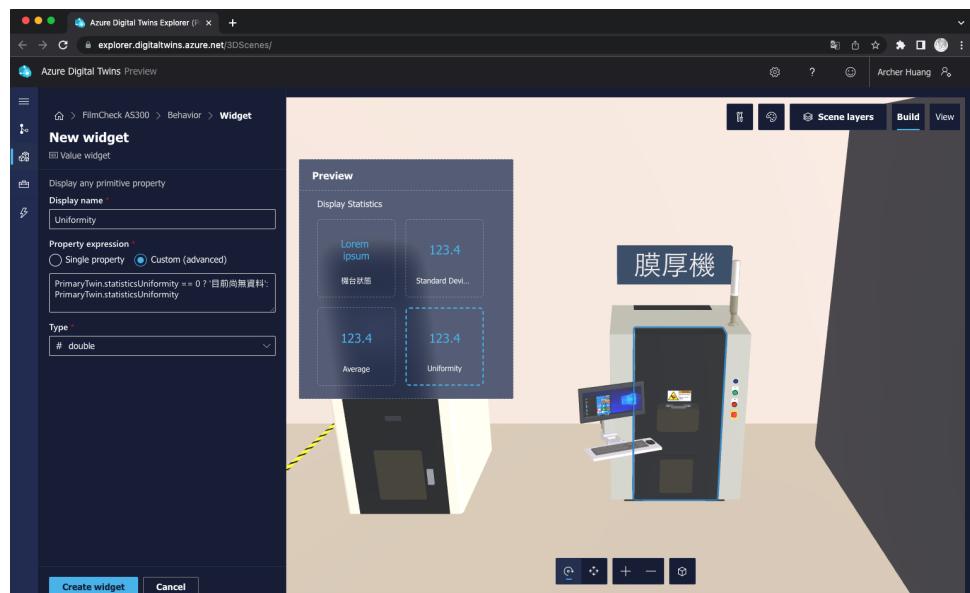
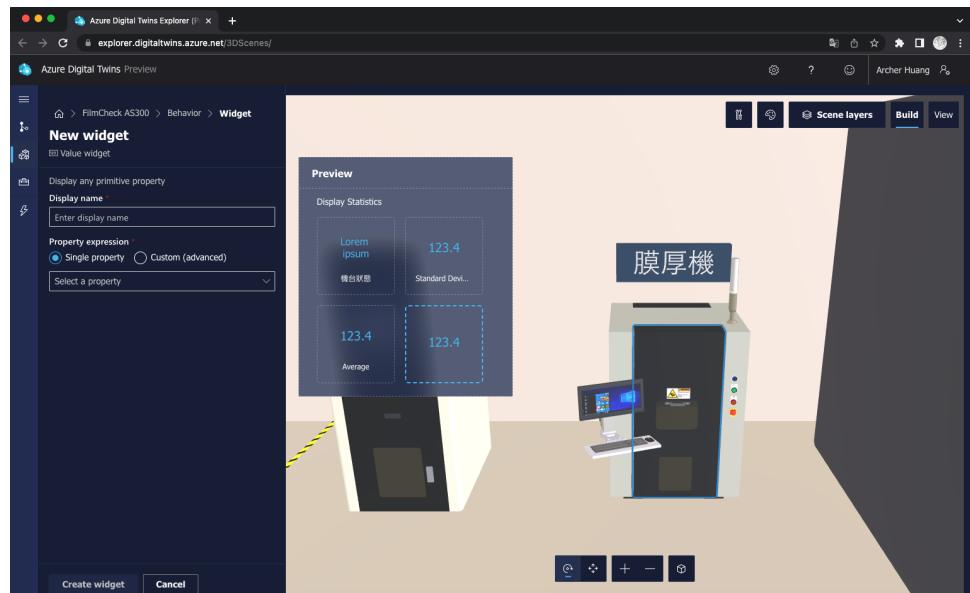
- select **Add widget**.



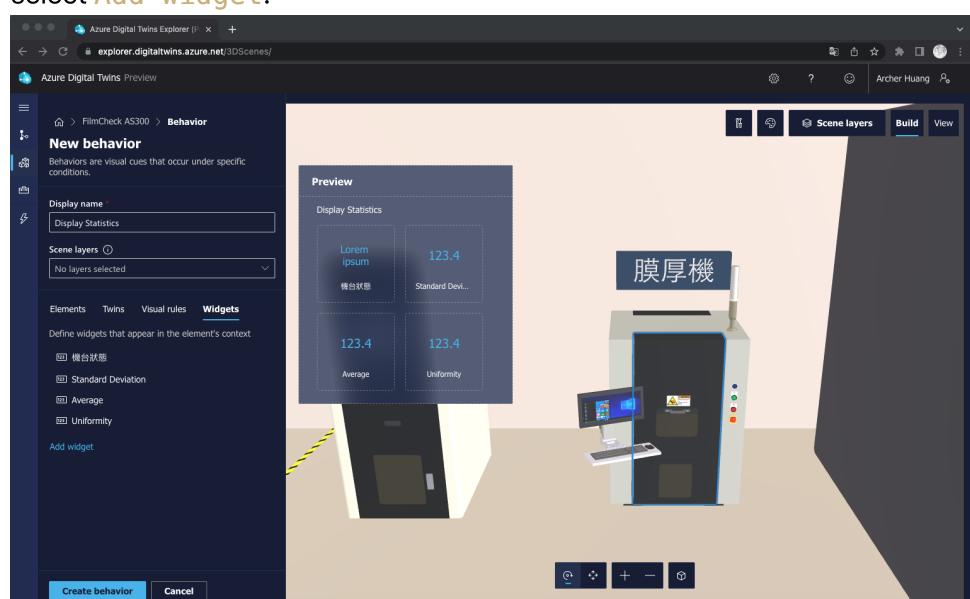
- Select the **Value** widget and select **Add widget**.



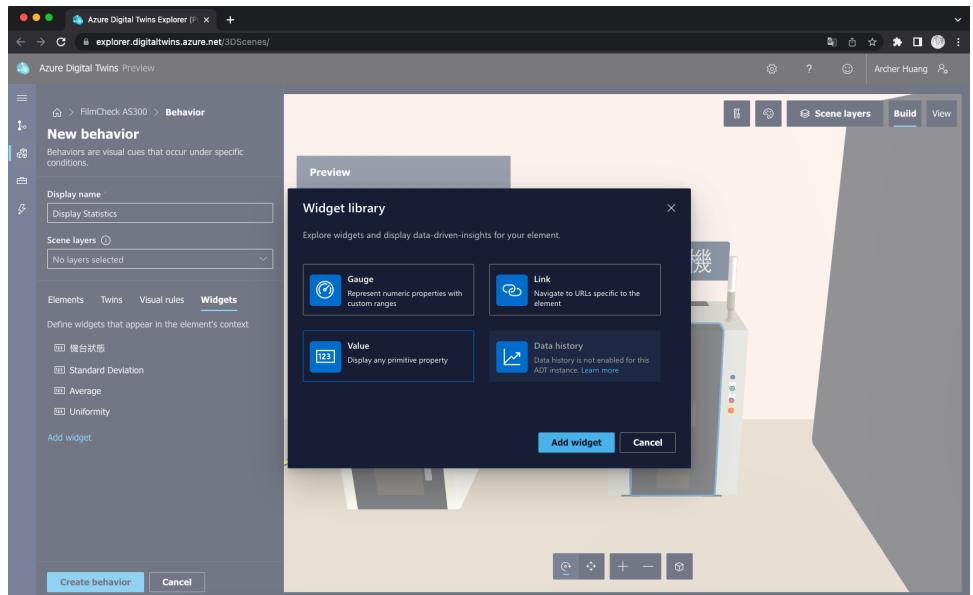
- In the New widget options, add a Display name of **Uniformity** and a **Custom (advanced)** Property expression of
`PrimaryTwin.statisticsUniformity == 0 ? '目前尚無資料' : PrimaryTwin.statisticsUniformity`, Type is **double**



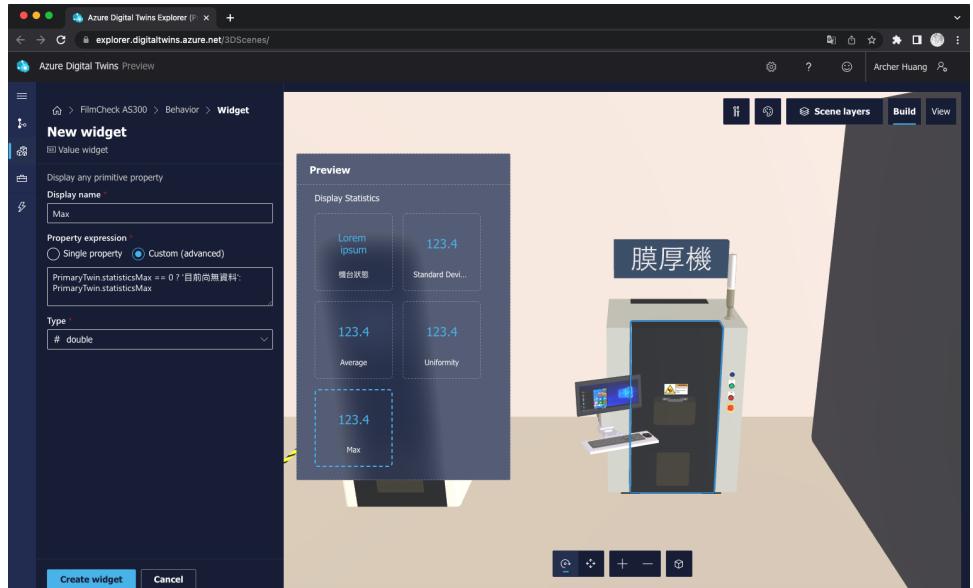
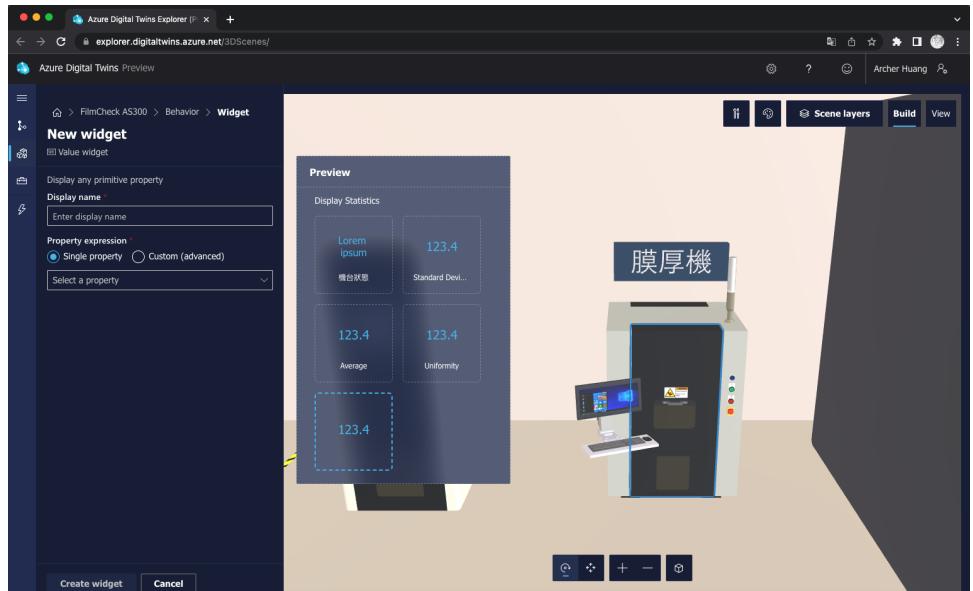
- Add Max widget
- select Add widget.



- Select the **Value** widget and select **Add widget**.

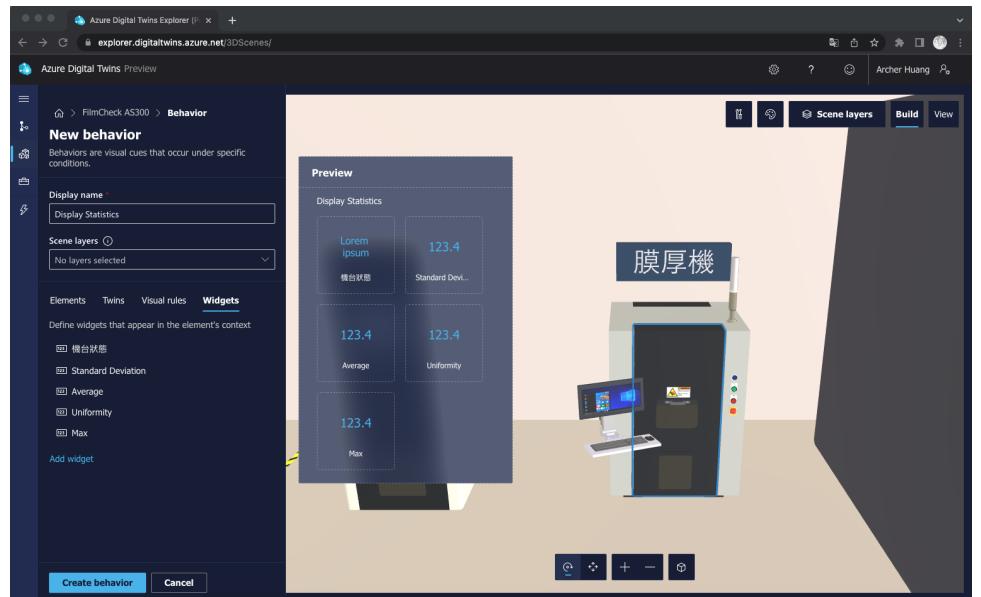


- In the New widget options, add a Display name of **Max** and a **Custom (advanced)** Property expression of **PrimaryTwin.statisticsMax == 0 ? '目前尚無資料' : PrimaryTwin.statisticsMax**, Type is **double**

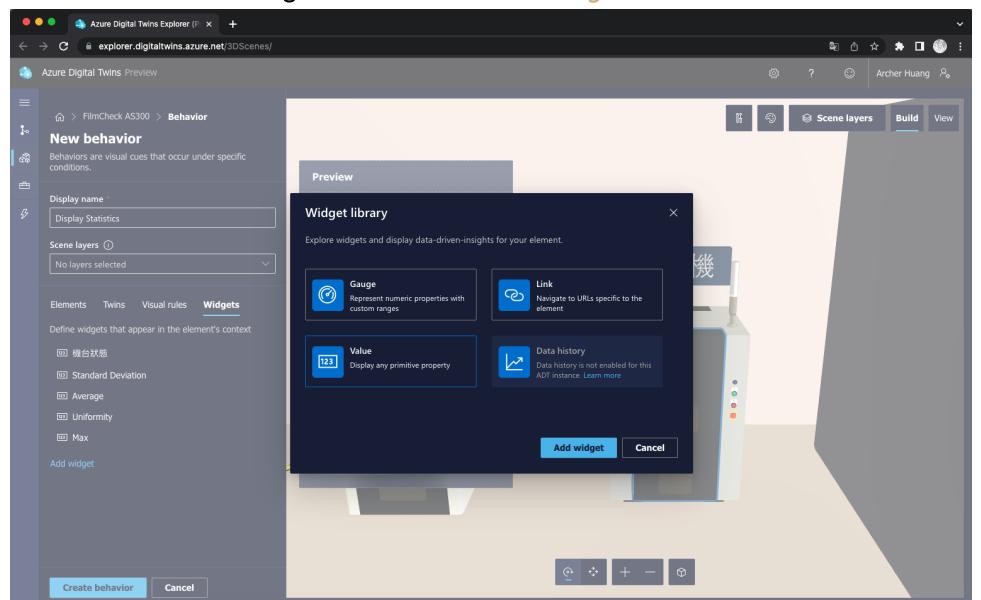


- Add **Min** widget

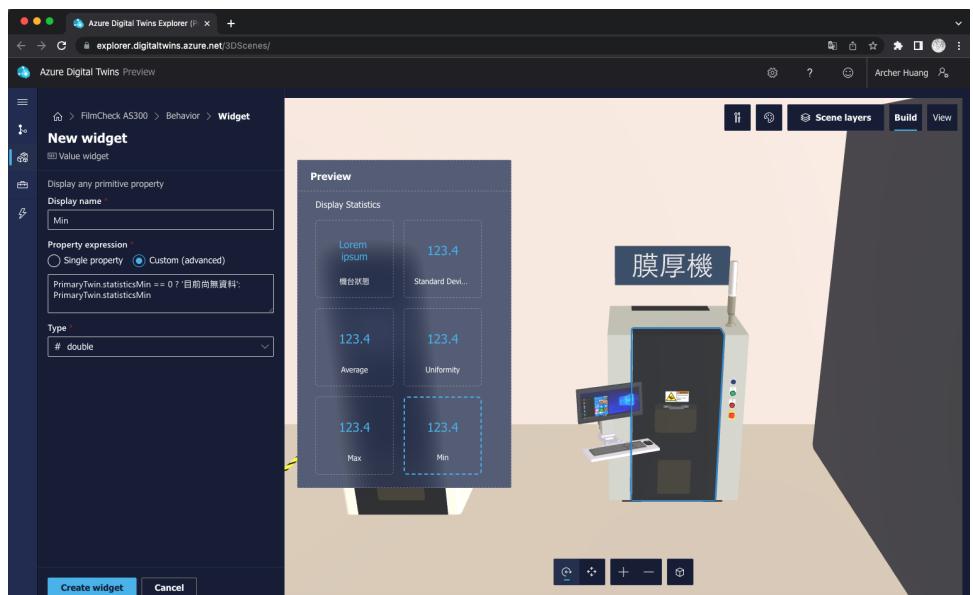
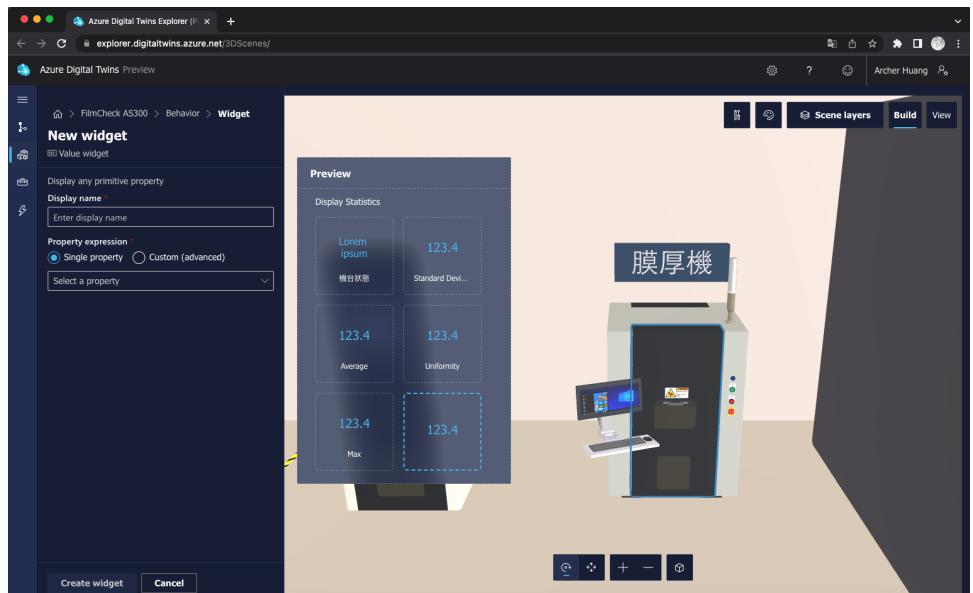
- select Add widget.



- Select the Value widget and select Add widget.

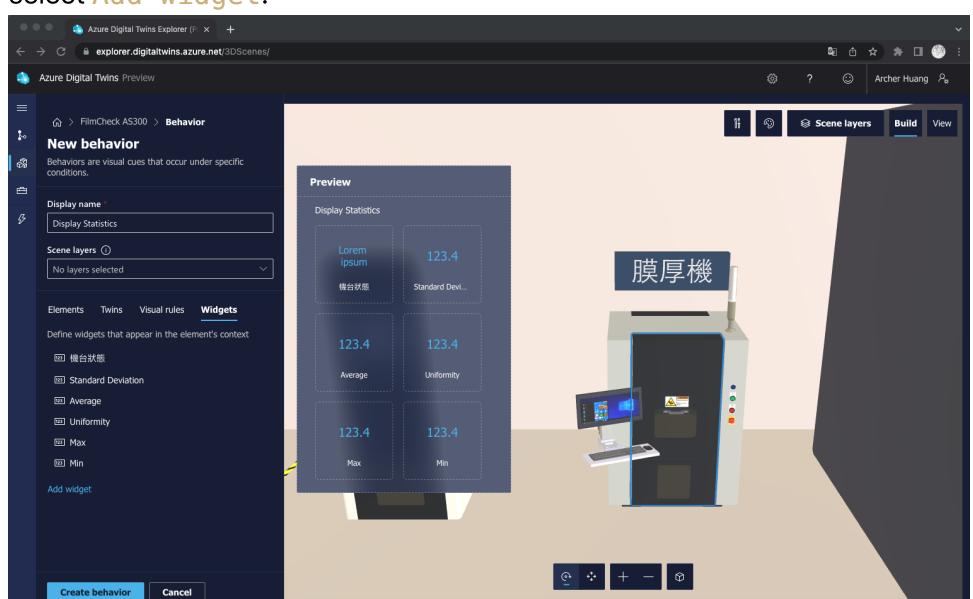


- In the New widget options, add a Display name of Min and a Custom (advanced) Property expression of PrimaryTwin.statisticsMin == 0 ? '目前尚無資料': PrimaryTwin.statisticsMin, Type is double

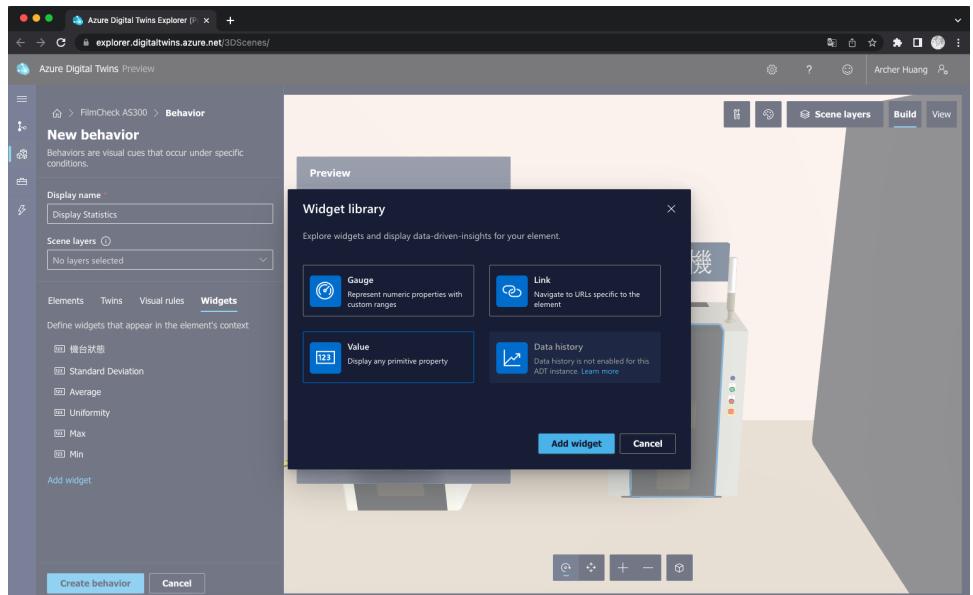


■ Add Max Min widget

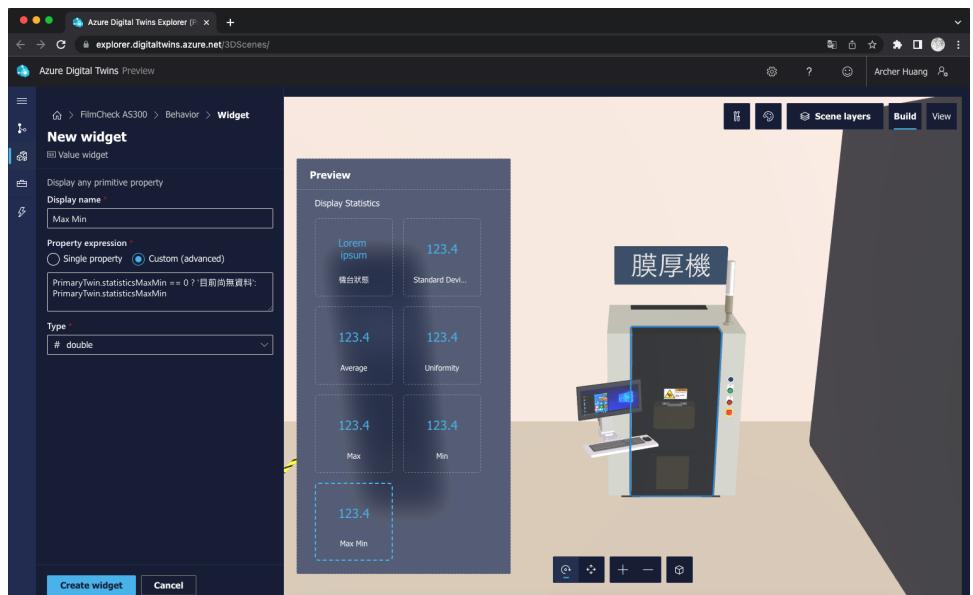
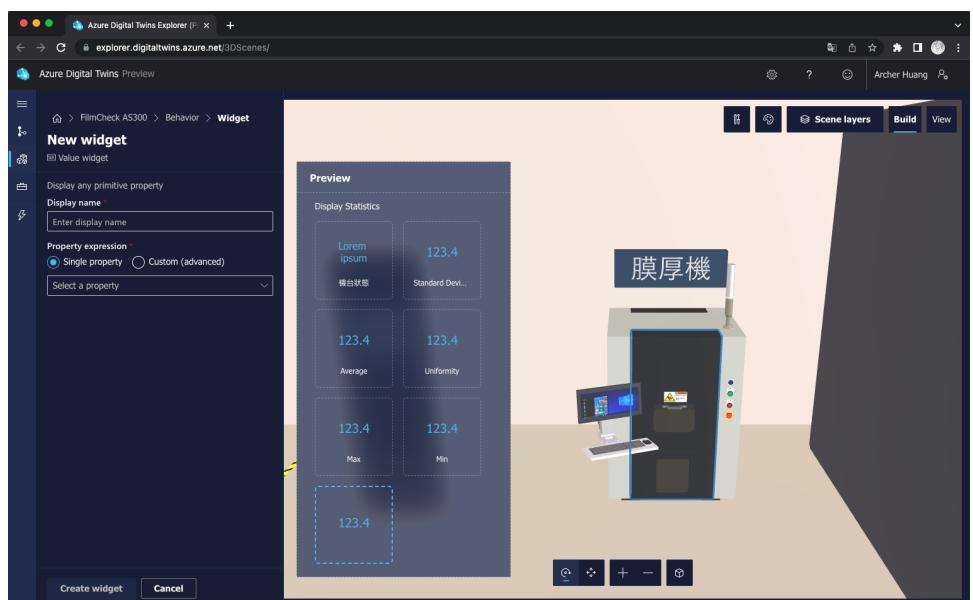
■ select Add widget.



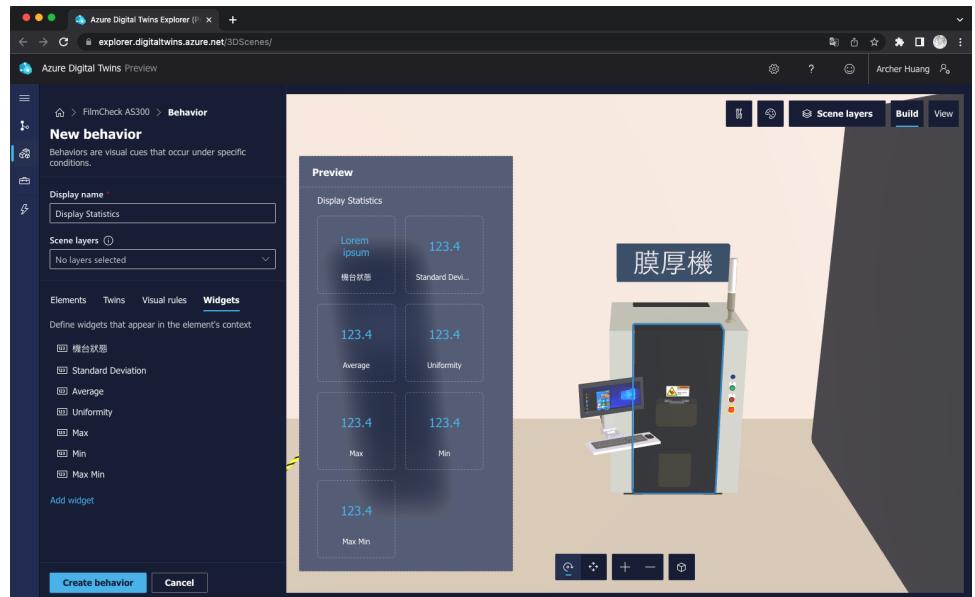
- Select the **Value** widget and select **Add widget**.



- In the New widget options, add a Display name of **Max Min** and a **Custom (advanced)** Property expression of **PrimaryTwin.statisticsMaxMin == 0 ? '目前尚無資料' : PrimaryTwin.statisticsMaxMin**, Type is **double**

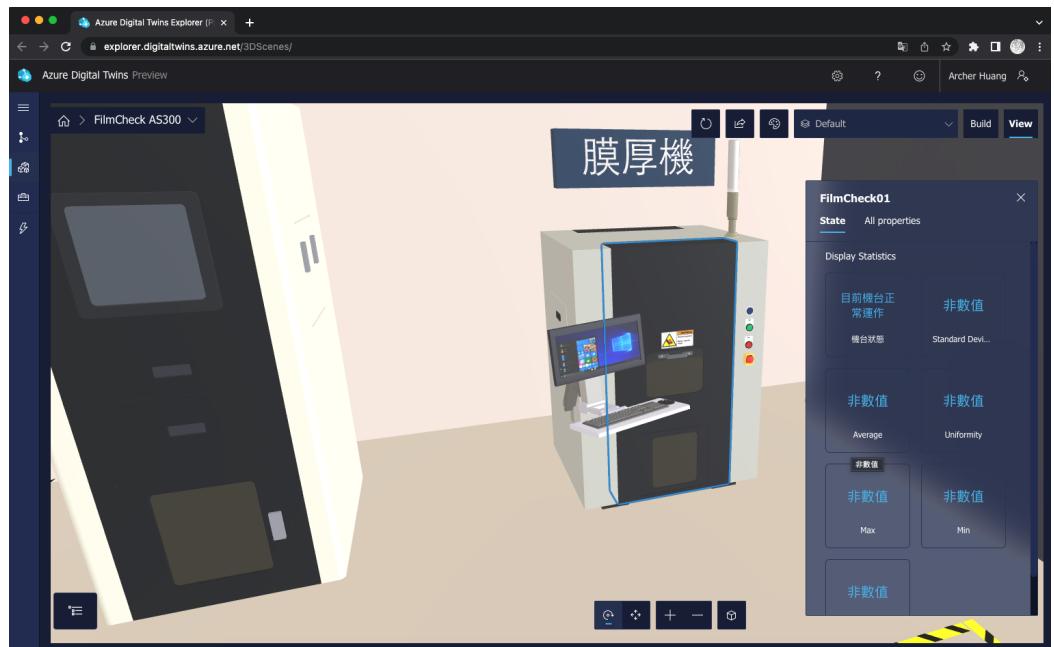


■ click Create behavior



■ View scene

- So far, you've been working with 3D Scenes Studio in Build mode. Now, switch the mode to View.



7. Setting up notifications to be sent through Microsoft Teams

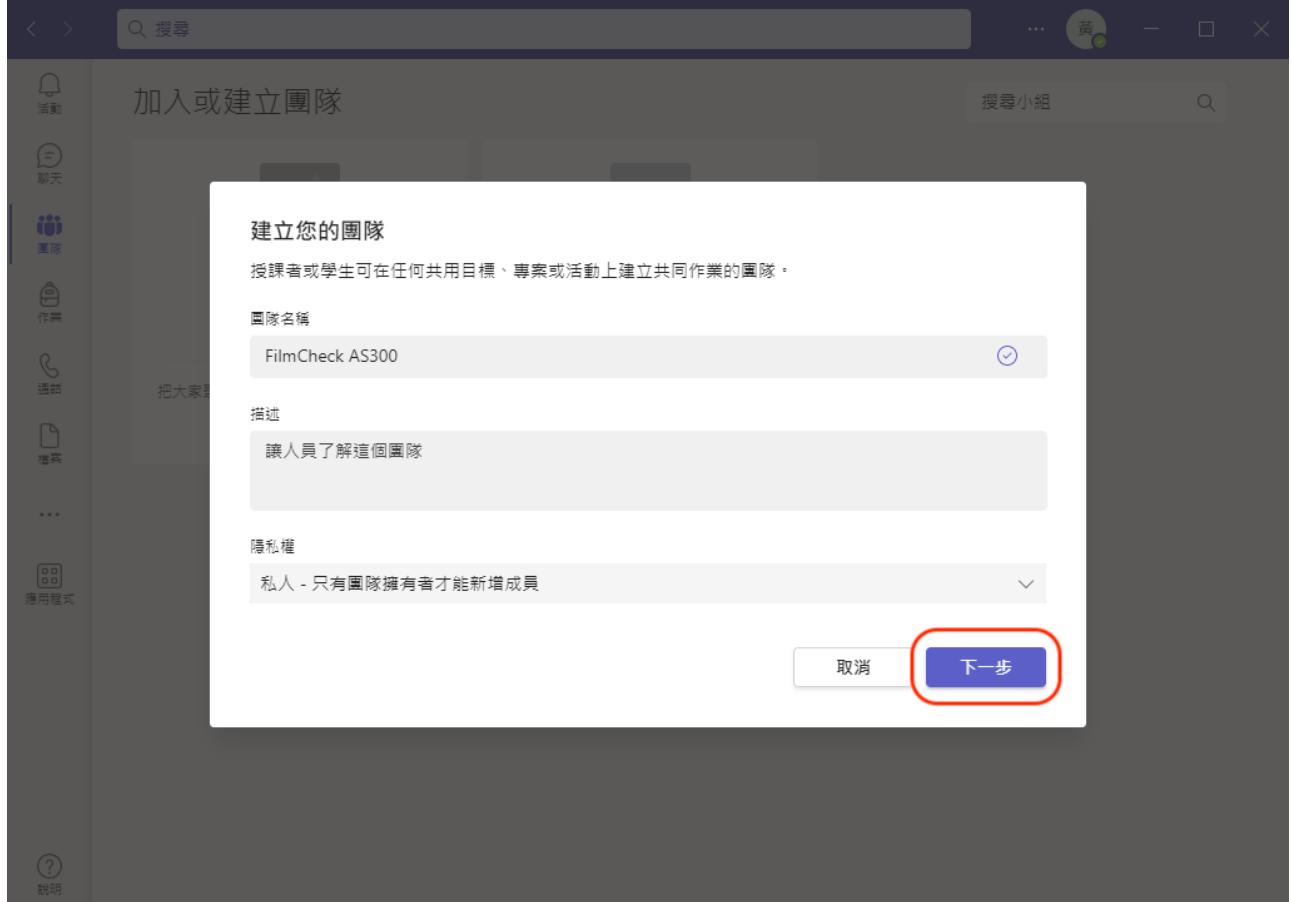
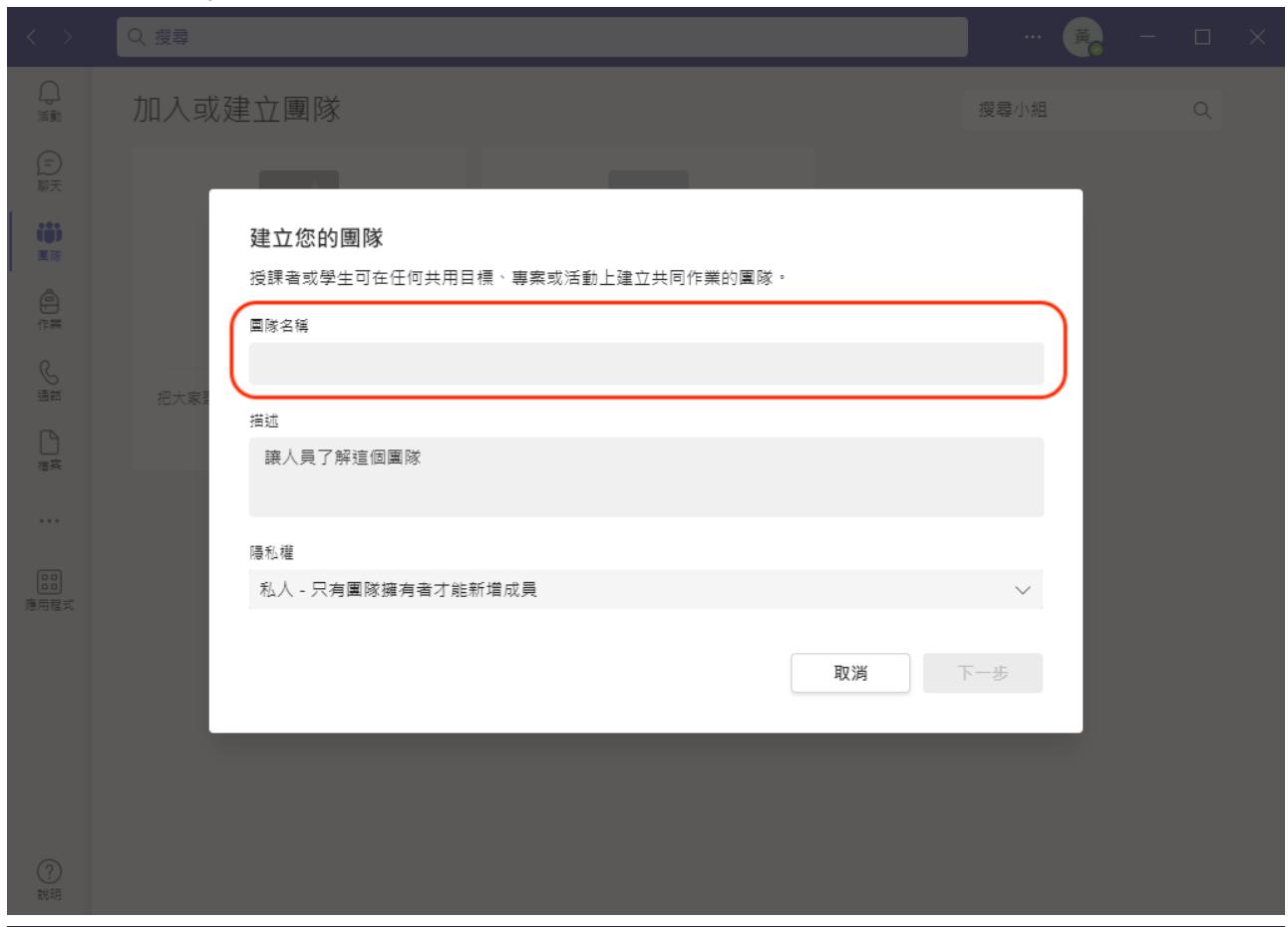
- Click the 建立團隊 button



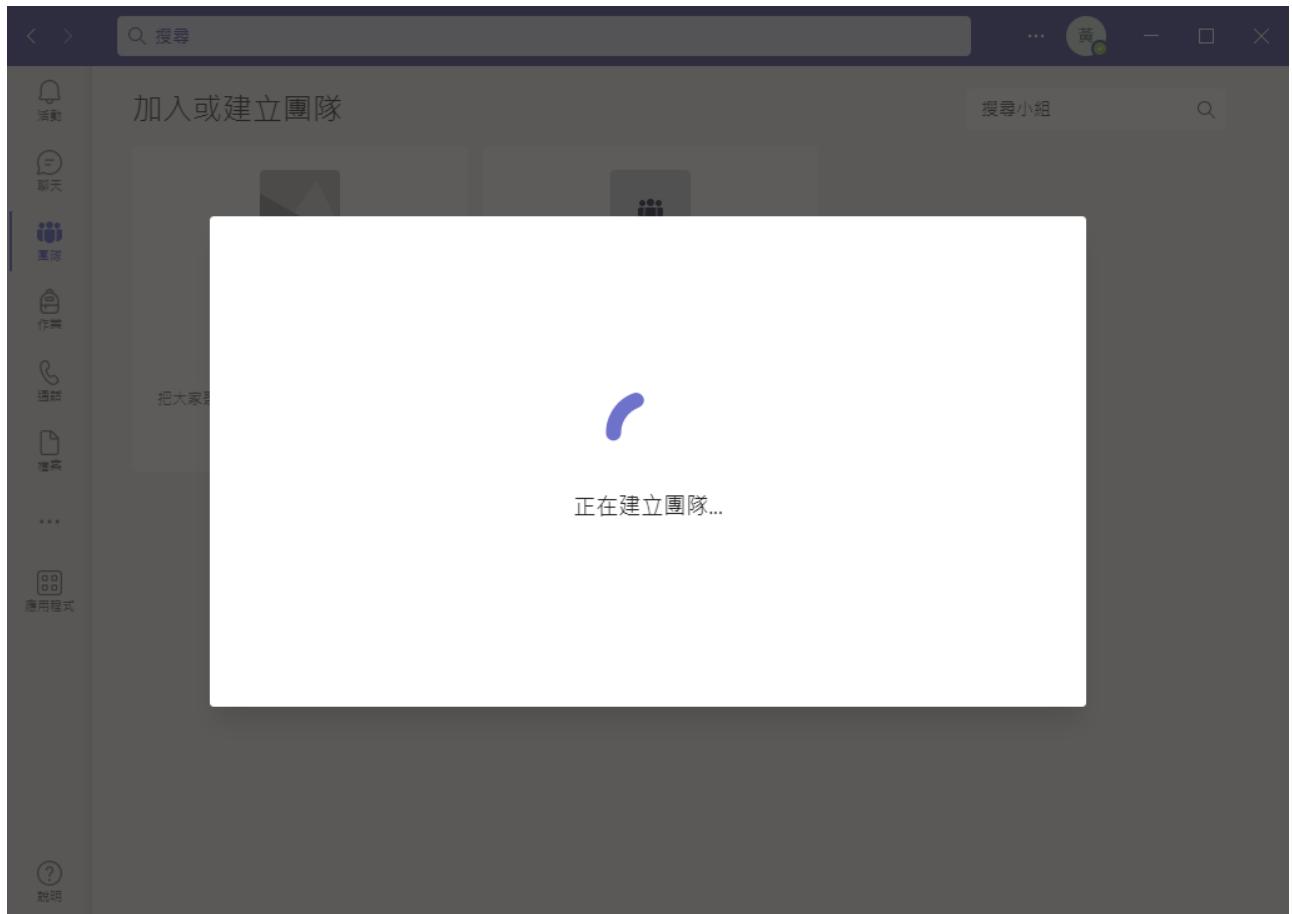
- Click the 其他 button



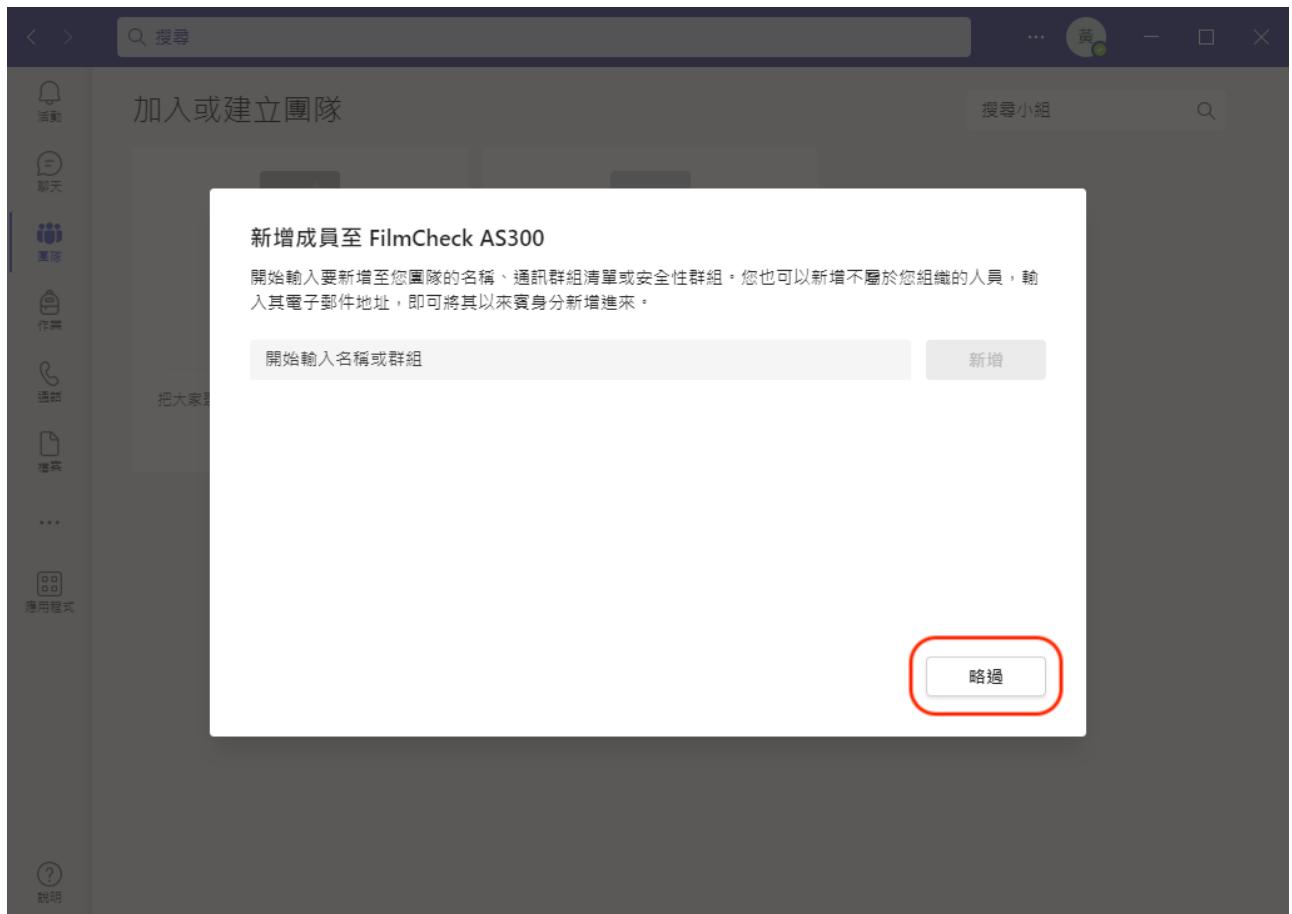
- Please enter a unique and identifiable name in the **團隊名稱** field, and click **下一步** after you have finished entering it.



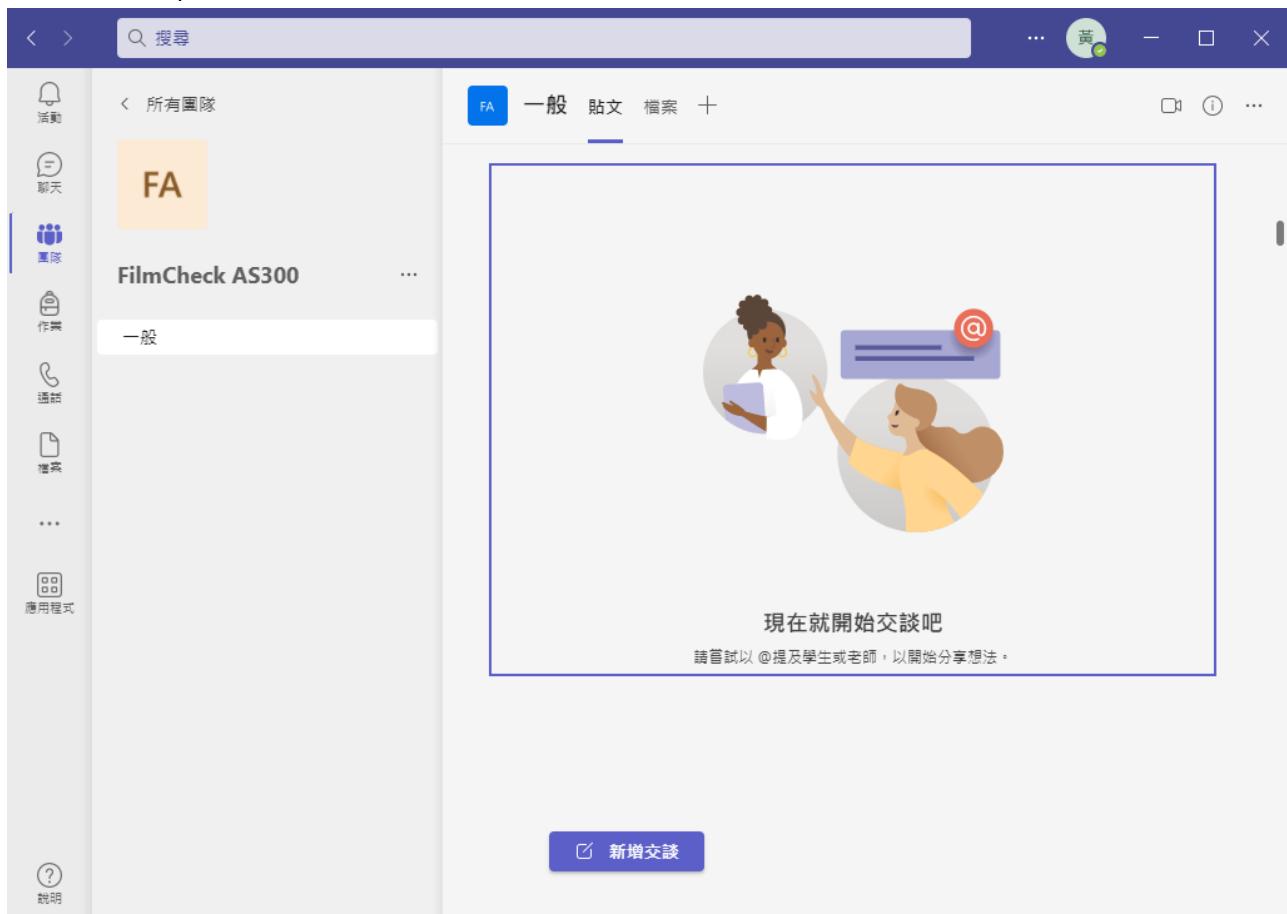
- During the team creation process



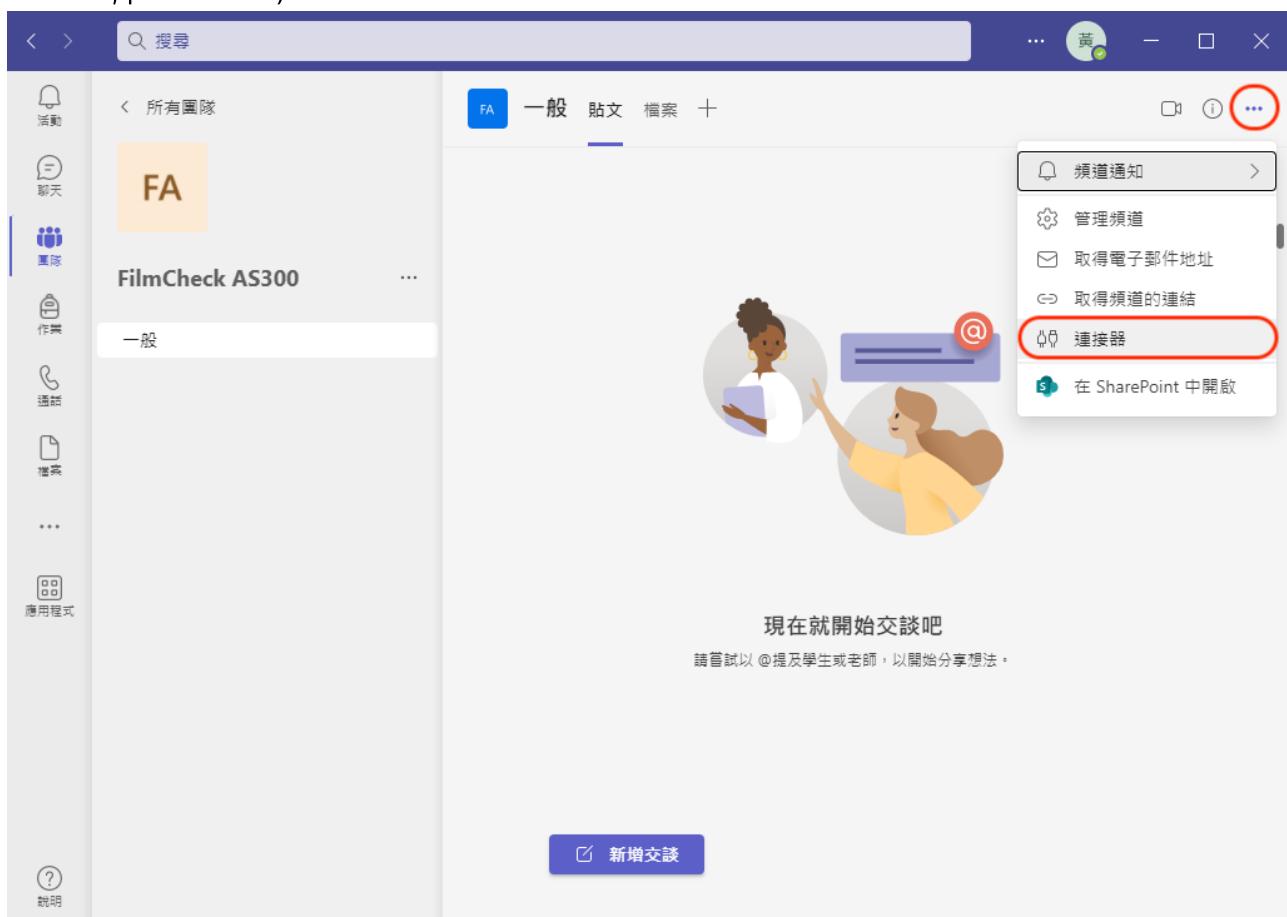
- Click the 略過 button



- Creation completed



- Click the **連接器** button in the **...** menu at the top right corner. (The **連接器** option will appear in a moment, please wait.)



- Click the 新增 button on the right side of 傳入 Webhook

「FilmCheck AS300」團隊中「一般」頻道的連接器

下列群組的 Connectors: 'Fil...'

讓您的群組與來自其他服務的內容及更新保持同步。

搜尋 全部 排序方式: 人氣指數

管理

已設定 我的帳戶

類別

全部 分析 CRM 客戶支援 開發人員工具 HR 行銷 新聞與社交 專案管理 其他

適用於貴小組的連接器

Forms 輕鬆建立問卷、測驗與投票。 設定

Azure DevOps 於線上共同作業及管理軟體專案。 新增

RSS 取得您群組的 RSS 摘要。 新增

傳入 Webhook 即時從服務傳送資料至您的 Office 365 群組。 新增

JIRA Cloud 收集、組織並指派在您軟體中偵測到的問題。 新增

Yammer 已更新 新增

- Click the 新增 button

Incoming Webhook
Microsoft Corporation

新增

概觀 功能 權限 探索更多應用程式

Send data from a service to your Office 365 group in real time.

The Incoming Webhook connector enables external services to notify you about activities that you want to track.

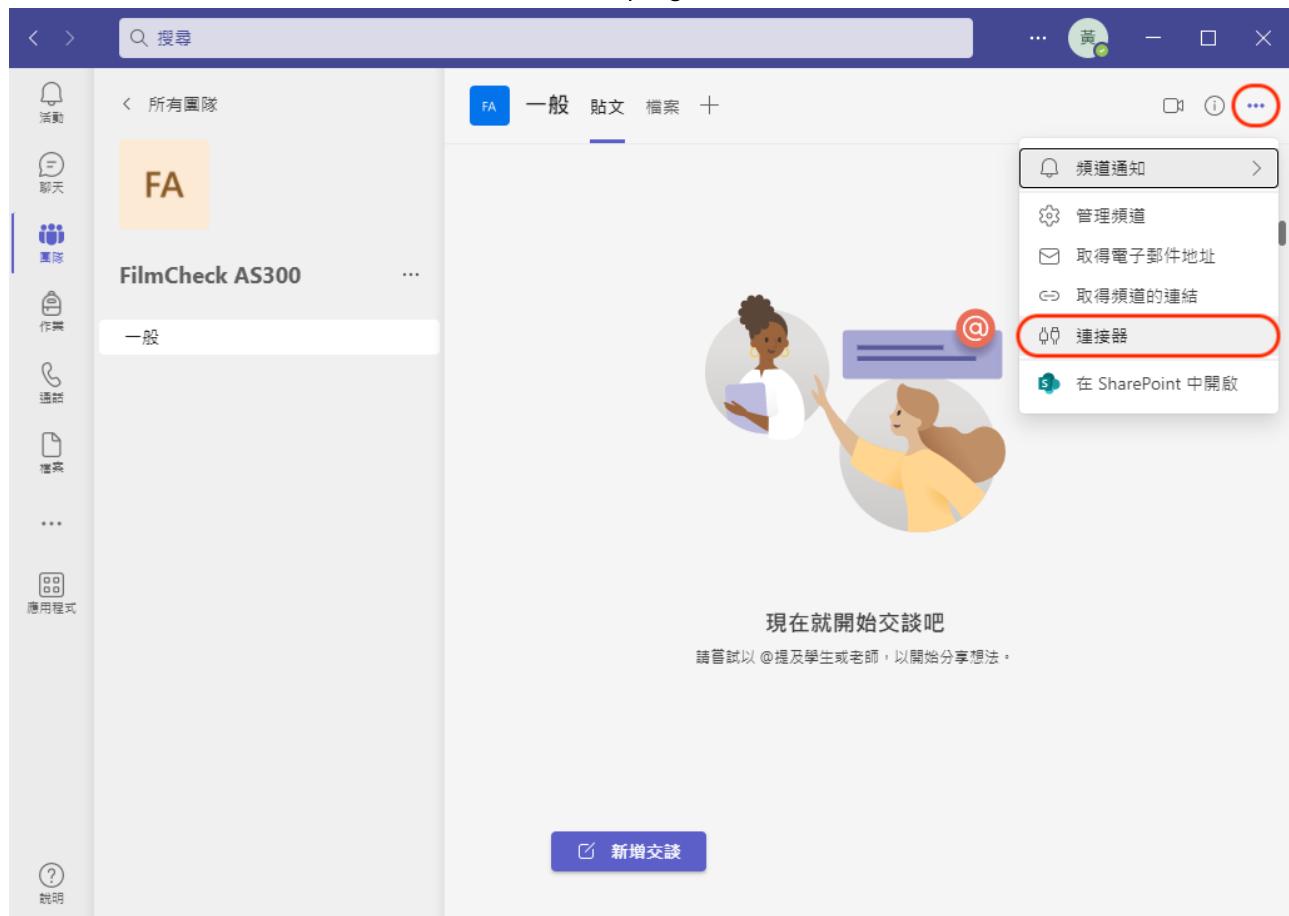
建立者: Microsoft Corporation
版本 1.0

功能

使用連接器在頻道中取得更新

< 返回 | 一旦使用 Incoming Webhook，即代表您同意 [隱私權原則](#)、[使用條款](#) 與 [權限](#)。

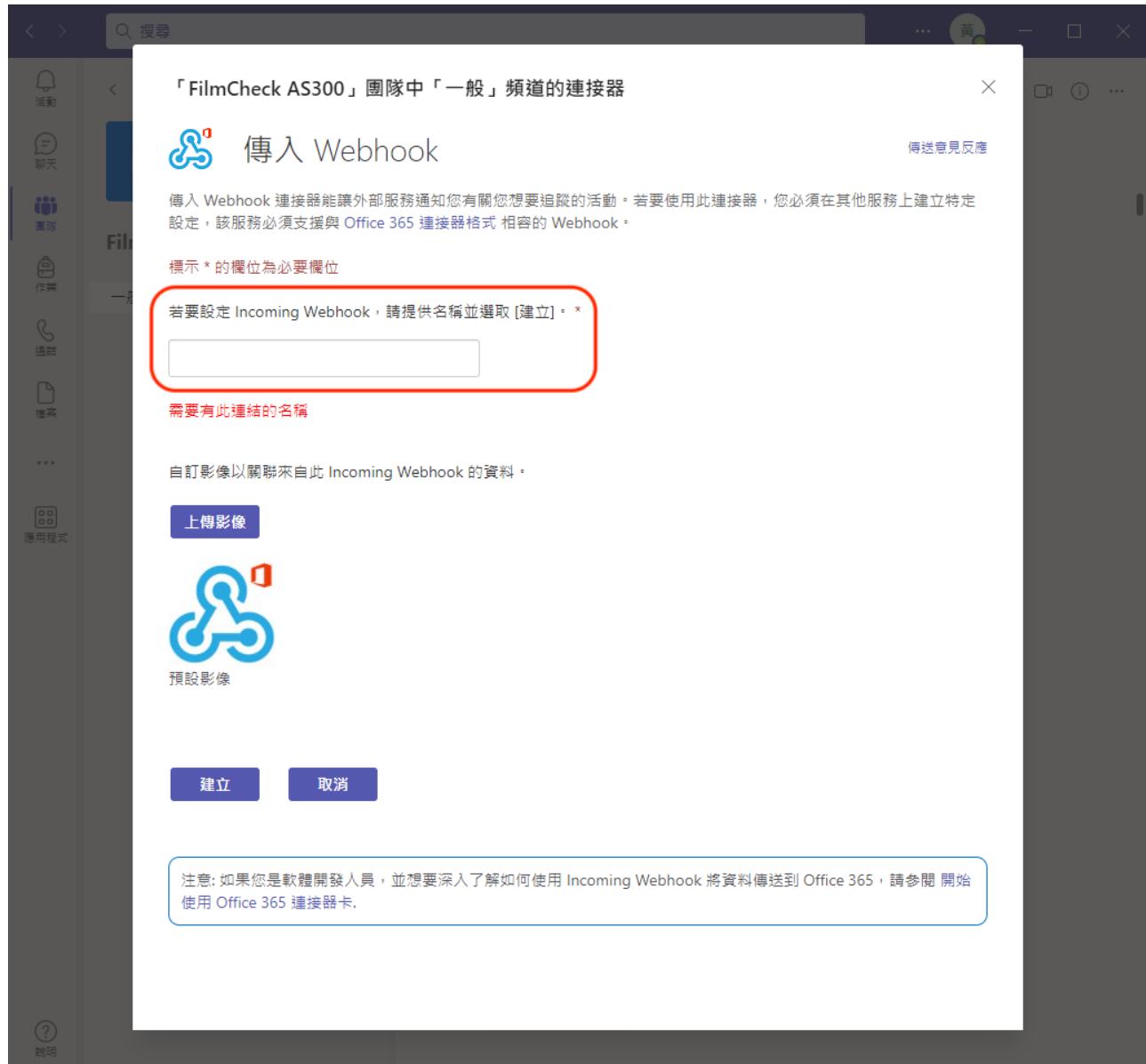
- Click the **連接器** button in the **...** menu at the top right corner



- Click the **設定** button on the right side of **傳入 Webhook**



- Please enter a unique and identifiable name in the **Incoming Webhook** field, and click **建立** after you have finished entering it.





- After creation is completed, please copy the URL and then click the 完成 button



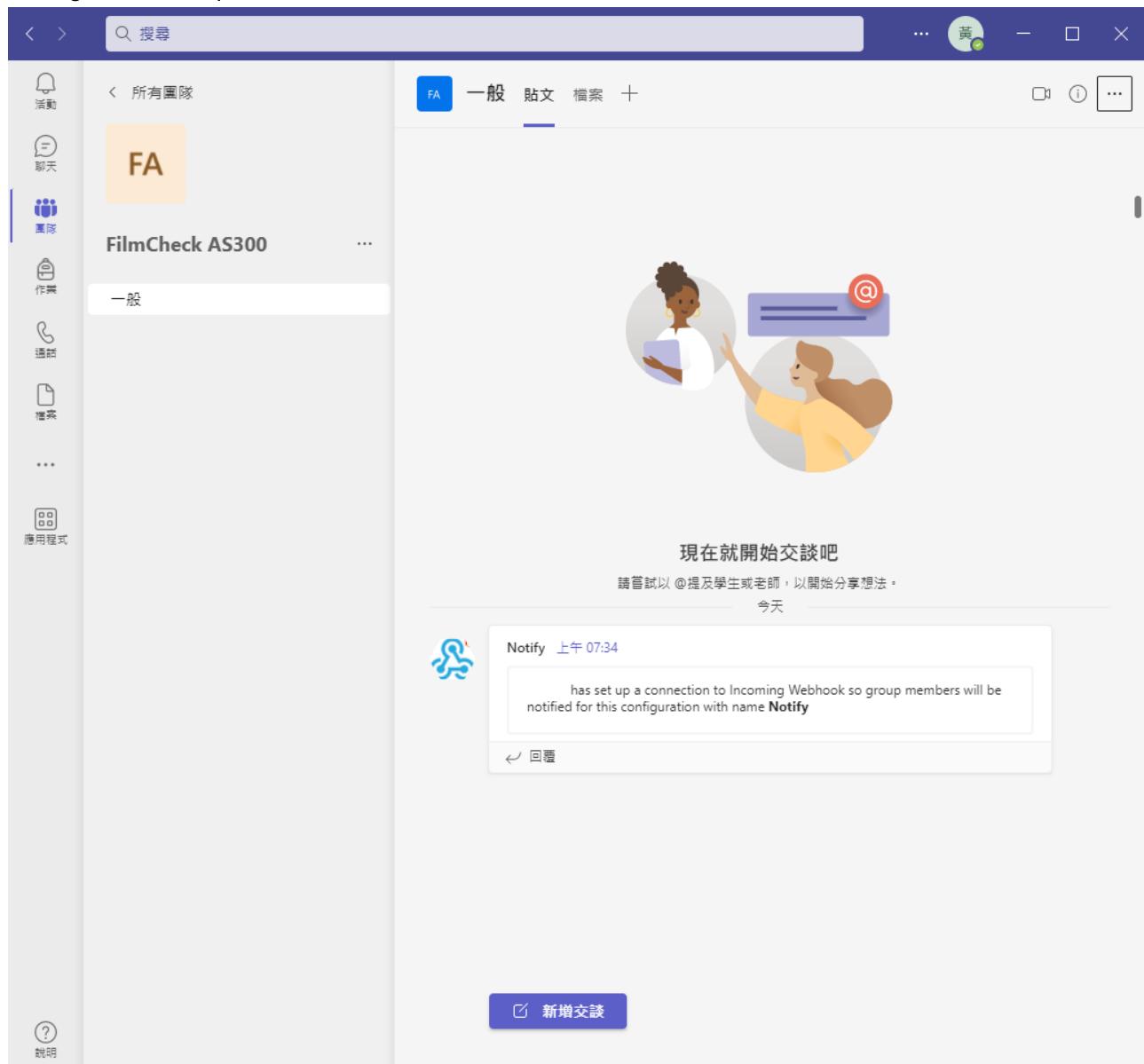
- Commands for macOS and Ubuntu environment

```
export WEBHOOURL='Paste the copied URL'

echo $WEBHOOURL
```

```
archer@archer-MacBook-Pro:~ Azure-Digital-Twins-End-to-End-Sample % export WEBHOOURL='https://itrihq.webhook.office.com/webhookb2/2820f94d-8dd8-428c-a297-7c44b749d557f73ffef322-3a8c-4d1c-93ed-6d567af559aa/IncomingWebhook/85d03e9debf4382a3969e0f93271f45/7c77c344-6f5f-4209-9ba4-e0b1acd32ab'
archer@archer-MacBook-Pro:~ Azure-Digital-Twins-End-to-End-Sample % echo $WEBHOOURL
https://itrihq.webhook.office.com/webhookb2/2820f94d-8dd8-428c-a297-7c44b749d557f73ffef322-3a8c-4d1c-93ed-6d567af559aa/IncomingWebhook/85d03e9debf4382a3969e0f93271f45/7c77c344-6f5f-4209-9ba4-e0b1acd32abd
archer@archer-MacBook-Pro:~ Azure-Digital-Twins-End-to-End-Sample %
```

- Configuration completed



8. Database environment setup and configuration

- Create a server
 - Commands for macOS and Ubuntu environment

```
az postgres server create --name $DB_PG_NAME --resource-group
$RESOURCE_GROUP --location $REGION --admin-user $DB_USER_NAME --
admin-password $DB_USER_PASSWORD --sku-name $DB_SKU --version 11
--ssl-enforcement Enabled
```

```

archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az postgres server create --name $DB_PG_NAME --resource-group $RESOURCE_GROUP --location $REGION --admin-user $DB_USER_NAME --admin-password $DB_USER_PASSWORD --sku-name $DB_SKU --version 11 --ssl-enforcement Enabled
Checking the existence of the resource group 'adt-3d-rg'...
Creating postgres Server 'semiconductor' in group 'adt-3d-rg'...
Your server 'semiconductor' is using sku 'GP_Gen0_2' (Read Tier). Please refer to https://aka.ms/postgres-pricing for pricing details
Make sure of your password if you forgot, you would have to reset your password with 'az postgres server update -n semiconductor -g adt-3d-rg -p <new-password>'.

{
  "additionalProperties": {},
  "administratorLogin": "archeruser",
  "connectionString": "postgres://azuresuser$DBsemiconductor:Pu661wB0$semiconductor.postgres.database.azure.com/postgres?sslmode=require",
  "earliestRestoreDate": "2023-03-07T02:16:59.930000+00:00",
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.DBforPostgreSQL/servers/semiconductor",
  "location": "westus2",
  "infrastructureEncryption": "Disabled",
  "locationId": "jameeast",
  "maxComputeCapacity": 1,
  "minComputeVersion": "TLS1EnforcementDisabled",
  "maxComputeCapacity": 1,
  "password": "P@ssw0rd",
  "privateEndpointConnections": [],
  "publicNetworkAccess": "Enabled",
  "replicaCapacity": 5,
  "replicaType": "None",
  "resourceGroup": "adt-3d-rg",
  "storageMB": 5120
}
{
  "additions": 2,
  "capacity": 2,
  "computeMode": "GeneralPurpose",
  "name": "GP_Gen0_2",
  "tier": "GeneralPurpose"
},
  "sslEnforcement": "Enabled",
  "storageProfile": {},
  "tags": null
}
{
  "type": "Microsoft.DBforPostgreSQL/servers"
}
{
  "version": "11"
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- Allow access to Azure Services

- Commands for macOS and Ubuntu environment

```

az postgres server firewall-rule create --resource-group
$RESOURCE_GROUP \
--server-name "$DB_PG_NAME" \
--name "allow-azure-internal" \
--start-ip-address 0.0.0.0 \
--end-ip-address 0.0.0.0

```

```

archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az postgres server firewall-rule create --resource-group $RESOURCE_GROUP \
--server-name "$DB_PG_NAME" \
--name "allow-azure-internal" \
--start-ip-address 0.0.0.0 \
--end-ip-address 0.0.0.0
{
  "endIpAddress": "0.0.0.0",
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.DBforPostgreSQL/servers/semiconductor/firewallRules/allow-azure-internal",
  "name": "allow-azure-internal",
  "resourceGroup": "adt-3d-rg",
  "startIpAddress": "0.0.0.0",
  "type": "Microsoft.DBforPostgreSQL/servers/firewallRules"
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- Get the local IP address.

- Commands for Local environment

```

export LOCAL_IP=`curl ifconfig.me`

echo $LOCAL_IP

```

```

archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % export LOCAL_IP=`curl ifconfig.me`
echo $LOCAL_IP
% Total    % Received % Xferd  Average Speed   Time   Time     Current
          Dload  Upload Total   Spent    Left Speed
100      12  100      12     0      0   26      0 --::--- --::--- --:--- 26
42.[REDACTED].15
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- Configure a server-based firewall rule

- Commands for macOS and Ubuntu environment

```

az postgres server firewall-rule create --resource-group
$RESOURCE_GROUP --server $DB_PG_NAME --name AllowLocalIp --start-

```

```
ip-address $LOCAL_IP --end-ip-address $LOCAL_IP
```

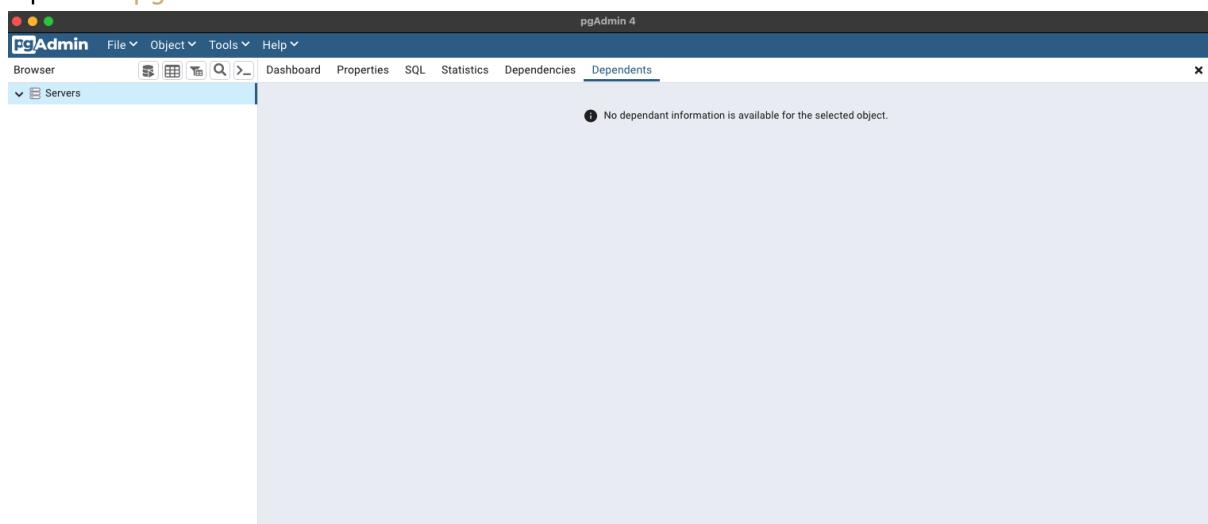
```
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % az postgres server firewall-rule create --resource-group $RESOURCE_GROUP --server $DB_P0_NAME --name AllowLocalIp --start-ip-address $LOCAL_IP --end-ip-address $LOCAL_IP
{
  "endIpAddress": "42.1.1.15",
  "id": "/subscriptions/.../resourceGroups/adt-3d-rg/providers/Microsoft.DBforPostgreSQL/servers/semiconductor/firewallRules/AllowLocalIp",
  "name": "AllowLocalIp",
  "resourceGroup": "adt-3d-rg",
  "startIpAddress": "42.1.1.15",
  "type": "Microsoft.DBforPostgreSQL/servers/firewallRules"
}
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

- Get the server name and the admin username

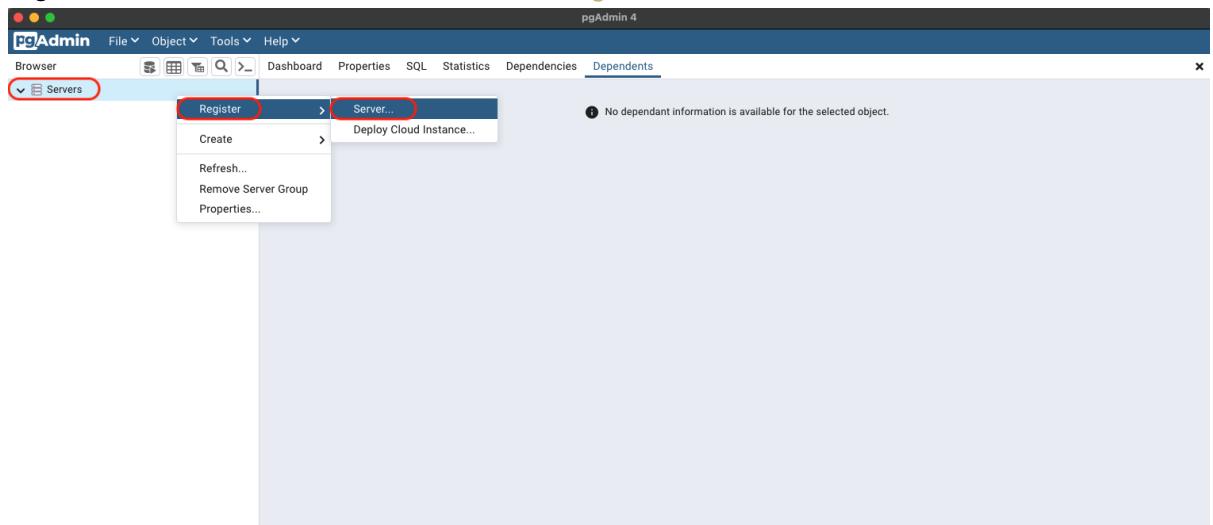
The screenshot shows the Azure portal interface for managing a PostgreSQL database. The top navigation bar includes the Microsoft Azure logo, a search bar, and a user profile. Below the navigation, the URL 'Azure Database for PostgreSQL servers' is visible. The main content area is titled 'semiconductor' and shows the 'Overview' tab selected. On the left, there's a sidebar with various management options like Activity log, Access control (IAM), Tags, and Diagnose and solve problems. The 'Essentials' section on the right provides key details about the server, including its resource group (adt-3d-rg), status (Available), location (Japan East), and PostgreSQL version (11). It also lists the admin username (azureuser@semiconductor) and SSL enforce status (ENABLED). A chart titled 'Resource utilization (semiconductor)' tracks CPU and storage usage over time, showing a significant spike around 7:30 AM UTC+08:00.

- Create a database

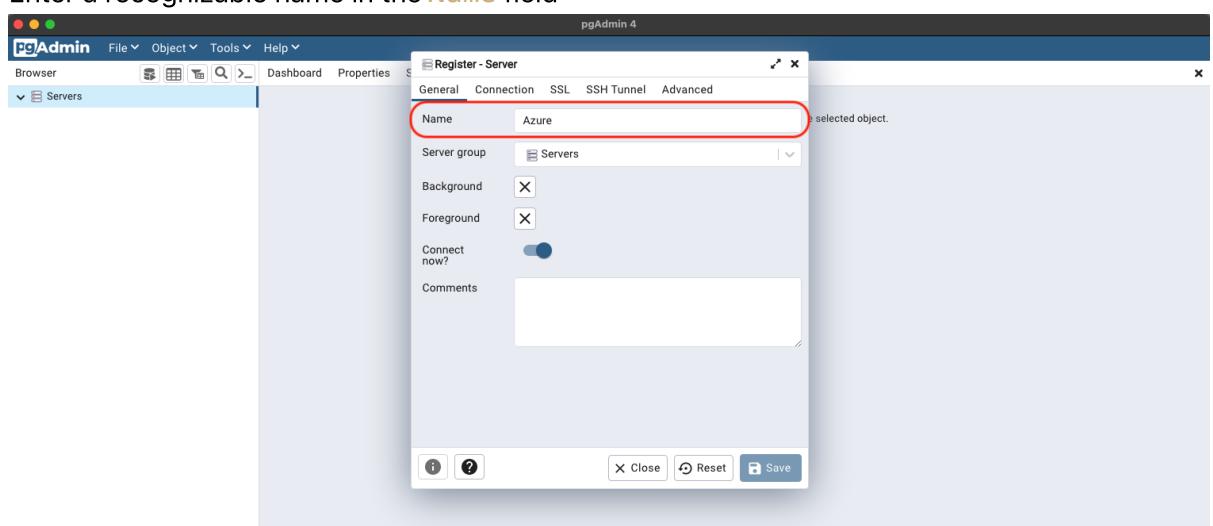
- Open the pgAdmin software



- Right-click the **Servers** button > Click the **Register** button > Click the **Server...** button

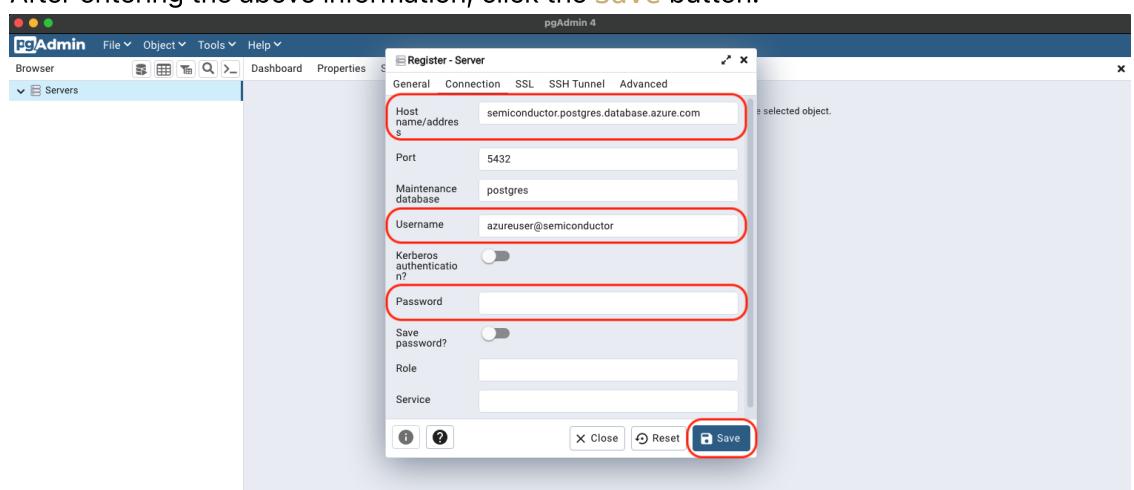


- Enter a recognizable name in the **Name** field



- Enter relevant information on the **Connection** tab

- In the **Host name** field, enter the **Server name** obtained from the **Get the server name and the admin username** section.
- In the **Username** field, enter the **Admin username** obtained from the **Get the server name and the admin username** section.
- In the **Password** field, enter the password you have set.
- After entering the above information, click the **Save** button.



- If login fails, please reset your password.

The screenshot shows the Azure portal interface for managing a PostgreSQL single server. The server name is 'semiconductor'. In the top navigation bar, there is a link to 'Reset the password'. A modal window titled 'Reset the password' is open, containing fields for 'Password' (with placeholder 'New password') and 'Confirm password' (with placeholder 'Re-enter new password'). Both of these fields are circled in red.

- Establish **FilmCheck** Database

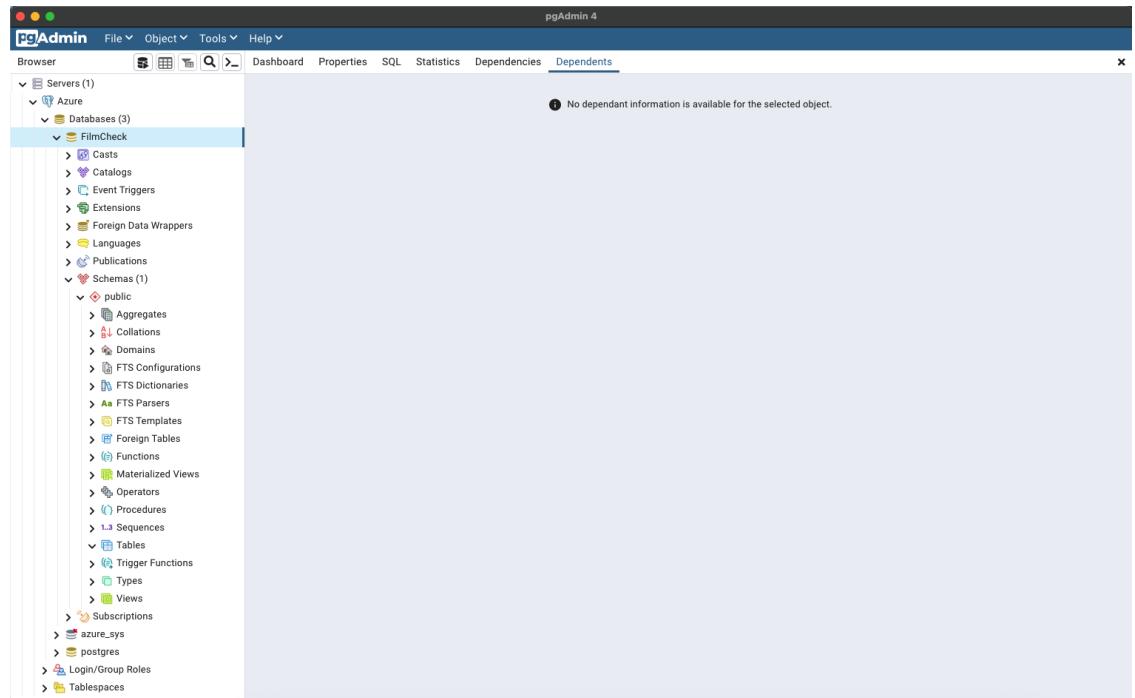
- Right-click the **Databases** button > Click the **Create** button > Click the **Database...** button

The screenshot shows the pgAdmin 4 interface. On the left, the 'Browser' pane shows a tree view of 'Servers (1) > Azure > Databases'. A context menu is open over the 'Databases' item, with the 'Create' and 'Database...' buttons highlighted by a red box.

- Enter **FilmCheck** in the **Database** field.
- After entering the above information, click the **Save** button.

The screenshot shows the 'Create - Database' dialog box. The 'Database' field is filled with 'FilmCheck'. The 'Owner' field is set to 'azureuser'. At the bottom right of the dialog, the 'Save' button is highlighted with a red box.

- Completion screen created



- Create the Log and Report Table

- Switch working directory

```
cd ./AzureContainerApp/DB_Ops
```

- Install required packages

```
npm i
```

```
archer@ArcherdeMacBook-Pro DB_Ops % npm i
added 160 packages, and audited 161 packages in 818ms
14 packages are looking for funding
  run `npm fund` for details

1 critical severity vulnerability

To address all issues, run:
  npm audit fix

Run `npm audit` for details.
archer@ArcherdeMacBook-Pro DB_Ops %
```

- Modify the content of **development** in the **config/config.json** file (**username**、**password**、**database**)

```
{
  "development": {
    "username": "Please modify it with the information obtained earlier.",
    "password": "Please modify it with the information obtained earlier.",
    "database": "Please modify it with the information obtained earlier.",
    "host": "Please modify it with the information obtained earlier.",
    "dialect": "postgres",
    "ssl": true,
    "dialectOptions": {
      "ssl": {
        "require": true
      }
    }
  },
}
```

- Create the Tables

```
npx sequelize db:migrate --env development
```

```
archer@ArcherdeMacBook-Pro DB_Ops % npm i
up to date, audited 161 packages in 3s

14 packages are looking for funding
  run `npm fund` for details

1 critical severity vulnerability

To address all issues, run:
  npm audit fix

Run `npm audit` for details.
archer@ArcherdeMacBook-Pro DB_Ops % npx sequelize db:migrate

Sequelize CLI [Node: 16.18.1, CLI: 6.6.0, ORM: 6.28.0]

Loaded configuration file "config/config.json".
Using environment "development".
== 20230219235350-create-log: migrating =====
== 20230219235350-create-log: migrated (0.451s)

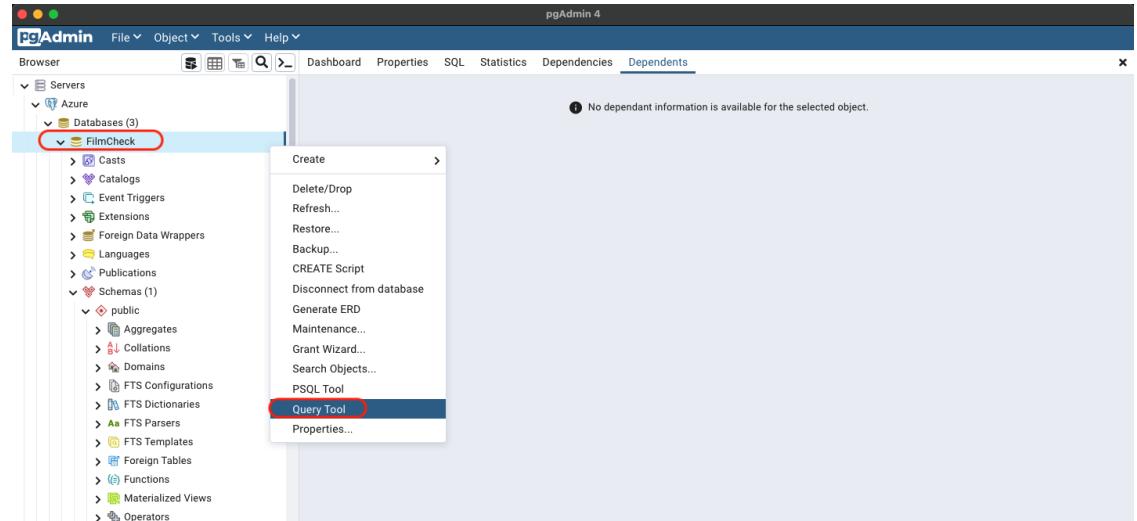
== 20230220012714-create-report: migrating =====
== 20230220012714-create-report: migrated (0.354s)

== 20230309235001-create-status: migrating =====
== 20230309235001-create-status: migrated (2.335s)

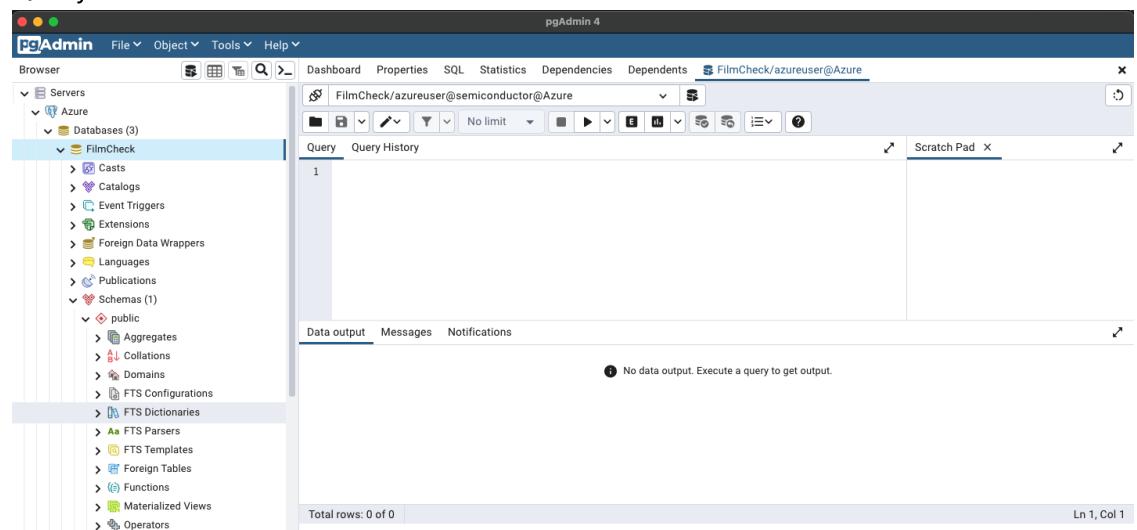
archer@ArcherdeMacBook-Pro DB_Ops %
```

- Open Query Tool

- Right-click on the created database > Click the **Query Tool**



- **Query Tool**



- Check the Log Table

```
SELECT * FROM public."Logs"
```

The screenshot shows the pgAdmin 4 interface with the following details:

- Servers:** Shows one server named "Azure".
- Databases:** Shows three databases: "FilmCheck", "Logs", and "postgres".
- Tables:** Under "FilmCheck", there are three tables: "Logs", "Reports", and "SequelizeMeta".
- Query Window:** Displays the SQL query: `SELECT * FROM public."Logs"`.
- Data Output:** Shows the schema for the "Logs" table with columns: id [PK] integer, name character varying (255), date character varying (255), createdAt timestamp with time zone, updatedAt timestamp with time zone.
- Messages:** Shows "Total rows: 0 of 0 Query complete 00:00:00.667".
- Notifications:** Shows "Ln 1, Col 28".

- Check the Report Table

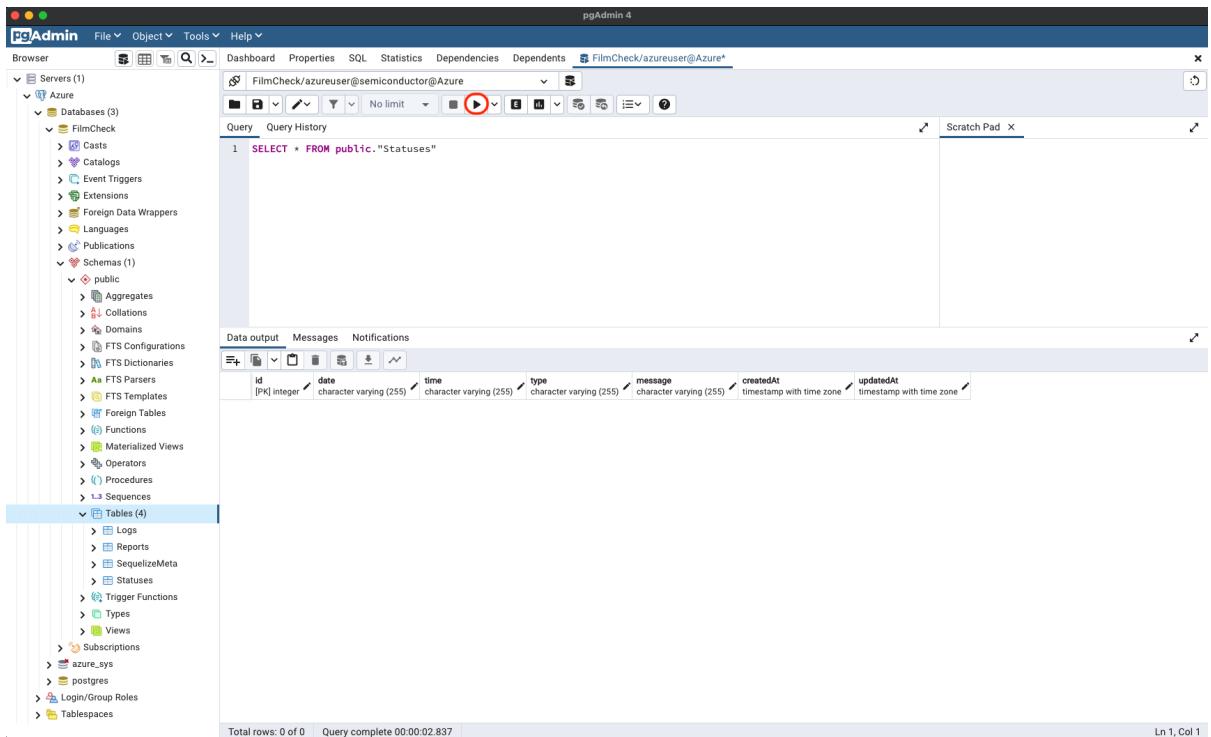
```
SELECT * FROM public."Reports"
```

The screenshot shows the pgAdmin 4 interface with the following details:

- Servers:** Shows one server named "Azure".
- Databases:** Shows three databases: "FilmCheck", "Logs", and "postgres".
- Tables:** Under "FilmCheck", there are three tables: "Logs", "Reports", and "SequelizeMeta".
- Query Window:** Displays the SQL query: `SELECT * FROM public."Reports"`.
- Data Output:** Shows the schema for the "Reports" table with columns: id [PK] integer, standard_deviation double precision, average double precision, uniformity double precision, max double precision, min double precision, max_min double precision, file_name character varying (255), date character varying (255), createdAt timestamp with time zone, updatedAt timestamp with time zone.
- Messages:** Shows "Total rows: 0 of 0 Query complete 00:00:00.599".
- Notifications:** Shows "Ln 1, Col 29".

- Check the Status Table

```
SELECT * FROM public."Statuses"
```



9. Deploy the Azure Container App

- Upgrade the Azure CLI

```
az upgrade
az config set auto-upgrade.enable=yes
az extension add --name containerapp --upgrade
```

- Create an Azure Container Registry

- Commands for macOS and Ubuntu environment

```
az acr create \
--resource-group $RESOURCE_GROUP \
--name $ACR_NAME \
--sku Basic \
--admin-enabled true
```

```

archer@ArcherdeMacBook-Pro config % az acr create \
--resource-group $RESOURCE_GROUP \
--name $ACR_NAME \
--sku Basic \
--admin-enabled true
{
  "adminUserEnabled": true,
  "anonymousPullEnabled": false,
  "creationDate": "2023-03-09T05:12:07.976803+00:00",
  "dataEndpointEnabled": false,
  "dataEndpointHostNames": [],
  "encryption": {
    "keyVaultProperties": null,
    "status": "disabled"
  },
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.ContainerRegistry/registries/containerforacr",
  "identity": null,
  "location": "japaneast",
  "loginServer": "containerforacr.azurecr.io",
  "name": "containerforacr",
  "networkRuleBypassOptions": "AzureServices",
  "networkRuleSet": null,
  "policies": {
    "azureAdAuthenticationAsArmPolicy": {
      "status": "enabled"
    },
    "exportPolicy": {
      "status": "enabled"
    },
    "quarantinePolicy": {
      "status": "disabled"
    },
    "retentionPolicy": {
      "days": 7,
      "lastUpdatedTime": "2023-03-09T05:12:16.456390+00:00",
      "status": "disabled"
    },
    "softDeletePolicy": {
      "lastUpdatedTime": "2023-03-09T05:12:16.456390+00:00",
      "retentionDays": 7,
      "status": "disabled"
    },
    "trustPolicy": {
      "status": "disabled",
      "type": "Notary"
    }
  },
  "privateEndpointConnections": [],
  "provisioningState": "Succeeded",
  "publicNetworkAccess": "Enabled",
  "resourceGroup": "adt-3d-rg",
  "sku": {
    "name": "Basic",
    "tier": "Basic"
  },
  "status": null,
  "systemData": {
    "createdAt": "2023-03-09T05:12:07.976803+00:00",
    "createdBy": "mmosconi@gmail.com",
    "createdByType": "User",
    "lastModifiedAt": "2023-03-09T05:12:07.976803+00:00",
    "lastModifiedBy": "mmosconi@gmail.com",
    "lastModifiedByType": "User"
  },
  "tags": {},
  "type": "Microsoft.ContainerRegistry/registries",
  "zoneRedundancy": "Disabled"
}
archer@ArcherdeMacBook-Pro config %

```

- List the container registries under the current subscription

- Commands for macOS and Ubuntu environment

```

az acr list \
  -o table \
  -g $RESOURCE_GROUP

```

```

archer@ArcherdeMacBook-Pro config % az acr list \
  -o table \
  -g $RESOURCE_GROUP
NAME      RESOURCE GROUP   LOCATION     SKU      LOGIN SERVER          CREATION DATE   ADMIN ENABLED
-----  -----  -----  -----  -----  -----
containerforacr  adt-3d-rg  japaneast  Basic  containerforacr.azurecr.io  2023-03-09T05:12:07Z  True
archer@ArcherdeMacBook-Pro config %

```

- Log in to the Azure Container Registry

- Commands for macOS environment

```

az acr login --name $ACR_NAME

```

```
config -- zsh - 81x69
archer@ArcherdeMacBook-Pro config % az acr login --name $ACR_NAME
Login Succeeded
archer@ArcherdeMacBook-Pro config %
```

- Commands for Ubuntu environment

```
az acr credential show --name containerforacr.azurecr.io --query
passwords[0].value --output tsv

sudo az acr login --name $ACR_NAME

Username: containerforacr
Password: Please enter the result obtained from the command 'az
acr credential show'
```

```
az acr credential show --name containerforacr.azurecr.io --query passwords[0].value --output tsv
The login server endpoint suffix '.azurecr.io' is automatically omitted.
zfcQgTHyASVl9DTrXKbzr7oYFkU+is1HnZpC18tE+ACRMqCY
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/AzureContainerApp/DB_Ops$ sudo az acr login --name $ACR_NAME
Unable to get AAD authorization tokens with message: Please run 'az login' to setup account.
Unable to get admin user credentials with message: Please run 'az login' to setup account.
Username: containerforacr
Password:
Login Succeeded
WARNING! Your password will be stored unencrypted in /root/.docker/config.json.
Configure a credential helper to remove this warning. See
https://docs.docker.com/engine/reference/commandline/login/#credentials-store
mmosconi@adt-vm:~/Azure-Digital-Twins-End-To-End-Sample/AzureContainerApp/DB_Ops$
```

- Switch working directory (IoT Hub To ADT)

```
cd ../../IoTHub_To_ADT_Notify
```

- Modify the content of **development** in the **config/config.json** file (**username**、**password**、**database**)

```
{
  "development": {
    "username": "Please modify it with the information obtained earlier.",
    "password": "Please modify it with the information obtained earlier.",
    "database": "Please modify it with the information obtained earlier.",
    "host": "Please modify it with the information obtained earlier.",
    "dialect": "postgres",
    "ssl": true,
    "dialectOptions": {
      "ssl": {
        "require": true
      }
    }
  },
}
```

- Create a Docker Image (IoT Hub To ADT)

- Commands for macOS and Ubuntu environment

```
sudo docker buildx build . --platform linux/amd64 --push -t
$ACR_NAME.azurecr.io/hub-to-adt-notify:0.1 -f docker-
manifests/Dockerfile
```

```
archer@ArcherdeMacBook-Pro IoTHub_To_ADT_Notify % sudo docker buildx build . --platform linux/amd64 --push -t $ACR_NAME.azurecr.io/hub-to-adt-notify:0.1 -f docker-manifests/Dockerfile
Password: 
Building 237.7s (19/19) FINISHED
   => internal: building buildkit
   => internal: load build definition from Dockerfile
   => => transferring buildkit:158B
   => => internal: load buildkit
   => => internal: transfer context: 99B
   => [linux/amd64 internal] load metadata for docker.io/library/node:18.13-alpine3.17
   => [linux/arm64 internal] load metadata for docker.io/library/node:18.13-alpine3.17
   => [internal] load build context
   => => internal: transfer context: 1.9kB
   => [linux/amd64 1/5] FROM docker.io/library/node:18.13-alpine3.17@sha256:fd98168118e5a8f4269efca4101ee51dd5c75c0fe56d8eb6fad80455c2f5827
   => [linux/arm64 1/5] FROM docker.io/library/node:18.13-alpine3.17@sha256:fd98168118e5a8f4269efca4101ee51dd5c75c0fe56d8eb6fad80455c2f5827
   => => resolve: docker.io/library/node:18.13-alpine3.17@sha256:fd98168118e5a8f4269efca4101ee51dd5c75c0fe56d8eb6fad80455c2f5827
   => => resolve: docker.io/library/node:18.13-alpine3.17@sha256:fd98168118e5a8f4269efca4101ee51dd5c75c0fe56d8eb6fad80455c2f5827
   => => CACHED [linux/arm64 3/5] WORKDIR /app
   => CACHED [linux/arm64 3/5] RUN apk upgrade --no-cache
   => CACHED [linux/arm64 4/5] COPY . .
   => CACHED [linux/amd64 2/5] RUN apk upgrade --no-cache
   => CACHED [linux/amd64 3/5] WORKDIR /app
   => CACHED [linux/amd64 4/5] COPY . .
   => CACHED [linux/amd64 5/5] RUN npm install
   => CACHED [linux/amd64 5/5] RUN npm install
   => exporting to image
   => => exporting layers
   => => exporting manifest sha256:40cd341fb5f65fb90945d88e3d3473b8ddc85addffab59f4dd94fbba10823
   => => exporting config sha256:8a39b9cc9747aa4a5fb8b23b195bb9a69d27a5eaef92b887e8bd325d81389d3
   => => exporting manifest sha256:5366a029b31b9203a77b7422227a479935333c3f4983237acdddf5b52d2f1a
   => => exporting config sha256:f94913a997da57b7a3bc697a71e2b6fb4e5c515795838ca5c19b734624a7
   => => exporting manifest list sha256:f5c2b79755ad03082b024992dd4b651ef5f7c377dc8f05e957a3ed848527b
   => => pushing manifest for containerforacr.azurecr.io/hub-to-adt-notify:0.1@sha256:f5c2b79755ad03082b024992dd4b651ef5f7c377dc8f05e957a3ed848527b
   => (auth) hub-to-adt-notify:push query-adtpull token for containerforacr.azurecr.io
   => (auth) hub-to-adt-notify:push query-adtpush token for containerforacr.azurecr.io
archer@ArcherdeMacBook-Pro IoTHub_To_ADT_Notify % ]
```

- Check Azure container registry from Browser

Tag	Digest	Last modified
0.1	sha256:8b6ff49c81d3330d84dc99c2093a...	2/16/2023, 3:01 PM GMT+8

- Create a Container Apps Environments (IoT Hub To ADT)

- Commands for macOS and Ubuntu environment

```
az containerapp env create \
--name $ACA_ENVIRONMENT_HUB \
--resource-group $RESOURCE_GROUP \
--location $REGION
```

```

archer@ArcherdeMacBook-Pro IoTHub_To_ADT_Notify % az containerapp env create \
--name $ACA_ENVIRONMENT_HUB \
--resource-group $RESOURCE_GROUP \
--location $REGION
No Log Analytics workspace provided.
Generating a Log Analytics workspace with name "workspace=adt3drg7ED8"
Container Apps environment created. To deploy a container app, use: az containerapp create --help

{
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.App/managedEnvironments/env-region-containerapps-hub",
  "location": "japaneast",
  "name": "env-region-containerapps-hub",
  "properties": {
    "appLogsConfiguration": {
      "destination": "log-analytics",
      "logAnalyticsConfiguration": {
        "customerId": "ec4a357e-4b6e-41c8-929c-c9b6c4bdaefc"
      }
    },
    "customDomainConfiguration": {
      "customDomainId": "2B3A4472823479CD4EE58DA50E1FD7BF82DE7C7BA43AD366A7B836CE6000B76"
    },
    "defaultDomain": "ambitioussand-32555d0.japaneast.azurecontainerapps.io",
    "eventStreamEndpoint": "https://japaneast.azurecontainerapps.dev/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/managedEnvironments/env-region-containerapps-hub/eventstream",
    "provisioningState": "Succeeded",
    "staticIp": "20.27.131.202",
    "zoneRedundant": false
  },
  "resourceGroup": "adt-3d-rg",
  "systemData": {
    "createdAt": "2023-03-09T05:26:16.9000219",
    " createdBy": "mmosconi@gmail.com",
    "createdByType": "User",
    "lastModifiedAt": "2023-03-09T05:26:16.9000219",
    "lastModifiedBy": "mmosconi@gmail.com",
    "lastModifiedByType": "User"
  },
  "type": "Microsoft.App/managedEnvironments"
}
archer@ArcherdeMacBook-Pro IoTHub_To_ADT_Notify %

```

- Get default Domain (IoT Hub To ADT)

- Commands for macOS and Ubuntu environment

```

az containerapp env show \
--name $ACA_ENVIRONMENT_HUB \
--resource-group $RESOURCE_GROUP

```

```

archer@ArcherdeMacBook-Pro IoTHub_To_ADT_Notify % az containerapp env show \
--name $ACA_ENVIRONMENT_HUB \
--resource-group $RESOURCE_GROUP
{
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.App/managedEnvironments/env-region-containerapps-hub",
  "location": "japaneast",
  "name": "env-region-containerapps-hub",
  "properties": {
    "appLogsConfiguration": {
      "destination": "log-analytics",
      "logAnalyticsConfiguration": {
        "customerId": "ec4a357e-4b6e-41c8-929c-c9b6c4bdaefc"
      }
    },
    "customDomainConfiguration": {
      "customDomainId": "2B3A4472823479CD4EE58DA50E1FD7BF82DE7C7BA43AD366A7B836CE6000B76"
    },
    "defaultDomain": "ambitioussand-32555d0.japaneast.azurecontainerapps.io",
    "eventStreamEndpoint": "https://japaneast.azurecontainerapps.dev/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/managedEnvironments/env-region-containerapps-hub/eventstream",
    "provisioningState": "Succeeded",
    "staticIp": "20.27.131.202",
    "zoneRedundant": false
  },
  "resourceGroup": "adt-3d-rg",
  "systemData": {
    "createdAt": "2023-03-09T05:26:16.9000219",
    " createdBy": "mmosconi@gmail.com",
    "createdByType": "User",
    "lastModifiedAt": "2023-03-09T05:26:16.9000219",
    "lastModifiedBy": "mmosconi@gmail.com",
    "lastModifiedByType": "User"
  },
  "type": "Microsoft.App/managedEnvironments"
}
archer@ArcherdeMacBook-Pro IoTHub_To_ADT_Notify %

```

- Set parameters

- Get Build-in Event Hub-compatible endpoint

- Commands for macOS and Ubuntu environment

```

az iot hub connection-string show --hub-name $IOT_HUB_NAME \
--default-eventhub --resource-group $RESOURCE_GROUP --query \
connectionString

```

```

export EVENTHUB_CONNECTION_STRING="Enter the
connectionString obtained in the previous step."

```

```

echo $EVENTHUB_CONNECTION_STRING

```

```
archer@ArcherdeMacBook-Pro ~ % export EVENTHUB_CONNECTION_STRING="az iot hub connection-string show --hub-name IOT_HUB_NAME --default-eventhub --resource-group $RESOURCE_GROUP --query connectionString"
archer@ArcherdeMacBook-Pro ~ % echo $EVENTHUB_CONNECTION_STRING
$endpoint=https://iothub-ms-adt-3d-24776808-ea89d22d36.servicebus.windows.net/?SharedAccessKeyName=iothubowner;SharedAccessKey=1j8uXq1ZC0Op7yQLbjbq+b0vG06z3OMITCL9J73+0mU=:EntityPath=adt-3d"
archer@ArcherdeMacBook-Pro ~ %
```

- Get Azure Digital Twin Host URL

- Commands for macOS and Ubuntu environment

```
az dt show --dt-name $ADT_NAME --resource-group $RESOURCE_GROUP --query hostName

export ADT_Host_Name="Enter the Azure Digital Twin Host URL obtained in the previous step."

echo $ADT_Host_Name
```

```
archer@ArcherdeMacBook-Pro ~ % export ADT_Host_Name=`az dt show --dt-name $ADT_NAME --resource-group $RESOURCE_GROUP --query hostName`
archer@ArcherdeMacBook-Pro ~ % echo $ADT_Host_Name
"adt-3d.api.jpe.digitaltwins.azure.net"
archer@ArcherdeMacBook-Pro ~ %
```

- Confirm parameters

```
echo $ADT_NAME
echo $IOT_HUB_CONSUMER_GROUP_CONTAINER_APP
echo $EVENTHUB_CONNECTION_STRING
echo $ADT_Host_Name
echo $WEBHOOK_URL
```

```
archer@ArcherdeMacBook-Pro IoT_Hub_To_ADT_Notify % echo $ADT_NAME
echo $IOT_HUB_CONSUMER_GROUP_CONTAINER_APP
echo $EVENTHUB_CONNECTION_STRING
echo $ADT_Host_Name
echo $WEBHOOK_URL
adt-3d
containerapp
iotHub-ns-adt-3d-24776808-ea89d22d36.servicebus.windows.net/?SharedAccessKeyName=iothubowner;SharedAccessKey=1j8uXq1ZC0Op7yQLbjbq+b0vG06z3OMITCL9J73+0mU=:EntityPath=adt-3d"
"adt-3d.api.jpe.digitaltwins.azure.net"
https://1trihq.webhook.office.com/webhookb2/2820f94d-8d8d-420c-a297-7c44b749d557@73ffe322-3a8c-4d1c-936d-665676f559aa/IncomingWebhook/85d583e9de0f4382a3969e9f93271f45//c77c344-6f5f-42d9-95a4-e5b16c6326bd
archer@ArcherdeMacBook-Pro IoT_Hub_To_ADT_Notify %
```

- Deploy the image to Azure Container App (IoT Hub To ADT)

- Commands for macOS and Ubuntu environment

```
az containerapp create \
--name $ACA_NAME_HUB \
--resource-group $RESOURCE_GROUP \
--environment $ACA_ENVIRONMENT_HUB \
--registry-server $ACR_NAME.azurecr.io \
--image $ACR_NAME.azurecr.io/hub-to-adt-notify:0.1 \
--env-vars "EVENTHUB_NAME=secretref:eventhub-name"
"CONSUMER_GROUP_NAME=secretref:consumer-group-name"
"EVENTHUB_CONNECTION_STRING=secretref:eventhub-connection-string"
"ADT_Host_Name=secretref:adt-host-name"
"WEBHOOK_URL=secretref:webhook-url" \
--secrets "eventhub-name=$ADT_NAME" "consumer-group-name=$IOT_HUB_CONSUMER_GROUP_CONTAINER_APP" "eventhub-connection-string=$EVENTHUB_CONNECTION_STRING" "adt-host-
```

```

name=$ADT_Host_Name" "webhook-url=$WEBHOOK_URL" \
--min-replicas 1 \
--max-replicas 1 \
--ingress 'internal' \
--target-port 3000 \
--query properties.configuration.ingress.fqdn

"adt3dhub.internal.proudsky-
415d04fa.japaneast.azurecontainerapps.io"

```

```

archer@ArcherdeMacBook-Pro IoHub_To_ADT_Notify % az containerapp create \
--name $ACA_NAME_HUB \
--resource-group $RESOURCE_GROUP \
--environment $ACI_ENVIRONMENT_HUB \
--registry-server $ACR_NAME.azurecr.io \
--image $ACR_NAME.azurecr.io/$ACI_ENVIRONMENT_HUB \
--secret-type system \
--secret-value $ACR_NAME \
--env-vars "EVENTHUB_NAME=$ADT_NAME" "CONSUMER_GROUP_NAME=$ACI_ENVIRONMENT_HUB" "EVENTHUB_CONNECTION_STRING=$secretref:eventhub-connection-string" "ADT_Host_Name=$secretref:host-name" "WEBHOOK_URL=$secretref:webhook-url" \
--secrets "eventhub-name=$ADT_NAME" "consumer-group-name=$LOT_HUB_CONSUMER_GROUP_CONTAINER_APP" "eventhub-connection-string=$SEVENTHUB_CONNECTION_STRING" "adt-host-name=$ADT_Host_Name" "webhook-url=$WEBHOOK_URL" \
--uri $ACI_ENVIRONMENT_HUB \
--max-replicas 1 \
--ingress internal \
--target-port 3000 \
--query properties.configuration.ingress fqdn
No credential was provided to access Azure Container Registry. Trying to look up credentials...
Adding registry password as a secret with name ContainerForIoTContainerForIoT
Container app created. Access your app at https://adt3dhub.internal.ambitiousand-32555de0.japaneast.azurecontainerapps.io/
*adt3dhub.internal.ambitiousand-32555de0.japaneast.azurecontainerapps.io*
archer@ArcherdeMacBook-Pro IoHub_To_ADT_Notify %

```

- Set role assignment

- Enable System assigned

- Commands for macOS and Ubuntu environment

```

az containerapp identity assign --g $RESOURCE_GROUP --n
$ACA_NAME_HUB --system-assigned

```

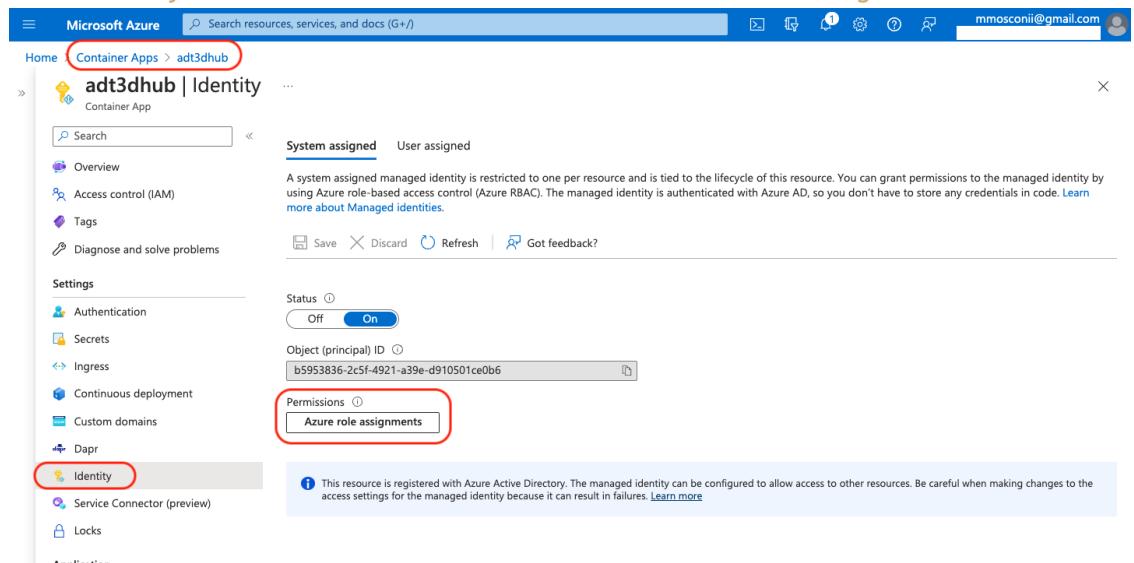
```

archer@ArcherdeMacBook-Pro IoHub_To_ADT_Notify % az containerapp identity assign --g $RESOURCE_GROUP --n $ACA_NAME_HUB --system-assigned
{
  "principalId": "b5953836-2c5f-4921-a39e-d910501ce0b6",
  "tenantId": "c7f98dc5-2792-4fd7-bb88-7cb2590df48b",
  "type": "SystemAssigned"
}
archer@ArcherdeMacBook-Pro IoHub_To_ADT_Notify %

```

- Add role assignment

- Click on the created **adt3dhub** in the **Container App** on the **Azure portal** > Click on **Identity** in the left-hand menu > Click on **Azure role assignments**



- Click on the **+ Add role assignment (Preview)** button

The screenshot shows the 'Add role assignment (Preview)' dialog in the Microsoft Azure portal. The 'Scope' dropdown is set to 'Subscription'. The 'Role' dropdown is set to 'Azure Digital Twins Data Owner'. At the bottom left, the 'Save' button is highlighted with a red circle.

- Enter the relevant information

- Select **Subscription** in the **Scope** field.
- Select the desired subscription in the **Subscription** field.
- Select **Azure Digital Twins Data Owner** in the **Role** field.
- After entering the above information, click on the **Save** button.

- Switch working directory (Query ADT)

```
cd ../../Query_ADT
```

- Create a Container Apps Environments (Query ADT)

- Commands for macOS and Ubuntu environment

```
az containerapp env create \
--name $ACA_ENVIRONMENT_QUERY \
--resource-group $RESOURCE_GROUP \
--location $REGION
```

```
archer@ArcherdeMacBook-Pro IoTHub_To_ADT_Notify % az containerapp env create \
--name $ACA_ENVIRONMENT_QUERY \
--resource-group $RESOURCE_GROUP \
--location $REGION
No Log Analytics workspace provided.
Generating a Log Analytics workspace with name "workspace-adt3drgvFEB"
Container Apps environment created. To deploy a container app, use: az containerapp create --help

{
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.App/managedEnvironments/env-region-containerapps-query",
  "location": "japaneast",
  "name": "env-region-containerapps-query",
  "properties": {
    "appLogsConfiguration": {
      "destination": "log-analytics",
      "logAnalyticsConfiguration": {
        "customerId": "624a92e-eed1-45d9-b194-d2fde2998866"
      }
    },
    "customDomainConfiguration": {
      "customDomainId": "2834472823479CD4AE58DA50E1FD7DFB2DE7C7BA43D366A78836CE6690D876"
    },
    "defaultDomain": "salmonglacier-bbfaf691.japaneast.azurecontainerapps.io",
    "eventStreamEndpoint": "https://japaneast.azurecontainerapps.dev/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/managedEnvironments/env-region-containerapps-query/eventstream",
    "provisioningState": "Succeeded",
    "status": "Up 20.70.254.199",
    "zoneRedundant": false
  },
  "resourceGroup": "adt-3d-rg",
  "systemData": {
    "createdAt": "2023-03-09T00:18:48.8144135",
    "createdBy": "mmosconi@gmail.com",
    "createdByType": "User",
    "lastModifiedAt": "2023-03-09T00:18:48.8144135",
    "lastModifiedBy": "mmosconi@gmail.com",
    "lastModifiedByType": "User"
  },
  "type": "Microsoft.App/managedEnvironments"
}
archer@ArcherdeMacBook-Pro IoTHub_To_ADT_Notify %
```

- Get default Domain (Query ADT)

- Commands for macOS and Ubuntu environment

```
az containerapp env show \
    --name $ACA_ENVIRONMENT_QUERY \
    --resource-group $RESOURCE_GROUP
```

```
archer@ArcherdeMacBook-Pro ~ % az containerapp env show \
--name SACA_ENVIRONMENT_QUERY \
--resource-group $RESOURCE_GROUP
{
  "id": "d1e0a2a2-1a2c-4f3a-8a2a-1a2c1a2c1a2c", "type": "Microsoft.App/containerApps", "location": "japaneast", "name": "env-region-containerapps-query", "properties": {
    "appLogConfiguration": {
      "destination": "log-analytics",
      "logAnalyticsConfiguration": {
        "customerId": "8274a929-aed1-45d9-b194-d2fde299866"
      }
    },
    "customDomainConfiguration": {
      "customDomainVerificationId": "2B3A4472823479CD4AE58DA50E1FD7FB2DE7C78A43AD366A7B836CE600DB76"
    },
    "defaultEndpoint": "salmonglacier-bbe91.japaneast.azurecontainerapps.io",
    "eventStreamEndpoint": "https://japaneast.azurecontainerapps.dev/subscriptions/",
    "image": "mcr.microsoft.com/oss/redis:6.2.5",
    "latency": "100ms",
    "statistic": "20.78.254.199",
    "zoneRedundant": false
  },
  "resourceGroup": "adt-3d-rg",
  "systemData": {
    "createdAt": "2023-03-09T06:18:48.0144135",
    "createdBy": "moscnail@gmail.com",
    "createdByType": "User",
    "lastModifiedAt": "2023-03-09T06:18:48.0144135",
    "lastModifiedBy": "moscnail@gmail.com",
    "lastModifiedByType": "User"
  },
  "type": "Microsoft.App/managedEnvironments"
}
archer@ArcherdeMacBook-Pro ~ %
```

- Create the Query ADT Docker Image (Query ADT)

- Commands for macOS and Ubuntu environment

```
sudo docker buildx build . --platform linux/amd64 --push -t $ACR_NAME.azurecr.io/query-adt:0.2 -f docker-manifests/Dockerfile
```

- Confirm parameters

- Commands for macOS and Ubuntu environments

```
echo $ADT Host Name
```

```
export ADT_Host_Name="adt-3d.api.jpe.digitaltwins.azure.net"
```

```
archer@ArcherdeMacBook-Pro Query_ADT % echo $ADT_Host_Name
"adt-3d.api.jpe.digitaltwins.azure.net"
archer@ArcherdeMacBook-Pro Query_ADT %
```

- Deploy the Query ADT image to Azure Container App (Query ADT)
 - Please remember the URL returned after executing the command.
 - Commands for macOS and Ubuntu environment

```
az containerapp create \
--name $ACA_NAME_QUERY \
--resource-group $RESOURCE_GROUP \
--environment $ACA_ENVIRONMENT_QUERY \
--registry-server $ACR_NAME.azurecr.io \
--image $ACR_NAME.azurecr.io/query-adt:0.2 \
--env-vars "ADT_Host_Name=secretref:adt-host-name" \
--secrets "adt-host-name=$ADT_Host_Name" \
--min-replicas 1 \
--max-replicas 1 \
--ingress 'external' \
--target-port 80 \
--query properties.configuration.ingress.fqdn

"adt3dquery.kindpebble-
e066fde2.japaneast.azurecontainerapps.io"
```

```
archer@ArcherdeMacBook-Pro Query_ADT % az containerapp create \
--name $ACA_NAME_QUERY \
--resource-group $RESOURCE_GROUP \
--environment $ACA_ENVIRONMENT_QUERY \
--registry-server $ACR_NAME.azurecr.io \
--image $ACR_NAME.azurecr.io/query-adt:0.1 \
--env-vars "ADT_Host_Name=secretref:adt-host-name" \
--secrets "adt-host-name=$ADT_Host_Name" \
--min-replicas 1 \
--max-replicas 1 \
--ingress 'external' \
--target-port 80 \
--query properties.configuration.ingress.fqdn
No credential was provided to access Azure Container Registry. Trying to look up credentials...
Adding registry password as a secret with name "containerforacazurecregio-containerforacr"
Container app created. Access your app at https://adt3dquery.salmonglacier-bbefa691.japaneast.azurecontainerapps.io/
"adt3dquery.salmonglacier-bbefa691.japaneast.azurecontainerapps.io"
archer@ArcherdeMacBook-Pro Query_ADT %
```

- Set parameter
 - Commands for macOS and Ubuntu environment

```
export QUERY_ADT_URL="Enter the URL obtained in the previous
step."
echo $QUERY_ADT_URL
```

- Set role assignment (Query ADT)

- Enable System assigned

- Commands for macOS and Ubuntu environment

```
az containerapp identity assign -g $RESOURCE_GROUP -n $ACA_NAME_QUERY --system-assigned
```

```
archer@ArcherdeMacBook-Pro Query_ADT % az containerapp identity assign -g $RESOURCE_GROUP -n $ACA_NAME_QUERY --system-assigned
{
  "principalId": "21fb93ea-a914-430f-b9ac-b10d77ee82b3",
  "tenantId": "c7f98dc5-2792-4fd7-bb88-7cb2506df48b",
  "type": "SystemAssigned"
}
archer@ArcherdeMacBook-Pro Query_ADT %
```

- Add role assignment

- Click on the created **adt3dqury** in the **Container App** on the **Azure portal** > Click on **Identity** in the left-hand menu > Click on **Azure role assignments**

Microsoft Azure Search resources, services, and docs (G+) mmosconi@gmail.com

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Search Overview Access control (IAM) Tags Diagnose and solve problems

System assigned User assigned

A system assigned managed identity is restricted to one per resource and is tied to the lifecycle of this resource. You can grant permissions to the managed identity by using Azure role-based access control (Azure RBAC). The managed identity is authenticated with Azure AD, so you don't have to store any credentials in code. [Learn more about Managed identities.](#)

Status: Off Object (principal) ID: 21fb93ea-a914-430f-b9ac-b10d77ee82b3

Permissions: **Azure role assignments**

Authentications Secrets Ingress Continuous deployment Custom domains Dapr Identity Service Connector (preview) Locks Application

This resource is registered with Azure Active Directory. The managed identity can be configured to allow access to other resources. Be careful when making changes to the access settings for the managed identity because it can result in failures. [Learn more](#)

- Click on the **+ Add role assignment (Preview)** button

Microsoft Azure Search resources, services, and docs (G+) mmosconi@gmail.com

Home > Container Apps > adt3dqury | Identity

Add role assignment (Preview)

Scope: Subscription

Subscription

Role: Azure Digital Twins Data Owner

Learn more about RBAC

Save Discard

- Enter the relevant information

- Select **Subscription** in the **Scope** field.
 - Select the desired subscription in the **Subscription** field.

- Select **Azure Digital Twins Data Owner** in the **Role** field.
- After entering the above information, click on the **Save** button.
- Test (Query ADT)

```
https://adt3dquery.kindpebble-
e066fde2.japaneast.azurecontainerapps.io/hello
```

```
https://adt3dquery.kindpebble-
e066fde2.japaneast.azurecontainerapps.io/adt/query/statistics
```

- Switch working directory (DB Ops)

```
cd ../DB_Ops
```

- Modify the content of **development** in the **config/config.json** file (**username**、**password**、**database**)

```
{
  "development": {
    "username": "Please modify it with the information obtained earlier.",
    "password": "Please modify it with the information obtained earlier.",
    "database": "Please modify it with the information obtained earlier.",
    "host": "Please modify it with the information obtained earlier.",
    "dialect": "postgres",
    "ssl": true,
    "dialectOptions": {
      "ssl": {
        "require": true
      }
    }
  },
}
```

- Create the Query ADT Docker Image (DB Ops)
 - Commands for macOS and Ubuntu environment

```
sudo docker buildx build . --platform linux/amd64 --push -t
$ACR_NAME.azurecr.io/db-ops:0.1 -f docker-manifests/Dockerfile
```

```

archer@ArcherdeMacBook-Pro DB_Ops % sudo docker buildx build . --platform linux/amd64,linux/arm64 --push -t $ACR_NAME.azurecr.io/db-ops:0.1 -f docker-manifests/Dockerfile
Password:
[+] Building 54.3s (18/18) FINISHED
   > [internal] load dockerignore
   >> => transferring context: 98B
   >> [internal] load build definition from Dockerfile
   >> transferring dockerfile: 171B
   >> [linux/arm64 internal] load metadata for docker.io/library/node:18.13-alpine3.17
   >> [linux/amd64 internal] load metadata for docker.io/library/node:18.13-alpine3.17
   >> [internal] load build context
   >> => transferring context: 11.17kB
   >> [linux/arm64 1/5] FROM docker.io/library/node:18.13-alpine3.17@sha256:fd98168118e5a8f4269efca4191ee51dd5c75c0fe56d8eb6fad80455c2f5827
   >> => resolve docker.io/library/node:18.13-alpine3.17@sha256:fd98168118e5a8f4269efca4191ee51dd5c75c0fe56d8eb6fad80455c2f5827
   >> [linux/amd64 1/5] FROM docker.io/library/node:18.13-alpine3.17@sha256:fd98168118e5a8f4269efca4191ee51dd5c75c0fe56d8eb6fad80455c2f5827
   >> => resolve docker.io/library/node:18.13-alpine3.17@sha256:fd98168118e5a8f4269efca4191ee51dd5c75c0fe56d8eb6fad80455c2f5827
   >> CACHED [linux/arm64 2/5] RUN apk upgrade --no-cache
   >> CACHED [linux/arm64 3/5] WORKDIR /app
   >> CACHED [linux/arm64 4/5] COPY .
   >> CACHED [linux/arm64 5/5] WORKDIR /app
   >> [linux/amd64 4/5] COPY .
   >> [linux/amd64 5/5] RUN npm install
   >> [linux/amd64 5/5] RUN npm install
   >> exporting to image
   >> exporting layers
   >> => exporting manifest sha256:9a9296e4d9faafe8aa2497329aa4ffbb11b89a6dd227d3a9b5e5144349fc4d
   >> => pushing manifest sha256:90d9a112207084e11262982b117b37d3f4cd5f425e0922f2805d61ab18
   >> => exporting manifest sha256:313758hd9ce1c127e8fa75ff81d0c319085c13e95f11adebea85ac9effa11449
   >> => exporting config sha256:17b86f3070d00330509893d49f3dbbc233843757703138e349a97e65f6fe874ea
   >> => exporting manifest list sha256:4a7d32fe1f5eccbacia126c6bd83ba1f10b3cb01b932efff3f82b7a71d455c2472
   >> => pushing layers
   >> => pushing manifest for containerforacr.azurecr.io/db-ops:0.1@sha256:4a7d32fe1f5eccbacia126c6bd83ba1f10b3cb01b932efff3f82b7a71d455c2472
   >> [auth] db-ops:pull, push token for containerforacr.azurecr.io
   >> [auth] db-ops:pull, push token for containerforacr.azurecr.io
   >> [auth] db-ops:pull, push token for containerforacr.azurecr.io
archer@ArcherdeMacBook-Pro DB_Ops %

```

- Create a Container Apps Environments (DB Ops)

- Commands for macOS and Ubuntu environment

```

az containerapp env create \
--name $ACA_ENVIRONMENT_DB_OPS \
--resource-group $RESOURCE_GROUP \
--location $REGION

```

```

archer@ArcherdeMacBook-Pro DB_Ops % az containerapp env create \
--name $ACA_ENVIRONMENT_DB_OPS \
--resource-group $RESOURCE_GROUP \
--location $REGION
No Log Analytics workspace provided.
Generating a Log Analytics workspace with name "workspace-adt3dr9Tc3v"
Container Apps environment created. To deploy a container app, use: az containerapp create --help

{
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.App/managedEnvironments/env-region-containerapps-db-ops",
  "location": "japaneast",
  "name": "env-region-containerapps-db-ops",
  "properties": {
    "appLogsConfiguration": {
      "logAnalytics": {
        "logAnalyticsConfiguration": {
          "customerId": "6ca89b19-ea9-42ec-97ca-c962fa635998"
        }
      },
      "customDomainConfiguration": {
        "customDomainVerificationId": "283A4472823479CD4AEE58D0$E1FD7BF92DE7C7B4A3D366A7B8836CE6B000876"
      }
    },
    "defaultDomain": "orangemushroom-35ne7f2.japaneast.azurecontainerapps.io",
    "eventStreamEndpoint": "https://japaneast.azurecontainerapps.dev/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/managedEnvironments/env-region-containerapps-db-ops/eventstream",
    "provisioningState": "Succeeded",
    "staticIp": "20.89.184.105",
    "zoneRedundant": false
  },
  "resourceGroup": "adt-3d-rg",
  "systemData": {
    "createdAt": "2023-03-09T07:48:01.943869",
    "createdBy": "mosconigmail.com",
    "createdByType": "User",
    "lastModifiedAt": "2023-03-09T07:48:01.943869",
    "lastModifiedBy": "mosconigmail.com",
    "lastModifiedByType": "User"
  },
  "type": "Microsoft.App/managedEnvironments"
}
archer@ArcherdeMacBook-Pro DB_Ops %

```

- Deploy the Query ADT image to Azure Container App (DB Ops)

- Please remember the URL returned after executing the command.

- Commands for macOS and Ubuntu environment

```

az containerapp create \
--name $ACA_NAME_DB_Ops \
--resource-group $RESOURCE_GROUP \
--environment $ACA_ENVIRONMENT_DB_OPS \
--registry-server $ACR_NAME.azurecr.io \
--image $ACR_NAME.azurecr.io/db-ops:0.1 \
--min-replicas 1 \
--max-replicas 1 \
--ingress 'external' \
--target-port 80 \

```

```
--query properties.configuration.ingress.fqdn  
"dbops.victoriusground-  
728f9a8f.japaneast.azurecontainerapps.io"
```

```
DB_Ops -- zsh -- 128x66  
archer@ArcherdeMacBook-Pro DB_Ops % az containerapp create \  
--name $ACA_NAME_DB_Ops \  
--resource-group $RESOURCE_GROUP \  
--environment $ACA_ENVIRONMENT_DB_OPS \  
--registry-server $ACR_NAME.azurecr.io \  
--image $ACR_NAME.azurecr.io/db-ops:0.1 \  
--min-replicas 1 \  
--max-replicas 1 \  
--ingress 'external' \  
--target-port 80 \  
--query properties.configuration.ingress.fqdn  
No credential was provided to access Azure Container Registry. Trying to look up credentials...  
Adding registry password as a secret with name "containerforacrazurecrio-containerforacr"  
Container app created. Access your app at https://dbops.orangemushroom-635ae7f2.japaneast.azurecontainerapps.io/  
"dbops.orangemushroom-635ae7f2.japaneast.azurecontainerapps.io"  
archer@ArcherdeMacBook-Pro DB_Ops %
```

- Set parameter
 - Commands for macOS and Ubuntu environment

```
export DB_OPS_API_URL="Enter the URL obtained in the previous  
step."  
  
echo $DB_OPS_API_URL
```

- Test (DB Ops)
 - https://DB_OPS_API_URL/logs
 - https://DB_OPS_API_URL/reports
 - https://DB_OPS_API_URL/status/latest
 - https://DB_OPS_API_URL/reports/latest

10. Deploying the Frontend to Azure Static Web Apps

- Deploy files from the [./Azure-Digital-Twins-End-To-End-Sample/Frontend](#) folder to [GitHub](#).

A screenshot of a GitHub repository page for 'ArcherHuang / ADT_Web'. The page shows a list of recent commits from 'ArcherHuang' with updates to 'public', 'src', '.gitignore', 'README.md', 'babel.config.js', 'jsconfig.json', 'package-lock.json', 'package.json', and 'vue.config.js'. The commits were made 1 minute ago. On the right side, there's an 'About' section with a note about no description, website, or topics provided, and sections for Releases, Packages, and Settings.

- Click the **Settings** > Click the **Secrets and variables** > Click the **Actions** > Click the **New repository secret**

A screenshot of the GitHub repository settings page for 'ArcherHuang / ADT_Web'. The 'Actions secrets and variables' section is visible, featuring a 'New repository secret' button. The left sidebar shows various repository management options like General, Access, Collaborators, Moderation options, Code and automation, Security, and Integrations. The 'Actions' option under 'Code and automation' is highlighted with a red circle. The 'Secrets and variables' section is also highlighted with a red circle.

- Add the following **secret**

- Add VUE_APP_EVENTHUB_NAME

The screenshot shows the GitHub Actions secrets configuration page for a repository named 'ArcherHuang / ADT_Web'. The 'General' section is selected. In the 'Name *' field, 'VUE_APP_EVENTHUB_NAME' is entered. In the 'Secret *' field, 'adt-3d' is displayed. A green 'Add secret' button is visible at the bottom right.

- Enter VUE_APP_EVENTHUB_NAME in the Name field.
- Enter the string displayed by echo \$ADT_NAME in the Secret field.
- After entering the above information, click the Add secret button.

- Add VUE_APP_CONSUMER_GROUP_NAME

The screenshot shows the GitHub Actions secrets configuration page for the same repository. The 'General' section is selected. In the 'Name *' field, 'VUE_APP_CONSUMER_GROUP_NAME' is entered. In the 'Secret *' field, 'forStaticWeb' is displayed. A green 'Add secret' button is visible at the bottom right.

- Enter VUE_APP_CONSUMER_GROUP_NAME in the Name field.
- Enter the string displayed by echo \$IOT_HUB_CONSUMER_GROUP_STATIC_WEB_APP in the Secret field.

- After entering the above information, click the **Add secret** button.
- Add **VUE_APP_EVENTHUB_CONNECTION_STRING**
 - Get Build-in Event Hub-compatible endpoint


```
az iot hub connection-string show --hub-name $IOT_HUB_NAME --default-eventhub --resource-group $RESOURCE_GROUP --query connectionString
```
 - Add Secret

Actions secrets / New secret

Name *	VUE_APP_EVENTHUB_CONNECTION_STRING
Secret *	Endpoint=sb://iothub-ns-adt-3d-24776508-ea89d22d36.servicebus.windows.net/;SharedAccessKeyName=iothubowner;SharedAccessKey=1j8uXq1ZC0Op7yQLBjbq+b0uG06z30MITCL9J73+OmU=;EntityPath=adt-3d

Add secret
 - Enter **VUE_APP_EVENTHUB_CONNECTION_STRING** in the Name field.
 - Enter the result displayed in the previous step in the **Secret** field.
 - After entering the above information, click the **Add secret** button.
- Add **VUE_APP_API_URL** (ACA - DB Ops)

https://dbops.orangemushroom-635ae7f2.japaneast.azurecontainerapps.io/logs
 https://dbops.orangemushroom-635ae7f2.japaneast.azurecontainerapps.io/reports

---->

```

* Enter `VUE_APP_API_URL` in the Name field.
* Enter the string displayed by `echo $DB_OPS_API_URL` in the `Secret` field.
* After entering the above information, click the `Add secret`
```

button.

- Add **VUE_APP_BLOB_NAME**

[https://\\$process.env.VUE_APP_BLOB_NAME.blob.core.windows.net/adt/Log/log.txt](https://$process.env.VUE_APP_BLOB_NAME.blob.core.windows.net/adt/Log/log.txt)

---->

```

* Enter `VUE_APP_BLOB_NAME` in the Name field.
* Enter the string displayed by `echo $BLOB_NAME` in the `Secret` field.
* After entering the above information, click the `Add secret` button.
```

- Add **VUE_APP_QUERY_ARD_URL** (ACA - Query ADT)

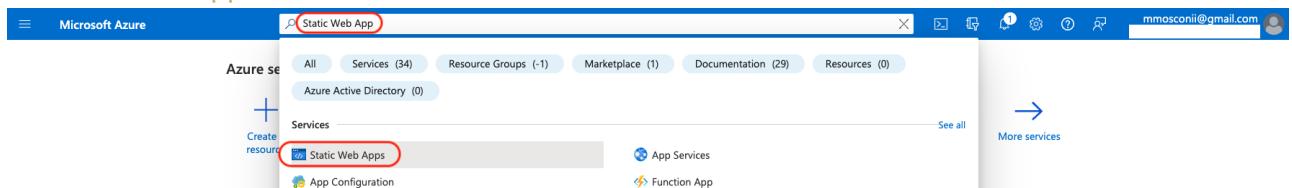
<https://adt3dquery.salmonglacier-bbefa691.japaneast.azurecontainerapps.io/adt/query/statistics>

---->

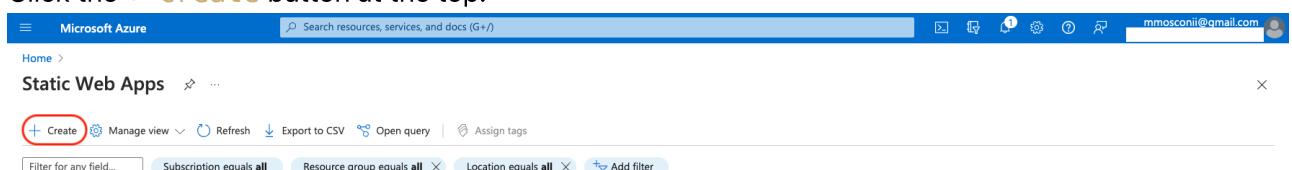
```

* Enter `VUE_APP_QUERY_ARD_URL` in the Name field.
* Enter the string displayed by `echo $QUERY_ARD_URL` in the `Secret` field.
* After entering the above information, click the `Add secret` button.
```

- Enter **Static Web App** in the search box of the **Azure Portal**. > Select the search result for **Static Web Apps**.



- Click the **+ Create** button at the top.



- Enter the relevant information.

Microsoft Azure  **mmosconii@gmail.com** 

Home > Static Web Apps > **Create Static Web App** 

Basics Tags Review + create

App Service Static Web Apps is a streamlined, highly efficient solution to take your static app from source code to global high availability. Pre-rendered content is distributed globally with no web servers required. [Learn more](#)

Project Details

Select a subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * 

Resource Group *  adt-3d-rg [Create new](#)

Static Web App details

Name * adt-3d 

Hosting plan

The hosting plan dictates your bandwidth, custom domain, storage, and other available features. [Compare plans](#)

Plan type Free: For hobby or personal projects Standard: For general purpose production apps

Azure Functions and staging details

Region for Azure Functions API and staging environments * Central US 

Deployment details

Source GitHub Azure DevOps Other

GitHub account ArcherHuang [Change account](#) 

 If you can't find an organization or repository, you might need to enable additional permissions on GitHub. You must have write access to your chosen repository to deploy with GitHub Actions. 

Organization * ArcherHuang 

Repository * ADT_Web 

Branch * main 

Build Details

Enter values to create a GitHub Actions workflow file for build and release. You can modify the workflow file later in your GitHub repository.

Build Presets Vue.js 

 These fields will reflect the app type's default project structure. Change the values to suit your app.

App location * / 

Api location  e.g. "api", "functions", etc...

Output location  dist

Workflow configuration

File with the GitHub Actions workflow configuration.

[Preview workflow file](#)

[Review + create](#) [< Previous](#) [Next : Tags >](#)

- Confirm the entered information.

Basics Tags Review + create

Summary

Static Web App
by Microsoft

Details

Subscription	adt-3d-rg
Resource Group	adt-3d-rg
Name	adt-3d
Region	centralus
SKU	Free
Repository	https://github.com/ArcherHuang/ADT_Web
Branch	main
App location	/
API location	
Output location	dist

Create < Previous Next > Download a template for automation

- Creation completed.

Microsoft.Web-StaticApp-Portal-332b8020-8701 | Overview

Your deployment is complete

Deployment name: Microsoft.Web-StaticApp-Por... Start time: 3/10/2023, 10:38:20 AM
Subscription: Correlation ID:
Resource group: adt-3d-rg

Deployment details

Next steps

Go to resource

Give feedback

Tell us about your experience with deployment

Cost Management

Get notified to stay within your budget and prevent unexpected charges on your bill.
[Set up cost alerts >](#)

Microsoft Defender for Cloud

Secure your apps and infrastructure
[Go to Microsoft Defender for Cloud >](#)

Free Microsoft tutorials

[Start learning today >](#)

Work with an expert

Azure experts are service provider partners who can help manage your assets on Azure and be your first line of support.

- After modifying `./ADT_Web/tree/main/.github/workflows/azure-static-web-apps-Random-Number.yml`, commit the changes (You can see this file from the GitHub repository). Add the information in the `env:` section below (Please align the format).

```
jobs:
  build_and_deploy_job:
    if: ...
    runs-on: ubuntu-latest
    name: Build and Deploy Job
    steps:
      - uses: actions/checkout@v2
```

```

with:
  submodules: true
- name: Build And Deploy
  id: builddeploy
  uses: Azure/static-web-apps-deploy@v1
  with:
    ...
env:
  VUE_APP_EVENTHUB_NAME: ${{ secrets.VUE_APP_EVENTHUB_NAME }}
  VUE_APP_CONSUMER_GROUP_NAME: ${{ secrets.VUE_APP_CONSUMER_GROUP_NAME }}
  VUE_APP_EVENTHUB_CONNECTION_STRING: ${{ secrets.VUE_APP_EVENTHUB_CONNECTION_STRING }}
  VUE_APP_API_URL: ${{ secrets.VUE_APP_API_URL }}
  VUE_APP_BLOB_NAME: ${{ secrets.VUE_APP_BLOB_NAME }}
  VUE_APP_QUERY_ADT_URL: ${{ secrets.VUE_APP_QUERY_ADT_URL }}

```

- Confirm the status from GitHub actions.

The screenshot shows the GitHub Actions interface for the repository `ArcherHuang / ADT_Web`. The `Actions` tab is active. On the left sidebar, there are sections for `Azure Static Web Apps CI/CD`, `Management`, and `Caches`. The main area displays the `All workflows` section, which lists `2 workflow runs`. The first run, `Update`, was triggered by a commit `630e8d9` pushed by `ArcherHuang` to the `main` branch 4 minutes ago. The second run, `ci: add Azure Static Web Apps workflow file`, was triggered by a commit `10011f3` pushed by `ArcherHuang` to the `main` branch 10 minutes ago. Both runs show a green checkmark indicating success.

Workflow Run	Event	Status	Branch	Actor	Time
<code>Update</code>	Commit 630e8d9	Success	main	ArcherHuang	4 minutes ago 4m 39s
<code>ci: add Azure Static Web Apps workflow file</code>	Commit 10011f3	Success	main	ArcherHuang	10 minutes ago 3m 10s

- Obtain the URL of the Static Web App.

The screenshot shows the Microsoft Azure portal interface. In the top navigation bar, 'Static Web Apps' is selected. Below it, the 'adt-3d' app is listed. The main content area shows the 'Essentials' section with details like Resource group (adt-3d-rg), Subscription (main), Location (Global), and Sku (Free). The URL is highlighted with a red circle and is shown as <https://zealous-tree-035510510.2.azurestaticapps.net>. To the right, there's a 'JSON View' link. Below the essentials, there are two charts: 'Requests' and 'Data out', both showing minimal activity over time.

11. Launching the program on the Edge

- Download the zip file of the source code to the edge and unzip it..
 - Please refer to the instructions on how to download the zip file of the source code.
- Install Mosquitto MQTT Broker On Ubuntu Edge

```
sudo apt update
sudo apt install -y mosquitto
```

- Change directory

```
cd ./Edge
```

- Install Python packages with pip and requirements.txt

```
pip3 install -r requirements.txt
```

- Get FilmCheck01 IoT Device Connection String

```
az iot hub device-identity connection-string show --hub-name $IOT_HUB_NAME
--device-id $IOT_DEVICE_NAME --output table --resource-group
$RESOURCE_GROUP
```

```
az iot hub device-identity connection-string show --hub-name $IOT_HUB_NAME
--device-id $IOT_DEVICE_NAME --output table --resource-group $RESOURCE_GROUP
ConnectionString
HostName=adt-3d.azure-devices.net;DeviceId=FilmCheck01;SharedAccessKey=KbdZnk6MUSdNH5zDSliosaAcm4Xr49Xu9eqBOD9pE=
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %
```

- Get the Connection string for the blob

- Perform operations on the created blob.

Storage accounts > adt3dstorageaccount

adt3dstorageaccount | Access keys

Data storage

- Containers
- File shares
- Queues
- Tables

Security + networking

- Networking
- Azure CDN
- Access keys** (highlighted with ②)
- Shared access signature
- Encryption
- Microsoft Defender for Cloud

Data management

- Redundancy
- Data protection

key1 Rotate key
Last rotated: 2023/3/9 (4 days ago)
Key: [REDACTED] **Show**

Connection string (highlighted with ③)
DefaultEndpointsProtocol=https;AccountName=adt3dstorageaccount;AccountKe... **Show**

key2 Rotate key
Last rotated: 2023/3/9 (4 days ago)
Key: [REDACTED] **Show**

- Get the container name for the blob

- Perform operations on the created blob.

Storage accounts > adt3dstorageaccount

adt3dstorageaccount | Containers

Containers (highlighted with ②)

Name	Last modified	Public access level	Lease state
\$logs	3/9/2023, 10:07:55 AM	Private	Available ***
adt (highlighted with ③)	3/9/2023, 9:55:10 AM	Blob	Available ***

Data storage

- Containers** (highlighted with ②)
- File shares
- Queues
- Tables

Security + networking

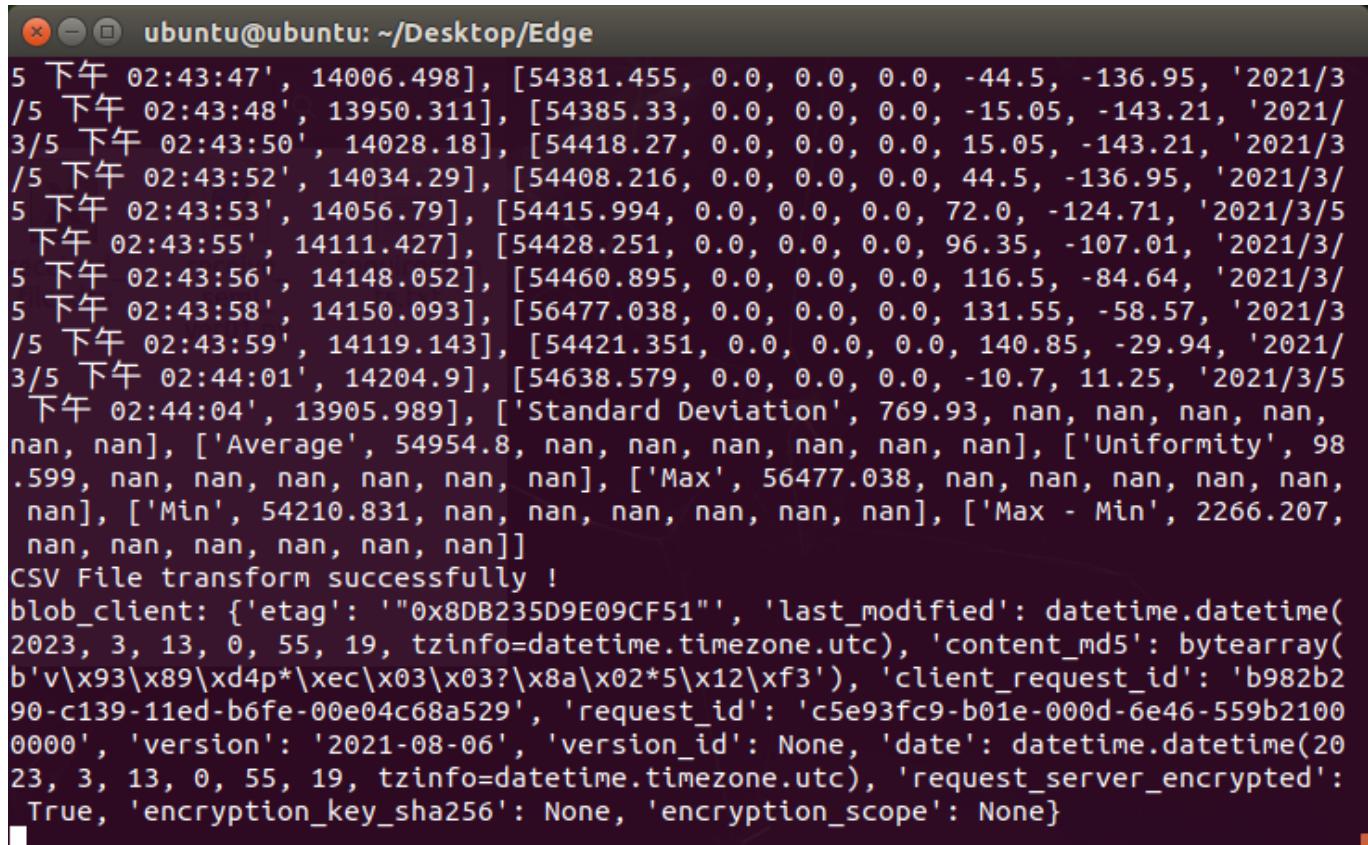
- Networking
- Azure CDN

- Create `.env` File and Add the following information.

```
IOT_HUB_DEVICE_CONNECTION_STRING="Enter the result obtained from the Get
FilmCheck01 IoT Device Connection String."
BLOB_CONNECTION_STRING="Enter the result obtained from the Get the
Connection string for the blob."
BLOB_CONTAINER_NAME="Enter the result obtained from the Get the container
name for the blob."
```

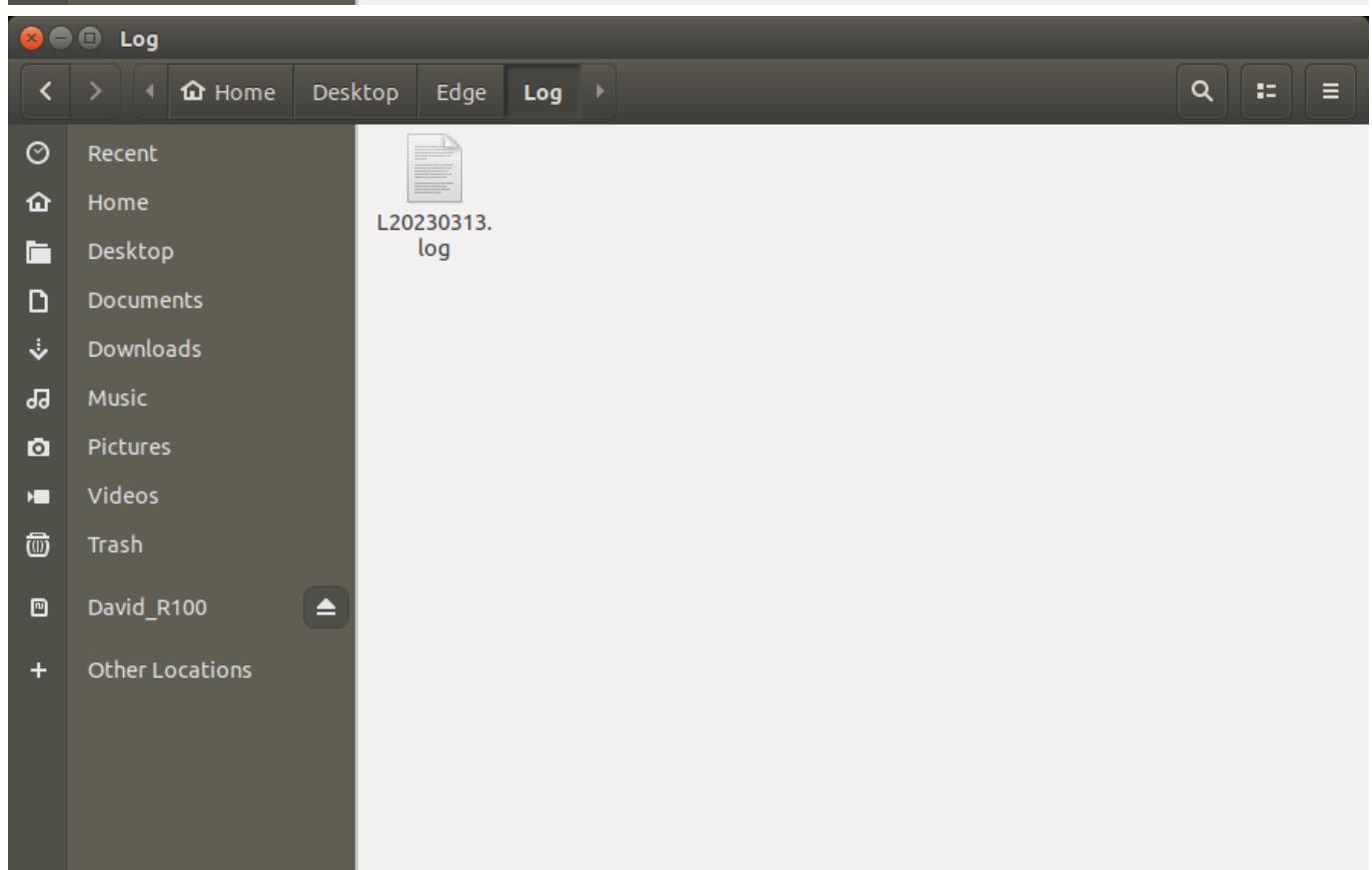
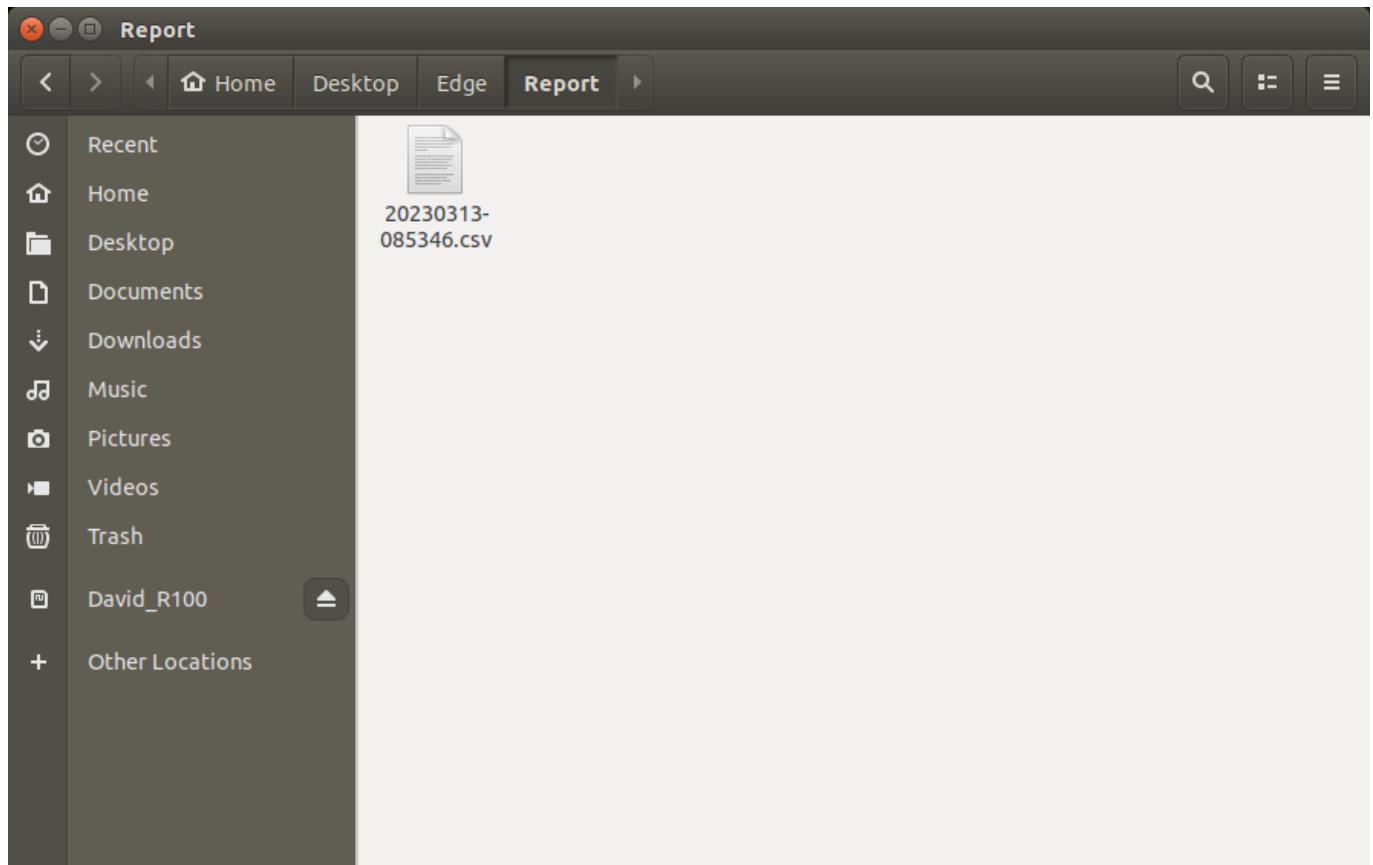
- Run Code

```
python3 edge.py
```



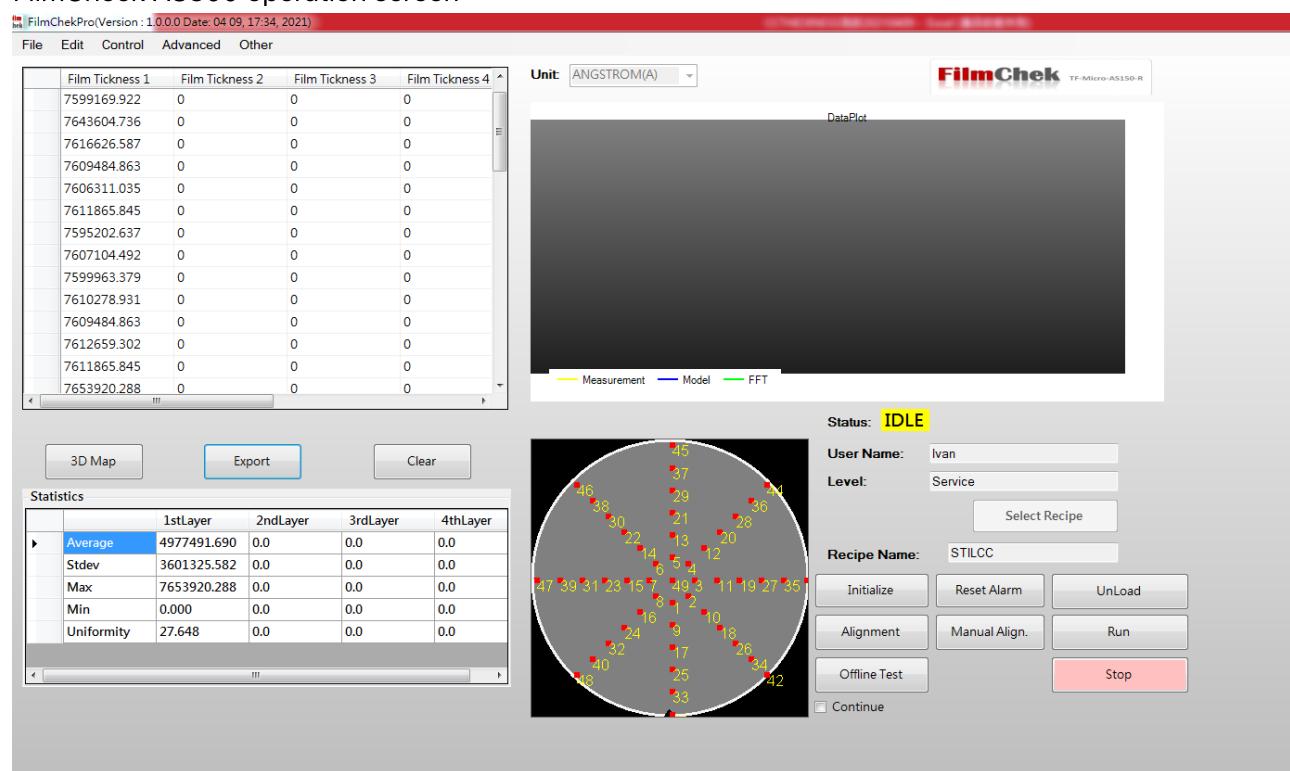
```
ubuntu@ubuntu: ~/Desktop/Edge
5 下午 02:43:47', 14006.498], [54381.455, 0.0, 0.0, 0.0, -44.5, -136.95, '2021/3
/5 下午 02:43:48', 13950.311], [54385.33, 0.0, 0.0, 0.0, -15.05, -143.21, '2021/
3/5 下午 02:43:50', 14028.18], [54418.27, 0.0, 0.0, 0.0, 15.05, -143.21, '2021/3
/5 下午 02:43:52', 14034.29], [54408.216, 0.0, 0.0, 0.0, 44.5, -136.95, '2021/3/
5 下午 02:43:53', 14056.79], [54415.994, 0.0, 0.0, 0.0, 72.0, -124.71, '2021/3/5
下午 02:43:55', 14111.427], [54428.251, 0.0, 0.0, 0.0, 96.35, -107.01, '2021/3/
5 下午 02:43:56', 14148.052], [54460.895, 0.0, 0.0, 0.0, 116.5, -84.64, '2021/3/
5 下午 02:43:58', 14150.093], [56477.038, 0.0, 0.0, 0.0, 131.55, -58.57, '2021/3
/5 下午 02:43:59', 14119.143], [54421.351, 0.0, 0.0, 0.0, 140.85, -29.94, '2021/
3/5 下午 02:44:01', 14204.9], [54638.579, 0.0, 0.0, 0.0, -10.7, 11.25, '2021/3/5
下午 02:44:04', 13905.989], ['Standard Deviation', 769.93, nan, nan, nan, nan,
nan, nan], ['Average', 54954.8, nan, nan, nan, nan, nan], ['Uniformity', 98
.599, nan, nan, nan, nan, nan], ['Max', 56477.038, nan, nan, nan, nan, nan],
['Min', 54210.831, nan, nan, nan, nan, nan], ['Max - Min', 2266.207,
nan, nan, nan, nan, nan]]
CSV File transform successfully !
blob_client: {'etag': '"0x8DB235D9E09CF51"', 'last_modified': datetime.datetime(
2023, 3, 13, 0, 55, 19, tzinfo=datetime.timezone.utc), 'content_md5': bytearray(
b'\v\x93\x89\xd4p*\xec\x03\x03?\x8a\x02*5\x12\xf3'), 'client_request_id': 'b982b2
90-c139-11ed-b6fe-00e04c68a529', 'request_id': 'c5e93fc9-b01e-000d-6e46-559b2100
0000', 'version': '2021-08-06', 'version_id': None, 'date': datetime.datetime(20
23, 3, 13, 0, 55, 19, tzinfo=datetime.timezone.utc), 'request_server_encrypted':
True, 'encryption_key_sha256': None, 'encryption_scope': None}
```

- After receiving the log information from FilmCheck AS300, Edge will store the log information locally and upload it to Azure Blob at 5:00 every day. Similarly, upon receiving the report information from FilmCheck AS300, Edge will store the report information locally and upload it to Azure Blob in real-time.



12. Launch the program for FilmCheck AS300

- FilmCheck AS300 operation screen

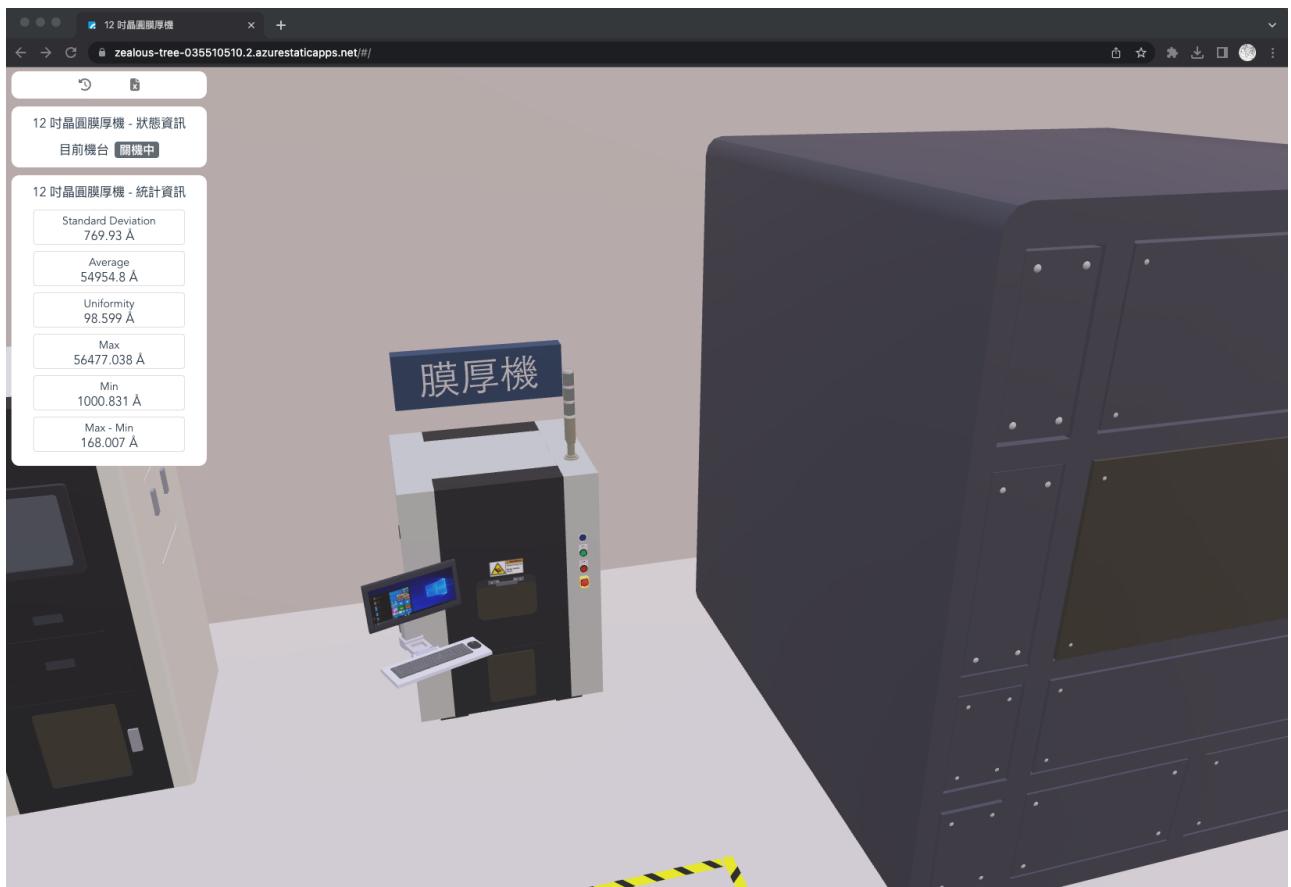


13. Confirming the results from Azure Digital Twins 3D Scenes Studio

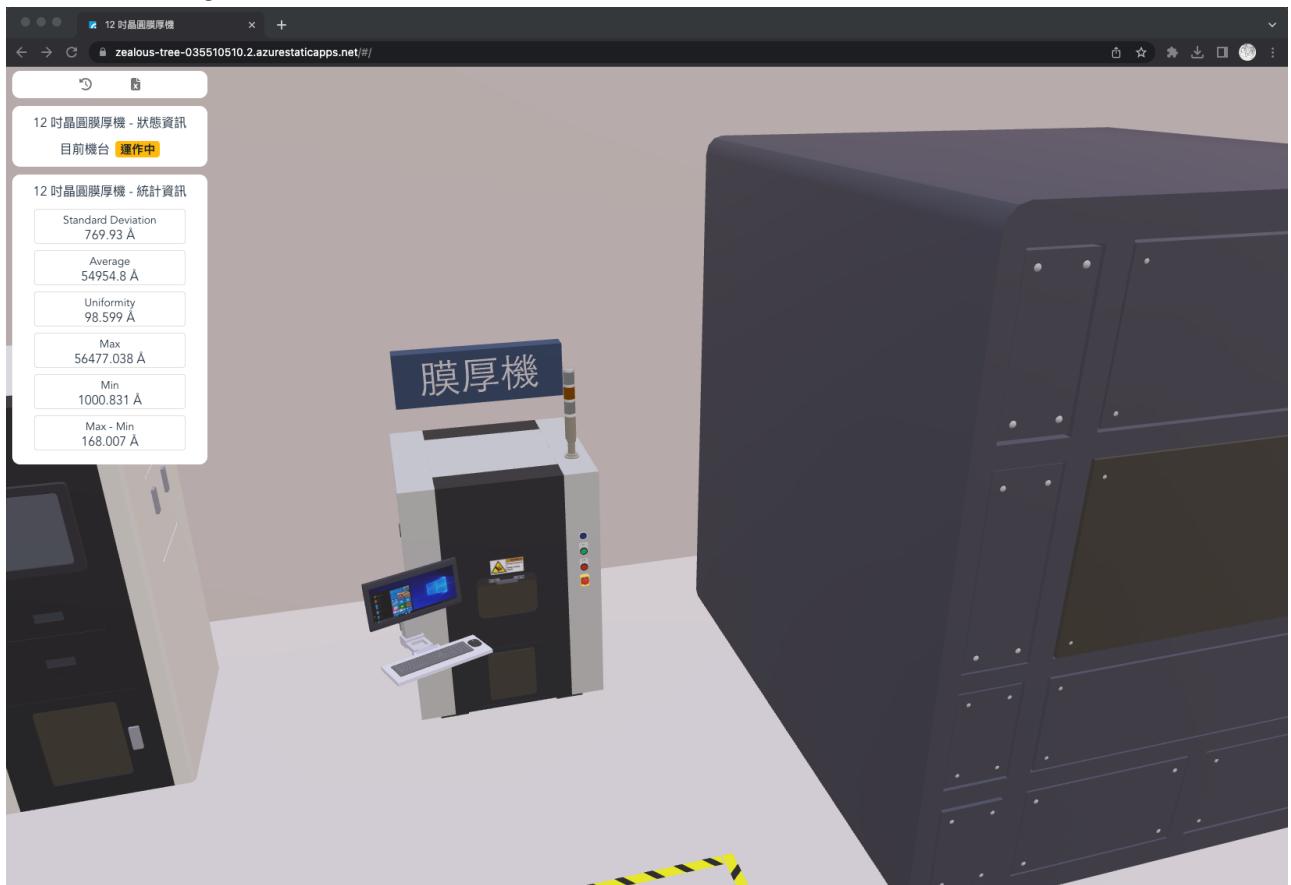


14. Confirming the results from the Frontend

- Machine idle



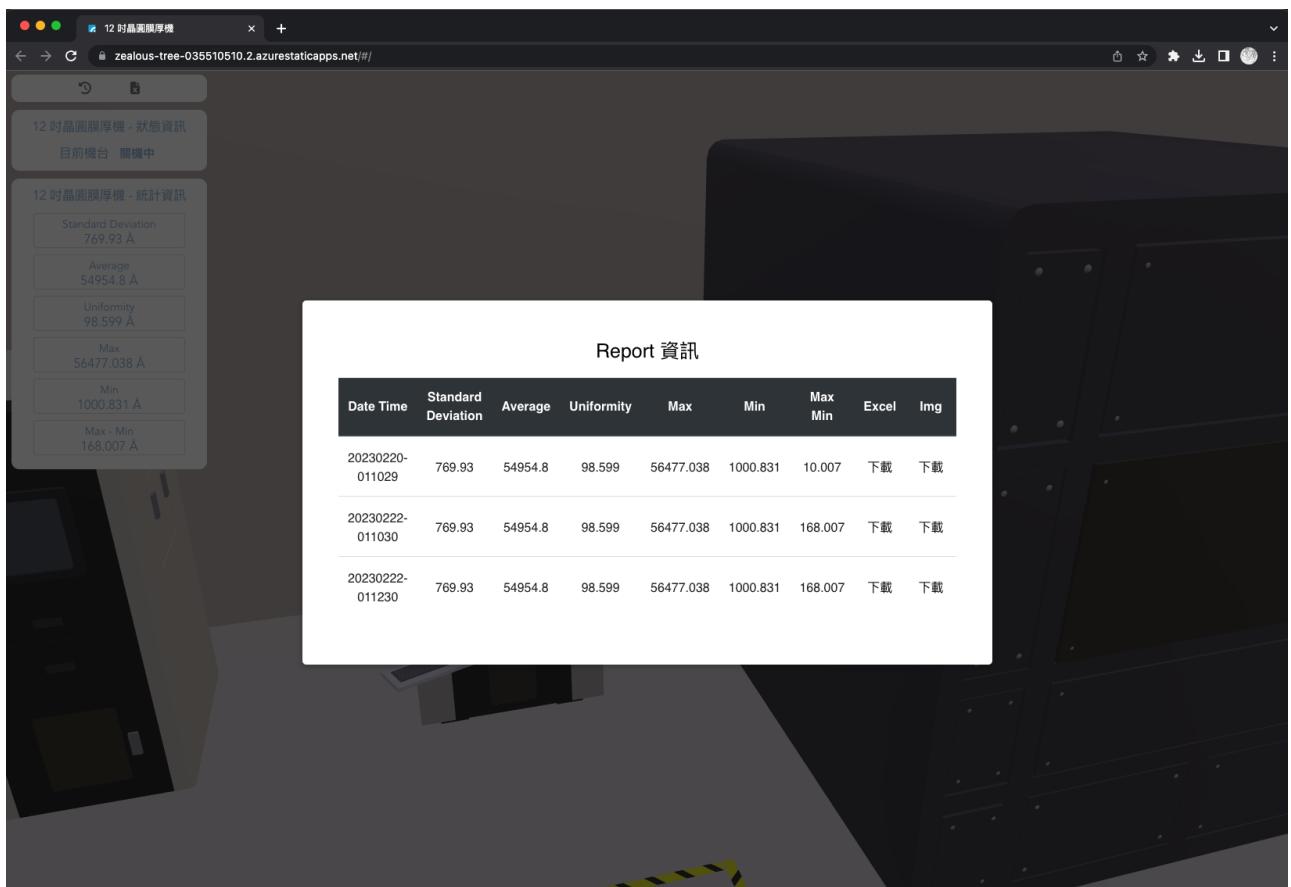
- Machine running



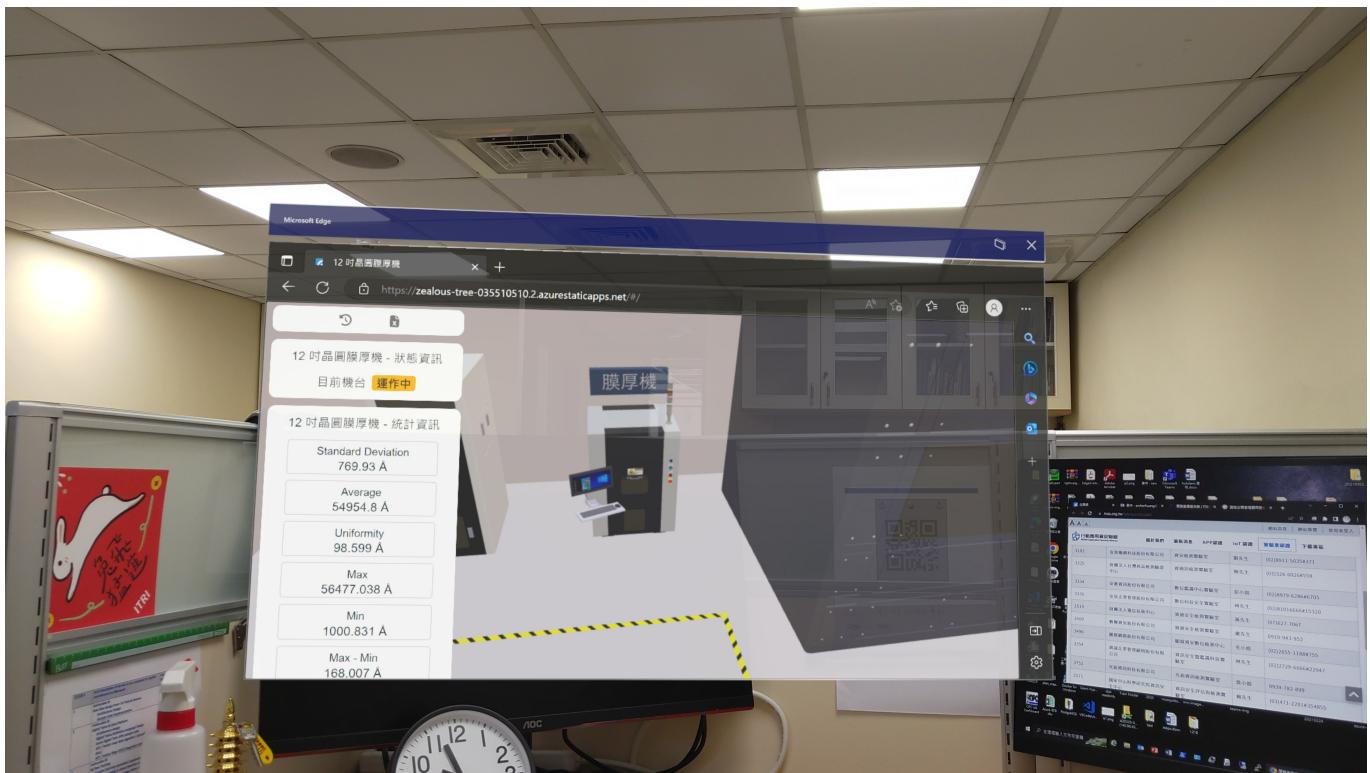
- Machine malfunction



- Machine statistics information



15. Confirming the results from the Microsoft HoloLens



16. Analysis and Learning of Film Thickness Data

- Enter **Azure Machine Learning** in the search box above and click on **Azure Machine Learning** in the search results.

- Click on the **+ Create** button in the upper left corner. > Then click on **New Workspace**.

- Enter the relevant information.

Azure Machine Learning ...

Create a machine learning workspace

Basics Networking Advanced Tags Review + create

Resource details

Every workspace must be assigned to an Azure subscription, which is where billing happens. You use resource groups like folders to organize and manage resources, including the workspace you're about to create.

[Learn more about Azure resource groups](#)

Subscription *

Resource group * [Create new](#)

Workspace details

Configure your basic workspace settings like its storage connection, authentication, container, and more. [Learn more](#)

Workspace name *

Region *

Storage account * [Create new](#)

Key vault * [Create new](#)

Application insights * [Create new](#)

Container registry * [Create new](#)

[Review + create](#) [< Previous](#) [Next : Networking](#)

Azure Machine Learning ...

Create a machine learning workspace

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Application insights * [Create new](#)

Container registry * [Create new](#)

[Review + create](#) [< Previous](#) [Next : Networking](#)

- After verifying the relevant information, click on **Create** in the lower left corner.

- During the creation process.

- After the creation is completed, please click on **Go to resource**.

- Click on **Launch studio**.

The screenshot shows the Microsoft Azure Machine Learning workspace overview page. On the left, there's a sidebar with sections like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Events, Settings (Networking, Properties, Locks), Monitoring (Alerts, Metrics, Diagnostic settings, Logs), and Compute. The main area displays workspace details: Resource group: adt-ml, Location: Japan East, Subscription: Azure, Subscription ID: adtm1273861399, Storage: adtm1273861399. It also shows the Studio web URL: <https://ml.azure.com/tid>, Container Registry: adtm, Key Vault: adtm3999658526, Application Insights: adtm5989354107, and MLflow tracking URI: azurerm://japaneast.api.azureml.ms/mlflow/v1.0/subscriptions/095c17da... . A large 'Launch studio' button is prominently displayed in the center.

- Click on **Compute** on the left side to create a compute resource.

The screenshot shows the Microsoft Azure Machine Learning Studio workspace. The sidebar on the left has options like Home, Notebooks, Automated ML, Designer, Assets, Data, Jobs, Components, Pipelines, Environments, Models, Endpoints, Manage, and Compute. The Compute option is highlighted with a red circle. The main area shows recent resources: Jobs, Compute, Models, Data. Under Compute, there are four cards: Create new (Notebooks, Automated ML, Designer). Below this is a section for Recent resources showing 'No jobs to display'.

- Click on the **+ New** button below.

The screenshot shows the Microsoft Azure Machine Learning Studio workspace. The sidebar on the left has options like Home, Notebooks, Automated ML, Designer, Assets, Data, Jobs, Components, Pipelines, Environments, Models, Endpoints, Manage, Compute, Linked Services, and Data Labeling. The Compute option is highlighted with a red circle. The main area shows the Compute section with tabs: Compute instances, Compute clusters, Kubernetes clusters, Attached computes. It features a cloud icon and text: 'Get started with Azure Machine Learning notebooks and R scripts by creating a compute instance'. Below this is a 'Compute instances' card with a '+ New' button highlighted with a red circle. Other buttons include 'View Azure Machine Learning tutorials' and 'View available quota'.

- After selecting the desired CPU or GPU specifications, click on Create below.

Create compute instance

Required Settings

Configure required settings
Select the name and virtual machine size you would like to use for your compute instance. Please note that a compute instance can not be shared. It can only be used by a single assigned user. By default, it will be assigned to the creator and you can change this to a different user in the advanced settings section.

Compute name * mmosconi2

Location japaneast

Virtual machine type CPU GPU

Virtual machine size Select from recommended options Select from all options

Name ↑	Category	Workload types	Available quota	Cost
Standard_DS11_v2 2 cores, 14GB RAM, 28GB storage	Memory optimized	Development on Notebooks (or other IDE) and light weight testing	268 cores	\$0.23/hr
Standard_DS3_v2 4 cores, 14GB RAM, 28GB storage	General purpose	Classical ML model training on small datasets	268 cores	\$0.41/hr
Standard_DS12_v2 4 cores, 28GB RAM, 56GB storage	Memory optimized	Data manipulation and training on medium-sized datasets (1-10GB)	268 cores	\$0.46/hr
Standard_D13_v2 8 cores, 56GB RAM, 400GB storage	Memory optimized	Data manipulation and training on large datasets (> 10 GB)	268 cores	\$0.92/hr

Create

- During the creation process

Compute

The 'Kubernetes clusters' tab is now where you can access previous versions of "inference clusters" (also known as "AKS clusters") and "attached Kubernetes" compute types along with any previously created compute targets using those types. Learn more about Kubernetes clusters.

Compute instances Compute clusters Kubernetes clusters Attached computes

+ New Refresh Start Stop Restart Schedule Delete Edit columns Reset view View quota

Search Show all instances State All filters Clear all

Name	State	Applications	Size	Created on	Assigned to
mmosconi2	Creating		STANDARD_DS12_V2	Mar 1, 2023 8:18 AM	Archer Huang

- Click on Notebooks in the upper left corner.

Notebooks is your space to add, browse, and edit files.

You can add files of any type, including Jupyter Notebooks (.ipynb). The files you see here are stored in the workspace file share, and are accessible and shared within the workspace.

In order to run notebooks and scripts, you must connect to an Azure Machine Learning compute resource. Once a notebook or terminal is connected, you can access all workspace assets including experiment details, data, models, and more. [Learn more](#)

+ Files Terminal

- Create a notebook.

- Click on the symbol. > Then click on **Upload folder**.

Notebooks is your space to add, browse, and edit files.

You can add files of any type, including Jupyter Notebooks (.ipynb). The files you see here are stored in the workspace file share, and are accessible and shared within the workspace.

In order to run notebooks and scripts, you must connect to an Azure Machine Learning compute resource. Once a notebook or terminal is connected, you can access all workspace assets including experiment details, data, models, and more. [Learn more](#)

+ Files Terminal

- Click on **Click to browse and select folder(s)**.

Upload folder

Folder upload location
Users/mmosconii [Edit location](#)

Folder(s) selected:

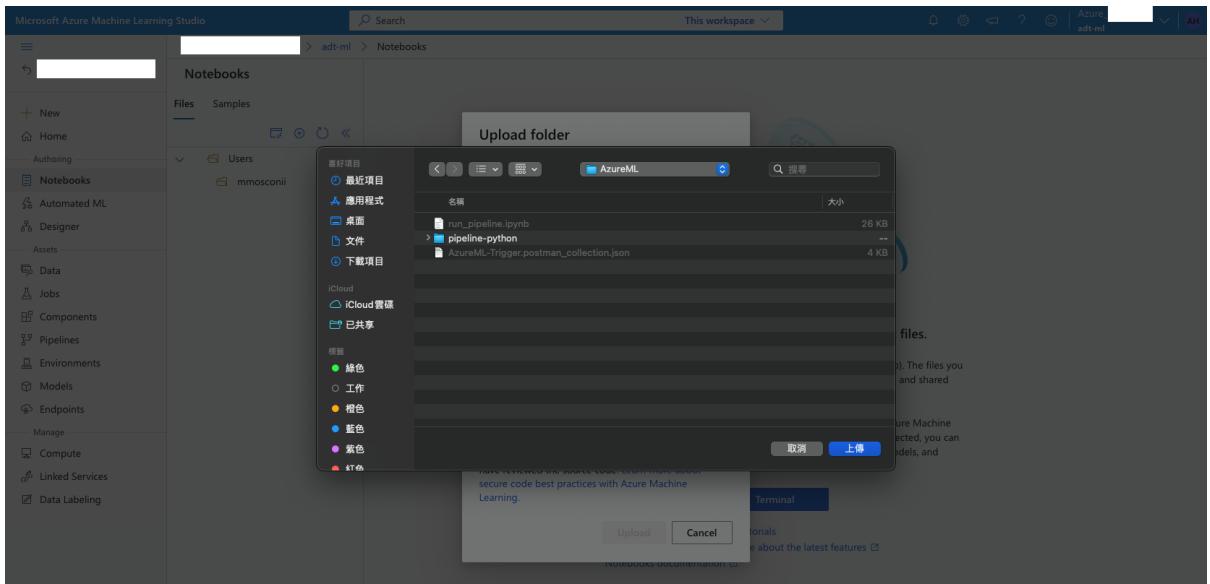
Overwrite if already exists

I trust contents of this file *

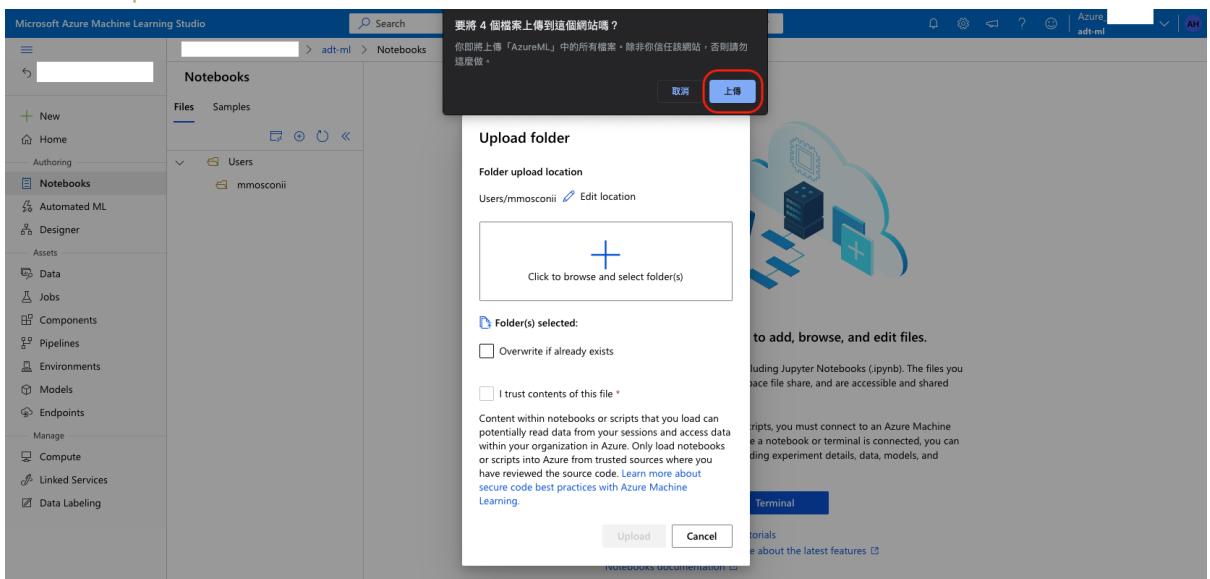
Content within notebooks or scripts that you load can potentially read data from your sessions and access data within your organization in Azure. Only load notebooks or scripts into Azure from trusted sources where you have reviewed the source code. [Learn more](#) about secure code best practices with Azure Machine Learning.

Upload Cancel

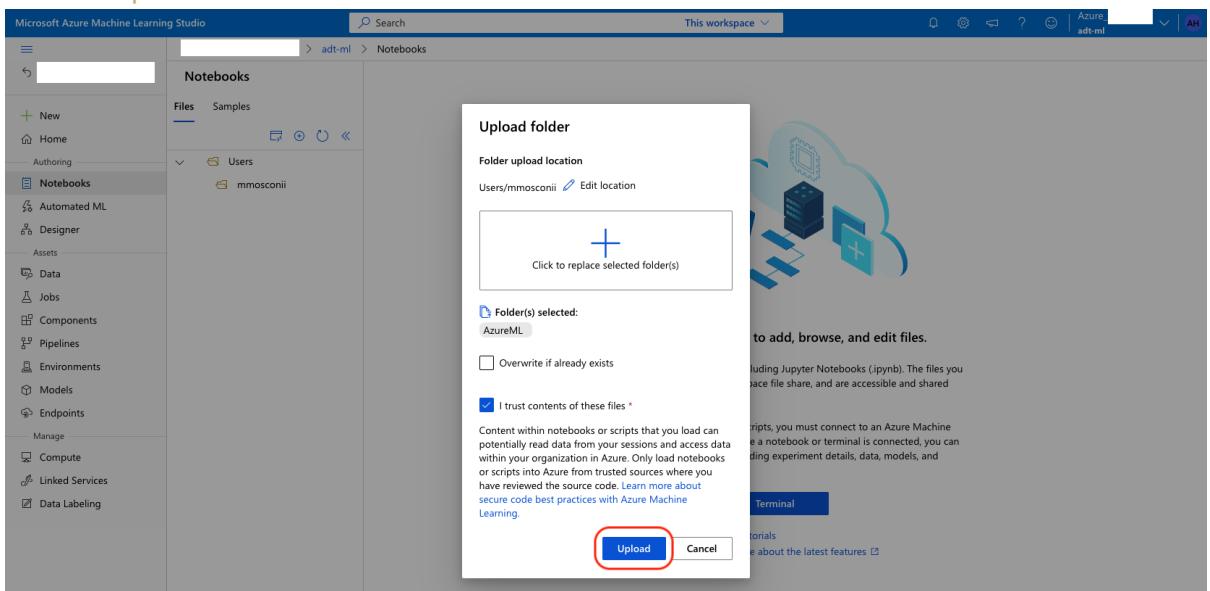
- Upload the files from the Azure-Digital-Twins-End-To-End-Sample/AzureML.



- Click on **Upload**.



- Click on **Upload**.



- Upload completed.

The screenshot shows the Microsoft Azure Machine Learning Studio interface. The left sidebar has 'Notebooks' selected. The main area shows a tree view of files under 'Users/mmosconi/AzureML/pipeline-python'. A file named 'run_pipeline.ipynb' is highlighted with a red box. To the right is a decorative cloud icon with a laptop and server. Below the tree view is a note about notebooks being a space to add, browse, and edit files. It also includes links to tutorials, release notes, and documentation.

- Click on `run_pipeline.ipynb`.

This screenshot is identical to the one above, showing the 'Notebooks' section of the Azure Machine Learning Studio. The 'run_pipeline.ipynb' file is again highlighted with a red box. The interface includes the same sidebar, tree view, decorative icon, and explanatory text as the first screenshot.

- Click on the **Python 3.8 – AzureML** execution environment in the upper right corner (green light indicates it is running).

請於右上角選擇「Azure 3.8 - AzureML」環境

安裝 azureml-pipeline 套件

```
1 !pip3 install azureml-pipeline
Press shift + enter to run
```

安裝套件與確認 SDK 版本

```
1 import os
2 import azureml.core
3 from azureml.core import (
4     Workspace,
5     Experiment,
6     Dataset,
7     Datastore,
8     ComputeTarget,
9     Environment,
10    ScriptRunConfig
11 )
```

- Confirm that the **Compute instance** is running (green light indicates it is running).

請於右上角選擇「Azure 3.8 - AzureML」環境

安裝 azureml-pipeline 套件

```
1 !pip3 install azureml-pipeline
Press shift + enter to run
```

安裝套件與確認 SDK 版本

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1 import os
2 import azureml.core
3 from azureml.core import (
4     Workspace,
5     Experiment,
6     Dataset,
7     Datastore,
8     ComputeTarget,
9     Environment,
10    ScriptRunConfig
11 )
```

- The relevant code

- Execute the **安裝套件與確認 SDK 版本** code block.

■ Click on the left side ▶ symbol.

```

import os
import azureml.core
from azureml.core import (
    Workspace,
    Experiment,
    Dataset,
    Datastore,
    ComputeTarget,
    Environment,
    ScriptRunConfig
)
from azureml.data import OutputFileDatasetConfig
from azureml.core.compute import AmlCompute
from azureml.core.compute_target import ComputeTargetException
from azureml.pipeline.steps import PythonScriptStep
from azureml.pipeline.core import Pipeline
from azureml.core.runconfig import RunConfiguration
from azureml.core.conda_dependencies import CondaDependencies
from azureml.pipeline.core import PublishedPipeline
from azureml.pipeline.core import PipelineData
# check core SDK version number
print("Azure ML SDK Version: ", azureml.core.VERSION)

```

■ The execution result

```

import os
import azureml.core
from azureml.core import (
    Workspace,
    Experiment,
    Dataset,
    Datastore,
    ComputeTarget,
    Environment,
    ScriptRunConfig
)
from azureml.data import OutputFileDatasetConfig
from azureml.core.compute import AmlCompute
from azureml.core.compute_target import ComputeTargetException
from azureml.pipeline.steps import PythonScriptStep
from azureml.core.runconfig import RunConfiguration
from azureml.core.conda_dependencies import CondaDependencies
from azureml.pipeline.core import PublishedPipeline
from azureml.pipeline.core import PipelineData
# check core SDK version number
print("Azure ML SDK Version: ", azureml.core.VERSION)
✓ <1 sec
... Azure ML SDK Version: 1.48.0

```

- Execute the 配置工作環境 code block.

■ Click on the left side ▶ symbol.

```

workspace = Workspace.from_config()
print("workspace: (workspace)")
exp = Experiment(workspace=workspace, name="test-fashion")

```

■ The execution result

```

workspace = Workspace.from_config()
print("workspace: (workspace)")
exp = Experiment(workspace=workspace, name="test-fashion")
✓ <1 sec
... workspace: Workspace.create(name='adt-ml', subscription_id='095c17da-056e-43f2-8d52-a30d1bdb6423', resource_group='adt-ml')

```

- Execute the 連接已有的 Blob code block.

- Modify lines 3, 4, and 5.

```

1 from azureml.core import Datastore
2 blob_datastore_name = 'adt3dstorageaccount'
3 blob_container_name = 'adt3dstorageaccount'
4 blob_account_key = '7xYjkMRkNNXKxJkqcTSRdsGqRUrtrzAmNdafkuLEBT2MpC9jW/Klm8gKD79nhqd...'
5 blob_container_name = 'adt'
6 blob_datastore = Datastore.register_azure_blob_container(workspace=workspace,
7                                         datastore_name=blob_datastore_name,
8                                         container_name=blob_container_name,
9                                         account_name=blob_account_name,
10                                        account_key=blob_account_key)

```

- Replace the right-hand side of the equal sign in **line 3** with the obtained **Storage account name**.

adt3dstorageaccount | Access keys

Storage account

Data storage

- Containers
- File shares
- Queues
- Tables

Security + networking

- Networking
- Azure CDN
- Access keys
- Shared access signature
- Encryption
- Microsoft Defender for Cloud

Data management

Storage account name: adt3dstorageaccount

key1 Rotate key

Last rotated: 2023/3/9 (1 days ago)

Key: 7xYjkMRkNNXKxJkqcTSRdsGqRUrtrzAmNdafkuLEBT2MpC9jW/Klm8gKD79nhqd...

Connection string: *****

key2 Rotate key

Last rotated: 2023/3/9 (1 days ago)

- Replace the right side of the equal sign in **line 4** with the obtained **Key**.

adt3dstorageaccount | Access keys

Storage account

Data storage

- Containers
- File shares
- Queues
- Tables

Security + networking

- Networking
- Azure CDN
- Access keys
- Shared access signature
- Encryption
- Microsoft Defender for Cloud

Data management

Storage account name: adt3dstorageaccount

key1 Rotate key

Last rotated: 2023/3/9 (1 days ago)

Key: 7xYjkMRkNNXKxJkqcTSRdsGqRUrtrzAmNdafkuLEBT2MpC9jW/Klm8gKD79nhqd...

Connection string: *****

key2 Rotate key

Last rotated: 2023/3/9 (1 days ago)

- Replace the right-hand side of the equal sign in **line 5** with the created blob container.

The screenshot shows the Microsoft Azure Storage account interface for 'adt3dstorageaccount'. In the left sidebar, under 'Data storage', the 'Containers' link is highlighted with a red circle. The main area displays a table of containers. One row for 'adt' is circled in red, showing details: Name 'adt', Last modified '3/9/2023, 9:55:10 AM', Public access level 'Blob', Lease state 'Available', and three-dot ellipsis.

■ Click on the left side ▶ symbol.

The screenshot shows the Microsoft Azure Machine Learning Studio interface. On the left, the 'Notebooks' section is selected. In the center, a notebook titled 'run_pipeline.ipynb' is open. To its right, a code editor window also displays the same notebook file. A red circle highlights the right-side navigation arrow icon (▶) located between the notebook names.

■ The execution result

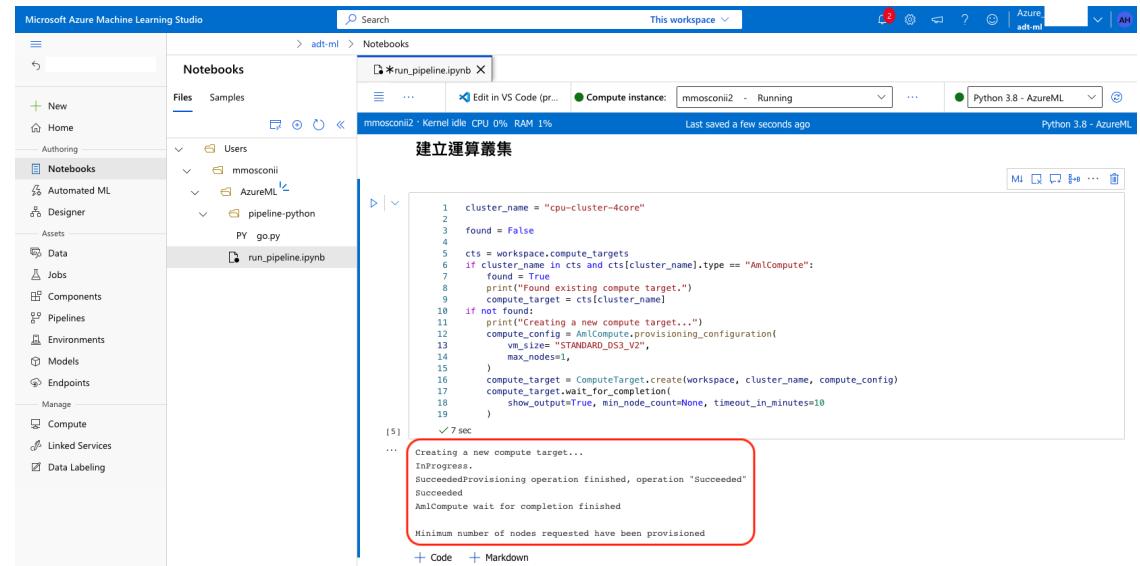
This screenshot is identical to the previous one, showing the Microsoft Azure Machine Learning Studio interface with the 'Notebooks' section selected. It displays the 'run_pipeline.ipynb' notebook and its execution results. A red circle highlights the right-side navigation arrow icon (▶) next to the notebook name.

○ Execute the 建立運算叢集 code block.

■ Click on the left side ▶ symbol.

The screenshot shows the Microsoft Azure Machine Learning Studio interface. The 'Notebooks' section is selected on the left. In the center, a notebook titled 'run_pipeline.ipynb' is open, and a code editor window to its right shows a code block titled '建立運算叢集'. A red circle highlights the right-side navigation arrow icon (▶) next to the notebook name.

■ The execution result



- Execute the 設定執行環境的 `config` code block.

- Click on the left side ▷ symbol.



■ The execution result



- Execute the 建立 Python 腳本步驟 code block.

■ Click on the left side ▶ symbol.

```

建立 Python 腳本步驟

1 datastore = workspace.get_default_datastore()
2 processed_data = PipelineData('processed_data', datastore=datastore)
3
4 script_folder = './pipeline-python'
5
6 prep_step = PythonScriptStep(
7     name="go step",
8     script_name="go.py",
9     arguments=[
10         '--output_path', processed_data,
11         '--blob_datastore_name', blob_datastore_name,
12         '--blob_account_name', blob_account_name,
13         '--blob_account_key', blob_account_key,
14         '--blob_container_name', blob_container_name,
15     ],
16     outputs=[processed_data],
17     source_directory=script_folder,
18     compute_target=compute_target,
19     runconfig=run_config,
20     allow_reuse=False,
21 )
22
23 pipeline = Pipeline(workspace, steps=[prep_step])
24 print("Pipeline is built")
    
```

■ The execution result

```

建立 Python 腳本步驟

1 datastore = workspace.get_default_datastore()
2 processed_data = PipelineData('processed_data', datastore=datastore)
3
4 script_folder = './pipeline-python'
5
6 prep_step = PythonScriptStep(
7     name="go step",
8     script_name="go.py",
9     arguments=[
10         '--output_path', processed_data,
11         '--blob_datastore_name', blob_datastore_name,
12         '--blob_account_name', blob_account_name,
13         '--blob_account_key', blob_account_key,
14         '--blob_container_name', blob_container_name,
15     ],
16     outputs=[processed_data],
17     source_directory=script_folder,
18     compute_target=compute_target,
19     runconfig=run_config,
20     allow_reuse=False,
21 )
22
23 pipeline = Pipeline(workspace, steps=[prep_step])
24 print("Pipeline is built")
    
```

(7)

Pipeline is built

- Execute the 部署成 pipeline 與儲存 pipeline ID code block.

■ Click on the left side ▶ symbol.

```

部署成 pipeline 與儲存 pipeline ID

1 published_pipeline = pipeline.publish(name="blob-trigger-pipeline", description="blob-trigger-pipeline", continue_on_step_failure=True)
2 open('pipeline.id', 'w').write(published_pipeline.id)
    
```

■ The execution result

```

部署成 pipeline 與儲存 pipeline ID

1 published_pipeline = pipeline.publish(name="blob-trigger-pipeline", description="blob-trigger-pipeline", continue_on_step_failure=True)
2 open('pipeline.id', 'w').write(published_pipeline.id)
    
```

(8)

Created step go step [5a967a43](9096e6b5b-4bf7-454b-bb7b-4cd978340819), (This step will run and generate new outputs)

- Create an AzureML Pipeline that is triggered when a report file is uploaded to Blob.

- Click on the **Pipelines** button on the left-hand side. > Click on the **Pipeline endpoints** button at the top. > Click on the **blob-trigger-pipeline**.

The screenshot shows the Microsoft Azure Machine Learning Studio interface. On the left sidebar, the 'Pipelines' option is selected and highlighted with a red box. In the main content area, the 'Pipeline endpoints' tab is selected. A single pipeline endpoint named 'blob-trigger-pipeline' is listed in the table. The table columns include Name, Description, Date updated, Updated by, Last job submit time, Last job status, and Status. The pipeline has a status of 'Active'.

- Copy the URL under **REST endpoints**

The screenshot shows the details of the 'blob-trigger-pipeline'. In the 'Published pipeline overview' section, the 'REST endpoints' field contains a URL: <https://japaneast.api.azureml.ms/pipelines/v1.0/subscriptions/.../resourceGroups/adt-ml/providers/Microsoft.MachineLearningServices/workspaces/adt-ml/PipelineRuns/PipelineSubmit/823e600d-a44c-421c-b441-78ebd221c68c>. This URL is highlighted with a red box.

- Set parameters

- EXPERIMENT_NAME

- Commands for macOS and Ubuntu environment

```
export EXPERIMENT_NAME='blob-trigger-pipeline'
echo $EXPERIMENT_NAME
```

```
archer@ArcherdeMacBook-Pro ~ % export EXPERIMENT_NAME='blob-trigger-pipeline'
archer@ArcherdeMacBook-Pro ~ % echo $EXPERIMENT_NAME
blob-trigger-pipeline
archer@ArcherdeMacBook-Pro ~ %
```

- TRIGGER_ML_ENDPOINT

- Commands for macOS and Ubuntu environment

```
export TRIGGER_ML_ENDPOINT='the REST endpoint URL
obtained earlier'
echo $TRIGGER_ML_ENDPOINT
```

```

archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % export TRIGGER_ML_ENDPOINT='https://japaneast.api.azureml.ms/pipelines/v1.0/subscriptions/095c17da-056e-43f2-8d52-a301bdb6423/resourceGroups/adt-3d-rg/providers/Microsoft.MachineLearningServices/workspaces/adt-ml/PipelineRuns/PipelineSubmit/8f30a668-964e-4b32-bd3c-aeb9f80e75d2'
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample % echo $TRIGGER_ML_ENDPOINT
https://japaneast.api.azureml.ms/pipelines/v1.0/subscriptions/095c17da-056e-43f2-8d52-a301bdb6423/resourceGroups/adt-3d-rg/providers/Microsoft.MachineLearningServices/workspaces/adt-ml/PipelineRuns/PipelineSubmit/8f30a668-964e-4b32-bd3c-aeb9f80e75d2
archer@ArcherdeMacBook-Pro Azure-Digital-Twins-End-To-End-Sample %

```

- Switch working directory (Blob Trigger)

```
cd ../Blob_Trigger
```

- Modify the content of **development** in the **config/config.json** file (**username**、**password**、**database**)

```
{
  "development": {
    "username": "Please modify it with the information obtained earlier.",
    "password": "Please modify it with the information obtained earlier.",
    "database": "Please modify it with the information obtained earlier.",
    "host": "Please modify it with the information obtained earlier.",
    "dialect": "postgres",
    "ssl": true,
    "dialectOptions": {
      "ssl": {
        "require": true
      }
    },
  }
}
```

- Create a Blob Trigger Container Apps Environments (Blob Trigger)

- Commands for macOS and Ubuntu environment

```
az containerapp env create \
--name $ACA_ENVIRONMENT_BLOB \
--resource-group $RESOURCE_GROUP \
--location $REGION
```

```
archerArcherdeMacBook-Pro Blob_Trigger % az containerapp env create \
--name $ACA_ENVIRONMENT_BLOB \
--resource-group $RESOURCE_GROUP \
--location $LOCATION
No Log Analytics workspace provided.
Generating a Log Analytics workspace with name "workspace-adt3drg5lwh"
Container Apps environment created. To deploy a container app, use: az containerapp create --help

{
  "id": "subscriptions//resourceGroups/adt-3d-rg/providers/Microsoft.App/managedEnvironments/env-region-containerrapps-blob",
  "location": "japaneast",
  "name": "env-region-containerrapps-blob",
  "properties": {
    "appLogsConfiguration": {
      "destination": "log-analytics",
      "logAnalyticsConfiguration": {
        "customerId": "a7c09f86-8362-41b5-a7fb-79f20560c8fd"
      }
    },
    "customDomainConfiguration": {
      "customDomainVerificationId": "2B3A4472823479CD4AE58DAE1FD7BF82DE7C7BA43AD366A7836CE6800B76"
    },
    "deafultDomain": "purple-rock-d1d319.japaneast.azurecontainerapps.io",
    "eventStreamEndpoint": "https://japaneast.azurecontainerapps.dev/subscriptions//resourceGroups/adt-3d-rg/managedEnvironments/env-region-containerrapps-blob/eventstream",
    "provisioningState": "Succeeded",
    "staticIp": "20.194.147.251",
    "zoneRedundant": false
  },
  "resourceGroup": "adt-3d-rg",
  "tags": {},
  "timeCreated": "2023-03-10T06:28:18.9695781",
  "timeCreatedUtc": "2023-03-10T06:28:18.9695781",
  "createdAt": "2023-03-10T06:28:18.9695781",
  "createdBy": "msconci@gmail.com",
  "createdByType": "User",
  "lastModified": "2023-03-10T06:28:18.9695781",
  "lastModifiedBy": "msconci@gmail.com",
  "lastModifiedByType": "User"
},
"type": "Microsoft.App/managedEnvironments"
}
archerArcherdeMacBook-Pro Blob_Trigger % ||
```

- Get default Domain (Blob Trigger)

- Commands for macOS and Ubuntu environment

```
az containerapp env show \
--name $ACA_ENVIRONMENT_BLOB \
--resource-group $RESOURCE_GROUP
```

```
archer@Archedre-MacBook-Pro ~ % az containerapp env show \
--name SACA_ENVIRONMENT_BLOB \
--resource-group $RESOURCE_GROUP
{
  "id": "/subscriptions/[REDACTED]/resourceGroups/adt-3d-rg/providers/Microsoft.App/managedEnvironments/env-region-containerapps-blob",
  "location": "japaneast",
  "name": "env-region-containerapps-blob",
  "properties": {
    "appLogsConfiguration": {
      "destination": "log-analytics",
      "logAnalyticsConfiguration": {
        "customerId": "a7e95f88-5352-418d-a7fb-79f28560c8fd"
      }
    },
    "customDomainConfiguration": {
      "customDomainName": "2B8A4472823479CD4EE58D450E1FD7BF820E7C78A43A0366A7B836CE6000D876"
    },
    "defaultDomain": "purplerock-cd14339.japaneast.azurecontainerapps.io",
    "eventStreamEndpoint": "https://[REDACTED].resourceGroups/adt-3d-rg.managedenvironments.env-region-containerapps-blob.eventstream",
    "ipAddress": "10.14.14.224",
    "staticIp": "20.194.147.224",
    "zoneRedundant": false
  },
  "resourceGroup": "adt-3d-rg",
  "systemData": {
    "createdAt": "2023-03-10T06:20:18.9695781",
    "createdBy": "mmosconi@gmail.com",
    "lastModifiedAt": "2023-03-10T06:20:18.9695781",
    "lastModifiedBy": "mmosconi@gmail.com",
    "lastModifiedByType": "User"
  },
  "type": "Microsoft.App/managedEnvironments"
}
archer@Archedre-MacBook-Pro ~ %
```

- Create the Blob Trigger Docker Image (Blob Trigger)

- Commands for macOS and Ubuntu environment

```
sudo docker buildx build . --platform linux/amd64 --push -t $ACR_NAME.azurecr.io/blob-trigger:0.1 -f docker-manifests/Dockerfile
```

- Deploy the Blob Trigger image to Azure Container App (Blob Trigger)

- Commands for macOS and Ubuntu environment

```
az containerapp create \
--name $ACA_NAME_BLOB \
--resource-group $RESOURCE_GROUP \
--environment $ACA_ENVIRONMENT_BLOB \
--registry-server $ACR_NAME.azurecr.io \
--image $ACR_NAME.azurecr.io/blob-trigger:0.1 \
--env-vars "EXPERIMENT_NAME=secretref:experiment-name" \
"TRIGGER_ML_ENDPOINT=secretref:trigger-ml-endpoint" \
--secrets "experiment-name=$EXPERIMENT_NAME" "trigger-ml- \
endpoint=$TRIGGER_ML_ENDPOINT" \
--min-replicas 1 \
--max-replicas 1 \
--ingress 'external' \
--target-port 80 \
--query properties.configuration.ingress.fqdn

"blobtrigger.ashysky- \
edb6ddb2.japaneast.azurecontainerapps.io"
```

```
archer@ArcherdeMacBook-Pro Blob_Trigger % az containerapp create \
--name $ACA_NAME_BLOB \
--resource-group $RESOURCE_GROUP \
--environment $ACA_ENVIRONMENT_BLOB \
--registry-server $ACR_NAME.azurecr.io \
--image $ACR_NAME.azurecr.io/blob-trigger:0.1 \
--env-vars "EXPERIMENT_NAME=secretref:experiment-name" "TRIGGER_ML_ENDPOINT=secretref:trigger-ml-endpoint" \
--secrets "experiment-name=$EXPERIMENT_NAME" "trigger-ml-endpoint=$TRIGGER_ML_ENDPOINT" \
--min-replicas 1 \
--max-replicas 1 \
--ingress 'external' \
--target-port 80 \
--query properties.configuration.ingress.fqdn
No credential was provided to access Azure Container Registry. Trying to look up credentials...
Adding registry password as a secret with name "containerforacazurecrio-containerforacr"
Container app created. Access your app at https://blobtrigger.purplerock-cd174319.japaneast.azurecontainerapps.io/
*blobtrigger.purplerock-cd174319.japaneast.azurecontainerapps.io*
archer@ArcherdeMacBook-Pro Blob_Trigger %
```

- URL obtained after Azure Container App for Blob Trigger is created.

```
archer@ArcherdeMacBook-Pro Blob_Trigger % az containerapp create \
--name $ACA_NAME_BLOB \
--resource-group $RESOURCE_GROUP \
--environment $ACA_ENVIRONMENT_BLOB \
--registry-server $ACR_NAME.azurecr.io \
--image $ACR_NAME.azurecr.io/blob-trigger:0.1 \
--env-vars "EXPERIMENT_NAME=secretref:experiment-name" "TRIGGER_ML_ENDPOINT=secretref:trigger-ml-endpoint" \
--secrets "experiment-name=$EXPERIMENT_NAME" "trigger-ml-endpoint=$TRIGGER_ML_ENDPOINT" \
--min-replicas 1 \
--max-replicas 1 \
--ingress 'external' \
--target-port 80 \
--query properties.configuration.ingress.fqdn
No credential was provided to access Azure Container Registry. Trying to look up credentials...
Adding registry password as a secret with name "containerforacazurecrio-containerforacr"
Container app created. Access your app at https://blobtrigger.purplerock-cd174319.japaneast.azurecontainerapps.io/
*blobtrigger.purplerock-cd174319.japaneast.azurecontainerapps.io*
archer@ArcherdeMacBook-Pro Blob_Trigger %
```

- Set **Azure role assignments** in the **Azure Container App** where the **Blob Trigger** was created. (ACA-blobtrigger)

- Click on the **Identity** on the left-hand side. > Click on the **System assigned** tab. > Set the **Status** to **On**. > Click the **Save** button.

■ Click on Yes.

■ Click on Azure role assignments.

■ Click on the + Add role assignment (Preview) button above.

■ Enter relevant information.

- Please select **Subscription** in the **Scope** field.
- Select **AzureML Data Scientist** for the **Role** field.

- After entering the above information, please click on **Save**.

The screenshot shows the 'Add role assignment (Preview)' dialog box overlaid on the Azure portal. The dialog has fields for 'Scope' (set to 'Subscription'), 'Role' (set to 'Select a role' and 'AzureML Data Scientist' is listed), and a link to 'Learn more about RBAC'. At the bottom are 'Save' and 'Discard' buttons, with 'Save' being highlighted by a red border.

- Input completed.

The screenshot shows the 'Azure role assignments' list. It displays one entry: 'AzureML Data Scientist' assigned to 'blobtrigger' with a 'Subscription' condition. The entire row is highlighted by a red border.

- Set up the Web hook to be triggered when a Blob is added.

- Click on the **Events** on the left side. > Then click on **More Options**. > Click on **Web Hook**.

The screenshot shows the Azure Storage account 'adt3dstorageaccount' Events page. The left sidebar lists various storage management options like Overview, Activity log, Tags, Diagnose and solve problems, Access Control (IAM), Data migration, and Events. The 'Events' option is highlighted with a red oval. At the top right, there are buttons for Event Subscription, Refresh, and Feedback. Below the sidebar, a main content area features a heading 'Events, automated.' and a brief description of Azure Event Grid. It includes links for Logic Apps, Azure Functions, and Azure Data Explorer, and a 'More Options' button which is also highlighted with a red oval. The main content area is divided into sections for different event handlers: Logic Apps, Azure Function, Web Hook, and Storage Queues. The 'Web Hook' section is highlighted with a red box.

- Enter relevant information.

- In the **Name** field, please enter a unique and identifiable name.
 - This example uses **blob-event-subscription**.
- In the **System Topic Name** field, please enter a unique and identifiable name.
 - This example uses **blob-event-topic**.
- In the **Filter to Event Types** field, please select **Blob Created** and **Blob Deleted**.
- In the **Endpoint Type** field, please select **Web Hook**.
- In the **Endpoint** field, please enter the URL obtained from the previous section **URL obtained after Azure Container App for Blob Trigger is created**.
- After completing the above information, please click on the **Create** button at the bottom left corner.

Microsoft Azure Search resources, services, and docs (G+)

Home > Storage accounts > adt3dstorageaccount | Events > Create Event Subscription

Event Grid

Basics Filters Additional Features Delivery Properties Advanced Editor

Event Subscriptions listen for events emitted by the topic resource and send them to the endpoint resource. [Learn more](#)

EVENT SUBSCRIPTION DETAILS

Name * ✓ 1

Event Schema

TOPIC DETAILS

Pick a topic resource for which events should be pushed to your destination. [Learn more](#)

Topic Type Storage account 2

Source Resource adt3dstorageaccount

System Topic Name * ✓ 3

EVENT TYPES

Pick which event types get pushed to your destination. [Learn more](#)

Filter to Event Types * 4

ENDPOINT DETAILS

Pick an event handler to receive your events. [Learn more](#)

Endpoint Type * Web Hook (change) 4

Endpoint * [Select an endpoint](https://blobtrigger.purplerock-cd174319.japaneast.azurecontainerapps.id) 5

6 **Select Web Hook** Event Grid

Feedback

Subscriber Endpoint * 7

Microsoft Azure Search resources, services, and docs (G+)

Home > Storage accounts > adt3dstorageaccount | Events > Create Event Subscription

Event Grid

Basics Filters Additional Features Delivery Properties Advanced Editor

Event Subscriptions listen for events emitted by the topic resource and send them to the endpoint resource. [Learn more](#)

EVENT SUBSCRIPTION DETAILS

Name * ✓

Event Schema

TOPIC DETAILS

Pick a topic resource for which events should be pushed to your destination. [Learn more](#)

Topic Type Storage account

Source Resource adt3dstorageaccount

System Topic Name * ✓

EVENT TYPES

Pick which event types get pushed to your destination. [Learn more](#)

Filter to Event Types *

ENDPOINT DETAILS

Pick an event handler to receive your events. [Learn more](#)

Endpoint Type * Web Hook (change)

Endpoint * <https://blobtrigger.purplerock-cd174319.japaneast.azurecontainerapps.id>

8 **Create** 7 **Confirm Selection**

8 **Create**

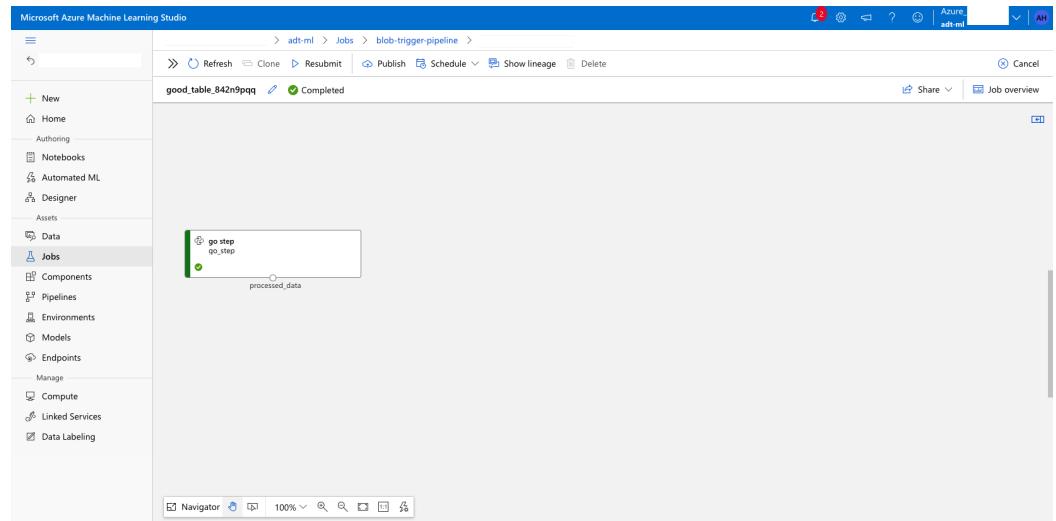
- Upload csv file through Edge to the created Blob to confirm that the pipeline has been triggered.

- The uploaded completed CSV file will be in the **Storage accounts > adt3dstorageaccount > Containers > adt > Report**.

- Verify the **Azure Machine Learning Pipeline**.

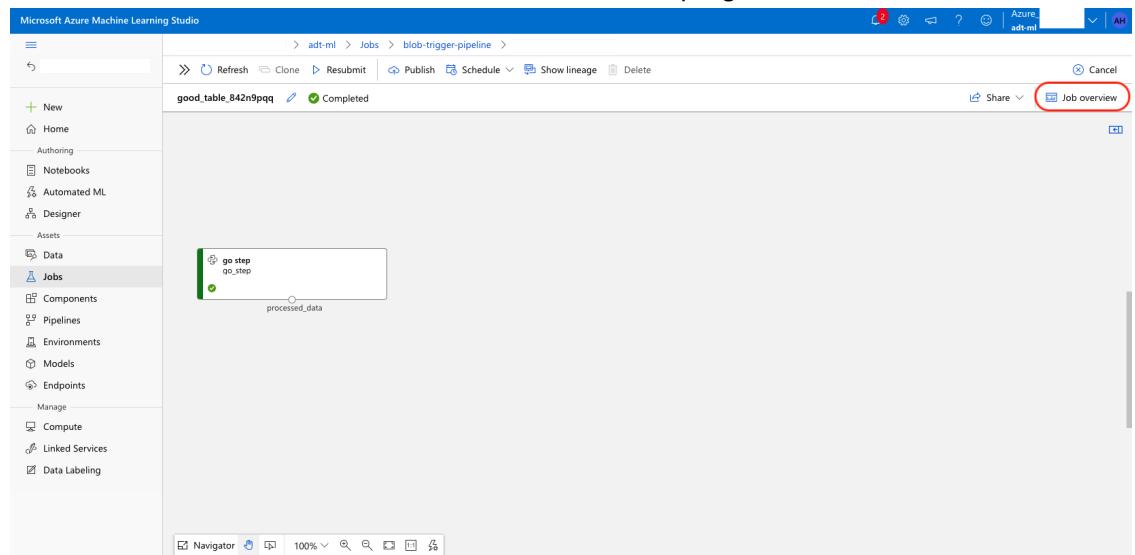
- Pipeline is executing.

■ Pipeline has completed execution.

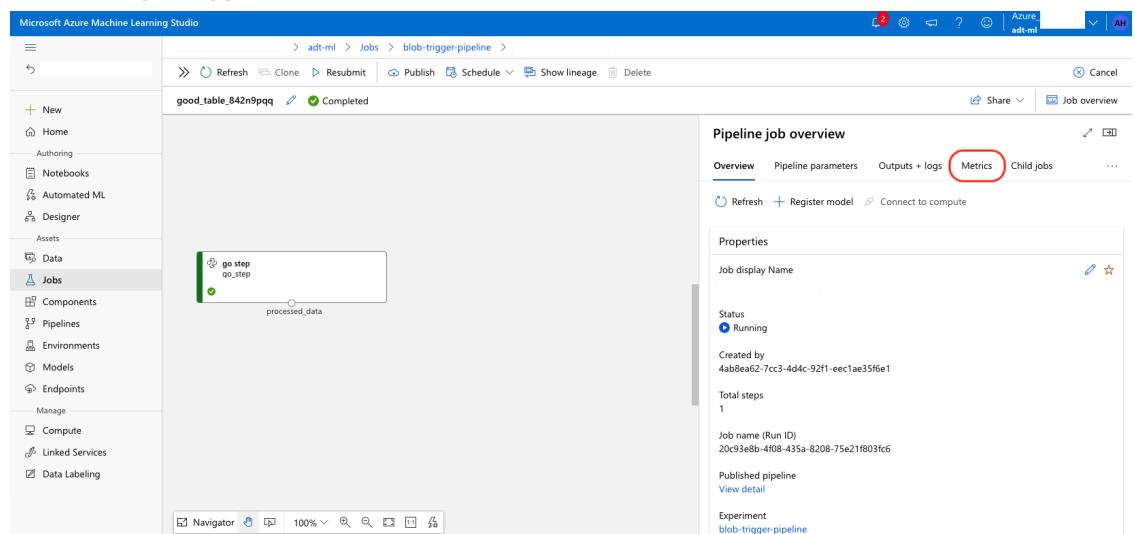


- Check Metrics and Image

■ Click on the **Job overview** button located on the top right corner.



■ Click on **Metrics**



■ Metrics Result

The screenshot shows the Microsoft Azure Machine Learning Studio interface. The left sidebar is collapsed. The main area displays a pipeline named 'blob-trigger-pipeline' under 'Jobs'. A specific step named 'go_step' is highlighted with a blue border. The top navigation bar shows the path: adt-ml > Jobs > blob-trigger-pipeline > good_table_842n9pqq. The status bar indicates the job is 'Completed'. The right panel is titled 'go step' and has tabs for Overview, Parameters, Outputs + logs, Metrics, Child jobs, Images, Code, and Explanations (preview). The 'Metrics' tab is selected. Below it, a sub-panel titled 'Select metrics' shows a dropdown menu with '[Data Tracking] defect ...' and the number '28'. The main content area displays a table titled 'Data Tracking' with the following data:

Step	X (mm)	Y (mm)	Thickness (A)
0	372	300	5.6011e+4
1	362	264	5.6106e+4
2	336	238	5.6058e+4
3	300	228	5.6051e+4
4	264	238	5.6048e+4

■ Click on Images

This screenshot shows the same Microsoft Azure Machine Learning Studio interface as the previous one, but with the 'Images' tab selected in the top navigation bar. The pipeline and job details are identical. The right panel now displays the 'outputs' section, which contains a file named '20230315-100020.png'. This file is a circular heatmap or scatter plot with a color scale ranging from 0 to 16,777,218. The visualization shows a complex pattern of colored squares (red, green, blue) on a black background, with numerical values labeled at the bottom right: Average = 54954, Uniformity = 98%, Max = 56477, and Min = 54620.

- Verify that the result file added by the pipeline earlier has been added to the **Image** folder in the created Blob.
- Search for **Storage accounts** > **adt3dstorageaccount** > **Containers** > **adt** > **Image**

The image shows two screenshots of the Microsoft Azure portal. The top screenshot is titled 'Storage accounts' and shows a list of storage accounts. One account, 'adt3dstorageaccount', is selected and highlighted with a red box. The bottom screenshot is titled 'Containers' and shows the contents of the 'adt' container. It lists two blobs: a folder named '[-]' and a file named '20230315-100020.png'. Both screenshots include navigation bars, search fields, and various management options like 'Upload', 'Delete', and 'Change access level'.

Reference

- <https://learn.microsoft.com/en-us/azure/digital-twins/quickstart-3d-scenes-studio>
- <https://learn.microsoft.com/en-us/azure/digital-twins/how-to-use-3d-scenes-studio#use-custom-advanced-expressions>
- <https://learn.microsoft.com/en-us/rest/api/azure-digitaltwins/#data-plane>

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