

1. Azure IoT Academy Month Two, Day Two, Lab One

Click Below Link to Watch Lab One Video

1.1. Day Two: Hands on Lab One Video

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

- Azure Digital Twins
- Azure Digital Twins Explorer

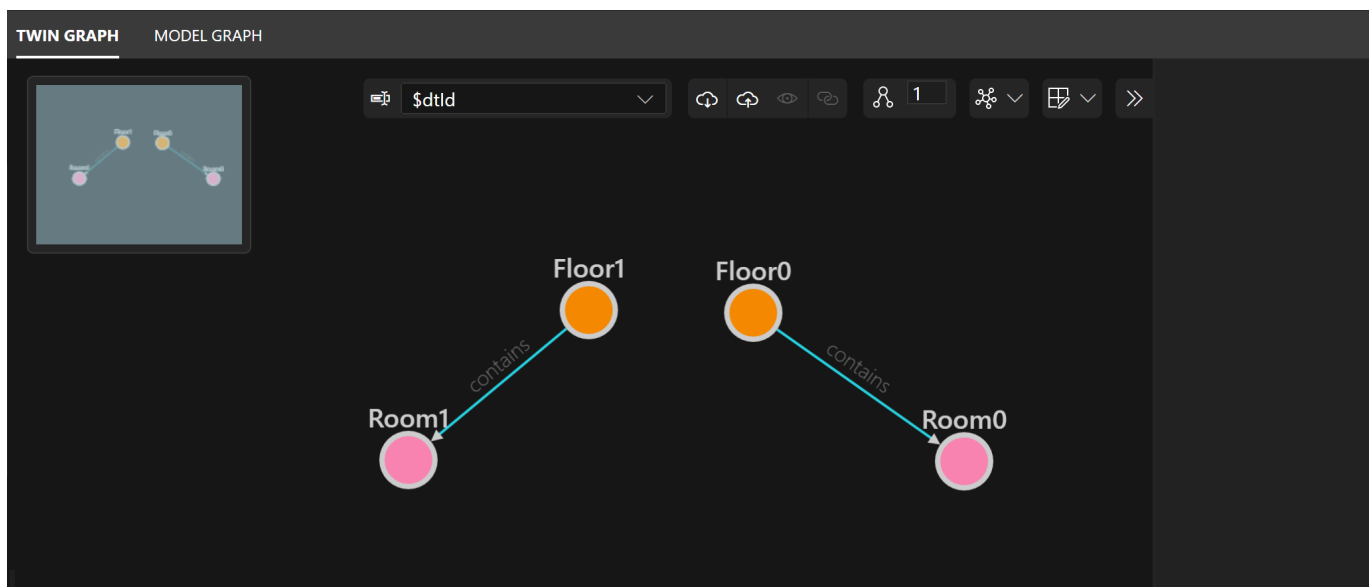
In this lab, you'll explore a prebuilt Azure Digital Twins graph using the [Azure Digital Twins Explorer](#). This tool allows you to visualize and interact with your Azure Digital Twins data within the Azure portal.

With Azure Digital Twins, you can create and interact with live models of your real-world environments, which can be part of wider IoT solutions. First, you model individual elements as digital twins. Then you connect them into a knowledge graph that can respond to live events and be queried for information.

You'll complete the following steps:

1. Create an Azure Digital Twins instance, and connect to it in Azure Digital Twins Explorer.
2. Upload prebuilt models and graph data to construct the sample scenario.
3. Explore the scenario graph that's created.
4. Make changes to the graph.
5. Review your learnings from the experience.

The Azure Digital Twins example graph you'll be working with represents a building with two floors and two rooms. Floor0 contains Room0, and Floor1 contains Room1. The graph will look like this image:



Course Content

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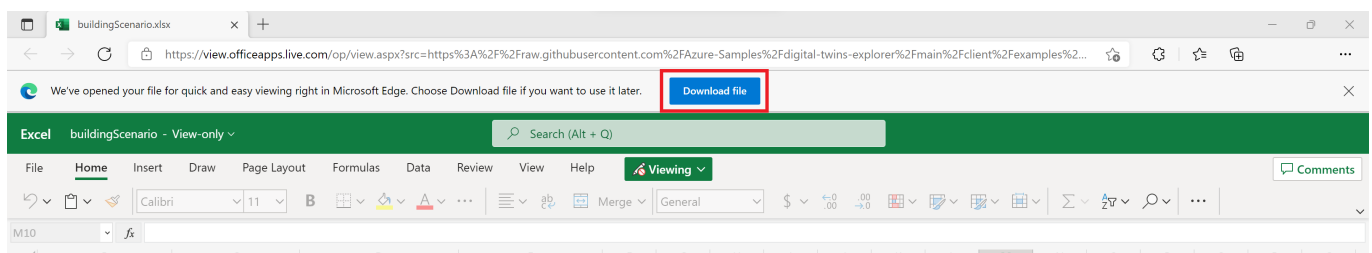
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1.2. Prerequisites

1.2.1. Download the materials for the sample graph

Use the instructions below to download the three required files. Later, you'll follow more instructions to upload them to Azure Digital Twins.

- **Room.json**: This is a model file representing a room in a building. Navigate to the link, right-click anywhere on the screen, and select Save as in your browser's right-click menu. Use the following Save As window to save the file somewhere on your machine with the name *Room.json*.
- **Floor.json**: This is a model file representing a floor in a building. Navigate to the link, right-click anywhere on the screen, and select Save as in your browser's right-click menu. Use the following Save As window to save the file to the same location as *Room.json*, under the name *Floor.json*.
- **buildingScenario.xlsx**: This file contains a graph of room and floor twins, and relationships between them. Depending on your browser settings, selecting this link may download the *buildingScenario.xlsx* file automatically to your default download location, or it may open the file in your browser with an option to download. Here is what that download option looks like in Microsoft Edge:



[!TIP]

These files are from the [Azure Digital Twins Explorer repository in GitHub](#). You can visit the

repo for other sample files, explorer code, and more.

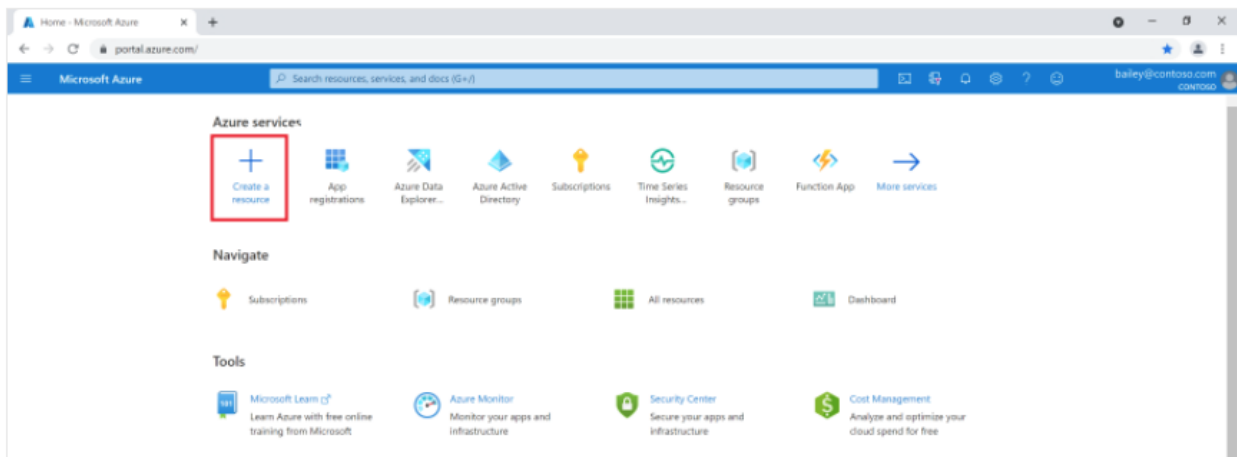
1.2.2. Set up Azure Digital Twins

The first step in working with Azure Digital Twins is to create an Azure Digital Twins instance. After you create an instance of the service, you can connect to the instance in Azure Digital Twins Explorer, which you'll use to work with the instance throughout the quickstart.

The rest of this section walks you through the instance creation.

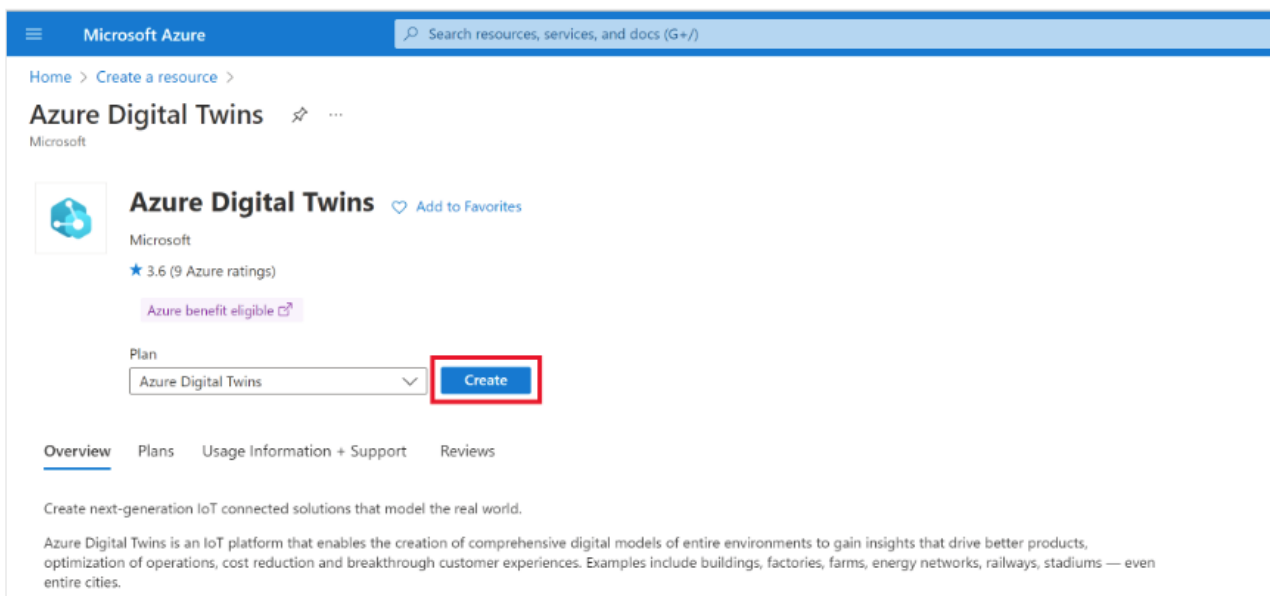
1.2.3. Create an Azure Digital Twins instance

1. Once in the portal, start by selecting **Create a resource** in the Azure services home page menu.



2. Search for *azure digital twins* in the search box, and choose the **Azure Digital Twins** service from the results.

Leave the **Plan** field set to **Azure Digital Twins** and select the **Create** button to start creating a new instance of the service.



3. Select the resource group that you created during Day 1: rg-iotacademy

Home > Create a resource > Azure Digital Twins >

Create Resource

Azure Digital Twins

* Basics * Networking Advanced Tags Review + create

Create an Azure Digital Twins instance to start building connected solutions that model the real world. [Learn more](#)

Project details

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

Subscription * Azure Digital Twins Subscription

Resource group * (New) ADT-resource-group [Create new](#)

Instance Details

Resource name * ADT-instance

Region * West Central US

Grant access to resource

To manage the elements within an instance, a user needs access to Azure Digital Twins data APIs. Select the suggested role below to grant yourself full access to the APIs. You can also use Access Control (IAM) to chose appropriate roles later. [Learn more](#)

☒ Assign Azure Digital Twins Data Owner Role ⓘ

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

4. Fill in the fields on the Basics tab of setup, including your Subscription, Resource group, a Resource name for your new instance, and Region. Check the Assign Azure Digital Twins Data Owner Role box to give yourself permissions to manage data in the instance.

[Home](#) > [Create a resource](#) > [Azure Digital Twins](#) >

Create Resource ...

Azure Digital Twins

[* Basics](#) [* Networking](#) [Advanced](#) [Tags](#) [Review + create](#)

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[Learn more](#)☒ Assign Azure Digital Twins Data Owner Role [Review + create](#)

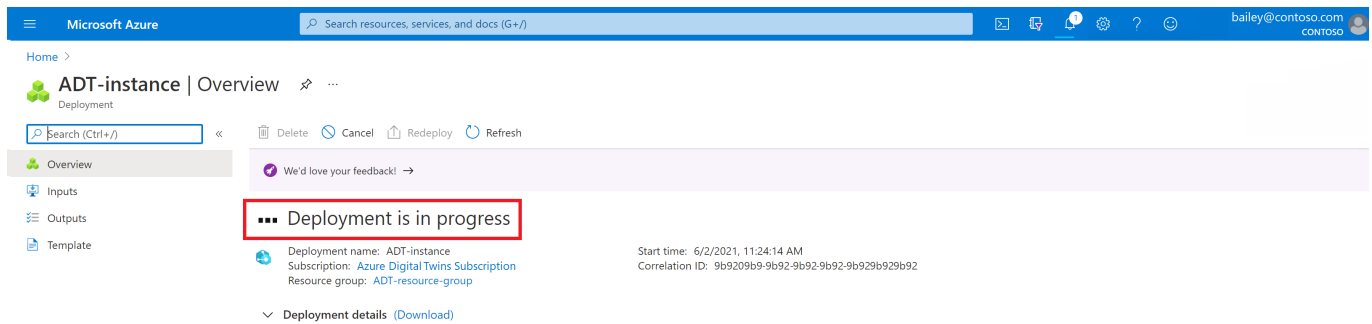
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Next: Networking >

[!NOTE] If the Assign Azure Digital Twins Data Owner Role box is greyed out, it means you don't have permissions in your Azure subscription to manage user access to resources. You can continue creating the instance in this section, and then should have someone with the necessary permissions [assign you this role on the instance](#) before completing the rest of this quickstart.

Common roles that meet this requirement are Owner, Account admin, or the combination of User Access Administrator and Contributor.

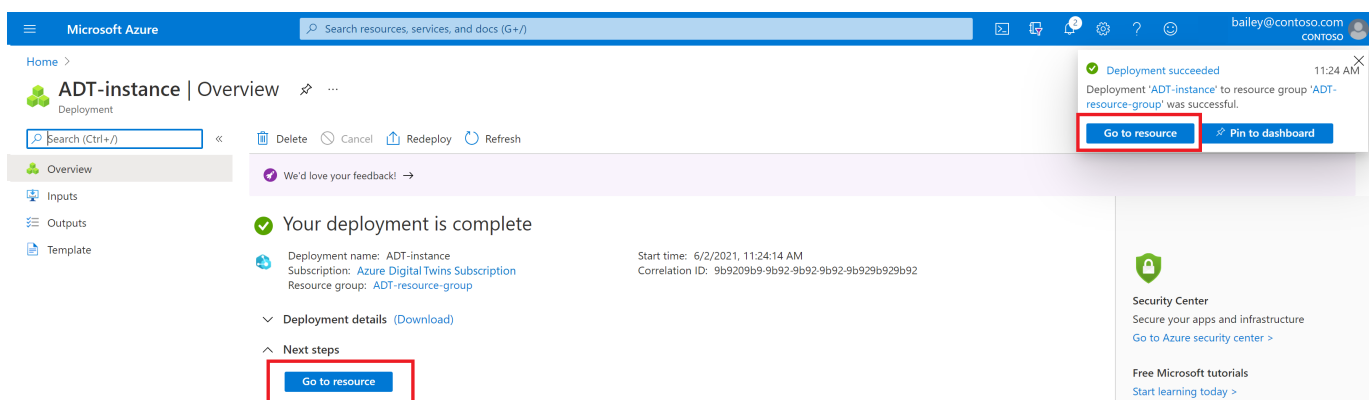
5. Select Review + Create to finish creating your instance.
6. You will see a summary page showing the details you've entered. Confirm and create the instance by selecting Create.
7. This will take you to an Overview page tracking the deployment status of the instance.



8. Wait for the page to say that your deployment is complete.

1.2.4. Open instance in Azure Digital Twins Explorer

After deployment completes, use the **Go to resource** button to navigate to the instance's Overview page in the portal.



1.2.5. Upload the sample materials

Next, you'll import the sample models and graph into Azure Digital Twins Explorer. You'll use the model files and the graph file that you downloaded to your machine in the [Prerequisites](#) section.

1.2.6. Models

The first step in an Azure Digital Twins solution is to define the vocabulary for your environment. You'll create custom *models* that describe the types of entity that exist in your environment.

Each model is written in a language like [JSON-LD](#) called *Digital Twin Definition Language (DTDL)*. Each model describes a single type of entity in terms of its properties, telemetry, relationships, and components. Later, you'll use these models as the basis for digital twins that represent specific instances of these types.

Typically, when you create a model, you'll complete three steps:

1. Write the model definition. In the quickstart, this step is already done as part of the sample solution.
2. Validate it to make sure the syntax is accurate. In the quickstart, this step is already done as part of the sample solution.
3. Upload it to your Azure Digital Twins instance.

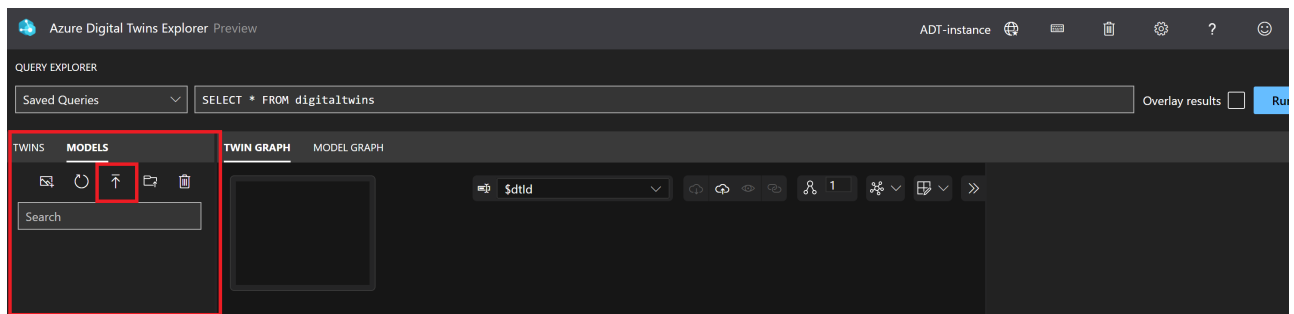
For this quickstart, the model files are already written and validated for you. They're included with the solution you downloaded. In this section, you'll upload two prewritten models to your instance to define these components of a building environment:

- Floor
- Room

1.2.6.1. Upload the models (.json files)

Follow these steps to upload models (the *.json* files you downloaded earlier).

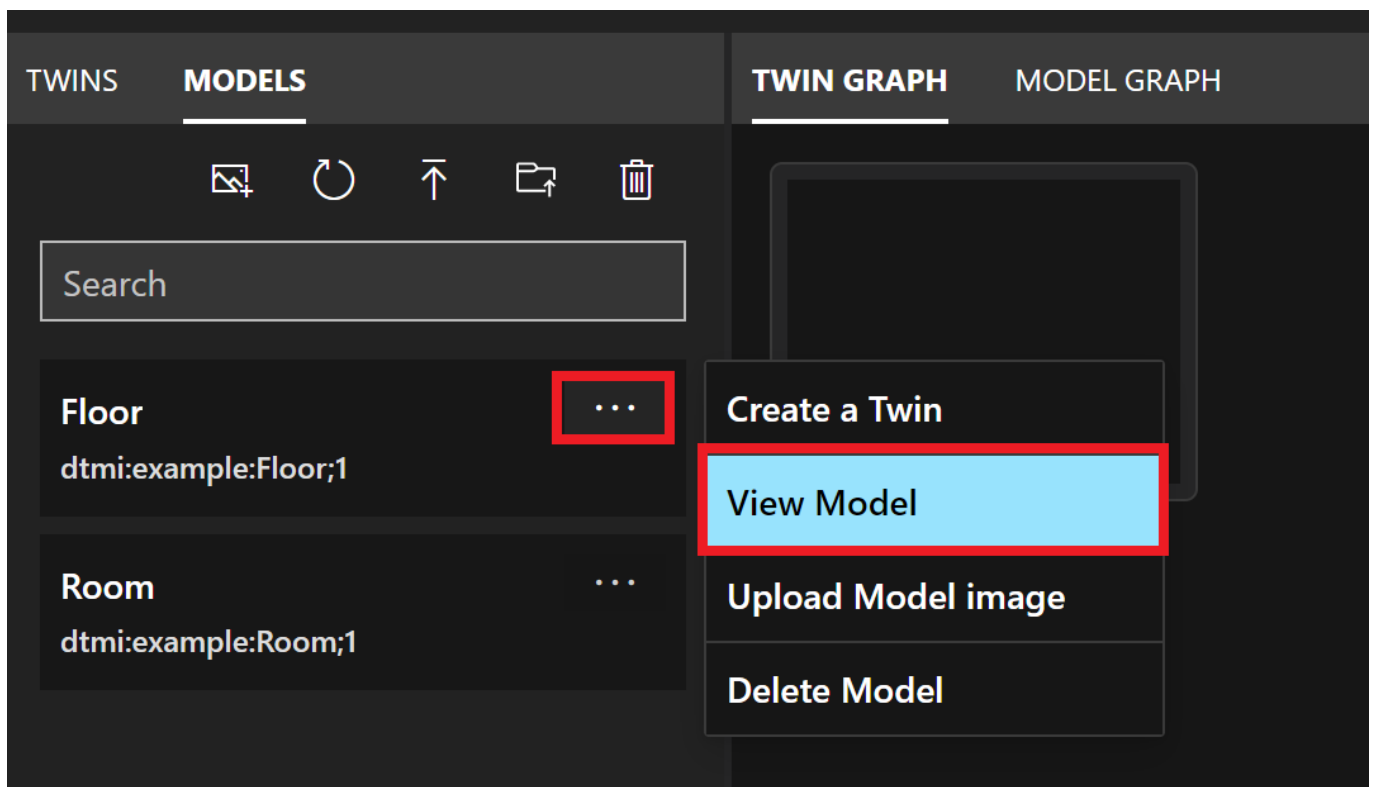
1. In the Models panel, select the Upload a Model icon that shows an arrow pointing upwards.



2. In the Open window that appears, navigate to the folder containing the *Room.json* and *Floor.json* files that you downloaded earlier.
3. Select *Room.json* and *Floor.json*, and select Open to upload them both.

Azure Digital Twins Explorer will upload these model files to your Azure Digital Twins instance. They should show up in the Models panel and display their friendly names and full model IDs.

You can select View Model for either model to see the DTDL code behind it.



1.2.7. Twins and the twin graph

Now that some models have been uploaded to your Azure Digital Twins instance, you can add *digital twins* based on the model definitions.

Digital twins represent the actual entities within your business environment. They can be things like sensors on a farm, lights in a car, or in this quickstart ☐ rooms on a building floor. You can create many twins of any given model type, such as multiple rooms that all use the Room model. You connect them with relationships into a *twin graph* that represents the full environment.

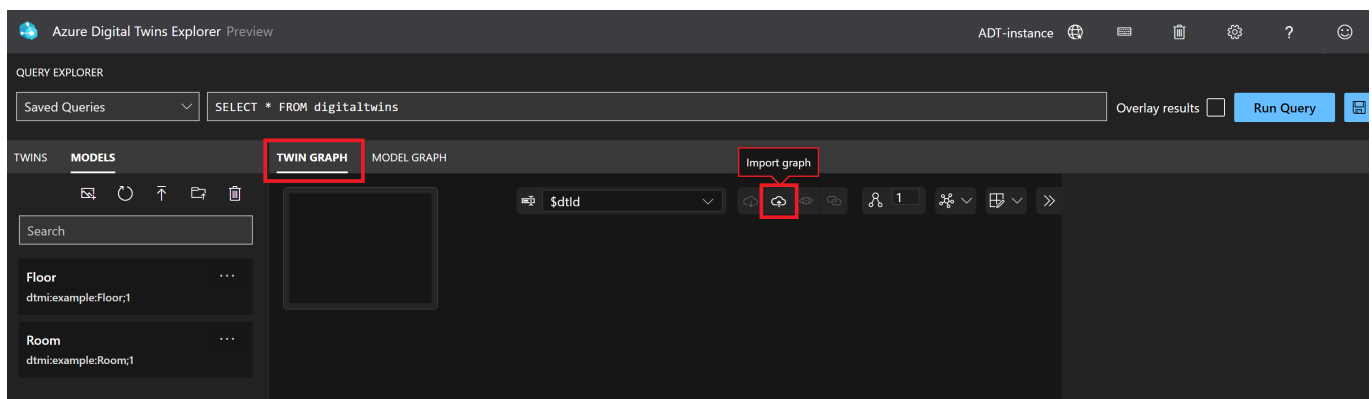
In this section, you'll upload pre-created twins that are connected into a pre-created graph. The graph contains two floors and two rooms, connected in the following layout:

- Floor0
 - Contains Room0
- Floor1
 - Contains Room1

1.2.7.1. Import the graph (.xlsx file)

Follow these steps to import the graph (the .xlsx file you downloaded earlier).

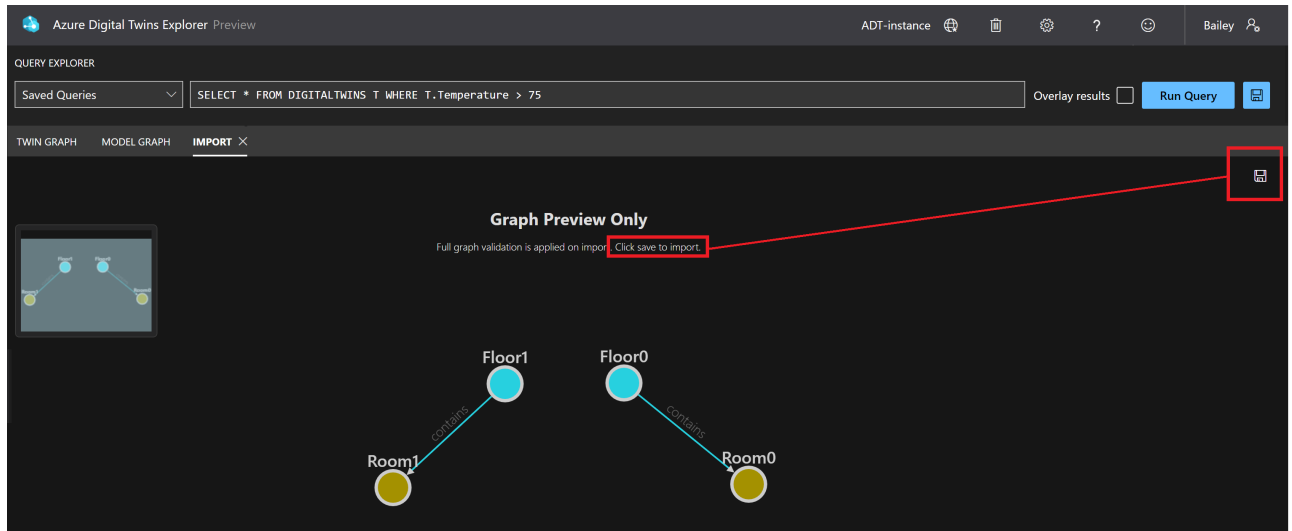
1. In the Twin Graph panel, select the Import Graph icon that shows an arrow pointing into a cloud.



2. In the Open window, navigate to the *buildingScenario.xlsx* file you downloaded earlier. This file contains a description of the sample graph. Select Open.

After a few seconds, Azure Digital Twins Explorer opens an Import view that shows a preview of the graph to be loaded.

3. To finish importing the graph, select the Save icon in the upper-right corner of the graph preview panel.



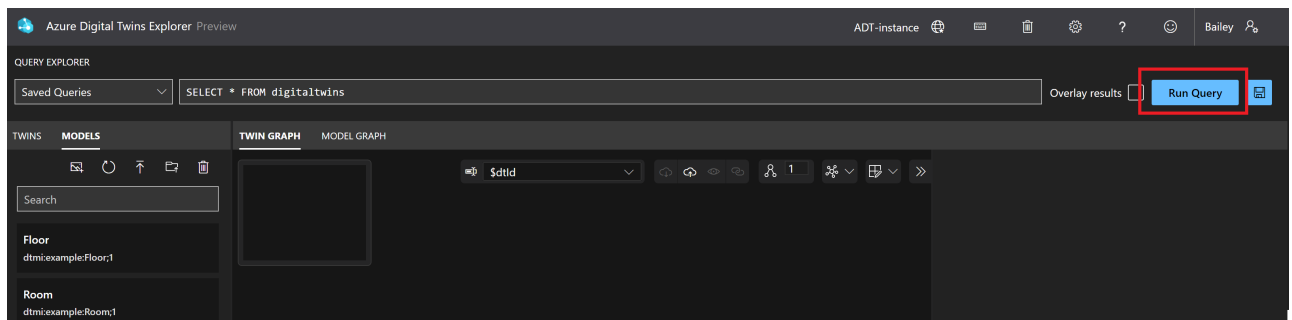
4. Azure Digital Twins Explorer will use the uploaded file to create the requested twins and relationships between them. Make sure you see the following dialog box indicating that the import was successful before moving on.



Select Close.

The graph has now been uploaded to Azure Digital Twins Explorer, and the Twin Graph panel will reload. It will appear empty.

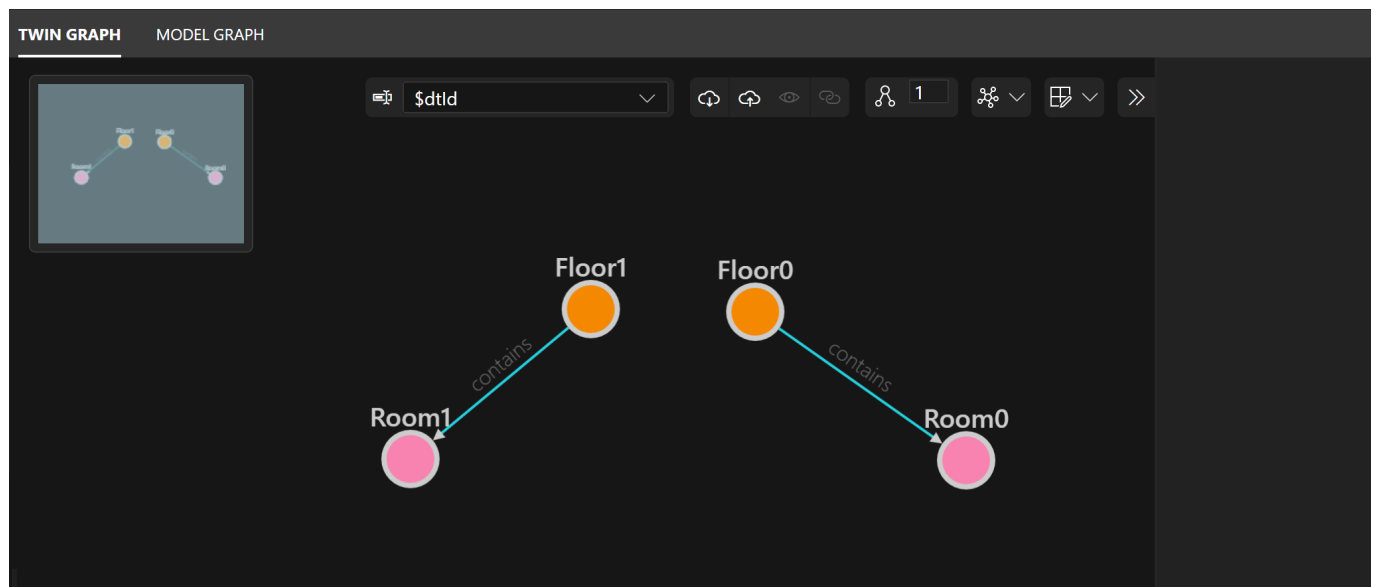
5. To see the graph, select the Run Query button in the Query Explorer panel, near the top of the Azure Digital Twins Explorer window.



This action runs the default query to select and display all digital twins. Azure Digital Twins Explorer retrieves all twins and relationships from the service. It draws the graph defined by them in the Twin Graph panel.

1.3. Explore the graph

Now you can see the uploaded graph of the sample scenario.



The circles (graph "nodes") represent digital twins. The lines represent relationships. The Floor0 twin contains Room0, and the Floor1 twin contains Room1.

If you're using a mouse, you can click and drag in the graph to move elements around.

1.3.1. View twin properties

You can select a twin to see a list of its properties and their values in the Twin Properties panel.

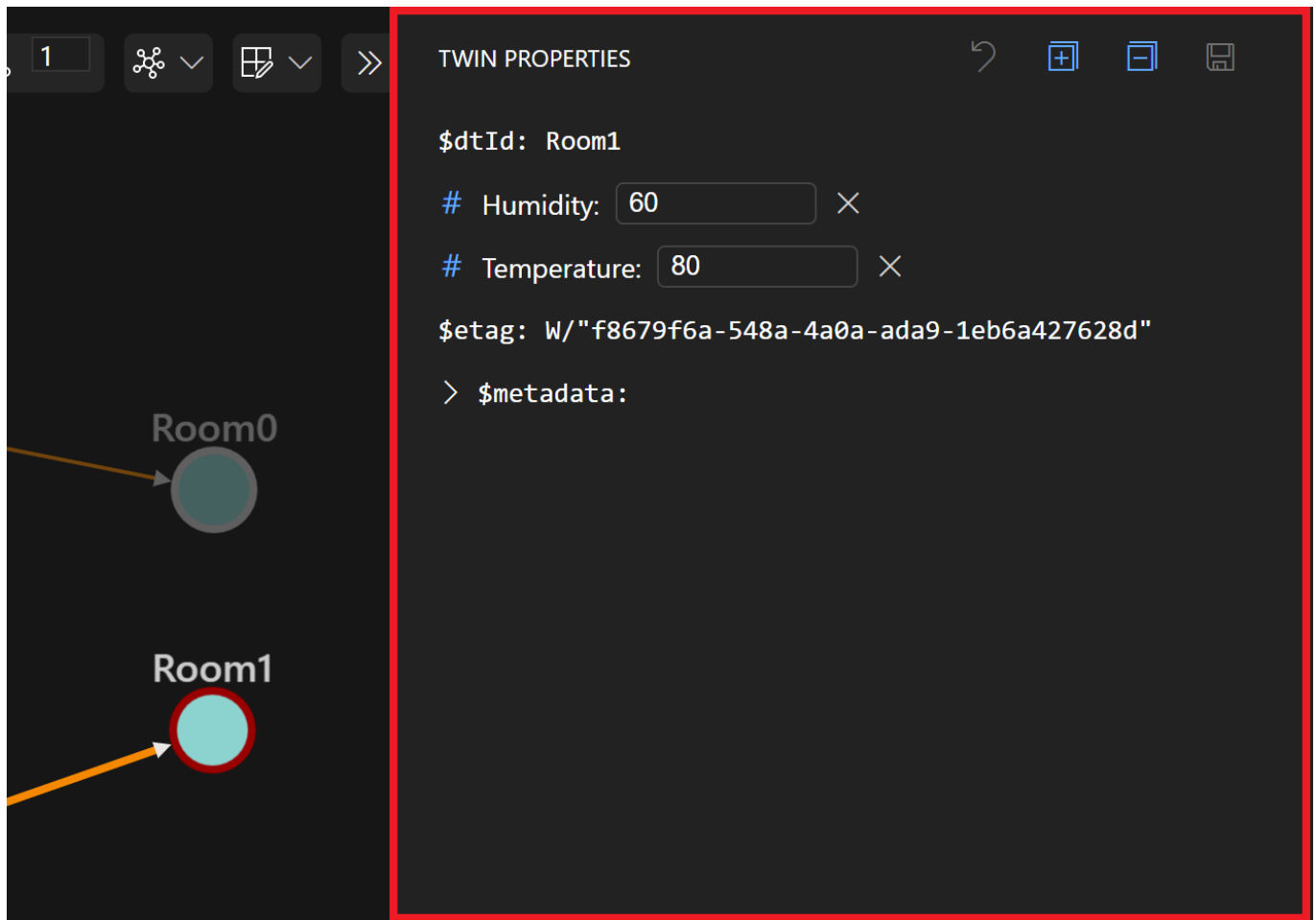
Here are the properties of Room0:

The screenshot displays a digital twin management interface. On the left, a diagram shows two nodes, Room0 and Room1. Room0 is highlighted with a red circle and an orange arrow. On the right, the 'TWIN PROPERTIES' panel for Room0 is open, showing the following details:

- \$dtId:** Room0
- # Humidity:** 30
- # Temperature:** 70
- \$etag:** W/"535b500c-e9e6-4280-a391-b02a93a6469a"
- > \$metadata:**

Room0 has a temperature of 70.

Here are the properties of Room1:



The screenshot shows the Azure Digital Twins interface. On the left, a graph displays two nodes: Room0 (a grey circle) and Room1 (a red circle). An orange arrow points from Room0 to Room1. On the right, the 'TWIN PROPERTIES' panel is open for Room1. It shows the following details:

- `$dtId`: Room1
- `# Humidity`: 60
- `# Temperature`: 80
- `$etag`: W/"f8679f6a-548a-4a0a-ada9-1eb6a427628d"
- `> $metadata`: (expanded, showing no further details)

Room1 has a temperature of 80.

1.3.2. Query the graph

In Azure Digital Twins, you can query your twin graph to answer questions about your environment, using the SQL-style *Azure Digital Twins query language*.

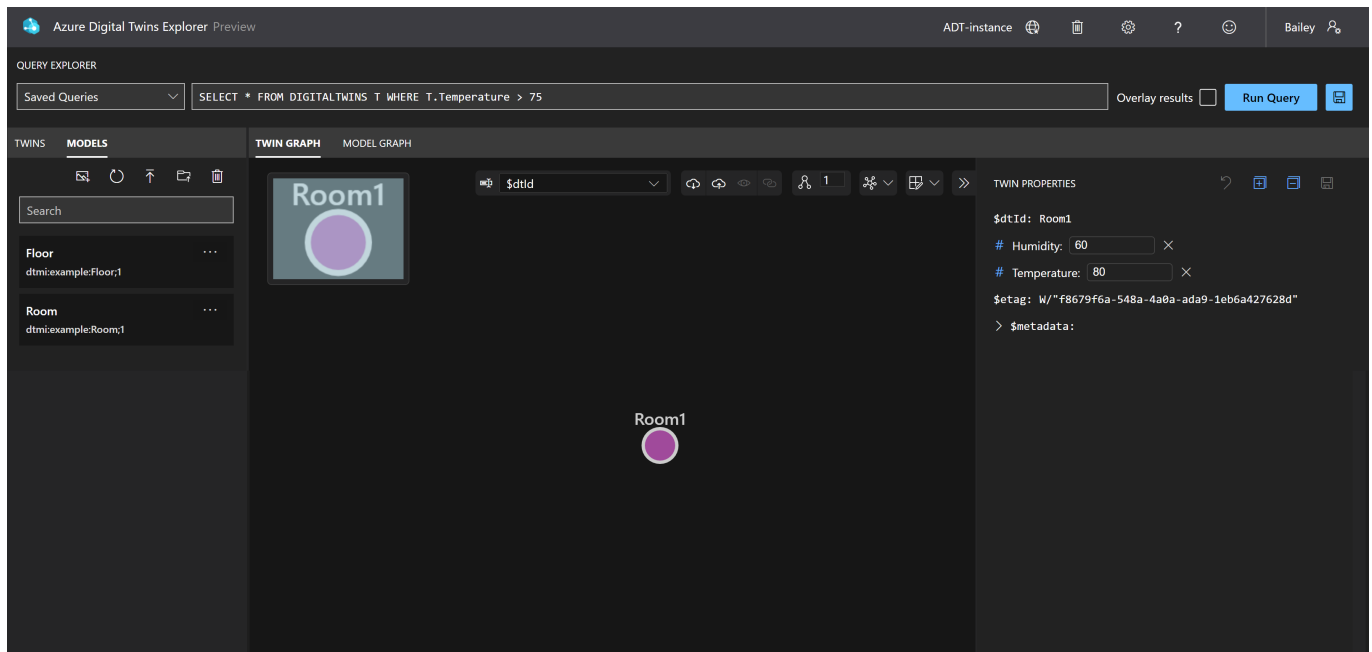
One way to query the twins in your graph is by their properties. Querying based on properties can help answer questions about your environment. For example, you can find outliers in your environment that might need attention.

In this section, you'll run a query to answer the question of how many twins in your environment have a temperature above 75.

To see the answer, run the following query in the Query Explorer panel.

```
SELECT * FROM DIGITALTWINS T WHERE T.Temperature > 75
```

Recall from viewing the twin properties earlier that Room0 has a temperature of 70, and Room1 has a temperature of 80. The Floor twins don't have a Temperature property at all. For these reasons, only Room1 shows up in the results here.

**[!TIP]**

Other comparison operators (<,>, =, or !=) are also supported within the preceding query. You can try plugging these operators, different values, or different twin properties into the query to try out answering your own questions.

1.4. Edit data in the graph

In a fully connected Azure Digital Twins solution, the twins in your graph can receive live updates from real IoT devices and update their properties to stay synchronized with your real-world environment. You can also manually set the properties of the twins in your graph, using Azure Digital Twins Explorer or another development interface (like the APIs or Azure CLI).

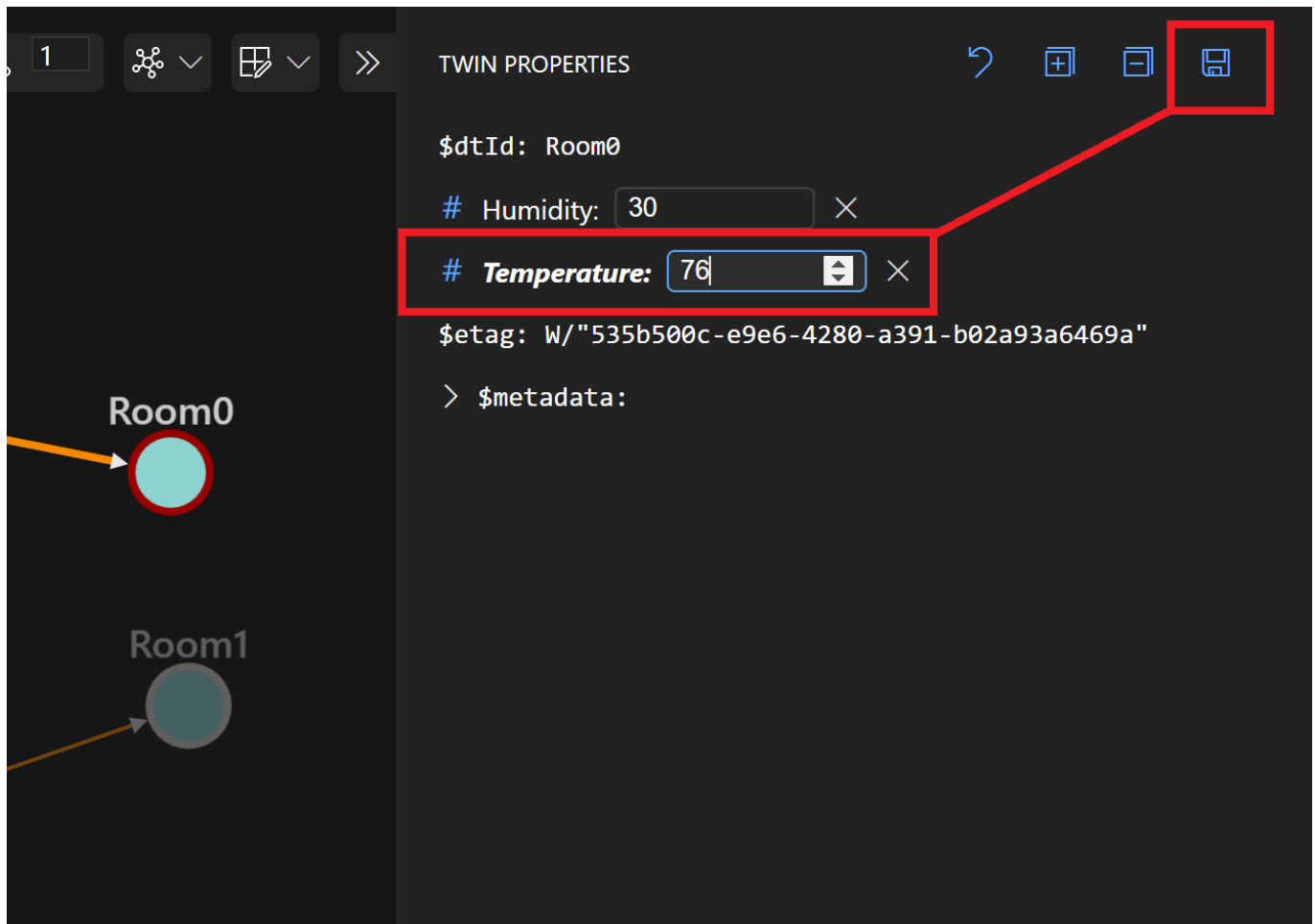
For simplicity, you'll use Azure Digital Twins Explorer here to manually set the temperature of Room0 to 76.

First, rerun the following query to select all digital twins. This will display the full graph once more in the Twin Graph panel.

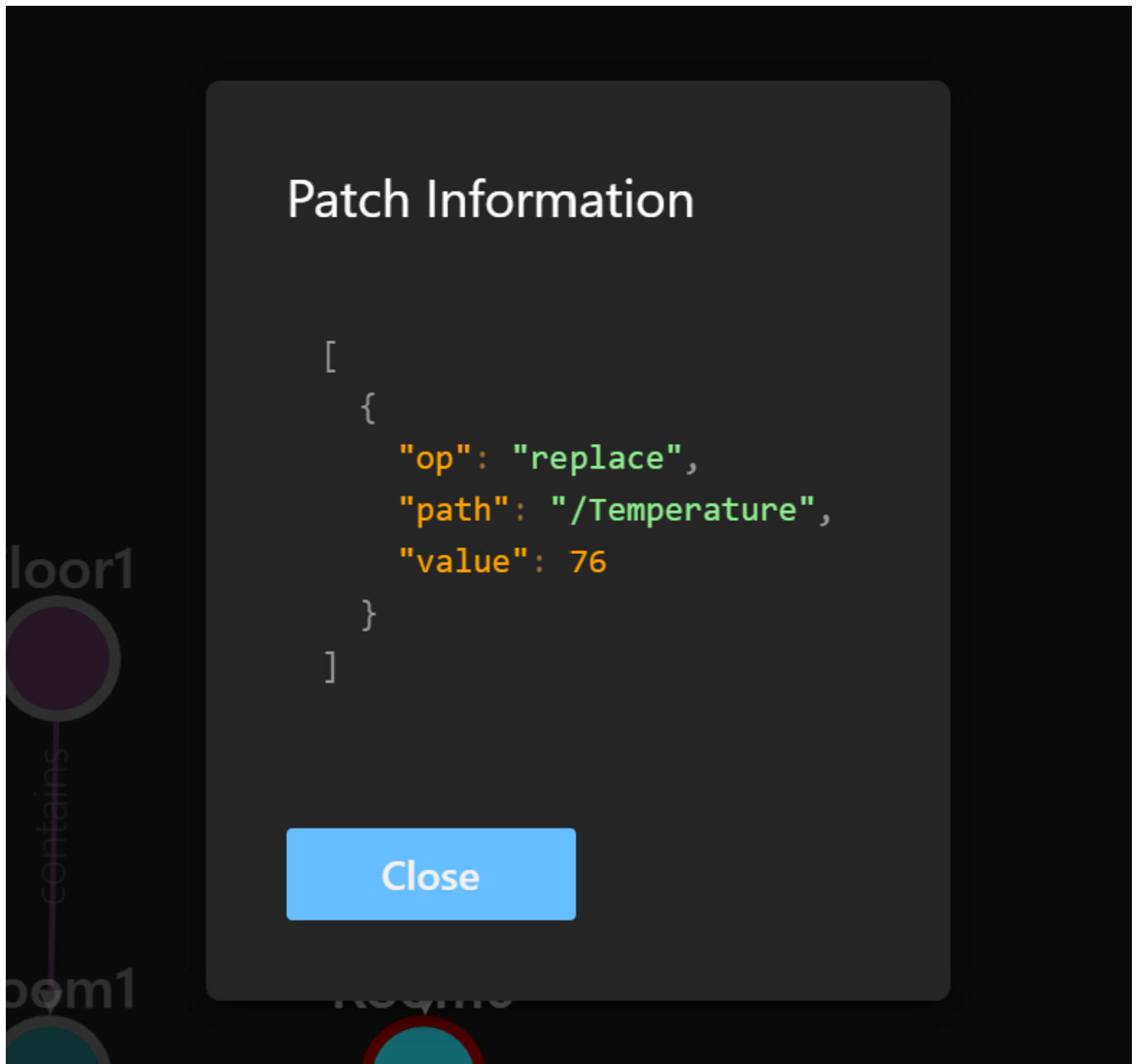
```
SELECT * FROM DIGITALTWINS
```

Select Room0 to bring up its property list in the Twin Properties panel.

The properties in this list are editable. Select the temperature value of 70 to enable entering a new value. Enter 76 and select the Save icon to update the temperature.



After a successful property update, you'll see a Patch Information box showing the patch code that was used behind the scenes with the [Azure Digital Twins APIs](#) to make the update.



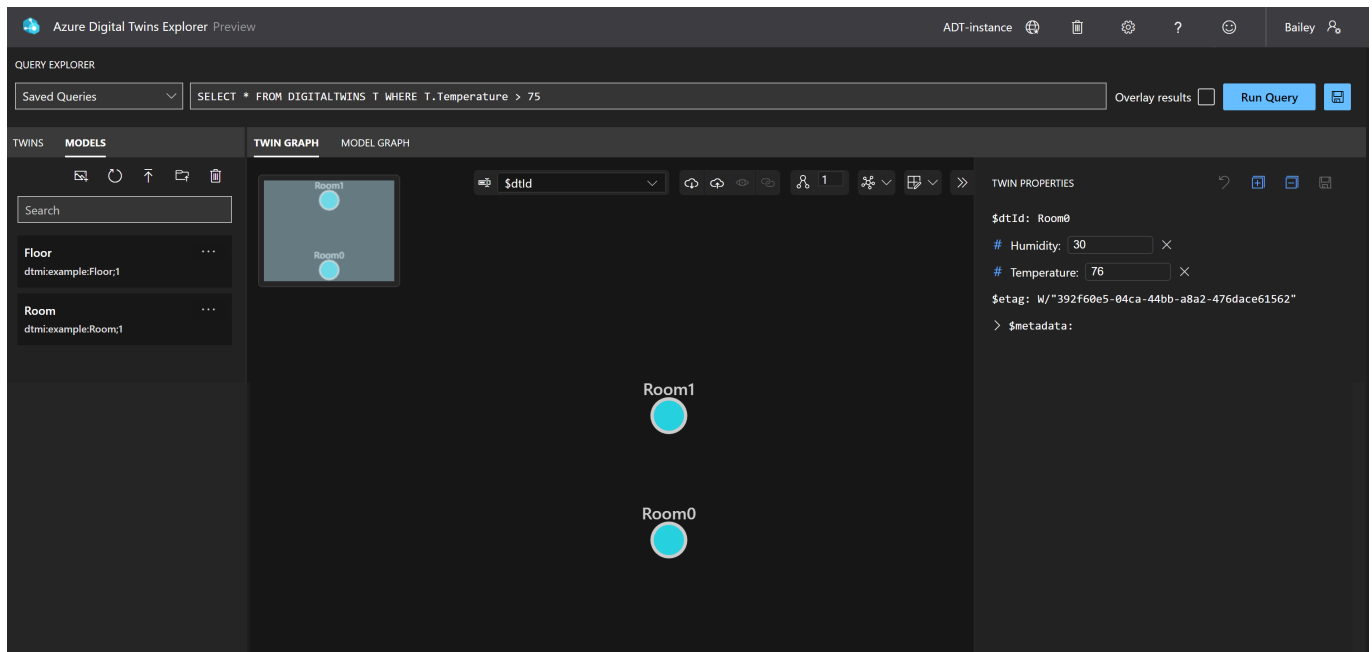
Close the patch information.

1.4.1. Query to see the result

To verify that the graph successfully registered your update to the temperature for Room0, rerun the query from earlier to get all the twins in the environment with a temperature above 75.

```
SELECT * FROM DIGITALTWINS T WHERE T.Temperature > 75
```

Now that the temperature of Room0 has been changed from 70 to 76, both twins should show up in the result.



1.5. Review and contextualize learnings

In this quickstart, you created an Azure Digital Twins instance and used Azure Digital Twins Explorer to populate it with a sample scenario.

You then explored the graph, by:

- Using a query to answer a question about the scenario.
- Editing a property on a digital twin.
- Running the query again to see how the answer changed as a result of your update.

The intent of this exercise is to demonstrate how you can use the Azure Digital Twins graph to answer questions about your environment, even as the environment continues to change.

In this quickstart, you made the temperature update manually. It's common in Azure Digital Twins to connect digital twins to real IoT devices so that they receive updates automatically, based on telemetry data. In this way, you can build a live graph that always reflects the real state of your environment. You can use queries to get information about what's happening in your environment in real time.

Move on to next [lab](#)