Monitoring

Azure Synapse Analytics provides a rich monitoring experience within the Azure portal to surface insights regarding your data warehouse workload. The Azure portal is the recommended tool when monitoring your data warehouse as it provides configurable retention periods, alerts, recommendations, and customizable charts and dashboards for metrics and logs. The portal also enables you to integrate with other Azure monitoring services such as Azure Monitor (logs) with Log analytics to provide a holistic monitoring experience for not only your data warehouse but also your entire Azure analytics platform for an integrated monitoring experience.

You can monitor active SQL requests using the SQL requests area of the Monitor Hub. This includes details like the pool, submitter, duration, queued duration, workload group assigned, importance, and the request content.

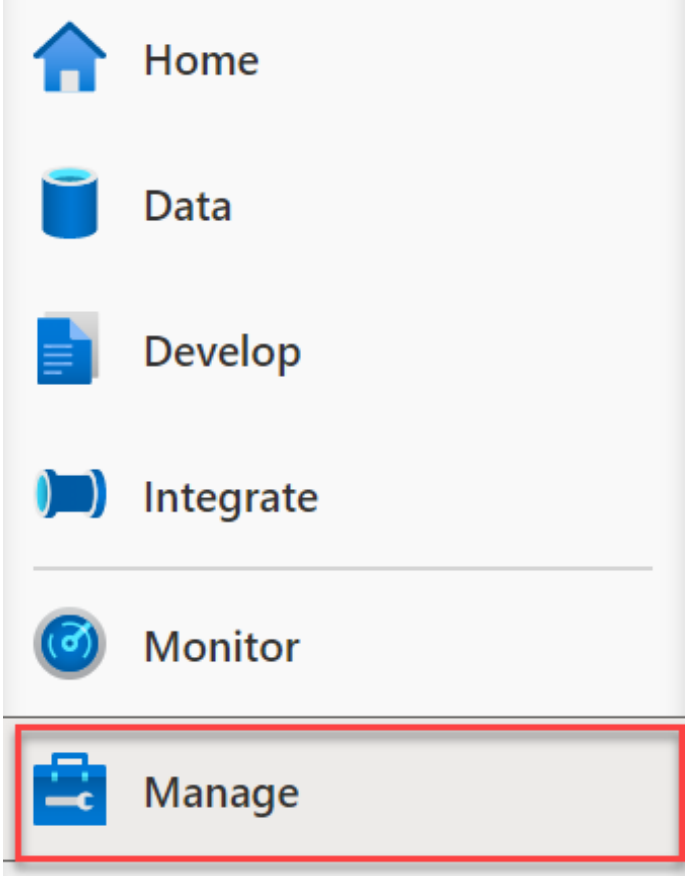
Pipeline runs can be monitored using the Monitor Hub and selecting Pipeline runs. Here you can filter pipeline runs and drill in to view the activity runs associated with the pipeline run and monitor the running of in-progress pipelines.

The execution of Spark applications representing the execution of notebooks and jobs can be monitored within the Monitor Hub, selecting Spark applications. Selecting a Spark application to view its progress and to launch the Spark UI to examine a running Spark job and stage details, or the Spark history server to examine a completed application.

Lab pre-requisite

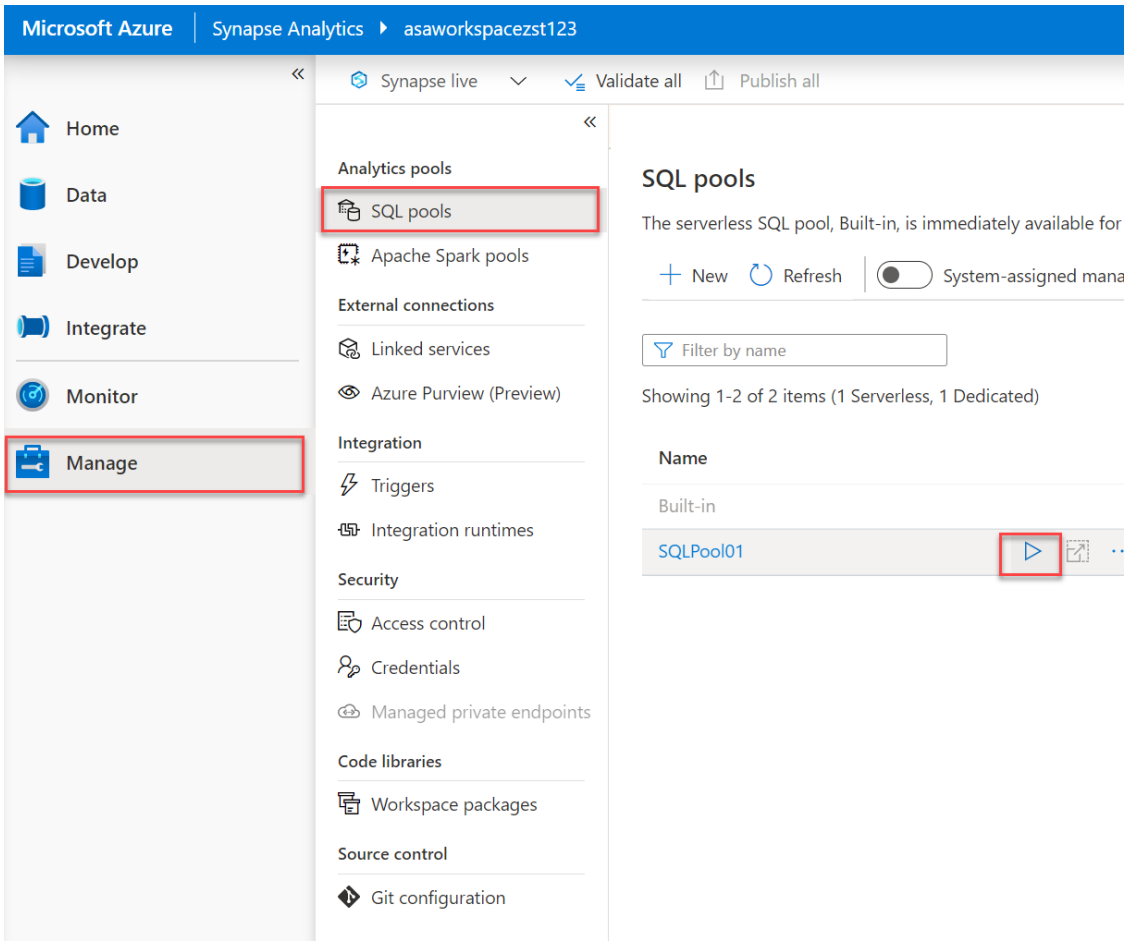
Start the SQL Pool in your lab environment.

1. Open the Synapse Studio workspace and navigate to the **Manage** hub.



The Manage menu item is highlighted.

2. From the center menu, select **SQL pools** from beneath the **Analytics pools** heading. Locate `SQLPool01`, and select the **Resume** button.



The Manage menu item is selected, with SQL pools selected from the center menu. The resume button is selected next to the SQLPool01 item.

Exercise 1 - Workload Management

Running mixed workloads can pose resource challenges on busy systems. Solution Architects seek ways to separate classic data warehousing activities (such as loading, transforming, and querying data) to ensure that enough resources exist to hit SLAs.

Synapse SQL pool workload management in Azure Synapse consists of three high-level concepts: Workload Classification, Workload Importance and Workload Isolation. These capabilities give you more control over how your workload utilizes system resources.

Workload importance influences the order in which a request gets access to resources. On a busy system, a request with higher importance has first access to resources. Importance can also ensure ordered access to locks.

Workload isolation reserves resources for a workload group. Resources reserved in a workload group are held exclusively for that workload group to ensure execution. Workload groups also allow you to define the amount of resources that are assigned per request, much like resource classes do. Workload groups give you the ability to reserve or

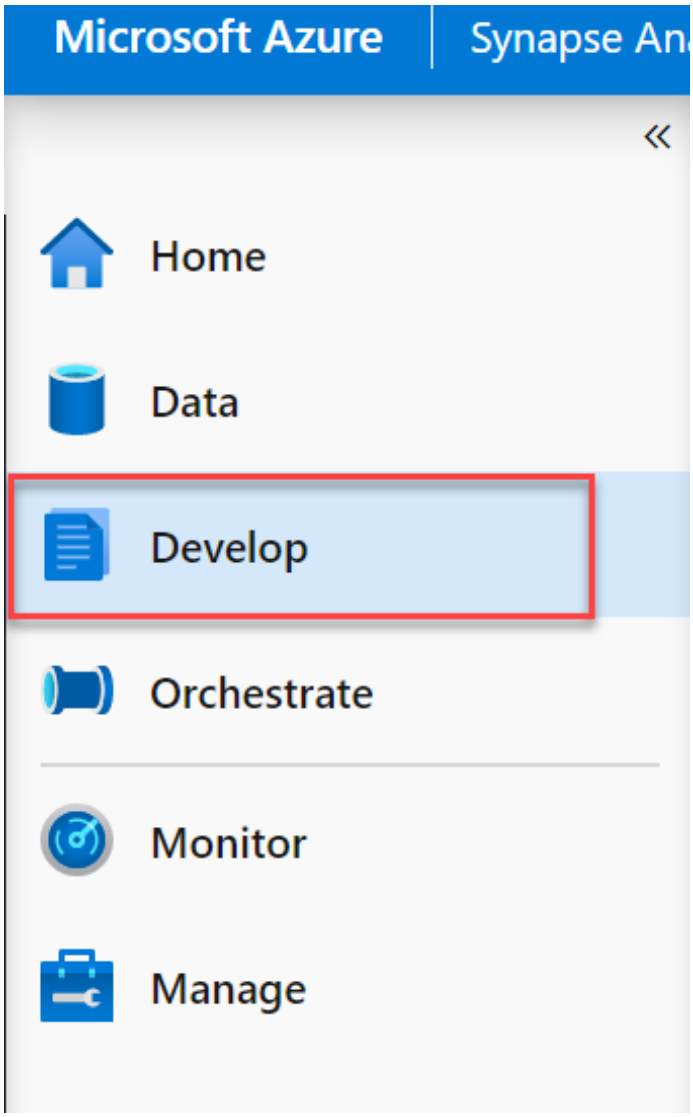
cap the amount of resources a set of requests can consume. Finally, workload groups are a mechanism to apply rules, such as query timeout, to requests.

Task 1 - Workload Importance

Often in a data warehouse scenario you have users who need their queries to run quickly. The user could be executives of the company who need to run reports or the user could be an analyst running an adhoc query.

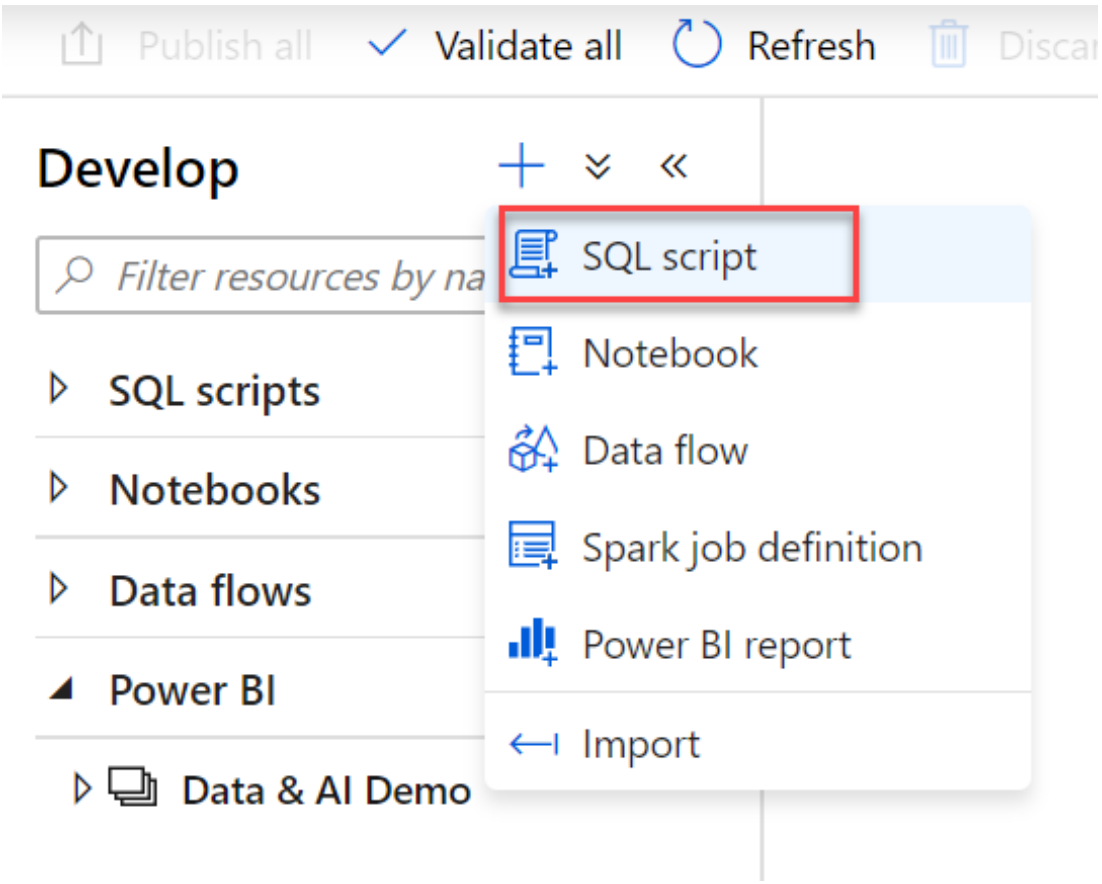
Setting importance in Synapse SQL for Azure Synapse allows you to influence the scheduling of queries. Queries with higher importance will be scheduled to run before queries with lower importance. To assign importance to queries, you need to create a workload classifier.

1. Open Synapse Analytics Studio (https://web.azuresynapse.net/), and then navigate to the **Develop** hub.



The Develop menu item is highlighted.

2. From the **Develop** menu, select the + button and choose **SQL Script** from the context menu.



The SQL script context menu item is highlighted.

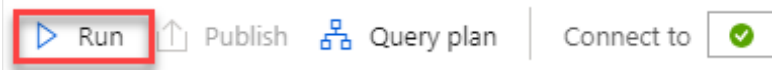
3. In the toolbar menu, connect to the **SQL Pool** database to execute the query.

The connect to option is highlighted in the query toolbar.

4. In the query window, replace the script with the following to confirm that there are no queries currently being run by users logged in as `asa.sql.workload01`, representing the CEO of the organization or `asa.sql.workload02` representing the data analyst working on the project:

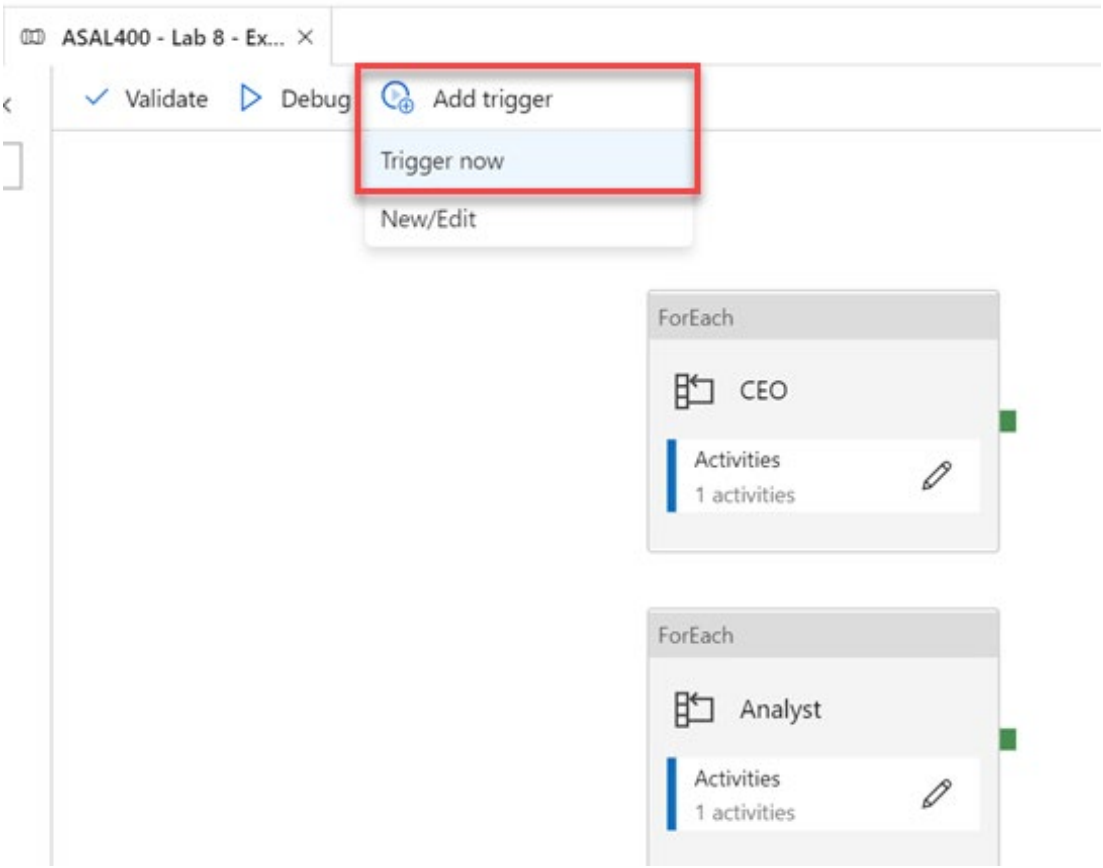
```
--First, let's confirm that there are no queries currently being run by
users logged in workload01 or workload02

SELECT s.login_name, r.[Status], r.Importance, submit_time,
start_time ,s.session_id FROM sys.dm_pdw_exec_sessions s
JOIN sys.dm_pdw_exec_requests r ON s.session_id = r.session_id
WHERE s.login_name IN ('asa.sql.workload01','asa.sql.workload02') and
Importance
is not NULL AND r.[status] in ('Running','Suspended')
--and submit_time>dateadd(minute,-2,getdate())
ORDER BY submit_time ,s.login_name
```

5. Select **Run** from the toolbar menu to execute the SQL command.



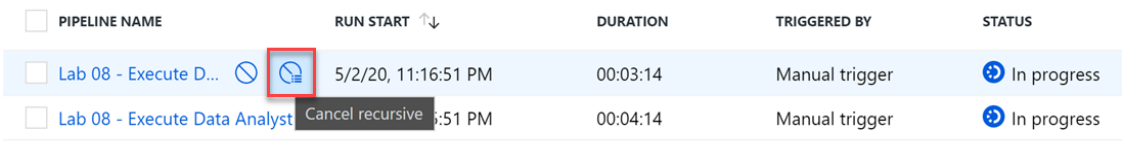
The run button is highlighted in the query toolbar.

6. You will flood the system with queries and see what happens for `asa.sql.workload01` and `asa.sql.workload02`. To do this, we'll run a Azure Synapse Pipeline which triggers queries. Select the `Integrate` hub. **Run** the **Lab 08 - Execute Data Analyst and CEO Queries** Pipeline, which will run / trigger the `asa.sql.workload01` and `asa.sql.workload02` queries. You can run the pipeline with the Debug option if you have an instance of the Integration Runtime running. Otherwise, select **Add trigger**, then **Trigger now**. In the dialog that appears, select **OK**.



The add trigger and trigger now menu items are highlighted.

7. Navigate to the **Monitor** hub, select **Pipeline runs**, and view the status of the current pipeline run. **Let the Pipeline run for 30 seconds to one minute**, then select **Cancel recursive** for the Lab 08 pipeline.

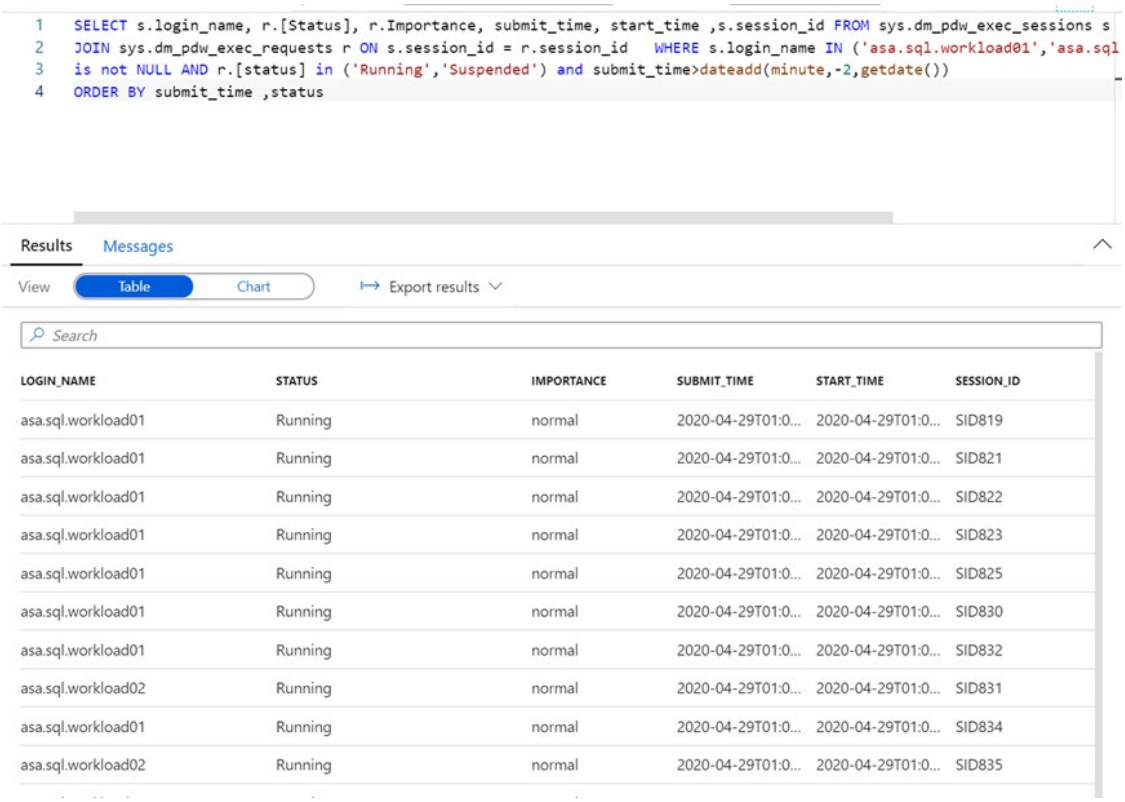


The cancel recursive option is shown.

8. Let's see what happened to all the queries we just triggered as they flood the system. Return to the query window, replace the script with the following:

```
SELECT s.login_name, r.[Status], r.Importance, submit_time, start_time
,s.session_id FROM sys.dm_pdw_exec_sessions s
JOIN sys.dm_pdw_exec_requests r ON s.session_id = r.session_id
WHERE s.login_name IN ('asa.sql.workload01','asa.sql.workload02') and
Importance
is not NULL AND r.[status] in ('Running','Suspended') and
submit_time>dateadd(minute,-2,getdate())
ORDER BY submit_time ,status
```

9. Select **Run** from the toolbar menu to execute the SQL command. You should see an output similar to the following:



SQL query results.

10. We will give our `asa.sql.workload01` user queries priority by implementing the **Workload Importance** feature. Return to the query window, replace the script with the following:

```
IF EXISTS (SELECT * FROM sys.workload_management_workload_classifiers
WHERE name = 'CEO')
BEGIN
    DROP WORKLOAD CLASSIFIER CEO;
END
CREATE WORKLOAD CLASSIFIER CEO
  WITH (WORKLOAD_GROUP = 'largerc'
  ,MEMBERNAME = 'asa.sql.workload01',IMPORTANCE = High);
```

11. Select **Run** from the toolbar menu to execute the SQL command.

12. Let's flood the system again with queries and see what happens this time for `asa.sql.workload01` and `asa.sql.workload02` queries. To do this, we'll run an Azure Synapse Pipeline which triggers queries. **Select** the `Integrate` hub, **run** the **Lab 08 - Execute Data Analyst and CEO Queries** Pipeline, which will run / trigger the `asa.sql.workload01` and `asa.sql.workload02` queries. **Please let this run for 30 seconds to one minute, then cancel recursively just as you have done before.**

13. In the query window, replace the script with the following to see what happens to the `asa.sql.workload01` queries this time:

```
SELECT s.login_name, r.[Status], r.Importance, submit_time, start_time
,s.session_id FROM sys.dm_pdw_exec_sessions s
JOIN sys.dm_pdw_exec_requests r ON s.session_id = r.session_id
WHERE s.login_name IN ('asa.sql.workload01','asa.sql.workload02') and
Importance
is not NULL AND r.[status] in ('Running','Suspended') and
submit_time>dateadd(minute,-2,getdate())
ORDER BY submit_time ,status desc
```

14. Select **Run** from the toolbar menu to execute the SQL command. You should see an output similar to the following that shows query executions for the `asa.sql.workload01` user having a **high** importance.

```
SELECT s.login_name, r.[Status], r.Importance, submit_time, start_time ,s.session_id FROM sys.dm_pdw_exec_sessions s
JOIN sys.dm_pdw_exec_requests r ON s.session_id = r.session_id   WHERE s.login_name IN ('asa.sql.workload01','asa.sql.
is not NULL AND r.[status] in ('Running','Suspended') and submit_time>dateadd(minute,-2,getdate())
ORDER BY submit_time ,status desc
```

Results | Messages

View: Table | Chart | Export results

Search

LOGIN_NAME	STATUS	IMPORTANCE	SUBMIT_TIME	START_TIME	SESSION_ID
asa.sql.workload01	Running	high	2020-04-29T01:3...	2020-04-29T01:3...	SID907
asa.sql.workload02	Suspended	normal	2020-04-29T01:3...	NULL	SID911
asa.sql.workload02	Suspended	normal	2020-04-29T01:3...	NULL	SID912
asa.sql.workload02	Suspended	normal	2020-04-29T01:3...	NULL	SID913
asa.sql.workload01	Running	high	2020-04-29T01:3...	2020-04-29T01:3...	SID917
asa.sql.workload01	Suspended	high	2020-04-29T01:3...	NULL	SID920
asa.sql.workload02	Suspended	normal	2020-04-29T01:3...	NULL	SID922
asa.sql.workload01	Suspended	high	2020-04-29T01:3...	NULL	SID923
asa.sql.workload01	Suspended	high	2020-04-29T01:3...	NULL	SID924
asa.sql.workload01	Suspended	high	2020-04-29T01:3...	NULL	SID929
asa.sql.workload02	Suspended	normal	2020-04-29T01:3	NULL	SID930

SQL query results.

Task 2 - Workload Isolation

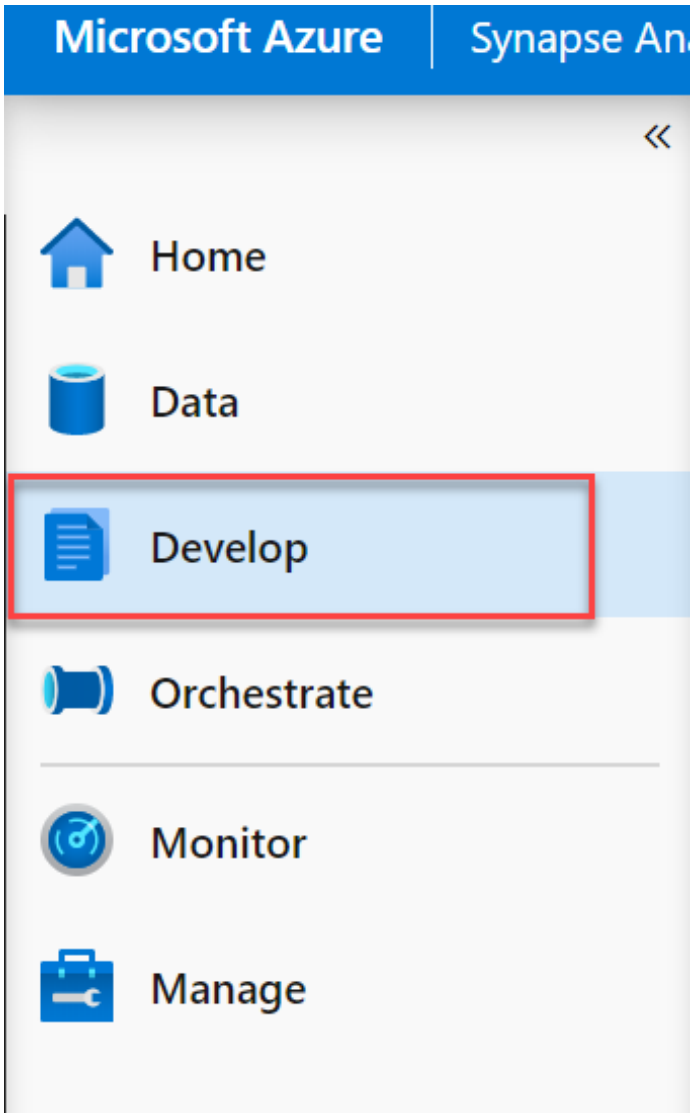
Workload isolation means resources are reserved, exclusively, for a workload group. Workload groups are containers for a set of requests and are the basis for how workload management, including workload isolation, is configured on a system. A simple workload management configuration can manage data loads and user queries.

In the absence of workload isolation, requests operate in the shared pool of resources. Access to resources in the shared pool is not guaranteed and is assigned on an importance basis.

Configuring workload isolation should be done with caution as the resources are allocated to the workload group even if there are no active requests in the workload group. Over-configuring isolation can lead to diminished overall system utilization.

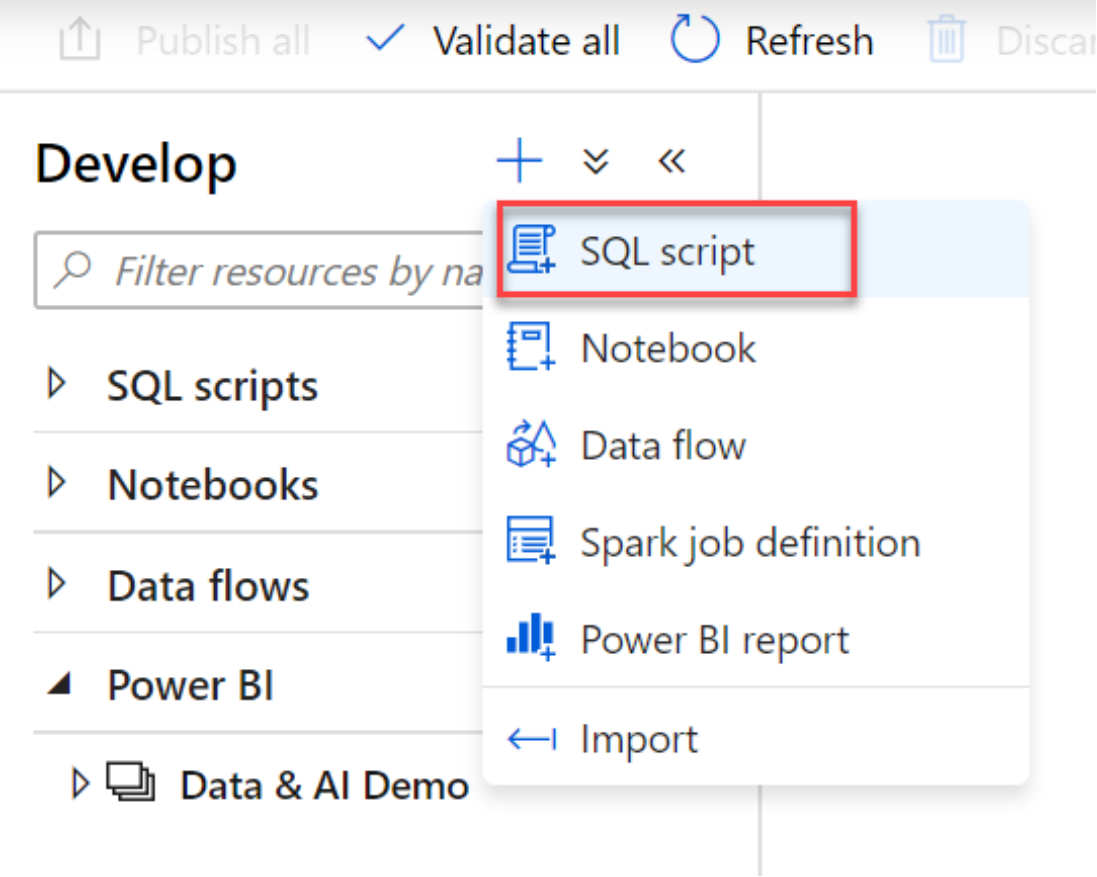
Users should avoid a workload management solution that configures 100% workload isolation: 100% isolation is achieved when the sum of `min_percentage_resource` configured across all workload groups equals 100%. This type of configuration is overly restrictive and rigid, leaving little room for resource requests that are accidentally misclassified. There is a provision to allow one request to execute from workload groups not configured for isolation.

1. Open Synapse Analytics Studio (https://web.azuresynapse.net/), and then navigate to the **Develop** hub.



The Develop menu item is highlighted.

2. From the **Develop** menu, select the + button and choose **SQL Script** from the context menu.



The SQL script context menu item is highlighted.

3. In the toolbar menu, connect to the **SQL Pool** database to execute the query.

The connect to option is highlighted in the query toolbar.

4. In the query window, replace the script with the following:

```
IF NOT EXISTS (SELECT * FROM sys.workload_management_workload_groups
where name = 'CEODemo')
BEGIN
    Create WORKLOAD GROUP CEODemo WITH
    ( MIN_PERCENTAGE_RESOURCE = 50        -- integer value
    ,REQUEST_MIN_RESOURCE_GRANT_PERCENT = 25 --
    ,CAP_PERCENTAGE_RESOURCE = 100
    )
END
```

The code creates a workload group called `CEODemo` to reserve resources exclusively for the workload group. In this example, a workload group with a `MIN_PERCENTAGE_RESOURCE` set to 50% and `REQUEST_MIN_RESOURCE_GRANT_PERCENT` set to 25% is guaranteed 2 concurrency.

5. Select **Run** from the toolbar menu to execute the SQL command.

6. In the query window, replace the script with the following to create a workload Classifier called `CEODreamDemo` that assigns a workload group and importance to incoming requests:

```
IF NOT EXISTS (SELECT * FROM sys.workload_management_workload_classifiers
where  name = 'CEODreamDemo')
BEGIN
    Create Workload Classifier CEODreamDemo with
    ( Workload_Group
='CEODemo',MemberName='asa.sql.workload02',IMPORTANCE = BELOW_NORMAL);
END
```

7. Select **Run** from the toolbar menu to execute the SQL command.

8. In the query window, replace the script with the following to confirm that there are no active queries being run by `asa.sql.workload02`:

```
SELECT s.login_name, r.[Status], r.Importance, submit_time,
start_time ,s.session_id FROM sys.dm_pdw_exec_sessions s
JOIN sys.dm_pdw_exec_requests r ON s.session_id = r.session_id
WHERE s.login_name IN ('asa.sql.workload02') and Importance
is not NULL AND r.[status] in ('Running','Suspended')
ORDER BY submit_time, status
```

   Note: There still may be queries left over from previous activities. You can choose to wait for them to complete, or access the SQL requests in the **Manage Hub** and cancel each session manually. Queries that are queued after the creation of the workload group and workload classifier will automatically have this workload management assigned to them.

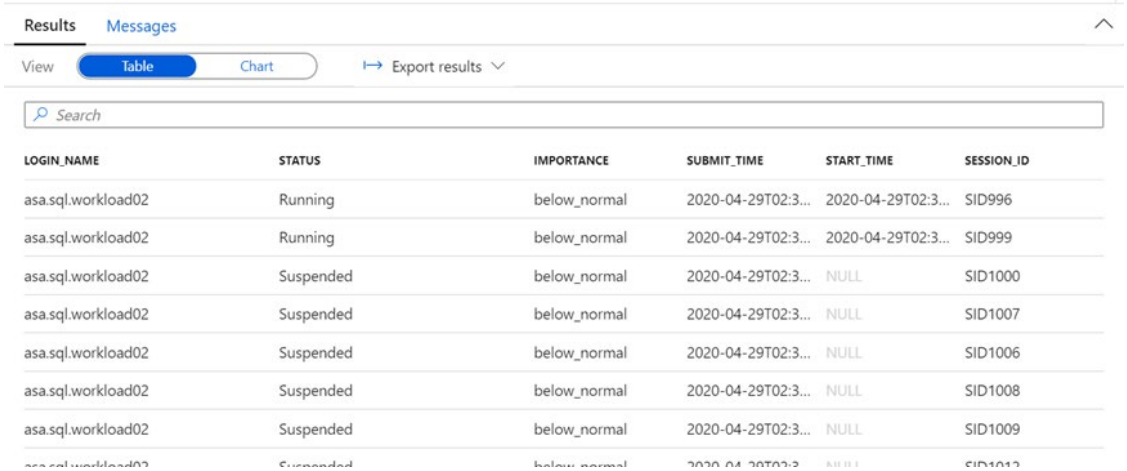
9. Let's flood the system with queries and see what happens for `asa.sql.workload02`. To do this, we will run an Azure Synapse Pipeline which triggers queries. Select the `Integrate` hub. **Run** the **Lab 08 - Execute Business Analyst Queries** Pipeline, which will run / trigger `asa.sql.workload02` queries. Ple**ase let this pipeline run for 30 seconds to one minute, then cancel it recursively**.

10. In the query window, replace the script with the following to see what happened to all the `asa.sql.workload02` queries we just triggered as they flood the system:

```
SELECT s.login_name, r.[Status], r.Importance, submit_time,
start_time ,s.session_id FROM sys.dm_pdw_exec_sessions s
JOIN sys.dm_pdw_exec_requests r ON s.session_id = r.session_id
WHERE s.login_name IN ('asa.sql.workload02') and Importance
is not NULL AND r.[status] in ('Running','Suspended')
ORDER BY submit_time, status
```

11. Select **Run** from the toolbar menu to execute the SQL command. You should see an output similar to the following that shows the importance for each session set to `below_normal`:

```
SELECT s.login_name, r.[Status], r.Importance, submit_time,
start_time ,s.session_id FROM sys.dm_pdw_exec_sessions s
JOIN sys.dm_pdw_exec_requests r ON s.session_id = r.session_id
WHERE s.login_name IN ('asa.sql.workload02') and Importance
is  not NULL AND r.[status] in ('Running','Suspended')
ORDER BY submit_time, status
```



Results | Messages

View: Table | Chart — Export results

Search

LOGIN_NAME	STATUS	IMPORTANCE	SUBMIT_TIME	START_TIME	SESSION_ID
asa.sql.workload02	Running	below_normal	2020-04-29T02:3...	2020-04-29T02:3...	SID996
asa.sql.workload02	Running	below_normal	2020-04-29T02:3...	2020-04-29T02:3...	SID999
asa.sql.workload02	Suspended	below_normal	2020-04-29T02:3...	NULL	SID1000
asa.sql.workload02	Suspended	below_normal	2020-04-29T02:3...	NULL	SID1007
asa.sql.workload02	Suspended	below_normal	2020-04-29T02:3...	NULL	SID1006
asa.sql.workload02	Suspended	below_normal	2020-04-29T02:3...	NULL	SID1008
asa.sql.workload02	Suspended	below_normal	2020-04-29T02:3...	NULL	SID1009

The script results show that each session was executed with below normal importance.

12. In the query window, replace the script with the following to set 3.25% minimum resources per request:

```
IF  EXISTS (SELECT * FROM sys.workload_management_workload_classifiers
where group_name = 'CEODemo')
BEGIN
    Drop Workload Classifier CEODreamDemo
    DROP WORKLOAD GROUP CEODemo
    --- Creates a workload group 'CEODemo'.
        Create  WORKLOAD GROUP CEODemo WITH
    (MIN_PERCENTAGE_RESOURCE = 26 -- integer value
        ,REQUEST_MIN_RESOURCE_GRANT_PERCENT = 3.25 -- factor of 26
(guaranteed more than 4 concurrencies)
    ,CAP_PERCENTAGE_RESOURCE = 100
    )
    --- Creates a workload Classifier 'CEODreamDemo'.
    Create Workload Classifier CEODreamDemo with
    (Workload_Group ='CEODemo',MemberName='asa.sql.workload02',IMPORTANCE
= BELOW_NORMAL);
END
```

Note: Configuring workload containment implicitly defines a maximum level of concurrency. With a CAP_PERCENTAGE_RESOURCE set to 60% and a REQUEST_MIN_RESOURCE_GRANT_PERCENT set to 1%, up to a 60-concurrency

level is allowed for the workload group. Consider the method included below for determining the maximum concurrency:

[Max Concurrency] = [CAP_PERCENTAGE_RESOURCE] / [REQUEST_MIN_RESOURCE_GRANT_PERCENT]

13. Let's flood the system again and see what happens for `asa.sql.workload02`. To do this, we will run an Azure Synapse Pipeline which triggers queries. Select the `Integrate` hub. **Run** the **Lab 08 - Execute Business Analyst Queries** Pipeline, which will run / trigger `asa.sql.workload02` queries. **Please let this run for 30 seconds to one minute, then cancel it recursively**.

14. In the query window, replace the script with the following to see what happened to all of the `asa.sql.workload02` queries we just triggered as they flood the system:

```
SELECT s.login_name, r.[Status], r.Importance, submit_time,
start_time ,s.session_id FROM sys.dm_pdw_exec_sessions s
JOIN sys.dm_pdw_exec_requests r ON s.session_id = r.session_id
WHERE s.login_name IN ('asa.sql.workload02') and Importance
is  not NULL AND r.[status] in ('Running','Suspended')
ORDER BY submit_time, status
```

15. Select **Run** from the toolbar menu to execute the SQL command.

Exercise 2 - Workload Monitoring

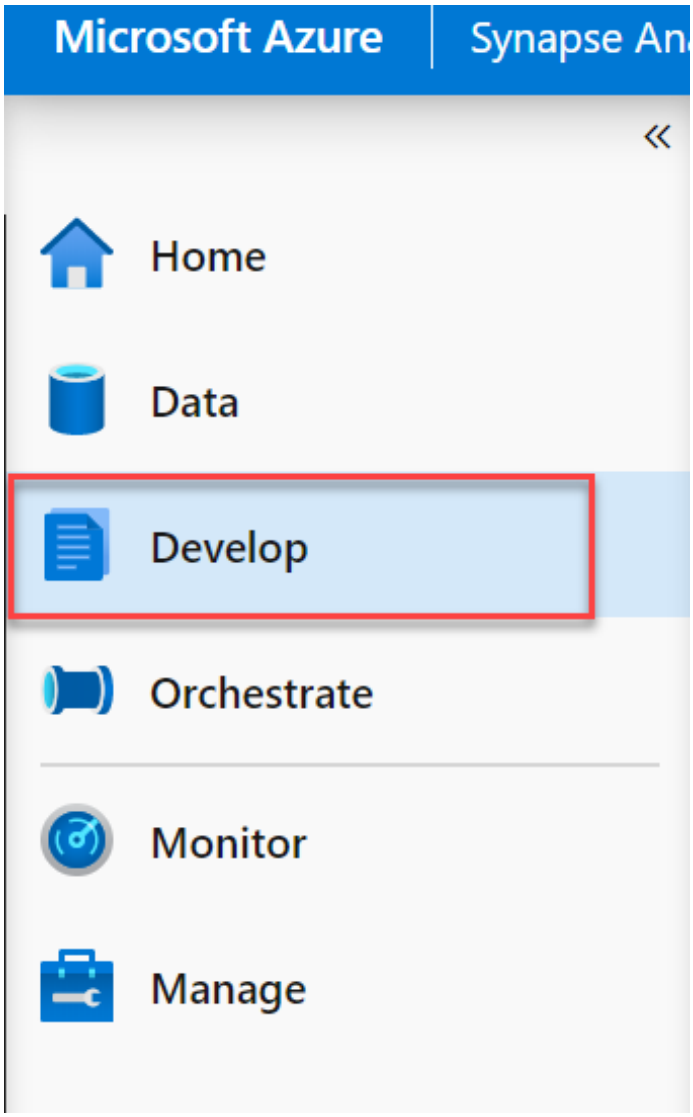
Azure Synapse Analytics provides a rich monitoring experience within the Azure portal to surface insights regarding your data warehouse workload. The Azure portal is the recommended tool when monitoring your data warehouse as it provides configurable retention periods, alerts, recommendations, and customizable charts and dashboards for metrics and logs. The portal also enables you to integrate with other Azure monitoring services such as Azure Monitor (logs) with Log analytics to provide a holistic monitoring experience for not only your data warehouse but also your entire Azure analytics platform for an integrated monitoring experience.

For a programmatic experience when monitoring SQL Analytics via T-SQL, the service provides a set of Dynamic Management Views (DMVs). These views are useful when actively troubleshooting and identifying performance bottlenecks with your workload.

Task 1 - Monitoring with Dynamic Management Views

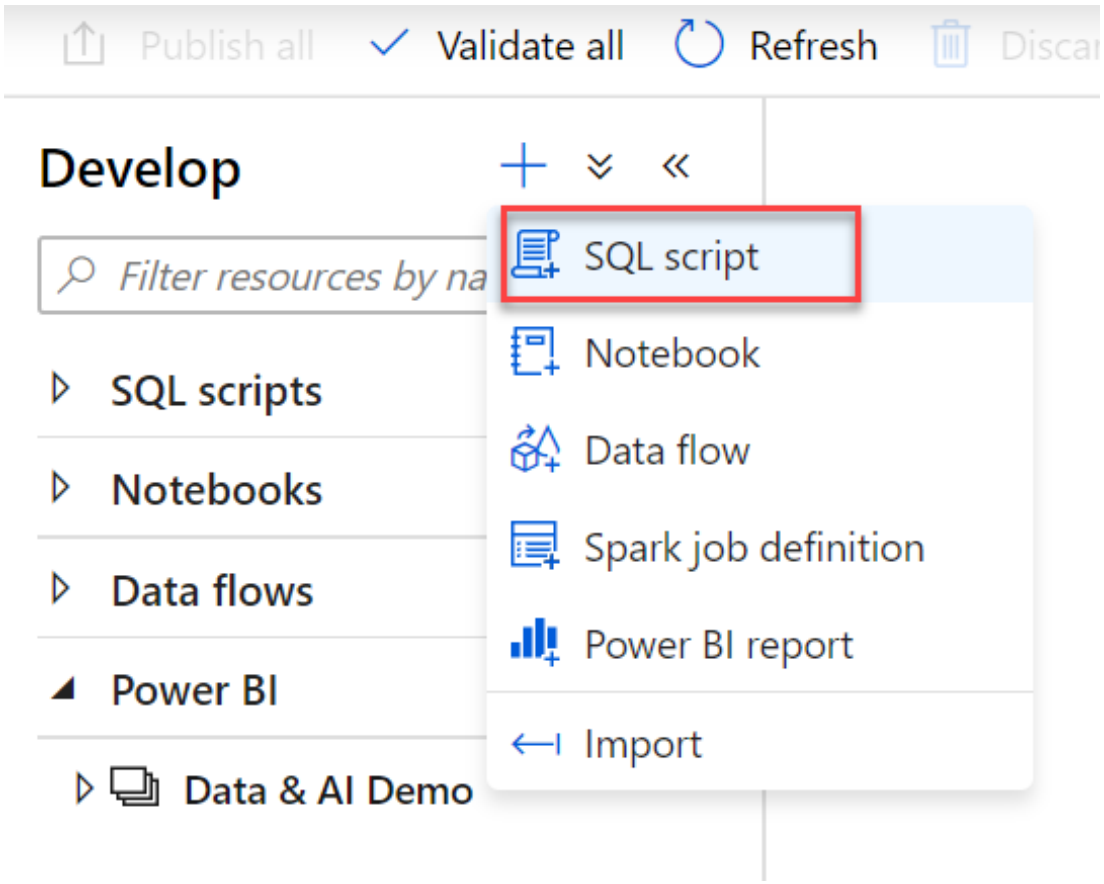
All logins to your data warehouse are logged to `sys.dm_pdw_exec_sessions`. This DMV contains the last 10,000 logins. The `session_id` is the primary key and is assigned sequentially for each new logon.

1. Open Synapse Analytics Studio (https://web.azuresynapse.net/), and then navigate to the **Develop** hub.



The Develop menu item is highlighted.

2. From the **Develop** menu, select the + button and choose **SQL Script** from the context menu.



The SQL script context menu item is highlighted.

3. In the toolbar menu, connect to the **SQL Pool** database to execute the query.

The connect to option is highlighted in the query toolbar.

4. In the query window, replace the script with the following:

```
SELECT * FROM sys.dm_pdw_exec_sessions where status <> 'Closed' and
session_id <> session_id();
```

All queries executed on SQL pool are logged to `sys.dm_pdw_exec_requests`. This DMV contains the last 10,000 queries executed. The `request_id` uniquely identifies each query and is the primary key for this DMV. The `request_id` is assigned sequentially for each new query and is prefixed with `QID`, which stands for query ID. Querying this DMV for a given `session_id` shows all queries for a given logon.

5. Select **Run** from the toolbar menu to execute the SQL command.

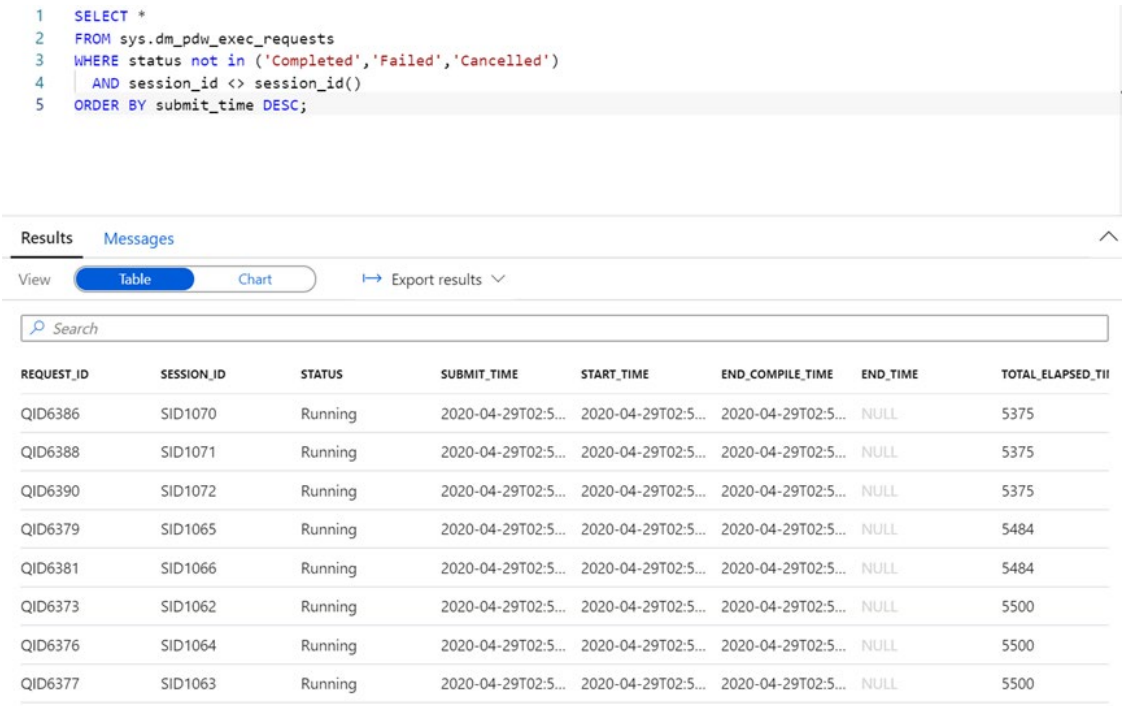
6. Let's flood the system with queries to create operations to monitor. To do this, we will run a Azure Synapse Pipeline which triggers queries. Select the `Integrate` hub. **Run** the **Lab 08 - Execute Business Analyst Queries** Pipeline, which will run / trigger

`asa.sql.workload02` queries. **Please let this pipeline run for 30 seconds to one minute, then cancel it recursively**.

7. In the query window, replace the script with the following:

```
SELECT *
FROM sys.dm_pdw_exec_requests
WHERE status not in ('Completed','Failed','Cancelled')
  AND session_id <> session_id()
ORDER BY submit_time DESC;
```

8. Select **Run** from the toolbar menu to execute the SQL command. You should see a list of sessions in the query results similar to the following. **Note the `Request_ID` of a query** in the results that you would like to investigate (*keep this value in a text editor for a later step*):



Active query results.

9. As an alternative, you can execute the following SQL command to find the top 10 longest running queries.

```
SELECT TOP 10 *
FROM sys.dm_pdw_exec_requests
ORDER BY total_elapsed_time DESC;
```

10. To simplify the lookup of a query in the `sys.dm_pdw_exec_requests` table, use `LABEL` to assign a comment to your query, which can be looked up in the `sys.dm_pdw_exec_requests` view. To test using the labels, replace the script in the query window with the following:

```
SELECT *
FROM sys.tables
OPTION (LABEL = 'My Query');
```

11. Select **Run** from the toolbar menu to execute the SQL command.

12. In the query window, replace the script with the following to filter the results with the label, `My Query`.

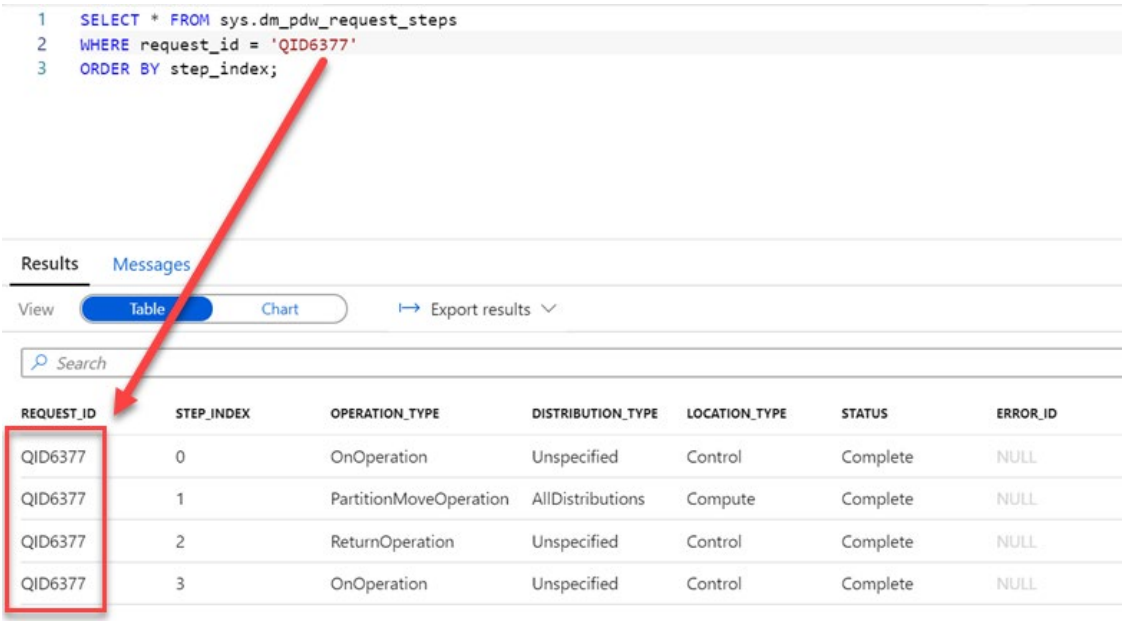
```
-- Find a query with the Label 'My Query'
-- Use brackets when querying the label column, as it it a key word
SELECT  *
FROM sys.dm_pdw_exec_requests
WHERE [label] = 'My Query';
```

13. Select **Run** from the toolbar menu to execute the SQL command. You should see the previously run query in the results view.

14. In the query window, replace the script with the following to retrieve the query's distributed SQL (DSQL) plan from `sys.dm_pdw_request_steps`. **Be sure to replace** the `QID#####` with the `Request_ID` you noted in Step 8:

```
SELECT * FROM sys.dm_pdw_request_steps
WHERE request_id = 'QID####'
ORDER BY step_index;
```

15. Select **Run** from the toolbar menu to execute the SQL command. You should see results showing the distributed query plan steps for the specified request:

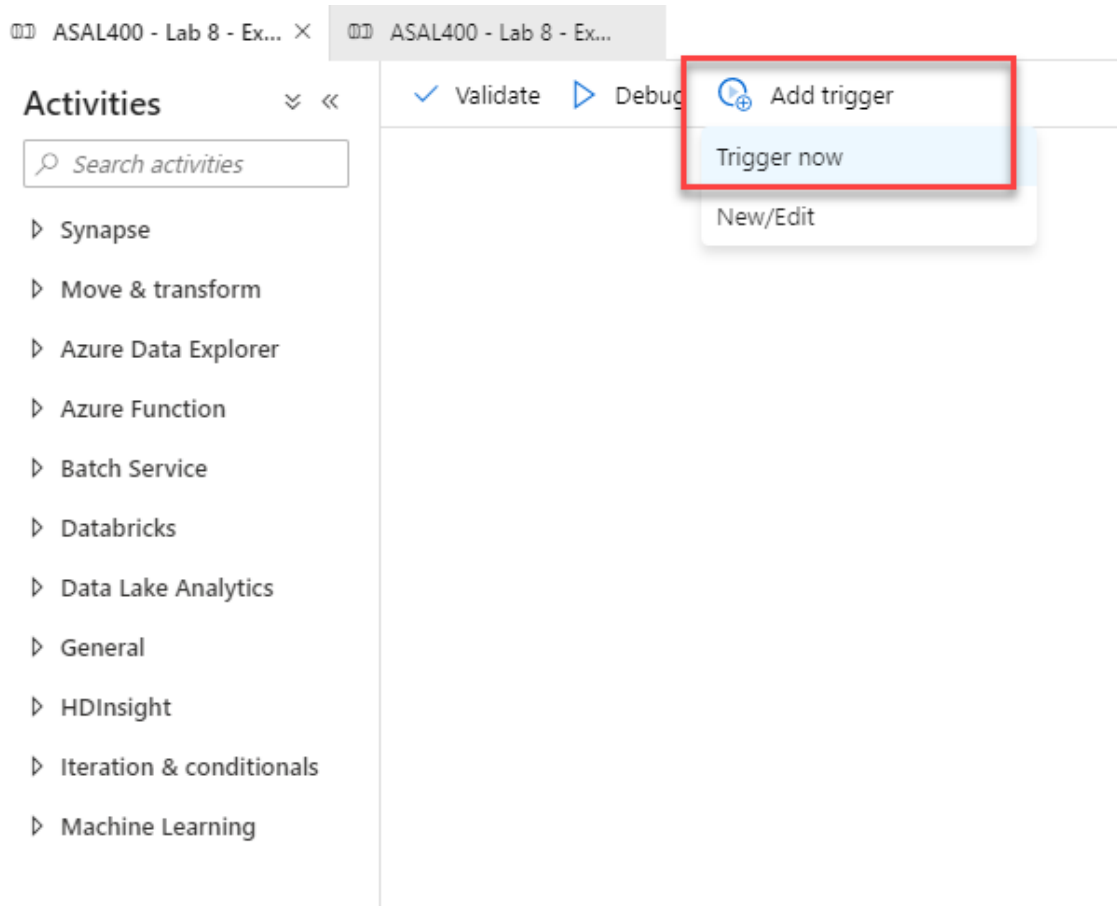


The query results are displayed.

When a DSQL plan is taking longer than expected, the cause can be a complex plan with many DSQL steps or just one step taking a long time. If the plan is many steps with several move operations, consider optimizing your table distributions to reduce data movement.

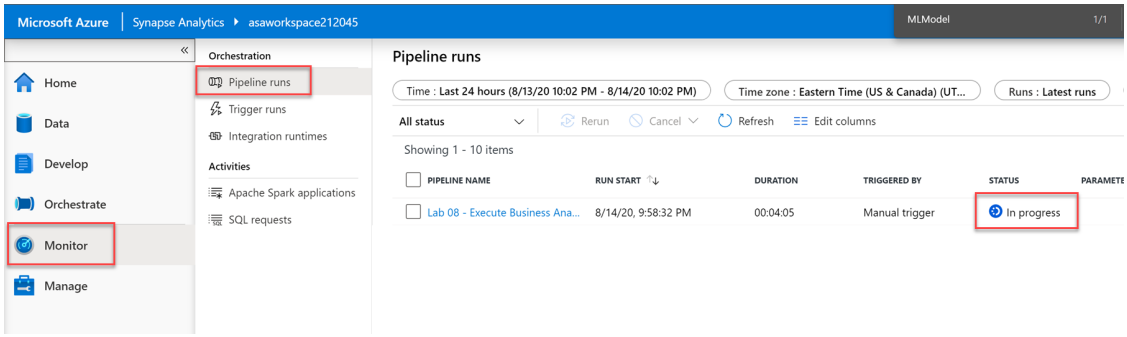
Task 2 - Orchestration Monitoring with the Monitor Hub

1. Let's run a pipeline to monitor its execution in the next step. To do this, select the `Integrate` hub. **Run** the **Lab 08 - Execute Business Analyst Queries** Pipeline.



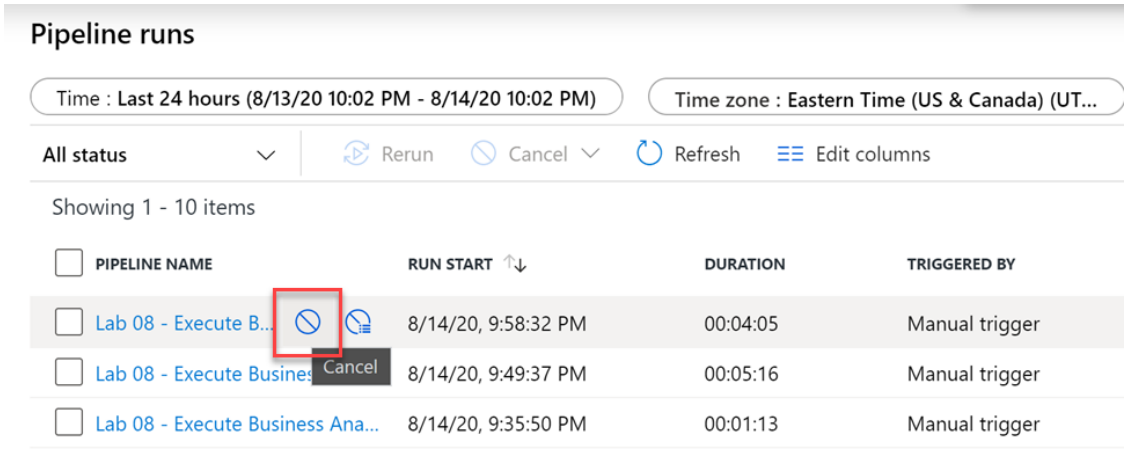
The add trigger and trigger now menu items are highlighted.

2. Navigate to the `Monitor` hub. Then select **Pipeline runs** to get a list of pipelines that ran during the last 24 hours. Observe the Pipeline status.



The pipeline runs blade is displayed within the Monitor hub.

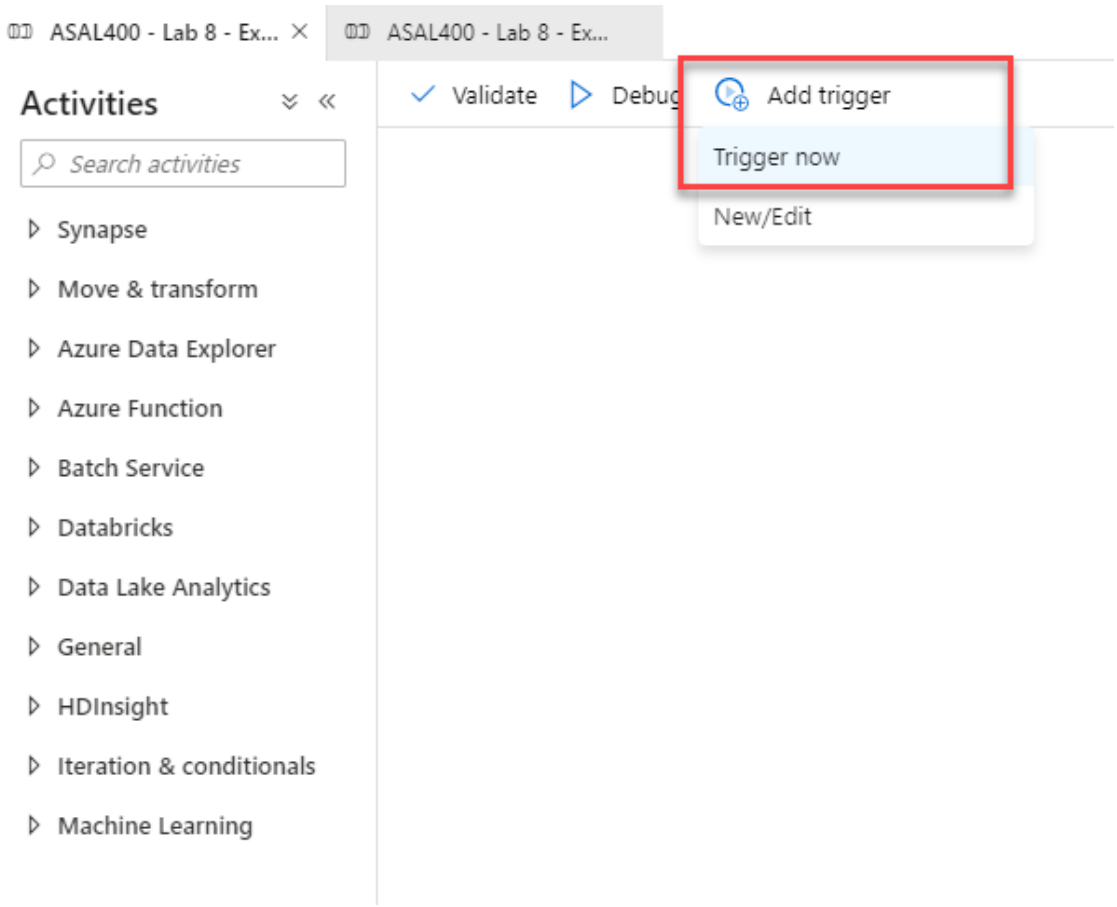
3. Hover over the running pipeline and select **Cancel** to cancel the execution of the current instance of the pipeline.



The Cancel option is highlighted.

Task 3 - Monitoring SQL Requests with the Monitor Hub

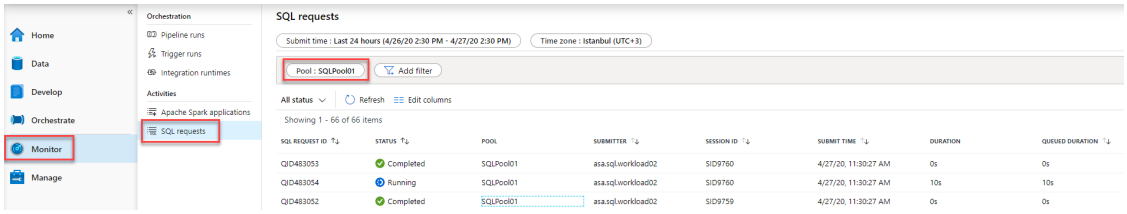
1. Let's run a pipeline to monitor its execution in the next step. To do this, select the `Integrate` hub. **Run** the **Lab 08 - Execute Business Analyst Queries** Pipeline. **Let this pipeline run for 30 seconds to one minute, then cancel it recursively**.



The add trigger and trigger now menu items are highlighted.

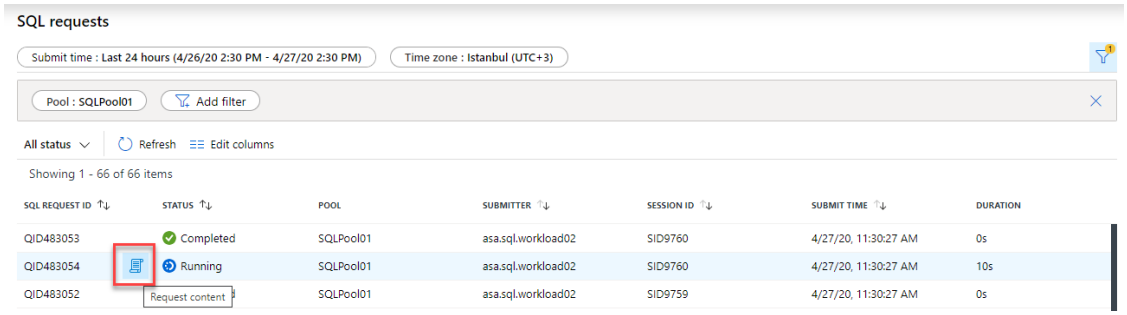
2. Navigate to the `Monitor` hub. Then select **SQL requests** to get a list of SQL requests that ran during the last 24 hours.

3. Select the **Pool** filter and select your SQL Pool. Observe the `Request Submitter`, `Submit Time`, `Duration`, and `Queued Duration` values.



The SQL requests blade is displayed within the Monitor hub.

4. Hover onto a SQL Request log and select `Request Content` to access the actual T-SQL command executed as part of the SQL Request.



The request content link is displayed over a SQL request.

Resources

- Workload Group Isolation
- Workload Isolation
- Workload Importance
- Workload Classification
- Monitoring workload using DMVs