100 XP

Introduction

1 minute

Azure Synapse Analytics includes serverless SQL pools, which are tailored for querying data in a data lake. With a serverless SQL pool you can use SQL code to query data in files of various common formats without needing to load the file data into database storage. This capability helps data analysts and data engineers analyze and process file data in the data lake using a familiar data processing language, without the need to create or maintain a relational database store.

After completing this module, you'll be able to:

- Identify capabilities and use cases for serverless SQL pools in Azure Synapse Analytics
- Query CSV, JSON, and Parquet files using a serverless SQL pool
- Create external database objects in a serverless SQL pool

Prerequisites

Before starting this module, you should have the following prerequisite skills and knowledge:

- Familiarity with the Microsoft Azure portal
- Familiarity with data lake and data warehouse concepts
- Experience of using SQL to query database tables

Next unit: Understand Azure Synapse serverless SQL pool capabilities and use cases

Continue

100 XP

Understand Azure Synapse serverless SQL pool capabilities and use cases

5 minutes

Azure Synapse Analytics is an integrated analytics service that brings together a wide range of commonly used technologies for processing and analyzing data at scale. One of the most prevalent technologies used in data solutions is SQL - an industry standard language for querying and manipulating data.

Serverless SQL pools in Azure Synapse Analytics

Azure Synapse SQL is a distributed query system in Azure Synapse Analytics that offers two kinds of runtime environments:

- **Serverless SQL pool**: on-demand SQL query processing, primarily used to work with data in a data lake.
- **Dedicated SQL pool**: Enterprise-scale relational database instances used to host data warehouses in which data is stored in relational tables.

In this module, we'll focus on serverless SQL pool, which provides a pay-per-query endpoint to query the data in your data lake. The benefits of using serverless SQL pool include:

- A familiar Transact-SQL syntax to query data in place without the need to copy or load data into a specialized store.
- Integrated connectivity from a wide range of business intelligence and ad-hoc querying tools, including the most popular drivers.
- Distributed query processing that is built for large-scale data, and computational functions - resulting in fast query performance.
- Built-in query execution fault-tolerance, resulting in high reliability and success rates even for long-running queries involving large data sets.
- No infrastructure to setup or clusters to maintain. A built-in endpoint for this service is provided within every Azure Synapse workspace, so you can start querying data as soon as the workspace is created.
- No charge for resources reserved, you're only charged for the data processed by queries you run.

When to use serverless SQL pools

Serverless SQL pool is tailored for querying the data residing in the data lake, so in addition to eliminating management burden, it eliminates a need to worry about ingesting the data into the system. You just point the query to the data that is already in the lake and run it.

Synapse SQL serverless resource model is great for unplanned or "bursty" workloads that can be processed using the always-on serverless SQL endpoint in your Azure Synapse Analytics workspace. Using the serverless pool helps when you need to know exact cost for each query executed to monitor and attribute costs.

> **Note**
>
> Serverless SQL pool is an analytics system and is not recommended for OLTP workloads such as databases used by applications to store transactional data. Workloads that require millisecond response times and are looking to pinpoint a single row in a data set are not good fit for serverless SQL pool.

Common use cases for serverless SQL pools include:

- **Data exploration**: Data exploration involves browsing the data lake to get initial insights about the data, and is easily achievable with Azure Synapse Studio. You can browse through the files in your linked data lake storage, and use the built-in serverless SQL pool to automatically generate a SQL script to select TOP 100 rows from a file or folder just as you would do with a table in SQL Server. From there, you can apply projections, filtering, grouping, and most of the operation over the data as if the data were in a regular SQL Server table.
- **Data transformation**: While Azure Synapse Analytics provides great data transformations capabilities with Synapse Spark, some data engineers might find data transformation easier to achieve using SQL. Serverless SQL pool enables you to perform SQL-based data transformations; either interactively or as part of an automated data pipeline.
- **Logical data warehouse**: After your initial exploration of the data in the data lake, you can define external objects such as tables and views in a serverless SQL database. The data remains stored in the data lake files, but are abstracted by a relational schema that can be used by client applications and analytical tools to query the data as they would in a relational database hosted in SQL Server.

Next unit: Query files using a serverless SQL pool

100 XP

Query files using a serverless SQL pool

10 minutes

You can use a serverless SQL pool to query data files in various common file formats, including:

- Delimited text, such as comma-separated values (CSV) files.
- JavaScript object notation (JSON) files.
- Parquet files.

The basic syntax for querying is the same for all of these types of file, and is built on the OPENROWSET SQL function; which generates a tabular rowset from data in one or more files. For example, the following query could be used to extract data from CSV files.

SQL

```
SELECT TOP 100 *
FROM OPENROWSET(
    BULK 'https://mydatalake.blob.core.windows.net/data/files/*.csv',
    FORMAT = 'csv') AS rows
```

The OPENROWSET function includes more parameters that determine factors such as:

- The schema of the resulting rowset
- Additional formatting options for delimited text files.

> **Tip**
>
> You'll find the full syntax for the OPENROWSET function in the **Azure Synapse Analytics documentation**.

The output from OPENROWSET is a rowset to which an alias must be assigned. In the previous example, the alias **rows** is used to name the resulting rowset.

The **BULK** parameter includes the full URL to the location in the data lake containing the data files. This can be an individual file, or a folder with a wildcard expression to filter the file types that should be included. The **FORMAT** parameter specifies the type of data being queried. The example above reads delimited text from all .csv files in the **files** folder.

> **Note**

This example assumes that the user has access to the files in the underlying store, If the files are protected with a SAS key or custom identity, you would need to **create a server-scoped credential**.

As seen in the previous example, you can use wildcards in the **BULK** parameter to include or exclude files in the query. The following list shows a few examples of how this can be used:

- `https://mydatalake.blob.core.windows.net/data/files/file1.csv`: Only include *file1.csv* in the *files* folder.
- `https://mydatalake.blob.core.windows.net/data/files/file*.csv`: All .csv files in the *files* folder with names that start with "file".
- `https://mydatalake.blob.core.windows.net/data/files/*`: All files in the *files* folder.
- `https://mydatalake.blob.core.windows.net/data/files/**`: All files in the *files* folder, and recursively its subfolders.

You can also specify multiple file paths in the **BULK** parameter, separating each path with a comma.

Querying delimited text files

Delimited text files are a common file format within many businesses. The specific formatting used in delimited files can vary, for example:

- With and without a header row.
- Comma and tab-delimited values.
- Windows and Unix style line endings.
- Non-quoted and quoted values, and escaping characters.

Regardless of the type of delimited file you're using, you can read data from them by using the OPENROWSET function with the **csv** FORMAT parameter, and other parameters as required to handle the specific formatting details for your data. For example:

SQL

```
SELECT TOP 100 *
FROM OPENROWSET(
    BULK 'https://mydatalake.blob.core.windows.net/data/files/*.csv',
    FORMAT = 'csv',
    PARSER_VERSION = '2.0',
    FIRSTROW = 2) AS rows
```

The **PARSER_VERSION** is used to determine how the query interprets the text encoding used in the files. Version 1.0 is the default and supports a wide range of file encodings, while version

2.0 supports fewer encodings but offers better performance. The **FIRSTROW** parameter is used to skip rows in the text file, to eliminate any unstructured preamble text or to ignore a row containing column headings.

Additional parameters you might require when working with delimited text files include:

- FIELDTERMINATOR - the character used to separate field values in each row. For example, a tab-delimited file separates fields with a TAB (*\t*) character. The default field terminator is a comma (,).
- ROWTERMINATOR - the character used to signify the end of a row of data. For example, a standard Windows text file uses a combination of a carriage return (CR) and line feed (LF), which is indicated by the code *\n*; while UNIX-style text files use a single line feed character, which can be indicated using the code *0x0a*.
- FIELDQUOTE - the character used to enclose quoted string values. For example, to ensure that the comma in the address field value *126 Main St, apt 2* isn't interpreted as a field delimiter, you might enclose the entire field value in quotation marks like this: "*126 Main St, apt 2*". The double-quote (") is the default field quote character.

> **Tip**
>
> For details of additional parameters when working with delimited text files, refer to the **Azure Synapse Analytics documentation**.

Specifying the rowset schema

It's common for delimited text files to include the column names in the first row. The OPENROWSET function can use this to define the schema for the resulting rowset, and automatically infer the data types of the columns based on the values they contain. For example, consider the following delimited text:

text

```
product_id,product_name,list_price
123,Widget,12.99
124,Gadget,3.99
```

The data consists of the following three columns:

- **product_id** (integer number)
- **product_name** (string)
- **list_price** (decimal number)

You could use the following query to extract the data with the correct column names and appropriately inferred SQL Server data types (in this case INT, NVARCHAR, and DECIMAL)

SQL

```
SELECT TOP 100 *
FROM OPENROWSET(
    BULK 'https://mydatalake.blob.core.windows.net/data/files/*.csv',
    FORMAT = 'csv',
    PARSER_VERSION = '2.0',
    HEADER_ROW = TRUE) AS rows
```

The **HEADER_ROW** parameter (which is only available when using parser version 2.0) instructs the query engine to use the first row of data in each file as the column names, like this:

product_id	product_name	list_price
123	Widget	12.9900
124	Gadget	3.9900

Now consider the following data:

text

```
123,Widget,12.99
124,Gadget,3.99
```

This time, the file doesn't contain the column names in a header row; so while the data types can still be inferred, the column names will be set to **C1**, **C2**, **C3**, and so on.

C1	C2	C3
123	Widget	12.9900
124	Gadget	3.9900

To specify explicit column names and data types, you can override the default column names and inferred data types by providing a schema definition in a **WITH** clause, like this:

SQL

```
SELECT TOP 100 *
FROM OPENROWSET(
    BULK 'https://mydatalake.blob.core.windows.net/data/files/*.csv',
    FORMAT = 'csv',
    PARSER_VERSION = '2.0')
WITH (
    product_id INT,
    product_name VARCHAR(20) COLLATE Latin1_General_100_BIN2_UTF8,
    list_price DECIMAL(5,2)
) AS rows
```

This query produces the expected results:

product_id	product_name	list_price
123	Widget	12.99
124	Gadget	3.99

> **Tip**
>
> When working with text files, you may encounter some incompatibility with UTF-8 encoded data and the collation used in the **master** database for the serverless SQL pool. To overcome this, you can specify a compatible collation for individual VARCHAR columns in the schema. See the **troubleshooting guidance** for more details.

Querying JSON files

JSON is a popular format for web applications that exchange data through REST interfaces or use NoSQL data stores such as Azure Cosmos DB. So, it's not uncommon to persist data as JSON documents in files in a data lake for analysis.

For example, a JSON file that defines an individual product might look like this:

JSON

```
{
    "product_id": 123,
    "product_name": "Widget",
    "list_price": 12.99
}
```

To return product data from a folder containing multiple JSON files in this format, you could use the following SQL query:

SQL

```
SELECT doc
FROM
    OPENROWSET(
        BULK 'https://mydatalake.blob.core.windows.net/data/files/*.json',
        FORMAT = 'csv',
        FIELDTERMINATOR ='0x0b',
        FIELDQUOTE = '0x0b',
        ROWTERMINATOR = '0x0b'
    ) WITH (doc NVARCHAR(MAX)) as rows
```

OPENROWSET has no specific format for JSON files, so you must use *csv* format with **FIELDTERMINATOR**, **FIELDQUOTE**, and **ROWTERMINATOR** set to *0x0b*, and a schema that includes a single NVARCHAR(MAX) column. The result of this query is a rowset containing a single column of JSON documents, like this:

doc
{"product_id":123,"product_name":"Widget","list_price": 12.99}
{"product_id":124,"product_name":"Gadget","list_price": 3.99}

To extract individual values from the JSON, you can use the JSON_VALUE function in the SELECT statement, as shown here:

SQL

```
SELECT JSON_VALUE(doc, '$.product_name') AS product,
           JSON_VALUE(doc, '$.list_price') AS price
FROM
    OPENROWSET(
        BULK 'https://mydatalake.blob.core.windows.net/data/files/*.json',
        FORMAT = 'csv',
        FIELDTERMINATOR ='0x0b',
        FIELDQUOTE = '0x0b',
        ROWTERMINATOR = '0x0b'
    ) WITH (doc NVARCHAR(MAX)) as rows
```

This query would return a rowset similar to the following results:

product	price
Widget	12.99
Gadget	3.99

Querying Parquet files

Parquet is a commonly used format for big data processing on distributed file storage. It's an efficient data format that is optimized for compression and analytical querying.

In most cases, the schema of the data is embedded within the Parquet file, so you only need to specify the **BULK** parameter with a path to the file(s) you want to read, and a **FORMAT** parameter of *parquet*; like this:

SQL

```
SELECT TOP 100 *
FROM OPENROWSET(
    BULK 'https://mydatalake.blob.core.windows.net/data/files/*.*',
    FORMAT = 'parquet') AS rows
```

Query partitioned data

It's common in a data lake to partition data by splitting across multiple files in subfolders that reflect partitioning criteria. This enables distributed processing systems to work in parallel on multiple partitions of the data, or to easily eliminate data reads from specific folders based on filtering criteria. For example, suppose you need to efficiently process sales order data, and often need to filter based on the year and month in which orders were placed. You could partition the data using folders, like this:

- /orders
  - /year=2020
    - /month=1
      - /01012020.parquet
      - /02012020.parquet
      - ...
    - /month=2
      - /01022020.parquet
      - /02022020.parquet

        - ...
    - ...
- /year=2021
    - /month=1
        - /01012021.parquet
        - /02012021.parquet
        - ...
    - ...

To create a query that filters the results to include only the orders for January and February 2020, you could use the following code:

SQL

```
SELECT *
FROM OPENROWSET(
    BULK
'https://mydatalake.blob.core.windows.net/data/orders/year=*/month=*/*.*',
    FORMAT = 'parquet') AS orders
WHERE orders.filepath(1) = '2020'
    AND orders.filepath(2) IN ('1','2');
```

The numbered filepath parameters in the WHERE clause reference the wildcards in the folder names in the BULK path -so the parameter 1 is the * in the *year=** folder name, and parameter 2 is the * in the *month=** folder name.

Next unit: Create external database objects

Continue >

How are we doing? ☆ ☆ ☆ ☆ ☆

100 XP

Create external database objects

6 minutes

You can use the OPENROWSET function in SQL queries that run in the default **master** database of the built-in serverless SQL pool to explore data in the data lake. However, sometimes you may want to create a custom database that contains some objects that make it easier to work with external data in the data lake that you need to query frequently.

Creating a database

You can create a database in a serverless SQL pool just as you would in a SQL Server instance. You can use the graphical interface in Synapse Studio, or a CREATE DATABASE statement. One consideration is to set the collation of your database so that it supports conversion of text data in files to appropriate Transact-SQL data types.

The following example code creates a database named *salesDB* with a collation that makes it easier to import UTF-8 encoded text data into VARCHAR columns.

SQL

```
CREATE DATABASE SalesDB
    COLLATE Latin1_General_100_BIN2_UTF8
```

Creating an external data source

You can use the OPENROWSET function with a BULK path to query file data from your own database, just as you can in the **master** database; but if you plan to query data in the same location frequently, it's more efficient to define an external data source that references that location. For example, the following code creates a data source named *files* for the hypothetical `https://mydatalake.blob.core.windows.net/data/files/` folder:

SQL

```
CREATE EXTERNAL DATA SOURCE files
WITH (
    LOCATION = 'https://mydatalake.blob.core.windows.net/data/files/'
)
```

One benefit of an external data source, is that you can simplify an OPENROWSET query to use the combination of the data source and the relative path to the folders or files you want to query:

SQL

```
SELECT *
FROM
    OPENROWSET(
        BULK 'orders/*.csv',
        DATA_SOURCE = 'files',
        FORMAT = 'csv',
        PARSER_VERSION = '2.0'
    ) AS orders
```

In this example, the **BULK** parameter is used to specify the relative path for all .csv files in the **orders** folder, which is a subfolder of the **files** folder referenced by the data source.

Another benefit of using a data source is that you can assign a credential for the data source to use when accessing the underlying storage, enabling you to provide access to data through SQL without permitting users to access the data directly in the storage account. For example, the following code creates a credential that uses a shared access signature (SAS) to authenticate against the underlying Azure storage account hosting the data lake.

SQL

```
CREATE DATABASE SCOPED CREDENTIAL sqlcred
WITH
    IDENTITY='SHARED ACCESS SIGNATURE',
    SECRET = 'sv=xxx...';
GO

CREATE EXTERNAL DATA SOURCE secureFiles
WITH (
    LOCATION = 'https://mydatalake.blob.core.windows.net/data/secureFiles/'
    CREDENTIAL = sqlcred
);
GO
```

Tip

In addition to SAS authentication, you can define credentials that use *managed identity* (the Azure Active Directory identity used by your Azure Synapse workspace), a specific Azure Active Directory principal, or passthrough authentication based on the identity of the user running the query (which is the default type of authentication). To learn more about using credentials in a serverless SQL pool, see the **Control storage account access**

for serverless SQL pool in Azure Synapse Analytics article in Azure Synapse Analytics documentation.

Creating an external file format

While an external data source simplifies the code needed to access files with the OPENROWSET function, you still need to provide format details for the file being access; which may include multiple settings for delimited text files. You can encapsulate these settings in an external file format, like this:

SQL

```
CREATE EXTERNAL FILE FORMAT CsvFormat
    WITH (
        FORMAT_TYPE = DELIMITEDTEXT,
        FORMAT_OPTIONS(
            FIELD_TERMINATOR = ',',
            STRING_DELIMITER = '"'
        )
    );
GO
```

After creating file formats for the specific data files you need to work with, you can use the file format to create external tables, as discussed next.

Creating an external table

When you need to perform a lot of analysis or reporting from files in the data lake, using the OPENROWSET function can result in complex code that includes data sources and file paths. To simplify access to the data, you can encapsulate the files in an external table; which users and reporting applications can query using a standard SQL SELECT statement just like any other database table. To create an external table, use the CREATE EXTERNAL TABLE statement, specifying the column schema as for a standard table, and including a WITH clause specifying the external data source, relative path, and external file format for your data.

SQL

```
CREATE EXTERNAL TABLE dbo.products
(
    product_id INT,
    product_name VARCHAR(20),
    list_price DECIMAL(5,2)
)
WITH
```

```
(
    DATA_SOURCE = files,
    LOCATION = 'products/*.csv',
    FILE_FORMAT = CsvFormat
);
GO

-- query the table
SELECT * FROM dbo.products;
```

By creating a database that contains the external objects discussed in this unit, you can provide a relational database layer over files in a data lake, making it easier for many data analysts and reporting tools to access the data by using standard SQL query semantics.

Next unit: Exercise - Query files using a serverless SQL pool

Continue >

How are we doing? ☆ ☆ ☆ ☆ ☆

200 XP

Knowledge check

5 minutes

1. What function is used to read the data in files stored in a data lake? *

- [ ] FORMAT
- [ ] ROWSET

✗ Incorrect. The ROWSET is not a valid function.

- [ ] OPENROWSET

✓ Correct. The OPENROWSET is used to read the data in files stored in a data lake.

2. What character in file path can be used to select all the file/folders that match rest of the path? *

- [ ] &
- [ ] *

✓ Correct. The asterisk character in file path can be used to select all the file or folders that match rest of the path.

- [ ] /

3. Which external database object encapsulates the connection information to a file location in a data lake store? *

- [ ] FILE FORMAT
- [ ] DATA SOURCE

✓ Correct. a DATA SOURCE provides the connection information to the files in a data lake store.

- [ ] EXTERNAL TABLE

✗ Incorrect. An EXTERNAL TABLE creates the table object without selecting data into it.

100 XP

Summary

1 minute

Serverless SQL pools enable you to easily query files in data lake. You can query various file formats CSV, JSON, Parquet, and create external database objects to provide a relational abstraction layer over the raw files.

In this module, you've learned how to:

- Identify capabilities and use cases for serverless SQL pools in Azure Synapse Analytics
- Query CSV, JSON, and Parquet files using a serverless SQL pool
- Create external database objects in a serverless SQL pool

Learn more

To learn more about using serverless SQL pools to query files, refer to the Azure Synapse Analytics documentation.

Module complete:

Unlock achievement

100 XP

Introduction

1 minute

While SQL is commonly used by data analysts to query data and support analytical and reporting workloads, data engineers often need to use SQL to *transform* data; often as part of a data ingestion pipeline or extract, transform, and load (ETL) process.

In this module, you'll learn how to use `CREATE EXTERNAL TABLE AS SELECT` (CETAS) statements to transform data, and store the results in files in a data lake that can be queried through a relational table in a serverless SQL database or processed directly from the file system.

After completing this module, you'll be able to:

- Use a CREATE EXTERNAL TABLE AS SELECT (CETAS) statement to transform data.
- Encapsulate a CETAS statement in a stored procedure.
- Include a data transformation stored procedure in a pipeline.

Prerequisites

Before starting this module, you should have the following prerequisite skills and knowledge:

- Familiarity with Azure Synapse Analytics.
- Experience using Transact-SQL to query and manipulate data.

Next unit: Transform data files with the CREATE EXTERNAL TABLE AS SELECT statement

Continue

100 XP

Transform data files with the CREATE EXTERNAL TABLE AS SELECT statement

5 minutes

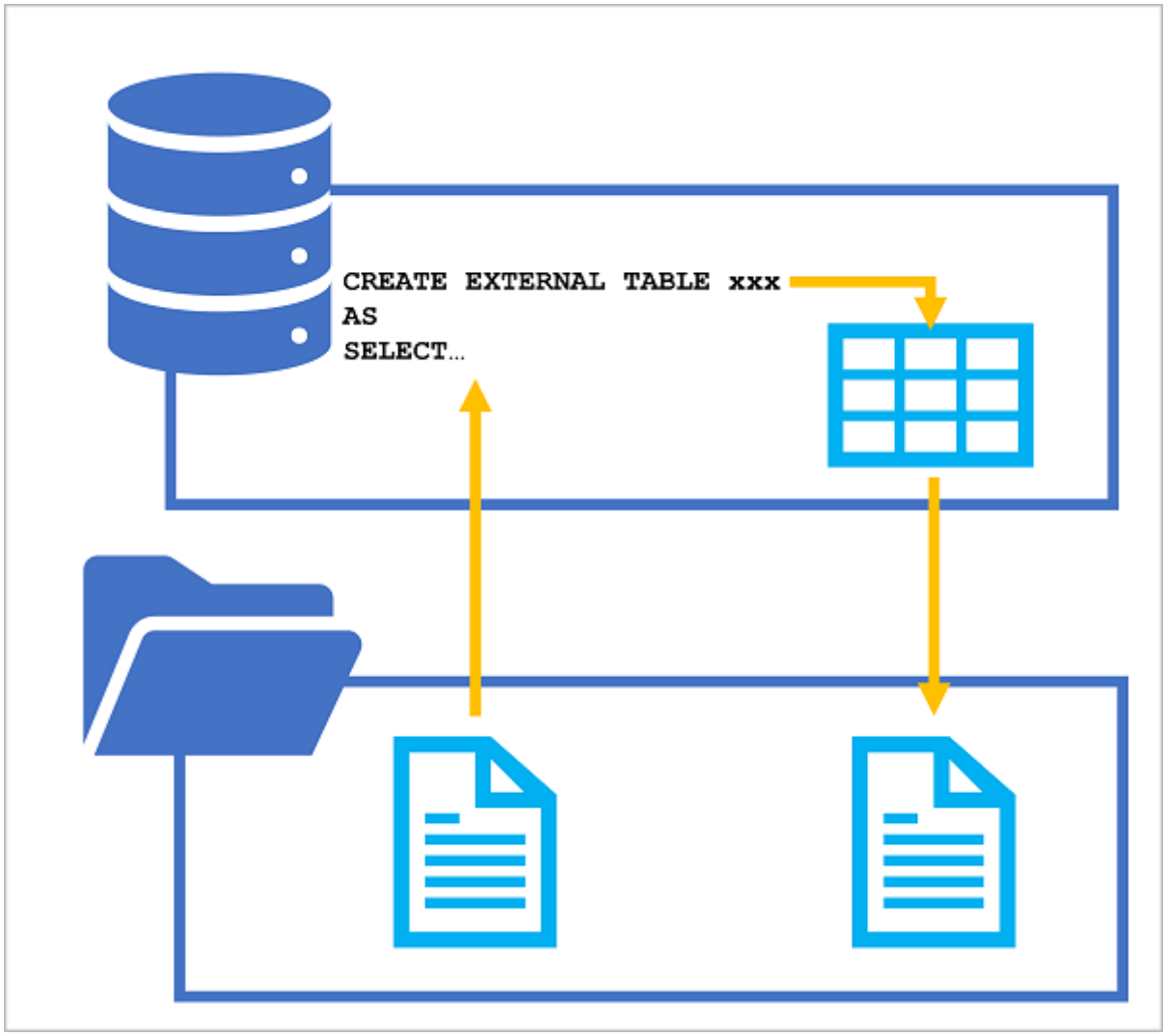
The SQL language includes many features and functions that enable you to manipulate data. For example, you can use SQL to:

- Filter rows and columns in a dataset.
- Rename data fields and convert between data types.
- Calculate derived data fields.
- Manipulate string values.
- Group and aggregate data.

Azure Synapse serverless SQL pools can be used to run SQL statements that transform data and persist the results as a file in a data lake for further processing or querying. If you're familiar with Transact-SQL syntax, you can craft a SELECT statement that applies the specific transformation you're interested in, and store the results of the SELECT statement in a selected file format with a metadata table schema that can be queried using SQL.

You can use a CREATE EXTERNAL TABLE AS SELECT (CETAS) statement in a dedicated SQL pool or serverless SQL pool to persist the results of a query in an external table, which stores its data in a file in the data lake.

The CETAS statement includes a SELECT statement that queries and manipulates data from any valid data source (which could be an existing table or view in a database, or an OPENROWSET function that reads file-based data from the data lake). The results of the SELECT statement are then persisted in an external table, which is a metadata object in a database that provides a relational abstraction over data stored in files. The following diagram illustrates the concept visually:



By applying this technique, you can use SQL to extract and transform data from files or tables, and store the transformed results for downstream processing or analysis. Subsequent operations on the transformed data can be performed against the relational table in the SQL pool database or directly against the underlying data files.

Creating external database objects to support CETAS

To use CETAS expressions, you must create the following types of object in a database for either a serverless or dedicated SQL pool. When using a serverless SQL pool, create these objects in a custom database (created using the `CREATE DATABASE` statement), not the **built-in** database.

External data source

An external data source encapsulates a connection to a file system location in a data lake. You can then use this connection to specify a relative path in which the data files for the external table created by the CETAS statement are saved.

If the source data for the CETAS statement is in files in the same data lake path, you can use the same external data source in the OPENROWSET function used to query it. Alternatively, you can create a separate external data source for the source files or use a fully qualified file path in the OPENROWSET function.

To create an external data source, use the `CREATE EXTERNAL DATA SOURCE` statement, as shown in this example:

SQL

```
CREATE EXTERNAL DATA SOURCE files
WITH (
    LOCATION = 'https://mydatalake.blob.core.windows.net/data/files/'
);
```

The previous example assumes that users running queries that use the external data source will have sufficient permissions to access the files. An alternative approach is to encapsulate a credential in the external data source so that it can be used to access file data without granting all users permissions to read it directly:

SQL

```
CREATE DATABASE SCOPED CREDENTIAL storagekeycred
WITH
    IDENTITY='SHARED ACCESS SIGNATURE',
    SECRET = 'sv=xxx...';

CREATE EXTERNAL DATA SOURCE secureFiles
WITH (
    LOCATION = 'https://mydatalake.blob.core.windows.net/data/secureFiles/'
    CREDENTIAL = storagekeycred
);
```

Tip

In addition to SAS authentication, you can define credentials that use *managed identity* (the Azure Active Directory identity used by your Azure Synapse workspace), a specific Azure Active Directory principal, or passthrough authentication based on the identity of the user running the query (which is the default type of authentication). To learn more about using credentials in a serverless SQL pool, see the **Control storage account access for serverless SQL pool in Azure Synapse Analytics** article in Azure Synapse Analytics documentation.

External file format

The CETAS statement creates a table with its data stored in files. You must specify the format of the files you want to create as an external file format.

To create an external file format, use the `CREATE EXTERNAL FILE FORMAT` statement, as shown in this example:

SQL

```
CREATE EXTERNAL FILE FORMAT ParquetFormat
WITH (
        FORMAT_TYPE = PARQUET,
        DATA_COMPRESSION = 'org.apache.hadoop.io.compress.SnappyCodec'
    );
```

Tip

In this example, the files will be saved in Parquet format. You can also create external file formats for other types of file. See **CREATE EXTERNAL FILE FORMAT (Transact-SQL)** for details.

Using the CETAS statement

After creating an external data source and external file format, you can use the CETAS statement to transform data and stored the results in an external table.

For example, suppose the source data you want to transform consists of sales orders in comma-delimited text files that are stored in a folder in a data lake. You want to filter the data to include only orders that are marked as "special order", and save the transformed data as Parquet files in a different folder in the same data lake. You could use the same external data source for both the source and destination folders as shown in this example:

SQL

```
CREATE EXTERNAL TABLE SpecialOrders
    WITH (
        -- details for storing results
        LOCATION = 'special_orders/',
        DATA_SOURCE = files,
        FILE_FORMAT = ParquetFormat
    )
AS
SELECT OrderID, CustomerName, OrderTotal
```

```
FROM
    OPENROWSET(
        -- details for reading source files
        BULK 'sales_orders/*.csv',
        DATA_SOURCE = 'files',
        FORMAT = 'CSV',
        PARSER_VERSION = '2.0',
        HEADER_ROW = TRUE
    ) AS source_data
WHERE OrderType = 'Special Order';
```

The `LOCATION` and `BULK` parameters in the previous example are relative paths for the results and source files respectively. The paths are relative to the file system location referenced by the **files** external data source.

An important point to understand is that you ***must*** use an external data source to specify the location where the transformed data for the external table is to be saved. When file-based source data is stored in the same folder hierarchy, you can use the same external data source. Otherwise, you can use a second data source to define a connection to the source data or use the fully qualified path, as shown in this example:

SQL

```
CREATE EXTERNAL TABLE SpecialOrders
    WITH (
        -- details for storing results
        LOCATION = 'special_orders/',
        DATA_SOURCE = files,
        FILE_FORMAT = ParquetFormat
    )
AS
SELECT OrderID, CustomerName, OrderTotal
FROM
    OPENROWSET(
        -- details for reading source files
        BULK
'https://mystorage.blob.core.windows.net/data/sales_orders/*.csv',
        FORMAT = 'CSV',
        PARSER_VERSION = '2.0',
        HEADER_ROW = TRUE
    ) AS source_data
WHERE OrderType = 'Special Order';
```

Dropping external tables

If you no longer need the external table containing the transformed data, you can drop it from the database by using the `DROP EXTERNAL TABLE` statement, as shown here:

SQL

```
DROP EXTERNAL TABLE SpecialOrders;
```

However, it's important to understand that external tables are a metadata abstraction over the files that contain the actual data. Dropping an external table does ***not*** delete the underlying files.

Next unit: Encapsulate data transformations in a stored procedure

Continue >

How are we doing? ☆ ☆ ☆ ☆ ☆

100 XP

Encapsulate data transformations in a stored procedure

4 minutes

While you can run a `CREATE EXTERNAL TABLE AS SELECT` (CETAS) statement in a script whenever you need to transform data, it's good practice to encapsulate the transformation operation in stored procedure. This approach can make it easier to operationalize data transformations by enabling you to supply parameters, retrieve outputs, and include additional logic in a single procedure call.

For example, the following code creates a stored procedure that drops the external table if it already exists before recreating it with order data for the specified year:

SQL

```
CREATE PROCEDURE usp_special_orders_by_year @order_year INT
AS
BEGIN

    -- Drop the table if it already exists
    IF EXISTS (
                SELECT * FROM sys.external_tables
                WHERE name = 'SpecialOrders'
            )
        DROP EXTERNAL TABLE SpecialOrders

    -- Create external table with special orders
    -- from the specified year
    CREATE EXTERNAL TABLE SpecialOrders
        WITH (
            LOCATION = 'special_orders/',
            DATA_SOURCE = files,
            FILE_FORMAT = ParquetFormat
        )
    AS
    SELECT OrderID, CustomerName, OrderTotal
    FROM
        OPENROWSET(
            BULK 'sales_orders/*.csv',
            DATA_SOURCE = 'files',
            FORMAT = 'CSV',
            PARSER_VERSION = '2.0',
            HEADER_ROW = TRUE
        ) AS source_data
    WHERE OrderType = 'Special Order'
```

```
    AND YEAR(OrderDate) = @order_year
END
```

> **Note**
>
> As discussed previously, dropping an existing external table does not delete the folder containing its data files. You must explicitly delete the target folder if it exists before running the stored procedure, or an error will occur.

In addition to encapsulating Transact-SQL logic, stored procedures also provide the following benefits:

Reduces client to server network traffic

The commands in a procedure are executed as a single batch of code; which can significantly reduce network traffic between the server and client because only the call to execute the procedure is sent across the network.

Provides a security boundary

Multiple users and client programs can perform operations on underlying database objects through a procedure, even if the users and programs don't have direct permissions on those underlying objects. The procedure controls what processes and activities are performed and protects the underlying database objects; eliminating the requirement to grant permissions at the individual object level and simplifies the security layers.

Eases maintenance

Any changes in the logic or file system locations involved in the data transformation can be applied only to the stored procedure; without requiring updates to client applications or other calling functions.

Improved performance

Stored procedures are compiled the first time they're executed, and the resulting execution plan is held in the cache and reused on subsequent runs of the same stored procedure. As a result, it takes less time to process the procedure.

---

100 XP

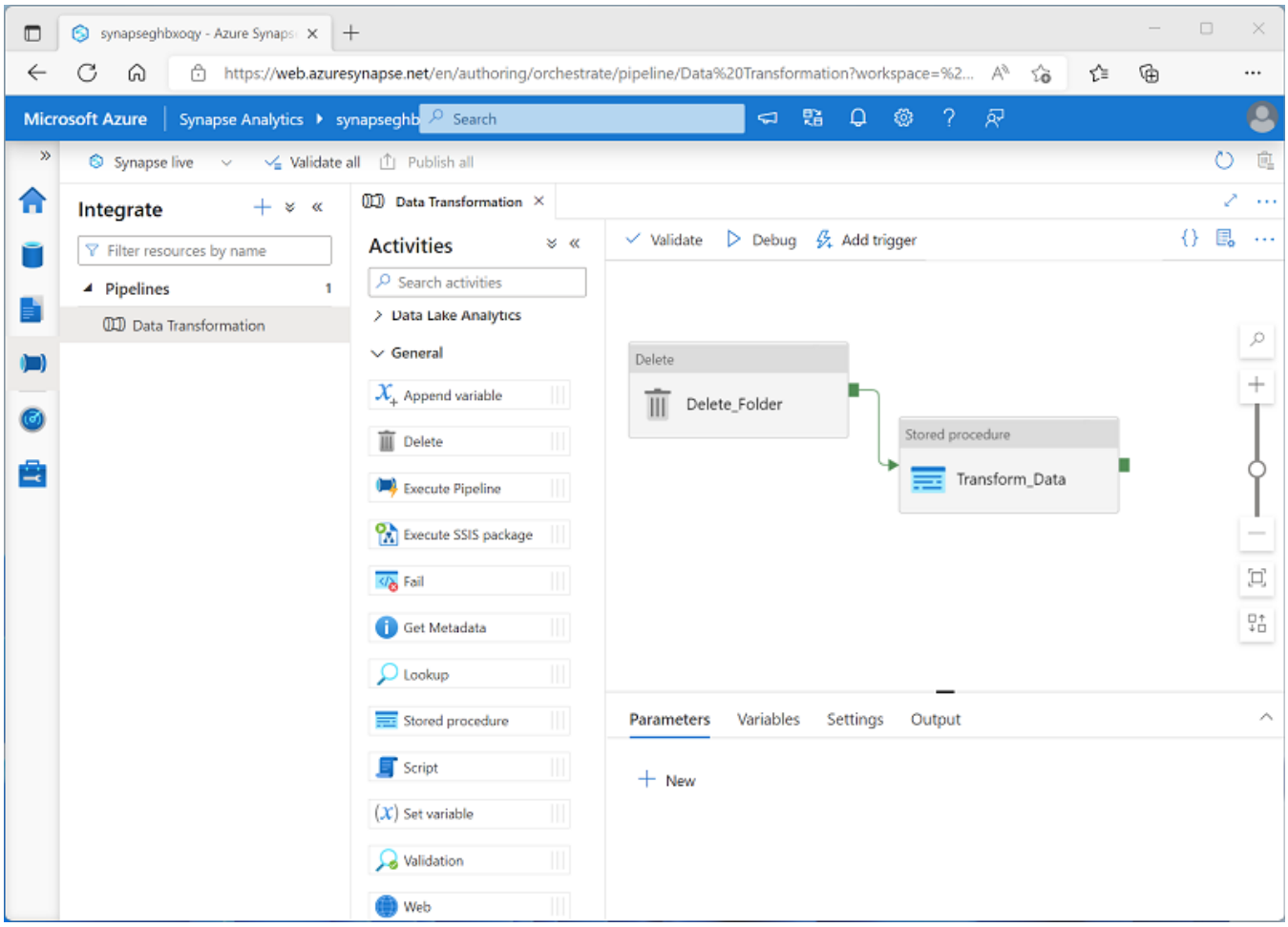
Include a data transformation stored procedure in a pipeline

3 minutes

Encapsulating a `CREATE EXTERNAL TABLE AS SELECT` (CETAS) statement in a stored procedure makes it easier for you to operationalize data transformations that you may need to perform repeatedly. In Azure Synapse Analytics and Azure Data Factory, you can create pipelines that connect to *linked services*, including Azure Data Lake Store Gen2 storage accounts that host data lake files, and serverless SQL pools; enabling you to call your stored procedures as part of an overall data extract, transform, and load (ETL) pipeline.

For example, you can create a pipeline that includes the following activities:

- A **Delete** activity that deletes the target folder for the transformed data in the data lake if it already exists.
- A **Stored procedure** activity that connects to your serverless SQL pool and runs the stored procedure that encapsulates your CETAS operation.



Creating a pipeline for the data transformation enables you to schedule the operation to run at specific times or based on specific events (such as new files being added to the source storage location).

> **Tip**
>
> For more information about using the **Stored procedure** activity in a pipeline, see **Transform data by using the SQL Server Stored Procedure activity in Azure Data Factory or Synapse Analytics** in the Azure Data Factory documentation.

Next unit: Exercise - Transform files using a serverless SQL pool

Continue >

How are we doing? ☆ ☆ ☆ ☆ ☆

5 minutes

1. You need to store the results of a query in a serverless SQL pool as files in a data lake. Which SQL statement should you use? *

- ○ BULK INSERT
- ○ CREATE EXTERNAL TABLE AS SELECT

✓ Correct. CREATE EXTERNAL TABLE AS SELECT enables you to transform your data using Transact-SQL and store the query results in a data lake.

- ○ COPY

2. Which of the following file formats can you use to persist the results of a query? *

- ○ CSV only
- ○ Parquet only.

✗ Incorrect. Parquet is not the only supported file format.

- ○ CSV and Parquet.

✓ Correct. You can store files for an external table in CSV or Parquet format (as well as other formats).

3. You drop an existing external table from a database in a serverless SQL pool. What else must you do before recreating an external table with the same location? *

- ○ Delete the folder containing the data files for dropped table.

✓ Correct. Dropping an external table does not delete the underlying files.

- ○ Drop and recreate the database.
- ○ Create an Apache Spark pool.

Next unit: Summary

Continue >

100 XP

Summary

1 minute

By using the CREATE EXTERNAL TABLE AS statement, you can use Azure Synapse serverless SQL pool to transform data as part of a data ingestion pipeline or an extract, transform, and load (ETL) process. The transformed data is persisted in files in the data lake with a relational table based on the file location; enabling you to work with the transformed data using SQL in the serverless SQL database, or directly in the file data lake.

In this lesson, you learned how to:

- Use a CREATE EXTERNAL TABLE AS SELECT (CETAS) statement to transform data.
- Encapsulate a CETAS statement in a stored procedure.
- Include a data transformation stored procedure in a pipeline.

Tip

For more information about using the CETAS statement, see **CETAS with Synapse SQL** in the Azure Synapse Analytics documentation.

Module complete:

Unlock achievement

100 XP

Introduction

1 minute

Data analysts and engineers often find themselves forced to choose between the flexibility of storing data files in a data lake, with the advantages of a structured schema in a relational database. *Lake databases* in Azure Synapse Analytics provide a way to combine these two approaches and benefit from an explicit relational schema of tables, views, and relationships that is decoupled from file-based storage.

In this module, you'll learn how to:

- Understand lake database concepts and components
- Describe database templates in Azure Synapse Analytics
- Create a lake database

Prerequisites

Before starting this module, you should have the following prerequisite skills and knowledge:

- Familiarity with the Microsoft Azure portal
- Familiarity with data lake and data warehouse concepts
- Experience of using SQL to query database tables

Next unit: Understand lake database concepts

Continue

100 XP

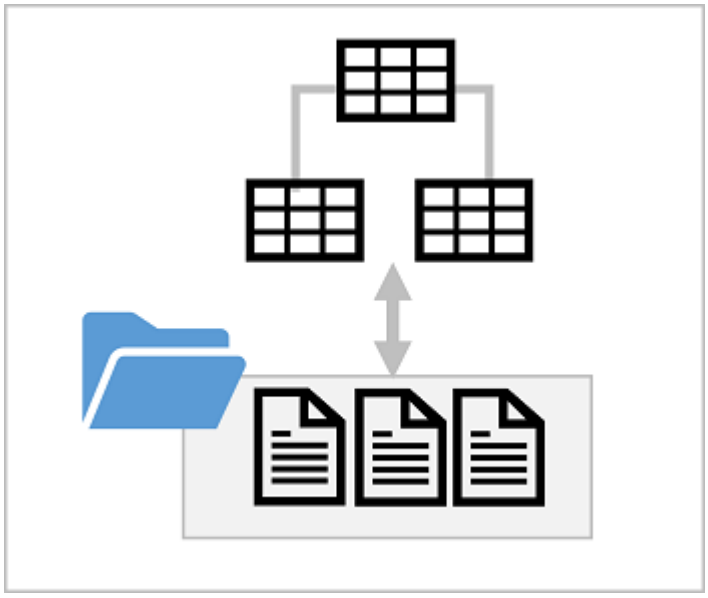
Understand lake database concepts

3 minutes

In a traditional relational database, the database schema is composed of tables, views, and other objects. Tables in a relational database define the entities for which data is stored - for example, a retail database might include tables for products, customers, and orders. Each entity consists of a set of attributes that are defined as columns in the table, and each column has a name and a data type. The data for the tables is stored in the database, and is tightly coupled to the table definition; which enforces data types, nullability, key uniqueness, and referential integrity between related keys. All queries and data manipulations must be performed through the database system.

In a data lake, there is no fixed schema. Data is stored in files, which may be structured, semi-structured, or unstructured. Applications and data analysts can work directly with the files in the data lake using the tools of their choice; without the constraints of a relational database system.

A *lake database* provides a relational metadata layer over one or more files in a data lake. You can create a lake database that includes definitions for tables, including column names and data types as well as relationships between primary and foreign key columns. The tables reference files in the data lake, enabling you to apply relational semantics to working with the data and querying it using SQL. However, the storage of the data files is decoupled from the database schema; enabling more flexibility than a relational database system typically offers.



Lake database schema

You can create a lake database in Azure Synapse Analytics, and define the tables that represent the entities for which you need to store data. You can apply proven data modeling principles to create relationships between tables and use appropriate naming conventions for tables, columns, and other database objects.

Azure Synapse Analytics includes a graphical database design interface that you can use to model complex database schema, using many of the same best practices for database design that you would apply to a traditional database.

Lake database storage

The data for the tables in your lake database is stored in the data lake as Parquet or CSV files. The files can be managed independently of the database tables, making it easier to manage data ingestion and manipulation with a wide variety of data processing tools and technologies.

Lake database compute

To query and manipulate the data through the tables you have defined, you can use an Azure Synapse serverless SQL pool to run SQL queries or an Azure Synapse Apache Spark pool to work with the tables using the Spark SQL API.

Next unit: Explore database templates

Continue >

---

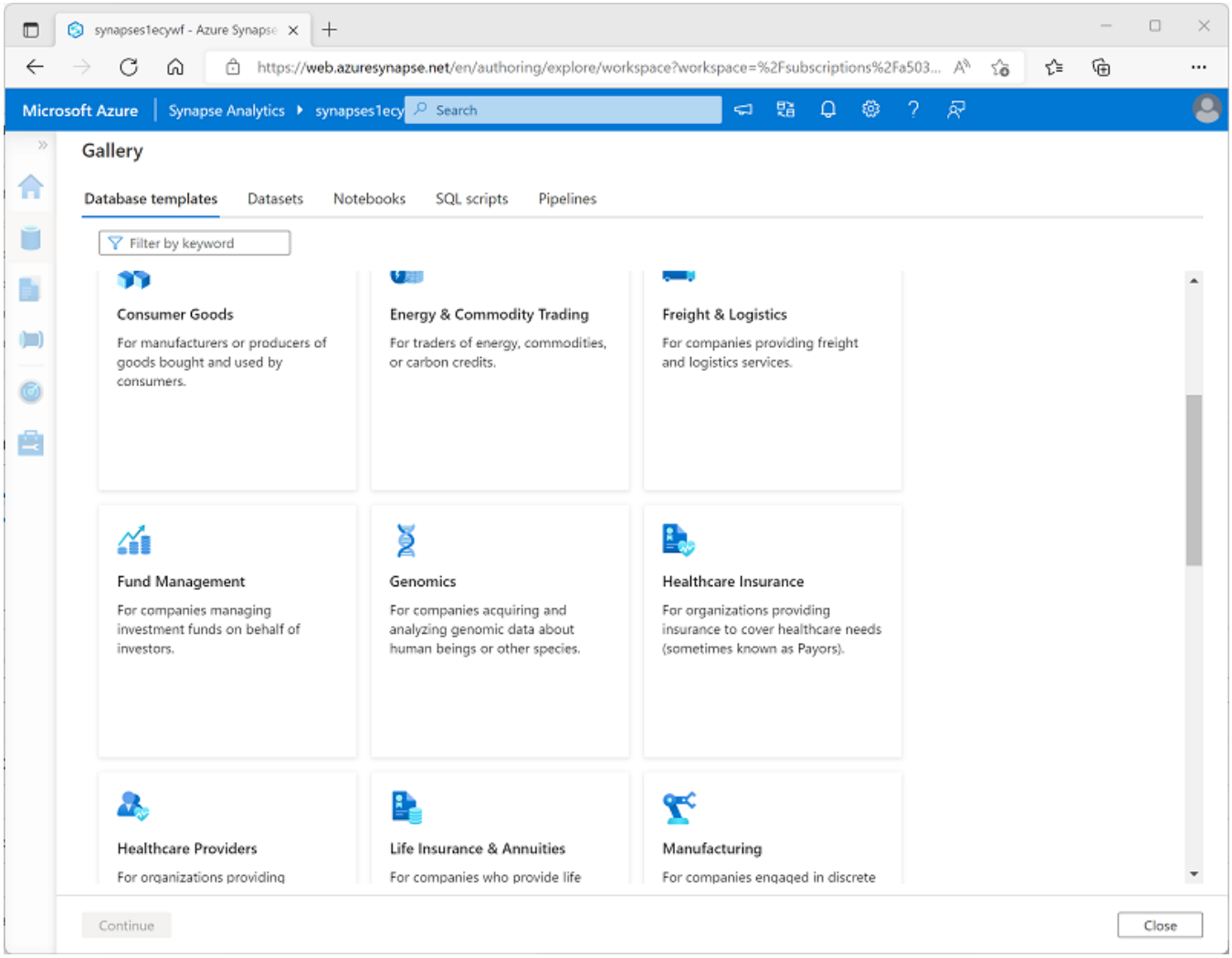
100 XP

Explore database templates

3 minutes

You can create a Lake database from an empty schema, to which you add definitions for tables and the relationships between them. However, Azure Synapse Analytics provides a comprehensive collection of database templates that reflect common schemas found in multiple business scenarios; including:

- Agriculture
- Automotive
- Banking
- Consumer goods
- Energy and commodity trading
- Freight and logistics
- Fund management
- Healthcare insurance
- Healthcare provider
- Manufacturing
- Retail
- *and many others...*



You can use one of the enterprise database templates as the starting point for creating your lake database, or you can start with a blank schema and add and modify tables from the templates as required.

Next unit: Create a lake database

Continue >

How are we doing? ☆ ☆ ☆ ☆ ☆

100 XP

Create a lake database

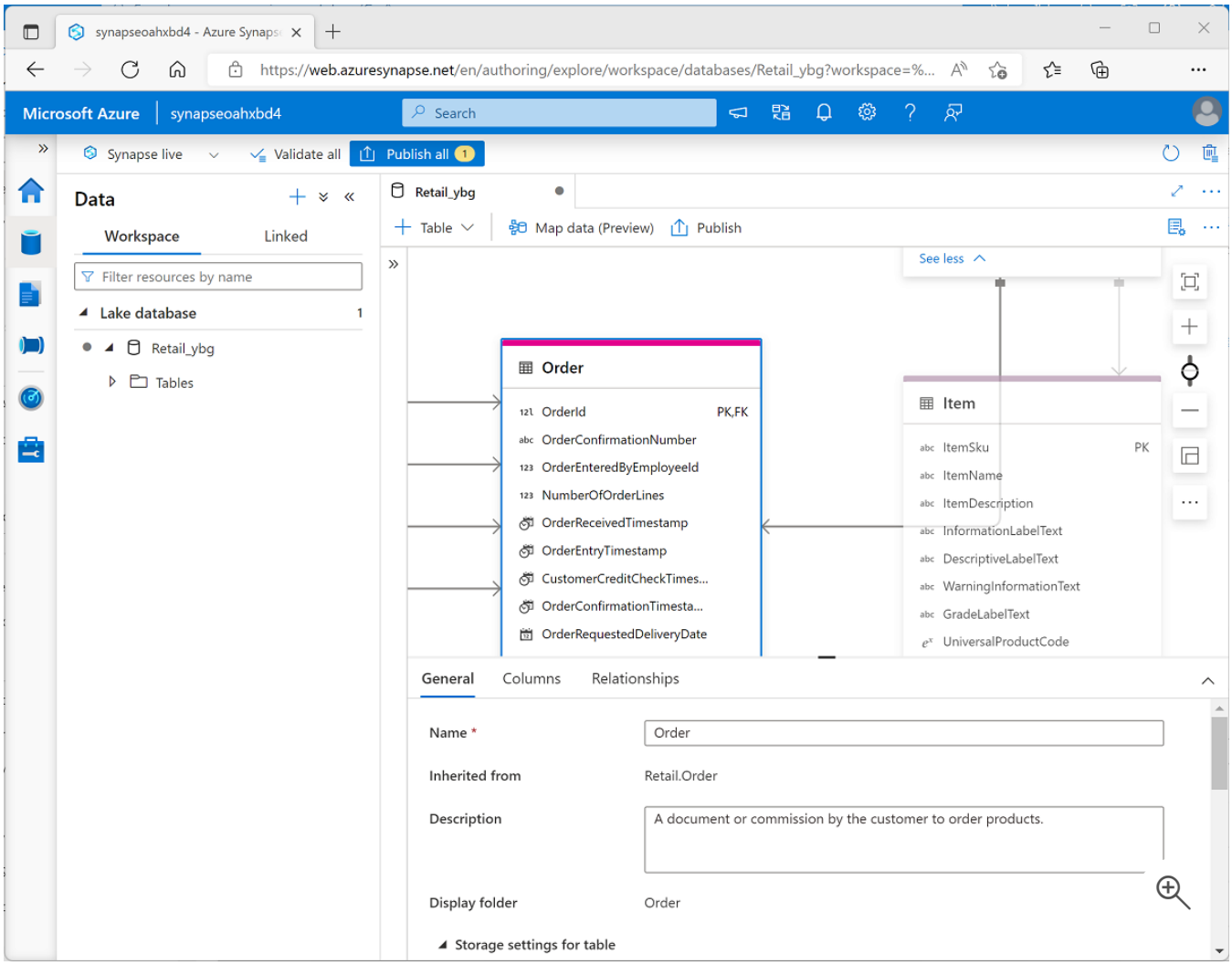
3 minutes

You can create a lake database using the lake database designer in Azure Synapse Studio. Start by adding a new lake database on the **Data** page, selecting a template from the gallery or starting with a blank lake database; and then add and customize tables using the visual database designer interface.

As you create each table, you can specify the type and location of the files you want to use to store the underlying data, or you can create a table from existing files that are already in the data lake. In most cases, it's advisable to store all of the database files in a consistent format within the same root folder in the data lake.

Database designer

The database designer interface in Azure Synapse Studio provides a drag-and-drop surface on which you can edit the tables in your database and the relationships between them.



Using the database designer, you can define the schema for your database by adding or removing tables and:

- Specifying the name and storage settings for each table.
- Specifying the names, key usage, nullability, and data types for each column.
- Defining relationships between key columns in tables.

When your database schema is ready for use, you can publish the database and start using it.

Next unit: Use a lake database

Continue >

How are we doing? ☆ ☆ ☆ ☆ ☆

100 XP

Use a lake database

3 minutes

After creating a lake database, you can store data files that match the table schemas in the appropriate folders in the data lake, and query them using SQL.

Using a serverless SQL pool

You can query a lake database in a SQL script by using a serverless SQL pool.

For example, suppose a lake database named **RetailDB** contains an **Customer** table. You could query it using a standard SELECT statement like this:

SQL

```
USE RetailDB;
GO

SELECT CustomerID, FirstName, LastName
FROM Customer
ORDER BY LastName;
```

There is no need to use an OPENROWSET function or include any additional code to access the data from the underlying file storage. The serverless SQL pool handles the mapping to the files for you.

Using an Apache Spark pool

In addition to using a serverless SQL pool, you can work with lake database tables using Spark SQL in an Apache Spark pool.

For example, you could use the following code to insert a new customer record into the **Customer** table.

SQL

```
%%sql
INSERT INTO `RetailDB`.`Customer` VALUES (123, 'John', 'Yang')
```

You could then use the following code to query the table:

```
SQL

%%sql
SELECT * FROM `RetailDB`.`Customer` WHERE CustomerID = 123
```

Next unit: Exercise - Analyze data in a lake database

Continue >

How are we doing? ☆ ☆ ☆ ☆ ☆

200 XP

Knowledge check

5 minutes

1. Which if the following statements is true of a lake database? *

- Data is stored in a relational database store and cannot be directly accessed in the data lake files.
- Data is stored in files that cannot be queried using SQL.
- A relational schema is overlaid on the underlying files, and can be queried using a serverless SQL pool or a Spark pool.

✔ **Correct. A lake database abstracts files with a relational schema that can be queried using SQL in a serverless SQL pool or a Spark pool.**

2. You need to create a new lake database for a retail solution. What's the most efficient way to do this? *

- Create a sample database in Azure SQL Database and export the SQL scripts to create the schema for the lake database.
- Start with the Retail database template in Azure Synapse Studio, and adapt it as necessary.

✔ **Correct. The Gallery in Azure Synapse Studio includes industry-proven database schema templates, including one for retail.**

- Start with an empty database and create a normalized schema.

3. You have Parquet files in an existing data lake folder for which you want to create a table in a lake database. What should you do? *

- Use a CREATE EXTERNAL TABLE AS SELECT (CETAS) query to create the table.
- Convert the files in the folder to CSV format.
- Use the database designer to create a table based on the existing folder.

✔ **Correct. You can add a table to a database from existing files.**

100 XP

Summary

1 minute

A lake database can provide the benefits of a relational schema and query interface with the flexibility of file storage in a data lake.

In this module, you learned how to:

- Understand lake database concepts and components
- Describe database templates in Azure Synapse Analytics
- Create a lake database

Learn more

To learn more about lake databases, refer to the Azure Synapse Analytics documentation.

Module complete:

Unlock achievement

100 XP

Introduction

3 minutes

In this lesson, you will learn how you can set up security when using Azure Synapse serverless SQL pools

After the completion of this lesson, you will be able to:

- Choose an authentication method in Azure Synapse serverless SQL pools
- Manage users in Azure Synapse serverless SQL pools
- Manage user permissions in Azure Synapse serverless SQL pools

Prerequisites

Before taking this lesson, it is recommended that the student is able to:

- Log into the Azure portal
- Explain the different components of Azure Synapse Analytics
- Use Azure Synapse Studio

Next unit: Choose an authentication method in Azure Synapse serverless SQL pools

Continue

100 XP

Choose an authentication method in Azure Synapse serverless SQL pools

3 minutes

Serverless SQL pool authentication refers to how users prove their identity when connecting to the endpoint. Two types of authentication are supported:

- **SQL Authentication**

  This authentication method uses a username and password.

- **Azure Active Directory Authentication**

  This authentication method uses identities managed by Azure Active Directory. For Azure AD users, multi-factor authentication can be enabled. Use Active Directory authentication (integrated security) whenever possible.

Authorization

Authorization refers to what a user can do within a serverless SQL pool database and is controlled by your user account's database role memberships and object-level permissions.

If SQL Authentication is used, the SQL user exists only in the serverless SQL pool and permissions are scoped to the objects in the serverless SQL pool. Access to securable objects in other services (such as Azure Storage) can't be granted to a SQL user directly since it only exists in scope of serverless SQL pool. The SQL user needs get authorization to access the files in the storage account.

If Azure Active Directory authentication is used, a user can sign in to a serverless SQL pool and other services, like Azure Storage, and can grant permissions to the Azure Active Directory user.

Access to storage accounts

A user that is logged into the serverless SQL pool service must be authorized to access and query the files in Azure Storage. Serverless SQL pool supports the following authorization types:

- Anonymous access

  To access publicly available files placed on Azure storage accounts that allow anonymous access.

- Shared access signature (SAS)

  Provides delegated access to resources in storage account. With a SAS, you can grant clients access to resources in storage account, without sharing account keys. A SAS gives you granular control over the type of access you grant to clients who have the SAS: validity interval, granted permissions, acceptable IP address range, acceptable protocol (https/http).

- Managed Identity.

  Is a feature of Azure Active Directory (Azure AD) that provides Azure services for serverless SQL pool. Also, it deploys an automatically managed identity in Azure AD. This identity can be used to authorize the request for data access in Azure Storage. Before accessing the data, the Azure Storage administrator must grant permissions to Managed Identity for accessing the data. Granting permissions to Managed Identity is done the same way as granting permission to any other Azure AD user.

- User Identity

  Also known as "pass-through", is an authorization type where the identity of the Azure AD user that logged into serverless SQL pool is used to authorize access to the data. Before accessing the data, Azure Storage administrator must grant permissions to Azure AD user for accessing the data. This authorization type uses the Azure AD user that logged into serverless SQL pool, therefore it's not supported for SQL user types.

Supported authorization types for database users can be found in the table below:

Authorization type	**SQL user**	**Azure AD user**
User Identity	Not supported	Supported
SAS	Supported	Supported
Managed Identity	Not supported	Supported

Supported storage and authorization types can be found in the table below:

Authorization type	Blob Storage	ADLS Gen1	ADLS Gen2
User Identity	Supported - SAS token can be used to access storage that is not protected with firewall	Not supported	Supported - SAS token can be used to access storage that is not protected with firewall
SAS	Supported	Supported	Supported
Managed Identity	Supported	Supported	Supported

Next unit: Manage users in Azure Synapse serverless SQL pools

Continue >

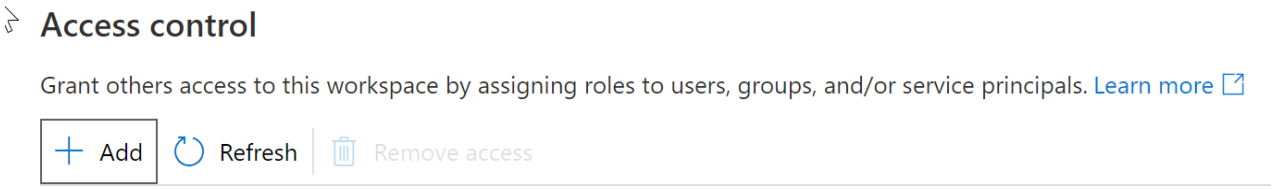
How are we doing? ☆ ☆ ☆ ☆ ☆

Manage users in Azure Synapse serverless SQL pools

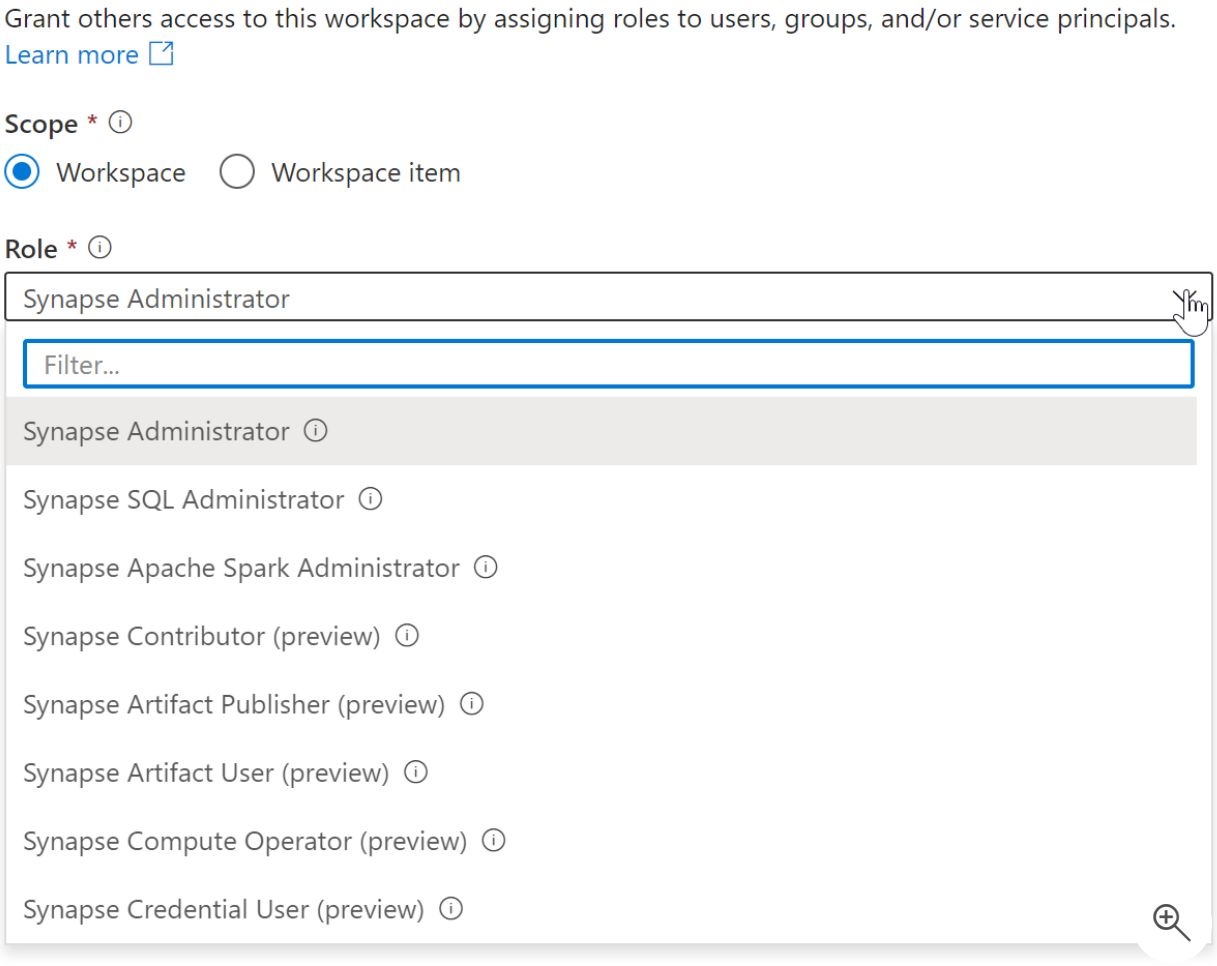
3 minutes

You can give administrator privileges to a user to Azure Synapse serverless SQL pool. To do this you should open the Azure Synapse workspace and do the following steps:

1. Go to **Manage** menu
2. Go to **Access control**
3. Click on **Add**



4. Choose **Synapse Administrator**



5. Select a User or Security group (a security group is the recommended option here)
6. Click **Apply**

Now this user or group is the administrator of the Azure Synapse workspace and serverless SQL pool.

Next unit: Manage user permissions in Azure Synapse serverless SQL pools

Continue >

How are we doing? ☆ ☆ ☆ ☆ ☆

100 XP

Manage user permissions in Azure Synapse serverless SQL pools

3 minutes

To secure data, Azure Storage implements an access control model that supports both Azure role-based access control (Azure RBAC) and access control lists (ACLs) like Portable Operating System Interface for Unix (POSIX)

You can associate a security principal with an access level for files and directories. These associations are captured in an access control list (ACL). Each file and directory in your storage account has an access control list. When a security principal attempts an operation on a file or directory, an ACL check determines whether that security principal (user, group, service principal, or managed identity) has the correct permission level to perform the operation.

There are two kinds of access control lists:

- **Access ACLs**

  Controls access to an object. Files and directories both have access ACLs.

- **Default ACLs**

  Are templates of ACLs associated with a directory that determine the access ACLs for any child items that are created under that directory. Files do not have default ACLs.

Both access ACLs and default ACLs have the same structure.

The permissions on a container object are Read, Write, and Execute, and they can be used on files and directories as shown in the following table:

Levels of permissions

Permission	File	Directory
Read (R)	Can read the contents of a file	Requires Read and Execute to list the contents of the directory
Write (W)	Can write or append to a file	Requires Write and Execute to create child items in a directory

Permission	File	Directory
Execute (X)	Does not mean anything in the context of Data Lake Storage Gen2	Required to traverse the child items of a directory

Guidelines in setting up ACLs

Always use Azure Active Directory security groups as the assigned principal in an ACL entry. Resist the opportunity to directly assign individual users or service principals. Using this structure will allow you to add and remove users or service principals without the need to reapply ACLs to an entire directory structure. Instead, you can just add or remove users and service principals from the appropriate Azure AD security group.

There are many ways to set up groups. For example, imagine that you have a directory named **/LogData** which holds log data that is generated by your server. Azure Data Factory (ADF) ingests data into that folder. Specific users from the service engineering team will upload logs and manage other users of this folder, and various Databricks clusters will analyze logs from that folder.

To enable these activities, you could create a LogsWriter group and a LogsReader group. Then, you could assign permissions as follows:

- Add the LogsWriter group to the ACL of the **/LogData** directory with rwx permissions.
- Add the LogsReader group to the ACL of the **/LogData** directory with r-x permissions.
- Add the service principal object or Managed Service Identity (MSI) for ADF to the LogsWriters group.
- Add users in the service engineering team to the LogsWriter group.
- Add the service principal object or MSI for Databricks to the LogsReader group.

If a user in the service engineering team leaves the company, you could just remove them from the LogsWriter group. If you did not add that user to a group, but instead, you added a dedicated ACL entry for that user, you would have to remove that ACL entry from the **/LogData** directory. You would also have to remove the entry from all subdirectories and files in the entire directory hierarchy of the **/LogData** directory.

Roles necessary for serverless SQL pool users

For users which need **read only** access you should assign role named **Storage Blob Data Reader**.

For users which need **read/write** access you should assign role named **Storage Blob Data Contributor**. Read/Write access is needed if user should have access to create external table as select (CETAS).

> ⓘ **Note**
>
> If user has a role Owner or Contributor, that role is not enough. Azure Data Lake Storage gen 2 has super-roles which should be assigned.

Database level permission

To provide more granular access to the user, you should use Transact-SQL syntax to create logins and users.

To grant access to a user to a single serverless SQL pool database, follow the steps in this example:

1. Create LOGIN

```
SQL
```

```
use master
CREATE LOGIN [alias@domain.com] FROM EXTERNAL PROVIDER;
```

2. Create USER

```
SQL
```

```
use yourdb -- Use your DB name
CREATE USER alias FROM LOGIN [alias@domain.com];
```

3. Add USER to members of the specified role

```
SQL
```

```
use yourdb -- Use your DB name
alter role db_datareader
Add member alias -- Type USER name from step 2
-- You can use any Database Role which exists
-- (examples: db_owner, db_datareader, db_datawriter)
-- Replace alias with alias of the user you would like to give access
and domain with the company domain you are using.
```

Server level permission

1. To grant full access to a user to all serverless SQL pool databases, follow the step in this example:

```SQL
CREATE LOGIN [alias@domain.com] FROM EXTERNAL PROVIDER;
ALTER SERVER ROLE sysadmin ADD MEMBER [alias@domain.com];
```

Next unit: Knowledge check

Continue >

How are we doing? ☆ ☆ ☆ ☆ ☆

200 XP

Knowledge check

3 minutes

1. Which authentication method would be the likeliest choice to use for an individual who needs to access your serverless SQL pool who works for an external organization? *

- ○ Local authentication.
- ○ SQL Authentication.

✔ Correct. SQL Authentication uses an authentication method of a username and password stored within the serverless SQL pool.

- ○ Azure Active Directory.

✕ Incorrect. Azure Active Directory uses identities managed by Azure Active Directory.

2. Which Azure Synapse Studio hub is where you assign administrator privileges to an Azure Synapse workspace? *

- ○ Manage.

✔ Correct. The manage hub is the area of Azure Synapse Studio where you assign administrator privileges to an Azure Synapse workspace.

- ○ Data.
- ○ Develop.

3. Which role enables a user to create external table as select (CETAS) against an Azure Data Lake Gen2 data store? *

- ○ Storage Blob Data Reader.
- ○ Storage Blob Data Contributor.

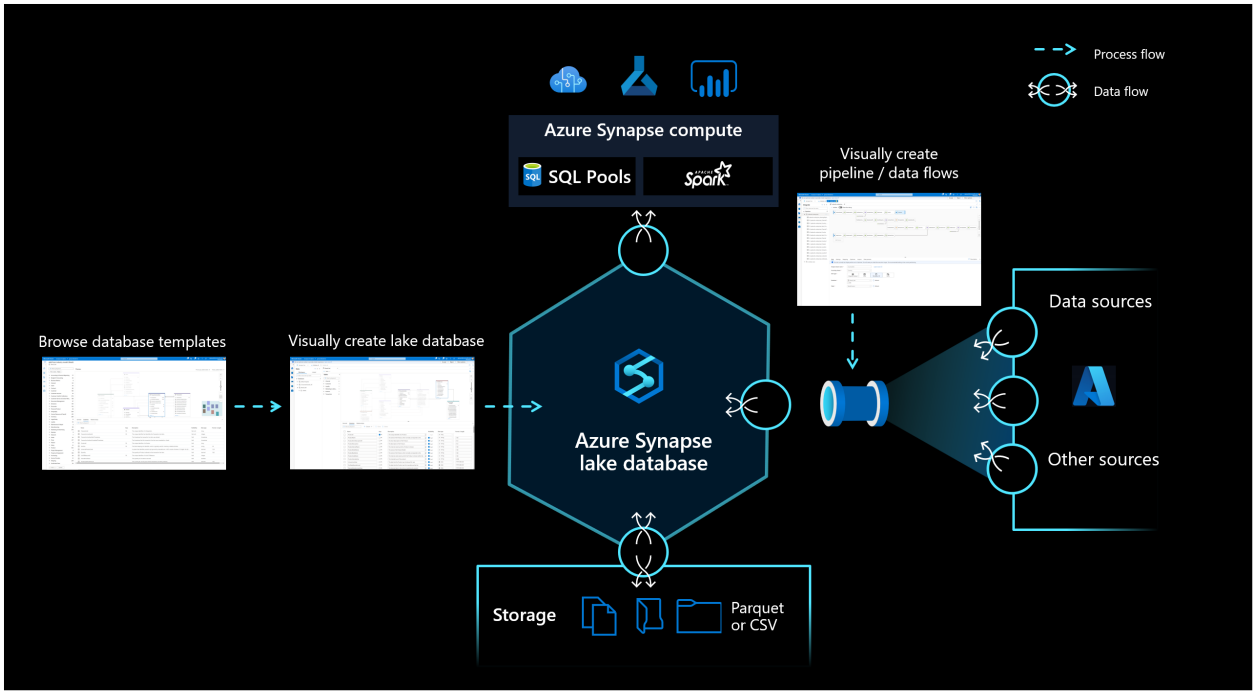
✔ Correct. This provides the read/write access required to execute a create external table as select statement.

- ○ Executor.

Lake database

Article • 03/04/2023

The lake database in Azure Synapse Analytics enables customers to bring together database design, meta information about the data that is stored and a possibility to describe how and where the data should be stored. Lake database addresses the challenge of today's data lakes where it is hard to understand how data is structured.



Database designer

The new database designer in Synapse Studio gives you the possibility to create a data model for your lake database and add additional information to it. Every Entity and Attribute can be described to provide more information about the model, which not only contains Entities but relationships as well. In particular, the inability to model relationships has been a challenge for the interaction on the data lake. This challenge is now addressed with an integrated designer that provides possibilities that have been available in databases but not on the lake. Also the capability to add descriptions and possible demo values to the model allows people who are interacting with it in the future to have information where they need it to get a better understanding about the data.

Data storage

Lake databases use a data lake on the Azure Storage account to store the data of the database. The data can be stored in Parquet, Delta or CSV format and different settings

can be used to optimize the storage. Every lake database uses a linked service to define the location of the root data folder. For every entity, separate folders are created by default within this database folder on the data lake. By default all tables within a lake database use the same format but the formats and location of the data can be changed per entity if that is requested.

> **Note**
>
> Publishing a lake database does not create any of the underlying structures or schemas needed to query the data in Spark or SQL. After publishing, load data into your lake database using **pipelines** to begin querying it.
>
> Currently, Delta format support for lake databases is not supported in Synapse Studio.
>
> The synchronization of lake database objects between storage and Synapse is one-directional. Be sure to perform any creation or schema modification of lake database objects using the database designer in Synapse Studio. If you instead make such changes from Spark or directly in storage, the definitions of your lake databases will become out of sync. If this happens, you may see old lake database definitions in the database designer. You will need to replicate and publish such changes in the database designer in order to bring your lake databases back in sync.

Database compute

The lake database is exposed in Synapse SQL serverless SQL pool and Apache Spark providing users with the capability to decouple storage from compute. The metadata that is associated with the lake database makes it easy for different compute engines to not only provide an integrated experience but also use additional information (for example, relationships) that was not originally supported on the data lake.

Next steps

Continue to explore the capabilities of the database designer using the links below.

- Create lake database quick start
- Database templates Concept