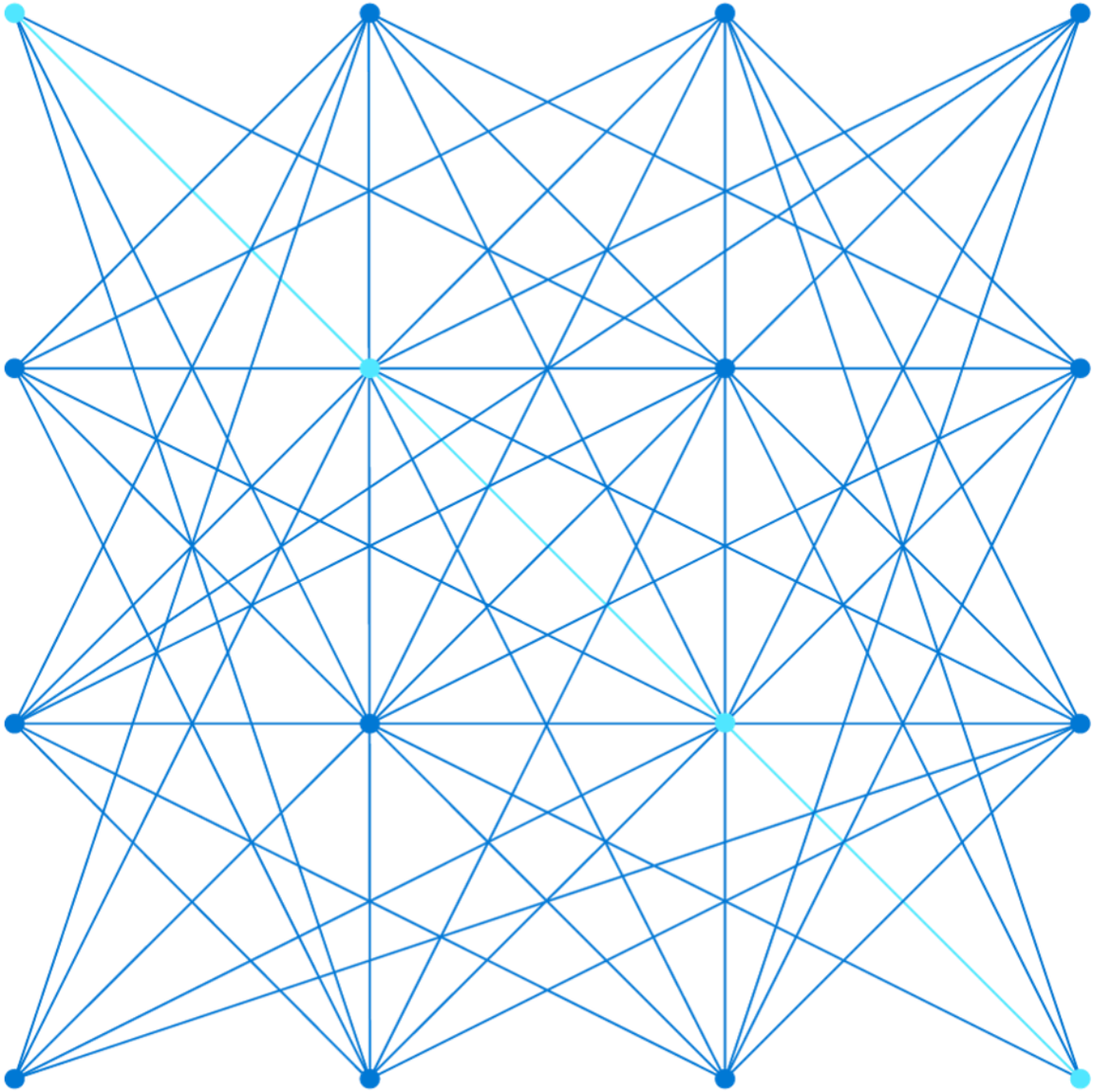
Microsoft Azure

Implementing an Azure Data Solution [DP-200]



Tissana Tanaklang

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- Master of Science Program in Software Engineering King Mongkut's University of Technology Thonburi
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- Microsoft Certified Trainer (MCT)

- Microsoft Certified Azure Data Engineer Associate
- Microsoft Certified Solutions Associate - Web Application Development

- Microsoft Certified Azure Fundamentals
- Microsoft Certified Azure Data Fundamentals
- Microsoft Certified Azure AI Fundamentals

Agenda

About this course

Audience

Course agenda

Prerequisites

About this course

In this course, the students will implement various data platform technologies into solutions that are in line with business and technical requirements including on-premises, cloud, and hybrid data scenarios incorporating both relational and No-SQL data. They will also learn how to process data using a range of technologies and languages for both streaming and batch data

The students will also explore how to implement data security including authentication, authorization, data policies and standards. They will also define and implement data solution monitoring for both the data storage and data processing activities. Finally, they will manage and troubleshoot Azure data solutions which includes the optimization and disaster recovery of big data, batch processing and streaming data solutions

Course agenda

Module 1
Azure for the Data Engineer

Lesson 01 – Explain the evolving world of data

Lesson 02 – Survey the services in the Azure Data Platform

Lesson 03 – Identify the tasks that are performed by a Data Engineer

Lesson 04 – Describe the use cases for the cloud in a case study

Module 2
Working with Data Storage

Lesson 01 – Choose a data storage approach in Azure

Lesson 02 – Create an Azure Storage Account

Lesson 03 – Explain Azure Data Lake Storage

Lesson 04 – Upload data into Azure Data Lake

Course agenda *(continued #1)*

Module 3
Enabling team based Data Science with Azure Databricks

Lesson 01 – Explain Azure Databricks

Lesson 02 – Work with Azure Databricks

Lesson 03 – Read data with Azure Databricks

Lesson 04 – Perform transformations with Azure Databricks

Module 4
Building globally distributed databases with Cosmos DB

Lesson 01 – Create an Azure Cosmos DB database built to scale

Lesson 02 – Insert and query data in your Azure Cosmos DB database

Lesson 03 – Build a .NET Core app for Azure Cosmos DB in Visual Studio Code

Lesson 04 – Distribute your data globally with Azure Cosmos DB

Course agenda *(continued #2)*

Module 5
Working with relational data stores in the cloud

Lesson 01 – Explain SQL Database

Lesson 02 – Explain SQL Data Warehouse

Lesson 03 – Provision and load data in Azure SQL Data Warehouse

Lesson 04 – Import data into Azure SQL Data Warehouse using PolyBase

Module 6
Performing real-time analytics with Stream Analytics

Lesson 01 – Explain data streams and event processing

Lesson 02 – Data ingestion with Event Hubs

Lesson 03 – Processing data with Stream Analytics jobs

Course agenda *(continued #3)*

Module 7
Orchestrating data movement with Azure Data Factory

Lesson 01 – Explain how Azure Data Factory works

Lesson 02 – Create linked services and datasets

Lesson 03 – Create pipelines and activities

Lesson 04 – Azure Data Factory pipeline execution and triggers

Module 8
Securing Azure Data Platforms

Lesson 01 – Introduction to security

Lesson 02 – Key security components

Lesson 03 – Securing storage accounts and Data Lake Storage

Lesson 04 – Security data stores

Lesson 05 – Securing streaming data

Course agenda *(continued #4)*

Module 9
Monitoring and troubleshooting Data Storage and processing

Lesson 01 – Explain the monitoring capabilities that are available

Lesson 02 – Troubleshoot common data storage issues

Lesson 03 – Troubleshoot common data processing issues

Lesson 04 – Manage disaster recovery

Audience

Primary audience:

The audience for this course are data professionals, data architects, and business intelligence professionals who want to learn about the data platform technologies that exist on Microsoft Azure

Secondary audience:

The secondary audience for this course are individuals who develop applications that deliver content from the data platform technologies that exist on Microsoft Azure

Prerequisites

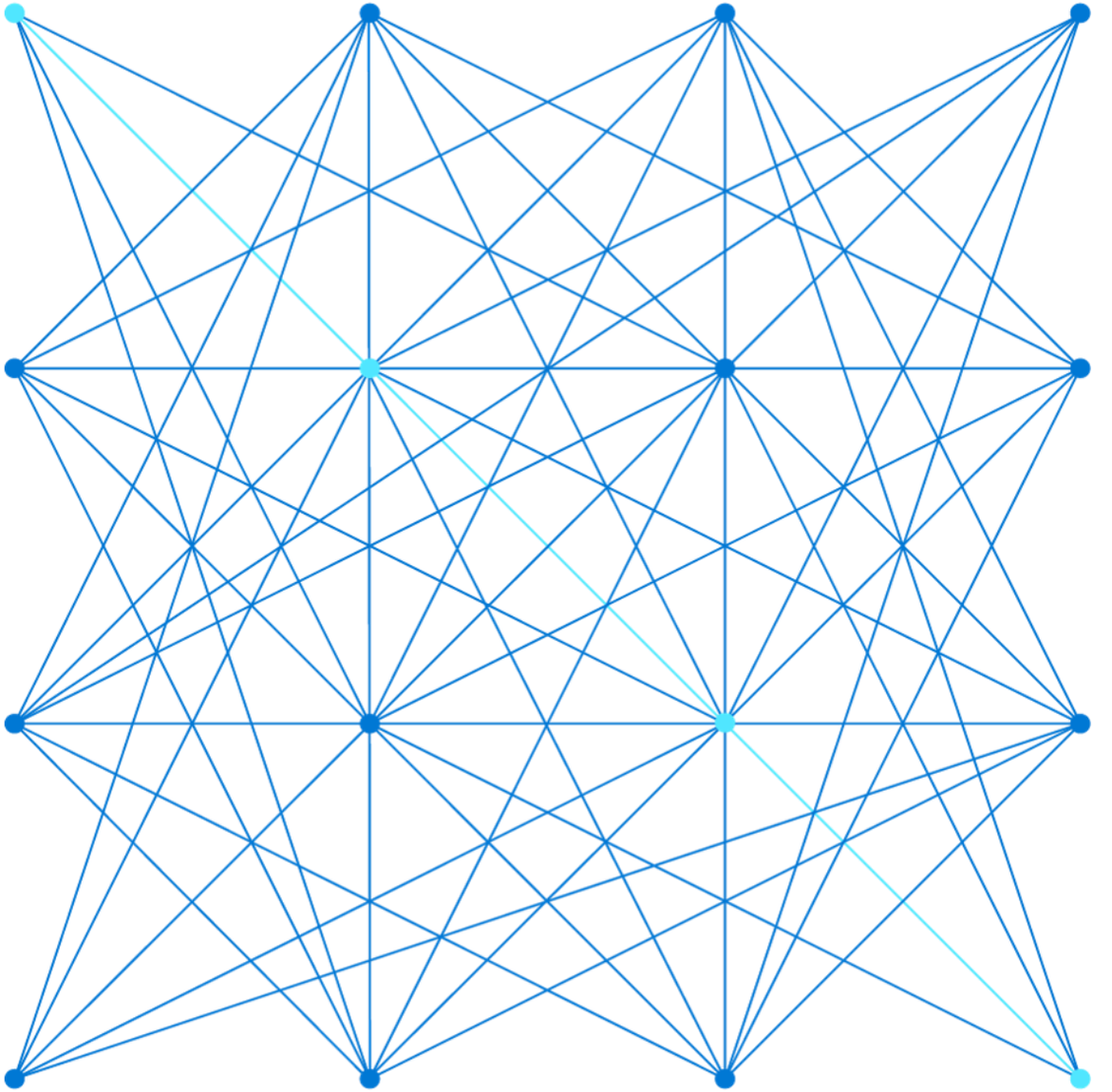
In addition to their professional experience, students who take this training should have technical knowledge equivalent to the following courses:

Azure fundamentals

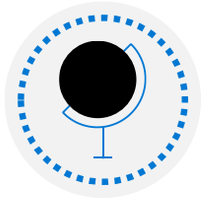
Microsoft Azure

Microsoft Azure

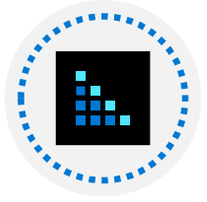
Module 01: Azure for the Data Engineer



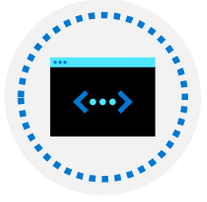
Agenda



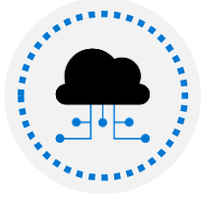
Lesson 01 – Explain the evolving world of data



Lesson 02 – Survey the services in the Azure Data Platform

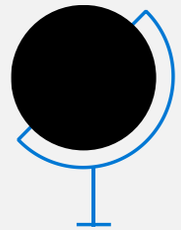


Lesson 03 – Identify the tasks that are performed by a Data Engineer

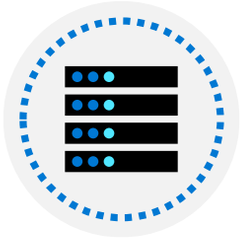


Lesson 04 – Describe the use cases for the cloud in a case study

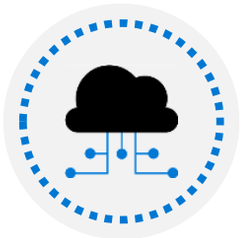
Lesson 01: The evolving world of data



Lesson objectives

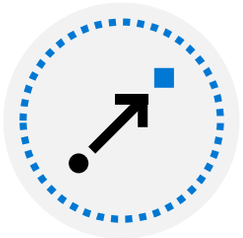


Data abundance



Differences between on-premises and cloud data technologies

How the role of the data professional is changing in organizations



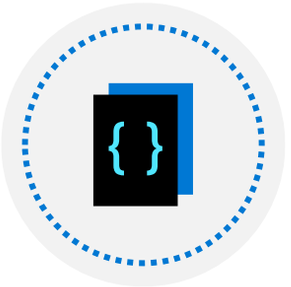
Identify use cases impacted by these changes

Data abundance

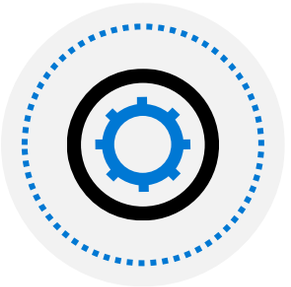
Processes	Businesses are tasked to store, interpret, manage, transform, process, aggregate and report on data
Consumers	There are a wider range of consumers using different types of devices to consume or generate data
Variety	There’s a wider variety of data types that need to be processed and stored
Responsibilities	A data engineers role is responsible for more data types and technologies
Technologies	Microsoft Azure provides a wide set of tools and technologies

On-premises versus cloud technologies

Computing Environment



Licensing Model

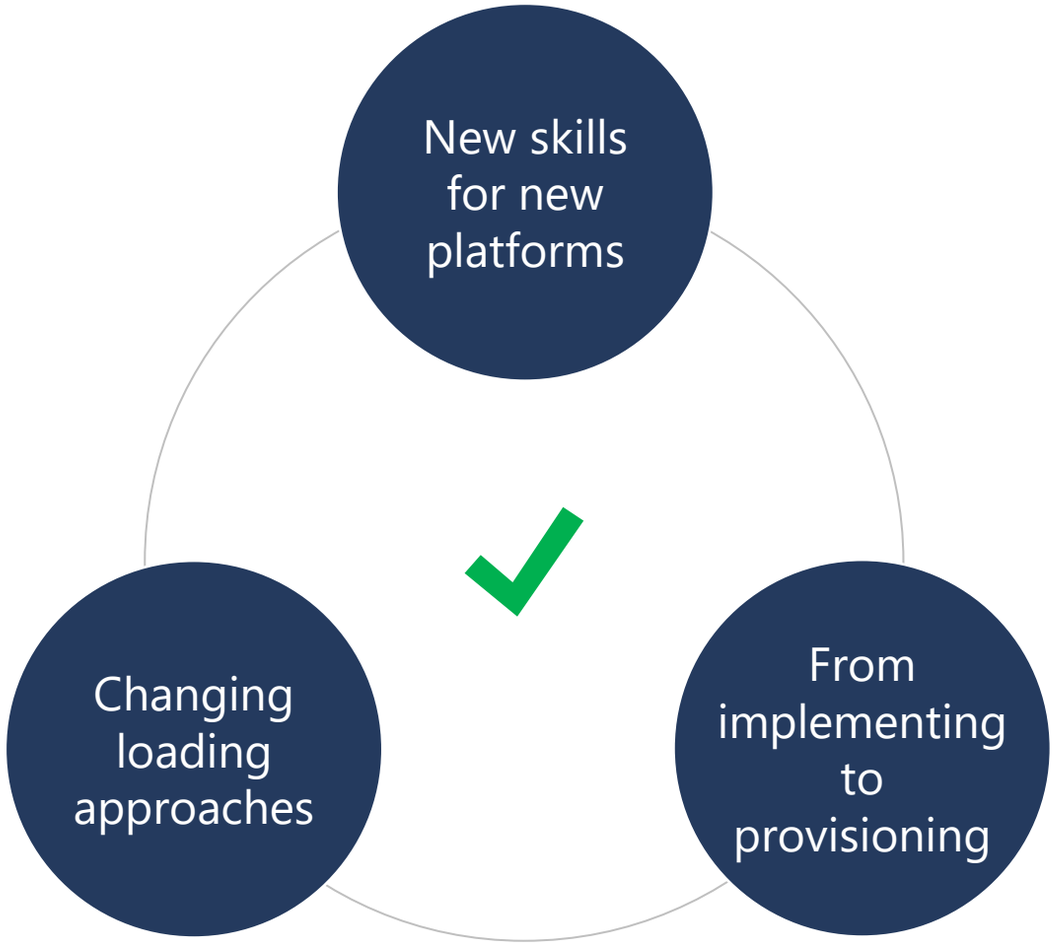


Maintainability

Scalability

Availability

Data engineering job responsibilities

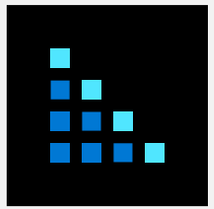


Use cases for the cloud

Here are some examples of industries making use of the cloud

Web retail	Using Azure Cosmos DB's multi-master replication model along with Microsoft's performance commitments, Data Engineers can implement a data architecture to support web and mobile applications that achieve less than a 10-ms response time anywhere in the world
Healthcare	Azure Databricks can be used to accelerate big data analytics and artificial intelligence (AI) solutions. Within the healthcare industry, it can be used to perform genome studies or pharmacy sales forecasting at petabyte scale
IoT scenarios	Hundreds of thousands of devices have been designed and sold to generate sensor data known as Internet of Things (IoT) devices. Using technologies like Azure IoT Hub, Data Engineers can easily design a data solution architecture that captures real-time data

Lesson 02: Survey the services in the Azure Data Platform



Lesson objectives

The differences between structured and unstructured data

Azure Storage

Azure Data Lake Storage

Azure Databricks

Azure Cosmos DB

Azure SQL Database

Azure SQL Data Warehouse

Azure Stream Analytics

Additional Azure Data Platform Services

Structured versus Unstructured data

There are three broad types of data and Microsoft Azure provides many data platform technologies to meet the needs of the wide varieties of data

Structured

Structured data is data that adheres to a schema, so all of the data has the same fields or properties. Structured data can be stored in a database table with rows and columns

Semi-Structured

Semi-structured data doesn't fit neatly into tables, rows, and columns. Instead, semi-structured data uses _tags_ or _keys_ that organize and provide a hierarchy for the data

Unstructured

Unstructured data encompasses data that has no designated structure to it. Known as No-SQL., there are four types of No-SQL databases:

- Key Value Store
- Document Database
- Graph Databases
- Column Base

What to use for Data

Storage Account

Module 02

- When you need a **low cost, high throughput** data store
- When you need to store **No-SQL** data
- When you **do not need to query** the data directly. **No ad hoc query** support
- Suits the storage of archive or **relatively static data**
- Suits acting as a **HDInsight Hadoop** data store

Data Lake Store

Module 02

- When you need a **low cost, high throughput** data store
- **Unlimited storage for No-SQL** data
- When you **do not need to query** the data directly. **No ad hoc query** support
- Suits the storage of archive or **relatively static data**
- Suits acting as a **Databricks , HDInsight** and **IoT** data store

Azure Databricks

Module 03

- **Eases the deployment** of a Spark based cluster
- Enables the **fastest processing** of Machine Learning solutions
- **Enables collaboration** between data engineers and data scientists
- Provides **tight enterprise security integration** with Azure Active Directory
- **Integration with other Azure Services and Power BI**

Azure CosmosDB

Module 04

- Provides **global distribution** for both structured and unstructured data stores
- **Millisecond query response** time
- **99.999% availability** of data
- **Worldwide elastic scale** of both the storage and throughput
- **Multiple consistency levels** to control data integrity with concurrency

Azure SQL Database

Module 05

- When you require a **relational** data store
- When you need to manage **transactional workloads**
- When you need to manage a **high volume on inserts and reads**
- When you need a service that **requires high concurrency**
- When you require a solution that can scale **elastically**

What to use for Data

Azure Synapse Analytics

Module 05

- When you require an integrated **relational** and **big data** store
- When you need to manage **data warehouse** and **analytical workloads**
- When you need **low cost storage**
- When you require the ability to **pause and restart the compute**
- When you require a solution that can scale **elastically**

Azure Stream Analytics

Module 06

- When you require a **fully managed event processing** engine
- When you require **temporal analysis of streaming** data
- Support for analyzing **IoT streaming** data
- Support for analyzing application data through **Event Hubs**
- Ease of use with a **Stream Analytics Query Language**

Azure Data Factory

Module 07

- When you want to **orchestrate the batch movement** of data
- When you want to connect to **wide range of data platforms**
- When you want to **transform or enrich** the data in movement
- When you want to **integrate with SSIS packages**
- Enables **verbose logging** of data processing activities

Azure HDInsight

- When you need a **low cost, high throughput** data store
- When you need to store **No-SQL** data
- Provides a Hadoop **Platform as a Service** approach
- Suits acting as a **Hadoop, Hbase, Storm or Kafka** data store
- **Eases the deployment and management** of clusters

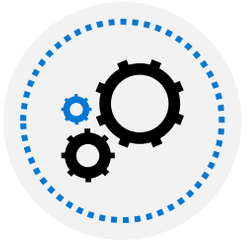
Azure Data Catalog

- When you require **documentation** of your data stores
- When you require a **multi user** approach to documentation
- When you need to **annotate data sources** with descriptive metadata
- A **fully managed cloud service** whose users can discover the data sources
- When you require **a solution that can help business users** understand their data

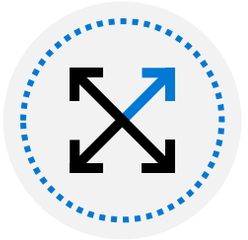
Lesson 03: Identify the tasks performed by a Data Engineer

Lesson objectives

List the new roles of modern data projects

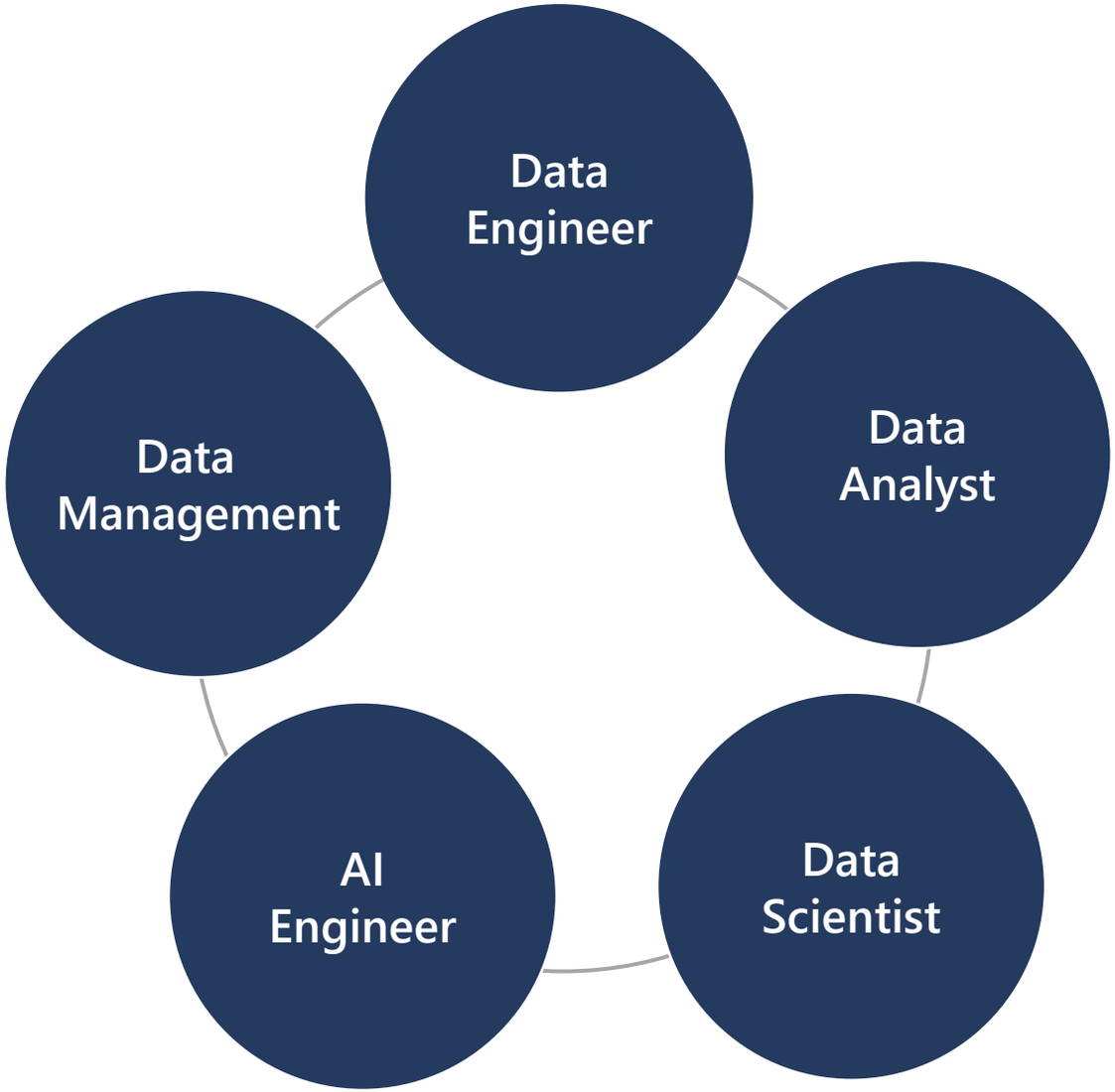


Outline data engineering practices

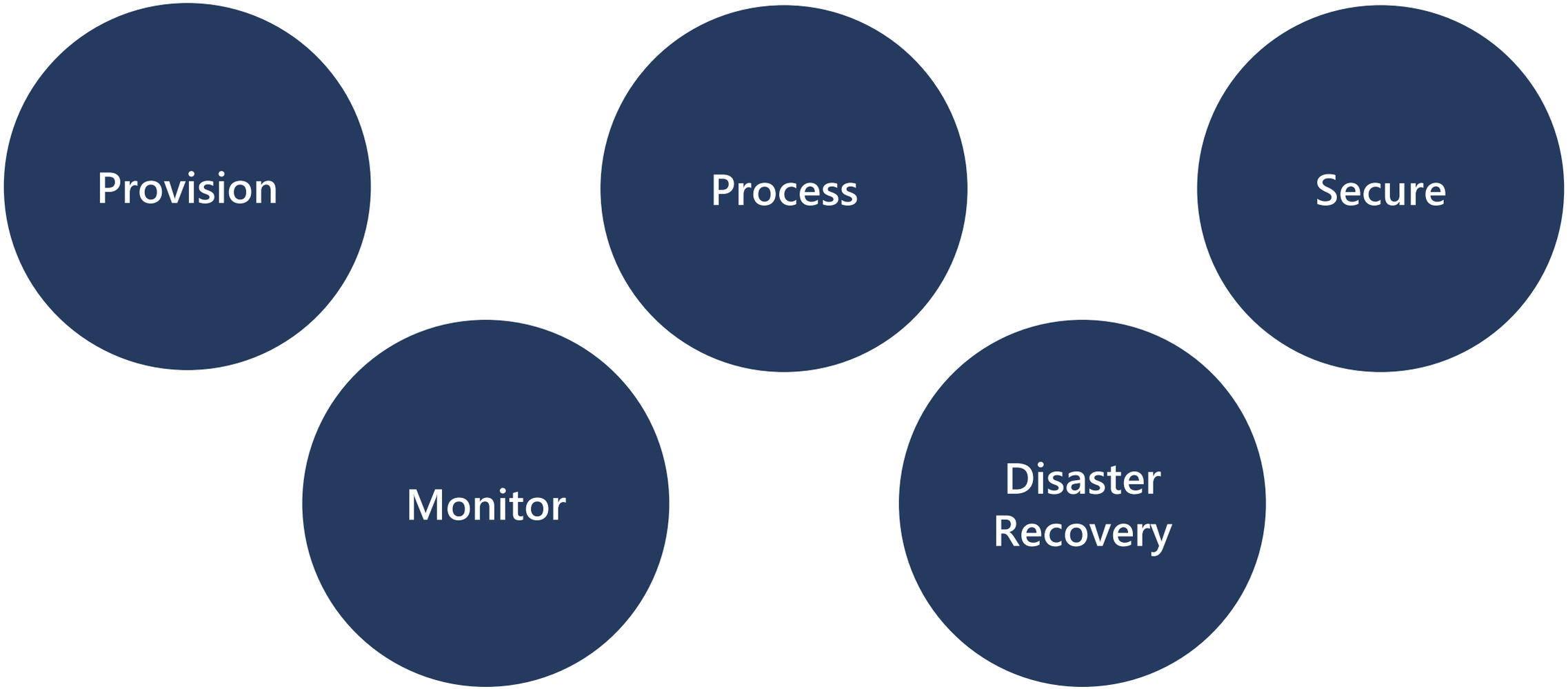


Explore the high-level process for architecting a data engineering project

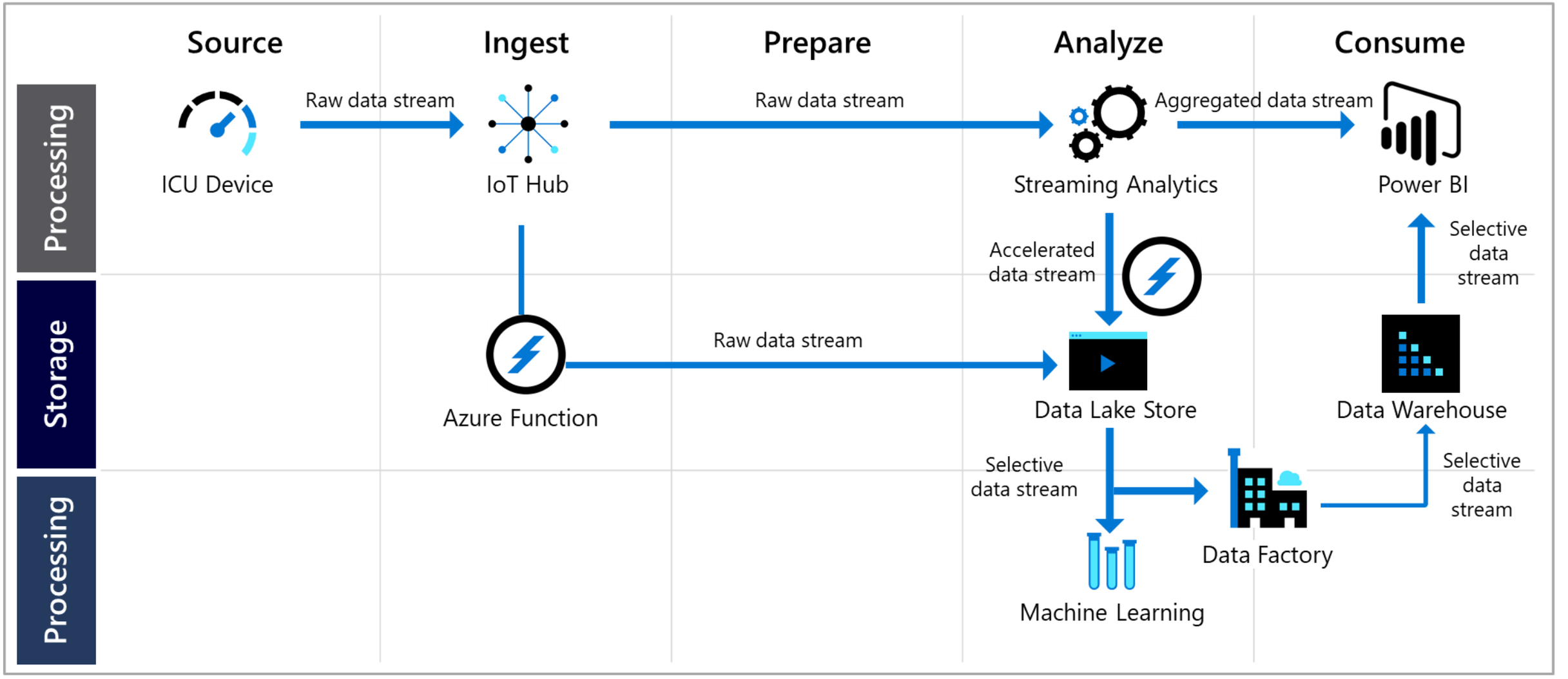
Roles in data projects



Data engineering practices



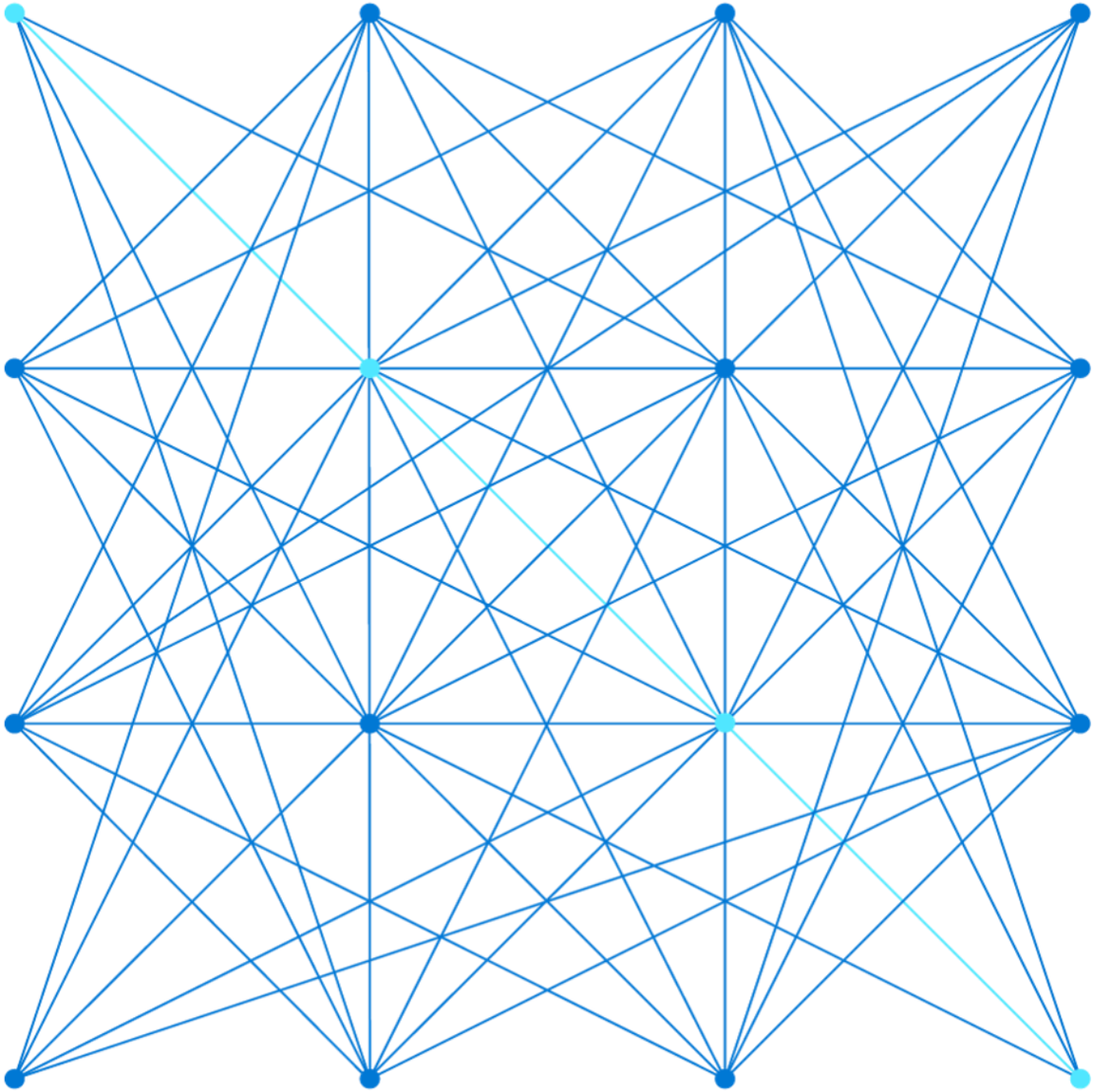
Architecting projects – An example



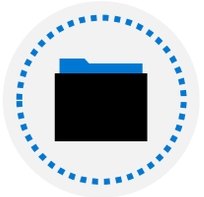
Microsoft Azure

Microsoft Azure

Module 02: Working with data storage



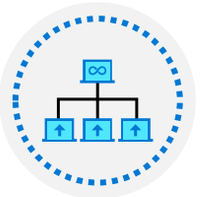
Agenda



Lesson 01: Choose a data storage approach in Azure

Lesson 02: Create an Azure Storage Account

Lesson 03: Explain Azure Data Lake Storage



Lesson 04: Upload data into Azure Data Lake Store

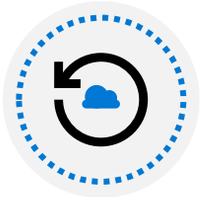
Lesson 01: Choose a data storage approach in Azure

Lesson objectives

The Benefits of using Azure to store data

Compare Azure data storage with on-premises storage

Benefits of using Azure to store data



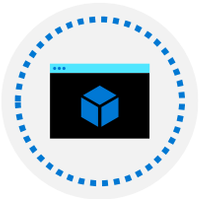
Automated backup

Support for data analytics

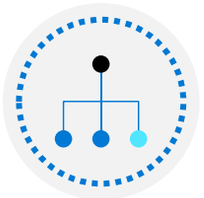
Global replication

Storage tiers

Encryption capabilities



Virtual disks



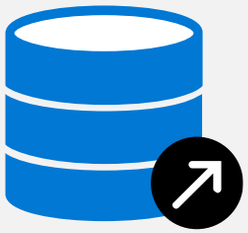
Multiple data types

Comparing Azure to on-premises storage

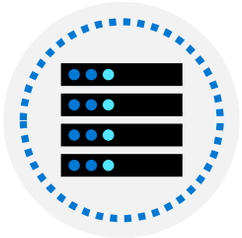
The term “on-premises” refers to the storage and maintenance of data on local hardware and servers

Cost effectiveness	Reliability	Storage types	Agility
On-premises storage requires up-front expenses. Azure data storage provides a pay-as-you-go pricing model	Azure data storage provides backup, load balancing, disaster recovery, and data replication to ensure safety and high availability. This capability requires significant investment with on-premises solutions	Azure data storage provides a variety of different storage options including distributed access and tiered storage	Azure data storage gives you the flexibility to create new services in minutes and allows you to change storage back-ends quickly

Lesson 02: Create Azure storage account



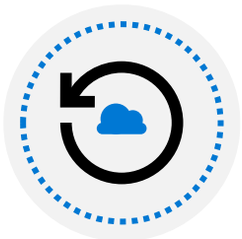
Lesson objectives



Describe storage accounts

Determine the appropriate settings for each storage account

Choose an account creation tool



Create a storage account using the Azure portal

Storage accounts

What is a storage account?

It is a container that groups a set of Azure Storage services. Only data services can be included in a storage account such as *Azure Blobs, Azure Files, Azure Queues, and Azure Tables*

How many do you need?

The number of storage accounts you need is typically determined by your data diversity, cost sensitivity, and tolerance for management overhead

The number of storage accounts you need is based on:

Data diversity:

Organizations often generate data that differs in where it is consumed and how sensitive it is

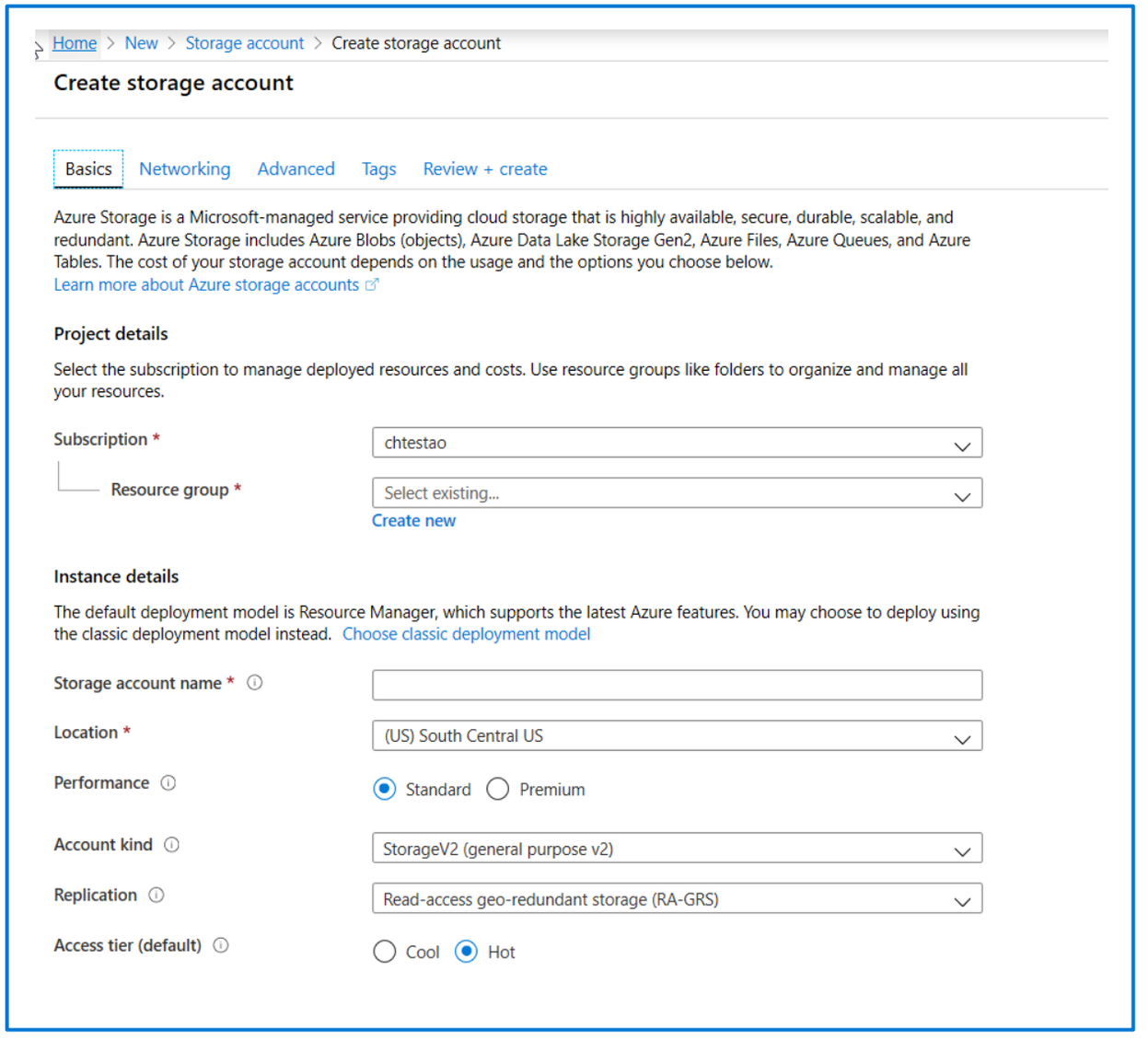
Cost sensitivity:

The settings you choose for the account do influence the cost of services, and the number of accounts you create

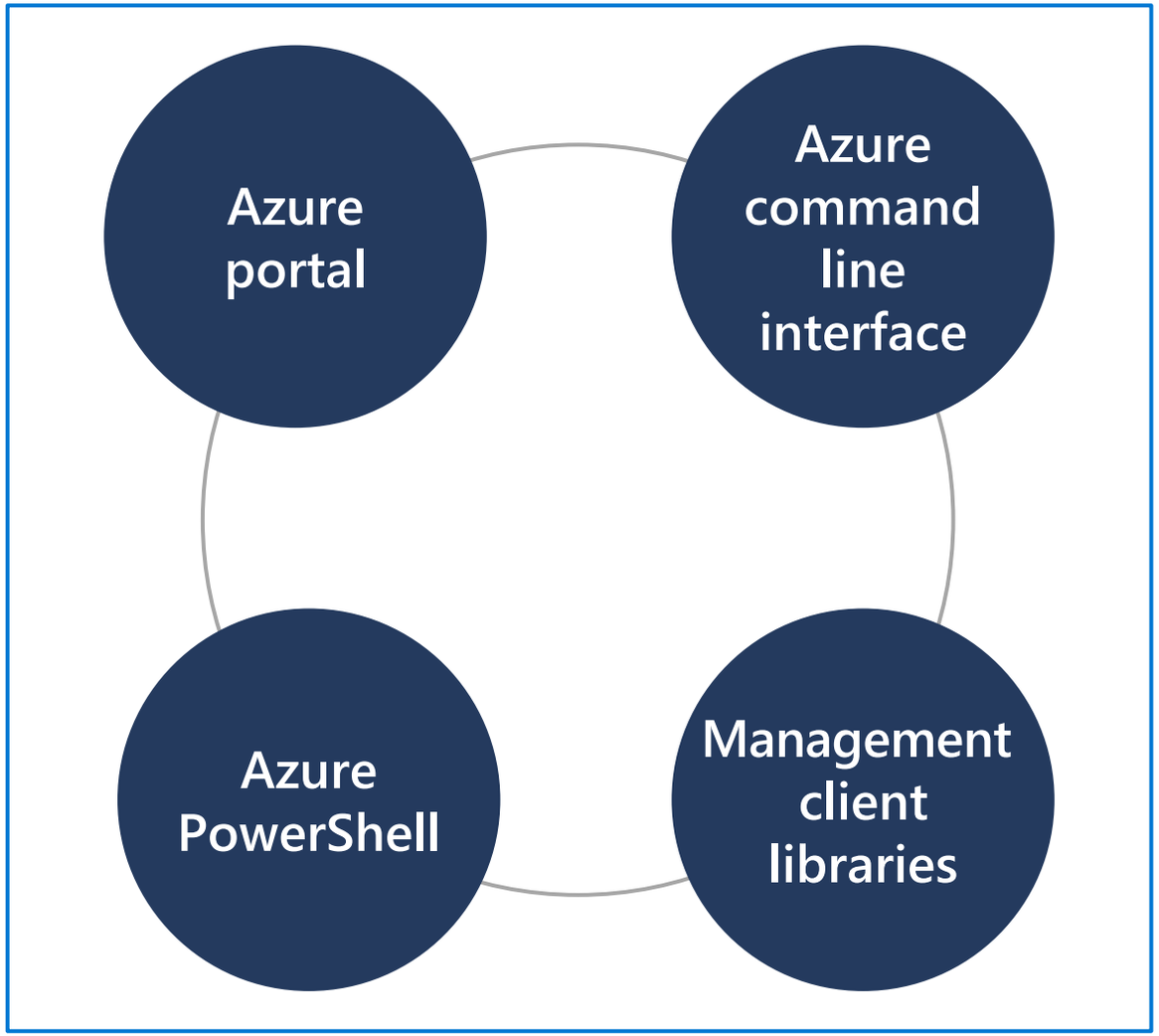
Management overhead:

Each storage account requires some time and attention from an administrator to create and maintain

Storage account settings

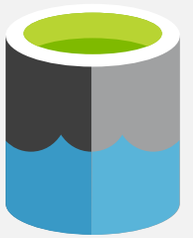


Storage account creation tool



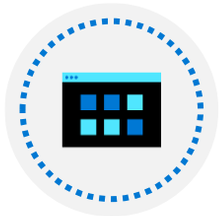
Create a storage account

Lesson 03: Azure Data Lake Storage

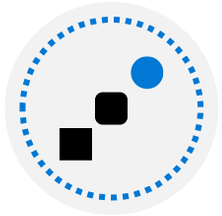


Lesson objectives

Explain Azure Data Lake Storage



Create an Azure Data Lake Store Gen 2 using the portal

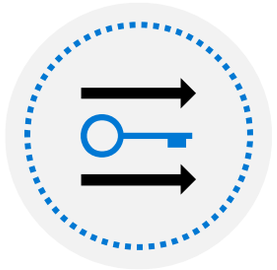


Compare Azure Blob Storage and Data Lake Store Gen 2

Explore the stages for processing Big Data using Azure Data Lake Store

Describe the use cases for Data lake Storage

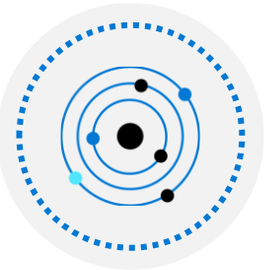
Azure Data Lake Storage – Generation II



Hadoop access

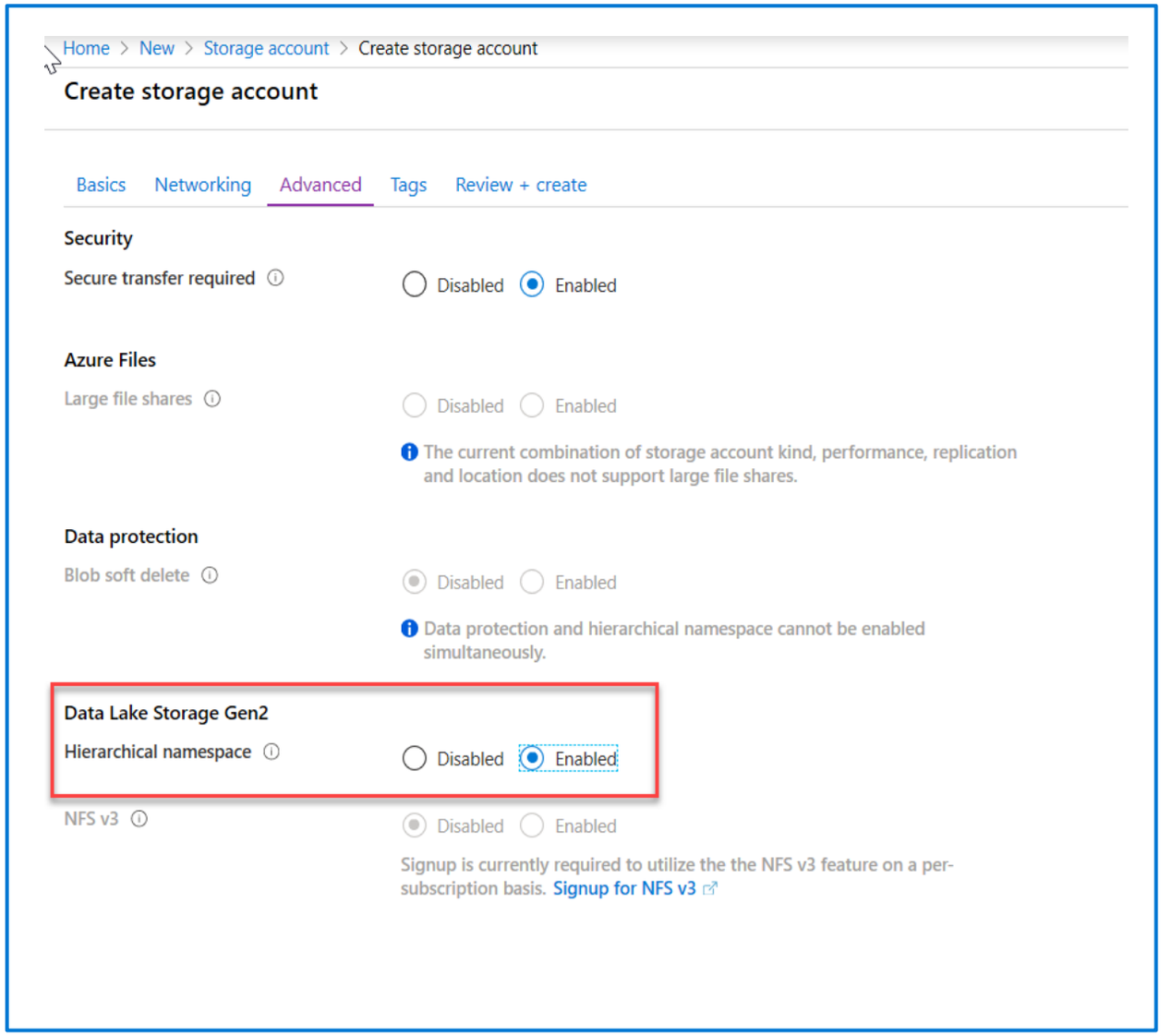
Security

Performance

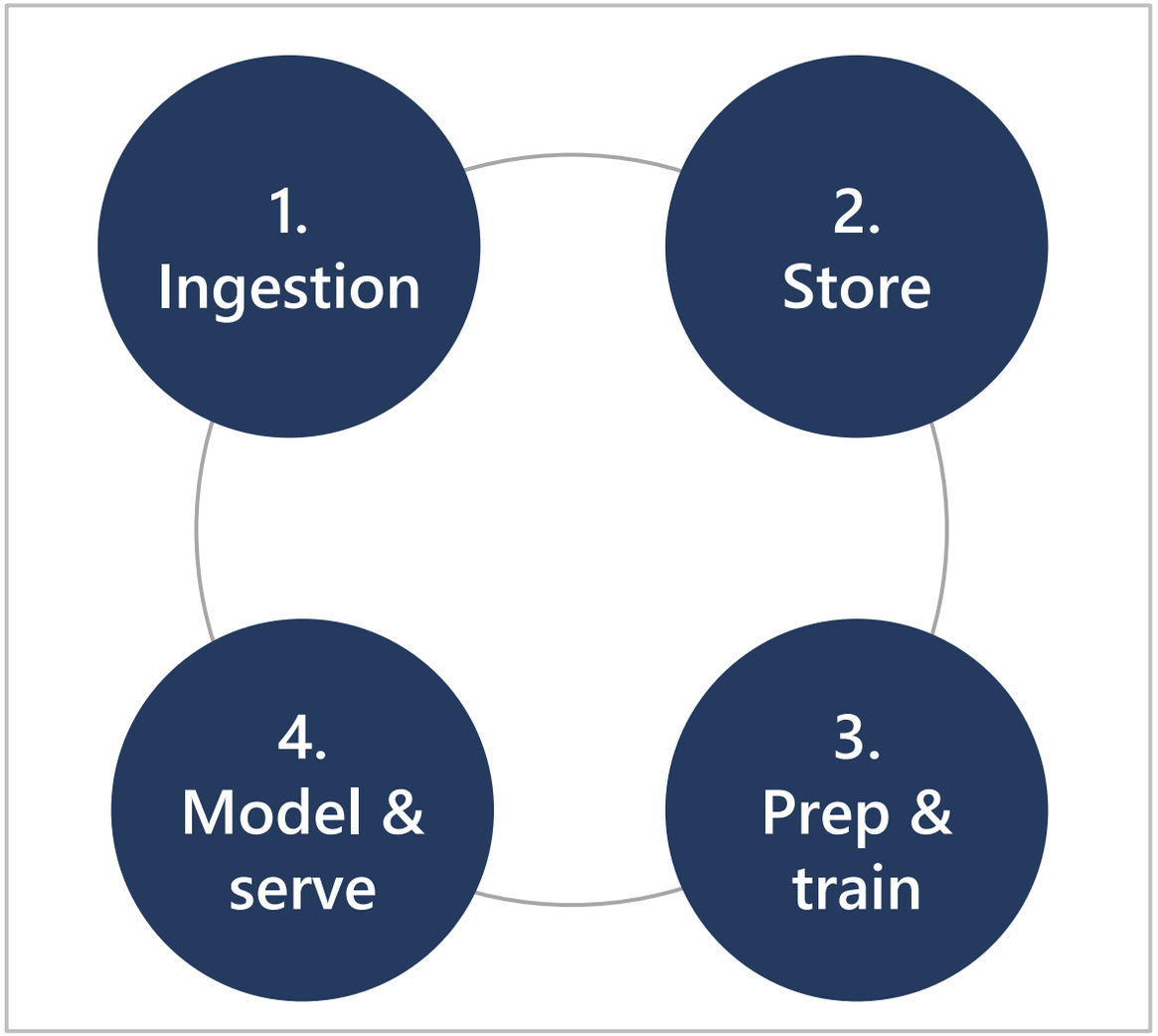


Redundancy

Create a Azure Data Lake Store (Gen II) using the portal



Processing Big Data with Azure Data Lake Store

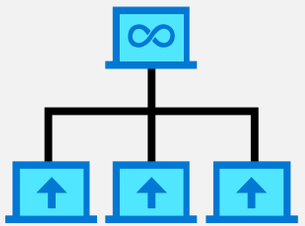


Big Data use cases

Let’s examine three use cases for leveraging an Azure Data Lake Store

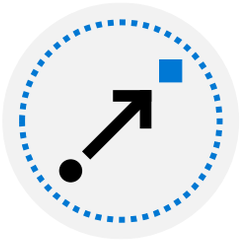
Modern data warehouse	This architecture sees Azure Data Lake Storage at the heart of the solution for a modern data warehouse. Using Azure Data Factory to ingest data into the Data Lake from a business application, and predictive models built in Azure Databricks, using Azure Synapse Analytics as a serving layer
Advanced analytics	In this solution, Azure Data factory is transferring terabytes of web logs from a web server to the Data Lake on an hourly basis. This data is provided as features to the predictive model in Azure Databricks, which is then trained and scored. The result of the model is then distributed globally using Azure Cosmos DB, that an application uses
Real time analytics	In this architecture, there are two ingestion streams. Azure Data Factory is used to ingest the summary files that are generated when the HGV engine is turned off. Apache Kafka provides the real-time ingestion engine for the telemetry data. Both data streams are stored in Data Lake store for use in the future

Lesson 04: Upload data into Azure Data Lake Store

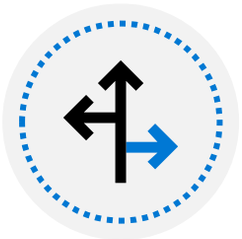


Lesson objectives

Create an Azure Data Lake Gen2 Store using PowerShell

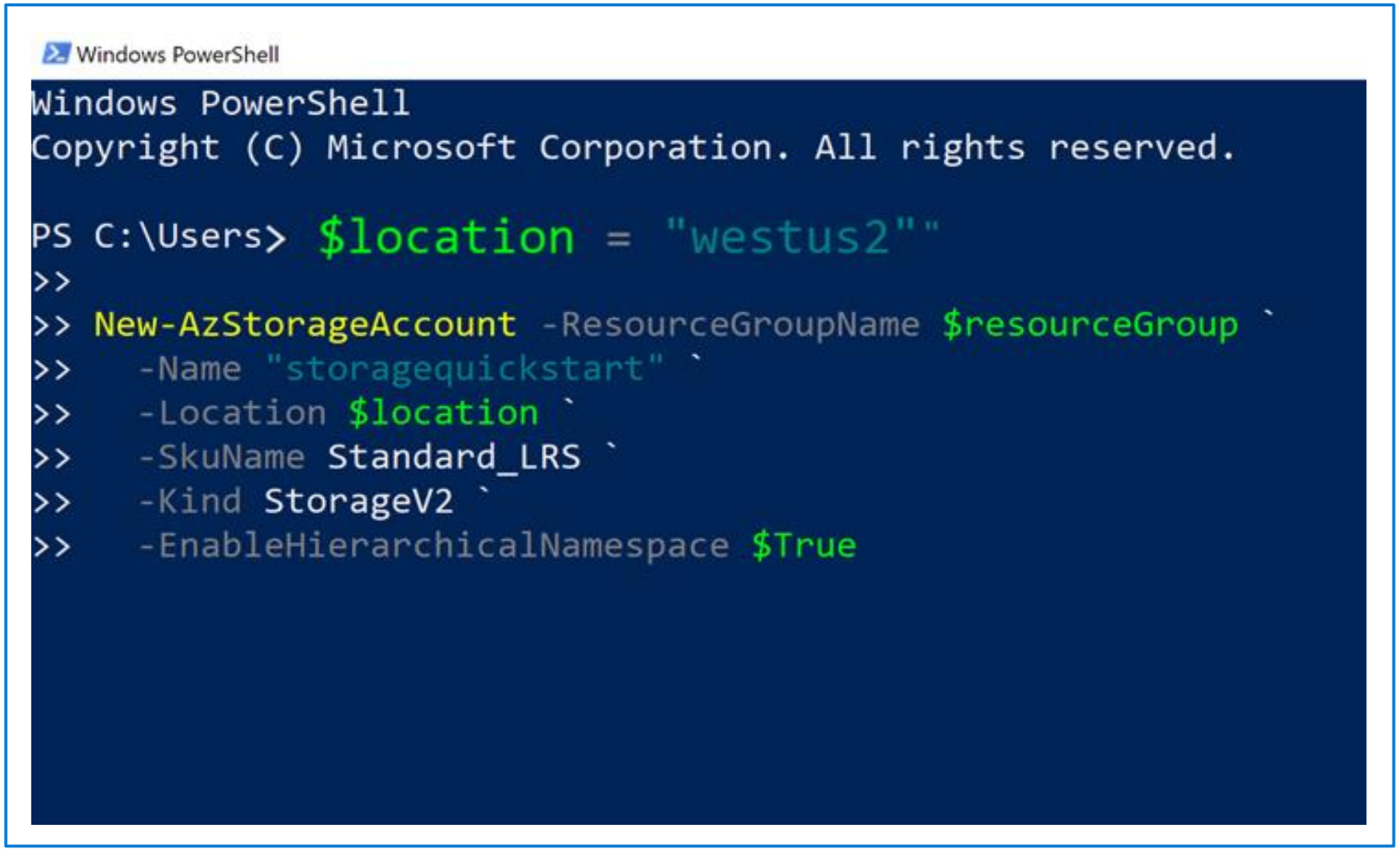


Upload data into the Data Lake Storage Gen2 using Azure Storage Explorer

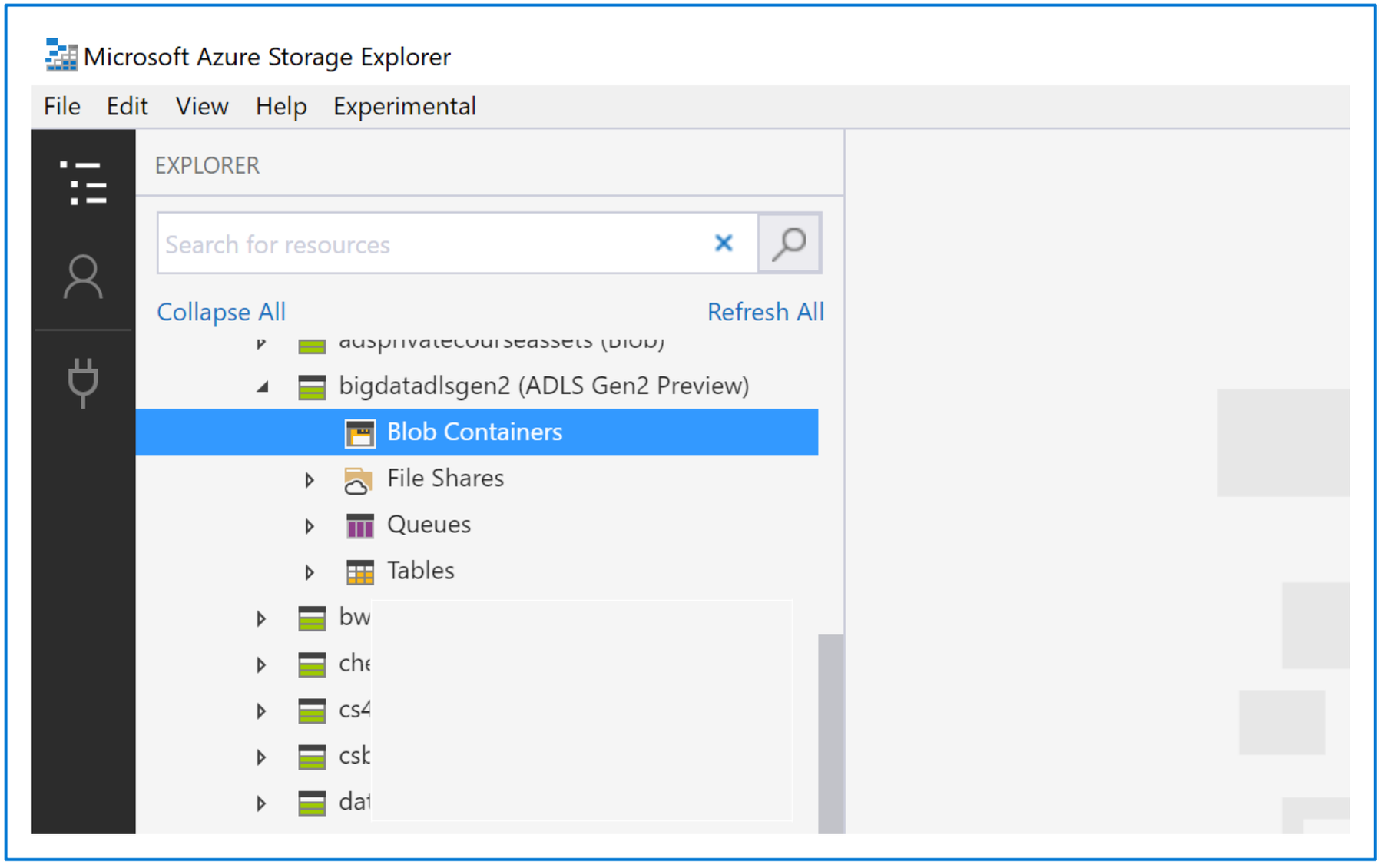


Copy data from an Azure Data Lake Store Gen1 to an Azure Data Lake Store Gen2

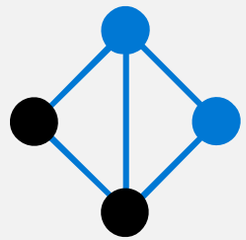
Create a Azure Data Lake Store (Gen II) using PowerShell



Uploading data with Azure Storage Explorer



Lab: Working with data storage



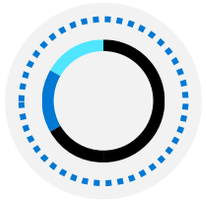
Microsoft Azure

Microsoft Azure

Module 03: Enabling team based Data Science with Azure Databricks

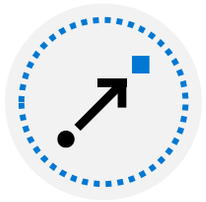
Agenda

Lesson 01 – Describe Azure Databricks



Lesson 02 – Provision Azure Databricks and Workspaces

Lesson 03 – Read data using Azure Databricks



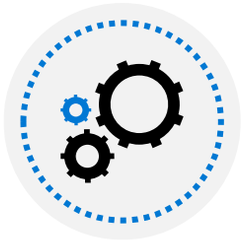
Lesson 04 – Perform transformations with Azure Databricks

Lesson 01: Describe Azure Databricks

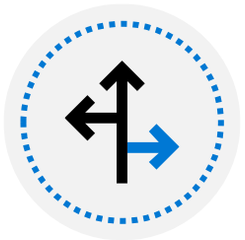
Lesson objectives

What is Azure Databricks

What are Spark based analytics platform



How Azure Databricks integrates with enterprise security



How Azure Databricks integrates with other cloud services

What is Azure Databricks

Apache Spark-based analytics platform:

Simplifies the provisioning and collaboration of Apache Spark-based analytical solutions

Enterprise Security:

Utilizes the security capabilities of Azure

Integration with other Cloud Services:

Can integrate with a variety of Azure data platform services and Power BI

What is Apache Spark

Apache Spark emerged to provide a parallel processing framework that supports in-memory processing to boost the performance of big-data analytical applications on massive volumes of data

Interactive Data Analysis:

Used by business analysts or data engineers to analyze and prepare data

Streaming Analytics:

Ingest data from technologies such as Kafka and Flume to ingest data in real-time

Machine Learning:

Contains a number of libraries that enables a Data Scientist to perform Machine Learning

Why use Azure Databricks?

Azure Databricks is a wrapper around Apache Spark that simplifies the provisioning and configuration of a Spark cluster in a GUI interface

Azure Databricks components:

Spark SQL and DataFrames

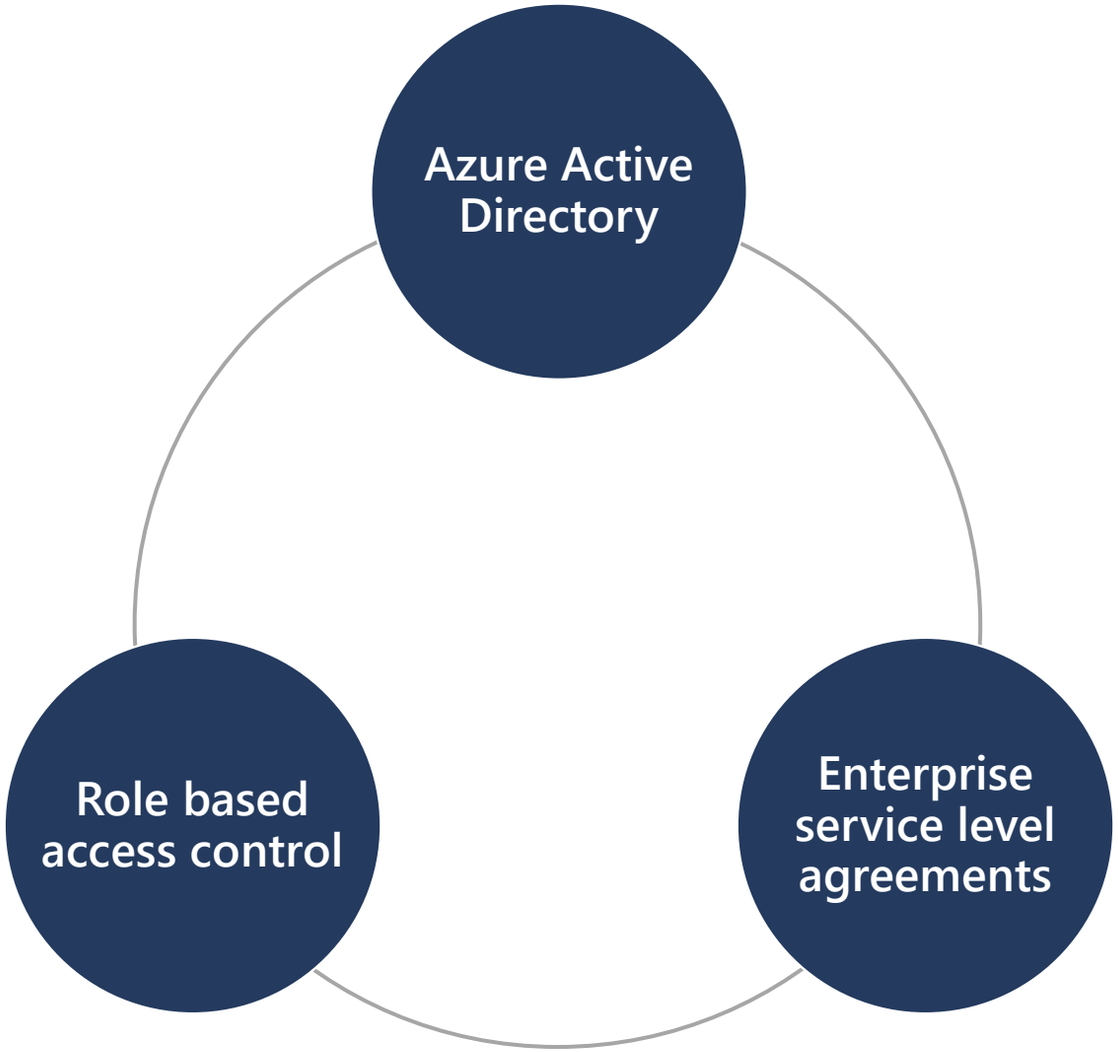
Streaming

Mlib

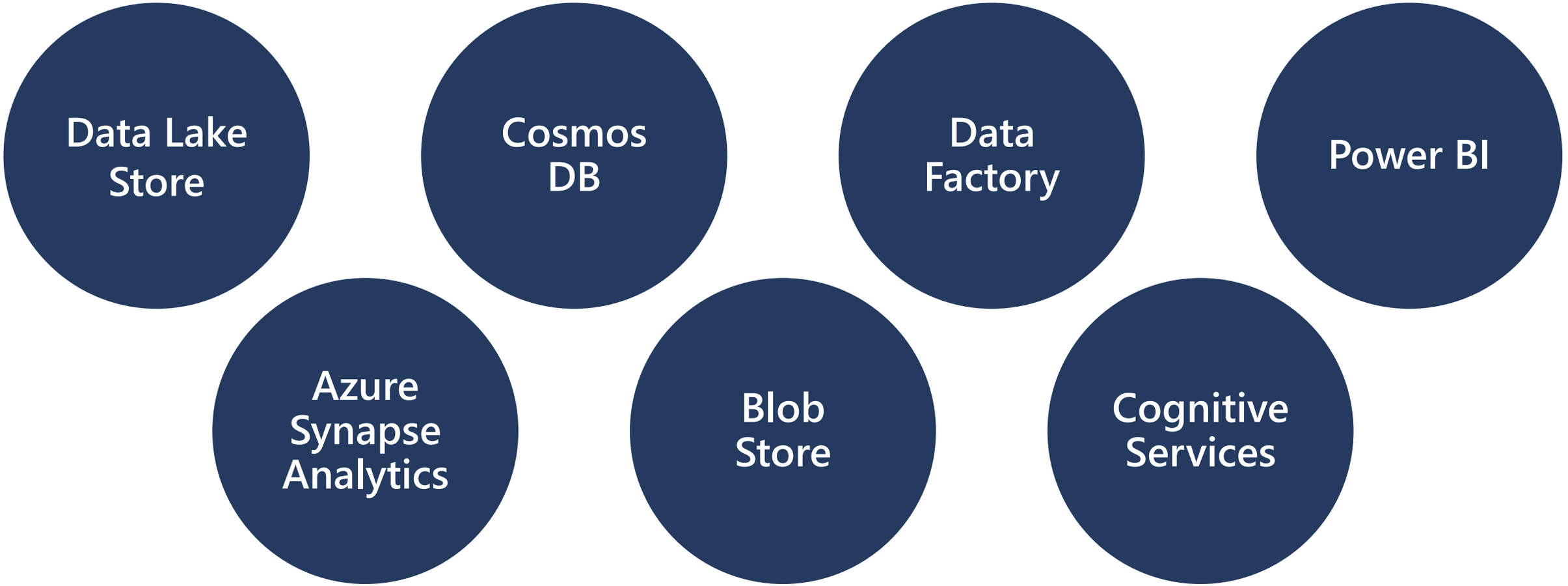
GraphX

Spark Core API

Enterprise security



Integration with cloud services



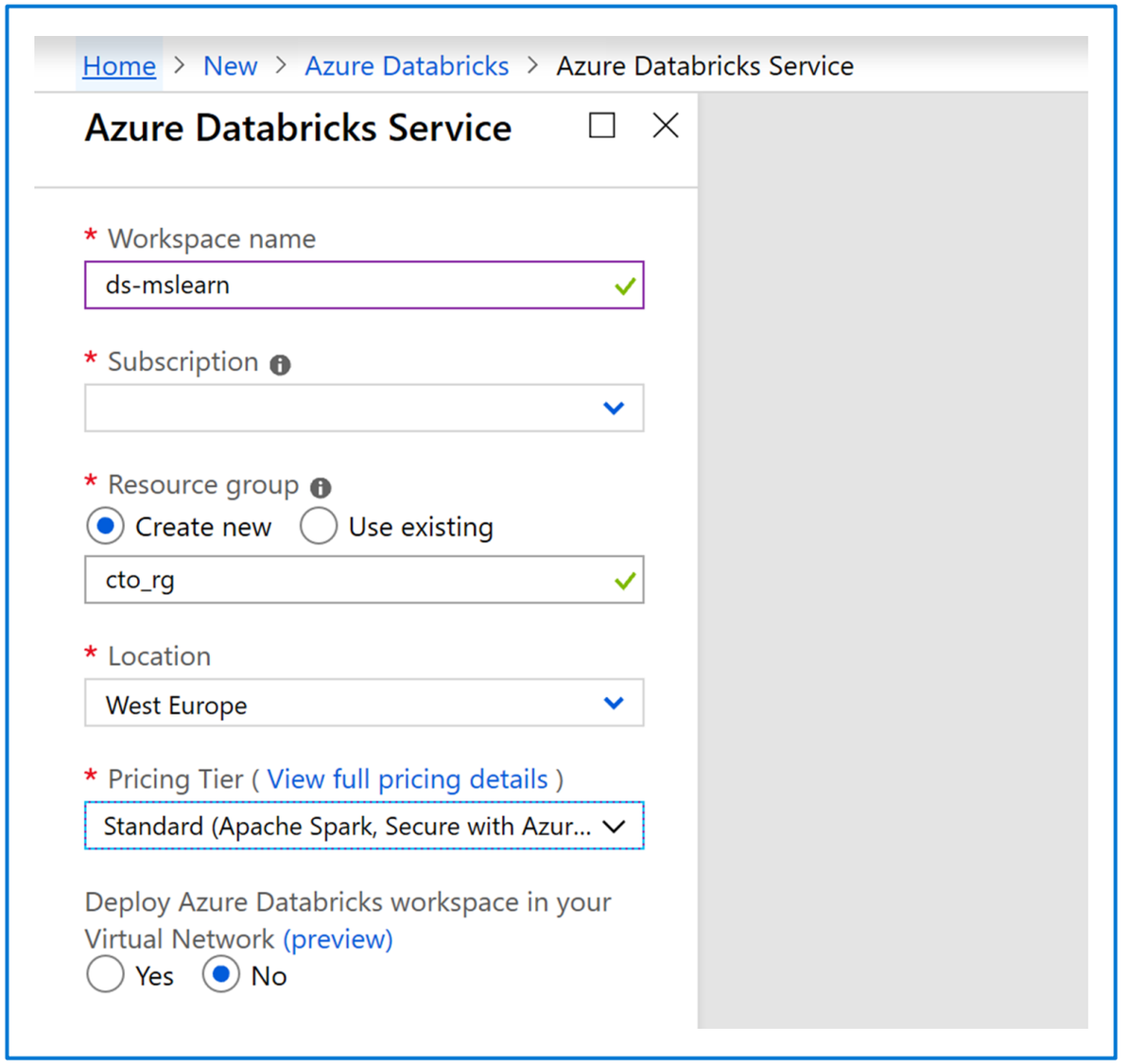
Lesson 02: Provision Azure Databricks and Workspaces

Lesson objectives

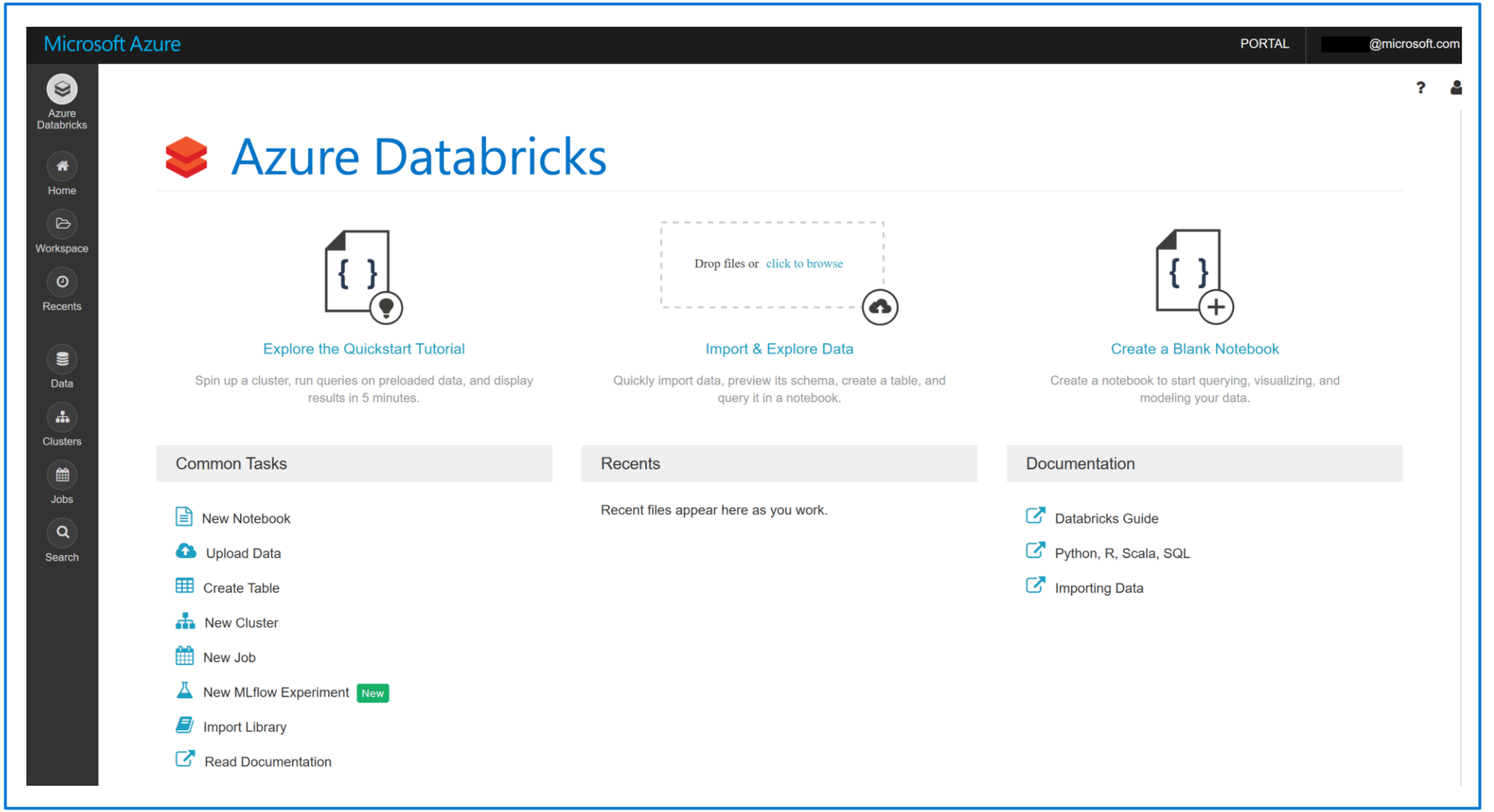
Create your own Azure Databricks workspace

Create a cluster and notebook in Azure Databricks

Create an Azure Databricks Workspace

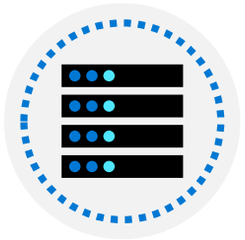


Create a Cluster and Notebook in Azure Databricks



Lesson 03: Read data using Azure Databricks

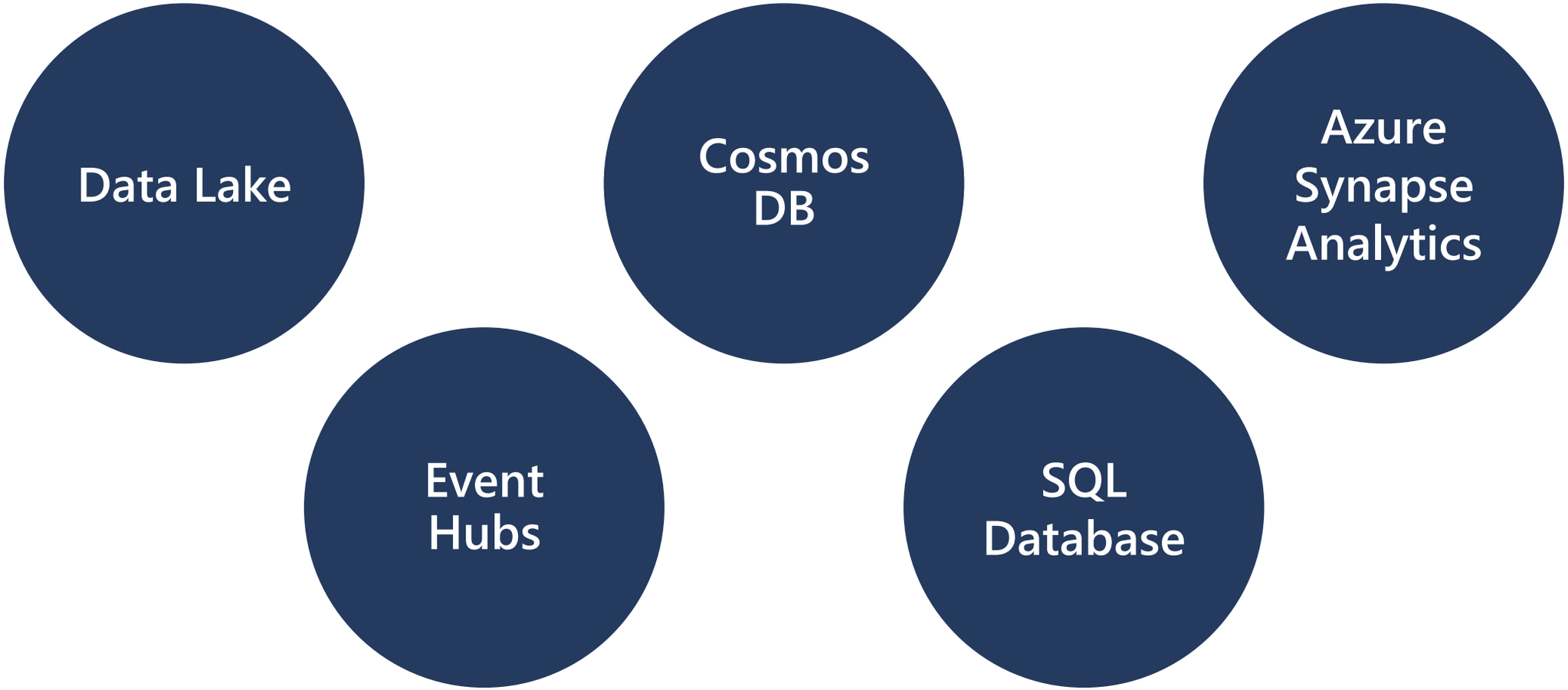
Lesson objectives



Use Azure Databricks to access data sources

Reading data in Azure Databricks

Use Azure Databricks to access data sources

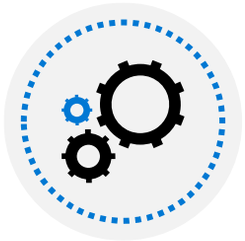


Reading data in Azure Databricks

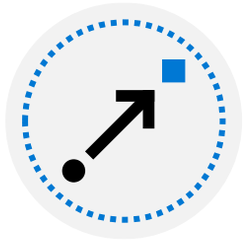
SQL	DataFrame (Python)
SELECT col_1 FROM myTable	df.select(col("col_1"))
DESCRIBE myTable	df.printSchema()
SELECT * FROM myTable WHERE col_1 > 0	df.filter(col("col_1") > 0)
..GROUP BY col_2	..groupBy(col("col_2"))
..ORDER BY col_2	..orderBy(col("col_2"))
..WHERE year(col_3) > 1990	..filter(year(col("col_3")) > 1990)
SELECT * FROM myTable LIMIT 10	df.limit(10)
display(myTable) (text format)	df.show()
display(myTable) (html format)	display(df)

Lesson 04: Perform transformations with Azure Databricks

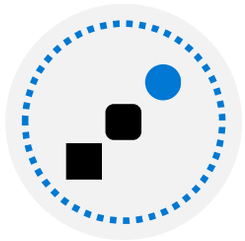
Lesson objectives



Performing ETL to populate a data model



Perform basic transformations



Perform advanced transformations with user-defined functions

Performing ETL to populate a data model

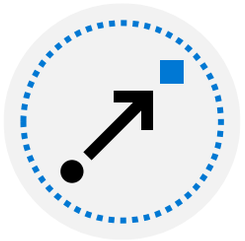
The goal of transformation in Extract Transform Load (ETL) is to transform raw data to populate a data model

Extraction	Data validation	Transformation	Corrupt record handling	Loading data
Connect to many data stores: Postgres SQL Server Cassandra Cosmos DB CSV, Parquet Many more..	Validate that the data is what you expect	Applying structure and schema to your data to transform it into the desired format	Built-in functions of Databricks allow you to handle corrupt data such as missing and incomplete information	Highly effective design pattern involves loading structured data back to DBFS as a parquet file

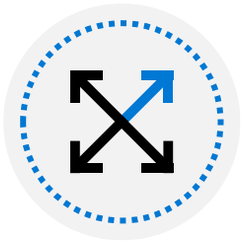
Basic transformation

Normalizing values

Missing/null data



De-duplication



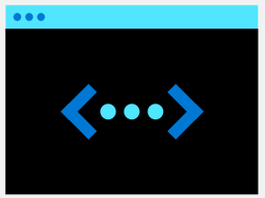
Pivoting data frames

Advanced transformations

Advanced data transformation using custom and advanced user-defined functions, managing complex tables and loading data into multiple databases simultaneously

User-defined functions	This fulfils scenarios when you need to define logic specific to your use case and when you need to encapsulate that solution for reuse. UDFs provide custom, generalizable code that you can apply to ETL workloads when Spark's built-in functions won't suffice
Joins and lookup tables	A standard (or shuffle) join moves all the data on the cluster for each table to a given node on the cluster. This is an expensive operation. Broadcast joins remedy this situation when one DataFrame is sufficiently small enough to duplicate on each node of the cluster, avoiding the cost of shuffling a bigger DataFrame
Multiple databases	Loading transformed data to multiple target databases can be a time-consuming activity. Partitions and slots are options to get optimum performance from database connections. A partition refers to the distribution of data while a slot refers to the distribution of computation

Lab: Enabling team-based Data Science with Azure Databricks

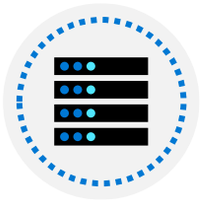


Microsoft Azure

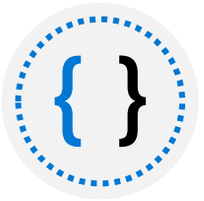
Microsoft Azure

Module 04: Building globally distributed databases with Cosmos DB

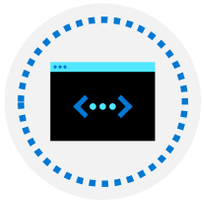
Agenda



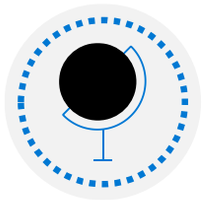
Lesson 01: Create an Azure Cosmos DB database built to scale



Lesson 02: Insert and query data in your Azure Cosmos DB database

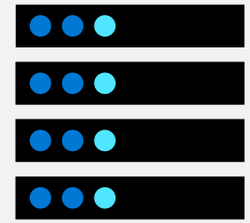


Lesson 03: Build a .NET Core app for Azure Cosmos DB in Visual Studio Code



Lesson 04: Distribute your data globally with Azure Cosmos DB

Lesson 01: Create an Azure Cosmos DB database built to scale



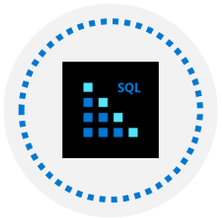
Lesson objectives

What is Cosmos DB

Create an Azure Cosmos DB account

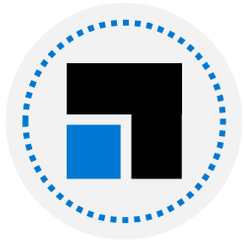
What is a Request Unit

Choose a partition key



Create a database and container for NoSQL data in Azure Cosmos DB

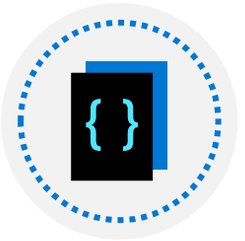
What is Azure Cosmos DB



Scalability

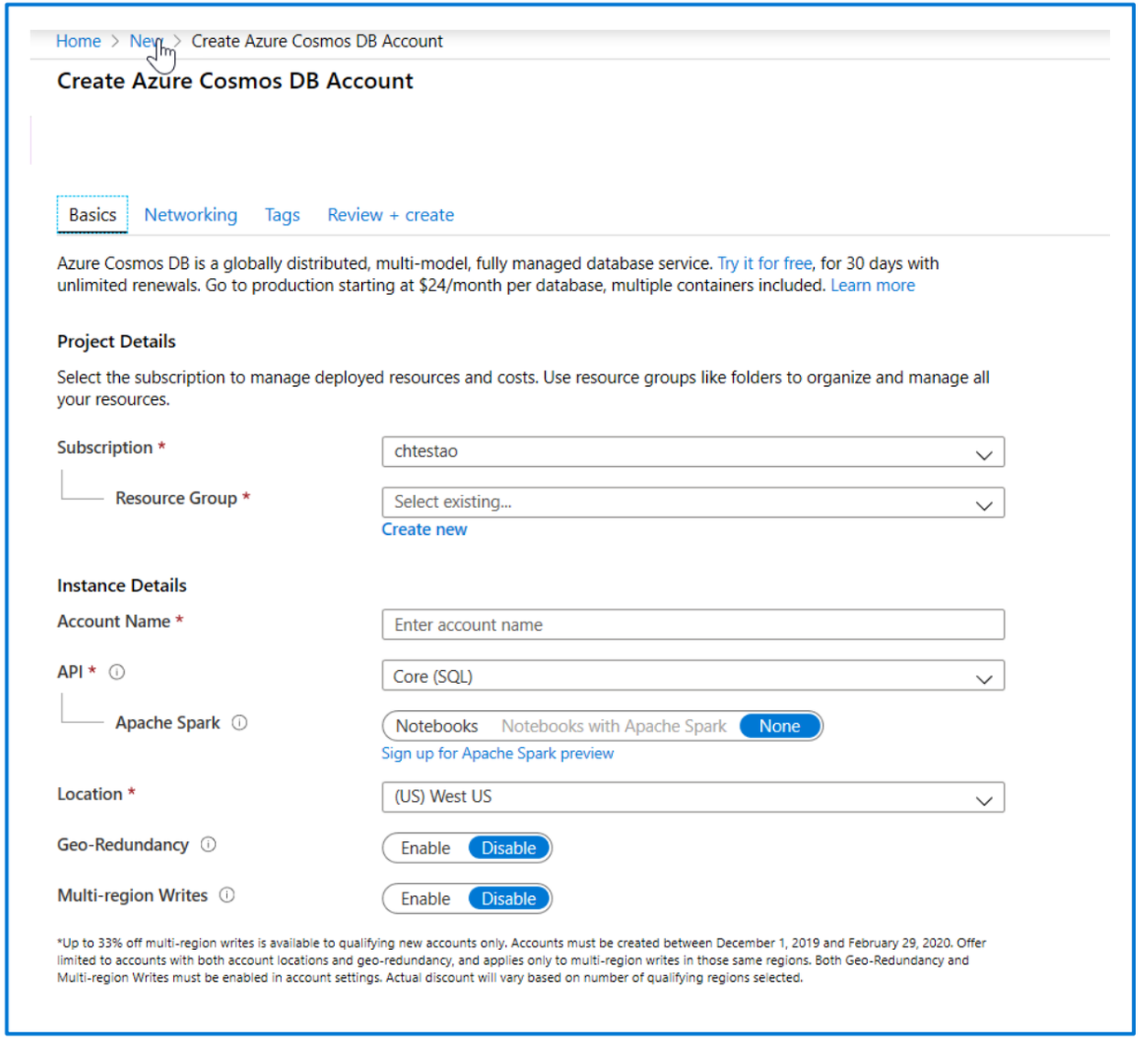
Performance

Availability



Programming model

Create an Azure Cosmos DB account



What are Request Units

Throughput is important to ensure you can handle the volume of transactions you need

Database throughput	Database throughput is the number of reads and writes that your database can perform in a single second
What is a Request Unit	Azure Cosmos DB measures throughput using something called a request unit (RU). Request unit usage is measured per second, so the unit of measure is request units per second (RU/s). You must reserve the number of RU/s you want Azure Cosmos DB to provision in advance
Exceeding throughput limits	If you don’t reserve enough request units, and you attempt to read or write more data than your provisioned throughput allows, your request will be rate-limited

Item size	Reads/second	Writes/second	Request units
1 KB	500	100	(500 * 1) + (100 * 5) = 1,000 RU/s
1 KB	500	500	(500 * 1) + (500 * 5) = 3,000 RU/s
4 KB	500	100	(500 * 1.3) + (100 * 7) = 1,350 RU/s
4 KB	500	500	(500 * 1.3) + (500 * 7) = 4,150 RU/s
64 KB	500	100	(500 * 10) + (100 * 48) = 9,800 RU/s
64 KB	500	500	(500 * 10) + (500 * 48) = 29,000 RU/s

Choosing a Partition Key

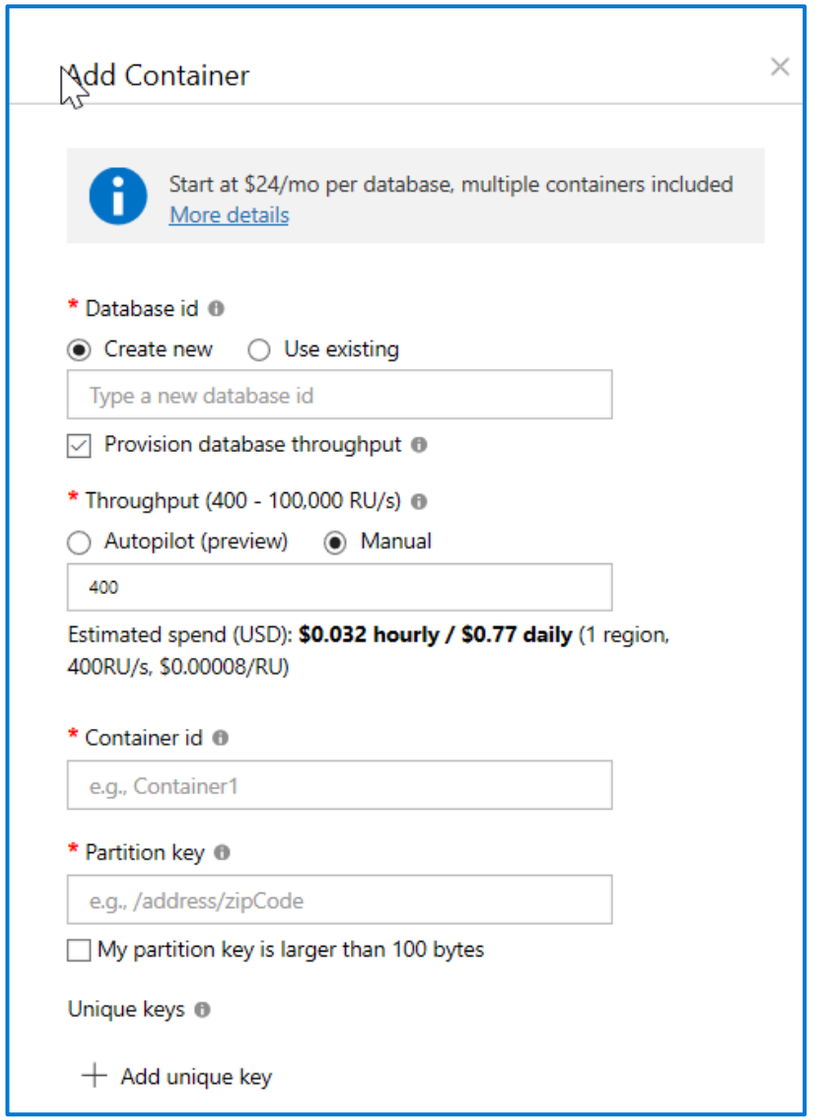
Why have a Partition Strategy?

Having a partition strategy ensures that when your database needs to grow, it can do so easily and continue to perform efficient queries and transactions

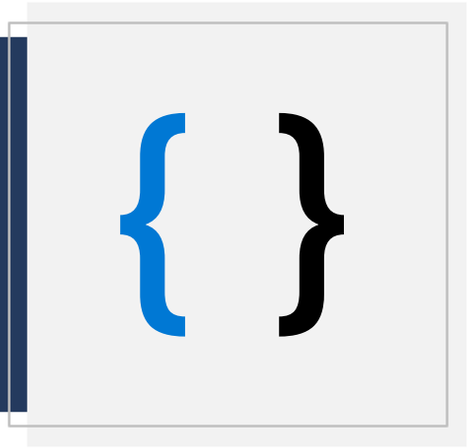
What is a Partition Key?

A partition key is the value by which azure organizes your data into logical divisions

Creating a Database and a Container in Cosmos DB



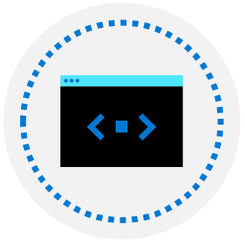
Lesson 02: Insert and Query Data in your Azure Cosmos DB Database



Lesson objectives

Create a product catalog document in the Data Explorer:

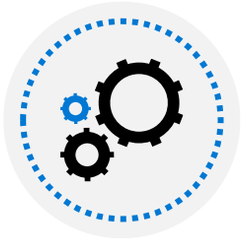
Add data



Perform Azure Cosmos DB queries:

Query types

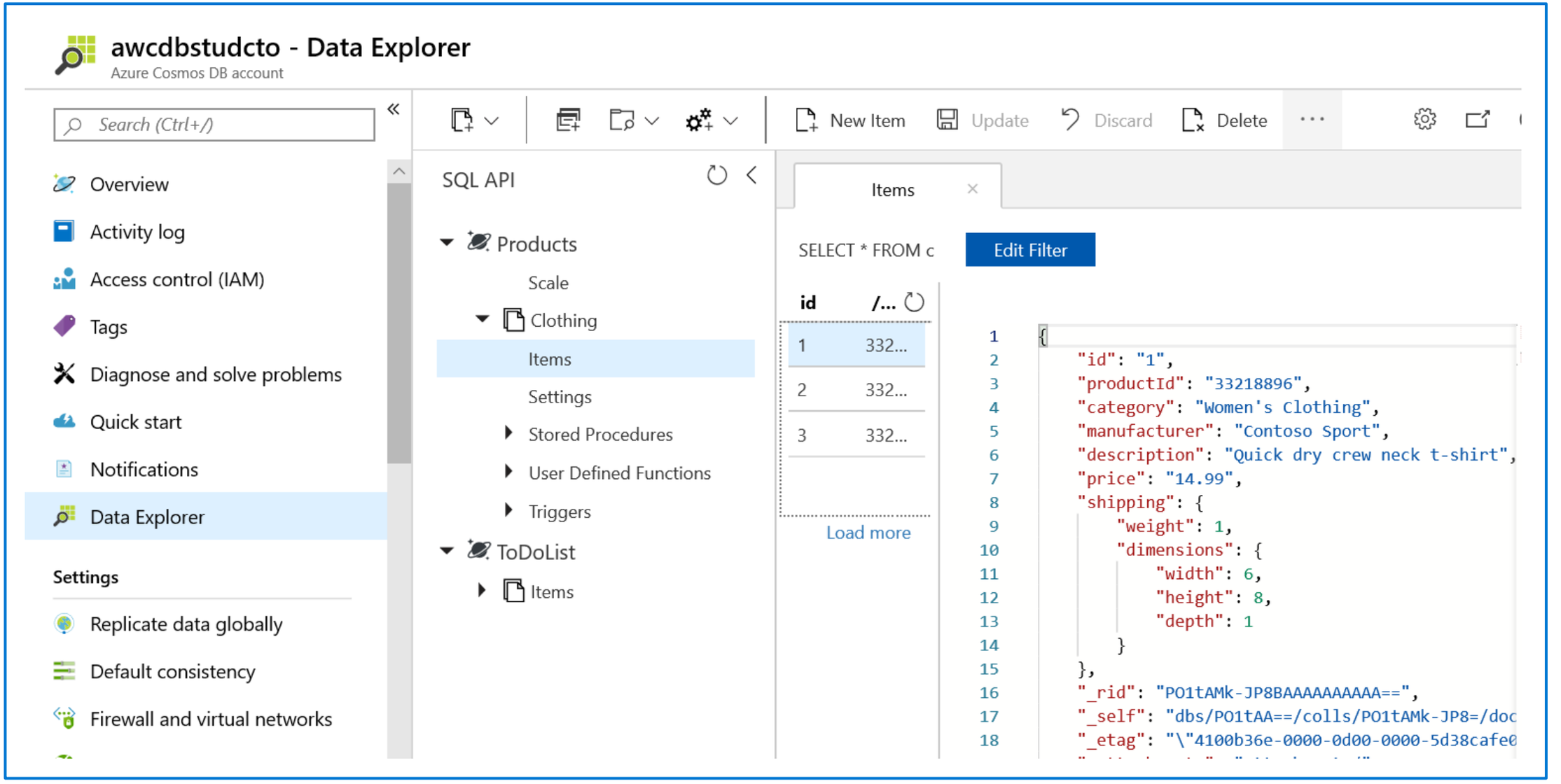
Run queries



Running complex operations on your data

Working with graph data

Create a product catalog documents in the Data Explorer



Perform Azure Cosmos DB Queries

SELECT Query Basics

```
SELECT <select_list>
[FROM <optional_from_specification>]
[WHERE <optional_filter_condition>]
[ORDER BY <optional_sort_specification>]
[JOIN <optional_join_specification>]
```

Examples

```
SELECT *
FROM Products p WHERE p.id ="1“

SELECT p.id, p.manufacturer, p.description
FROM Products p WHERE p.id ="1“

SELECT p.price, p.description, p.productId
FROM Products p ORDER BY p.price ASC

SELECT p.productId
FROM Products p JOIN p.shipping
```

Running complex operations on data

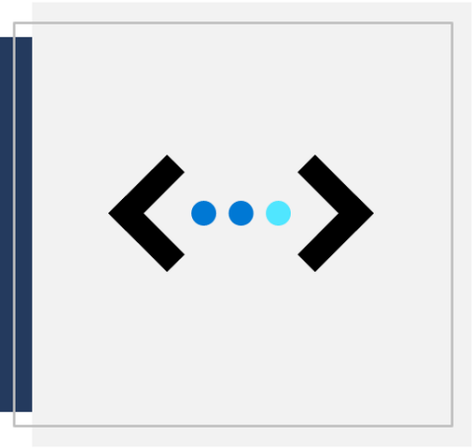
Multiple documents in your database frequently need to be updated at the same time. The way to perform these transactions in Azure Cosmos DB is by using stored procedures and user-defined functions (UDFs)

Stored procedures	User defined functions
Stored procedures perform complex transactions on documents and properties. Stored procedures are written in JavaScript and are stored in a collection on Azure Cosmos DB	User Defined Functions are used to extend the Azure Cosmos DB SQL query language grammar and implement custom business logic, such as calculations on properties and documents

Working with Graph Data

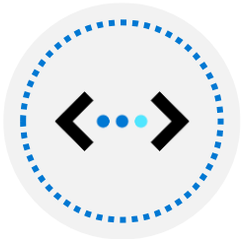
```
from gremlin_python.driver import client,
serializer
import sys, traceback

CLEANUP_GRAPH = "g.V().drop()"

INSERT_NATIONAL_PARK_VERTICES = [
   "g.addV('Park').property('id',
'p1').property('name',
'Yosemite').property('Feature', 'El Capitan')",
   "g.addV('Park').property('id',
'p2').property('name', 'Joshua
Tree').property('Feature', 'Yucca Brevifolia')",
   "g.addV('State').property('id',
's1').property('name',
'California').property('Location', 'USA')",
   "g.addV('Ecosystem').property('id',
'e1').property('name', 'Alpine')",
   "g.addV('Ecosystem').property('id',
'e2').property('name', 'Desert')",
   "g.addV('Ecosystem').property('id',
'e3').property('name', 'High Altitude')"
]

INSERT_NATIONAL_PARK_EDGES = [
   "g.V('p1').addE('is in').to(g.V('s1'))",
   "g.V('p2').addE('is in').to(g.V('s1'))",
   "g.V('p1').addE('has ecosystem
of').to(g.V('e1'))",
   "g.V('p2').addE('has ecosystem
of').to(g.V('e2'))",
   "g.V('p1').addE('has ecosystem
of').to(g.V('e3'))",
   "g.V('p2').addE('has ecosystem
of').to(g.V('e3'))"
]
```

Lesson 03: Build a .NET Core App for Azure Cosmos DB in VS Code

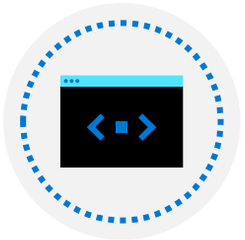


Lesson objectives

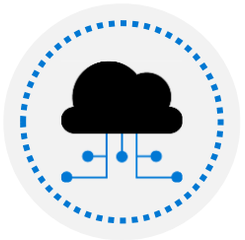
Create an Azure Cosmos DB account, database, and container in Visual Studio Code using the Azure Cosmos DB extension



Create an application to store and query data in Azure Cosmos DB

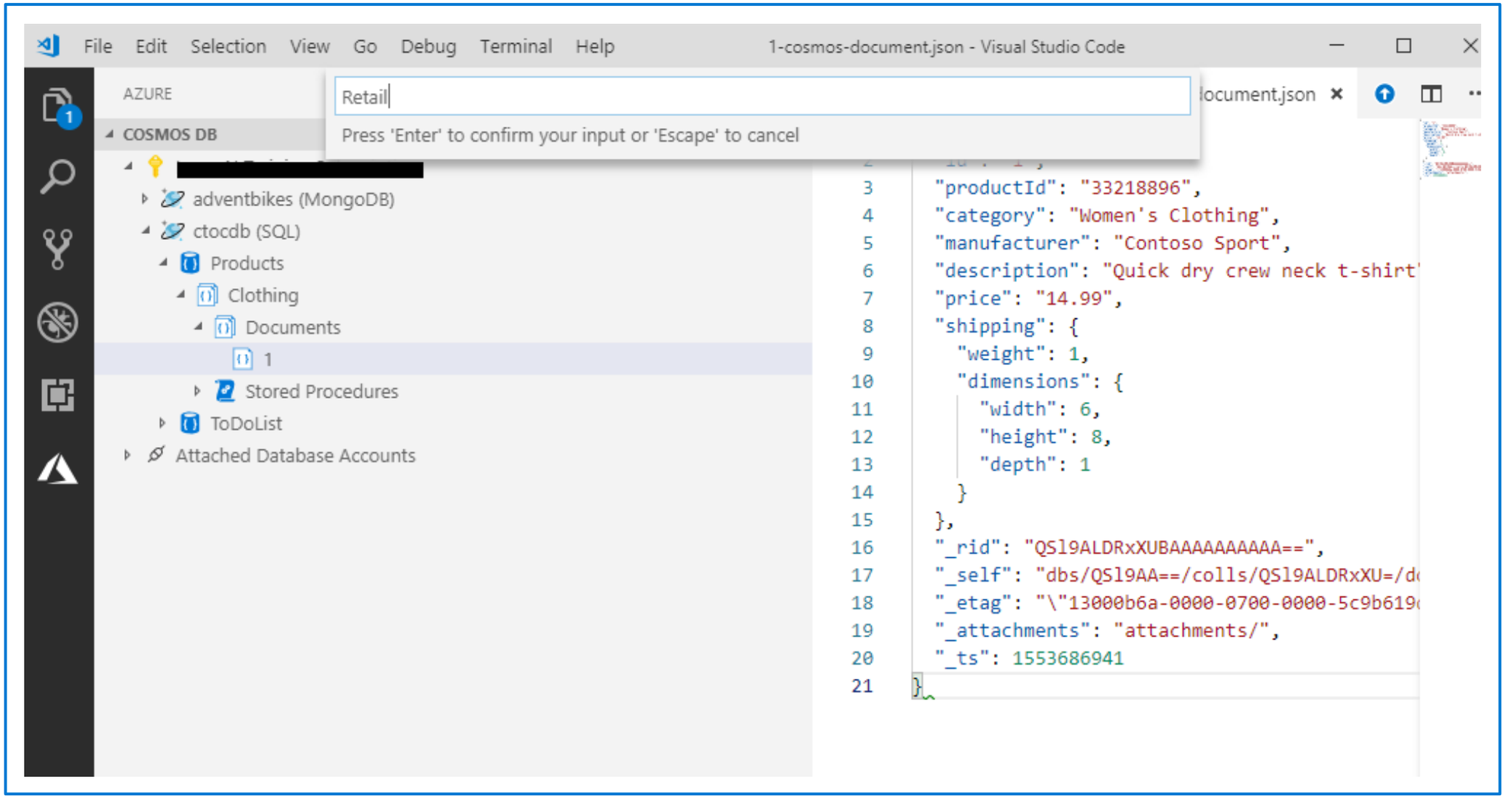


Use the Terminal in Visual Studio Code to quickly create a console application

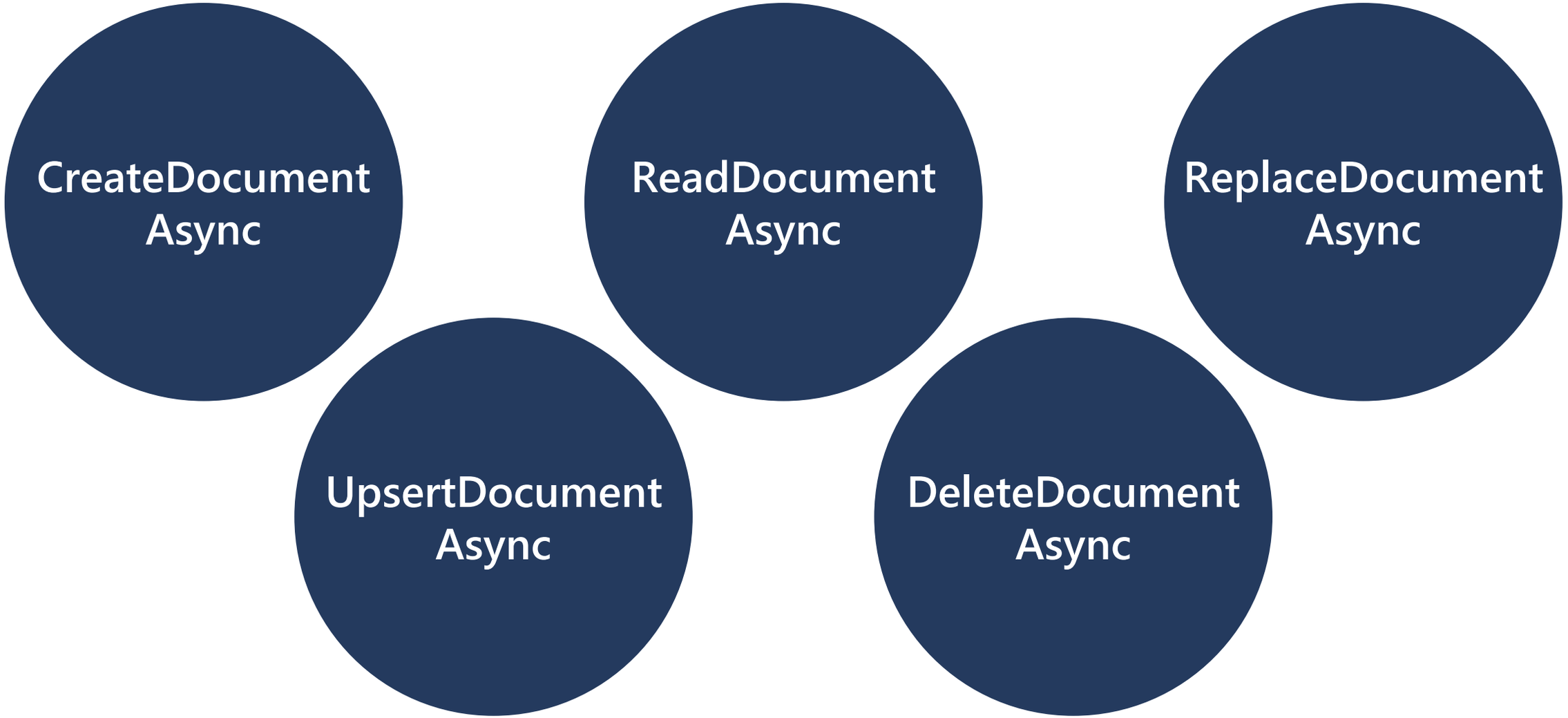


Add Azure Cosmos DB functionality with the help of the Azure Cosmos DB extension for Visual Studio Code

Creating Azure Cosmos DB in Visual Studio Code



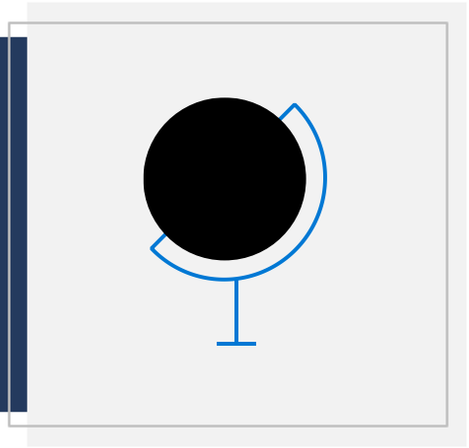
Working with documents programmatically



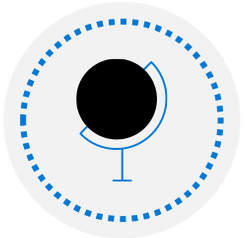
Querying document programmatically

```
{
// Set some common query options
FeedOptions queryOptions = new FeedOptions { MaxItemCount = -1, EnableCrossPartitionQuery = true };

// Here we find nelapin via their LastName
IQueryable<User> userQuery = this.client.CreateDocumentQuery<User>(
UriFactory.CreateDocumentCollectionUri(databaseName, collectionName), queryOptions)
.Where(u => u.LastName == "Pindakova");

// The query is executed synchronously here, but can also be executed asynchronously via the IDocumentQuery<T> interface
Console.WriteLine("Running LINQ query...");
foreach (User in userQuery)
{
Console.WriteLine("\tRead {0}", user);
}

// Now execute the same query via direct SQL
IQueryable<User> userQueryInSql = this.client.CreateDocumentQuery<User>(
UriFactory.CreateDocumentCollectionUri(databaseName, collectionName),
"SELECT * FROM User WHERE User.lastName = 'Pindakova'", queryOptions );

Console.WriteLine("Running direct SQL query...");
foreach (User in userQueryInSql)
{
Console.WriteLine("\tRead {0}", user);
}

Console.WriteLine("Press any key to continue ...");
Console.ReadKey();
}
```

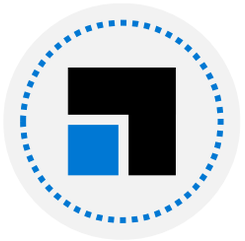
Lesson 04: Distribute your data globally with Azure Cosmos DB



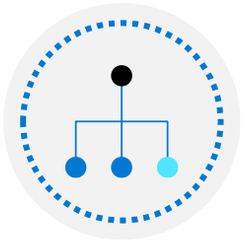
Lesson objectives



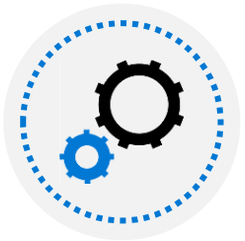
Learn about the benefits of writing and replicating data to multiple regions around the world



Cosmos DB multi-master replication

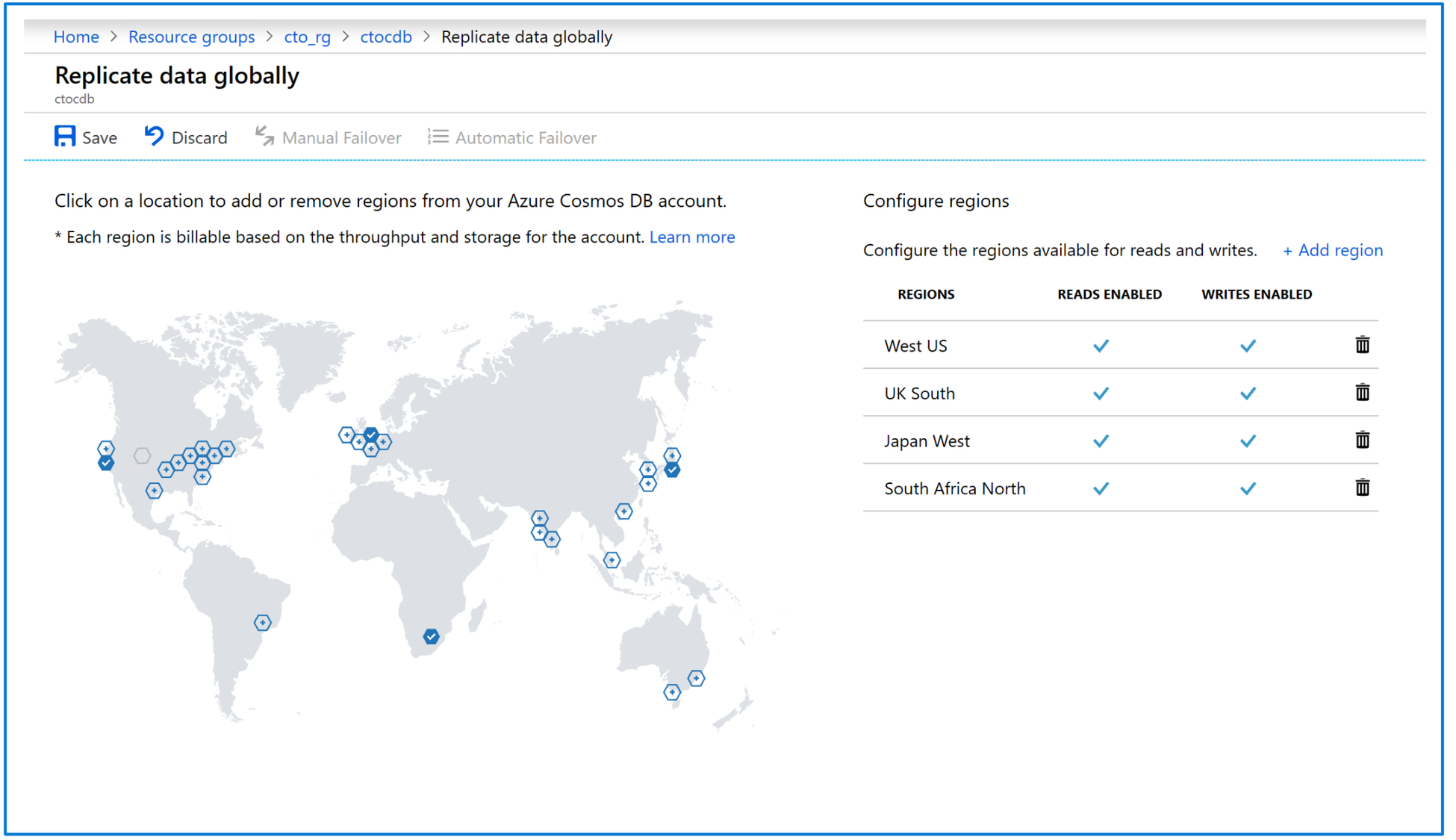


Cosmos DB failover management



Change the consistency setting for your database

Benefits of writing and replicating data to multiple regions



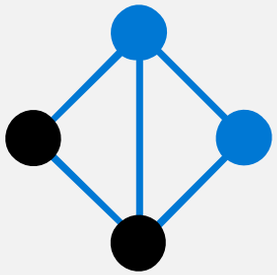
Cosmos DB multi-master replication

Cosmos DB failover management

Automated fail-over is a feature that comes into play when there's a disaster or other event that takes one of your read or write regions offline, and it redirects requests from the offline region to the next most prioritized region

Read region outage	Write region outage
Azure Cosmos DB accounts with a read region in one of the affected regions are automatically disconnected from their write region and marked offline	If the affected region is the current write region and automatic fail-over is enabled, then the region is automatically marked as offline. Then, an alternative region is promoted as the write region

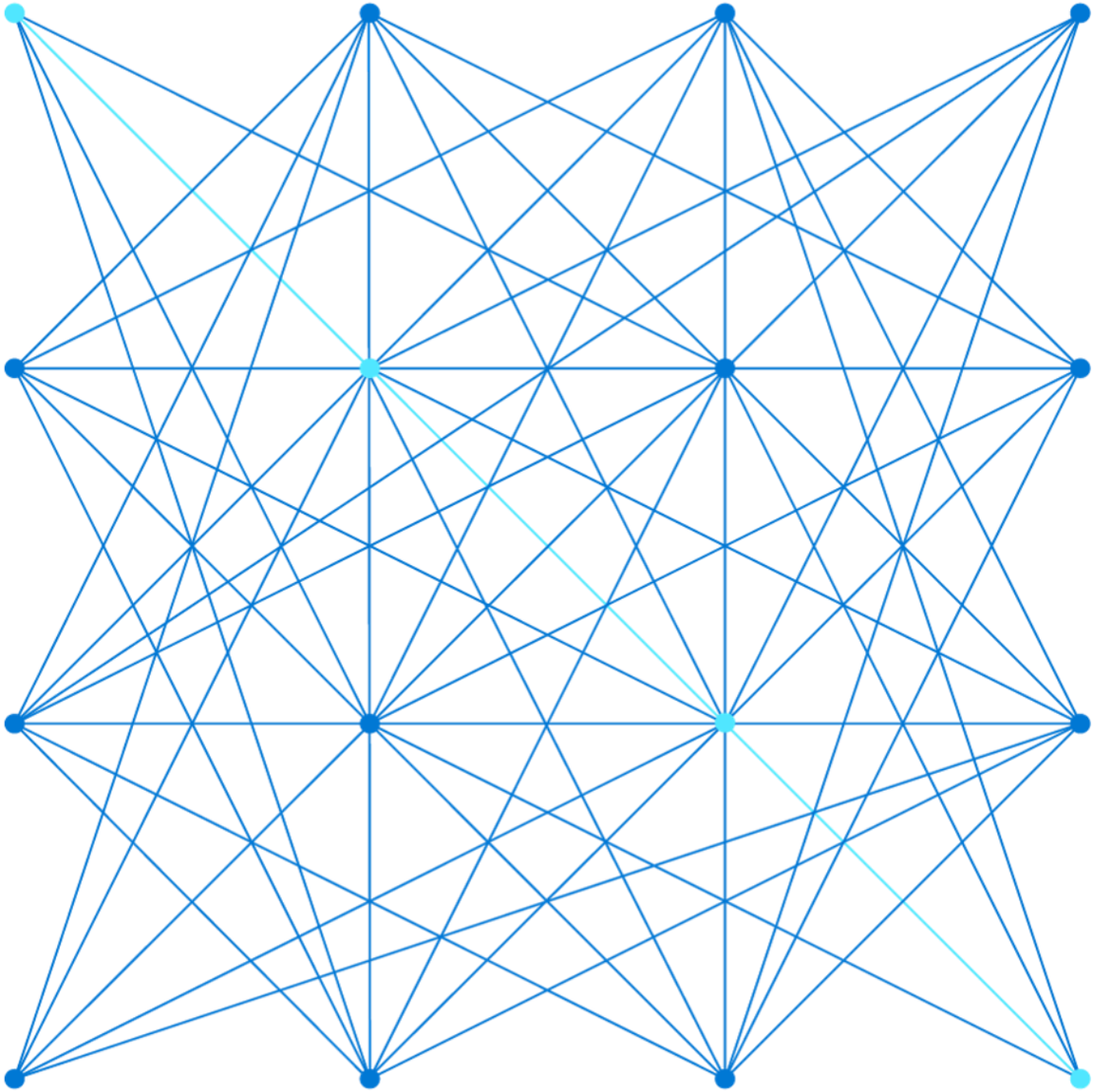
Lab: Building globally distributed databases with Cosmos DB



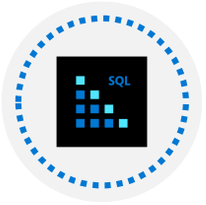
Microsoft Azure

Microsoft Azure

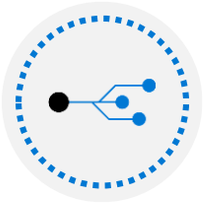
Module 05: Working with relational data stores in the cloud



Agenda

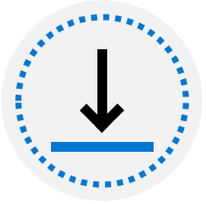


Lesson 01: Work with Azure SQL database



Lesson 02: Work with Azure Synapse Analytics

Lesson 03: Provision and query data in Azure Synapse Analytics



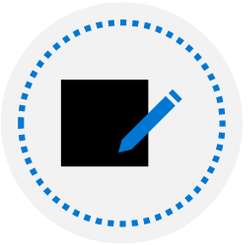
Lesson 04: Import data into Azure Synapse Analytics using PolyBase

Lesson 01: Azure SQL database

Lesson objectives

Why Azure SQL Database is a good choice for running your relational database

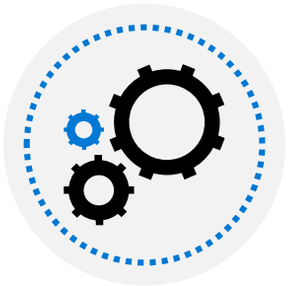
What configuration and pricing options are available for your Azure SQL database



How to create an Azure SQL database from the portal

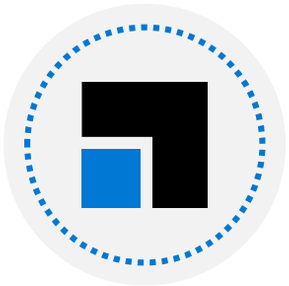
How to use Azure Cloud Shell to connect to your Azure SQL database, add a table, and work with data

Why Azure SQL Database is a good choice



Convenience

Cost



Scale

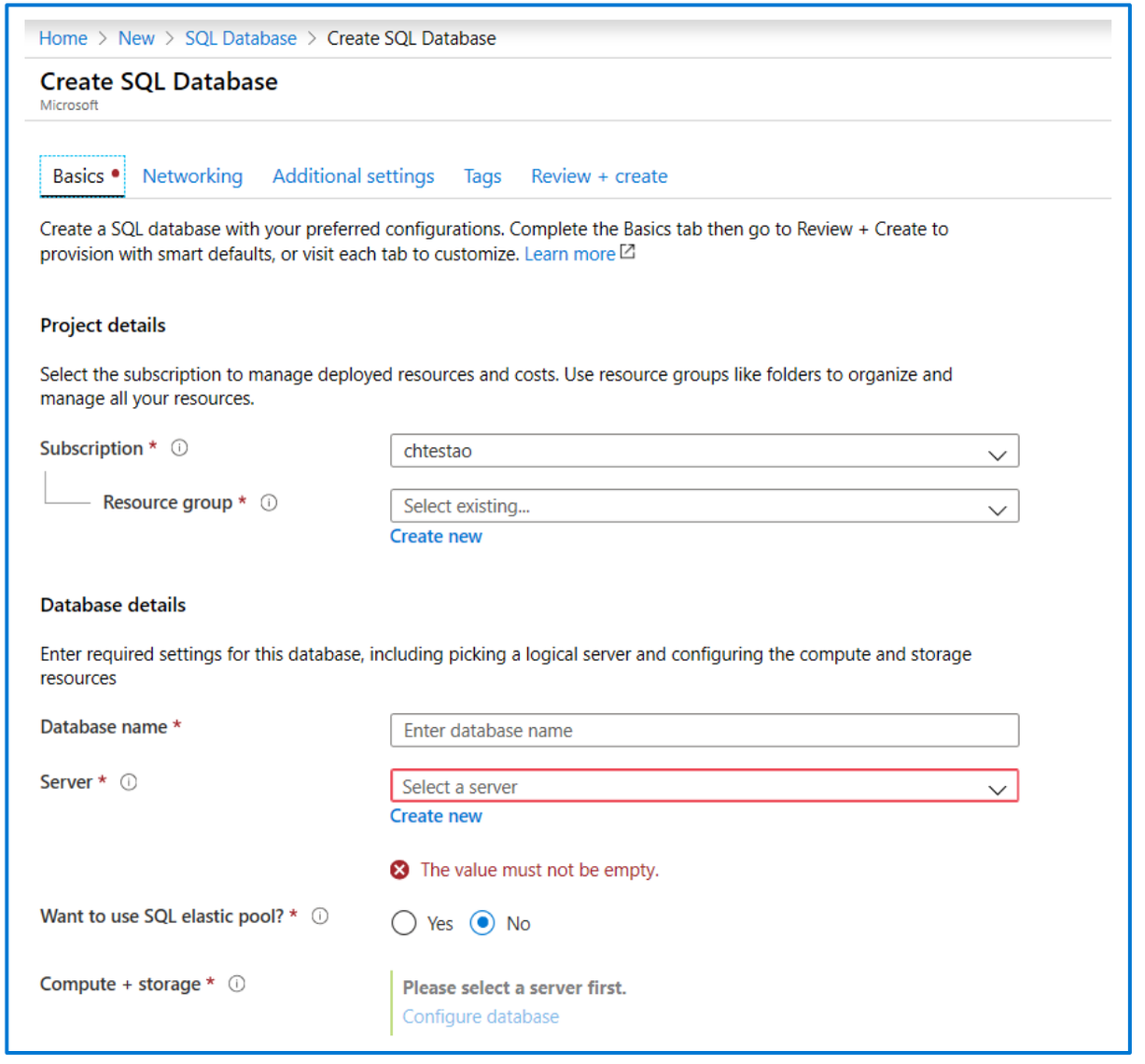
Security

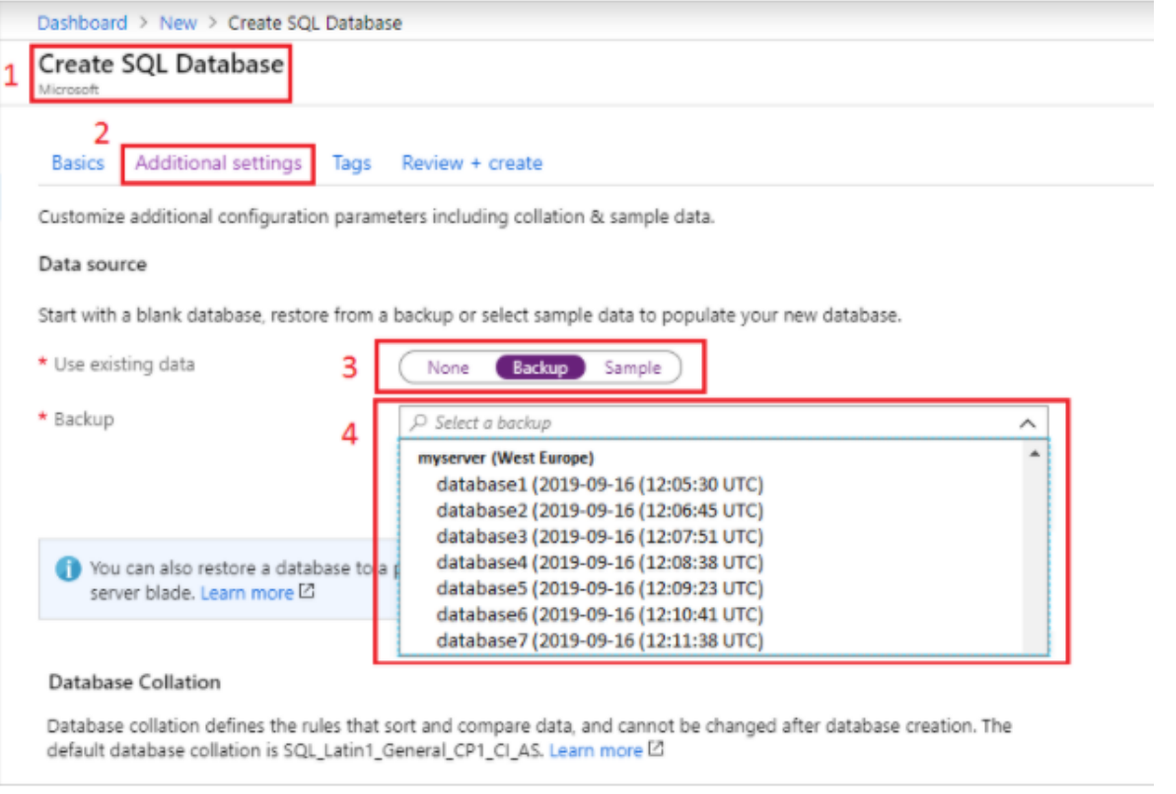
Azure SQL Database configuration options

When you create your first Azure SQL database, you also create an _*Azure SQL logical server*_. Think of a logical server as an administrative container for your databases

DTUs	vCores	SQL elastic pools	SQL managed instances
DTU stands for Database Transaction Unit and is a combined measure of compute, storage, and IO resources. Think of the DTU model as a simple, preconfigured purchase option	vCore gives you greater control over what compute and storage resources you create and pay for. vCore model enables you to configure resources independently	SQL elastic pools relate to eDTUs. They enable you to buy a set of compute and storage resources that are shared among all the databases in the pool. Each database can use the resources they need	The SQL managed instance creates a database with near 100% compatibility with the latest SQL Server on-premises Enterprise Edition database engine, useful for SQL Server customers who would like to migrate on-premises servers instance in a “lift and shift” manner

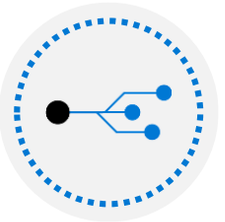
Create an Azure SQL database



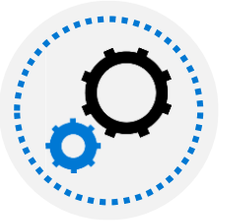


Lesson 02: Azure Synapse Analytics

Lesson objectives

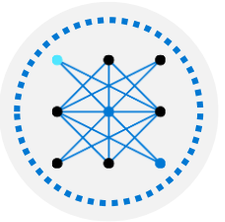


Explain Azure Synapse Analytics

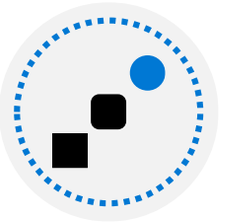


Explain Azure Synapse Analytics features

Types of solution workloads



Explain massively parallel processing concepts



Compare table geometries

Azure Synapse Analytics

What is Azure Synapse Analytics?

A unified environment by combining the enterprise data warehouse of SQL, the Big Data analytics capabilities of Spark, and data integration technologies to ease the movement of data between both, and from external data sources

Data warehouse capabilities

SQL Analytics:

A centralized data warehouse store that provides a relational analytics and decision support services across the whole enterprise

SQL Pools:

CPU, memory, and IO are bundled into units of compute scale called SQL, determined by Data Warehousing Units (DWU)

Future features:

Will include a Spark engine, a data integration and Azure Synapse Analytics Studio

Azure Synapse Analytics features

Workload management	This capability is used to prioritize the query workloads that take place on the server using Workload Management. This involves three components: • Workload Groups • Workload Classification • Workload Importance
Result-set cache	Result-set caching can be used to improve the performance of the queries that retrieve these results. When result-set caching is enabled, the results of the query are cached in the SQL pool storage
Materialized views	A materialized view pre-computes, stores, and maintains its data like a table. They are automatically updated when data in underlying tables are changed
SSDT CI/CD support	Database project support in SQL Server Data Tools (SSDT) allows teams of developers to collaborate over a version-controlled Azure Synapse Analytics, and track, deploy and test schema changes

Types of solution workloads

The modern data warehouse extends the scope of the data warehouse to serve Big Data that's prepared with techniques beyond relational ETL

Modern data warehousing

We want to integrate all our data—including Big Data—with our data warehouse

Advanced analytics

We're trying to predict when our customers churn

Real-time analytics

We're trying to get insights from our devices in real-time

Massively Parallel Processing (MPP) concepts

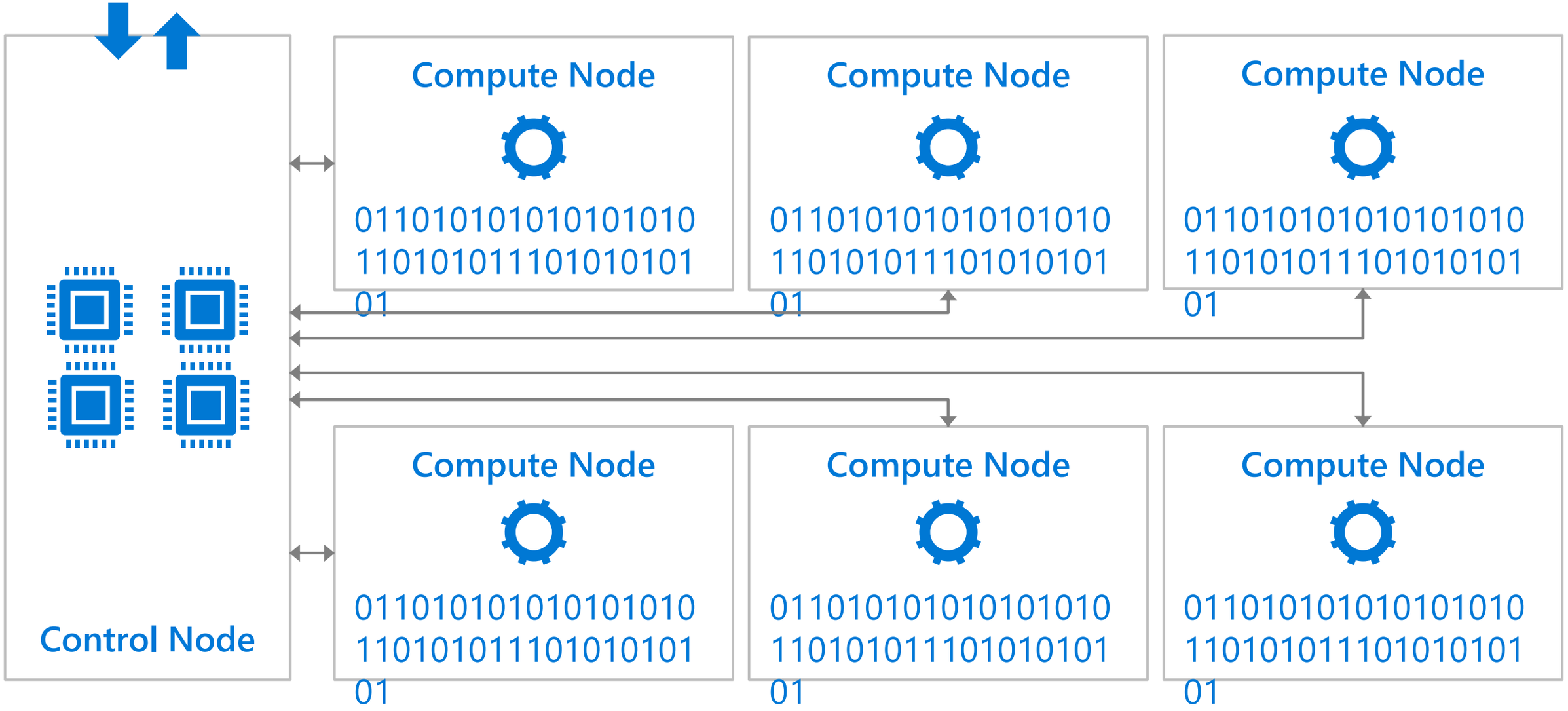
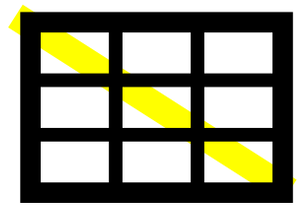
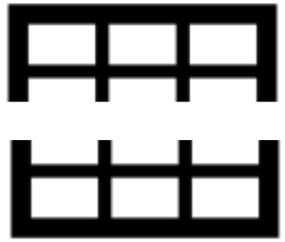


Table geometries

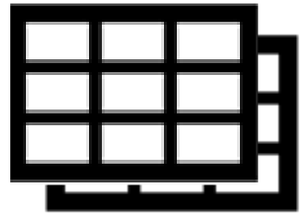
Table distribution



Round Robin Tables

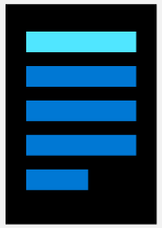


Hash Distributed Tables



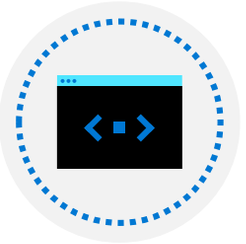
Replicated Tables

Lesson 03: Creating and querying an Azure Synapse Analytics



Lesson objectives

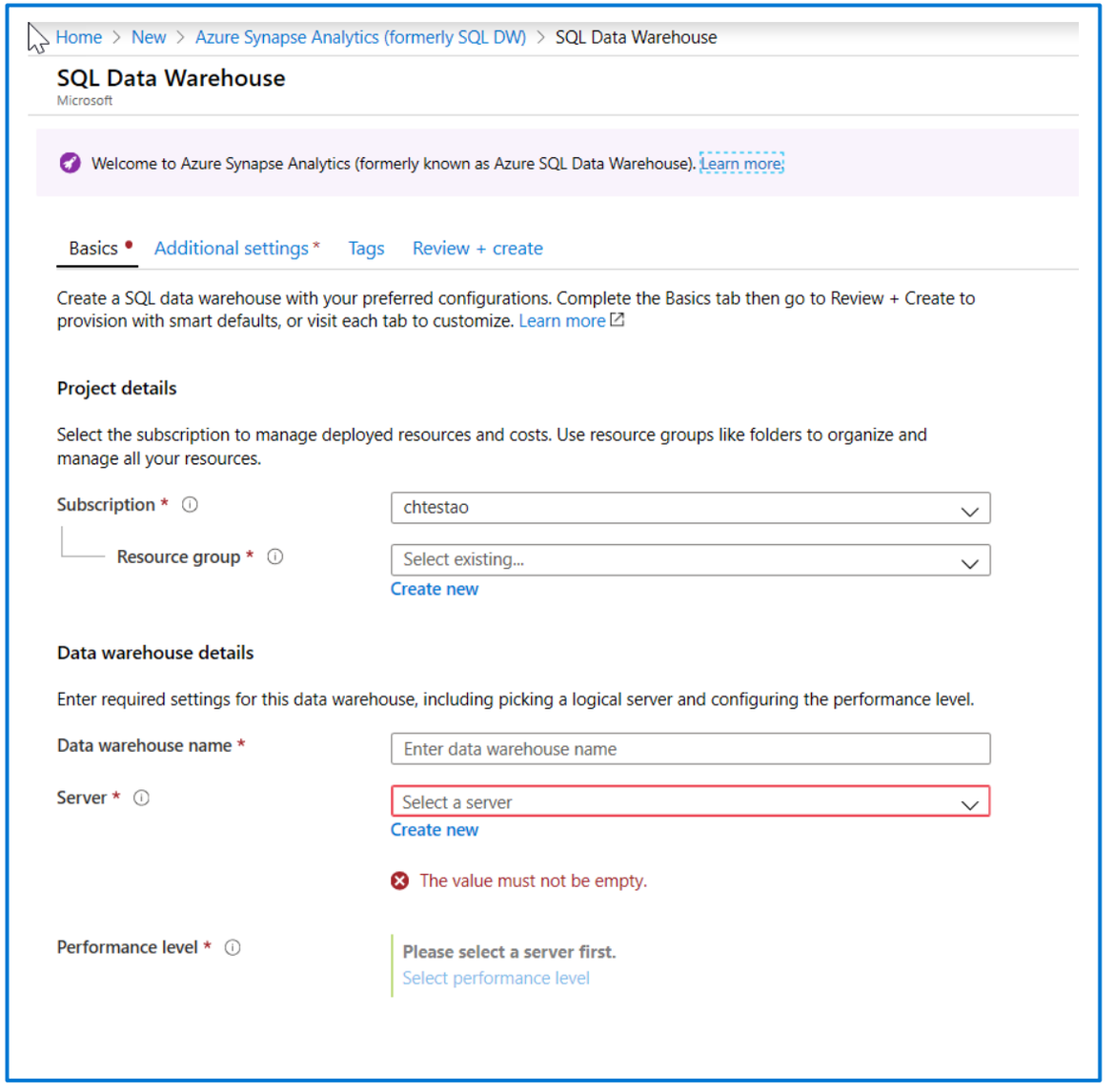
Create an Azure Synapse Analytics sample database



Query the sample database with the SELECT statement and its clauses

Use the queries in different client applications such as SQL Server Management Studio, and PowerBI

Create an Azure Synapse Analytics



Perform Azure Synapse Analytics queries

SELECT Query Basics

```
SELECT <select_list>
[FROM <optional_from_specification>]
[WHERE <optional_filter_condition>]
[ORDER BY <optional_sort_specification>]
[JOIN <optional_join_specification>]
```

Examples

```
SELECT *
FROM Products p WHERE p.id ="1“

SELECT p.id, p.manufacturer, p.description
FROM Products p WHERE p.id ="1“

SELECT p.price, p.description, p.productId
FROM Products p ORDER BY p.price ASC

SELECT p.productId
FROM Products p JOIN p.shipping
```

Perform Azure Synapse Analytics queries

Create Table as Select (CTAS)

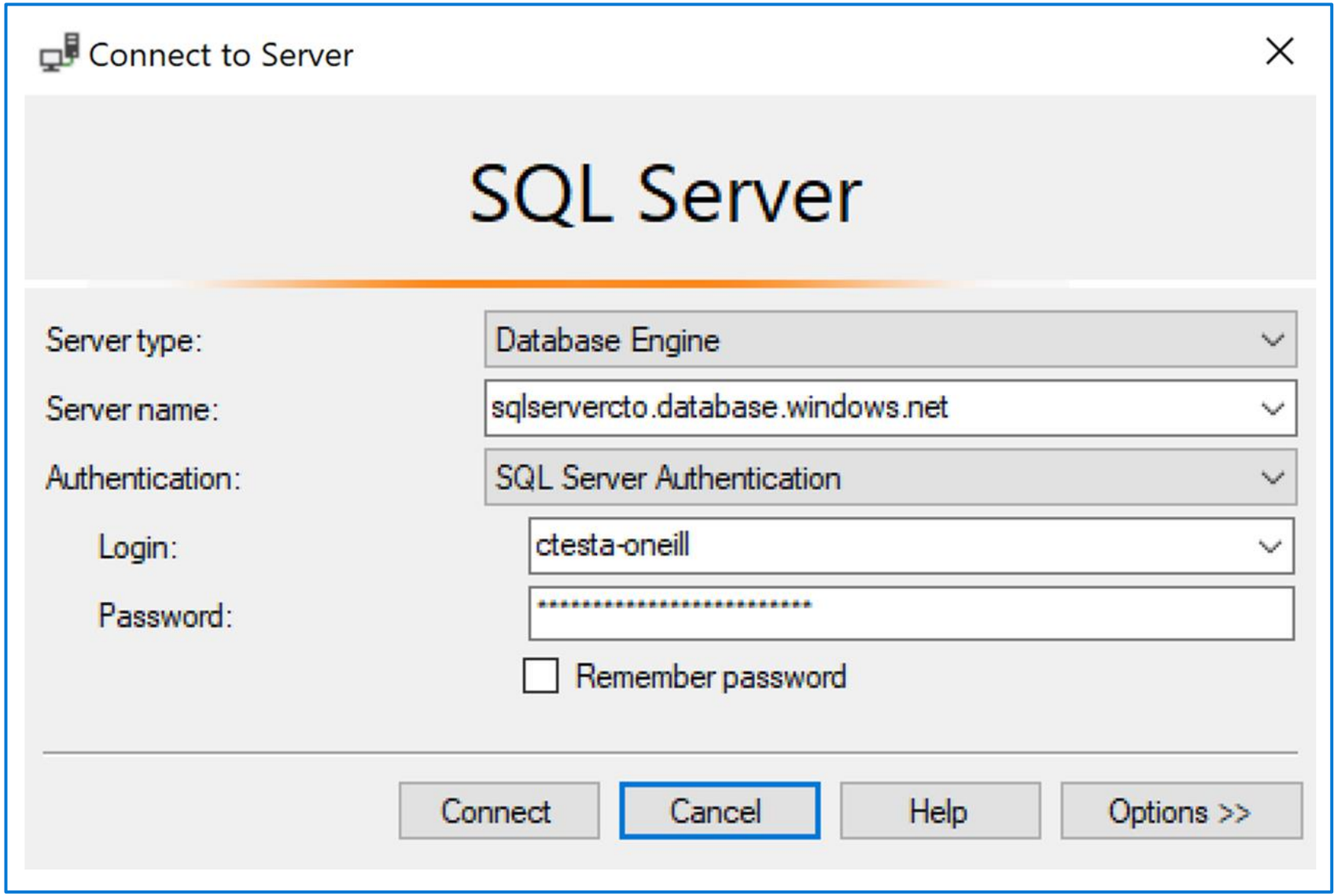
Used in parallel data loads

```
CREATE TABLE
[ database_name . [ schema_name ] . | schema_name. ] table_name
        [ ( { column_name } [ ,...n ] ) ]
WITH ( DISTRIBUTION =
     { HASH( distribution_column_name )                  REPLICATE | ROUND_ROBIN }
            [ , <CTAS_table_option> [ ,...n ] ]
    )
    AS <select_statement> [;]
```

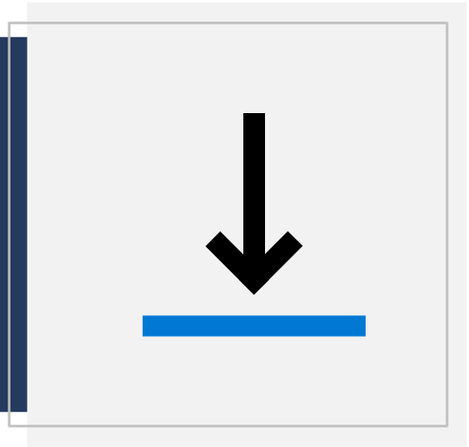
Example

```
CREATE TABLE FactInternetSales_Copy
WITH
(DISTRIBUTION = HASH(SalesOrderNumber))
AS SELECT * FROM FactInternetSales
```

Querying with different client applications

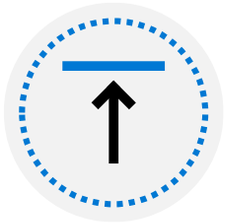


Lesson 04: Using PolyBase to Load Data in Azure Synapse Analytics



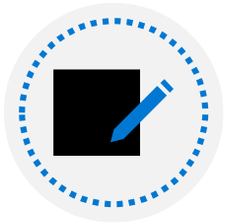
Lesson objectives

Explore how PolyBase works

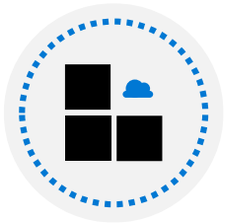


Upload text data to Azure Blob store

Collect the security keys for Azure Blob store



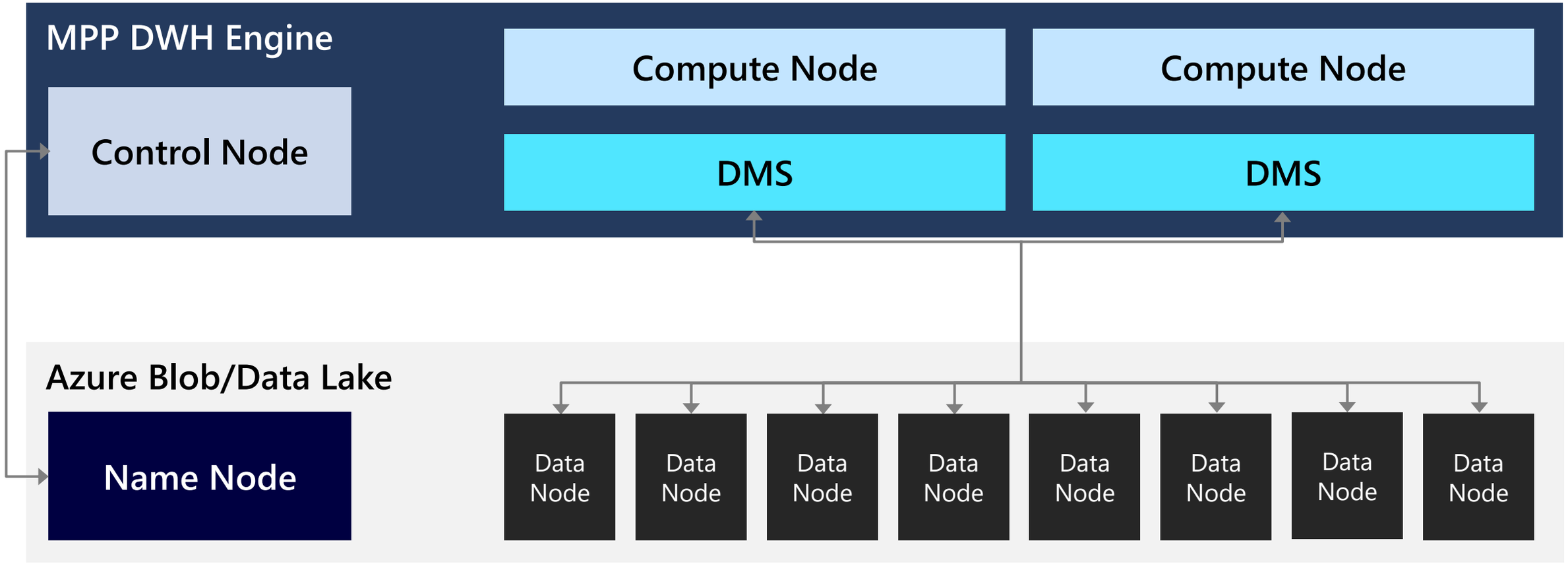
Create an Azure Synapse Analytics



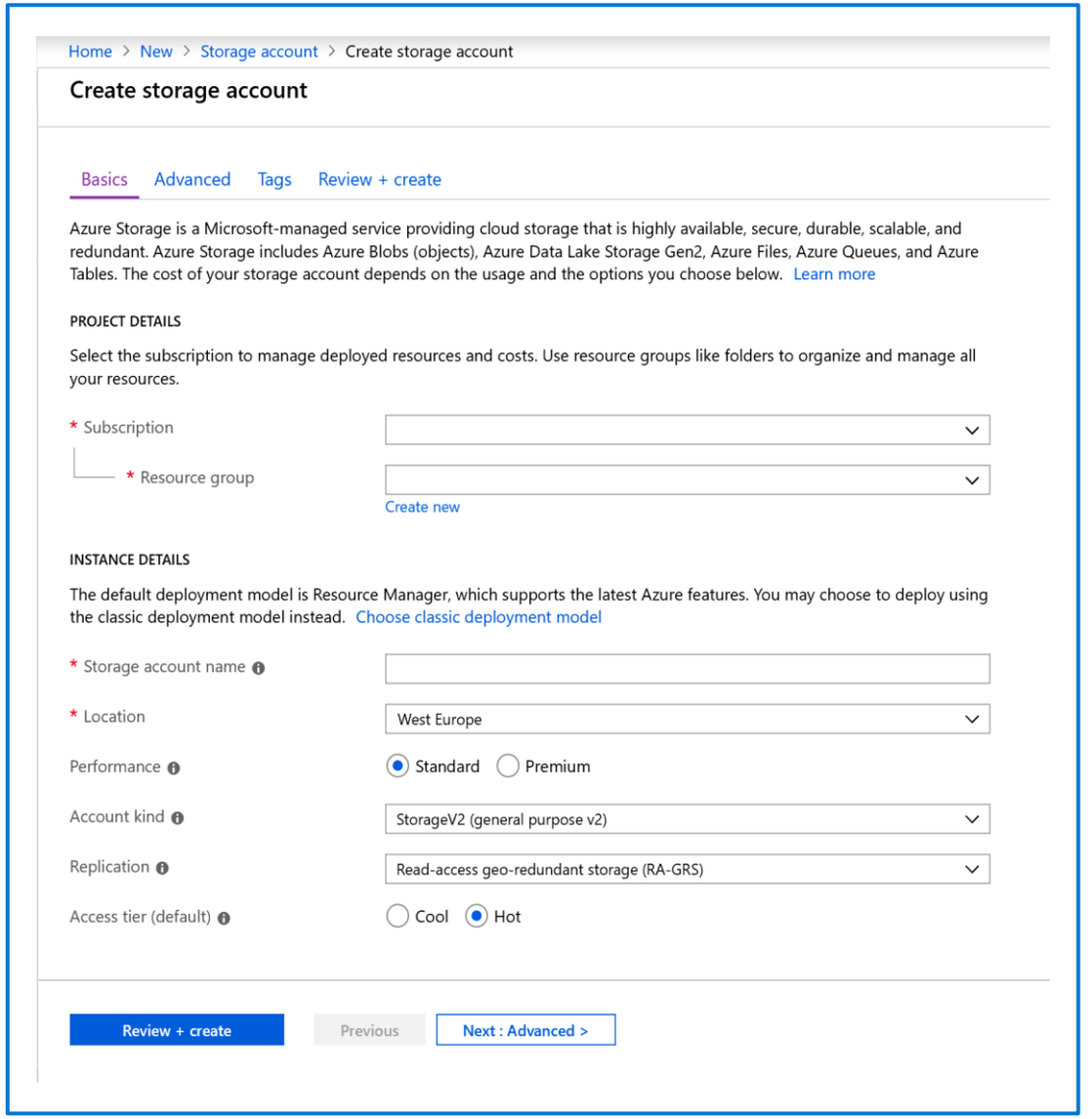
Import data from Blob Storage to the Data Warehouse

How PolyBase works

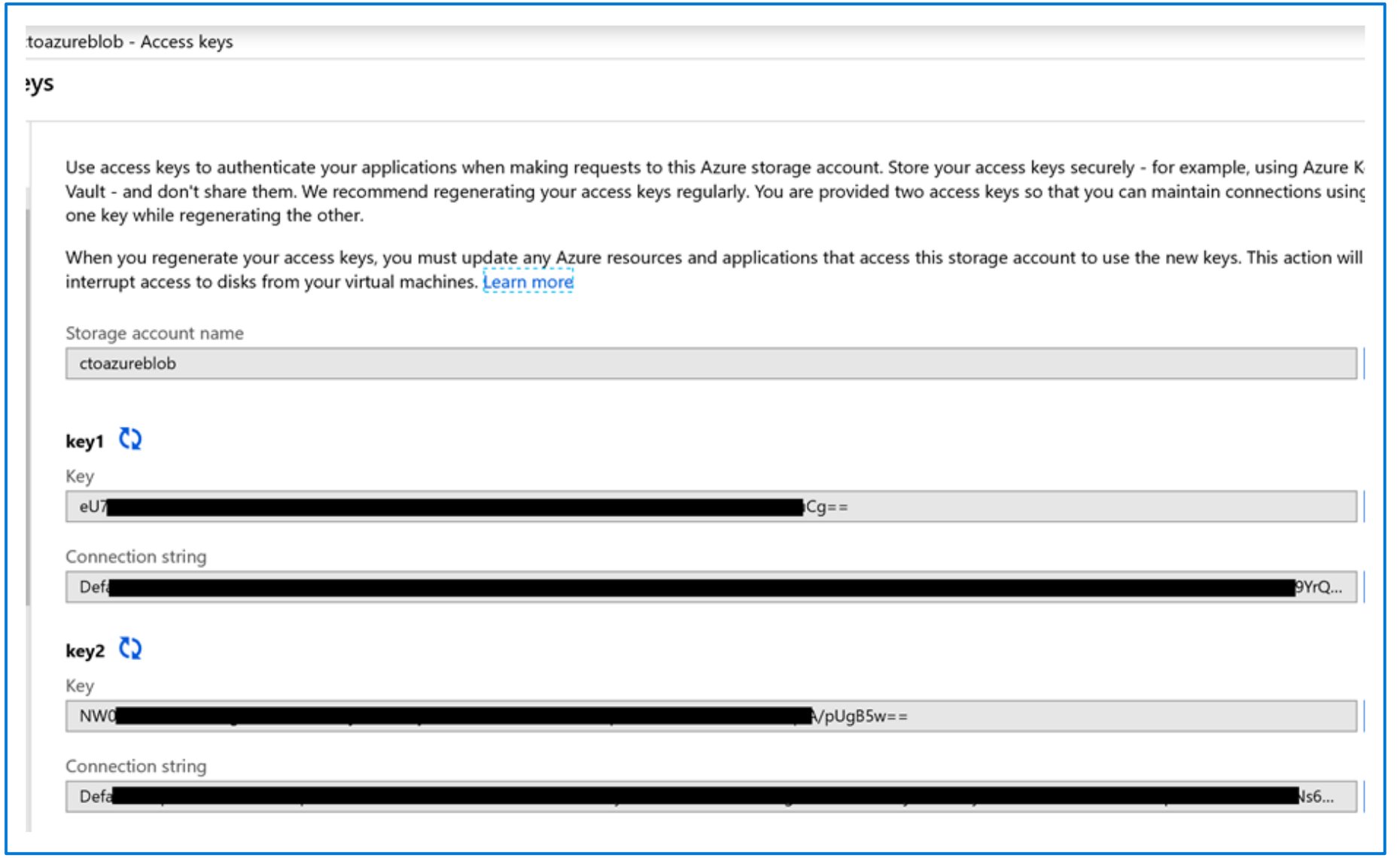
The MPP engine's integration method with PolyBase



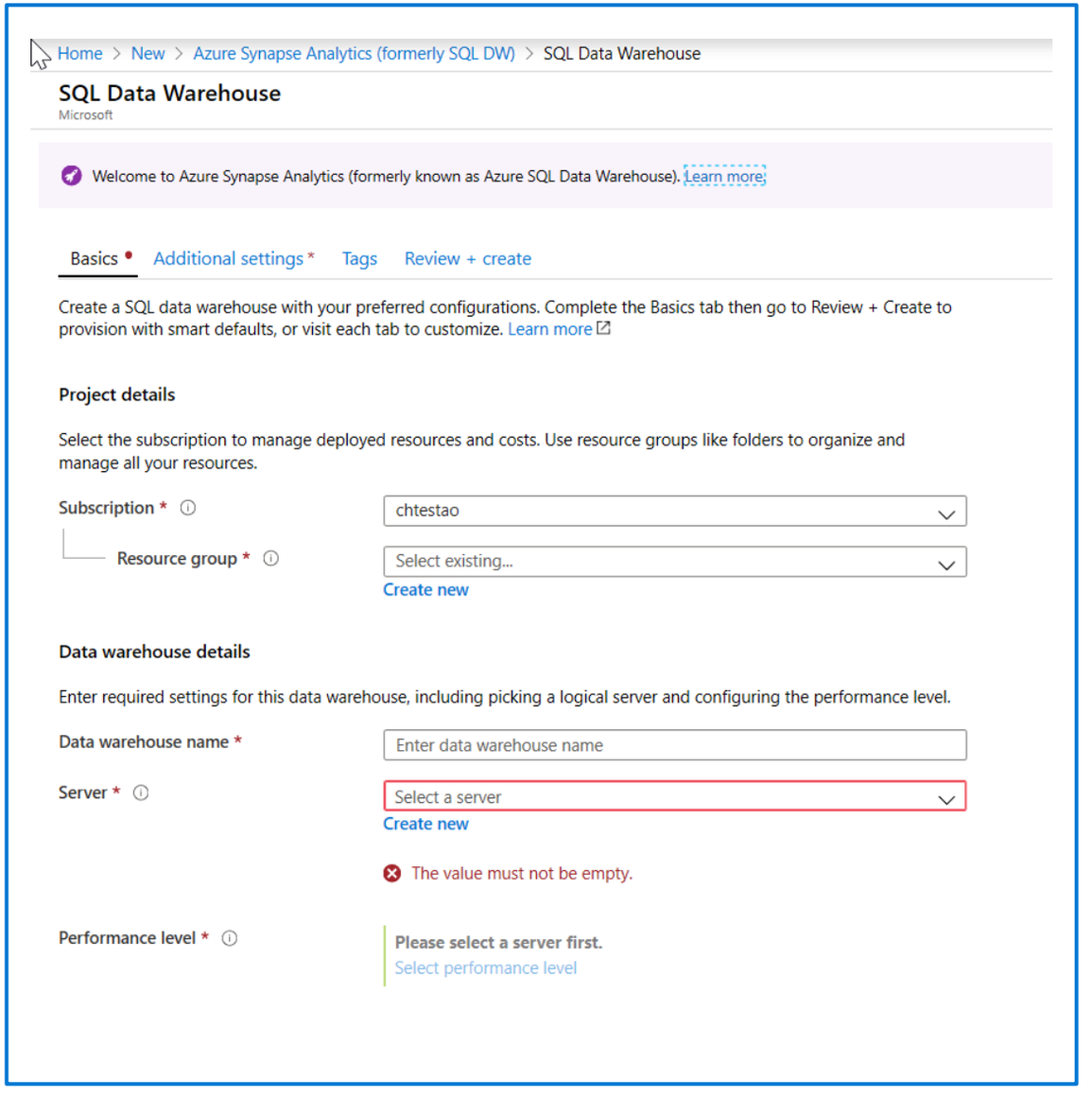
Upload text data to Azure Blob store



Collect the storage keys



Create an Azure Synapse Analytics



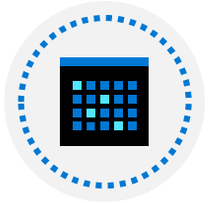
Lab: Working with relational data stores in the cloud

Microsoft Azure

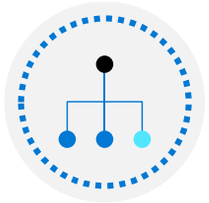
Microsoft Azure

Module 06: Performing real-time analytics with Stream Analytics

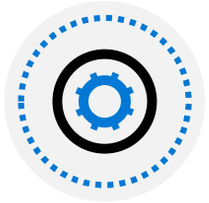
Agenda



Lesson 01 – Data streams and event processing

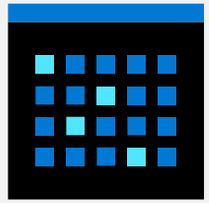


Lesson 02 – Data ingestion with Event Hubs

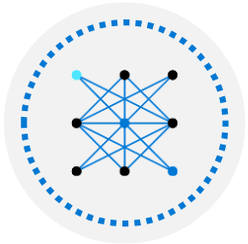


Lesson 03 – Processing data with Stream Analytics Jobs

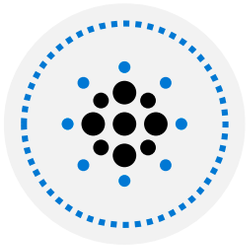
Lesson 01: Data streams and event processing



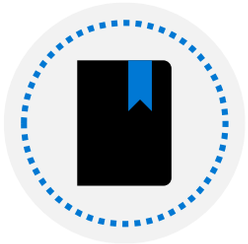
Lesson objectives



Explain data streams



Explain event processing



Learn about processing events with Azure Stream Analytics

What are data streams

Data streams:

In the context of analytics, data streams are event data generated by sensors or other sources that can be analyzed by another technology

Data stream processing approach:

There are two approaches. Reference data is streaming data that can be collected over time and persisted in storage as static data. In contrast, streaming data have relatively low storage requirements. And run computations in sliding windows

Data streams are used to:

Analyze data:
Continuously analyze data to detect issues and understand or respond to them

Understand systems:
Understand component or system behavior under various conditions to fuel further enhancements of said system

Trigger actions:
Trigger specific actions when certain thresholds are identified

Event processing

The process of consuming data streams, analyzing them, and deriving actionable insights out of them is called Event Processing and has three distinct components:

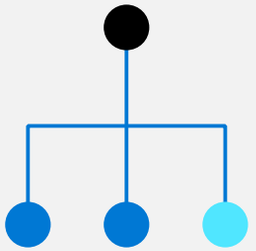
Event producer	Examples include sensors or processes that generate data continuously such as a heart rate monitor or a highway toll lane sensor
Event processor	An engine to consume event data streams and deriving insights from them. Depending on the problem space, event processors either process one incoming event at a time (such as a heart rate monitor) or process multiple events at a time (such as a highway toll lane sensor)
Event consumer	An application which consumes the data and takes specific action based on the insights. Examples of event consumers include alert generation, dashboards, or even sending data to another event processing engine

Processing events with Azure Stream Analytics

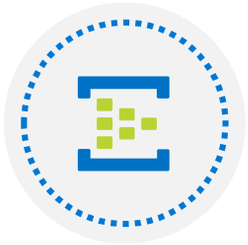
Microsoft Azure Stream Analytics is an event processing engine. It enables the consumption and analysis of high volumes of streaming data in real time

Source	Ingestion	Analytical engine	Destination
Sensors	Event Hubs	Stream Analytics Query Language	Azure Data Lake
Systems	IoT Hubs	.NET SDK	Cosmos DB
Applications	Azure Blob Store		SQL Database
			Blob Store
			Power BI

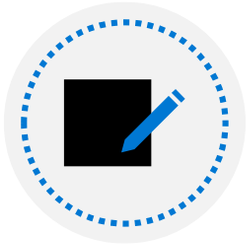
Lesson 02: Data ingestion with Event Hubs



Lesson objectives



Describe Azure Event Hubs



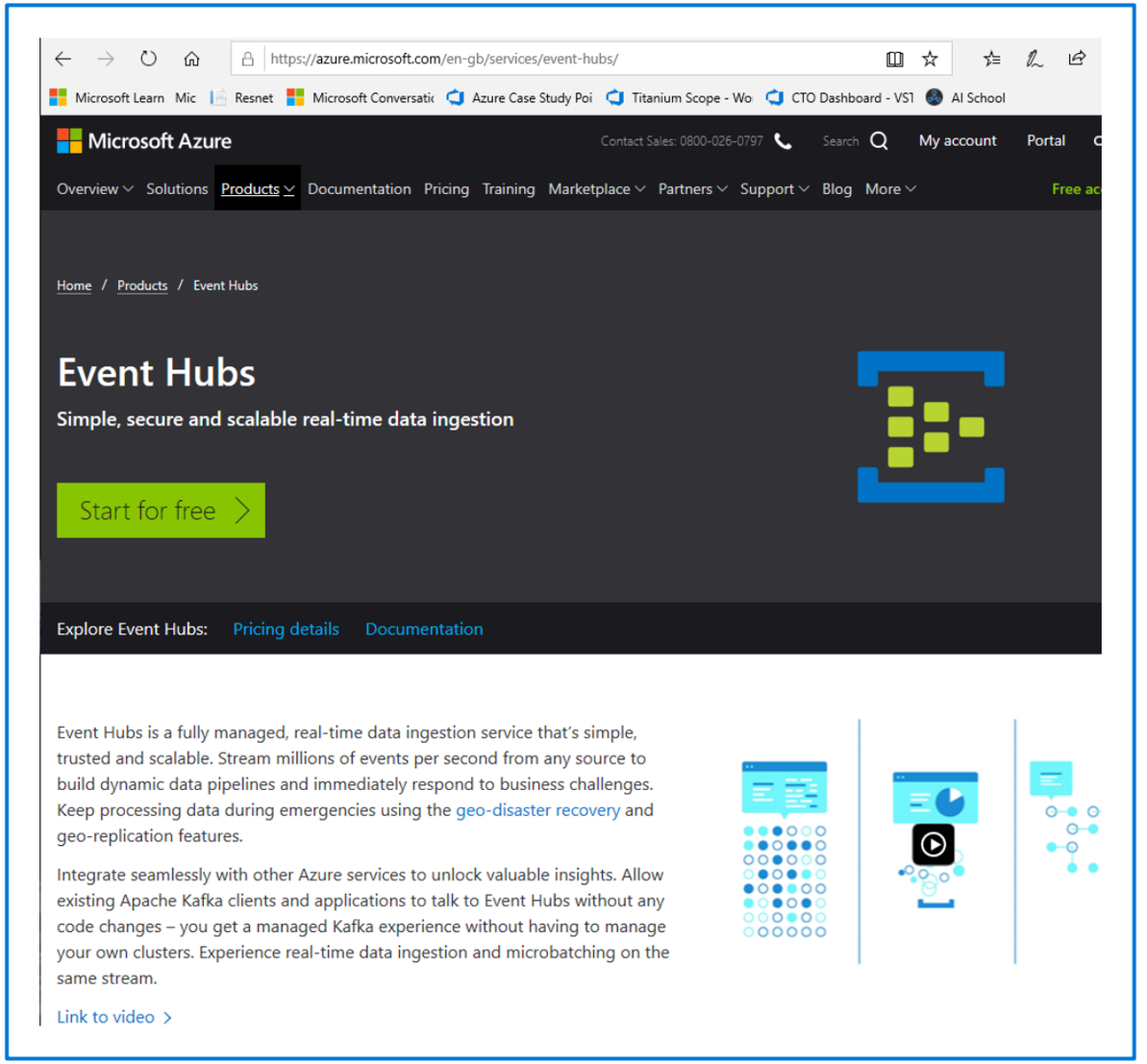
Create an Event Hub

Evaluate the performance of an Event Hub

Configure applications to use an Event Hub

Azure Event Hubs

Azure Event Hubs is a highly scalable publish-subscribe service that can ingest millions of events per second and stream them into multiple applications



Create an Event Hub

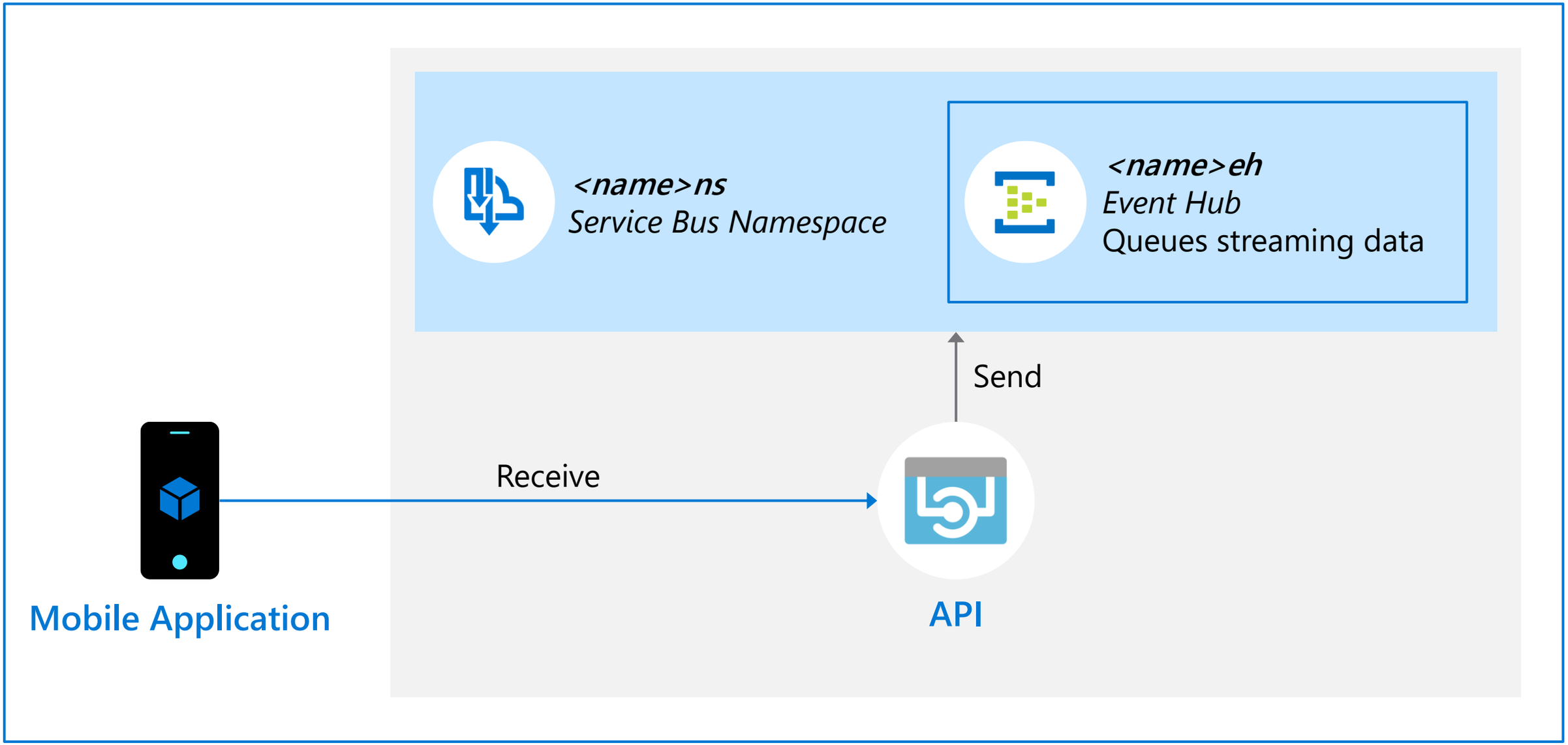
Create an event hub namespace

1. In the Azure portal, select **NEW,** type **Event Hubs,** and then select **Event Hubs** from the resulting search. Then select **Create**
2. Provide a name for the event hub, and then create a resource group. Specify **xx-name-eh** and **xx-name-rg** respectively, XX- represent your initials to ensure uniqueness of the Event Hub name and Resource Group name
3. Click the checkbox to **Pin to the dashboard**, then select the **Create** button

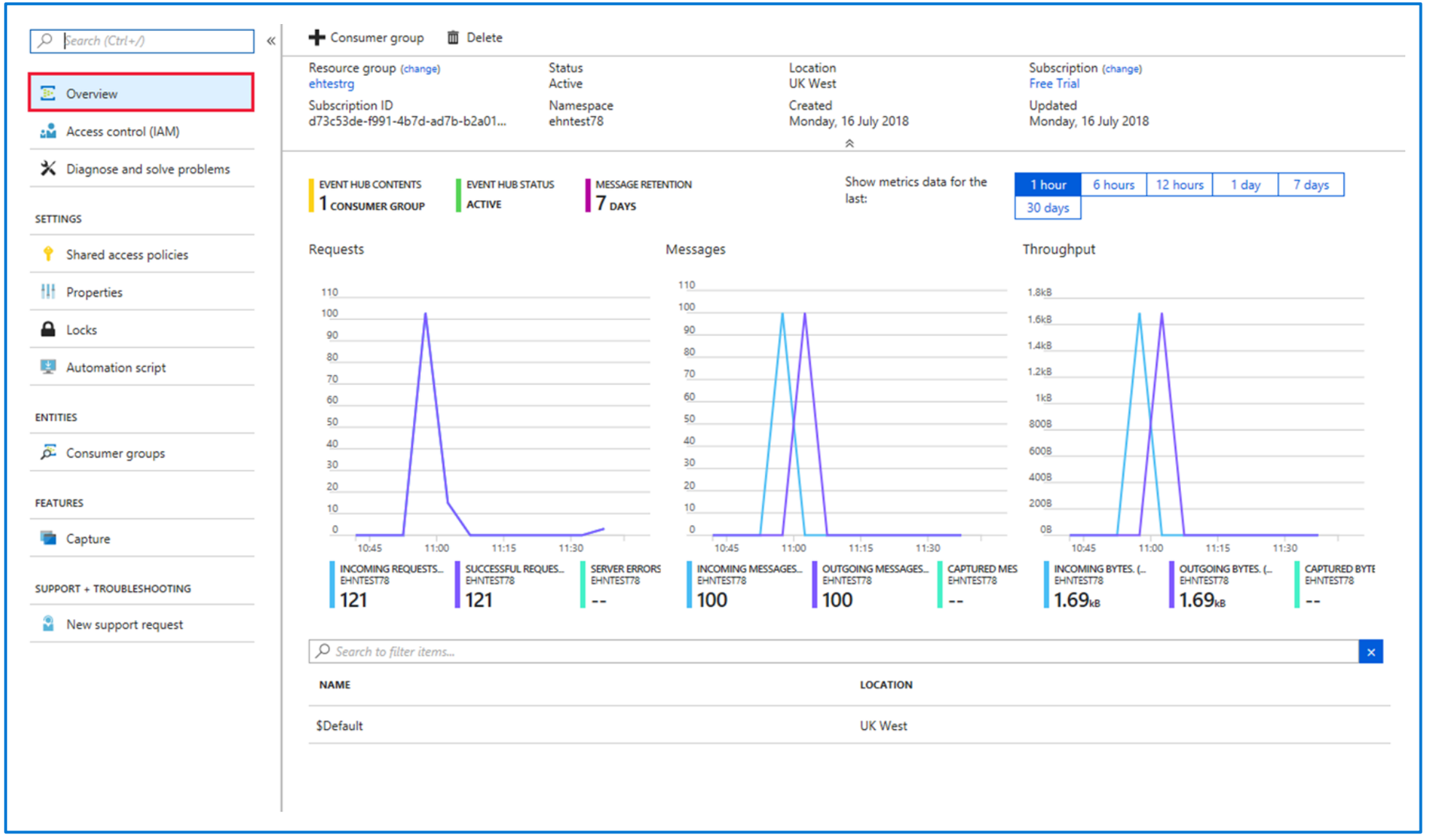
Create an event hub

1. After the deployment is complete, click the **xx-name-eh** event hub on the dashboard
2. Then, under **Entities**, select **Event Hubs**
3. To create the event hub, select the **+ Event Hub** button. Provide the name **socialstudy-eh**, and then select **Create**
4. To grant access to the event hub, we need to create a shared access policy. Select the **socialstudy-eh** event hub when it appears, and then, under **Settings**, select **Shared access policies**
5. Under **Shared access policies**, create a policy with **MANAGE** permissions by selecting **+ Add**. Give the policy the name of **xx-name-eh-sap**, check **MANAGE**, and then select **Create**
6. Select your new policy after it has been created, and then select the copy button for the **CONNECTION STRING – PRIMARY KEY** entity
7. Paste the **CONNECTION STRING – PRIMARY KEY** entity into Notepad, this is needed later in the exercise
8. Leave all windows open

Configure applications to use Event Hubs



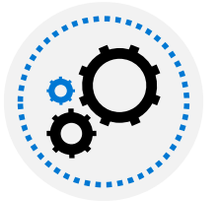
Evaluating the performance of Event Hubs



Lesson 03: Processing data with Stream Analytics Jobs

Lesson objectives

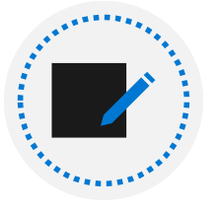
Explore the Streaming Analytics workflow



Create a Stream Analytics Job

Configure a Stream Analytics job input

Configure a Stream Analytics job output

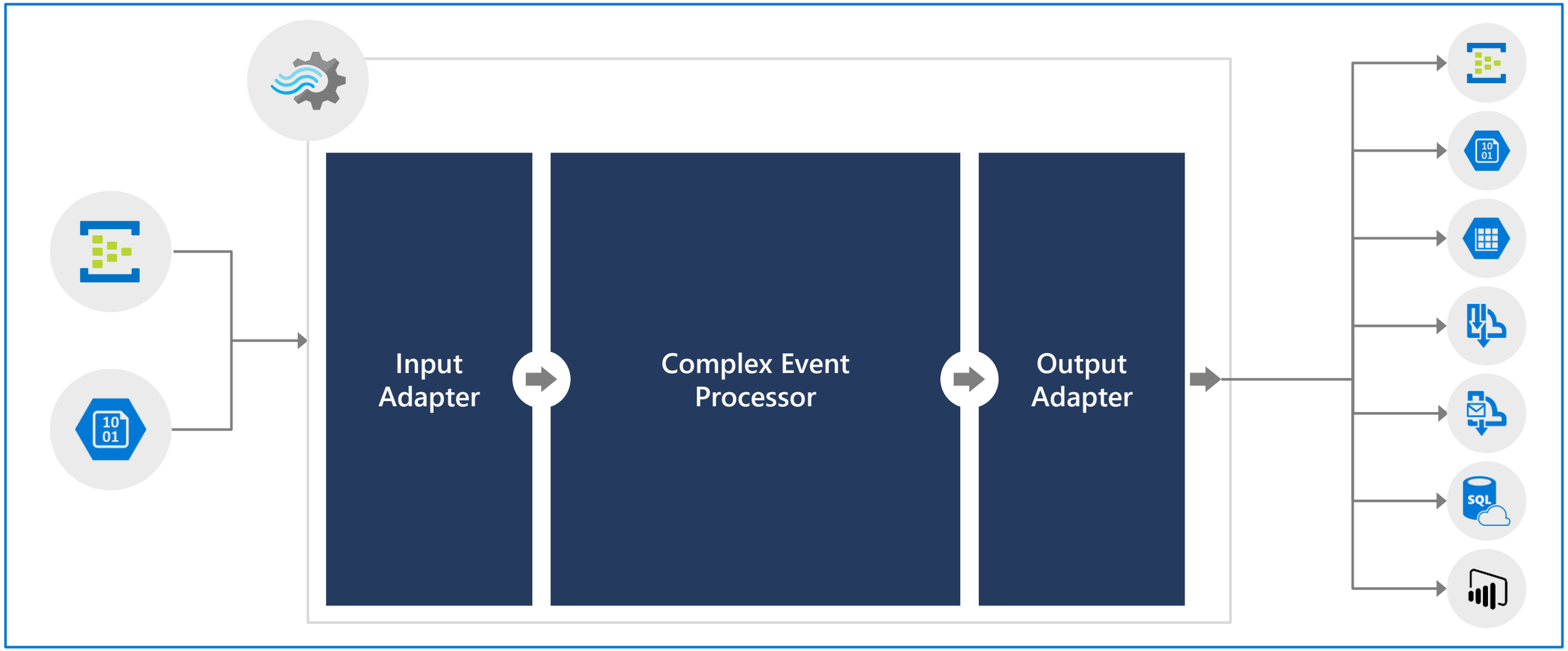


Write a transformation query

Start a Stream Analytics job

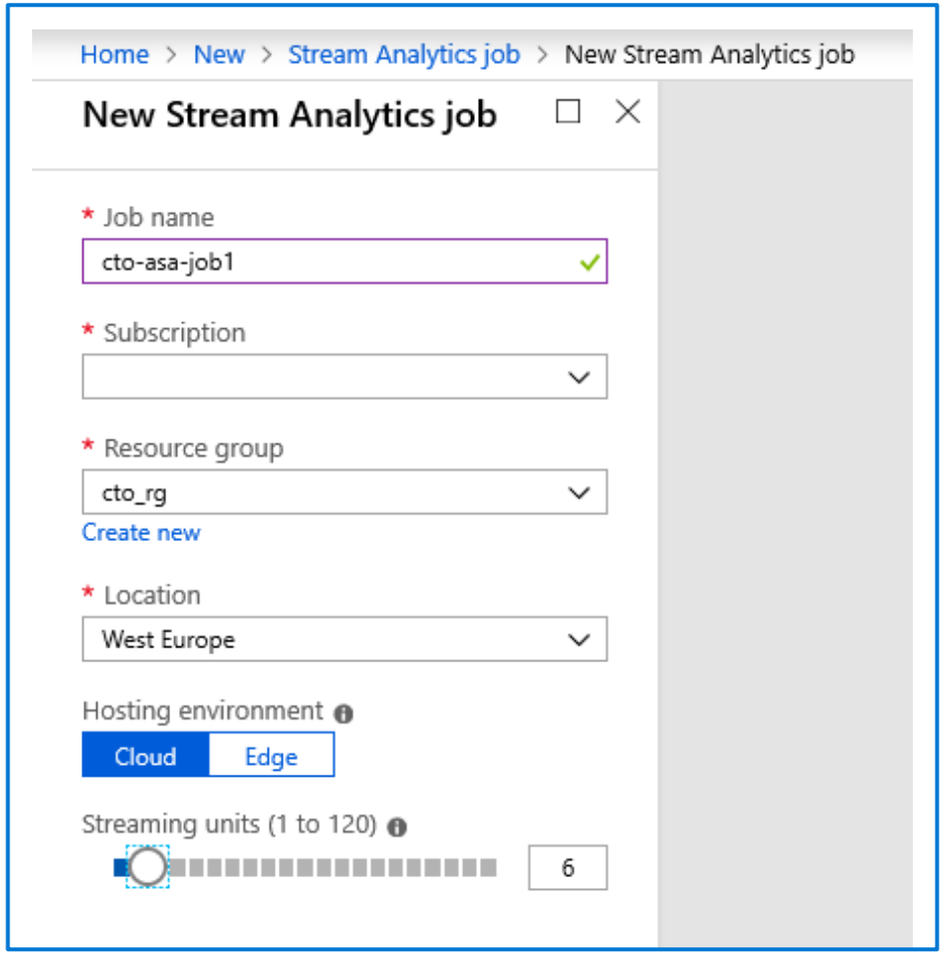
Azure Stream Analytics workflow

Complex event processing of Stream Data in Azure

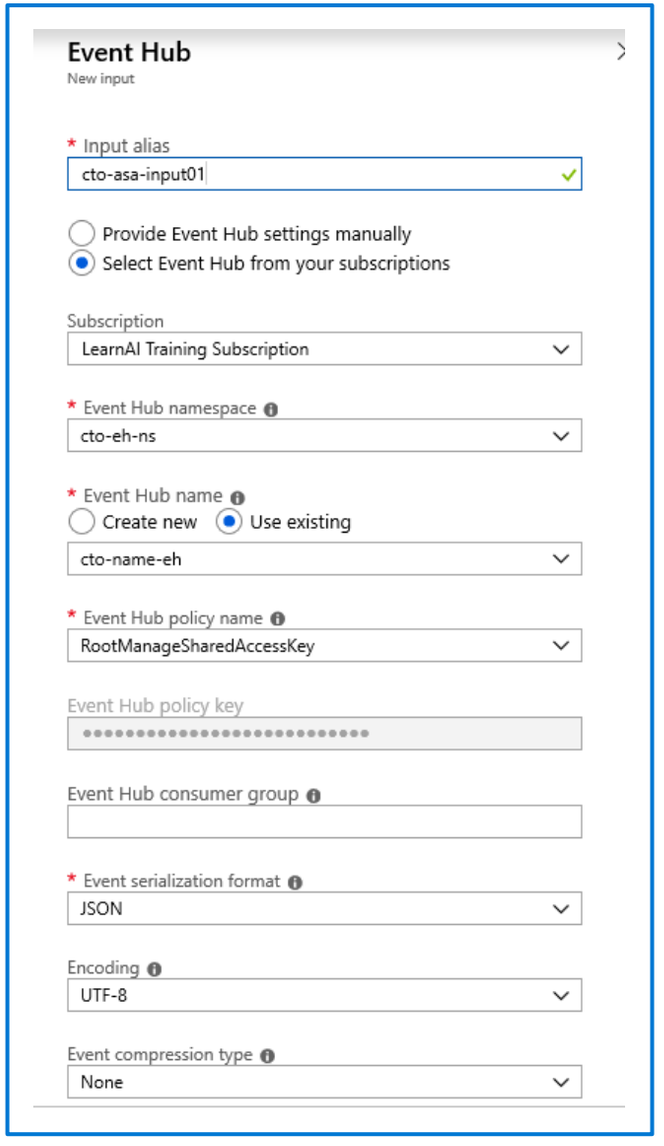


Create Stream Analytics service

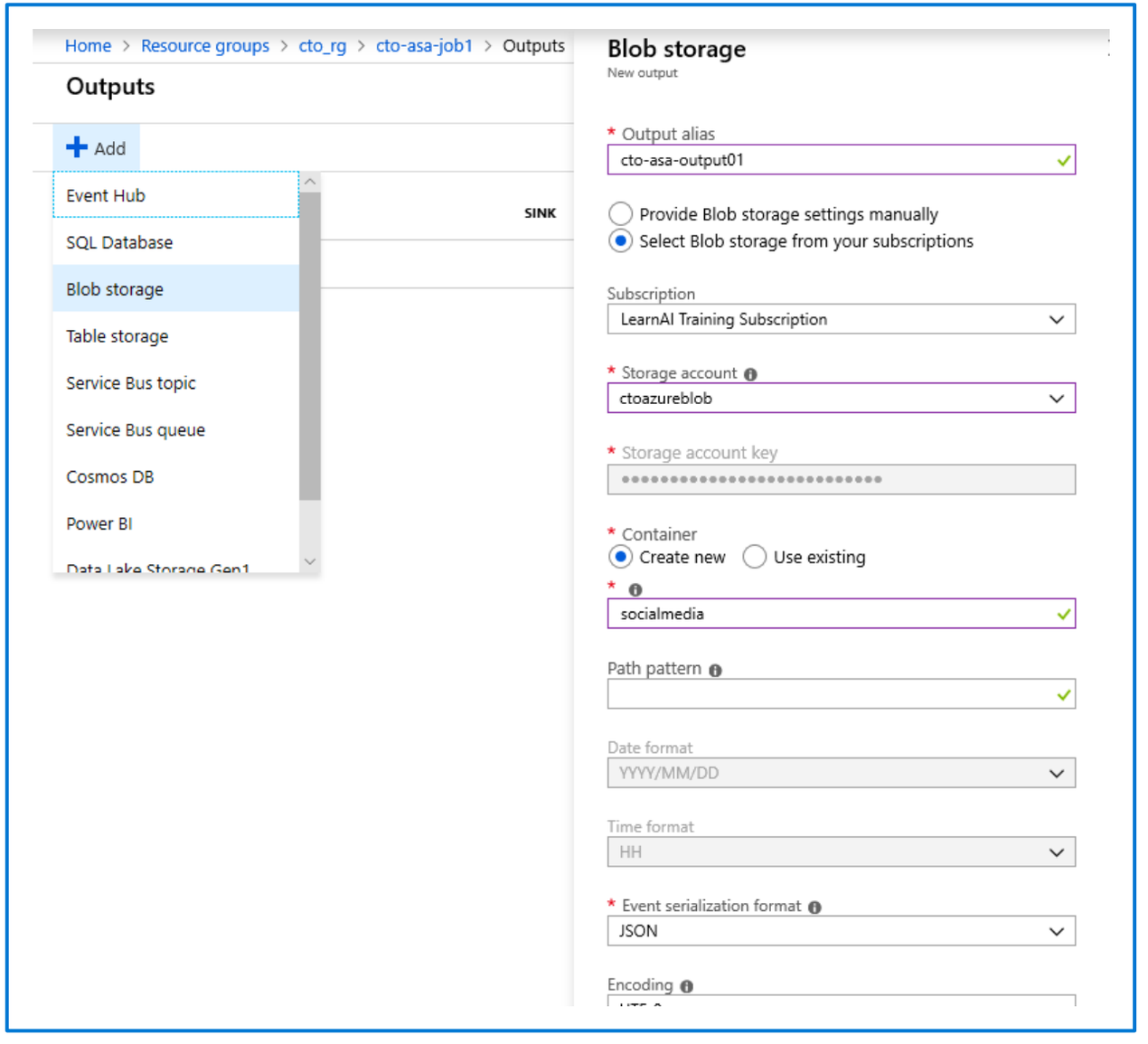
Job name	Subscription	Resource group	Location



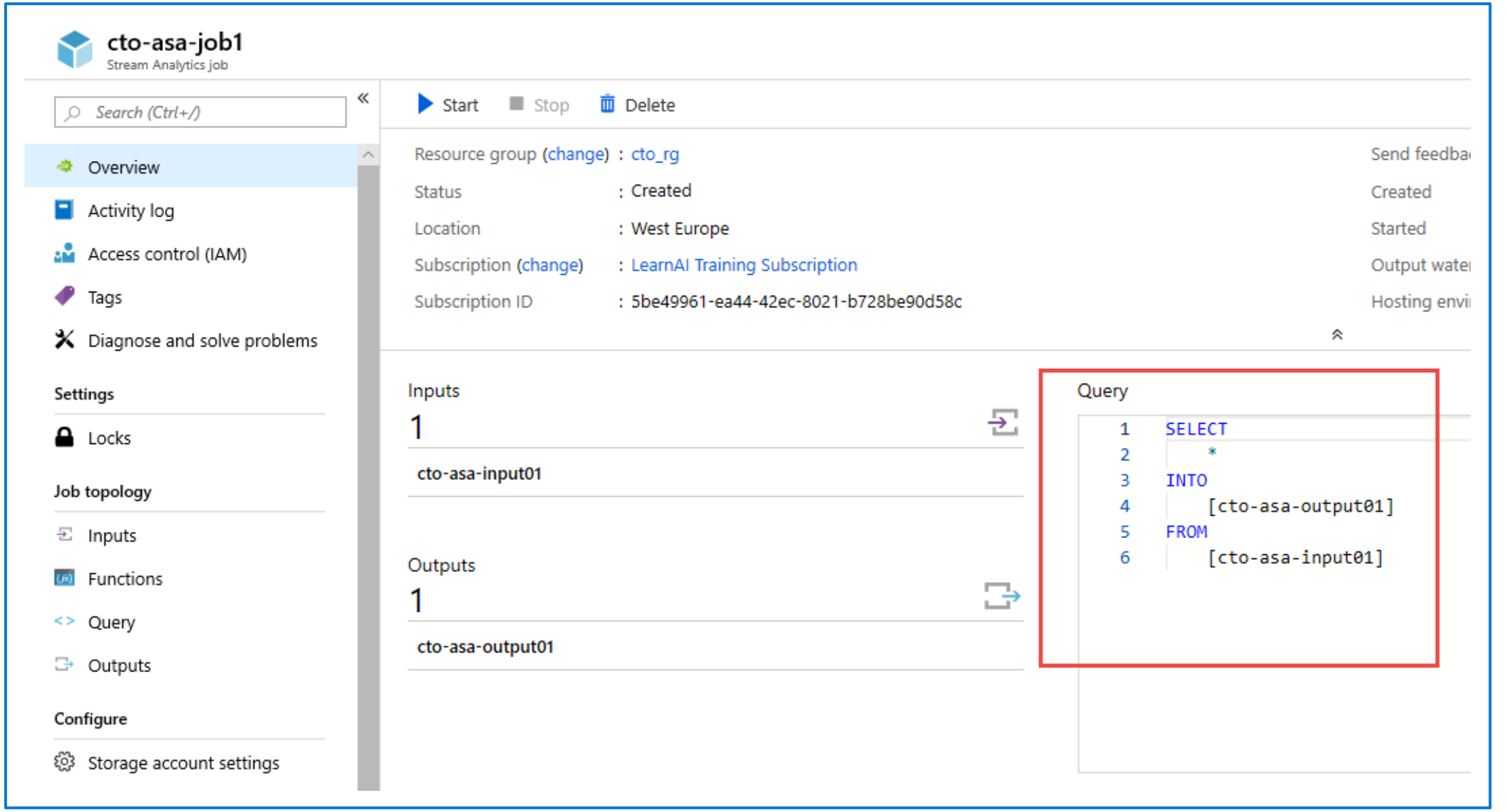
Create a Stream Analytics Job input



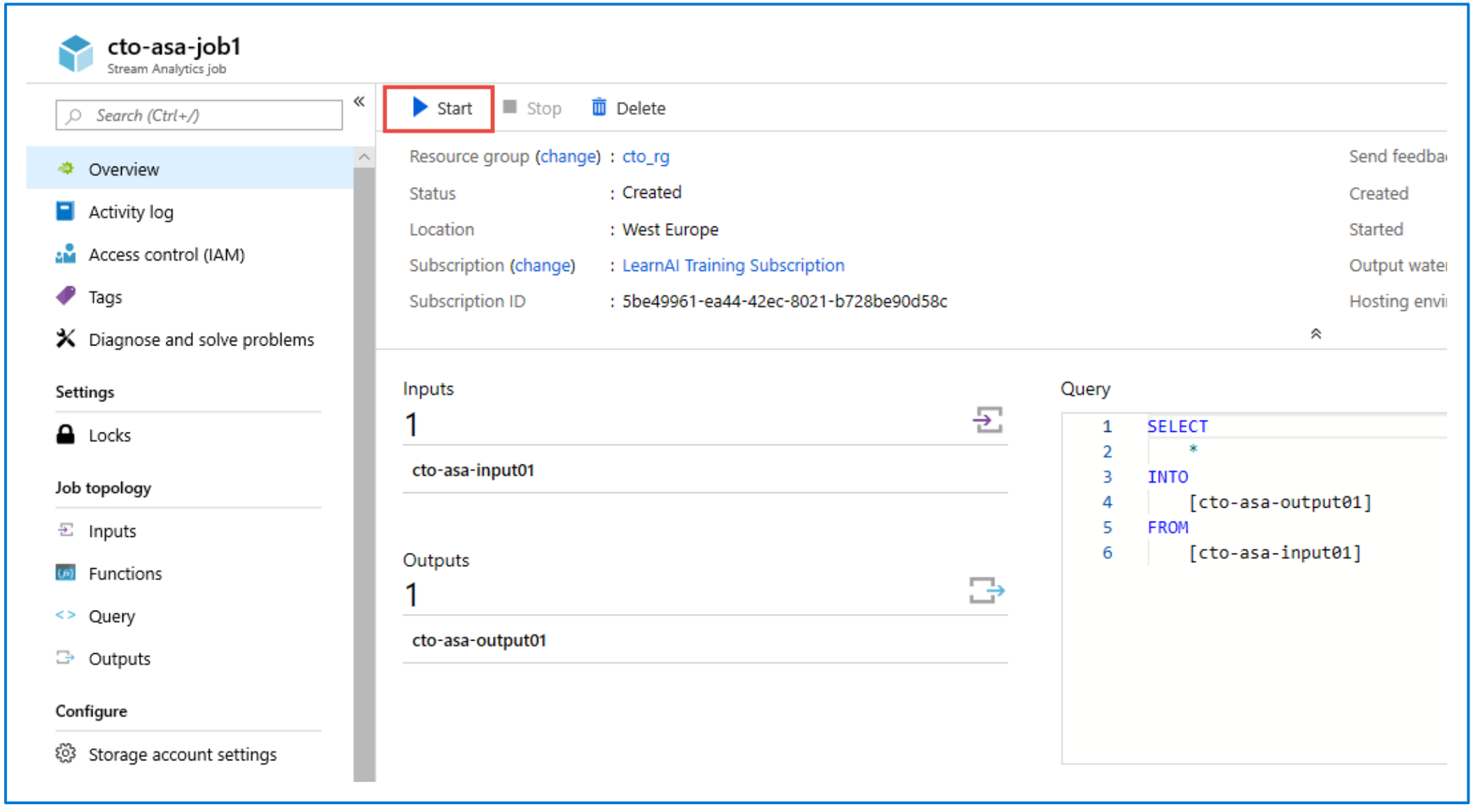
Create a Stream Analytics Job output



Write a transformation query



Start a Stream Analytics Job



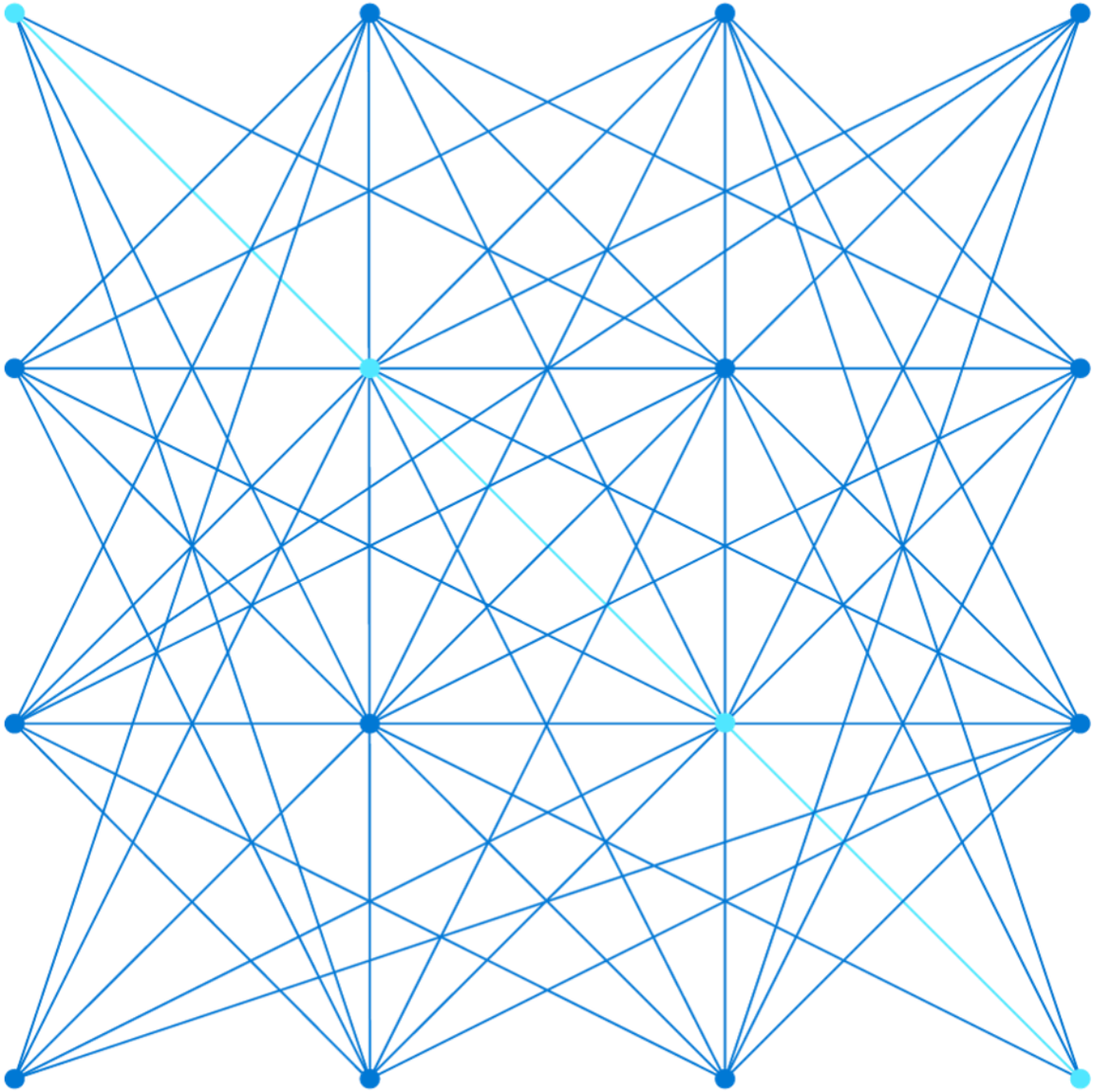
Lab: Performing real-time analytics with Stream Analytics

Microsoft Azure

Microsoft Azure

Module 07: Orchestrating data movement with Azure Data Factory

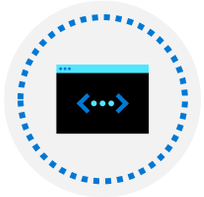
Start : 09.15



Agenda

Lesson 01 – Introduction to Azure Data Factory

Lesson 02 – Understand Azure Data Factory components

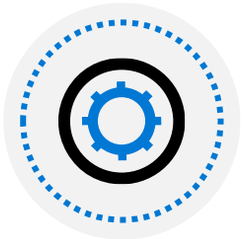


Lesson 03 – Integrate Azure Data Factory with Databricks

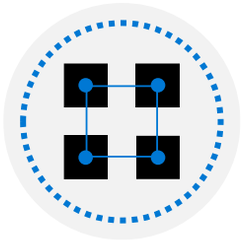
Lesson 01: Introduction to Azure Data Factory

Lesson objectives

What is Azure Data Factory



The Data Factory process



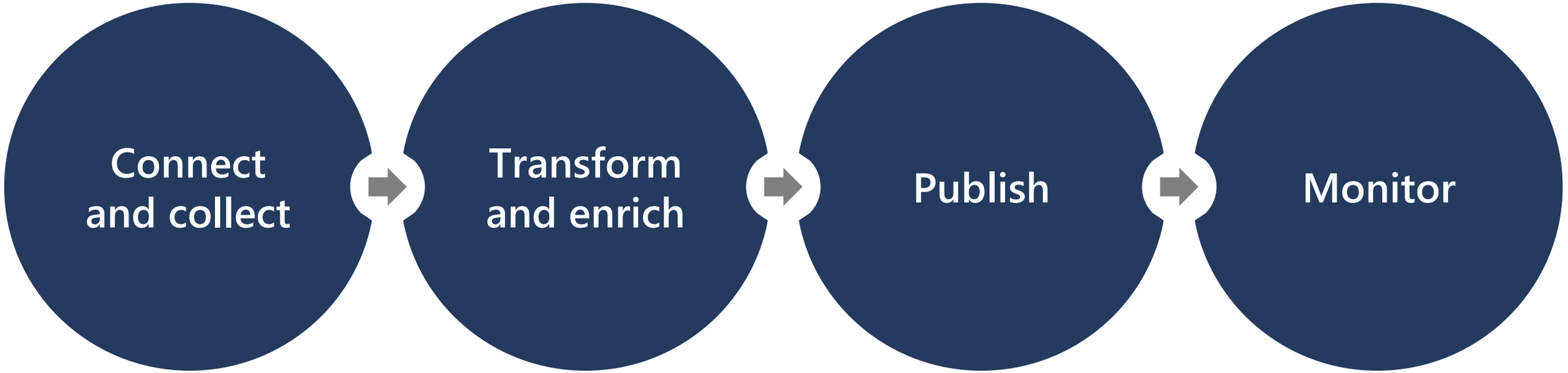
Azure Data Factory components

Azure Data Factory security

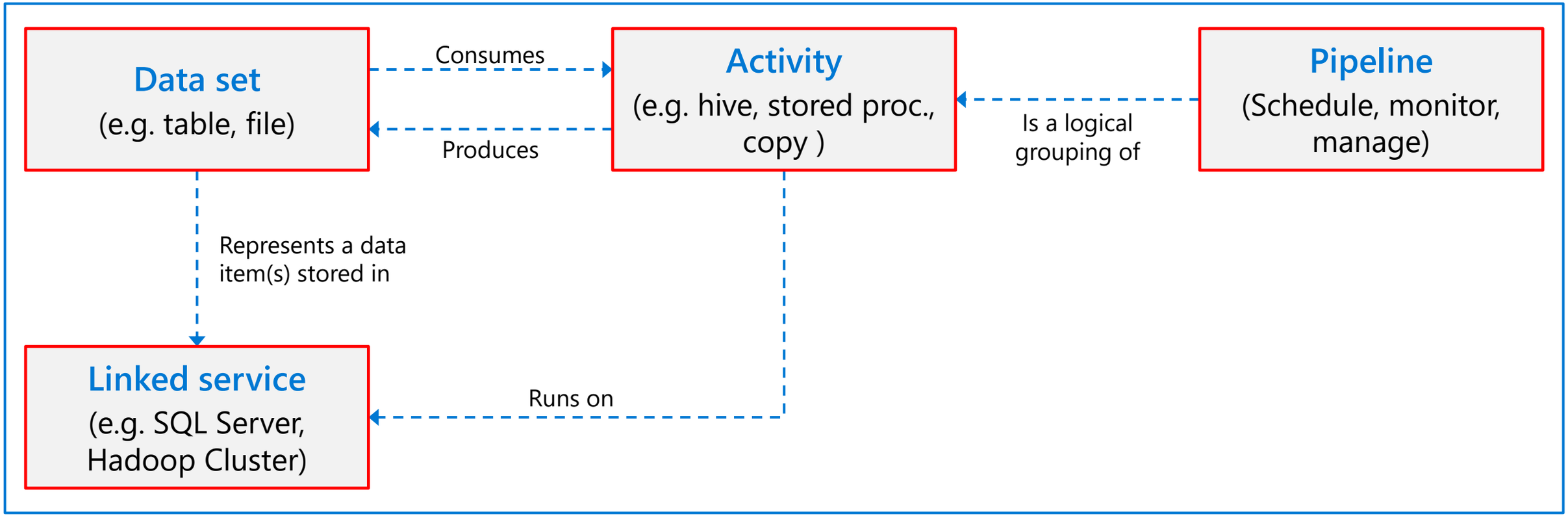
What is Azure Data Factory

Creates, orchestrates, and automates the movement, transformation and/or analysis of data through in the cloud

The Data Factory process



Azure Data Factory components



Control flow | Parameters | Integration runtime

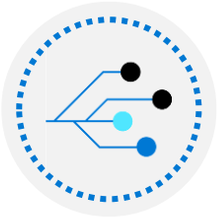
Azure Data Factory security

Data factory contributor role

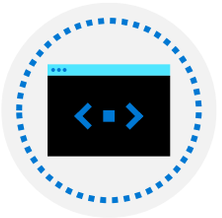
1. Create, edit, and delete data factories and child resources including datasets, linked services, pipelines, triggers, and integration runtimes
2. Deploy Resource Manager templates. Resource Manager deployment is the deployment method used by Data Factory in the Azure portal
3. Manage App Insights alerts for a data factory
4. At the resource group level or above, lets users deploy Resource Manager template
5. Create support tickets

Lesson 02: Azure Data Factory components

Lesson objectives

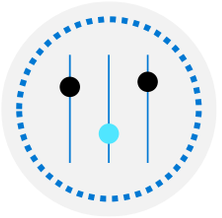


Linked services

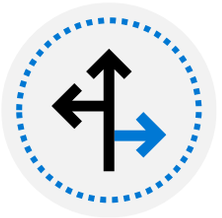


Datasets

Data Factory activities

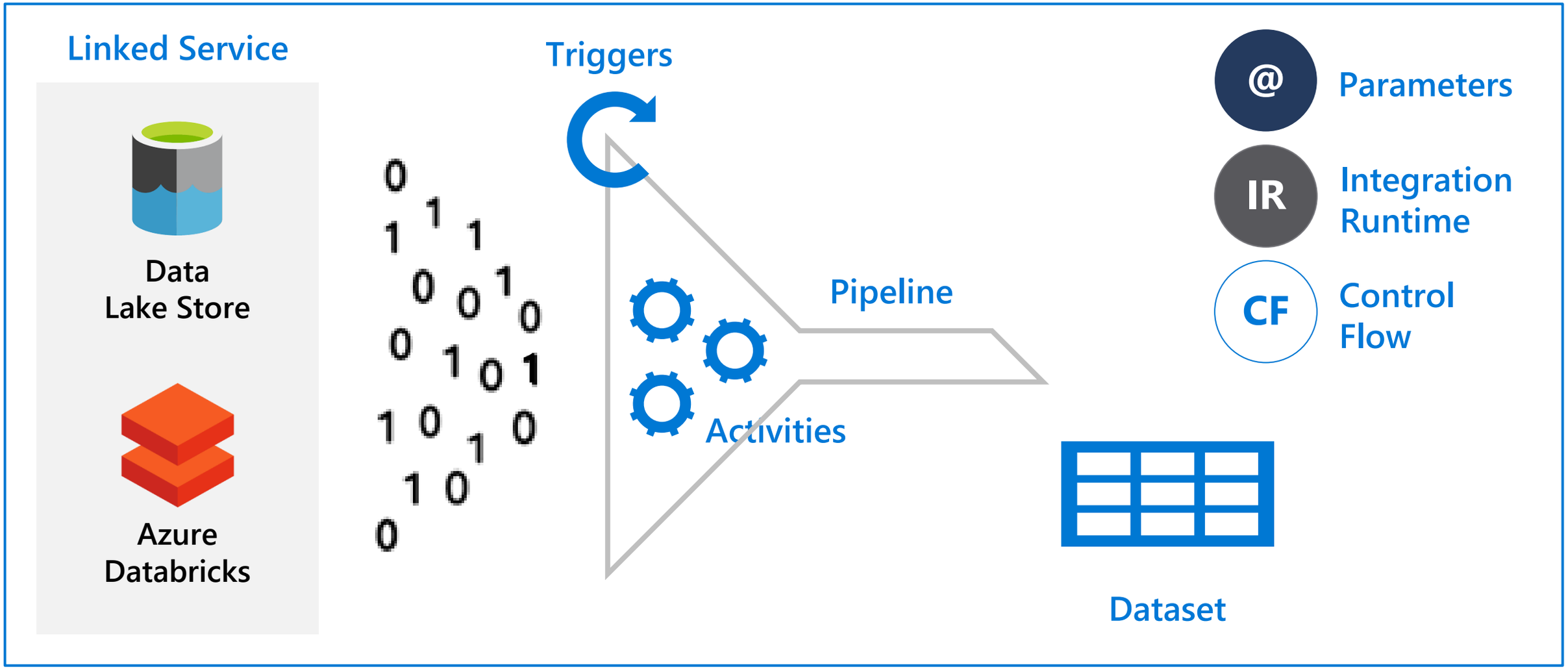


Pipelines



Pipeline example

Azure Data Factory components



Data factory activities

Activities within Azure Data Factory defines the actions that will be performed on the data and there are three categories including:

Data movement activities	Data movement activities simply move data from one data store to another. A common example of this is in using the Copy Activity
Data transformation activities	Data transformation activities use compute resource to change or enhance data through transformation, or it can call a compute resource to perform an analysis of the data
Control Activities	Control flow orchestrate pipeline activities that includes chaining activities in a sequence, branching, defining parameters at the pipeline level, and passing arguments while invoking the pipeline on-demand or from a trigger

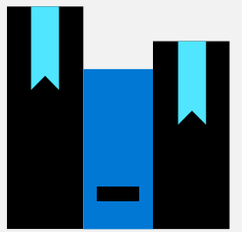
Pipelines

Pipeline is a grouping of logically related activities

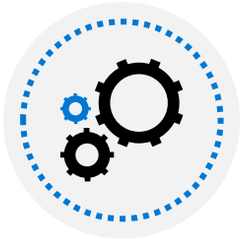
Pipeline can be scheduled so the activities within it get executed

Pipeline can be managed and monitored

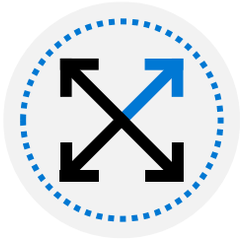
Lesson 03: Ingesting and transforming data



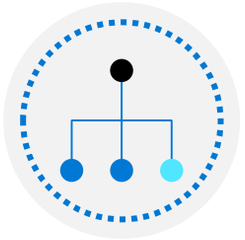
Lesson objectives



How to setup Azure Data Factory

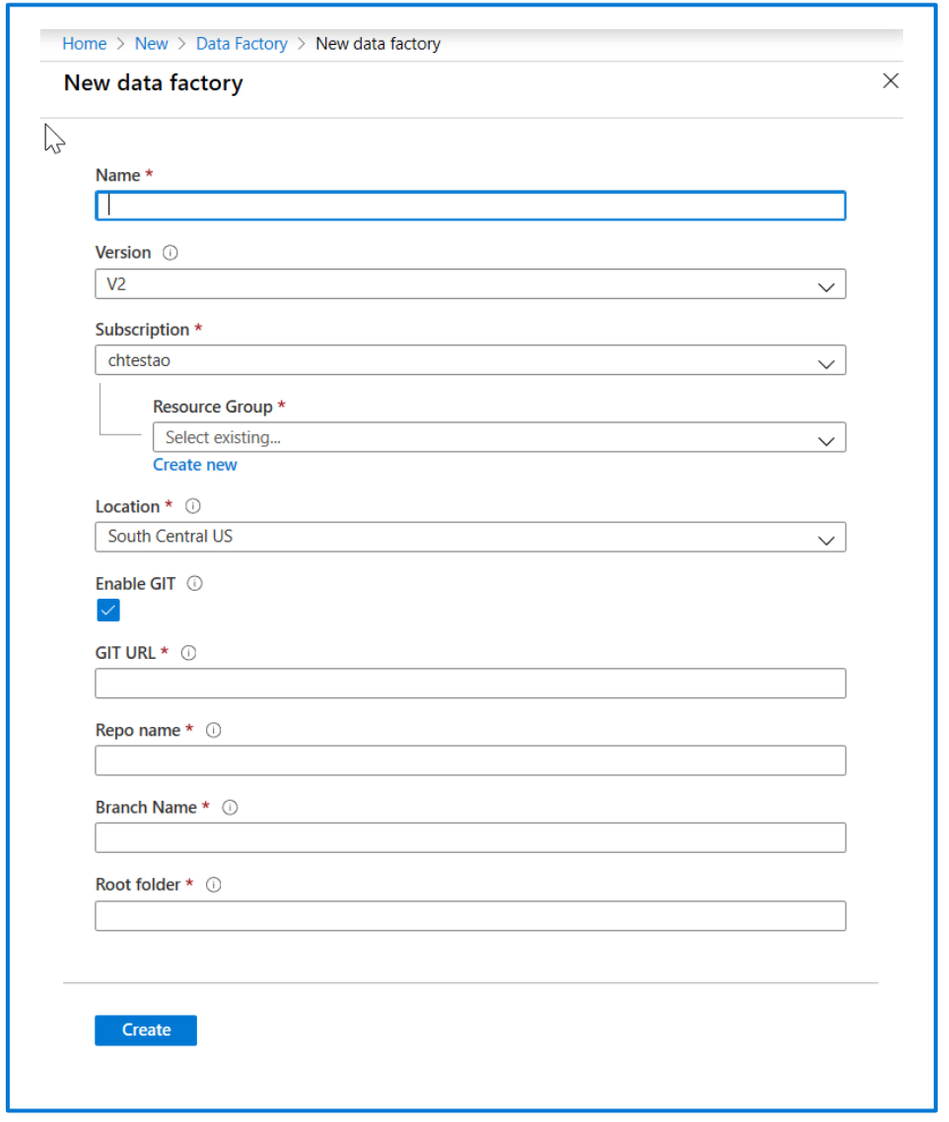


Ingest data using the Copy Activity

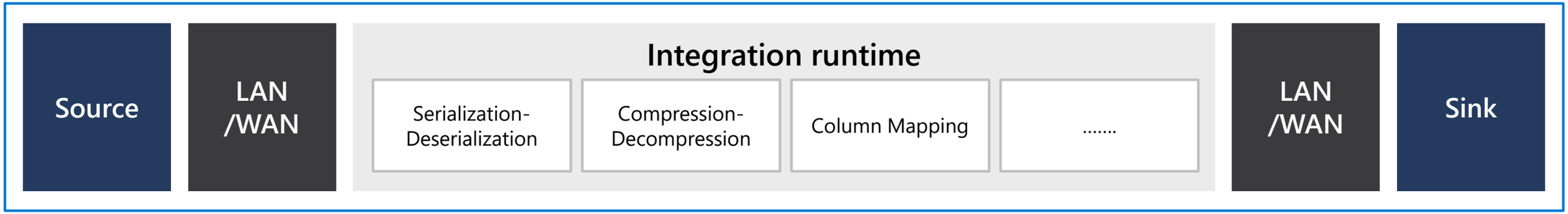


Transforming data with the Mapping Data Flow

Create Azure Data Factory



Ingesting data with the copy activity



Reads data from a source data store

Performs serialization/deserialization, compression/decompression, column mapping, and so on. It performs these operations based on the configuration of the input dataset, output dataset, and Copy activity

Writes data to the sink/destination data store

Transforming data with the Mapping Data Flow

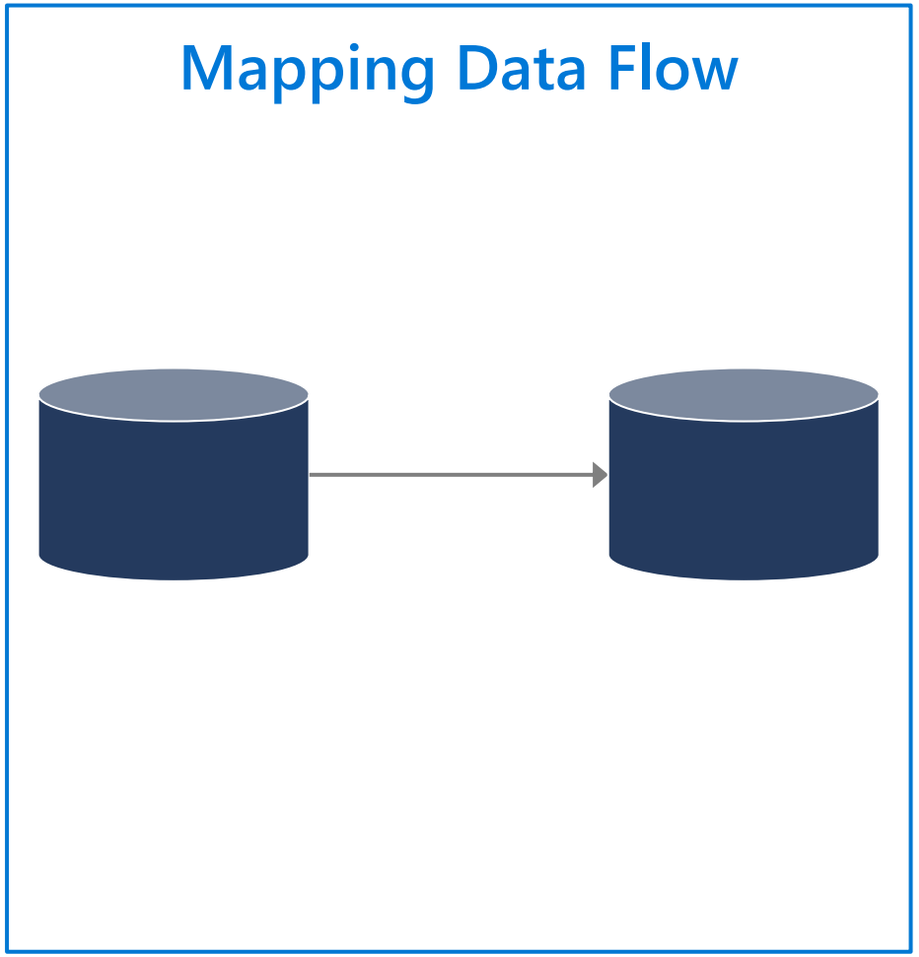
Code free data transformation at scale

Perform data cleansing, transformation, aggregations, etc.

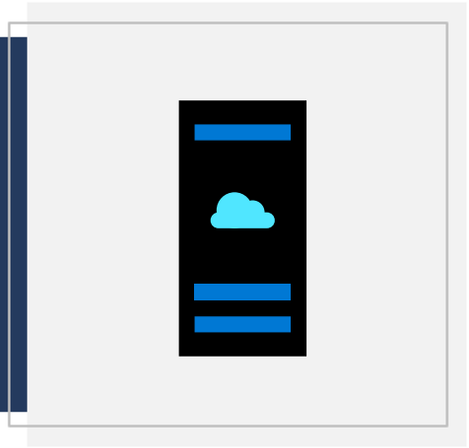
Enables you to build resilient data flows in a code free environment

Enable you to focus on building business logic and data transformation

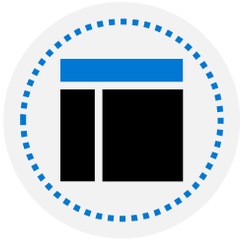
Underlying infrastructure is provisioned automatically with cloud scale via Spark execution



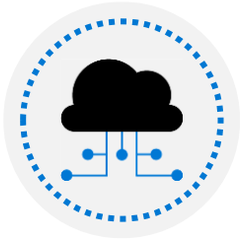
Lesson 04: Integrate Azure Data Factory with Azure Databricks



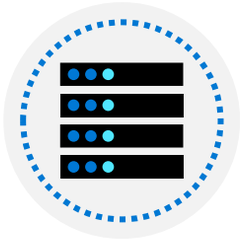
Lesson objectives



Use Azure Data Factory (ADF) to ingest data and create an ADF pipeline



Create Azure Storage account and the Azure Data Factory instance



Use ADF to orchestrate data transformations using a Databricks Notebook activity

Working with documents programmatically

1. Create Storage Account

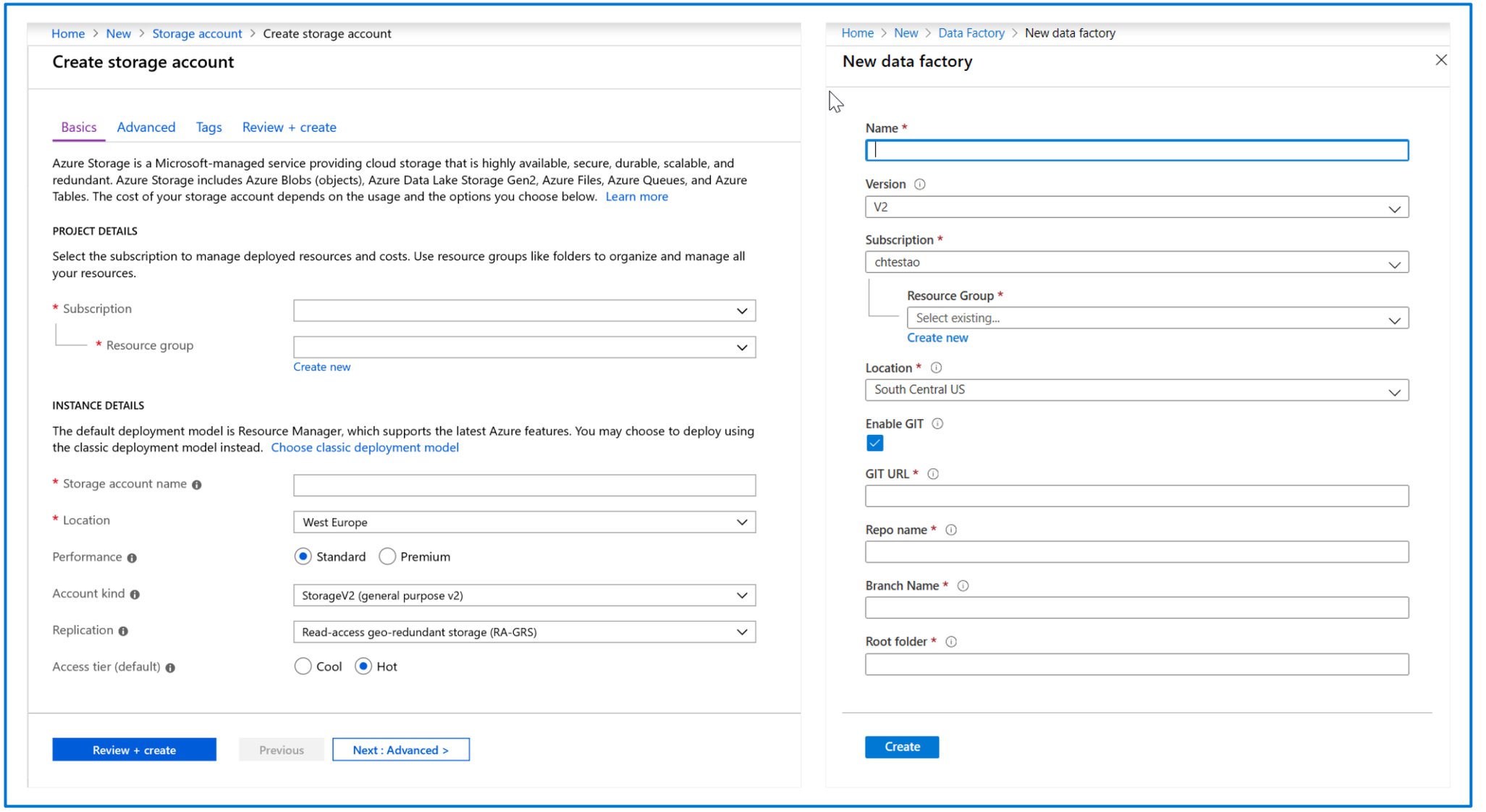
2. Create Azure Data Factory

3. Create data workflow pipeline

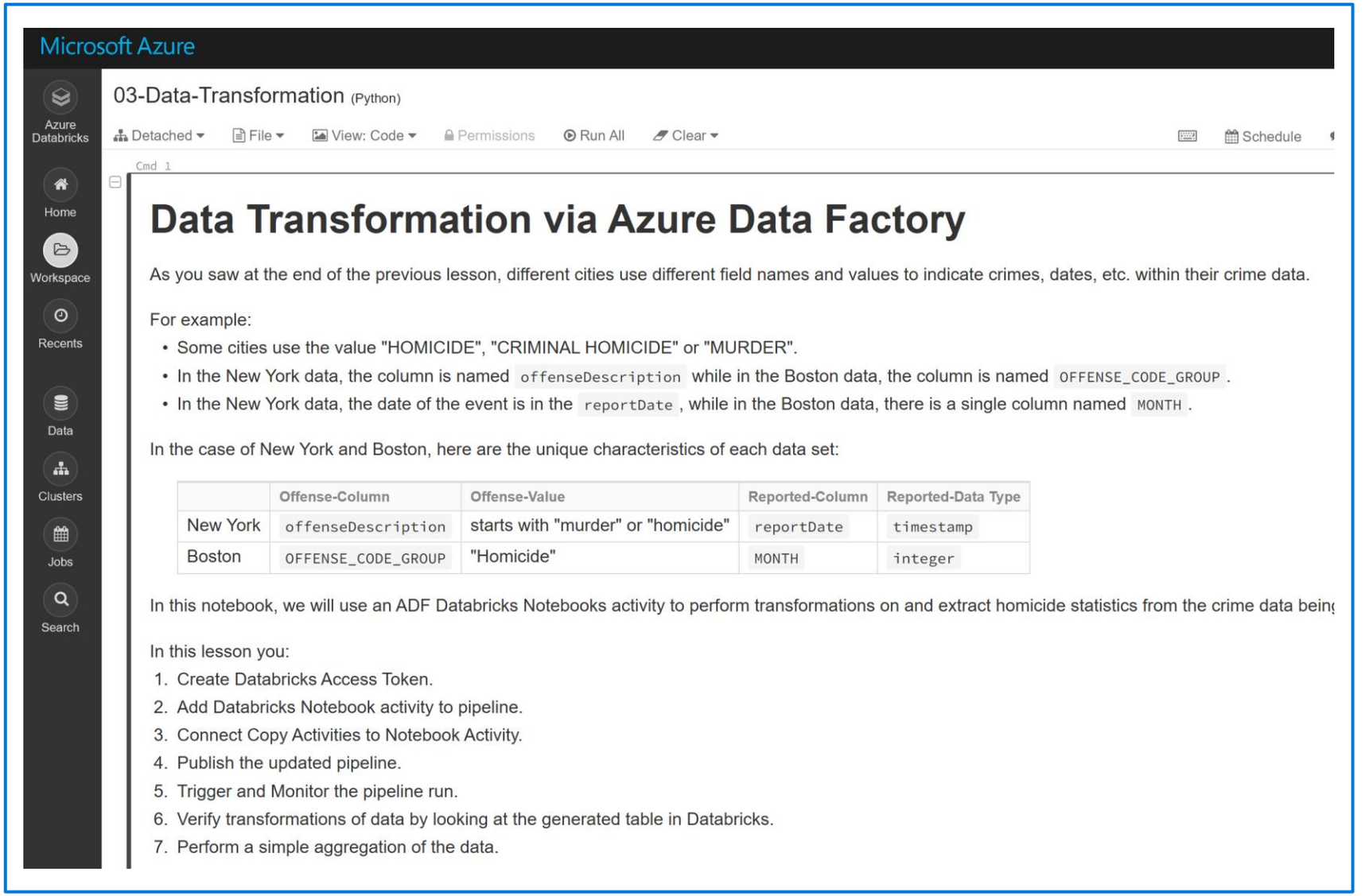
4. Add Databricks Workbook to pipeline

5. Perform analysis on the data

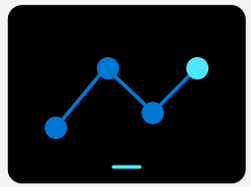
Create Azure Storage account and the Azure Data Factory instance



Use ADF to orchestrate data transformations using a Databricks Notebook activity



Lab: Orchestrating data movement with Azure Data Factory



Microsoft Azure

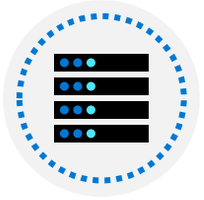
Microsoft Azure

Module 08: Securing Azure Data Platforms

Agenda

Lesson 01 – An introduction to security

Lesson 02 – Key security components



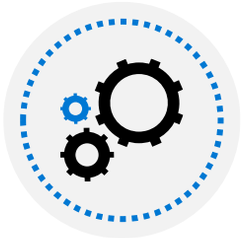
Lesson 03 – Securing storage accounts and Data Lake Storage

Lesson 04 – Securing data stores

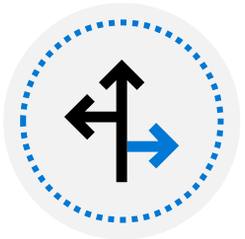
Lesson 05 – Securing streaming data

Lesson 01: An Introduction to security

Lesson objectives

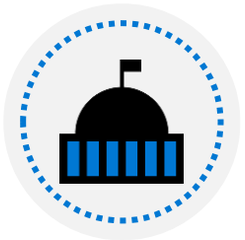


Shared security responsibility



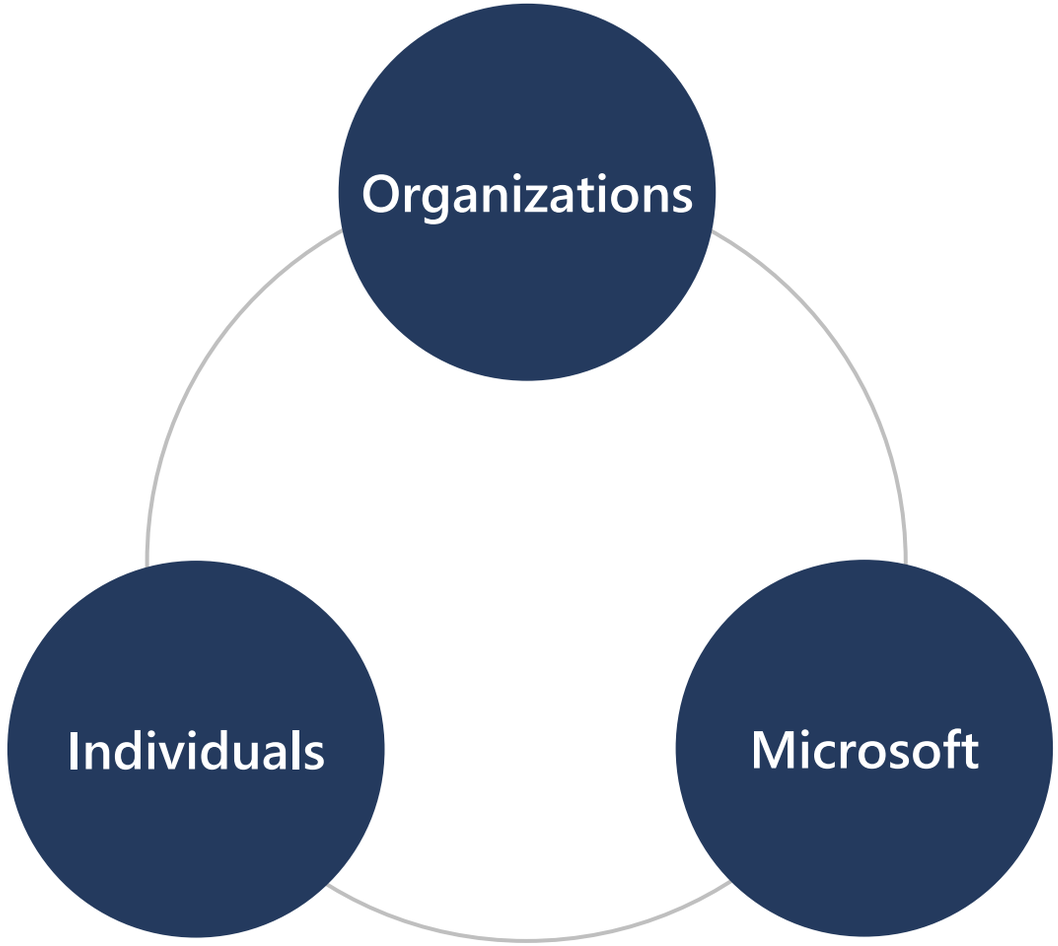
A layered approach to security

The Azure security center

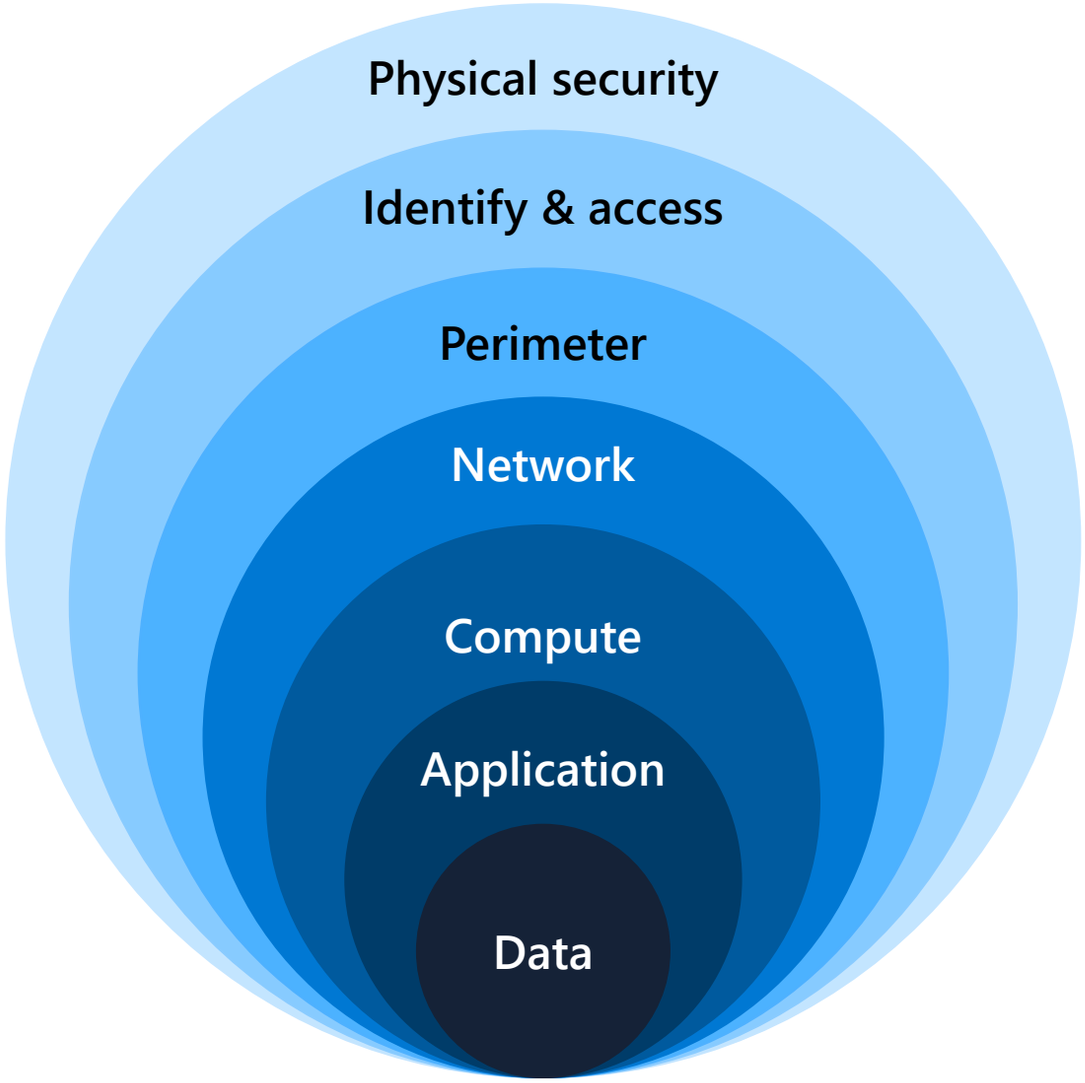


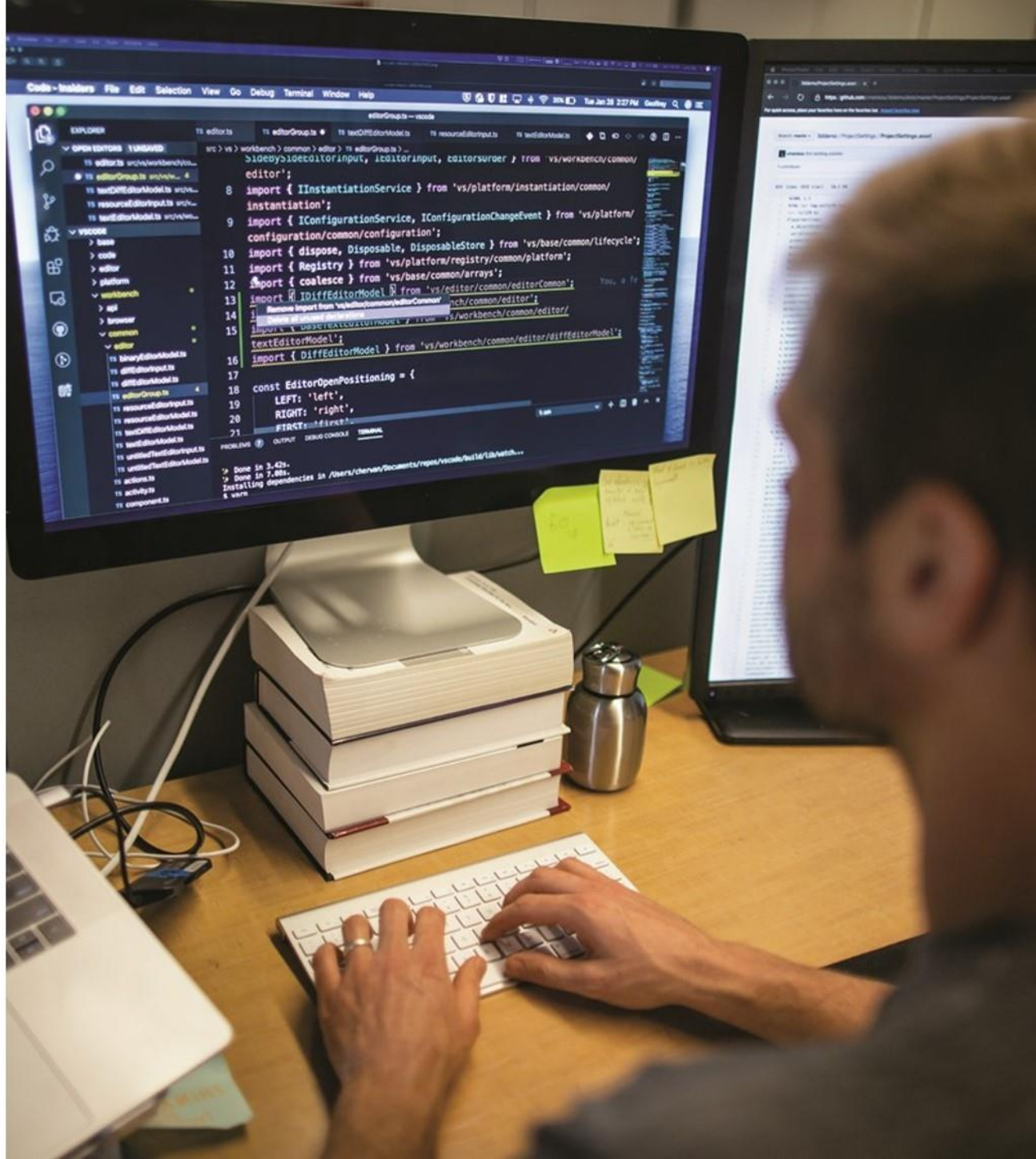
Azure Government

Shared security responsibility



A layered approach to security





Azure security center

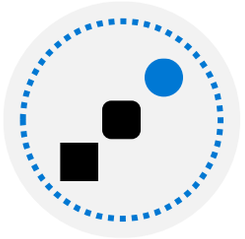
Use for incident response:

You can use Security Center during the detection, assessment, and diagnosis of security at various stages

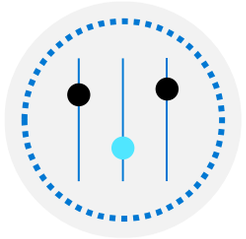
Use to enhance security:

Reduce the chances of a significant security event by configuring a security policy, and then implementing the recommendations provided by Azure Security Center

Azure Government

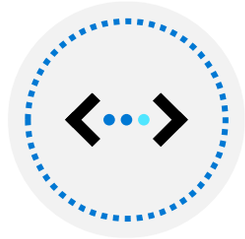


Modernize Government services



Provide a platform of agility

Advanced Government mission



Physically separate from Azure

Lesson 02: Key security components

Lesson objectives

Network security

Identity and access management

Encryption capabilities built into Azure

Azure threat protection

Network security

Securing your network from attacks and unauthorized access is an important part of any architecture

Internet protection	Firewalls	DDoS protection	Network security groups
Assess the resources that are internet-facing, and to only allow inbound and outbound communication where necessary. Make sure you identify all resources that are allowing inbound network traffic of any type	To provide inbound protection at the perimeter, there are several choices: • Azure Firewall • Azure Application Gateway • Azure Storage Firewall	The Azure DDoS Protection service protects your Azure applications by scrubbing traffic at the Azure network edge before it can impact your service's availability	Network Security Groups allow you to filter network traffic to and from Azure resources in an Azure virtual network. An NSG can contain multiple inbound and outbound security rules

Identity and access

Authentication

This is the process of establishing the identity of a person or service looking to access a resource. Azure Active Directory is a cloud-based identity service that provide this capability

Authorization

This is the process of establishing what level of access an authenticated person or service has. It specifies what data they're allowed to access and what they can do with it. Azure Active Directory also provides this capability

Azure Active Directory features

Single sign-on

Enables users to remember only one ID and one password to access multiple applications

Apps & device management

You can manage your cloud and on-premises apps and devices and the access to your organizations resources

Identity services

Manage Business to business (B2B) identity services and Business-to-Customer (B2C) identity services

Encryption

Encryption at rest

Data at rest is the data that has been stored on a physical medium. This could be data stored on the disk of a server, data stored in a database, or data stored in a storage account

Encryption in transit

Data in transit is the data actively moving from one location to another, such as across the internet or through a private network. Secure transfer can be handled by several different layers

Encryption on Azure

Raw encryption

Enables the encryption of:

- Azure Storage
- V.M. Disks
- Disk Encryption

Database encryption

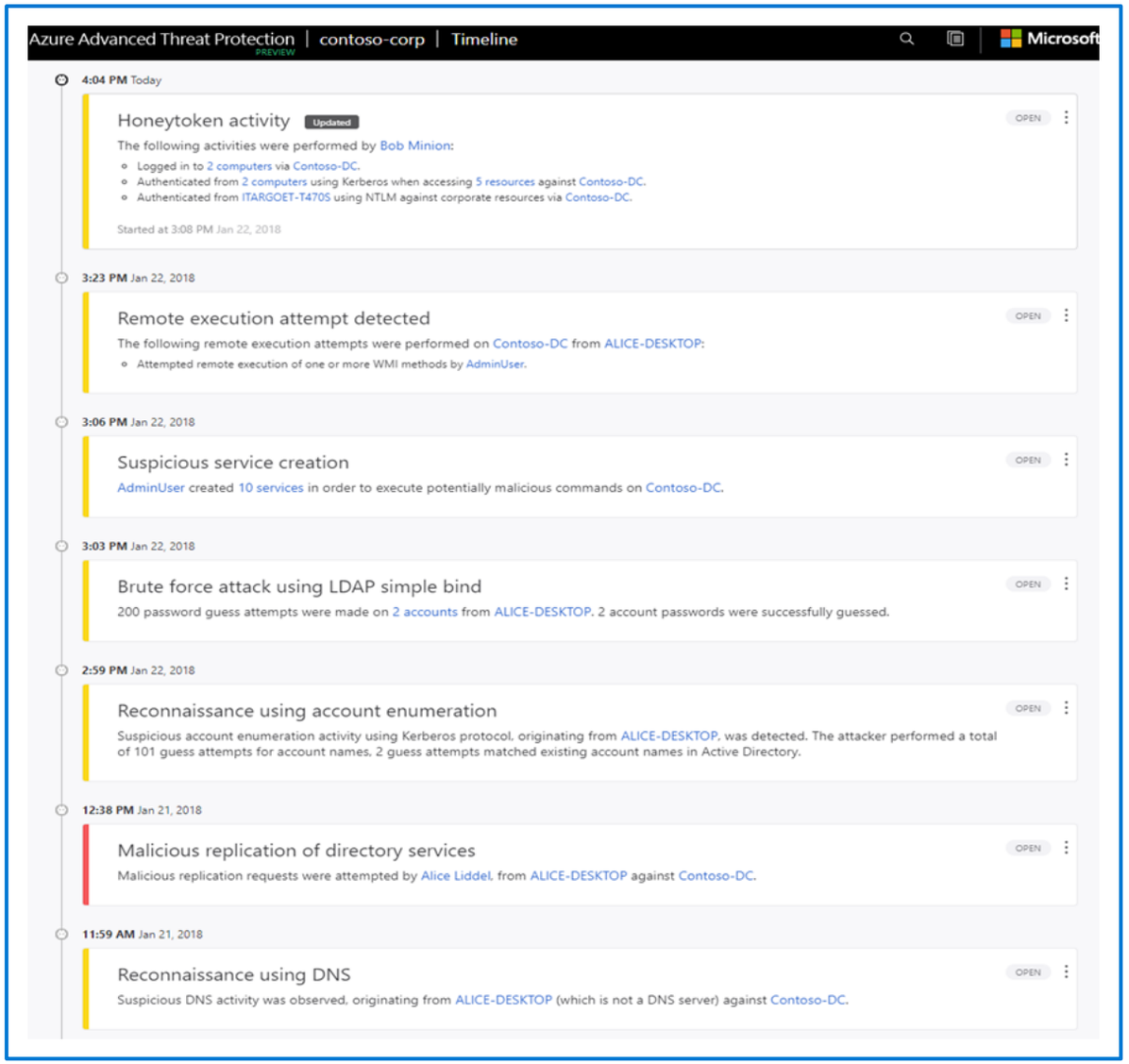
Enables the encryption of databases using:

- Transparent Data Encryption

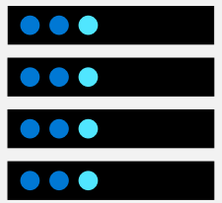
Encrypting secrets

Azure Key Vault is a centralized cloud service for storing your application secrets

Azure threat protection



Lesson 03: Securing storage accounts and Data Lake Storage



Lesson objectives

Storage account security features

Explore the authentication options available to access data: Storage account key | Shared access signature

Control network access to the data

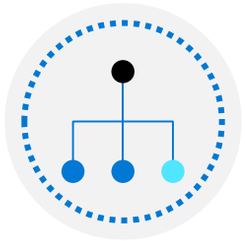
Managing encryption

Azure Data Lake Storage Gen II security features

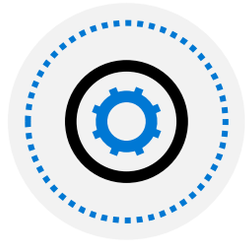
Storage account security features

Encryption at rest

Encryption in transit

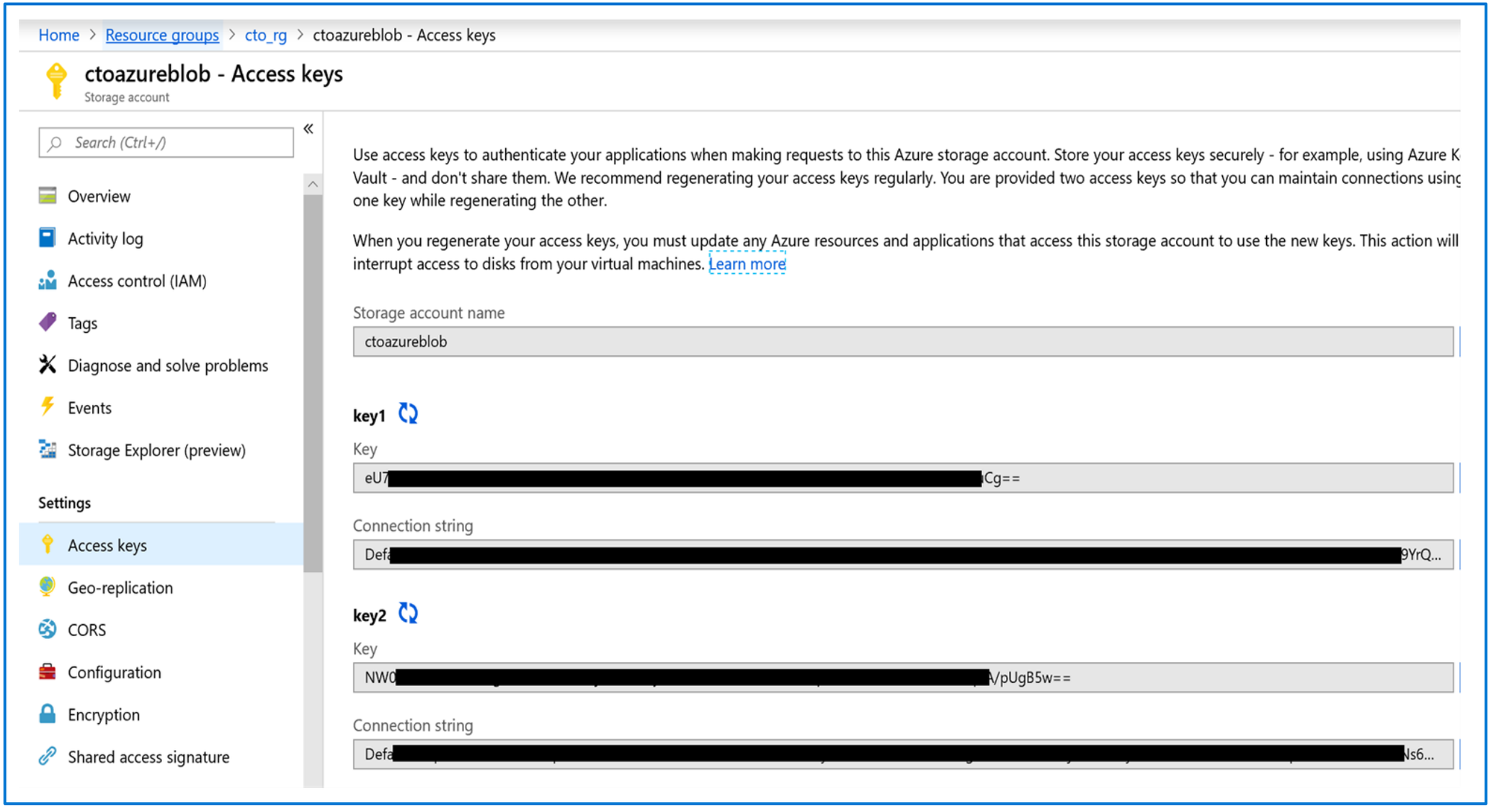


Role based access control

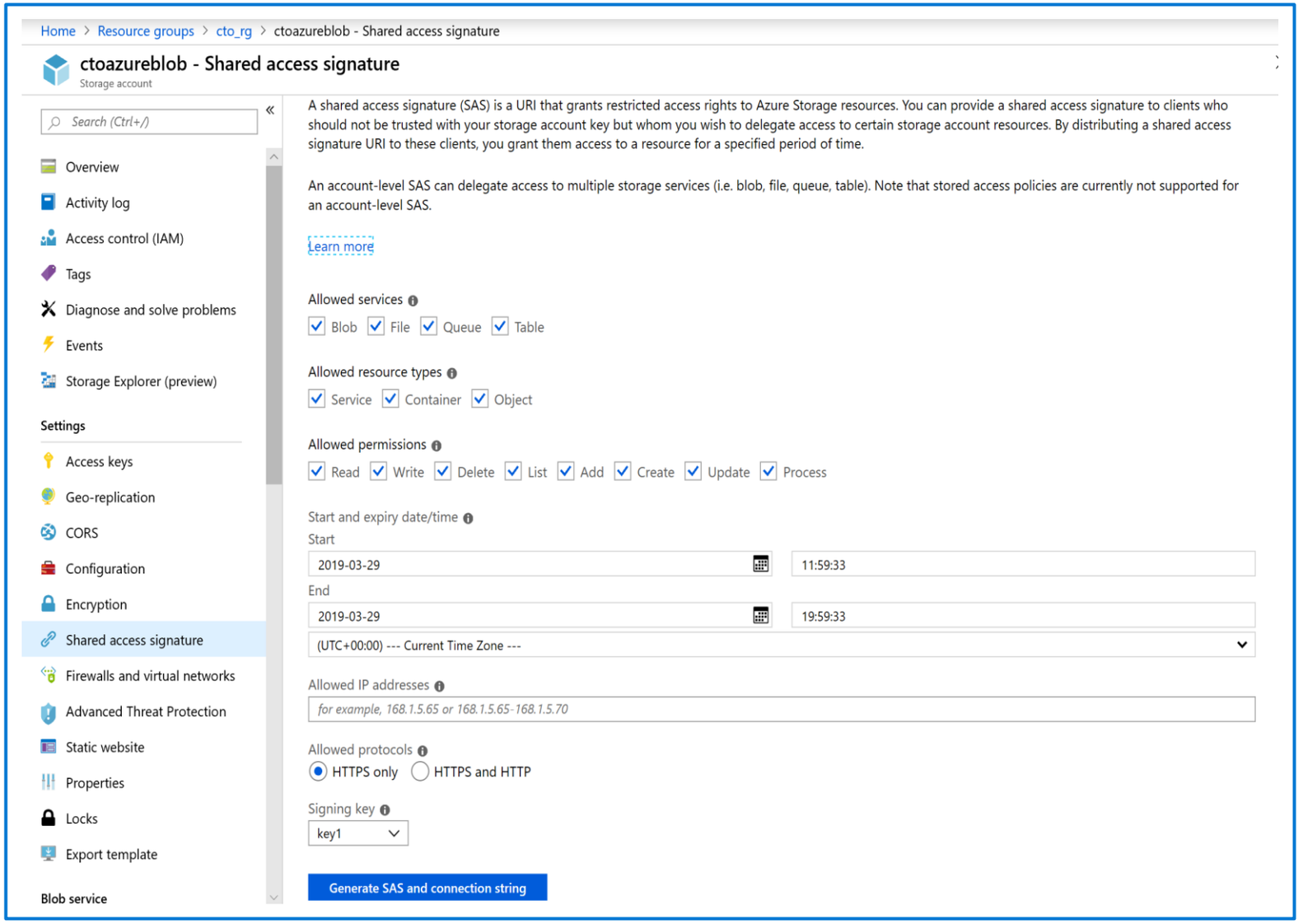


Auditing access

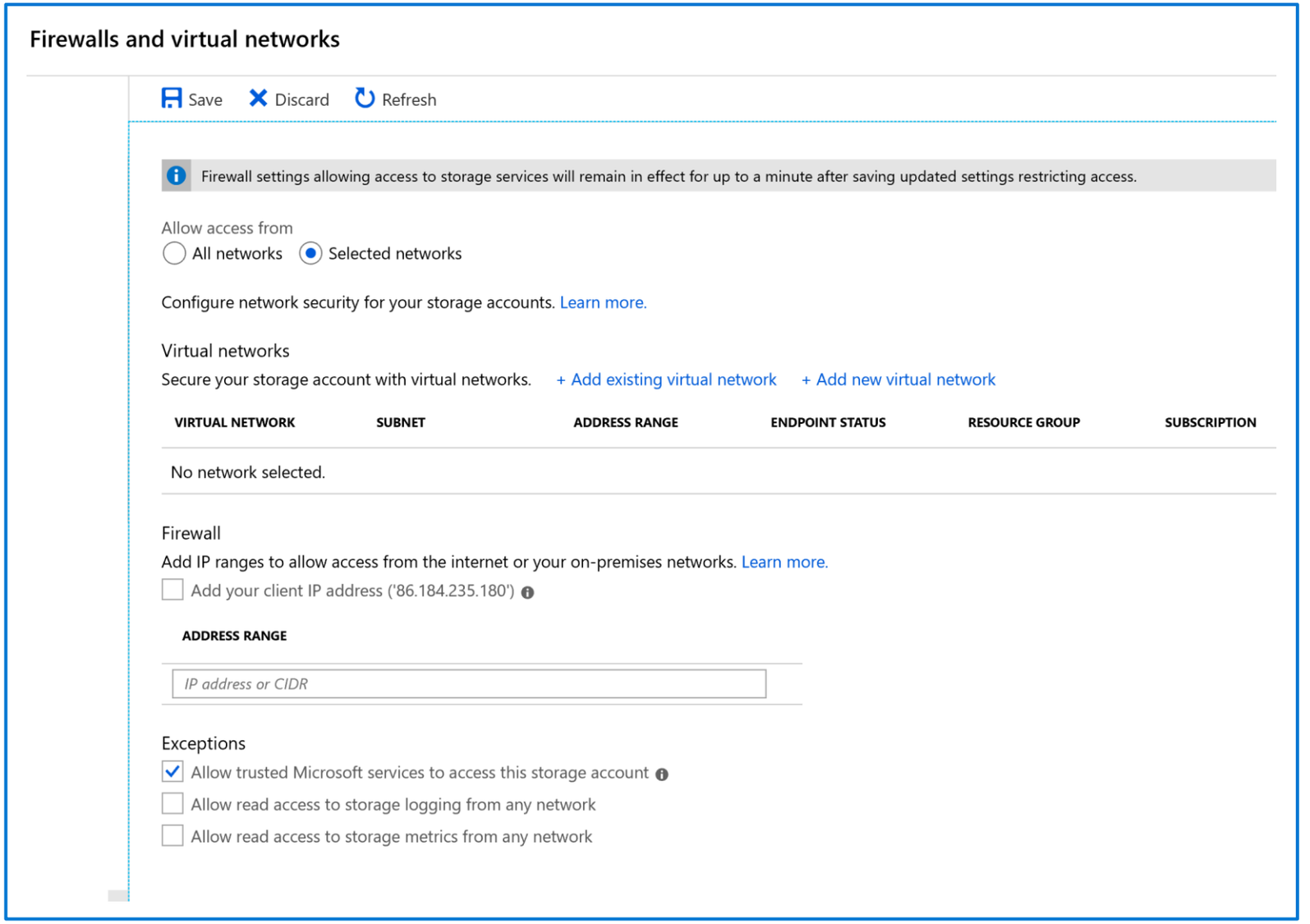
Storage account keys



Shared access signatures



Control network access to data

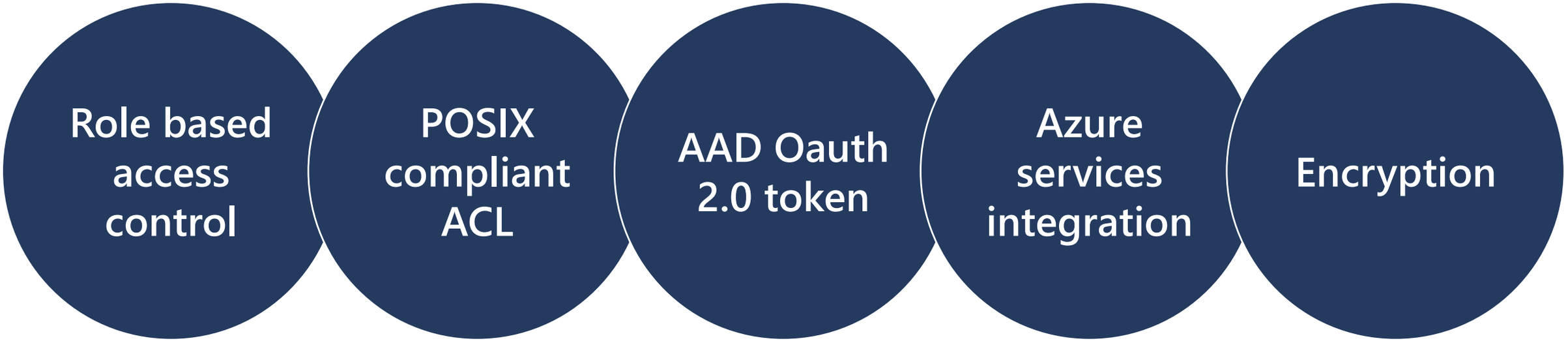


Managing encryption

Databases stores information that is sensitive, such as physical addresses, email addresses, and phone numbers. The following can be used to protect this data

Transport Layer Security (TLS)	Azure SQL Database and Data Warehouse enforces Transport Layer Security (TLS) encryption at all times for all connections, which ensures all data is encrypted “in transit” between the database and the client
Transparent data encryption	Both Azure Data Warehouse and SQL Database protects your data at rest using transparent data encryption (TDE). TDE performs real-time encryption and decryption of the database, associated backups, and transaction log files at rest without requiring changes to the application
Application encryption	Data in transit is a method to prevent man-in-the-middle attacks. To encrypt data in transit, specify **Encrypt=true** in the connection string in your client applications

Azure Data Lake Storage Gen2 security features



Lesson 04: Securing data stores

Lesson objectives

Control network access to your data stores using firewall rules

Control user access to your data stores using authentication and authorization

Dynamic data masking

Audit and monitor your Azure SQL Database for access violations

Control network access to your data stores using firewall rules

There are a number of ways you can control access to your Azure SQL Database or Data Warehouse over the network

Server-level firewall rules	Database level firewall rules
These rules enable clients to access your **entire Azure SQL server,** that is, all the databases within the same logical server	These rules allow access to an individual database on a logical server and are stored in the database itself. For database-level rules, only **IP address rules** can be configured

Control user access to your data stores using authentication and authorization

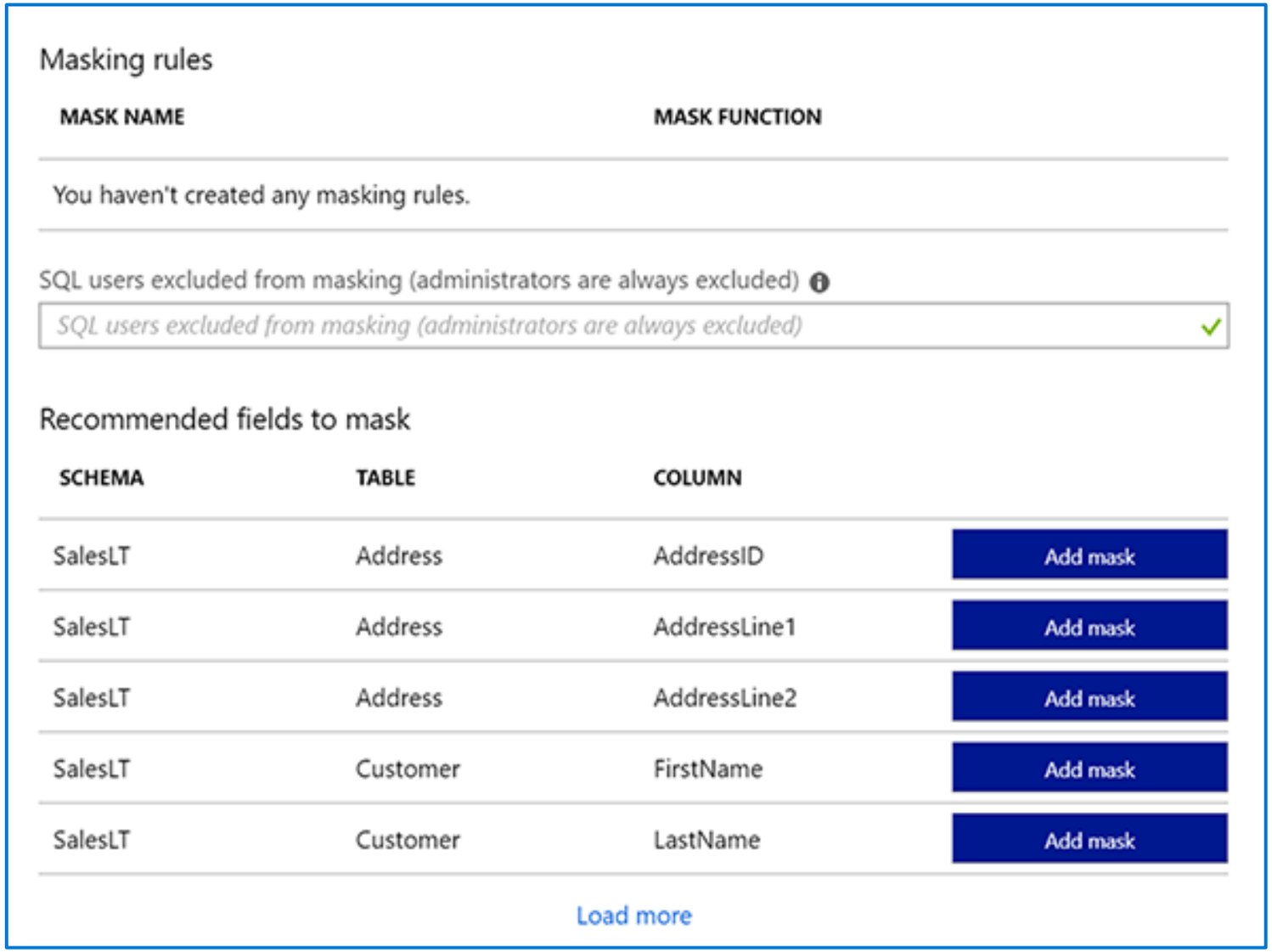
Authentication

SQL Database and Azure Synapse Analytics supports two types of authentication: SQL authentication and Azure Active Directory authentication

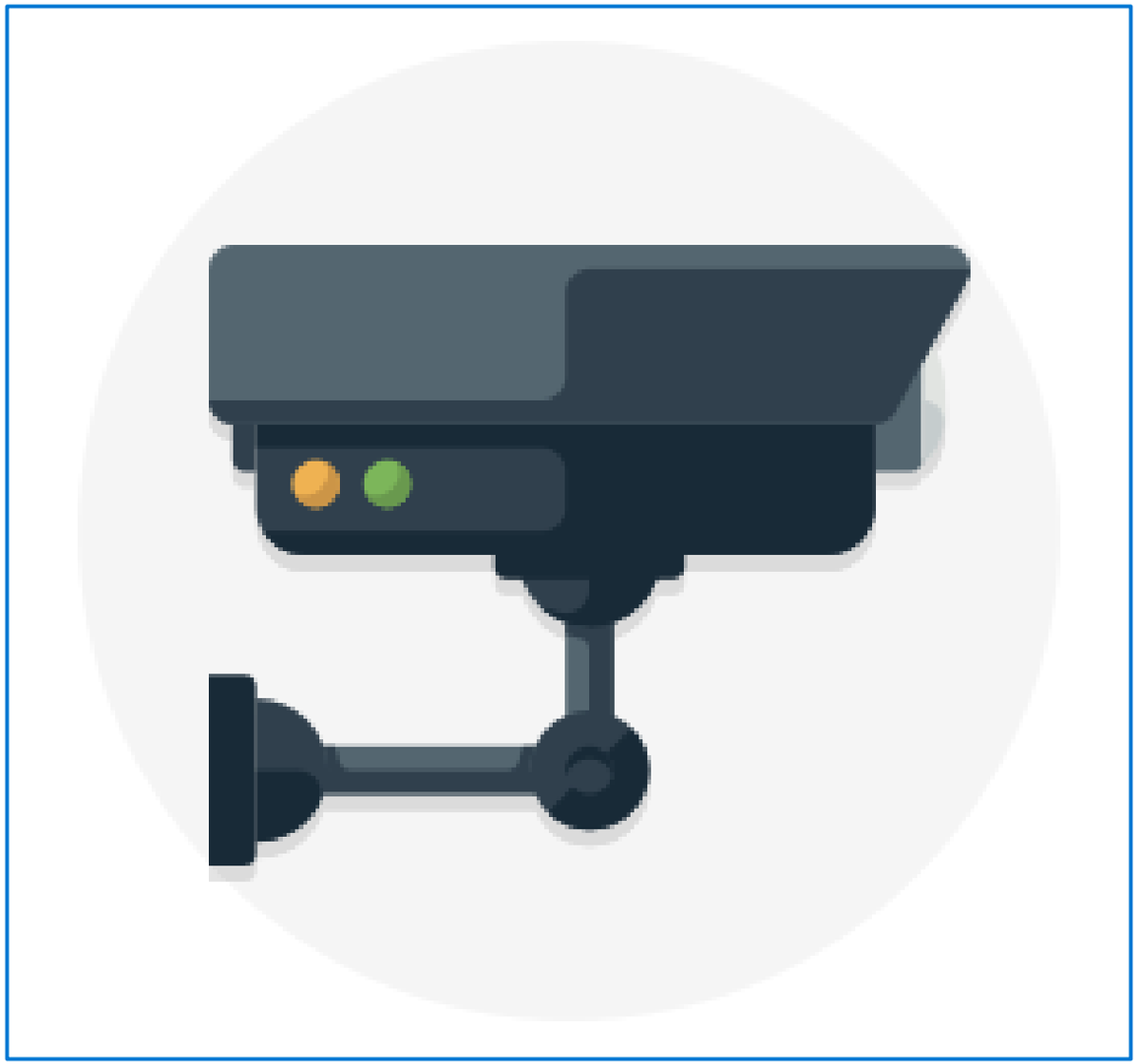
Authorization

Authorization is controlled by permissions granted directly to the user account and/or database role memberships. A database role is used to group permissions together to ease administration

Dynamic data masking



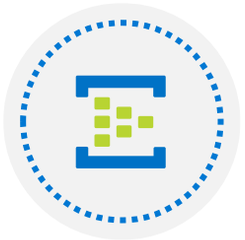
Auditing and monitoring



Lesson 05: Securing streaming data

Lesson objectives

Understand Stream Analytics security



Understand Event Hub security

Stream Analytics security

Data in transit

Azure Stream Analytics encrypts all incoming and outgoing communications and supports Transport Layer Security v 1.2

Data at rest

Stream Analytics doesn't store the incoming data since all processing is done in-memory. Therefore, consider setting security for services such as Event Hubs or Internet of Things Hubs, or for data stores such as Cosmos DB

Event Hub security

Authentication

Authentication makes use of Shared Access Signatures and Event Publishers to ensure that only applications or devices with valid credentials are only allowed to send data to an Event Hub. Each client is assigned a token

Token management

Once the tokens have been created, each client is provisioned with its own unique token. If a token is stolen by an attacker, the attacker can impersonate the client whose token has been stolen. Adding a client to a blocked recipients list renders that client unusable

Lab: Securing Azure Data Platforms

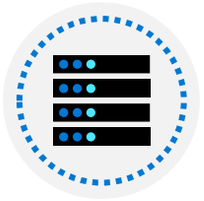
Microsoft Azure

Microsoft Azure

Module 09: Monitoring and troubleshooting data storage and processing

Agenda

Lesson 01: General Azure monitoring capabilities



Lesson 02: Troubleshoot common data storage issues

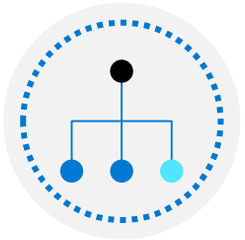
Lesson 03: Troubleshoot common data processing issues

Lesson 04: Manage disaster recovery

Lesson 01: General Azure monitoring capabilities

Lesson objectives

Azure Monitor



Monitoring the network

Diagnose and solve problems

Azure Monitor

Azure Monitor provides a holistic monitoring approach by collecting, analyzing, and acting on telemetry from both cloud and on-premises environments

Metric data	Provides quantifiable information about a system over time that enables you to observe the behavior of a system
Log data	Logs can be queried and even analyzed using Azure Monitor logs. In addition, this information is typically presented in the overview page of an Azure Resource in the Azure portal
Alerts	Alerts notify you of critical conditions and potentially take corrective automated actions based on triggers from metrics or logs

Monitoring the network

Azure Monitor logs within Azure monitor has the capability to monitor and measure network activity

Network performance monitor

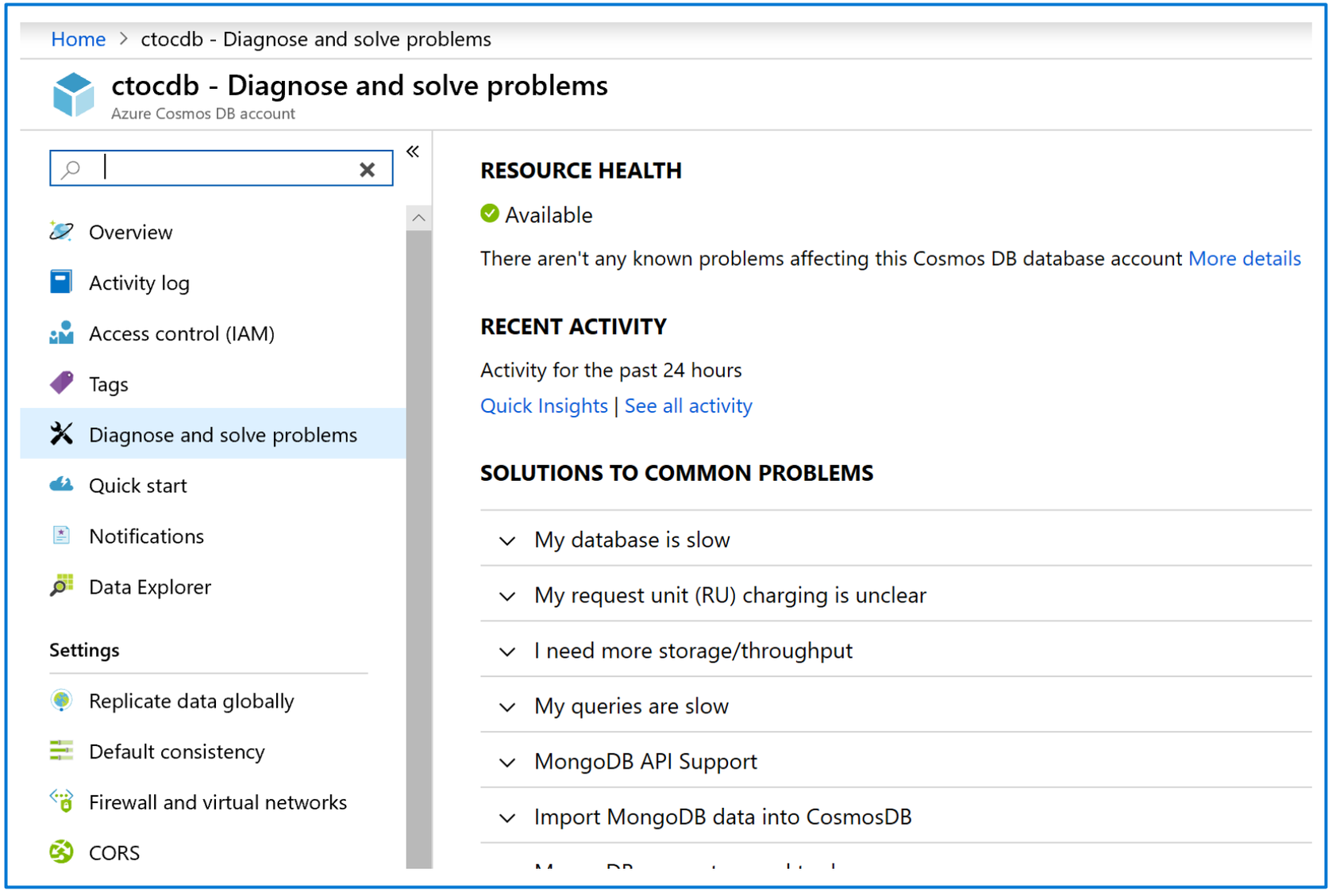
Network Performance Monitor measures the performance and reachability of the networks that you have configured

Application gateway analytics

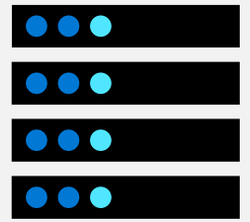
Application Gateway Analytics contains rich, out-of-the box views you can get insights into key scenarios, including:

- Monitor client and server errors
- Check requests per hour

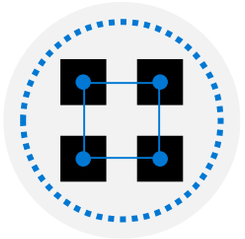
Diagnose and solve issues



Lesson 02: Troubleshoot common data storage issues

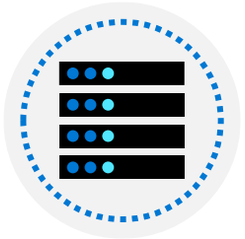


Lesson objectives



Connectivity issues

Performance issues



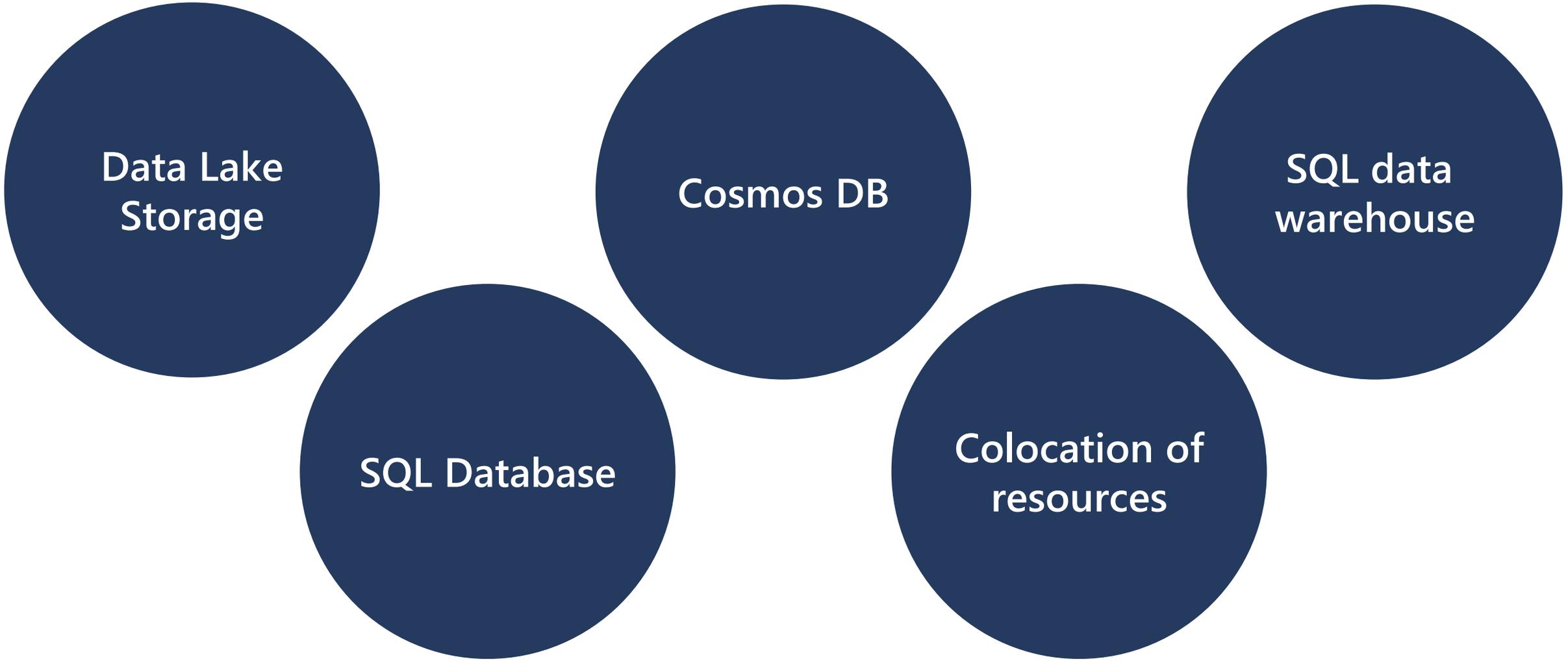
Storage issues

Connectivity issues

There are a range of issues that can impact connectivity issues, including:

Unable to connect to the data platform	Authentication failures	Cosmos DB Mongo DB API errors	SQL database failover
The first area that you should check is the firewall configuration Test the connection by accessing it from a location external to your network Check maintenance schedules	The first check is to ensure that the username and password is correct Check the storage account keys and ensure that they match in the connection string	Mongo client drivers establishes more than one connection On the server side, connections which are idle for more than 30 minutes are automatically closed down Check for timeouts	Should you receive an “unable to connect” message (error code 40613) in the Azure SQL Database, this scenario commonly occurs when a database has been moved because of deployment, failover, or load balancing

Performance issues



Storage issues

Consistency:

Consider the consistency levels of the following data stores that can impact data consistency:

- Cosmos DB
- SQL Data Warehouse
- SQL Database

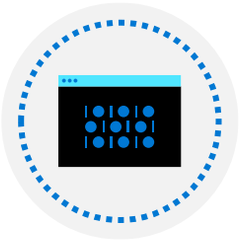
Corruption:

Data corruption can occur on any of the data platforms for a variety of reasons. You should have an appropriate disaster recovery strategy

Lesson 03: Troubleshoot common data processing issues

Lesson objectives

Troubleshoot streaming data



Troubleshoot batch data loads

Troubleshoot Azure Data Factory

Troubleshoot streaming data

When using Stream Analytics, a Job encapsulates the Stream Analytic work and is made up of three components:

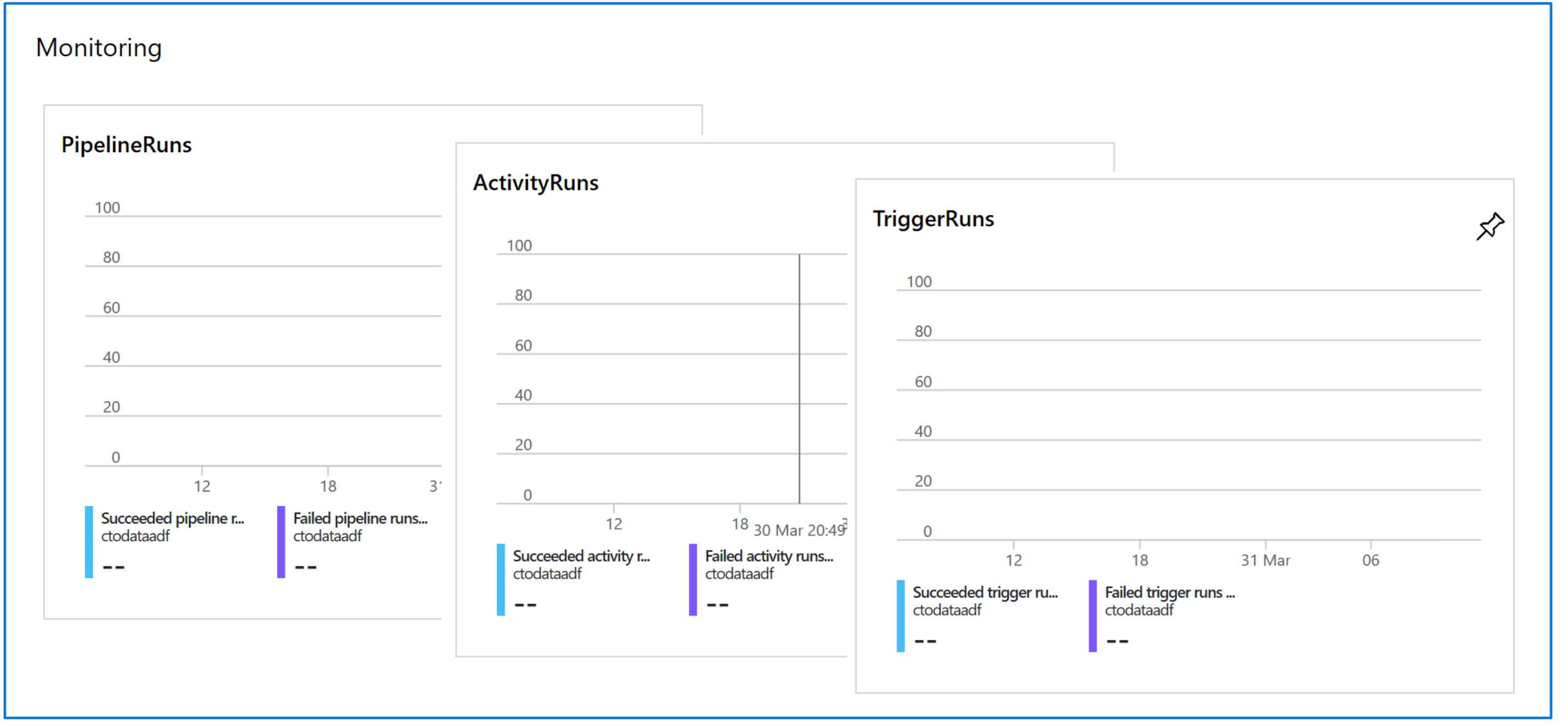
Job input	The job input contains a **Test Connection** button to validate that there is connectivity with the input. However, most errors associated with a job input is due to the malformed input data that is being ingested
Job query	A common issue associated with Stream Analytics query is the fact that the output produced is not expected. In this scenario it is best to check the query itself to ensure that there is no mistakes on the code there
Job output	As with the job input, there is a **Test Connection** button to validate that there is connectivity with the output, should there be no data appearing. You can also use the **Monitor** tab in Stream Analytics to troubleshoot issues

Troubleshoot batch data loads

When trying to resolve data load issues, it is first pragmatic to make the holistic checks on Azure, as well as the network checks and diagnose and solve issue check. After that, then check:

Azure Blob and Data Lake Store	SQL Data Warehouse	Cosmos DB	SQL Database
Notwithstanding network errors; occasionally, you can get timeout or throttling errors that can be a symptom of the availability of the storage accounts	Make sure you are always leveraging PolyBase Ensure CTAS statements are used to load data Break data down into multiple text files Consider DWU usage	Check that you have provisioned enough RU's Review partitions and partitioning keys Check for client connection string settings	Check that you have provisioned enough DTU's Review whether the database would benefit from elastic pools A wide range of tools can be used to troubleshoot SQL Database

Troubleshoot Azure Data Factory



Lesson 04: Managing disaster recovery

Lesson objectives

Data redundancy

Disaster recovery

Data redundancy

Data redundancy is the process of storing data in multiple locations to ensure that it is highly available

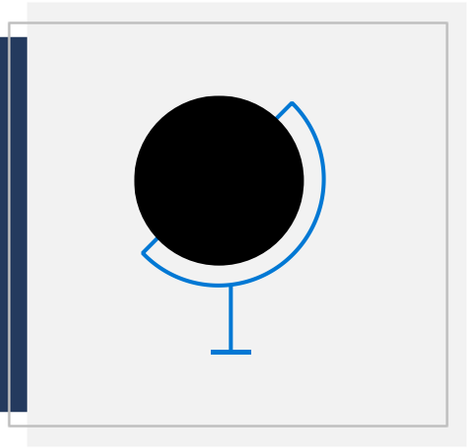
Azure Blob and Data Lake Store	SQL Data Warehouse	Cosmos DB	SQL Database
Locally redundant storage (LRS) Zone-redundant storage (ZRS) Geo-redundant storage (GRS) Read-access geo-redundant storage (RA-GRS)	SQL Data Warehouse performs a **geo-backup** once per day to a paired data center. The RPO for a geo-restore is 24 hours	Azure Cosmos DB is a globally distributed database service. You can configure your databases to be globally distributed and available in any of the Azure regions	Check that you have provisioned enough DTU's Review whether the database would benefit from elastic pools A wide range of tools can be used to troubleshoot SQL Database

Disaster Recovery

There should be processes that are involved in backing up or providing failover for databases in an Azure data platform technology. Depending on circumstances, there are numerous approaches that can be adopted

Azure Blob and Data Lake Store	SQL Data Warehouse	Cosmos DB	SQL Database
Supports account failover for geo-redundant storage accounts You can initiate the failover process for your storage account if the primary endpoint becomes unavailable	SQL Data Warehouse performs a **geo-backup** once per day to a paired data center Data warehouse snapshot feature that enables you to create a restore point to create a copy of the warehouse to a previous state	Takes a backup of your database every **4 hours** and at any point of time Only the latest 2 backups are stored	Creates database backups that are kept between 7 and 35 days Uses Azure read-access geo-redundant storage (RA-GRS) to ensure that they preserved even if data center is unavailable

Lab: Monitoring and troubleshooting data storage and processing



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