Module 2: Relation Data Services in Azure

1 Explore Relational Data Services in Azure

2 Provisioning Relational Services in Azure

3 Querying Relational data in Azure

Explore relational data services in Azure

What are Azure Data Services?

IaaS vs PaaS

SQL Server on Azure virtual machines

Azure SQL DB

PostgreSQL, MySQL, MariaDB

What are Azure Data Services?

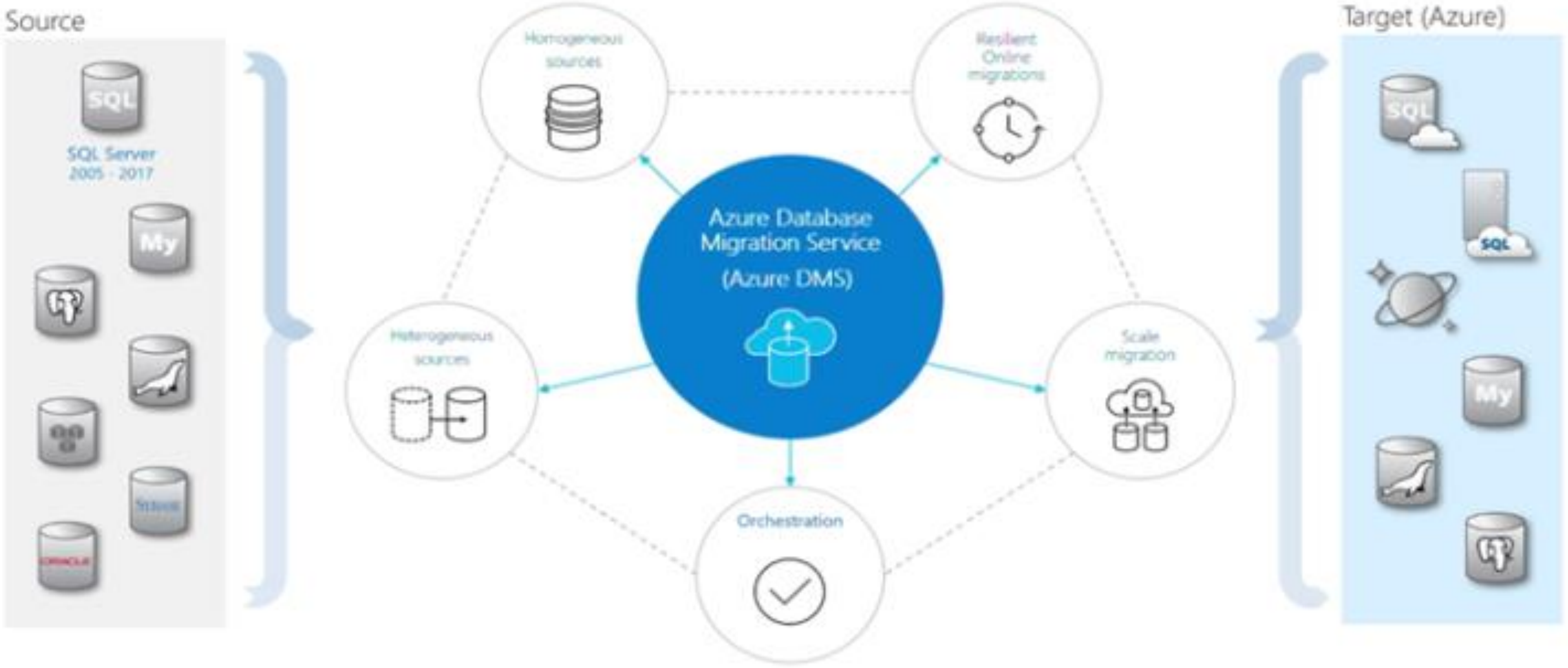
PostgreSQL, MySQL, MariaDB

Azure Database for PostgreSQL is a relational database service in the Microsoft cloud based on the PostgreSQL Community Edition database engine.

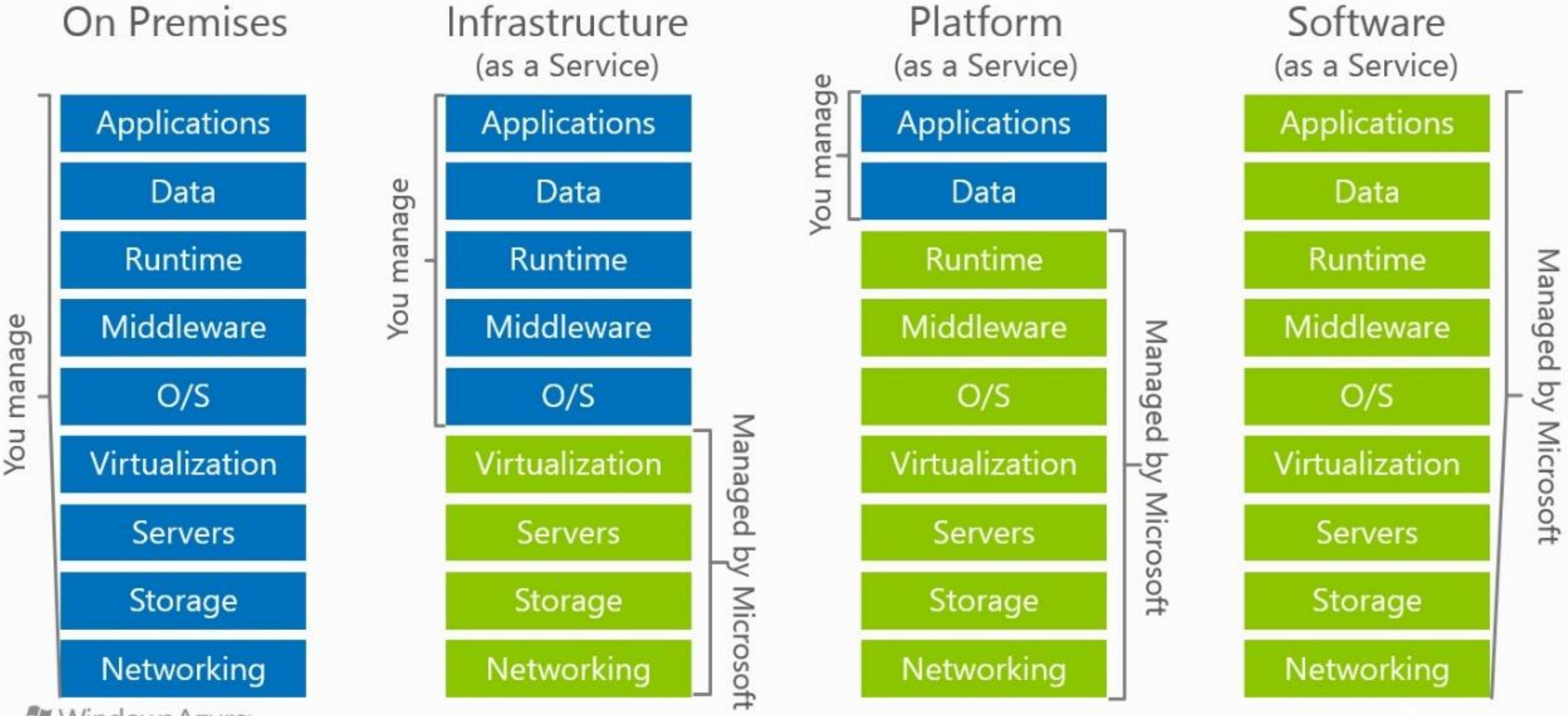
Azure Database for MySQL is a PaaS implementation of MySQL in the Azure cloud, based on the MySQL Community Edition.

Azure Database for MariaDB is an implementation of the MariaDB database management system adapted to run in Azure. It's based on the MariaDB Community Edition.

Migrate databases to Azure



Cloud Models



On Premises

You manage
- Applications
- Data
- Runtime
- Middleware
- O/S
- Virtualization
- Servers
- Storage
- Networking

Infrastructure (as a Service)

You manage
- Applications
- Data
- Runtime
- Middleware
- O/S

Managed by Microsoft
- Virtualization
- Servers
- Storage
- Networking

Platform (as a Service)

You manage
- Applications
- Data

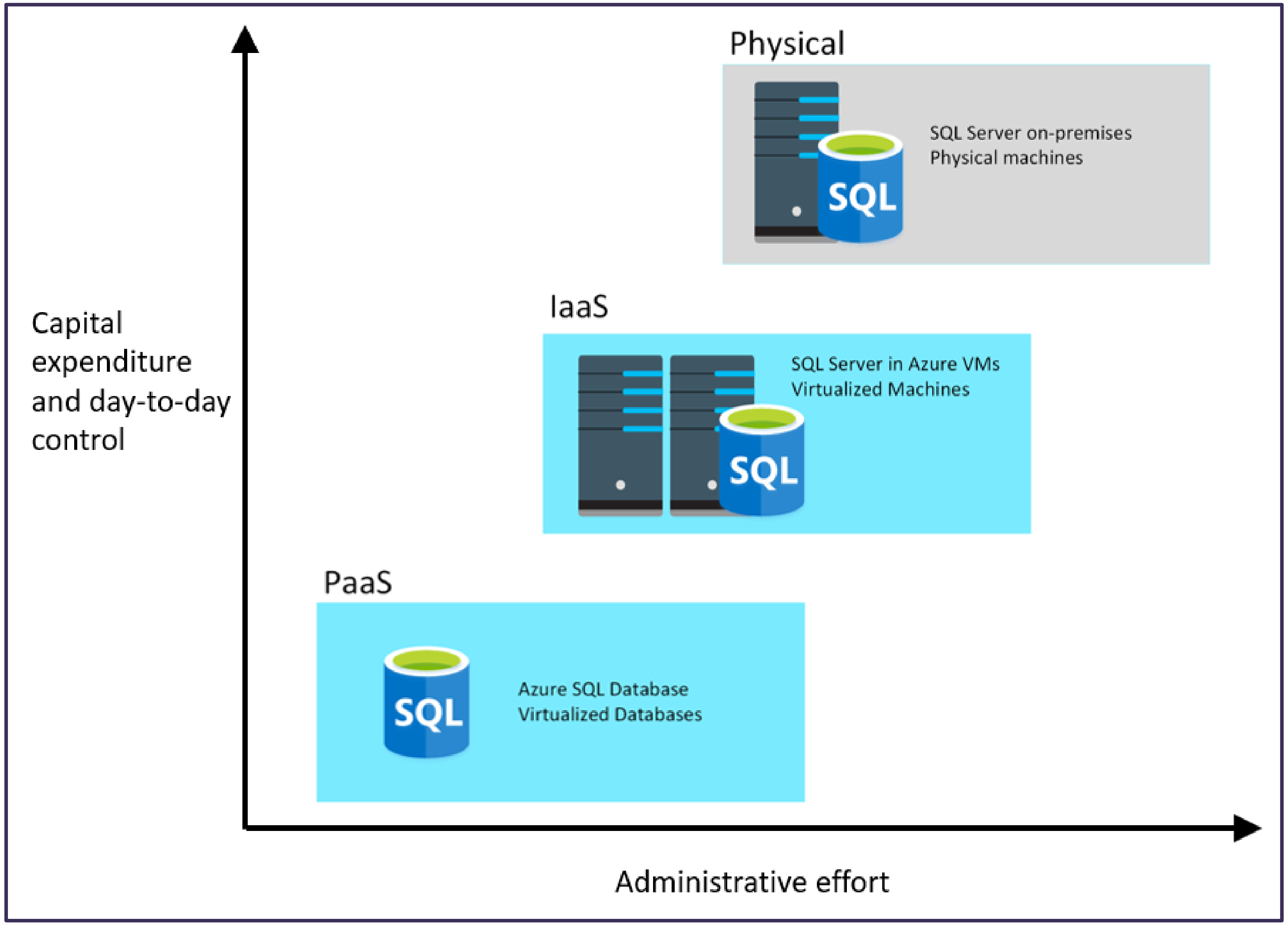
Managed by Microsoft
- Runtime
- Middleware
- O/S
- Virtualization
- Servers
- Storage
- Networking

Software (as a Service)

Managed by Microsoft
- Applications
- Data
- Runtime
- Middleware
- O/S
- Virtualization
- Servers
- Storage
- Networking

Windows Azure

IaaS vs PaaS


Physical
SQL
SQL Server on-premises
Physical machines
IaaS
SQL
SQL Server in Azure VMs
Virtualized Machines
PaaS
SQL
Azure SQL Database
Virtualized Databases
Capital expenditure and day-to-day control
Administrative effort

SQL Server on Azure

SQL Server on Azure Virtual Machines

Azure SQL Managed Instance

Azure SQL Database

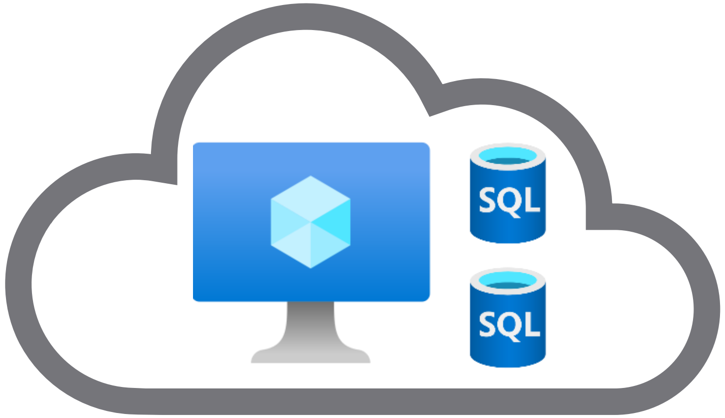
Infrastructure as a Service

Platform as a Service

SQL Server on Azure Virtual Machines

- **SQL Server on Virtual Machines** is an IaaS solution that enables users to use full versions of SQL Server in the Cloud without having to manage any on-premises hardware.

  - Guaranteed compatibility to SQL Server on premises
  - Customer manages everything – OS upgrades, software upgrades, backups, replication
  - Pay for the server and licensing, not per database



Azure SQL Database

- **Azure SQL Database** is a PaaS offering where users create a managed database server in the cloud, and then deploy the databases on the server.

- Low-cost option with minimal administration
- Best for new cloud projects with flexible application design
- Supports systems with variable loads – scale up and down quickly without restarting

Single Database

Create and run a database server in the cloud and access the database through the server.

Elastic Pool

Multiple databases share the same resources, such as memory, storage, and processing power.

Azure SQL Managed Instance

- **Azure SQL Managed Instance** allows you to pre-provision compute resources and deploy several individual managed instances up to your pre-provisioned compute level.
  - Automatic backups, software patching, database monitoring, and other administrative tasks
  - Near 100% compatibility with on-premises SQL Server
  - Supported by other Azure services

Single Instance

One SQL Server instance, multiple databases.

Instance Pool

Multiple instances share the same resources.

Azure SQL Managed Instance or Azure SQL Database

Azure SQL Managed Instance

Single instance:

SQL Server surface area (vast majority)

Native virtual network support

Fully managed service

Instance pool:

Pre-provision compute resources for migration

Enables cost-efficient migration

Ability to host smaller instances (2Vcore)

Currently in public preview

Azure SQL Database

Single database:

Hyperscale storage (up to 100TB)

Serverless compute

Fully managed service

Elastic pool:

Resource sharing between multiple databases to price optimize

Simplified performance management for multiple databases

Fully managed service

Azure Database for MySQL

Features

- Simple-to-use open-source database management
- Can be used for Linux, Apache, MySQL, and PHP (LAMP) stack
- Several editions: Community, Standard, and Enterprise.

Benefits

- High availability
- Scalable
- Secure data, both at rest and in motion.
- Automatic backups and point-in-time restore for the last 35 days.
- Enterprise-level security and compliance with legislation.
- Azure Database for MySQL servers provides monitoring functionality to add alerts, and to view metrics and logs.

Azure Database for MariaDB

Features

- New DBMS, created by the original developers of MySQL
- Compatibility with Oracle Database
- Optimized to improve performance
- Built-in support for temporal data

Benefits

- Fully managed and controlled by Azure
- Built-in high availability with no additional cost.
- Predictable performance, using inclusive pay-as-you-go pricing.
- Scaling as needed within seconds.
- Secured protection of sensitive data at rest and in motion.
- Automatic backups and point-in-time-restore for up to 35 days.
- Enterprise-grade security and compliance.

Azure Database for PostgreSQL

Features

- Hybrid relational-object database
- Enables you to store custom data types, with their own non-relational properties
- Code modules can be added
- Manipulate geometric data, such as lines, circles, and polygons
- Use pgsql tool to query on command line

Benefits

- Provides the same availability, performance, scaling, security, and administrative benefits
- Certain features of on-premises PostgreSQL databases are not available in Azure Database for PostgreSQL
- Use pgAdmin tool to manage

Benefits of Azure Database for PostgreSQL, MySQL, MariaDB

Fully managed community database:
Take advantage of a fully managed service while still using the tools and languages you're familiar with

Built-in high availability for lowest TCO:
Ensure your data is always available without the need for additional costs

Intelligent performance and scale:
Improve performance with built-in intelligence and up to 16TB storage and 20K IOPs

Industry-leading security and compliance:
Protect your data with enhanced security features including Advanced Threat Protection

Integration with the Azure ecosystem:
Build apps faster with Azure services and safeguard your innovation with Azure IP Advantage

Lesson 1: Knowledge check (continued on next slide)

Which deployment requires the fewest changes when migrating an existing SQL Server on-premises solution?

❑ Azure SQL Database Managed Instance
☑ SQL Server running on a virtual machine
❑ Azure SQL Database Single Database

Which of the following statements is true about SQL Server running on a virtual machine?

❑ You must install and maintain the software for the database management system yourself, but backups are automated
❑ Software installation and maintenance are automated, but you must do your own backups
☑ You’re responsible for all software installation and maintenance, and performing back ups

Which of the following statement is true about Azure SQL Database?

❑ Scaling up doesn’t take effect until you restart the database
❑ Scaling out doesn’t take effect until you restart the database
☑ Scaling up or out will take effect without restarting the SQL database

Lesson 1: Knowledge check (continued)

When using an Azure SQL Database managed instance, what is the simplest way to implement backups?

□ Manual Configuration of the SQL server

□ Create a scheduled task to back up

☑ Backups are automatically handled

What is the best way to transfer the data in a PostgreSQL database running on-premises into a database running Azure Database for PostgreSQL service?

□ Export the data from the on-premises database and import it manually into the database running in Azure

□ Upload a PostgreSQL database backup file to the database running in Azure

☑ Use the Azure Database Migration Services

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Querying Relational data in Azure

Provisioning Relational Database services in Azure

Provision relational data services

Configure relational data services

Explore basic connectivity issues

Explore data security

Demo: What is provisioning?

Provisioning and ***deployment*** means to execute series of steps to create and configure a service

- We need to provide parameters that provide estimate of size of workload we want to run
- Behind the scene Azure will create other required resources: Disks, memory, CPUs, network and so on
- You will be charged for these resources until you delete them
- We can Scale dynamically up or down as needed

This video summarizes the process that Azure performs when you provision a service

Methods for Provisioning and Deployment

The Azure portal

- Convenient but manual

The Azure command-line interface (CLI)

- Set of commands to create and manage Azure resources specifically
- Can run from the operating system command prompt or the Cloud Shell in the Azure portal.
- Suitable if you need to automate service creation

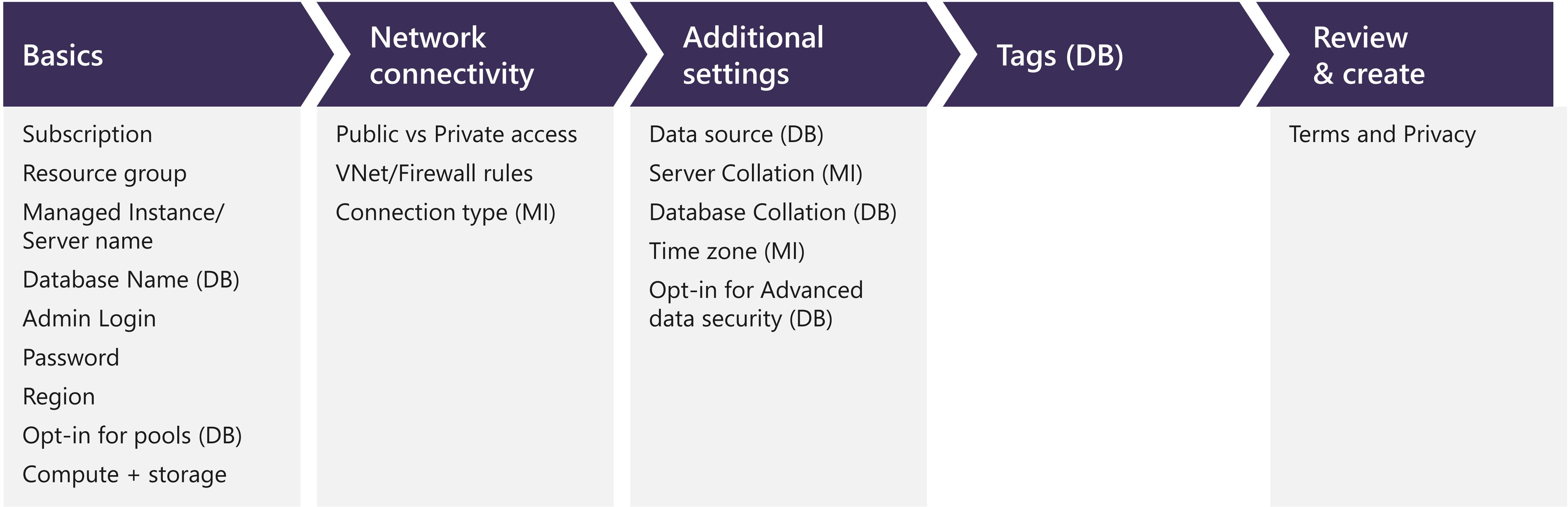
Azure PowerShell

- This is a cross-platform task automation and configuration management framework.
- Command-line shell and scripting language that is built on top of .Net
- Azure provides a series of commandlets (Azure-specific commands) that you can use in PowerShell to create and manage Azure resources.

Azure Resource Manager templates

- JSON (JavaScript Object Notation) file template that describes the service and can be used to create resources.

Configure relational data services



Basics

- Subscription
- Resource group
- Managed Instance/ Server name
- Database Name (DB)
- Admin Login
- Password
- Region
- Opt-in for pools (DB)
- Compute + storage

Network connectivity

- Public vs Private access
- VNet/Firewall rules
- Connection type (MI)

Additional settings

- Data source (DB)
- Server Collation (MI)
- Database Collation (DB)
- Time zone (MI)
- Opt-in for Advanced data security (DB)

Tags (DB)

Review & create

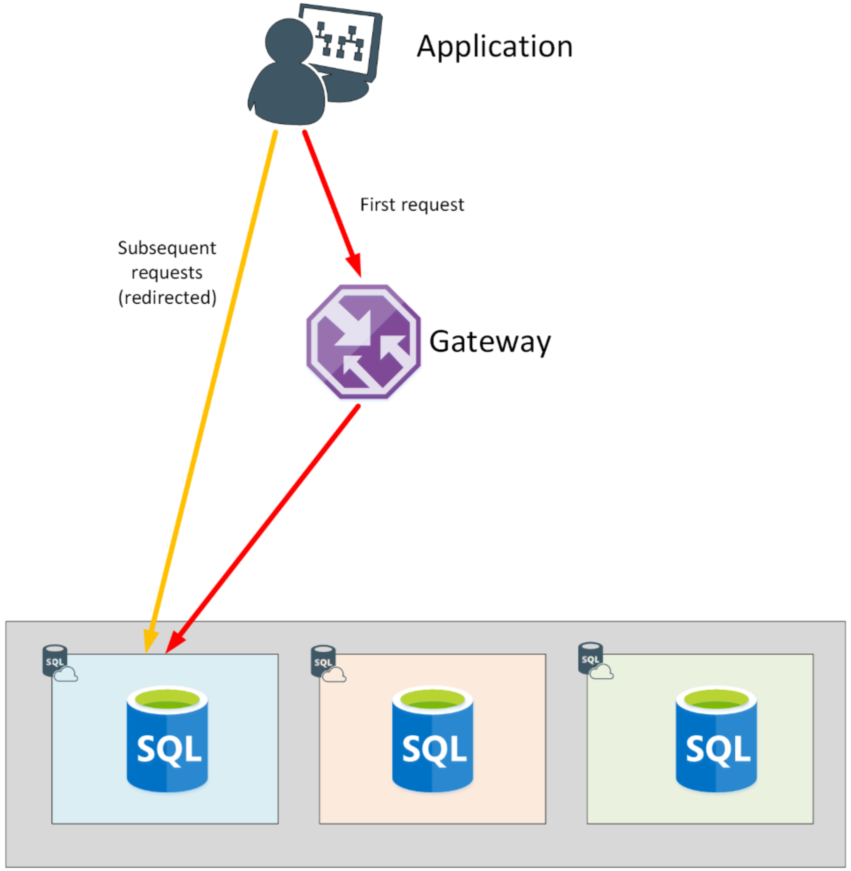
- Terms and Privacy

Demo

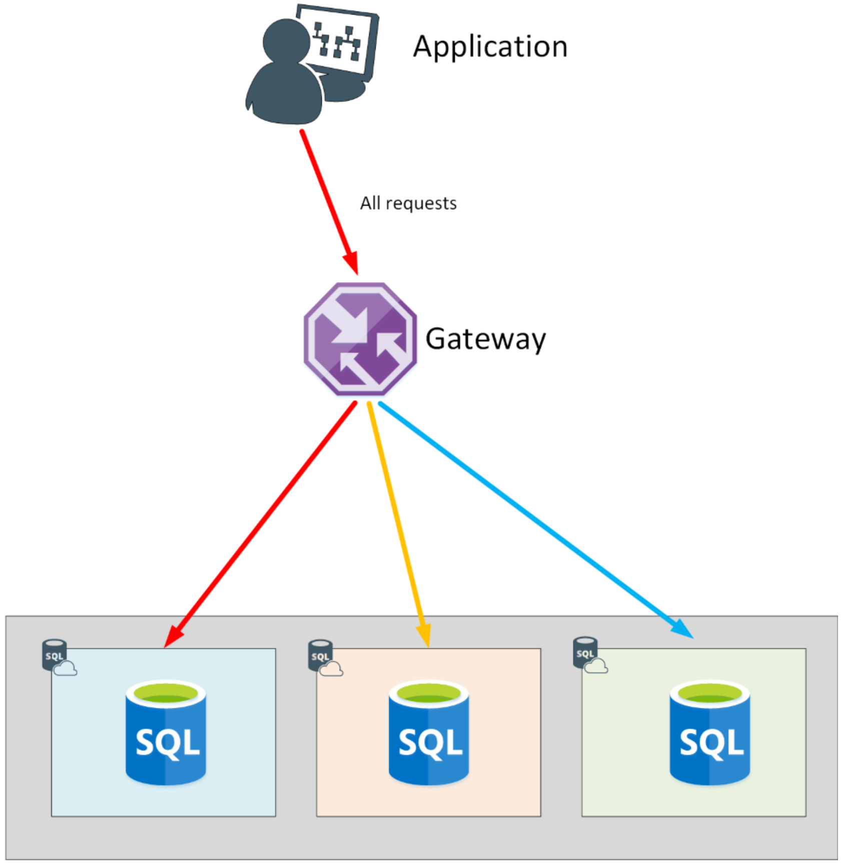
Connectivity from within Azure

Policy of Redirect

1. An application establishes a connection to the Azure SQL database through the gateway
2. All requests after the first, will go directly to the database
3. If connectivity to the database fails, the application will have to reconnect through the gateway.
4. The application may be directed to a different copy of the database running on another server in the cluster.



Connectivity from outside of Azure



Policy of Proxy

1. An application establishes a connection to the Azure SQL database via the gateway
2. All requests will go through the gateway
3. The application may be directed to a different copy of the database running on another server in the cluster.

Authentication and Access Control

“Mixed Mode” authentication forced

SQL Auth for deployment: server admin:

Server-level principal for logical server for DB

Member of sysadmin server role for MI

Need Windows Auth? Use Azure AD Authentication Azure Managed Instance:

Azure AD Server Admin

SQL or Azure AD Logins

Database Users

SQL Server Contained Database supported

Azure SQL Database:

Azure AD Server Admin

SQL logins

loginmanager and dbmanager roles for limited server admins

Database Users

Contained Database Users including Azure AD (recommended)

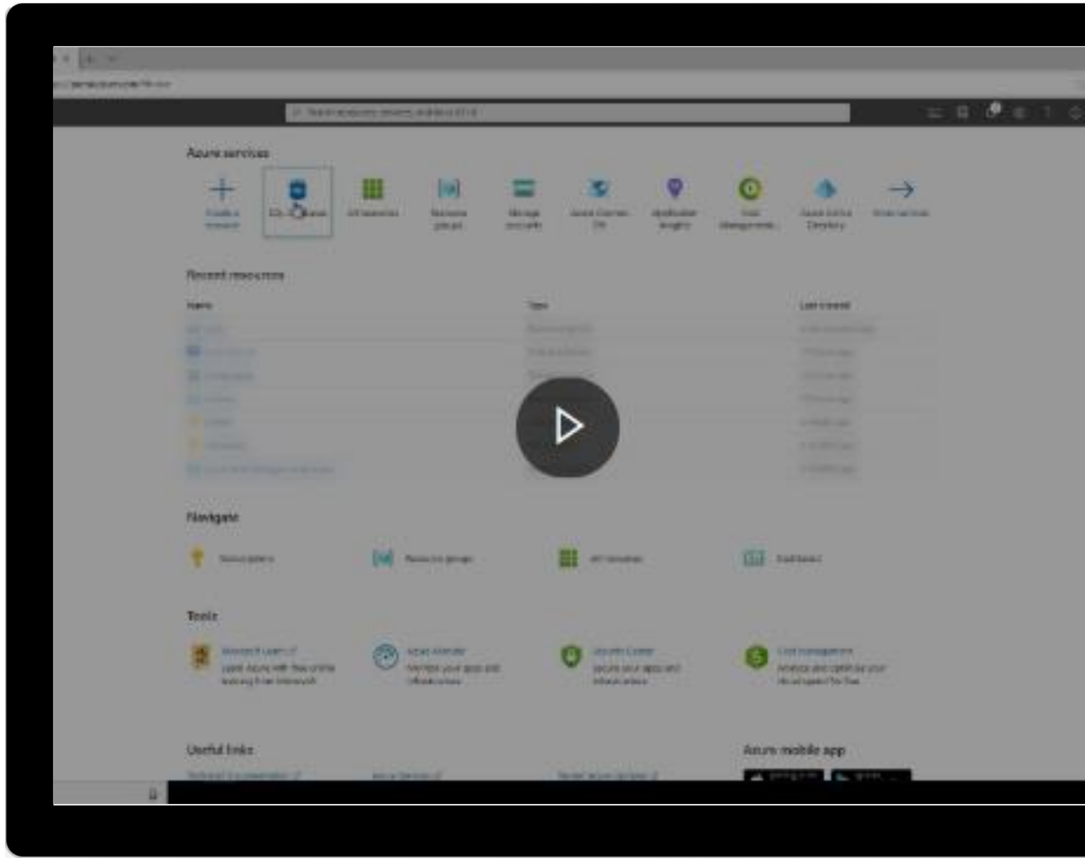
Azure Role Based Access Control (RBAC)

Azure Role Based Access Control (RBAC) helps you manage who has access to Azure resources, and what they can do with those resources.
You control access to resources using role assignments. A role assignment consists of three elements:

- **Security principal:** an object that represents a user or service that is requesting access to Azure resource
- **Role:** a collection of permissions
- **Scope:** A lists the set of resources that the access applies to

Demo: Provision an Azure SQL Database instance

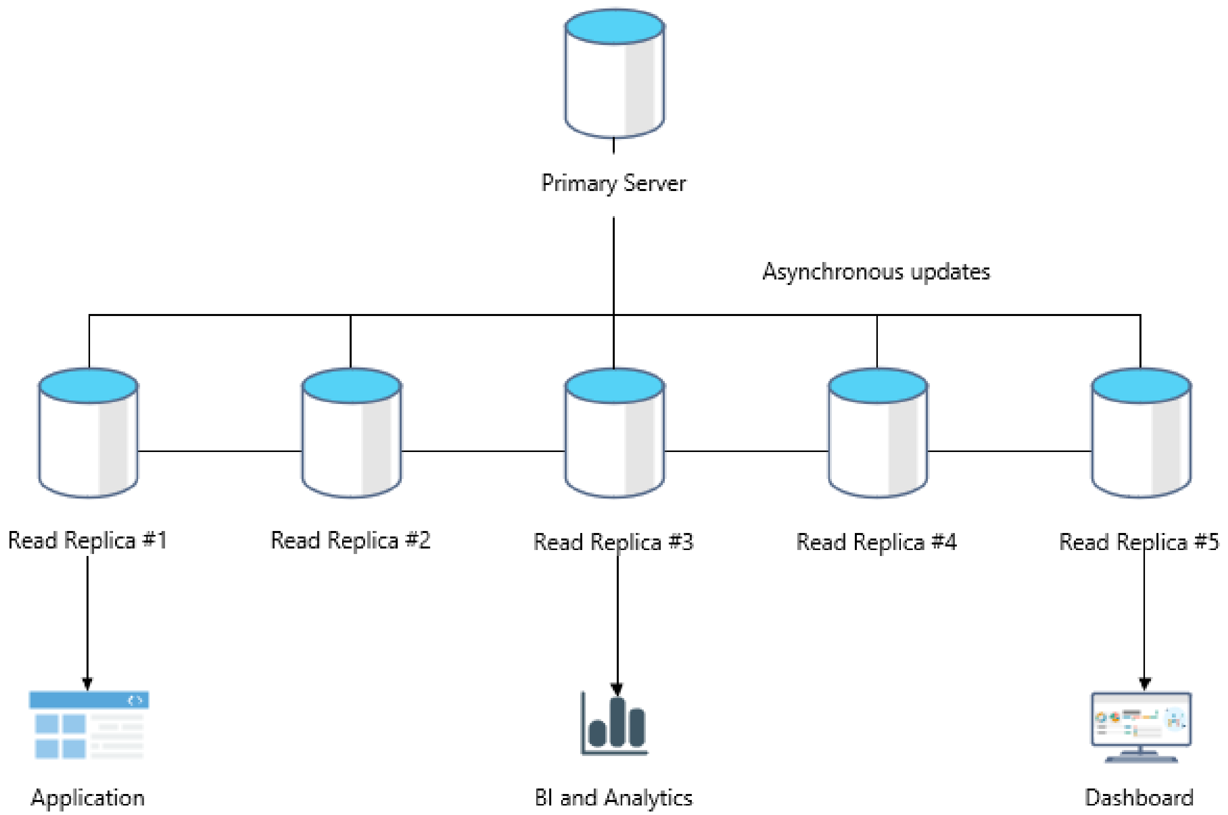
This video demonstrates how to provision an Azure SQL Database instance, to create a database and server



Azure DB – Read replicas

- Read replicas help improve performance and scale of read-intensive workloads such as BI and analytics
- Consider the read replica features in scenarios when delays in synching data between the primary and replicas are acceptable
- Create a replica in a different Azure region from the primary for a disaster recovery plan, where a replica replaces the primary in cases of regional disasters
- Data storage on replica servers grows automatically without impacting workloads

Create up to five read-only replicas of the primary server



Lab: Provision Azure relational database service

As part of your role at Contoso as a data engineer, you've been asked to create and configure SQL Server, PostgreSQL, and MySQL servers for Azure

Go to the exercise **Provision relational Azure data services** module on Microsoft Learn, and follow the instructions in the module to create data stores

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Querying Relational data in Azure

Query relational data in Azure

- Query relational data
- Describe query techniques for data using the SQL language

Introduction to SQL

SQL is a standard language for use with relational databases

SQL standards are maintained by ANSI and ISO

Proprietary RDBMS systems have their own extensions of SQL such as T-SQL, PL/SQL, pgSQL

SQL Statement Types

DML	DDL	DCL
Data Manipulation Language	Data Definition Language	Data Control Language
Used to query and manipulate data	Used to define database objects	Used to manage security permissions
SELECT, INSERT, UPDATE, DELETE	CREATE, ALTER, DROP, RENAME	GRANT, REVOKE, DENY

SQL DML Statements

Statement	Description
SELECT	Select/read from a table
INSERT	Insert new rows in a table
UPDATE	Edit/Update existing rows in a table
DELETE	Delete existing rows in a table

Elements of the SELECT Statement

Clause	Expression
SELECT	<select list>
FROM	<table or view>
WHERE	<search condition>
GROUP BY	<group by list>
ORDER BY	<order by list>

SELECT Statement

```sql
SELECT EmployeeId, YEAR(OrderDate) AS OrderYear
FROM Sales.Orders
WHERE CustomerId = 71
GROUP BY EmployeeId, YEAR(OrderDate)
HAVING COUNT(*) > 1
ORDER BY EmployeeId, OrderYear;
```

INSERT Statement

The INSERT … VALUES statement inserts a new row

```
INSERT INTO Sales.OrderDetails
     (orderid, productid, unitprice, qty, discount)
VALUES (10255,39,18,2,0.05);
```

Table and row constructors add multirow capability to INSERT … VALUES

```
INSERT INTO Sales.OrderDetails
(orderid, productid, unitprice, qty, discount)

VALUES
(10256,39,18,2,0.05),
(10258,39,18,5,0.10);
```

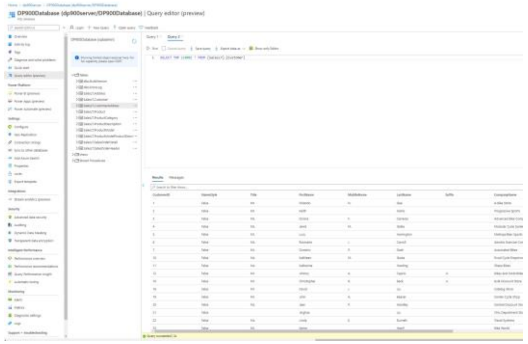
SQL DDL Statements

Statement	Description
CREATE	Create a new object in the database, such as a table or a view
ALTER	Modify the structure of an object. For instance, altering a table to add a new column.
DROP	Remove an object from the database.
RENAME	Rename an existing object.

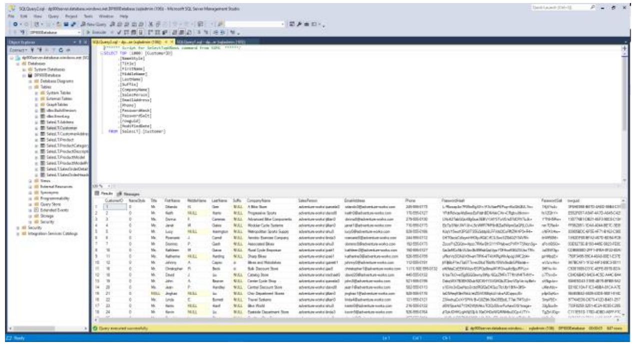
CREATE Statement

```
CREATE TABLE MyTable(
 Mycolumn1 int NOT NULL PRIMARY KEY,
 Mycolumn2 VARCHAR(50) NOT NULL,
 Mycolumn2 VARCHAR(10) NOT NULL
)
```

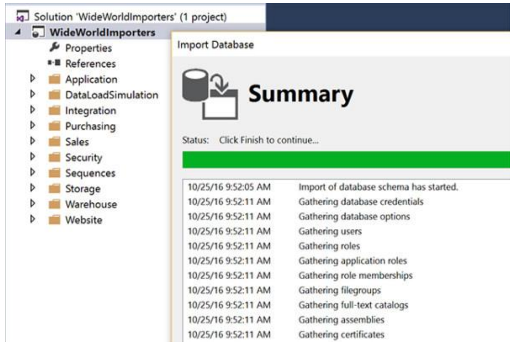
Query tools


DP900Database (dp900server/DP900Database) | Query editor (preview)

Azure portal



SQL Management Studio



Solution 'WideWorldImporters' (1 project)
WideWorldImporters
Properties
References
Application
DataLoadSimulation
Integration
Purchasing
Sales
Security
Sequences
Storage
Warehouse
Website

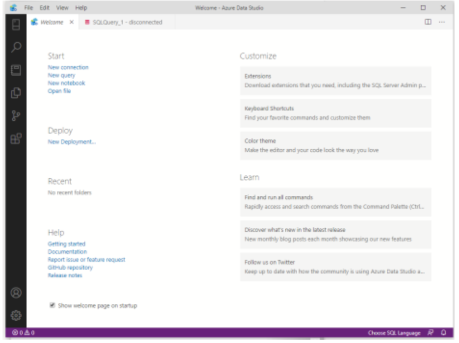
Import Database

Summary

Status: Click Finish to continue...

```
10/25/16 9:52:05 AM    Import of database schema has started.
10/25/16 9:52:11 AM    Gathering database credentials
10/25/16 9:52:11 AM    Gathering database options
10/25/16 9:52:11 AM    Gathering users
10/25/16 9:52:11 AM    Gathering roles
10/25/16 9:52:11 AM    Gathering application roles
10/25/16 9:52:11 AM    Gathering role memberships
10/25/16 9:52:11 AM    Gathering filegroups
10/25/16 9:52:11 AM    Gathering full-text catalogs
10/25/16 9:52:11 AM    Gathering assemblies
10/25/16 9:52:11 AM    Gathering certificates
```

SQL Server Data Tools



Start
New connection
New query
New notebook
Open file

Deploy
New Deployment...

Recent
No recent folders

Help
Getting started
Documentation
Report issue or feature request
GitHub repository
Release notes

☑ Show welcome page on startup

Customize

Extensions
Download extensions that you need, including the SQL Server Admin p...

Keyboard Shortcuts
Find your favorite commands and customize them

Color theme
Make the editor and your code look the way you love

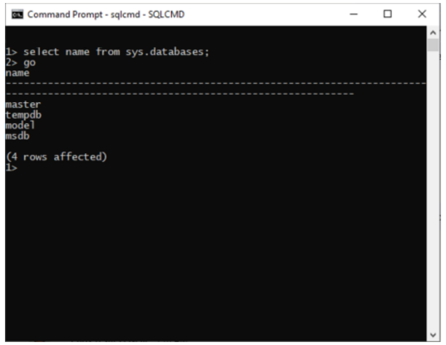
Learn

Find and run all commands
Rapidly access and search commands from the Command Palette (Ctrl...

Discover what's new in the latest release
New monthly blog posts each month showcasing our new features

Follow us on Twitter
Keep up to date with how the community is using Azure Data Studio a...

Azure Data Studio

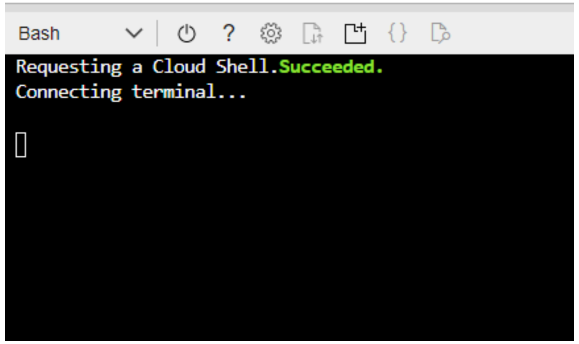


```
1> select name from sys.databases;
2> go
name
--------------------------------------------------------------------------------------------------------------------------------

master
tempdb
model
msdb

(4 rows affected)
1>
```

SQLCMD



```
Requesting a Cloud Shell.Succeeded.
Connecting terminal...

▯
```

Azure CLI/Cloud Shell

Query relational data in Azure Database for PostgreSQL

- Use PSQL to query a database

Azure Cloud Shell

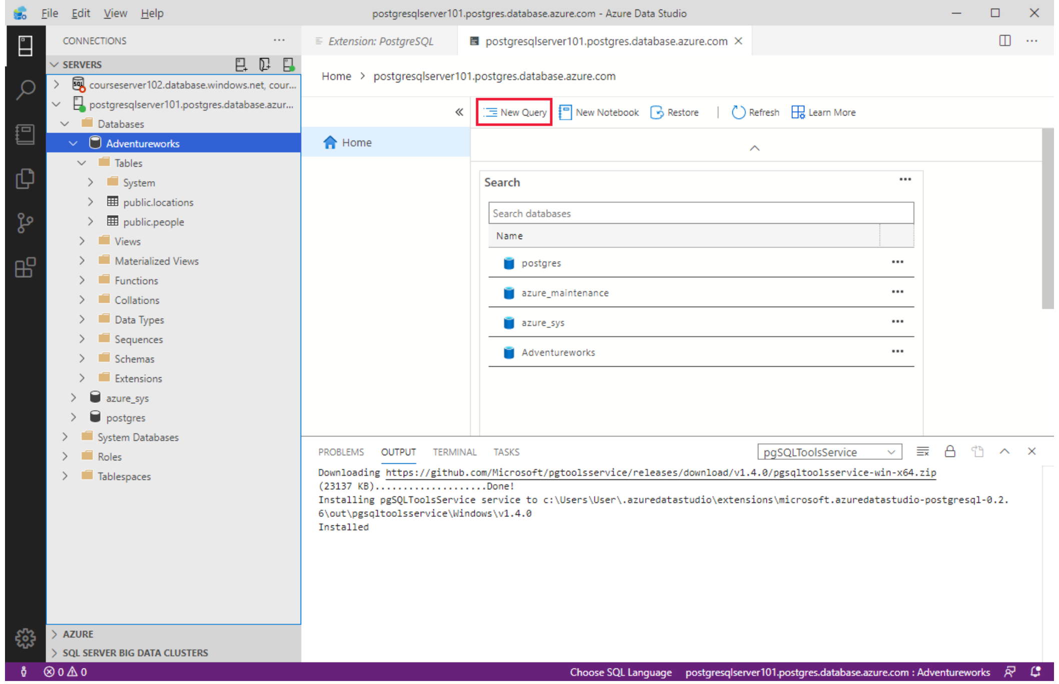
```
psql --host=<server-name>.postgres.database.azure.com
--username=<admin-user>@<server-name> --
dbname=postgres
```

```
CREATE DATABASE "Adventureworks";
```

```
CREATE TABLE PEOPLE(NAME TEXT NOT NULL, AGE INT NOT NULL);
INSERT INTO PEOPLE(NAME, AGE) VALUES ('Bob', 35);
INSERT INTO PEOPLE(NAME, AGE) VALUES ('Sarah', 28);
CREATE TABLE LOCATIONS(CITY TEXT NOT NULL, STATE TEXT NOT NULL);
INSERT INTO LOCATIONS(CITY, STATE) VALUES ('New York', 'NY’);
INSERT INTO LOCATIONS(CITY, STATE) VALUES ('Flint', 'MI');
```

```
SELECT * FROM PEOPLE;
SELECT * FROM LOCATIONS;
```

Azure Data Studio

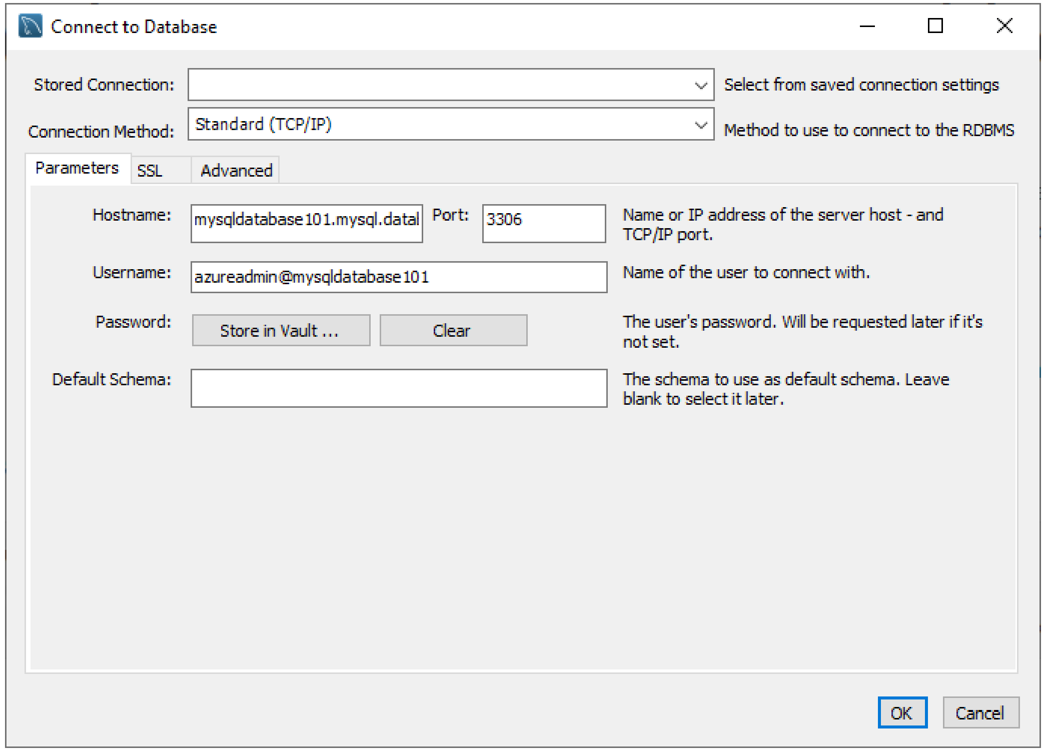


Name
postgres
azure_maintenance
azure_sys
Adventureworks

```
Downloading https://github.com/Microsoft/pgtoolsservice/releases/download/v1.4.0/pgsqltoolsservice-win-x64.zip
(23137 KB)....................Done!
Installing pgSQLToolsService service to c:\Users\User\.azuredatastudio\extensions\microsoft.azuredatastudio-postgresql-0.2.
6\out\pgsqltoolsservice\Windows\v1.4.0
Installed
```

Query relational data in Azure Database for MySQL

- Use MySQL Workbench to query a database



Connect to Database

Stored Connection: — Select from saved connection settings

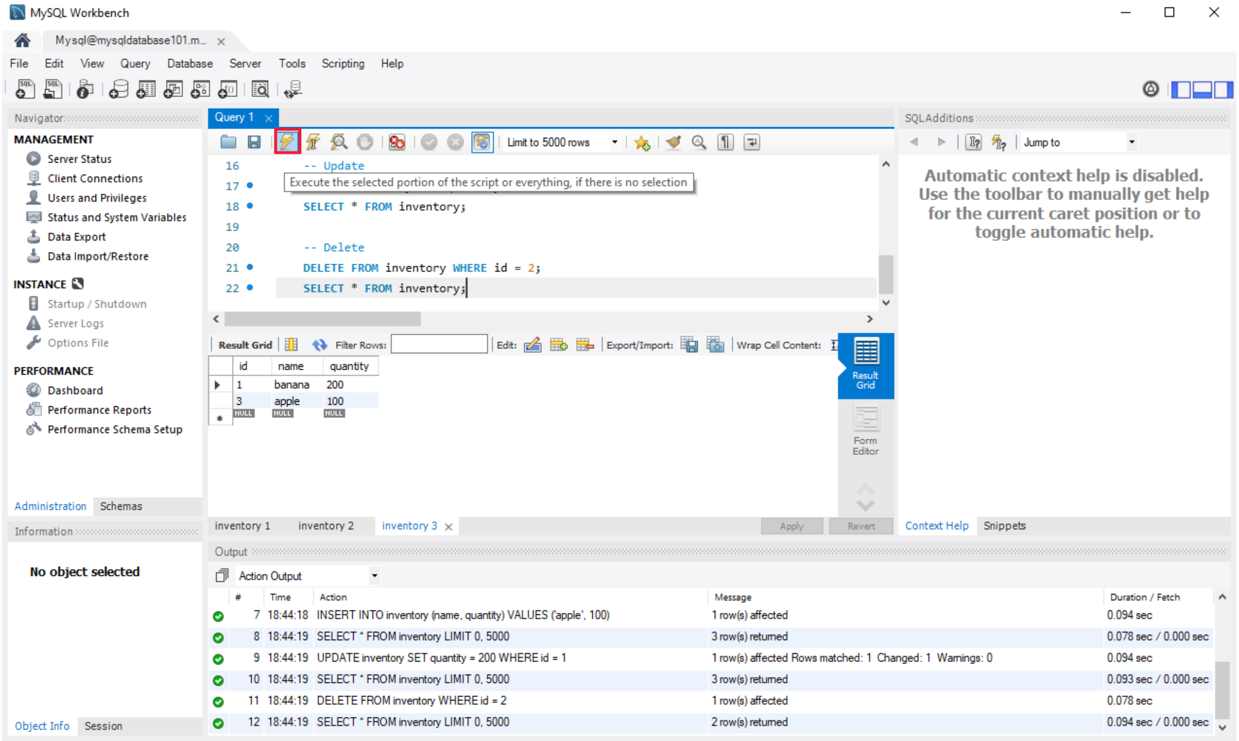
Connection Method: Standard (TCP/IP) — Method to use to connect to the RDBMS

Hostname: mysqldatabase101.mysql.datal Port: 3306 — Name or IP address of the server host - and TCP/IP port.

Username: azureadmin@mysqldatabase101 — Name of the user to connect with.

Password: Store in Vault ... Clear — The user's password. Will be requested later if it's not set.

Default Schema: — The schema to use as default schema. Leave blank to select it later.



Execute the selected portion of the script or everything, if there is no selection

```
-- Update

SELECT * FROM inventory;

-- Delete
DELETE FROM inventory WHERE id = 2;
SELECT * FROM inventory;
```

id	name	quantity
1	banana	200
3	apple	100
NULL	NULL	NULL

Automatic context help is disabled. Use the toolbar to manually get help for the current caret position or to toggle automatic help.

#	Time	Action	Message	Duration / Fetch
7	18:44:18	INSERT INTO inventory (name, quantity) VALUES ('apple', 100)	1 row(s) affected	0.094 sec
8	18:44:19	SELECT * FROM inventory LIMIT 0, 5000	3 row(s) returned	0.078 sec / 0.000 sec
9	18:44:19	UPDATE inventory SET quantity = 200 WHERE id = 1	1 row(s) affected Rows matched: 1 Changed: 1 Warnings: 0	0.094 sec
10	18:44:19	SELECT * FROM inventory LIMIT 0, 5000	3 row(s) returned	0.093 sec / 0.000 sec
11	18:44:19	DELETE FROM inventory WHERE id = 2	1 row(s) affected	0.078 sec
12	18:44:19	SELECT * FROM inventory LIMIT 0, 5000	2 row(s) returned	0.094 sec / 0.000 sec

Lab: Use SQL to query Azure SQL Database

Contoso has provisioned the SQL database and has imported all the inventory data into the data store.
As lead developer, you’ve been asked to run some queries over the data

Go to the exercise **Use SQL to query Azure SQL Database** module on Microsoft Learn, and follow the instructions to query the database to find how many products are in the database, and the number of items in stock for a particular product