

DP-300



Administering Relational Databases in Azure

Azure DBA Exam

DP-300



Relational Database Administration Exam

**Know how to
manage cloud
and on-prem
databases**



EXAMS

Exam DP-300: Administering Microsoft Azure SQL Solutions

Candidates for this exam should have subject matter expertise in building database solutions that are designed to support multiple workloads built with Azure SQL database services.

Candidates for this exam are database administrators who manage on-premises and cloud databases built with SQL Server and SQL database services.

The Azure database administrator implements and manages the operational aspects of cloud-native and hybrid data platform solutions built on SQL Server and SQL database services. Professionals in this role use a variety of methods and tools to perform and automate day-to-day operations, including applying knowledge of using T-SQL for administrative management purposes.

These professionals are responsible for management, availability, security, and performance monitoring and optimization of database solutions. They evaluate and implement migration strategies for moving databases to Azure. Plus, they work with Azure data engineers, Azure solution architects, Azure developers, and other professionals to manage operational aspects of data platform solutions.

Candidates for this exam should have knowledge of and experience with Azure SQL Edge, Azure SQL Database, Azure SQL Managed Instance, and SQL Server on Azure Virtual Machines (Windows and Linux).

Skills measured

- The English language version of this exam was updated on October 25, 2022. Download the study guide in the preceding “Tip” box for more details about the skills measured on this exam.
- Plan and implement data platform resources (20–25%)
- Implement a secure environment (15–20%)
- Monitor, configure, and optimize database resources (20–25%)
- Configure and manage automation of tasks (15–20%)
- Plan and configure a high availability and disaster recovery (HA/DR) environment (20–25%)

20%-25%

**plan and implement
data resources**

15%-20%
implement
security

20%-25%
monitor,
configure, and
optimize

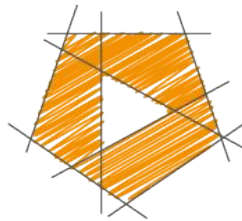
15%-20%
automation of
tasks

20%-25%
HA / DR

Practice is key

**Would not
attempt this if
you've never
used SQL Server**

**Need to know
concepts of
DP-900 already**



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Administering Relational Databases on Azure

Azure SQL Options

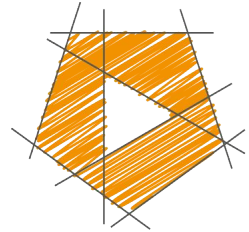
Azure Relational Database Options

- Azure SQL Database
- Azure SQL Managed Instance
- SQL Server in a VM (Windows and Linux)
- SQL Edge

Not Covered

- Cosmos DB (Non-relational, NoSQL)
- Azure Cache for Redis (In-memory)
- Azure SQL Data Warehouse (Synapse Analytics)
- Table Storage
- Azure Database for MySQL
- Azure Database for PostgreSQL
- Azure Database for MariaDB

SQL Server Management Studio (SSMS)



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Azure Relational DBs

Requirements

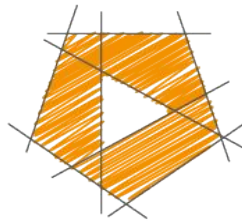
- Deploy database offerings on selected platforms
- Configure customized deployment templates
- Apply patches and updates for hybrid and IaaS deployment

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Introduction

- Azure SQL is a family that uses the SQL Server db engine on Azure
- You can use code to deploy SQL solution
- Patching SQL solution is important

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**Which Platform
to Use?**

Open Source Databases

MySQL, PostgreSQL, MariaDB

Migrating from existing hosted solution

You already use these in your project

Too hard/risky to move to Azure SQL Database

Want to preserve future migration to other platforms (avoid lock in)

Four “SQL Server Engine” Options

SQL Server in a VM

SQL Managed Instance

Azure SQL Database

SQL Edge

**Azure SQL
Database is the
cloud-native
relational DB**

When to Use Azure SQL Database

Starting a new project - no migration or legacy at all

Microsoft to manage the patching

Need an inexpensive solution

Suitable most of the time

When you don't have complex requirements

When to Use SQL in a VM

Migrating from existing solution

Don't have time to evaluate other options

Have very specific requirements that SQL Database can't handle

Have expertise to manage SQL Server yourself

Use existing tools

When to Use SQL Managed Instance

Migrating from existing solution

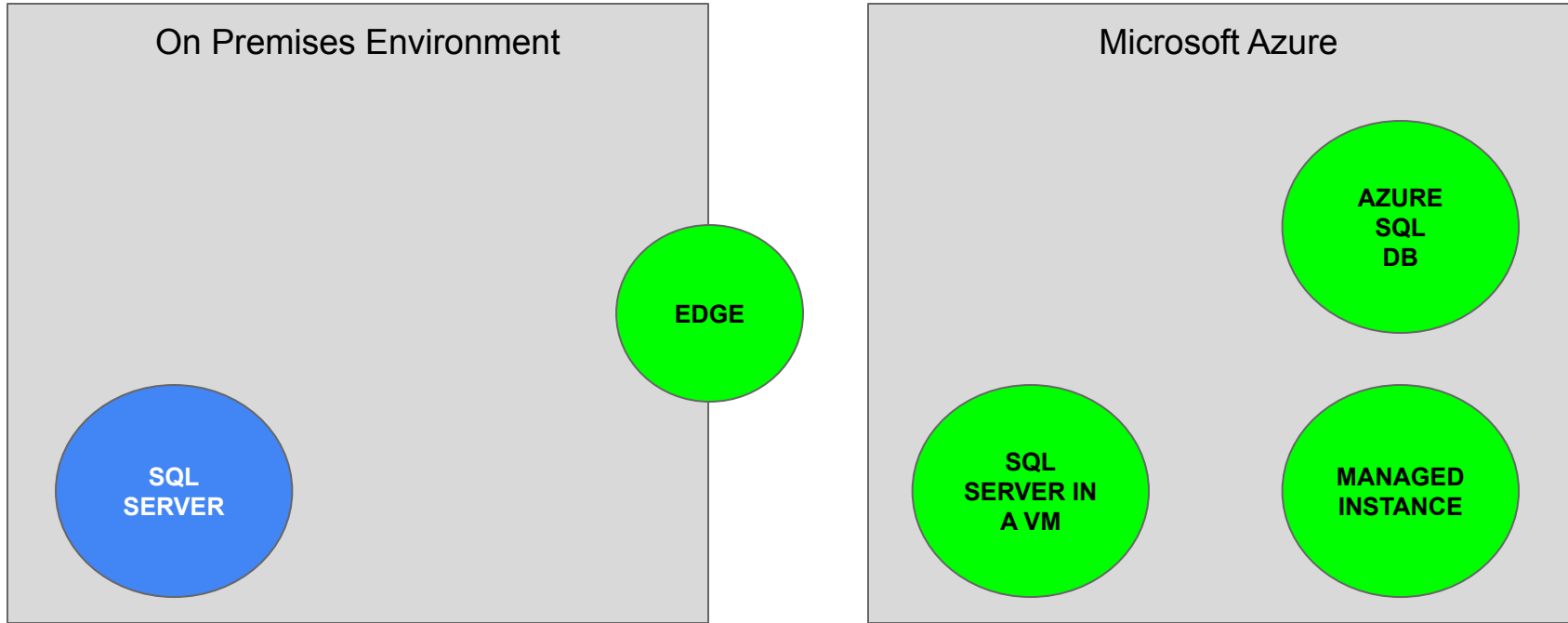
Want Microsoft to manage more of the patching

Extremely critical database

Cost less of an issue

Closest compatibility to the SQL Server engine

What is Edge Computing?



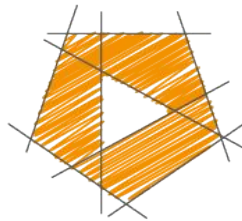
SQL Edge

“Small footprint, edge-optimized SQL Database engine with built-in AI”

Internet of Things (IoT) Database

**Ability to work
with data -
streaming, time
series**

Built-in Machine Learning / AI, Graph Features



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Functional Req.

Patching / Updates

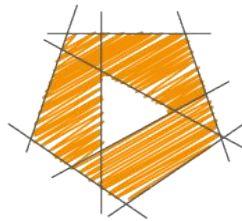
Intelligent Security

Cost

Expertise

SLA

Migration Time/Effort



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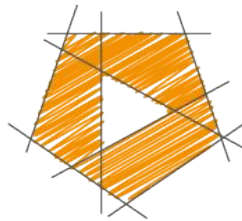
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Scaling Req.

Scale up/down

Read scale-out

**Global scale
out/sharding**



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HA/DR Req.

High Availability for Azure SQL Database, SQL MI

ges to choose from for easy configuration. [Learn more](#)

General Purpose (Scalable compute and storage options) 

vCore-based purchasing model

General Purpose (Scalable compute and storage options)

Hyperscale (On-demand scalable storage)

Business Critical (High transaction rate and high resiliency)

DTU-based purchasing model

Basic (For less demanding workloads)

Standard (For workloads with typical performance requirements)

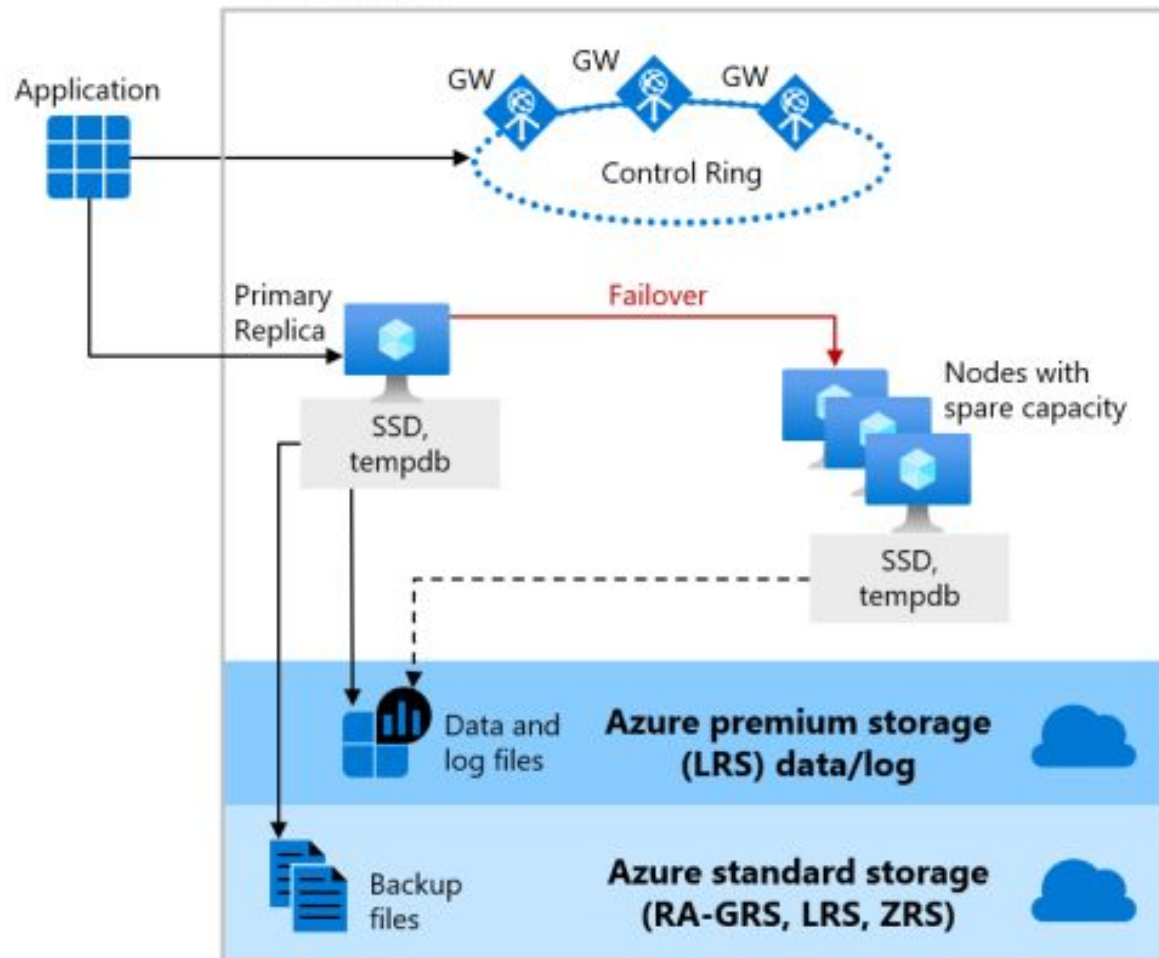
Premium (For IO-intensive workloads)

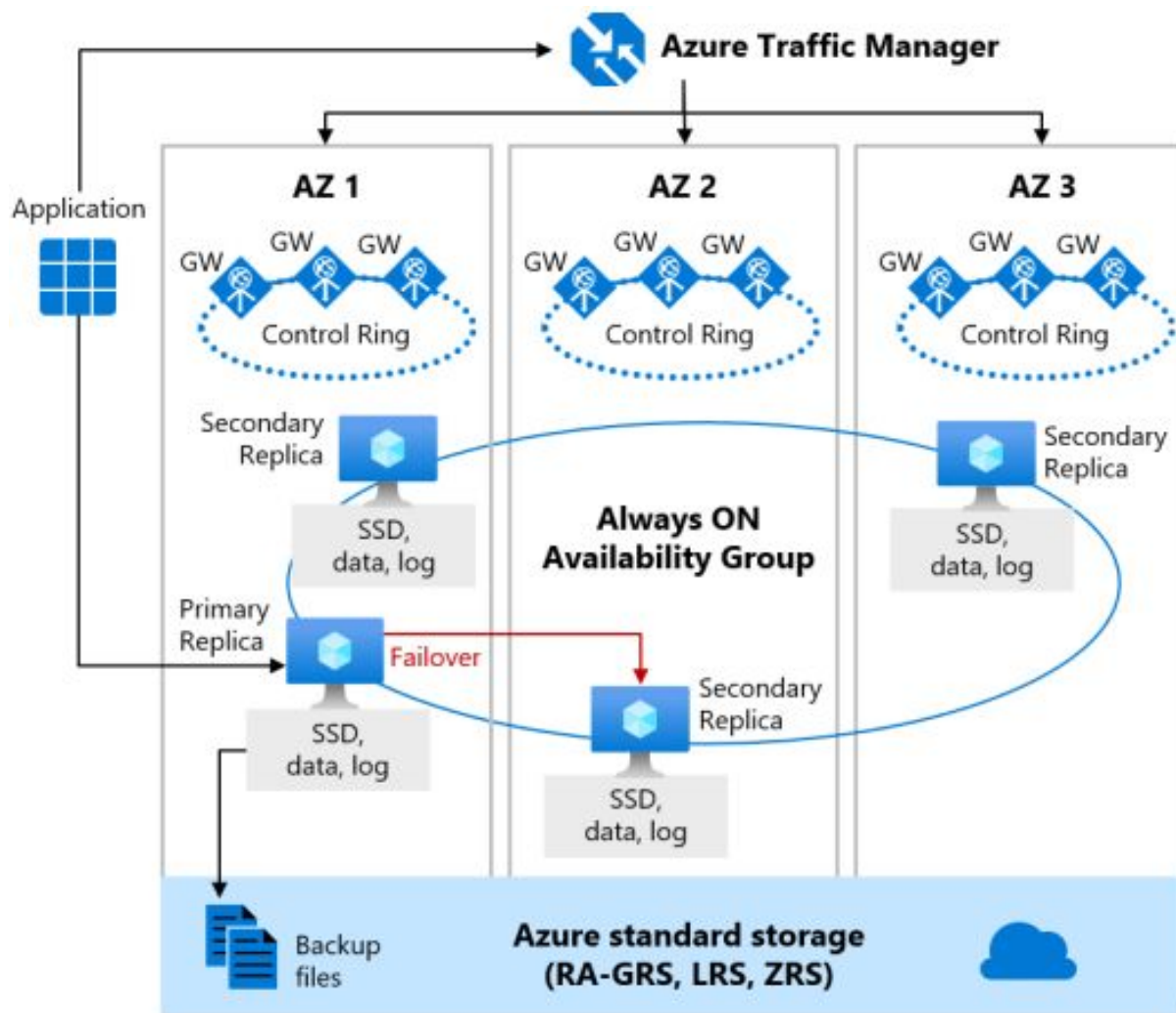
High Availability Architectures

Standard availability model - compute & storage separation

Premium availability model - cluster of db engine processes

Azure Region



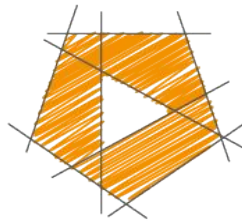


Zone Redundant Deployment

Would you like to make this database zone redundant? ⓘ

☒ Yes ☐ No

SQL in a VM



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Security Req.



Network: IP Firewall

Network: Virtual Network Endpoints

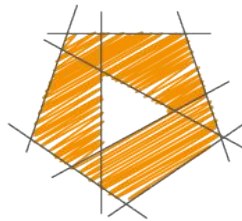
Access:
Authenticaiton

Authorization

Threat Protection

Encryption

Azure Defender



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Requirements

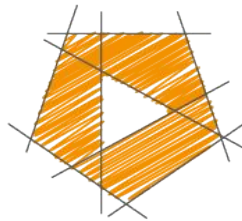
- Evaluate requirements for the deployment
- Evaluate the functional benefits/impact of possible database offerings
- Evaluate the scalability of the possible database offering
- Evaluate the HA/DR of the possible database offering
- Evaluate the security aspects of the possible database offering

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Introduction

- Understand requirements
- After deployment, check the db or instance status
- Use intelligence in Azure to deliver consistent performance
- HA/DR: backup/restore, failover clusters, Always On availability groups
- Security: protect your data, manage security (eg. auditing)

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Scaling

Requirements

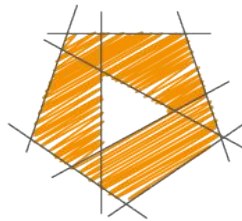
- Configure Azure SQL Database for scale and performance
- Configure Azure SQL managed instances for scale and performance
- Configure SQL Server in Azure VMs for scale and performance
- Calculate resource requirements
- Evaluate database partitioning techniques, such as database sharding
- Set up SQL Data Sync

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Introduction

- Managed Instances, Azure SQL and SQL Server
- Scale mem, CPU, I/O, indexes, partitions, and more
 - Vcore
 - DTU
- Use Resource Governor, MAXDOP, IQP, Auto Plan Correction, Auto Tuning, and more

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Introduction

- General requirements:
 - VNET, NSG's, FW (optional)
- Some requirements SQL Server to Azure SQL:
 - DMA, FW ports, SQL permissions
- Some requirements SQL Server to Managed Instance:
 - FW ports, SQL permissions, user account(s)

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Requirements

- Evaluate requirements for the migration
- Evaluate offline or online migration strategies
- Evaluate requirements for the upgrade
- Evaluate offline or online upgrade strategies

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Migration Strategy

Azure Database Migration Service

Requirements for DMS

- Prepare for the Azure Database Migration Service
- Allow communication to ports 443, 445, 59, 9354, 12000
- Configure firewall to allow communication between DMS and your source DB
- Configure Windows Firewall on the SQL Server Machine
- Enable TCP/IP Communication with that database

Migrate to Azure SQL Database

- Create an Azure SQL Database in the Azure portal
- Download Data Migration Assistant v3.3 or later
- Allow communication with port 1433 of the source db
- If the source db has multiple named instances on it, enable the SQL Browser Service and port 1434 to enable browsing of the instances
- Allow DMS access to the target db
- Ensure the credentials have the appropriate permissions

Migrate to SQL Managed Instance

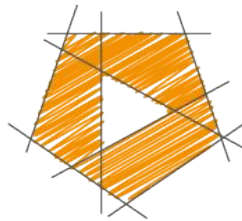
- Create an SQL Managed Instance in the Azure portal
- Allow SMB traffic over port 445 for the Azure Data Migration Service
- Allow communication with port 1433 of the source db
- If the source db has multiple named instances on it, enable the SQL Browser Service and port 1434 to enable browsing of the instances
- Ensure the credentials have the appropriate permissions

Online or Offline

If you have a large amount of data, it might be easier to use Azure Data Box

You can ship the data by hard disk to Azure, and they will give you access to that in your account

This could be if your data is 5TB+ - uploading that data over the wire becomes time consuming or risky



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Upgrade Strategy

Upgrading to SQL Server 2019

- Scenario: You're running an older version of SQL Server like 2012, 2014, 2016 or 2017
- Scenario: You're running a 32-bit version of SQL Server and want to go to a 64-bit version
- Scenario: You're running a Standard/Developer/Web/Express version of SQL Server and want to upgrade to a higher Edition

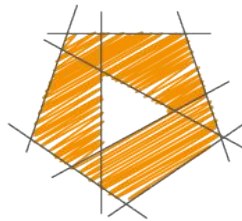
Data Migration Assistant

Multiple Techniques

Backup and restore for 2008 R2 or higher

Log shipping for 2008 SP3 or higher

Bulk load for 2008 or higher



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Implement Migration

Requirements

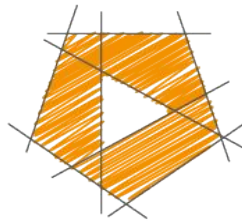
- Implement an online migration strategy
- Implement an offline migration strategy
- Implement an online upgrade strategy
- Implement an offline upgrade strategy

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Introduction

- Migrate from SQL Server to Azure SQL or Managed Instance
- Use Azure Database Migration Service (Online/Offline)
- Upgrades can rely on db backups for DR, or geo-replication for DR (online)
- Regular SQL Server Setup (offline)

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DB

Authentication

Requirements

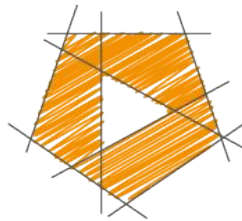
- Configure Azure AD authentication
- Create users from Azure AD identities
- Configure security principals

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Introduction

- AAD vs AD
- SQL Server authentication or Windows Authentication
- Logins and Server Roles are used on server-level
- Users, db roles and app roles are used on db level

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DB

Authorization

Requirements

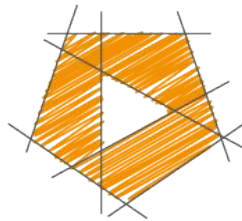
- Configure database and object-level permissions using graphical tools
- Apply principle of least privilege for all securables

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Introduction

- 4 basic DML permissions:
 - SELECT, INSERT, UPDATE, DELETED
- Always provide as less permissions as possible

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**Secure
Data At Rest**

Requirements

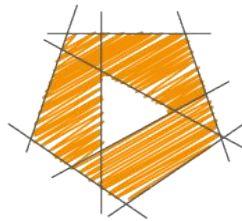
- Implement Transparent Data Encryption (TDE)
- Implement object-level encryption
- Implement Dynamic Data Masking
- Implement Azure Key Vault and disk encryption for Azure VMs

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Introduction

- Encryption at rest protects data files, transaction log files, and backup files (TDE)
- Azure Key Vault
- Doesn't encrypt data within tables
- Use DDM to prevent users from seeing sensitive data (eg. XXX-XX-1234)

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Secure Data In Transit

Requirements

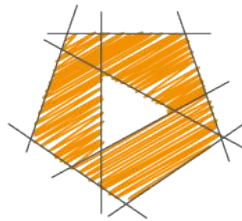
- Configure server and database-level firewall rules
- Implement Always Encrypted

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Introduction

- Each Azure SQL db maps to a public IP
- Grant access only when needed
- Virtual network endpoints
- Private link
- Protect data at rest and in transit
 - 2 types: deterministic and randomized (most secure)

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Introduction

- Classify data: column basis, labels, column names (auto), SSMS or T-SQL (manual)
- Advanced Threat Protection checks for:
 - Suspicious db activities
 - Potential db vulnerabilities
 - SQL Injection Attacks
 - Anomalous db access and query patterns
- Always enable auditing with Azure SQL db

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Compliance Controls

Requirements

- Apply a data classification strategy
- Configure server and database audits
- Implement data change tracking
- Perform vulnerability assessment

Data Classifications

Non-business data

Public data

General data

Confidential

Highly confidential

Data Discovery & Classification

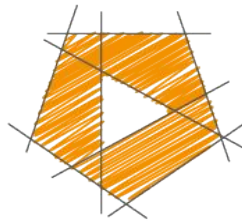
**Built into Azure
SQL Database
and Managed
Instance**

Recommendations

Apply Labels

Audit sensitivity of queries

**View reports in
Azure Portal**



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Monitor Performance

Performance Baseline

Measuring Baseline Performance

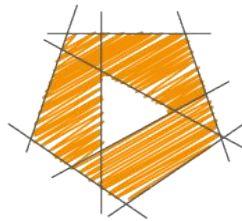
What does the system performance look like under normal conditions?

- Peak and off-peak?
- Query response times?
- Database backup and restore times?

Items that Affect Performance

- System resources
- Network architecture
- Operating system
- Database applications
- Client applications

**Measure
performance on
a regular basis
to establish
“normal”**



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Requirements

- Prepare an operational performance baseline
- Determine sources for performance metrics
- Interpret performance metrics
- Configure and monitor activity and performance at the infrastructure, server, service, and database levels

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Introduction

- A baseline is a collection of metrics that helps you understand the normal “steady state” of your app or server’s performance
- Azure Monitor
 - Configure Alerts for metrics
- Azure SQL db intelligent insights: captures runtime statistics and execution plan history

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**Implement
Performance
Maintenance**

Requirements

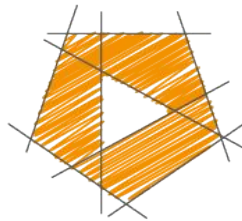
- Implement index maintenance tasks
- Implement statistics maintenance tasks
- Configure database auto-tuning
- Manage storage capacity

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Introduction

- Fragmentation happens over time, therefore:
 - Rebuild Indexes
- Statistics are used on columns and indexes to build execution plans, therefore:
 - Keep them up to date with “auto-update statistics”
- Last known good execution plan will be reverted via auto-tuning

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Identify Performance Issues

Requirements

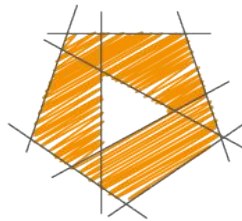
- Configure Query Store to collect performance data
- Identify sessions that cause blocking
- Assess growth/fragmentation of databases and logs
- Assess performance-related database configuration parameters

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Introduction

- Query Store tracks query execution plans and runtime statistics
 - Contains reports to identify execution plans
- Use DMVs to identify in real time:
 - `Sys.dm_tran_locks`
 - `Sys.dm_exec_requests`
- Performance related db config parameters:
 - `AutoClose`
 - `AutoShrink`
 - `AutoGrowth`

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**Optimize
Resource
Performance**

Azure Resources Have Known Performance Characteristics

SQL Server in a VM

IO/s, MB/s of the disk

Managed Storage

- **Ultra Disk SSD** - 2,000 MB/s throughput, 160,000 IOPS
- **Premium SSD** - 900 MB/s throughput, 20,000 IOPS
- **Standard SSD** - 750 MB/s throughput, 6,000 IOPS
- **Standard HDD** - 500 MB/s throughput, 2,000 IOPS

Disk caching

**ReadOnly
caching for data
disk**

**No caching for
log files**

**Select proper
VM size or
SQL DB tier**

**Place database
close to client
applications**

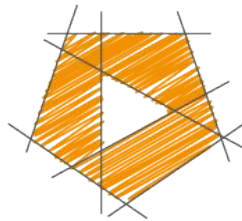
**Minimize the
amount of data
over a network
for query results**

**Minimize the
number of
queries**

**Keep the
connection open
for as long as
you need it**

tempdb size

Configure file and filegroup size growth



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Requirements

- Configure storage and infrastructure resources
- Configure server and service account settings for performance
- Configure Resource Governor for performance

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Introduction

- Available SQL Server storage types:
 - Blob
 - File
 - Disk
- Use either Premium SSD or Ultra Disk
- Can use Storage Spaces in Windows for extra throughput
- VM and TempDB sizing
- Resource Governor allows balancing resources allocated to workloads within SQL Server or Managed Instances

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Optimize Database Performance

Database Scoped Configuration

**T-SQL that
operates at the
database level**

```

ALTER DATABASE SCOPED CONFIGURATION
{
    { [ FOR SECONDARY] SET <set_options>}
}
| CLEAR PROCEDURE_CACHE [plan_handle]
| SET < set_options >
[;]

< set_options > ::=
{
    MAXDOP = { <value> | PRIMARY}
    | LEGACY_CARDINALITY_ESTIMATION = { ON | OFF | PRIMARY}
    | PARAMETER_SNIFFING = { ON | OFF | PRIMARY}
    | QUERY_OPTIMIZER_HOTFIXES = { ON | OFF | PRIMARY}
    | IDENTITY_CACHE = { ON | OFF }
    | INTERLEAVED_EXECUTION_TVF = { ON | OFF }
    | BATCH_MODE_MEMORY_GRANT_FEEDBACK = { ON | OFF }
    | BATCH_MODE_ADAPTIVE_JOINS = { ON | OFF }
    | TSQL_SCALAR_UDF_INLINING = { ON | OFF }
    | ELEVATE_ONLINE = { OFF | WHEN_SUPPORTED | FAIL_UNSUPPORTED }
    | ELEVATE_RESUMABLE = { OFF | WHEN_SUPPORTED | FAIL_UNSUPPORTED }
    | OPTIMIZE_FOR_AD_HOC_WORKLOADS = { ON | OFF }
    | XTP_PROCEDURE_EXECUTION_STATISTICS = { ON | OFF }
    | XTP_QUERY_EXECUTION_STATISTICS = { ON | OFF }
    | ROW_MODE_MEMORY_GRANT_FEEDBACK = { ON | OFF }
    | BATCH_MODE_ON_ROWSTORE = { ON | OFF }
    | DEFERRED_COMPILATION_TV = { ON | OFF }
    | ACCELERATED_PLAN_FORCING = { ON | OFF }
    | GLOBAL_TEMPORARY_TABLE_AUTO_DROP = { ON | OFF }
    | LIGHTWEIGHT_QUERY_PROFILING = { ON | OFF }
    | VERBOSE_TRUNCATION_WARNINGS = { ON | OFF }
    | LAST_QUERY_PLAN_STATS = { ON | OFF }
    | PAUSED_RESUMABLE_INDEX_ABORT_DURATION_MINUTES = <time>
    | ISOLATE_SECURITY_POLICY_CARDINALITY = { ON | OFF }
    | EXEC_QUERY_STATS_FOR_SCALAR_FUNCTIONS = { ON | OFF }
    | ASYNC_STATS_UPDATE_WAIT_AT_LOW_PRIORITY = { ON | OFF }
}

```

CLEAR PROCEDURE_CACHE
[plan_handle]

```
ALTER DATABASE SCOPED CONFIGURATION CLEAR PROCEDURE_CACHE;
```

ALTER DATABASE SCOPED CONFIGURATION

CLEAR PROCEDURE_CACHE

0x06000500F443610F003B7CD12C02000001000000000000000000
00;

MAXDOP = {<value> | PRIMARY } <value>


```
ALTER DATABASE SCOPED CONFIGURATION SET MAXDOP = 1 ;  
ALTER DATABASE SCOPED CONFIGURATION FOR SECONDARY SET MAXDOP = 4 ;
```

```
ALTER DATABASE SCOPED CONFIGURATION FOR SECONDARY SET MAXDOP = PRIMARY ;
```

**BATCH_MODE_MEMORY_GRANT_
FEEDBACK = { ON | OFF }**

```
BATCH_MODE_ADAPTIVE_JOINS =  
{ ON | OFF }
```

ALTER DATABASE SET

```

ALTER DATABASE { database_name | CURRENT }
SET
{
    <option_spec> [ ,...n ] [ WITH <termination> ]
}

<option_spec> ::=
{
    <accelerated_database_recovery>
  | <auto_option>
  | <automatic_tuning_option>
  | <change_tracking_option>
  | <containment_option>
  | <cursor_option>
  | <database_mirroring_option>
  | <date_correlation_optimization_option>
  | <db_encryption_option>
  | <db_state_option>
  | <db_update_option>
  | <db_user_access_option>
  | <delayed_durability_option>
  | <external_access_option>
  | FILESTREAM ( <FILESTREAM_option> )
  | <HADR_options>
  | <mixed_page_allocation_option>
  | <parameterization_option>
  | <query_store_options>
  | <recovery_option>
  | <remote_data_archive_option>
  | <service_broker_option>
  | <snapshot_option>
  | <sql_option>
  | <target_recovery_time_option>
  | <termination>
  | <temporal_history_retention>
  | <data_retention_policy>
}
;

```

```
<change_tracking_option> ::=  
{  
    CHANGE_TRACKING  
    {  
        = OFF  
        | = ON [ ( <change_tracking_option_list > [,...n] ) ]  
        | ( <change_tracking_option_list> [,...n] )  
    }  
}  
  
<change_tracking_option_list> ::=  
{  
    AUTO_CLEANUP = { ON | OFF }  
    | CHANGE_RETENTION = retention_period { DAYS | HOURS | MINUTES }  
}
```

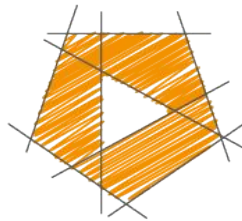
```

<query_store_options> ::=
{
    QUERY_STORE
    {
        = OFF [ ( FORCED ) ]
        | = ON [ ( <query_store_option_list> [,...n] ) ]
        | ( < query_store_option_list> [,...n] )
        | CLEAR [ ALL ]
    }
}

<query_store_option_list> ::=
{
    OPERATION_MODE = { READ_WRITE | READ_ONLY }
    | CLEANUP_POLICY = ( STALE_QUERY_THRESHOLD_DAYS = number )
    | DATA_FLUSH_INTERVAL_SECONDS = number
    | MAX_STORAGE_SIZE_MB = number
    | INTERVAL_LENGTH_MINUTES = number
    | SIZE_BASED_CLEANUP_MODE = { AUTO | OFF }
    | QUERY_CAPTURE_MODE = { ALL | AUTO | CUSTOM | NONE }
    | MAX_PLANS_PER_QUERY = number
    | WAIT_STATS_CAPTURE_MODE = { ON | OFF }
    | QUERY_CAPTURE_POLICY = ( <query_capture_policy_option_list> [,...n] )
}

<query_capture_policy_option_list> ::=
{
    STALE_CAPTURE_POLICY_THRESHOLD = number { DAYS | HOURS }
    | EXECUTION_COUNT = number
    | TOTAL_COMPILE_CPU_TIME_MS = number
    | TOTAL_EXECUTION_CPU_TIME_MS = number
}

```

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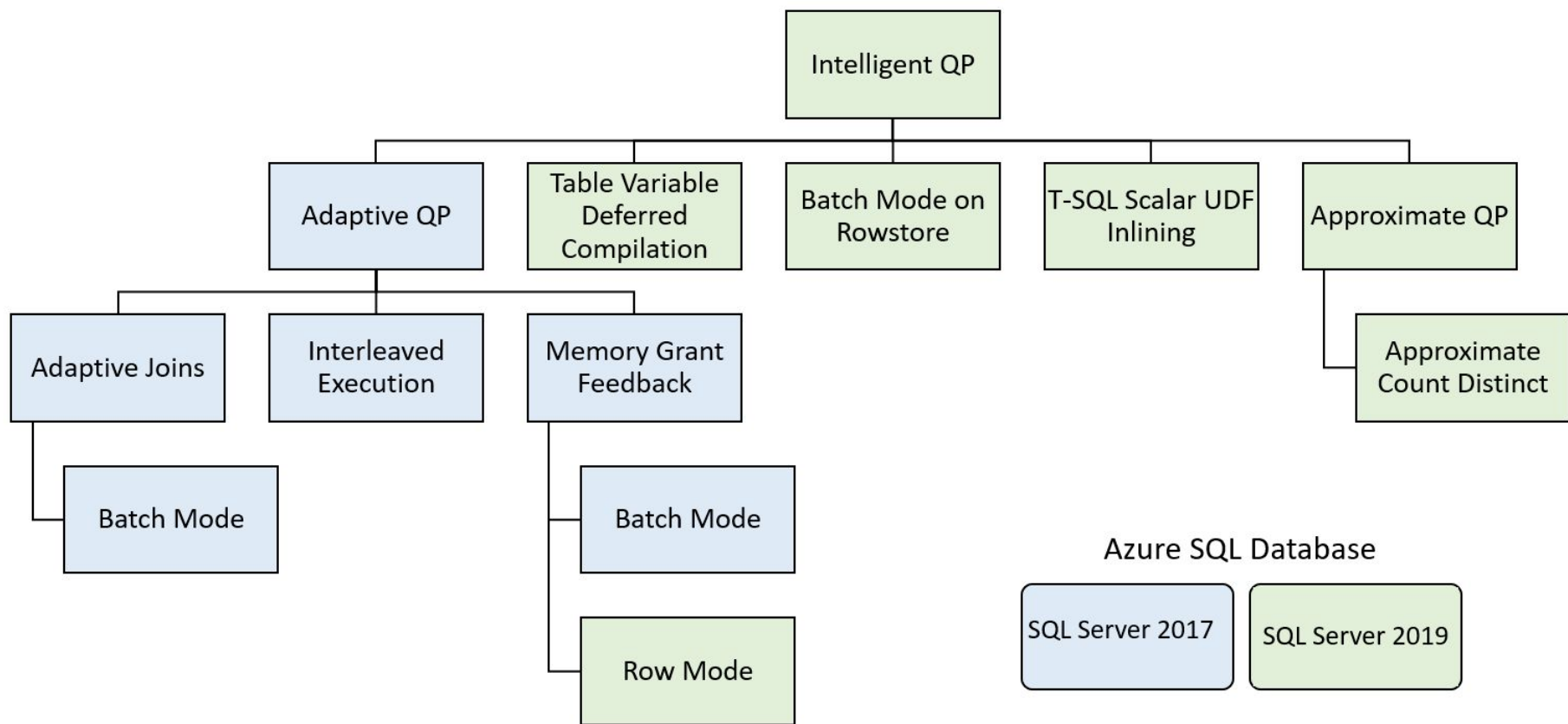
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Administering Relational Databases in Azure

Optimize Database Performance

Intelligent Query Processing (QP)



```
ALTER DATABASE [WideworldImportersDW] SET COMPATIBILITY_LEVEL = 150;
```

Batch mode
Adaptive joins

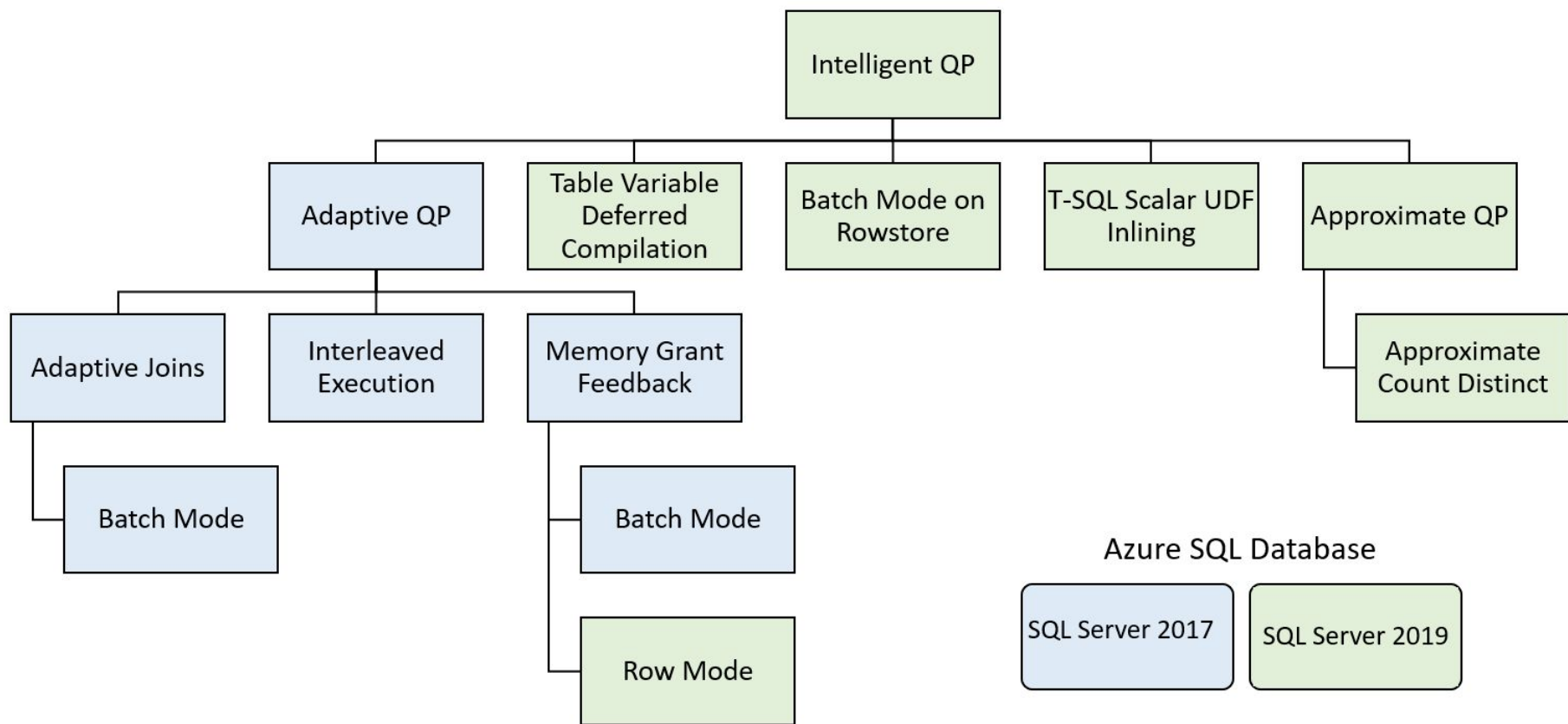
IQP Feature	Supported in Azure SQL Database and Azure SQL Managed Instance	Supported in SQL Server	Description
Adaptive Joins (Batch Mode)	Yes, under compatibility level 140	Yes, starting in SQL Server 2017 (14.x) under compatibility level 140	Adaptive joins dynamically select a join type during runtime based on actual input rows.

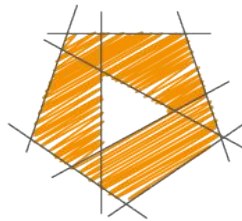
**Batch mode
memory grant
feedback**

IQP Feature	Supported in Azure SQL Database and Azure SQL Managed Instance	Supported in SQL Server	Description
Memory Grant Feedback (Batch Mode)	Yes, under compatibility level 140	Yes, starting in SQL Server 2017 (14.x) under compatibility level 140	If a batch mode query has operations that spill to disk, add more memory for consecutive executions. If a query wastes > 50% of the memory allocated to it, reduce the memory grant size for consecutive executions.

**Approximate
Count Distinct**

IQP Feature	Supported in Azure SQL Database and Azure SQL Managed Instance	Supported in SQL Server	Description
Approximate Count Distinct	Yes	Yes, starting in SQL Server 2019 (15.x)	Provide approximate COUNT DISTINCT for big data scenarios with the benefit of high performance and a low memory footprint.





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Administering Relational Databases in Azure

Query Plans

Requirements

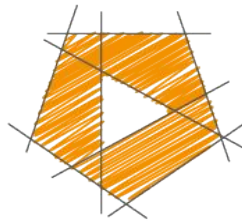
- Determine the appropriate type of execution plan
- Identify problem areas in execution plans
- Extract query plans from the Query Store

SLIDES

Introduction

- Three types of executions plans:
 - Estimated execution plans
 - Actual execution plans
 - Live query statistics
- Plans should be read from top to bottom and right to left

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Administering Relational Databases in Azure

**Evaluate
Performance**

Requirements

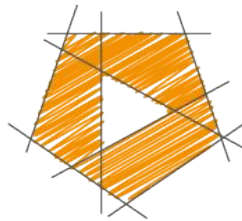
- Determine the appropriate Dynamic Management Views (DMVs) to gather query performance information
- Identify performance issues using DMVs
- Identify and implement index changes for queries
- Recommend query construct modifications based on resource usage
- Assess the use of hints for query performance

SLIDES

Introduction

- Data regarding database performance and status is provided by Dynamic Manage Views and Functions
- Use Index tuning methodology to improve query performance
- Query hints suggest behavior that should be utilized throughout the query
 - Eg. Limit the amount of memory granted to query

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Administering Relational Databases in Azure

Table and Index Design

Requirements

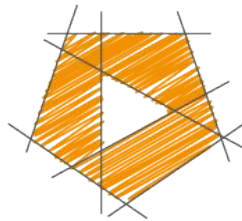
- Identify data quality issues with duplication of data
- Identify normal form of database
- Assess index design for performance
- Validate data types defined for columns
- Recommend table and index storage including filegroups
- Evaluate table partitioning strategy
- Evaluate the use of compression for tables and indexes

SLIDES

Introduction

- Database normalization is a design technique that organizes db data into tables and columns
 - Goal: reduce duplication
- Use the same data types in app code and db tables
- Index types:
 - (Non) Clustered and Columstore (allows higher compression)

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Administering Relational Databases in Azure

Scheduled Tasks

Requirements

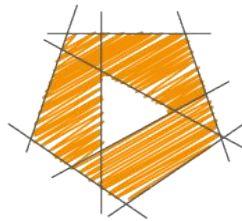
- Manage schedules for regular maintenance jobs
- Configure multi-server automation
- Configure notifications for task success/failure/non-completion

SLIDES

Introduction

- Databases require frequent maintenance, eg.:
 - Db Backups
 - Db Consistency Checks
- The SQL Server Agent provides:
 - Automation for SQL Server and Managed Instances
 - Notifications for job failures/success
- The SQL Server Agent can execute jobs on remote servers

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Administering Relational Databases in Azure

Alerts and Notifications

Requirements

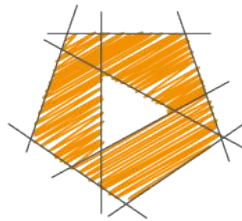
- Create event notifications based on metrics
- Create event notifications for Azure resources
- Create alerts for server configuration changes
- Create tasks that respond to event notifications

SLIDES

Introduction

- The SQL Server Agent can also be used to alert on performance conditions
 - Eg. High CPU utilization
- Use Extended Events to troubleshoot issues, eg.:
 - Blocking and deadlocking performance issues

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Administering Relational Databases in Azure

Manage Azure Alerts

Requirements

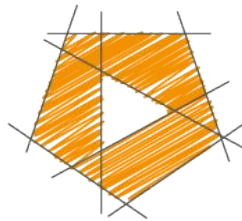
- Perform automated deployment methods for resources
- Implement policies by using automated evaluation modes

SLIDES

Introduction

- ARM Templates offer the advantage of deploying a collection of resources in a single declarative template
- Admins utilize Azure Policy to guarantee uniformity throughout an Azure environment

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Administering Relational Databases in Azure

High-Availability Disaster Recovery Strategy

**HA involves two
things**

Scaling

Redundancy

**DR involves
backup strategy**

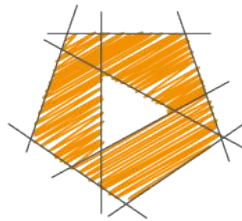
**Additional
complexities**

Hybrid issues

Data loss

Cost

RPO
RTO



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Requirements

- Recommend HADR strategy based on RPO/RTO requirements
- Evaluate HADR for hybrid deployments
- Evaluate Azure-specific HADR solutions
- Identify resources for HADR solutions

SLIDES

Introduction

- RPO is the point in time to which a database needs to be recovered
- RTO is the maximum length of time that resources may be brought back up following an outage or issue
- HADR IaaS:
 - Availability Zones, Availability sets and Azure Site Recovery
- HADR PaaS:
 - Built-in, just enable the feature
- Different (Azure) solutions provide different HADR features, eg.:
 - Always on availability group
 - Active Geo-Replication
 - Auto Failover Groups
 - Failover Cluster Instance

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Administering Relational Databases in Azure

Test HADR

Requirements

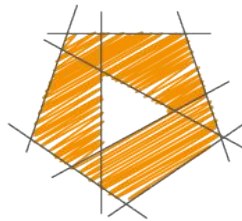
- Test HA by using failover
- Test DR by using failover or restore

SLIDES

Introduction

- Use Windows Server Failover Cluster Manager to test the configuration, or the Test-Cluster PowerShell cmdlet
- To test Always-On AG failover, use SQL Server Management Studio
- Azure SQL db Active Geo-Replication:
 - Auto-failover groups
 - Manual, automatic, planned, or unplanned failovers

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Administering Relational Databases in Azure

Backup and Restore

Requirements

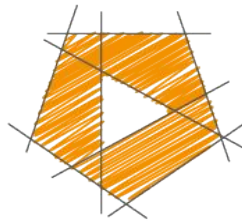
- Perform a database backup with options
- Perform a database restore with options
- Perform a database restore to a point in time
- Configure long-term backup retention

SLIDES

Introduction

- SQL Server backup types: Full, Differential, Transaction log
- Backup to and restore from URL
- If you need point-in-time recovery, do not use Simple recovery model
- Azure SQL and Managed Instances: auto backups
- For Azure SQL you can define backup retention

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Administering Relational Databases in Azure

High Availability and Disaster Recovery

Requirements

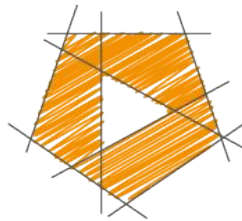
- Configure replication
- Configure auto-failover groups
- Create an Always On availability Group
- Integrate a database into an Always On Availability Group
- Configure quorum options for a Windows Server Failover Cluster
- Configure an Always On Availability Group listener
- Configure failover cluster instances on Azure VMs

SLIDES

Introduction

- Auto-failover groups depend on geo-replication
- Always On Availability Group protects instance (high availability)
- Always On Failover Cluster Instance protects database
 - Requires Active Directory
 - Quorum ensures that everything in the WSFC stays operational

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Administering Relational Databases in Azure

System Health

Requirements

- Evaluate database health using DMVs
- Evaluate server health using DMVs
- Perform database consistency checks by using DBCC

Version

SQL Server 2019 ▾



Filter by title

- Errors & events
- Event classes
- Native interfaces
- SQL PowerShell
- System catalog views
- System compatibility views
- System dynamic management views
 - System dynamic management views
 - Always On Availability Groups
 - Big Data Clusters
 - Change Data Capture
 - Change tracking

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System Dynamic Management Views

03/19/2021 • 3 minutes to read •  +8

Applies to:  SQL Server (all supported versions)  Azure SQL Database 
Azure SQL Managed Instance  Azure Synapse Analytics  Analytics Platform
System (PDW)

Dynamic management views and functions return server state information that can be used to monitor the health of a server instance, diagnose problems, and tune performance.

Important

Dynamic management views and functions return internal, implementation-specific state data. Their schemas and the data they return may change in future releases of SQL Server. Therefore, dynamic management views and functions in future releases may not be compatible with the dynamic management views and functions in this release. For example, in future releases of SQL Server, Microsoft may augment the definition of any dynamic management view by adding columns to the end of the column list. We

Is this page helpful?

Yes No

In this article

[Querying Dynamic Management Views](#)

[In This Section](#)

[See Also](#)

Dynamic Management Views

Generally have the **dm_*** naming convention

Uses the “**sys**” schema

```
SELECT wait_type, wait_time_ms
```

```
FROM sys.dm_os_wait_stats;
```

Required Permissions

Uses the **master** database

SELECT permission on the object itself

VIEW SERVER STATE or **VIEW DATABASE STATE** permissions

You can explicitly **DENY** access to objects that you don't want a user to have access to

Version

SQL Server 2019

Filter by title

Database

Database

[sys.dm_db_file_space_usage](#)[sys.dm_db_fts_index_physical_stats](#)[sys.dm_db_log_info](#)[sys.dm_db_log_space_usage](#)[sys.dm_db_log_stats](#)[sys.dm_db_page_info](#)[sys.dm_db_partition_stats](#)[sys.dm_db_persisted_sku_features](#)[sys.dm_db_session_space_usage](#)[sys.dm_db_task_space_usage](#)[sys.dm_db_uncontained_entities](#)[sys.dm_database_replica_states \(Azure SQL Database\)](#)[sys.](#)[dm_resource_governor_workload_groups](#)[_history_ex \(Azure SQL Database\)](#)

Database Mirroring

[Download PDF](#) [Retiring](#)

Database Related Dynamic Management Views (Transact-SQL)

01/29/2021 • 2 minutes to read • **Applies to:**  SQL Server (all supported versions)

This section describes the following dynamic management objects in SQL Server and sometimes in SQL Database.

[sys.dm_db_file_space_usage](#)[sys.dm_db_log_info](#)[sys.dm_db_log_stats](#)[sys.dm_db_partition_stats](#)[sys.dm_db_session_space_usage](#)[sys.dm_db_uncontained_entities](#)[sys.dm_db_wait_stats \(Azure SQL Database\)](#)[sys.dm_db_resource_stats \(Azure SQL Database\)](#)[sys.dm_operation_status \(Azure SQL Database\)](#)[sys.dm_db_fts_index_physical_stats](#)[sys.dm_db_log_space_usage](#)[sys.dm_db_page_info](#)[sys.dm_db_persisted_sku_features](#)[sys.dm_db_task_space_usage](#)[sys.dm_database_copies \(Azure SQL Database\)](#)[sys.dm_db_objects_impacted_on_version_change \(Azure SQL Database\)](#)

Is this page helpful?

[Yes](#) [No](#)

In this article

[See Also](#)

```
USE tempdb;  
GO  
SELECT SUM(unallocated_extent_page_count) AS [free pages],  
       (SUM(unallocated_extent_page_count)*1.0/128) AS [free space in MB]  
FROM sys.dm_db_file_space_usage;
```


Version

SQL Server 2019

Filter by title

[Resource Governor](#)[Security-Related](#)[Server-Related](#)**Server-Related**[sys.dm_server_memory_dumps](#)[sys.dm_server_services](#)[sys.dm_server_registry](#)[Service Broker](#)[Spatial data](#)[SQL Server Operating System](#)[Stretch Database](#)[Transactions](#)[System functions](#)[System information schema views](#)[System stored procedures](#)[System tables](#)[Transact-SQL \(T-SQL\) Reference](#)[xQuery](#)

Server-Related Dynamic Management Views and Functions (Transact-SQL)

01/29/2021 • 2 minutes to read • **Applies to:**  SQL Server (all supported versions)

This section contains the dynamic management views that are associated with the SQL Server, Full-text, and SQL Server Agent services that are installed on the host server. You can use these views to return property information for these services. These views also contain configuration, installation, and memory dump file information.

In This Section

[sys.dm_server_memory_dumps](#)[sys.dm_server_services](#)[sys.dm_server_registry](#)

Recommended content

[sys.dm_hadr_availability_group_states \(Transact-SQL\) - SQL Server](#)[sys.dm_hadr_availability_group_states \(Transact-SQL\)](#)

Is this page helpful?

[Yes](#) [No](#)

In this article

[In This Section](#)

Version

SQL Server 2019

Filter by title

SQL Server Operating System

sys.dm_os_buffer_descriptors

sys.

dm_os_buffer_pool_extension_configuration

sys.dm_os_child_instances

sys.dm_os_cluster_nodes

sys.dm_os_cluster_properties

sys.dm_os_dispatcher_pools

sys.dm_os_enumerate_fixed_drives

sys.dm_os_host_info

sys.dm_os_hosts

sys.dm_os_latch_stats

sys.dm_os_loaded_modules

sys.dm_os_memory_brokers

sys.dm_os_memory_cache_clock_hands

sys.dm_os_memory_cache_counters

sys.dm_os_memory_cache_entries

sys.dm_os_memory_cache_hash_tables

sys.dm_os_memory_clerks

sys.dm_os_memory_nodes

sys.dm_os_memory_objects

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SQL Server Operating System Related Dynamic Management Views (Transact-SQL)

03/30/2021 • 2 minutes to read • 

Applies to:  SQL Server (all supported versions)

This section documents dynamic management views (DMV) that are associated with SQL Server Operating System (SQLOS). SQLOS is responsible for managing operating system resources that are specific to SQL Server.

sys.dm_os_buffer_descriptors

sys.dm_os_buffer_pool_extension_configuration

sys.dm_os_child_instances

sys.dm_os_cluster_nodes

sys.dm_os_cluster_properties

sys.dm_os_dispatcher_pools

sys.dm_os_enumerate_fixed_drives

sys.dm_os_host_info

sys.dm_os_hosts

sys.dm_os_latch_stats

sys.dm_os_loaded_modules

sys.dm_os_memory_brokers

sys.dm_os_memory_cache_clock_hands

sys.dm_os_memory_cache_counters

sys.dm_os_memory_cache_entries

sys.dm_os_memory_cache_hash_tables

sys.dm_os_memory_clerks

sys.dm_os_memory_nodes

sys.dm_os_nodes

sys.dm_os_performance_counters

sys.dm_os_process_memory

sys.dm_os_schedulers

sys.dm_os_server_diagnostics_log_configurations

sys.dm_os_spinlock_stats

sys.dm_os_stacks

sys.dm_os_sys_info

sys.dm_os_sys_memory

sys.dm_os_tasks

sys.dm_os_threads

sys.dm_os_virtual_address_dump

sys.dm_os_volume_stats

sys.dm_os_waiting_tasks

sys.dm_os_wait_stats

sys.dm_os_windows_info

sys.dm_os_workers

The following SQL Server Operating System-related dynamic management views are Identified for informational purposes only. Not supported. Future compatibility is not guaranteed..

Is this page helpful?

 Yes  No

In this article

[See Also](#)

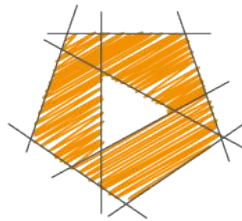
```
SELECT st.text AS [SQL Text], c.connection_id, w.session_id,  
       w.wait_duration_ms, w.wait_type, w.resource_address,  
       w.blocking_session_id, w.resource_description, c.client_net_address, c.connect_time  
FROM sys.dm_os_waiting_tasks AS w  
INNER JOIN sys.dm_exec_connections AS c ON w.session_id = c.session_id  
CROSS APPLY (SELECT * FROM sys.dm_exec_sql_text(c.most_recent_sql_handle)) AS st  
            WHERE w.session_id > 50 AND w.wait_duration_ms > 0  
ORDER BY c.connection_id, w.session_id  
GO
```

Database Console Commands (DBCC)

DBCC
CHECKDB

DBCC

SHRINKDATABASE



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Administering Relational Databases in Azure

Monitor DB Using T-SQL

Requirements

- Assess proper database autogrowth configuration
- Report on database free space
- Review database configuration options

**Autogrowth - a
contingency for
growth**

**Alerts and
monitoring -
proactive**

**Performance
penalty for
growing DB**

MAXSIZE

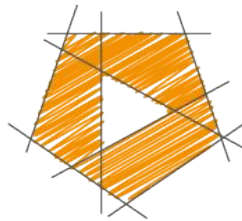
Autogrowth and Autoshrink

- The data files should all be the same size and have the same autogrowth settings
- Display data and log space information:

```
USE AdventureWorks2012;  
GO  
SELECT file_id, name, type_desc, physical_name, size, max_size  
FROM sys.database_files;  
  
GO
```

- To change the db option settings:

```
USE master;  
GO  
ALTER DATABASE AdventureWorks2012  
SET RECOVERY FULL, PAGE_VERIFY CHECKSUM;  
GO
```



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Administering Relational Databases in Azure

Backup and Restore Using T-SQL

Requirements

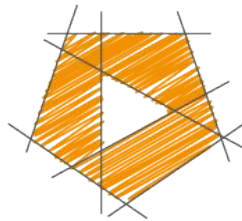
- Prepare databases for AlwaysOn Availability Groups
- Perform transaction log backup
- Perform restore of user databases
- Perform database backups with options

Introduction

- Preparing a db for Always On Availability Groups requires two steps
 1. Restore backup: RESTORE WITH NORECOVERY
 2. Join db to the Availability Group
- Transaction log backup example:

```
BACKUP LOG AdventureWorks2012  
    TO MyAdvWorks_FullRM_log1;  
GO
```

- Create backup options (SQL Server and Managed Instances):
 - SKIP, NOSKIP, INIT, and NOINIT



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Administering Relational Databases in Azure

Authentication Using T-SQL

Requirements

- Manage certificates
- Manage security principals

SLIDES

Introduction

- Manage certificate examples:
 - Remove private key:

```
ALTER CERTIFICATE Shipping04  
    REMOVE PRIVATE KEY;  
GO
```

- Change password that's used to encrypt private key:

```
ALTER CERTIFICATE Shipping11  
    WITH PRIVATE KEY (DECRYPTION BY PASSWORD = '95hkjdskghFDGGG4%',  
        ENCRYPTION BY PASSWORD = '34958tosdgfkh##38');  
GO
```

DEMO

Introduction

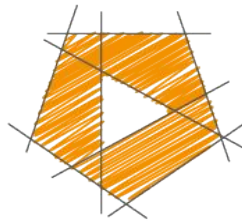
- Manage security principals examples:
 - Create login for a local AAD account:

```
USE master
GO
CREATE LOGIN login_name FROM EXTERNAL PROVIDER
GO
```

- Grant the AAD server principal the sysadmin role:

```
ALTER SERVER ROLE sysadmin ADD MEMBER login_name
GO
```

DEMO



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Administering Relational Databases in Azure

Authorization Using T-SQL

Requirements

- Configure permissions for users to access database objects
- Configure permissions by using custom roles

SLIDES

Requirements

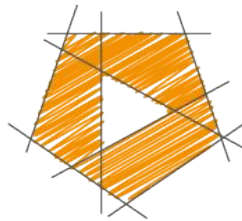
- Create a new db role in current db:

```
CREATE ROLE role_name [ AUTHORIZATION owner_name ]
```

- Grant column level permissions syntax:
 - <table_name>(<column_name>), eg.:

```
GRANT SELECT ON OBJECT::Customer(CustomerName) TO UserJoe;
```

DEMO



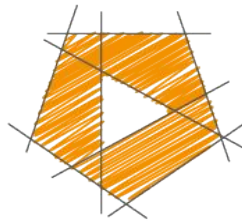
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Thank you!



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