Exam DP-420: Microsoft Azure Cosmos DB Developer Crash Course

Developing Cloud Native Applications Using Cosmos DB

October/2022

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Cloud Consultant and Trainer

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Course Overview

DP-420 Exam Page

https://docs.microsoft.com/en-us/certifications/exams/dp-420

Course Repository

https://github.com/zaalion/oreilly-dp-420

DP-420 Crash Course

- Design and implement data models
- Design and implement data distribution
- Integrate an Azure Cosmos DB solution
- Optimize an Azure Cosmos DB solution
- Maintain an Azure Cosmos DB solution

Design and Implement Data Models

Design a Non-relational Data Model for Azure Cosmos DB Core API

- Develop a design by storing multiple entity types in the same container
- Develop a design by storing multiple related entities in the same document
- Develop a model that denormalizes data across documents
- Develop a design by referencing between documents
- Identify primary and unique keys
- Identify data and associated access patterns
- Specify a default TTL on a container for a transactional store

Cosmos DB is a Schema-free Database

```
{
    "name": "Reza",
    "email": "Reza@contoso.com"
}
```

```
{
    "name": "Reza",
    "last": "Salehi"
    "email": "Reza@contoso.com",
    "Courses": [
        "DP-420",
        "AZ-900",
        "AZ-500",
        "AI-102"
    ]
}
```

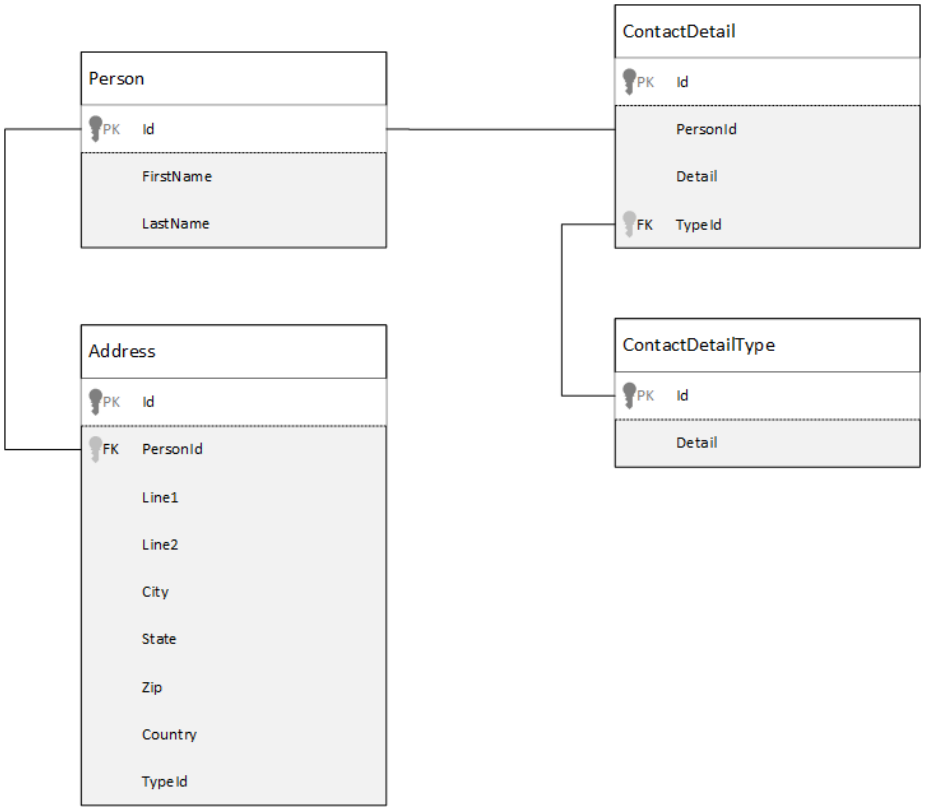
```
{
    "title": "C# Cookbook",
    "ISBN": "123-456-789"
}
```

Data Modeling in Azure Cosmos DB

- **Embed data**: Entities will be stored as self-contained items represented as JSON documents. (denormalized)
- **Reference data**: Entities will be stored as separate JSON documents with references to one another. (normalized)
- **Hybrid data models**: Combination of the above

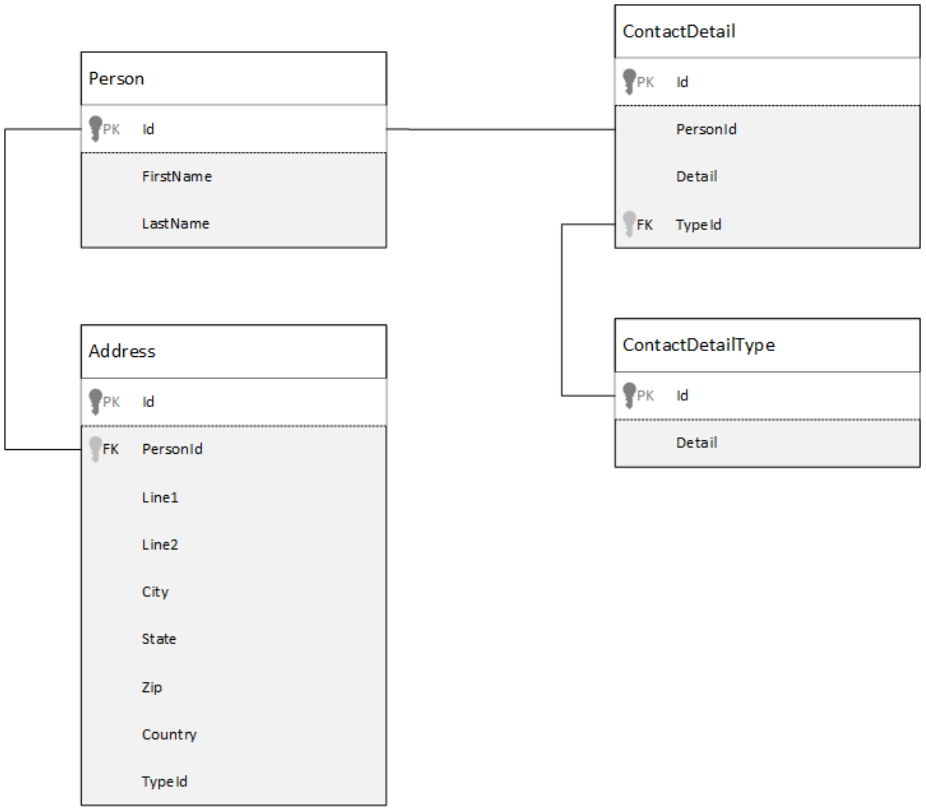
Reference

Embed Data



Reference

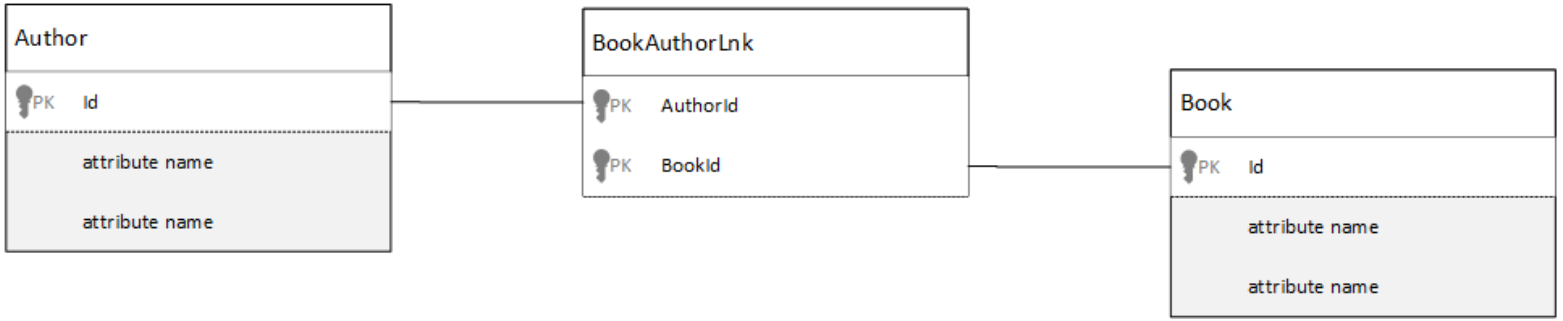
Embed Data




```
{
    "id": "1",
    "firstName": "Thomas",
    "lastName": "Andersen",
    "addresses": [
        {
            "line1": "100 Some Street",
            "line2": "Unit 1",
            "city": "Seattle",
            "state": "WA",
            "zip": 98012
        }
    ],
    "contactDetails": [
        {"email": "thomas@andersen.com"},
        {"phone": "+1 555 555-5555", "extension": 5555}
    ]
}
```

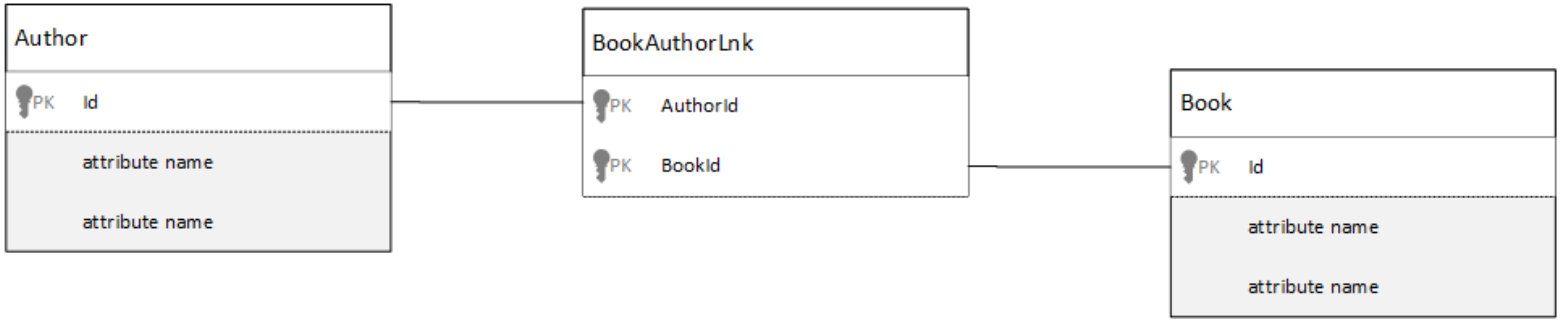
Reference

Reference Data



Reference

Reference Data



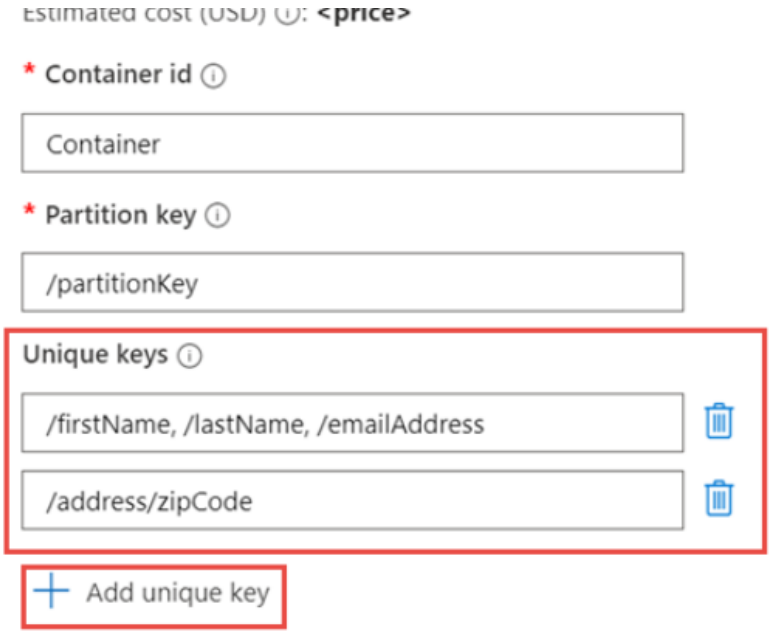

```
Publisher document:
{
    "id": "mspress",
    "name": "Microsoft Press",
    "books": [ 1, 2, 3, ..., 100, ..., 1000]
}

Book documents:
{"id": "1", "name": "Azure Cosmos DB 101" }
{"id": "2", "name": "Azure Cosmos DB for RDBMS Users" }
{"id": "3", "name": "Taking over the world one JSON doc at a time" }
...
{"id": "100", "name": "Learn about Azure Cosmos DB" }
...
{"id": "1000", "name": "Deep Dive into Azure Cosmos DB" }
```

Reference

Azure Cosmos DB Keys

- Partition Key (Primary Key)
- Unique Key



Time to Live (TTL) in Azure Cosmos DB

- Ability to delete items automatically from a container after a certain time period.

Design a Data Partitioning Strategy for Azure Cosmos DB Core API

- Choose a partitioning strategy based on a specific workload
- Choose a partition key
- Plan for transactions when choosing a partition key
- Evaluate the cost of using a cross-partition query
- Calculate and evaluate data distribution based on partition key selection
- Calculate and evaluate throughput distribution based on partition key selection
- Construct and implement a synthetic partition key
- Design partitioning for workloads that require multiple partition keys

Azure Cosmos DB Partitions

- Logical partitions: A set of items that have the same partition key.
- Physical partitions: Smaller containers could have many logical partitions, but they might only need a single physical partition. Physical partitions are entirely managed by Azure Cosmos DB.

Azure Cosmos DB Partition Key

- Its value should not change
- Only “string“ values
- This property should have a wide range of possible values to avoid “hot”, or “cold” partitions.
- Spread process, and data storage evenly across all logical partitions as much as possible
- **“A logical partition also defines the scope of database transactions”**

Reference

Cosmos DB Query Types

- In-partition query

- Cross-partition query

Reference

Cosmos DB Query Types

- In-partition query

```sql
SELECT * FROM c WHERE c.DeviceId = 'XMS-0001'
```

- Cross-partition query

```sql
SELECT * FROM c WHERE c.Location = 'Seattle`
```

Reference

Synthetic Partition Key

- It is best to have a partition key with several values, in the hundreds or thousands
- This results in evenly distributing the data (and workload)
- In many cases, such a property doesn't exist in your data, so you can create a synthetic partition key.

Reference

Synthetic Partition Key

```
{
"deviceId": "abc-123",
"date": 2018
}
```



```
{
"deviceId": "abc-123",
"date": 2018,
"partitionKey": "abc-123-2018"
}
```

Reference

Synthetic Partition Key Types

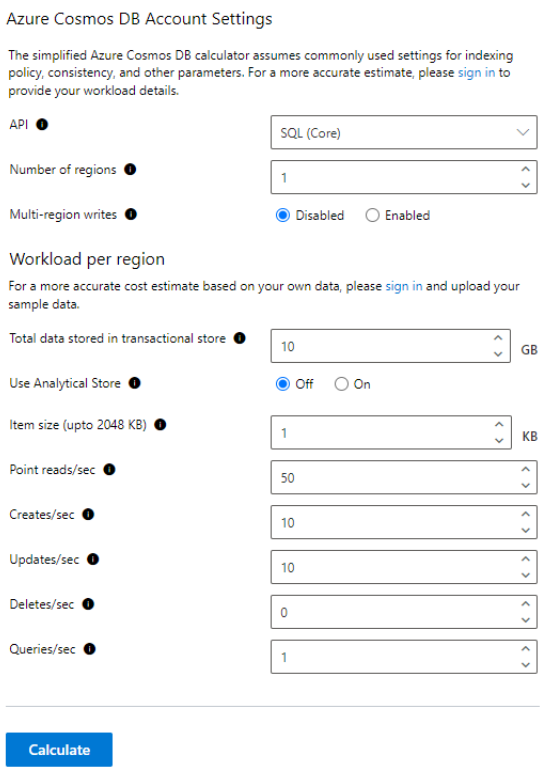
- Concatenate multiple properties of an item
- Use a partition key with a random suffix (e.g., 2022-09-09.24)
- Use a partition key with pre-calculated suffixes (e.g., Vehicle-Identification-Number, VIN)

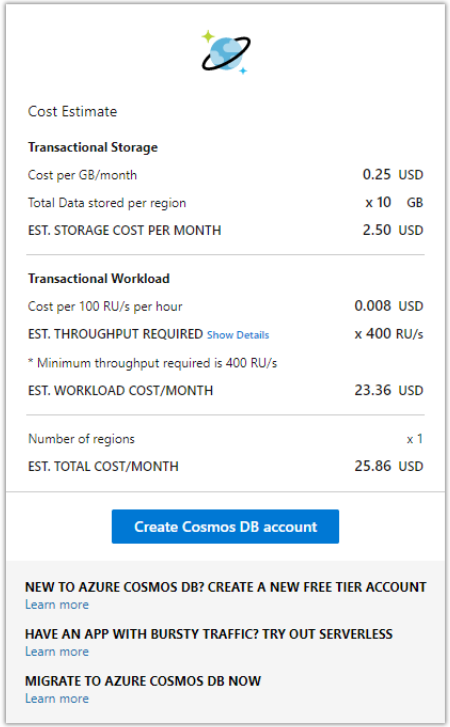
Reference

Plan and Implement Sizing and Scaling for a Database Created with Azure Cosmos DB

- Evaluate the throughput and data storage requirements for a specific workload
- Choose between serverless and provisioned models
- Choose when to use database-level provisioned throughput
- Design for granular scale units and resource governance
- Evaluate the cost of the global distribution of data
- Configure throughput for Azure Cosmos DB by using the Azure portal

Azure Cosmos DB Capacity Calculator





Cosmos DB Provisioning Models

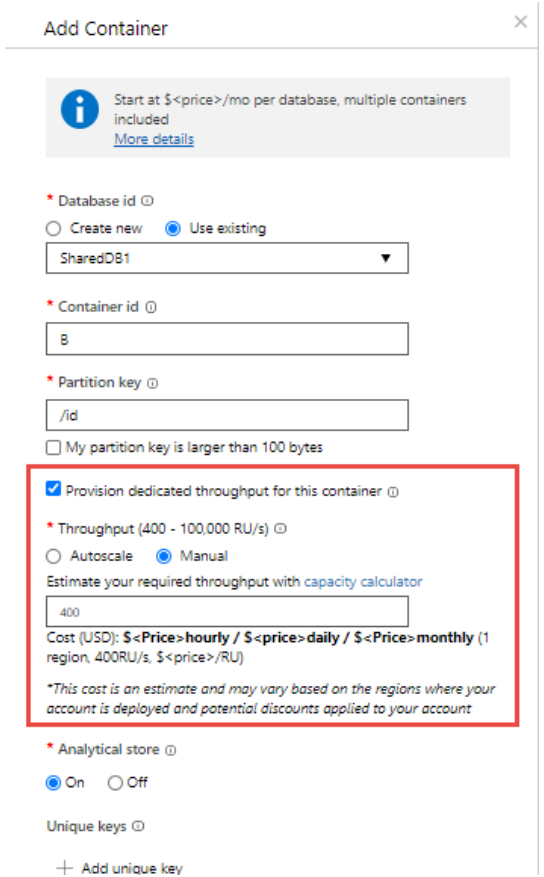
- Provisioned: You will set throughput (RUs) for your databases or/and containers
- Auto-scale: “Scale the throughput (RU/s) of your database or container automatically and instantly”
- Serverless: Use the Azure Cosmos account in a consumption-based mode

- Auto scale vs. Serverless

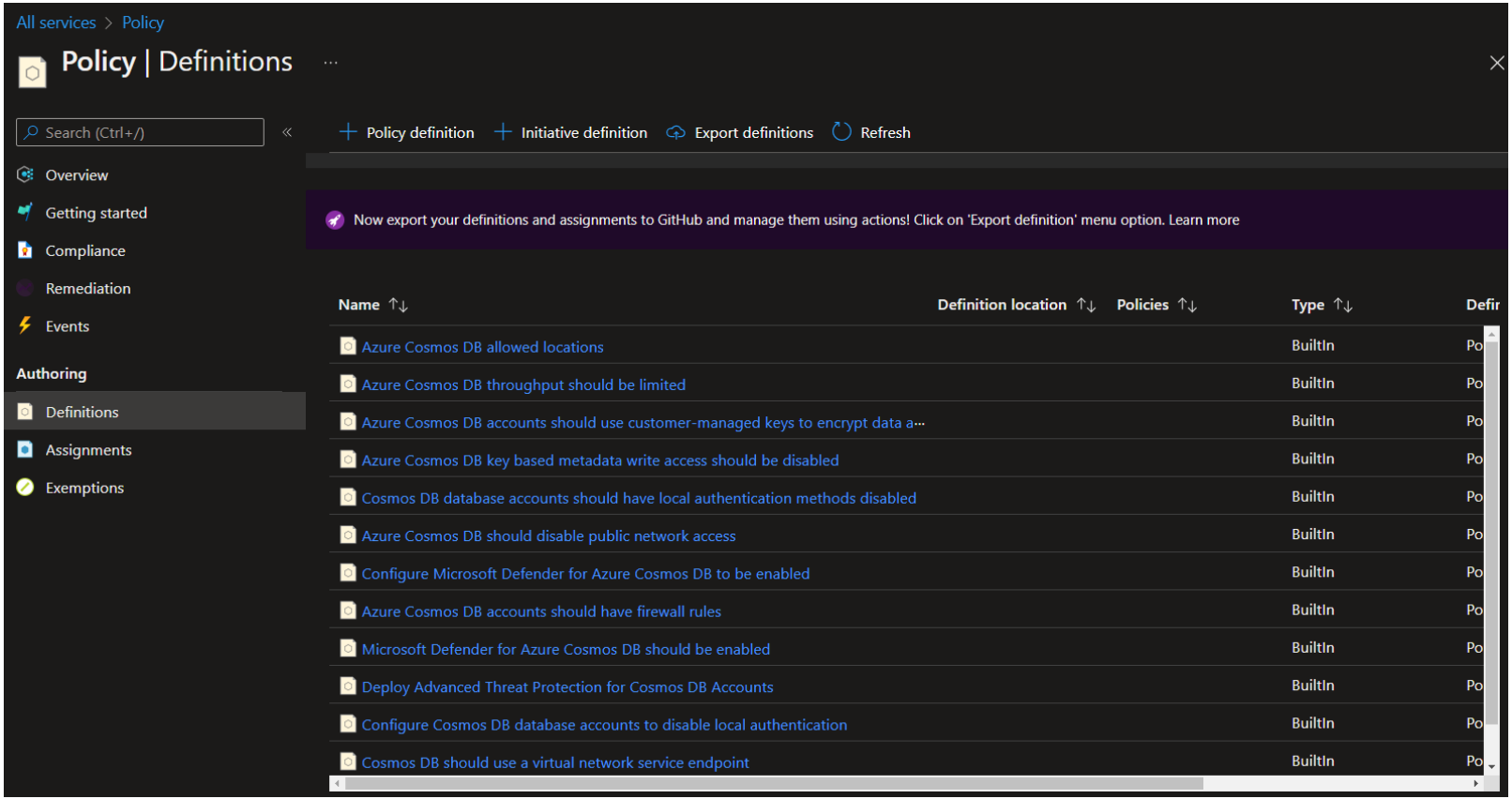
Reference

Provisioned throughput in Azure Cosmos DB

- At the Azure Cosmos DB containers level
- At the Azure Cosmos DB databases level



Govern Azure Cosmos DB



Implement Client Connectivity Options in the Azure Cosmos DB SDK

- Choose a connectivity mode (gateway versus direct)
- Implement a connectivity mode
- Create a connection to a database
- Enable offline development by using the Azure Cosmos DB emulator
- Handle connection errors (also see the these)
- Implement a singleton for the client
- Specify a region for global distribution
- Configure client-side threading and parallelism options
- Enable SDK logging

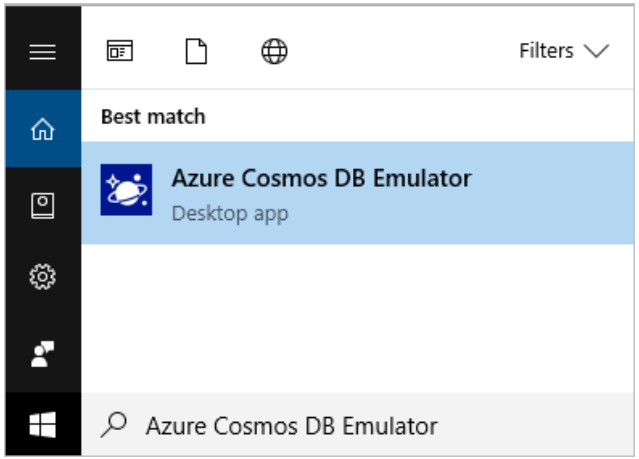
Azure Cosmos DB Connectivity Modes

- Gateway mode: Supported on all SDKs. Best option, if your application runs within a corporate network with strict firewall restrictions. It uses the standard HTTPS port and a single DNS endpoint.

- Direct mode: Supports TCP connectivity, using TLS for authentication and traffic encryption. It offers better performance

Azure Cosmos DB Emulator

- Allows developers to work offline without connecting to a live Azure Cosmos DB instance.
- You can download the emulator from Microsoft



Reference

Checklist for Troubleshooting Issues

- Use the latest SDK.
- Review the performance tips and follow the suggested practices.
- Enable the SDK logging to help you troubleshoot an issue.
- Log metrics by using the Azure portal.
- Portal metrics show the Azure Cosmos DB telemetry
- Log the diagnostics string in the V2 SDK or diagnostics in V3 SDK from the point operation responses.
- Log the SQL Query Metrics from all the query responses

Reference

Connection Errors

- Request header too large
- Request timeout exceptions
- Slow requests
- Service unavailable exceptions

Reference

Implement Data Access by Using the Azure Cosmos DB SQL Language

- Implement queries that use arrays, nested objects, aggregation, and ordering
- Implement a correlated subquery
- Implement queries that use array and type-checking functions
- Implement queries that use mathematical, string, and date functions
- Implement queries based on variable data

Implement Data Access by Using SQL API SDKs

- Choose when to use a point operation versus a query operation
- Implement a point operation that creates, updates, and deletes documents
- Implement an update by using a patch operation
- Manage multi-document transactions using SDK Transactional Batch
- Perform a multi-document load using Bulk Support in the SDK
- Implement optimistic concurrency control using ETags
- Implement session consistency by using session tokens
- Implement a query operation that includes pagination
- Implement a query operation by using a continuation token
- Handle transient errors and 429s
- Specify TTL for a document
- Retrieve and use query metrics

Point Operation vs. Query Operation

- Ways to read data in Cosmos DB
- Point reads (SDK): A key/value lookup on a single item ID and partition key.
- Query reads

	Point read (assumes 1 KB item)	**Query**
Latency	Typically less than 10 ms	Variable
RU charge	1 RU	At least 2.3 RUs, variable
Number of items returned	1 item	Unlimited (if results size is too large, results are split across multiple pages)
Include partition key?	Required	Recommended

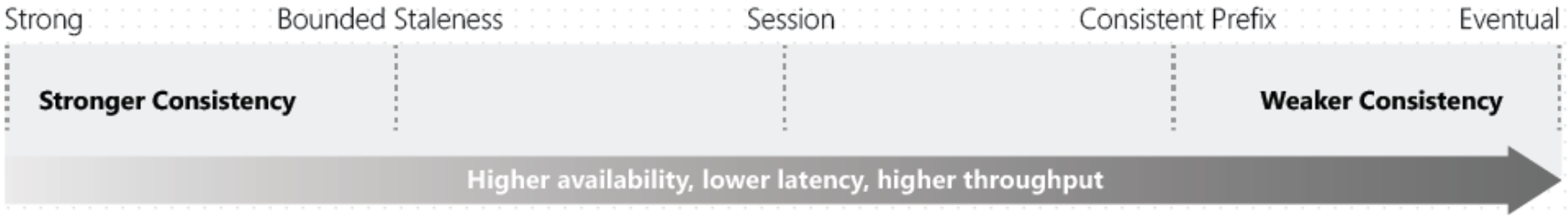
Reference

Document Update in Azure Cosmos DB

- Ways to update data in Cosmos DB
- Update the whole JSON record
- Partial document update

Reference

Azure Cosmos DB Consistency Levels



Reference

Specify TTL Using Cosmos DB SDK

.NET SDK v3 | Java SDK v4 | Node SDK | Python SDK

C# Copy

```
Database database = client.GetDatabase("database");

ContainerProperties properties = new ()
{
    Id = "container",
    PartitionKeyPath = "/customerId",
    // Never expire by default
    DefaultTimeToLive = -1
};

// Create a new container with TTL enabled and without any expiration value
Container container = await database
    .CreateContainerAsync(properties);
```

Reference

Specify TTL Using Cosmos DB SDK

.NET SDK v3 | Java SDK v4 | Node SDK | Python SDK

C# Copy

```
Database database = client.GetDatabase("database");

ContainerProperties properties = new ()
{
    Id = "container",
    PartitionKeyPath = "/customerId",
    // Expire all documents after 90 days
    DefaultTimeToLive = 90 * 60 * 60 * 24
};

// Create a new container with TTL enabled and without any expiration value
Container container = await database
    .CreateContainerAsync(properties);
```

Reference

Implement Server-side Programming in Azure Cosmos DB Core API by Using JavaScript

- Write, deploy, and call a stored procedure
- Design stored procedures to work with multiple items transactionally
- Implement and call triggers
- Implement a user-defined function

Cosmos DB Stored Procedures

JavaScript Copy

```javascript
var helloWorldStoredProc = {
    id: "helloWorld",
    serverScript: function () {
        var context = getContext();
        var response = context.getResponse();

        response.setBody("Hello, World");
    }
}
```

Reference

Cosmos DB Pre-triggers

JavaScript Copy

```javascript
function validateToDoItemTimestamp() {
    var context = getContext();
    var request = context.getRequest();

    // item to be created in the current operation
    var itemToCreate = request.getBody();

    // validate properties
    if (!("timestamp" in itemToCreate)) {
        var ts = new Date();
        itemToCreate["timestamp"] = ts.getTime();
    }

    // update the item that will be created
    request.setBody(itemToCreate);
}
```

Reference

Cosmos DB Post-triggers

JavaScript Copy

```
function updateMetadata() {
    var context = getContext();
    var container = context.getCollection();
    var response = context.getResponse();

    // item that was created
    var createdItem = response.getBody();

    // query for metadata document
    var filterQuery = 'SELECT * FROM root r WHERE r.id = "_metadata"';
    var accept = container.queryDocuments(container.getSelfLink(), filterQuery,
        updateMetadataCallback);
    if(!accept) throw "Unable to update metadata, abort";

    function updateMetadataCallback(err, items, responseOptions) {
        if(err) throw new Error("Error" + err.message);
            if(items.length != 1) throw 'Unable to find metadata document';

            var metadataItem = items[0];

            // update metadata
            metadataItem.createdItems += 1;
            metadataItem.createdNames += " " + createdItem.id;
            var accept = container.replaceDocument(metadataItem._self,
                metadataItem, function(err, itemReplaced) {
                        if(err) throw "Unable to update metadata, abort";
                });
            if(!accept) throw "Unable to update metadata, abort";
            return;
    }
}
```

Reference

Cosmos DB UDF

JavaScript Copy

```javascript
function tax(income) {
    if (income == undefined)
        throw 'no input';

    if (income < 1000)
        return income * 0.1;
    else if (income < 10000)
        return income * 0.2;
    else
        return income * 0.4;
}
```

Reference

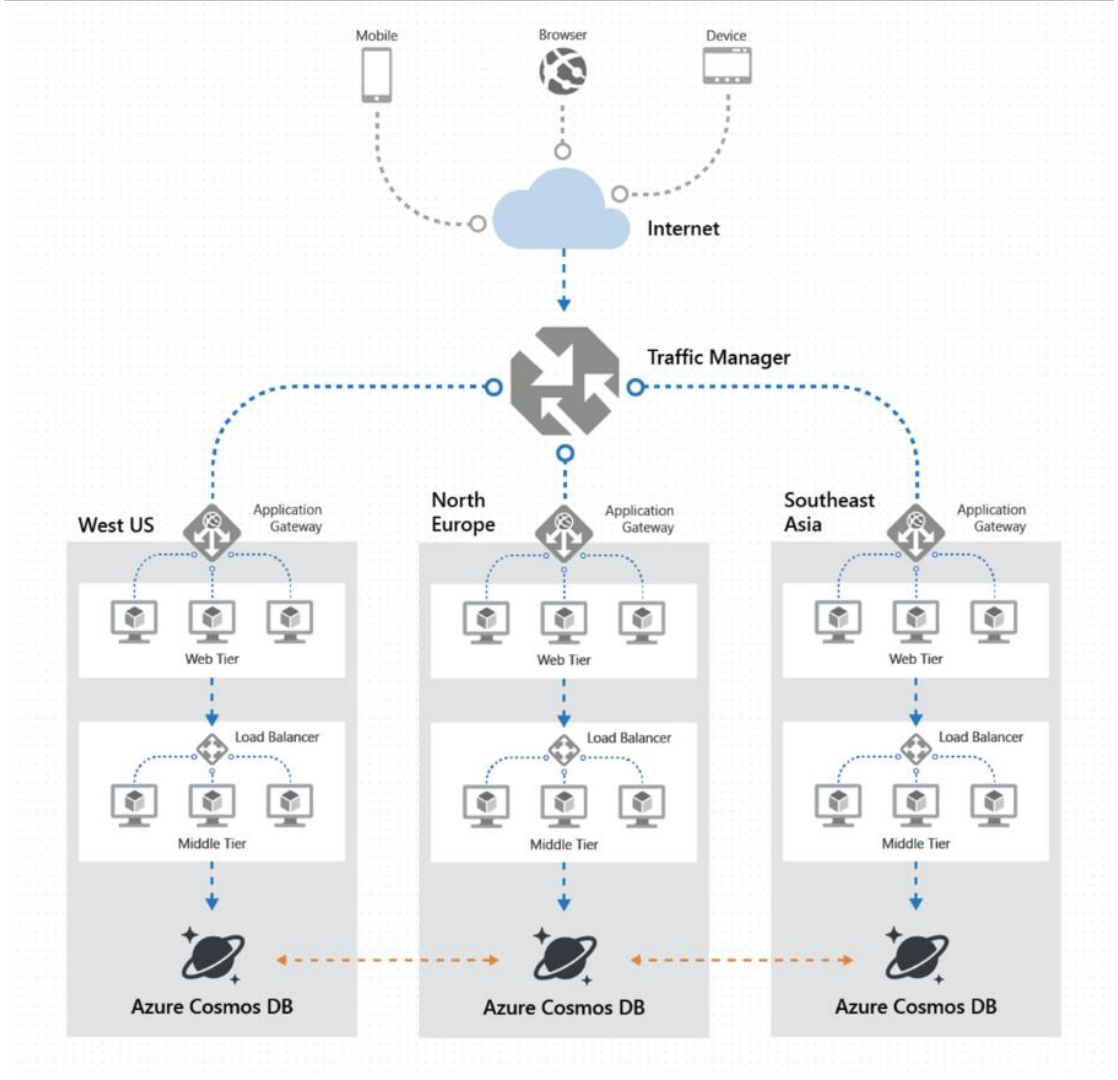
Design and Implement Data Distribution

Design and implement a replication strategy for Azure Cosmos DB

- Choose when to distribute data
- Automatic failover policies for regional failure for Azure Cosmos DB Core API
- Perform manual failovers to move single master write regions
- Choose a consistency model
- Identify use cases for different consistency models
- Evaluate the impact of consistency model choices on availability and associated RU cost
- Evaluate the impact of consistency model choices on performance and latency
- Specify application connections to replicated data

Distribute Data

- Azure Cosmos DB is a globally distributed database system
- Allows you to read and write data from the local region replicas of your database.
- Azure Cosmos DB transparently replicates the data to all the regions associated with your Cosmos account.


Mobile
Browser
Device
Internet
Traffic Manager
West US
Application Gateway
Web Tier
Load Balancer
Middle Tier
Azure Cosmos DB
North Europe
Application Gateway
Web Tier
Load Balancer
Middle Tier
Azure Cosmos DB
Southeast Asia
Application Gateway
Web Tier
Load Balancer
Middle Tier
Azure Cosmos DB

Home > notebookaccount

notebookaccount | Replicate data globally

Azure Cosmos DB account

Search (Ctrl+/)

- Overview
- Activity log
- Access control (IAM)
- Tags
- Diagnose and solve problems
- Quick start
- Notifications
- Data Explorer

Settings

- Features
- Replicate data globally
- Default consistency

Save | Discard | Manual Failover | Automatic Failover

Click on a location to add or remove regions from your Azure Cosmos DB account.

* Each region is billable based on the throughput and storage for the account. Learn more

Configure regions

Multi-region writes

Disable | Enable

Configure the regions for reads, writes and availability zone (supported in selected regions and can only be configured when a new region is added). + Add region

Regions	Reads Enabled	Writes Enabled	Availability Zone	Action
East US 2	✓	✓		
South Central US	✓	✓		

Design and Implement Multi-region Write

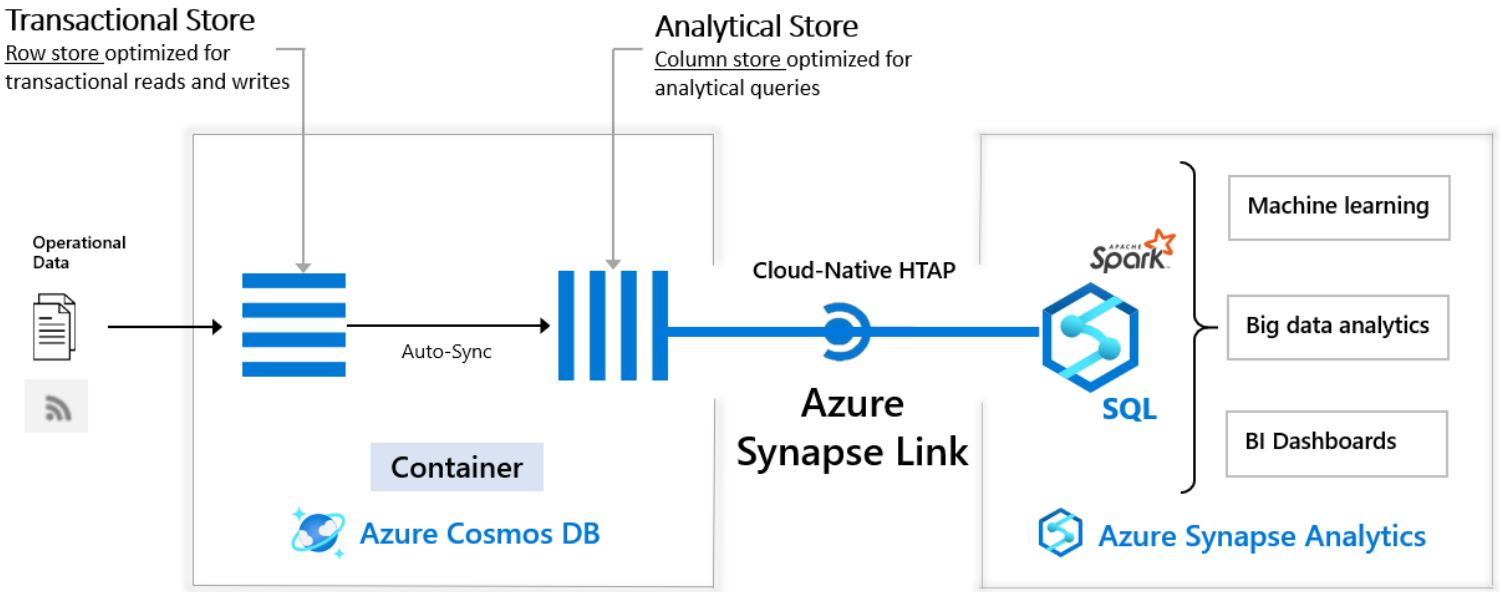
- Choose when to use multi-region write
- Implement multi-region write
- Implement a custom conflict resolution policy for Azure Cosmos DB Core API

Integrate an Azure Cosmos DB Solution

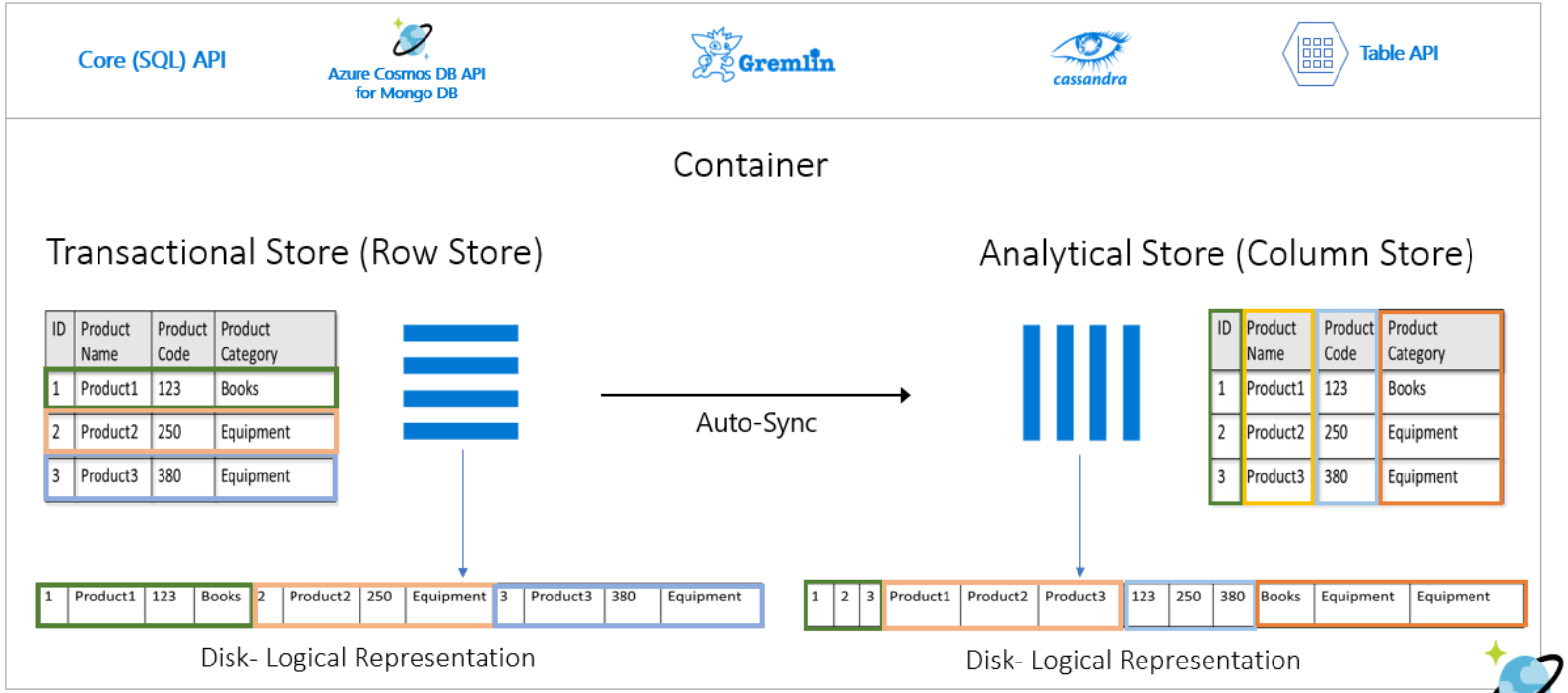
Enable Azure Cosmos DB Analytical Workloads

- Enable Azure Synapse Link
- Choose between Azure Synapse Link and Spark Connector
- Enable the analytical store on a container
- Connection to an analytical store and query from Azure Synapse Spark or Azure Synapse SQL
- Perform a query against the transactional store from Spark
- Write data back to the transactional store from Spark

Azure Synapse Link



Azure Cosmos DB Analytical Store



Write Spark DataFrame to Azure Cosmos DB

Java

Copy

```
// To select a preferred list of regions in a multi-region Azure Cosmos DB account, add option("spark.cos

import org.apache.spark.sql.SaveMode

df.write.format("cosmos.oltp").
    option("spark.synapse.linkedService", "<enter linked service name>").
    option("spark.cosmos.container", "<enter container name>").
    option("spark.cosmos.write.upsertEnabled", "true").
    mode(SaveMode.Overwrite).
    save()
```

Implement Solutions Across Services

- Integrate events with other applications by using Azure Functions and Azure Event Hubs
- Denormalize data by using Change Feed and Azure Functions
- Enforce referential integrity by using Change Feed and Azure Functions
- Aggregate data by using Change Feed and Azure Functions, including reporting
- Archive data by using Change Feed and Azure Functions
- Implement Azure Cognitive Search for an Azure Cosmos DB solution

Optimize an Azure Cosmos DB Solution

Optimize Query Performance in Azure Cosmos DB Core API

- Adjust indexes on the database
- Calculate the cost of the query
- Retrieve request unit cost of a point operation or query
- Implement Azure Cosmos DB integrated cache

Design and Implement Change Feeds for an Azure Cosmos DB Core API

- Develop an Azure Functions trigger to process a change feed
- Consume a change feed from within an application by using the SDK
- Manage the number of change feed instances by using the change feed estimator
- Implement denormalization by using a change feed
- Implement referential enforcement by using a change feed
- Implement aggregation persistence by using a change feed
- Implement data archiving by using a change feed

Define and Implement an Indexing Strategy for an Azure Cosmos DB Core API

- Choose when to use a read-heavy versus write-heavy index strategy
- Choose an appropriate index type
- Configure a custom indexing policy by using the Azure portal
- Implement a composite index
- Optimize index performance

Maintain an Azure Cosmos DB Solution

Monitor and Troubleshoot an Azure Cosmos DB Solution

- Evaluate response status code and failure metrics
- Monitor metrics for normalized throughput usage by using Azure Monitor
- Monitor server-side latency metrics by using Azure Monitor
- Monitor data replication in relation to latency and availability
- Configure Azure Monitor alerts for Azure Cosmos DB
- Implement and query Azure Cosmos DB logs (and see this)
- Monitor throughput across partitions
- Monitor distribution of data across partitions
- Monitor security by using logging and auditing

Implement Backup and Restore for an Azure Cosmos DB Solution

- Choose between periodic and continuous backup
- Configure periodic backup
- Configure continuous backup and recovery
- Locate a recovery point for a point-in-time recovery
- Recover a database or container from a recovery point

Implement Security for an Azure Cosmos DB Solution

- Choose between service-managed and customer-managed encryption keys
- Configure network-level access control for Azure Cosmos DB
- Configure data encryption for Azure Cosmos DB
- Manage control plane access to Azure Cosmos DB by using Azure role-based access control (RBAC)
- Manage data plane access to Azure Cosmos DB by using keys
- Manage data plane access to Azure Cosmos DB by using Azure Active Directory
- Configure Cross-Origin Resource Sharing (CORS) settings
- Manage account keys by using Azure Key Vault
- Implement customer-managed keys for encryption
- Implement Always Encrypted

Implement Data Movement for an Azure Cosmos DB Solution

- Choose a data movement strategy
- Move data by using client SDK bulk operations
- Move data by using Azure Data Factory and Azure Synapse pipelines
- Move data by using a Kafka connector
- Move data by using Azure Stream Analytics
- Move data by using the Azure Cosmos DB Spark Connector

Implement a DevOps Process for an Azure Cosmos DB Solution

- Choose when to use declarative versus imperative operations
- Provision and manage Azure Cosmos DB resources by using ARM templates
- Migrate between standard and auto scale throughput by using PowerShell or Azure CLI
- Initiate a regional failover by using PowerShell or Azure CLI
- Maintain index policies in production by using ARM templates

The Exam

DP-420

- Exam AZ-900
- Skills measured

Two ways to prepare

Online - Free | Instructor-led - Paid

Items in this collection

LEARNING PATH

Get started with Azure Cosmos DB SQL API

2 Modules

Intermediate | Data Engineer | Azure

Start >

⊕ Save

LEARNING PATH

Plan and implement Azure Cosmos DB SQL API

3 Modules

Intermediate | Developer | Cosmos DB

⊕ Save

LEARNING PATH

Connect to Azure Cosmos DB SQL API with the SDK

2 Modules

Intermediate | Developer | Cosmos DB

Questions in DP-420

- Number of Questions 40-60 Questions
- Questions
  - Multiple choice
  - Drag and drop
  - Scenario based
- There will NOT be hands-on labs but watch for updates!
- Pass Score 700 (on a scale of 1-1000)

Schedule exam

Exam AZ-900: Microsoft Azure Fundamentals

United States

Languages: English, Japanese, Chinese (Simplified), Korean, Spanish, German, French, Indonesian (Indonesia), Arabic (Saudi Arabia), Chinese (Traditional), Italian, Portuguese (Brazil), Russian
Retirement date: none

This exam measures your ability to describe the following concepts: cloud concepts; core Azure services; core solutions and management tools on Azure; general security and network security features; identity, governance, privacy, and compliance features; and Azure cost management and Service Level Agreements.

$99 USD*

Price based on the country in which the exam is proctored.

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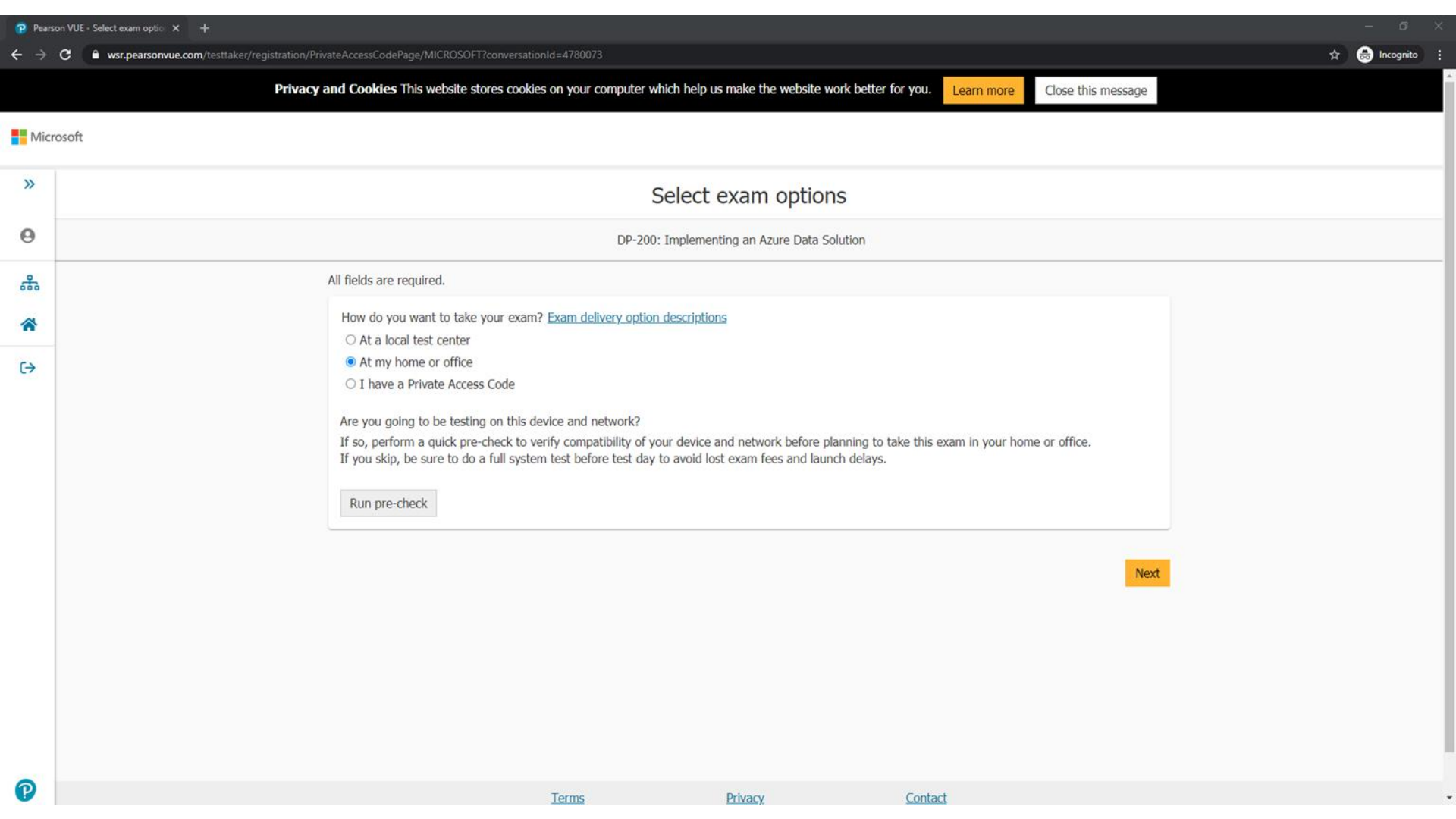
Pearson VUE - Select exam optio
wsr.pearsonvue.com/testtaker/registration/PrivateAccessCodePage/MICROSOFT?conversationId=4780073
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Privacy and Cookies This website stores cookies on your computer which help us make the website work better for you.
Learn more
Close this message
Microsoft
Select exam options
DP-200: Implementing an Azure Data Solution
All fields are required.
How do you want to take your exam? Exam delivery option descriptions
At a local test center
At my home or office
I have a Private Access Code
Are you going to be testing on this device and network?
If so, perform a quick pre-check to verify compatibility of your device and network before planning to take this exam in your home or office.
If you skip, be sure to do a full system test before test day to avoid lost exam fees and launch delays.
Run pre-check
Next
Terms
Privacy
Contact

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systemcheck.proctorcam.com/systemcheck?candidateId=247036059

Incognito

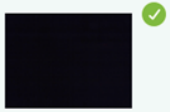
Pearson | VUE

System check - Checking your requirements

Microphone

Default - Microphone (SI

Internet speed



Webcam

Integrated Webcam (0c4

Next

Course Repository

https://github.com/zaalion/oreilly-dp-420

Q&A

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Thank you!

Reza Salehi

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