AWS Technical Essentials

Lesson 5—AWS Managed Services and Database

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WHAT YOU'LL LEARN

- Describe Amazon DynamoDB
- Verify key aspects of Amazon RDS
- Execute an Amazon RDS driven application

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Amazon DynamoDB

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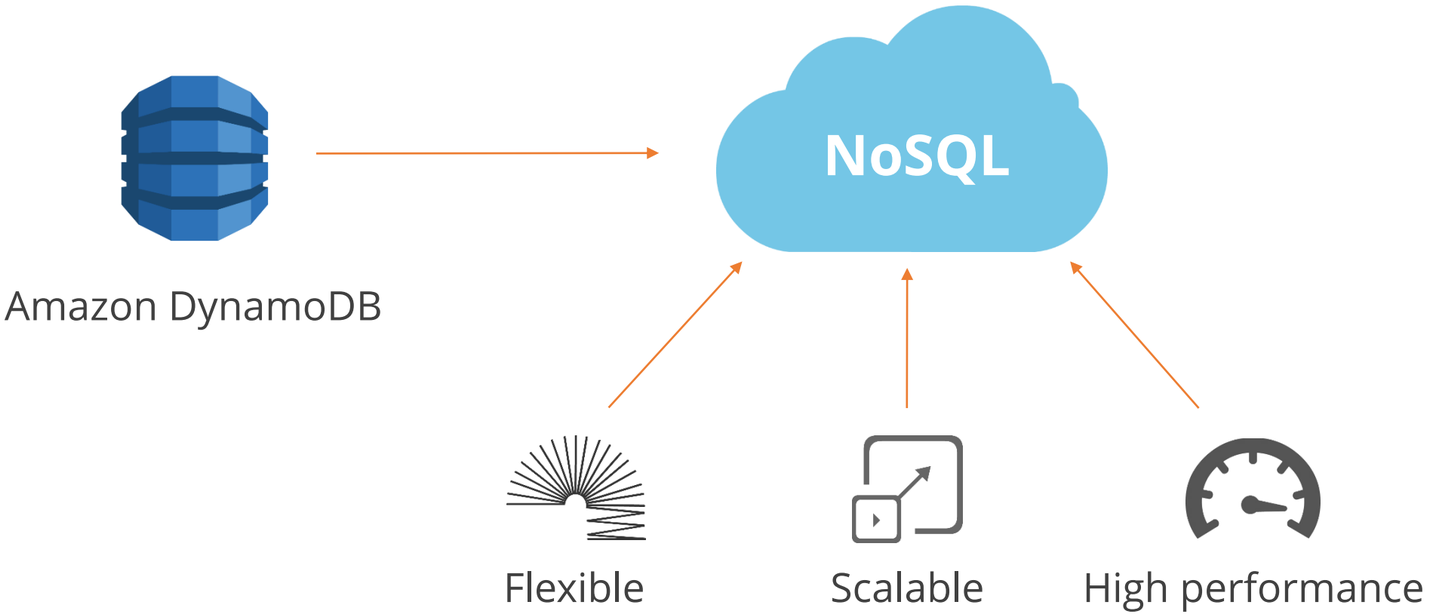
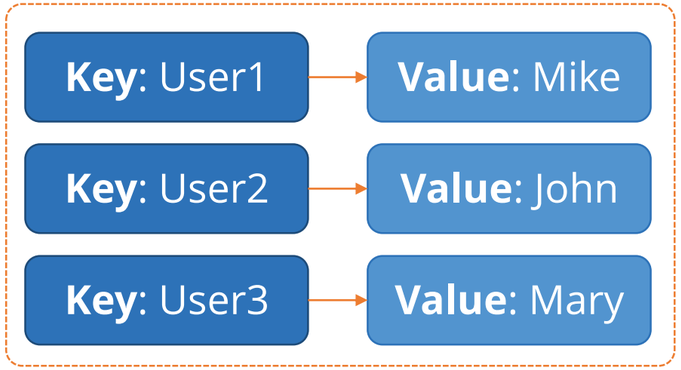
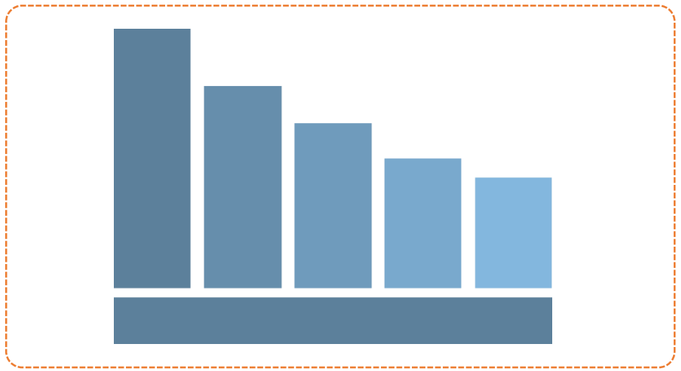
Introduction to Amazon DynamoDB

Amazon DynamoDB is a service that offers NoSQL databases.







DynamoDB is a fully managed service and it relieves you from the administrative load of running and scaling a distributed database. You can employ it to perform all critical tasks such as setting up a database, provisioning the required hardware, replicating the tables, and scaling the database capacity.

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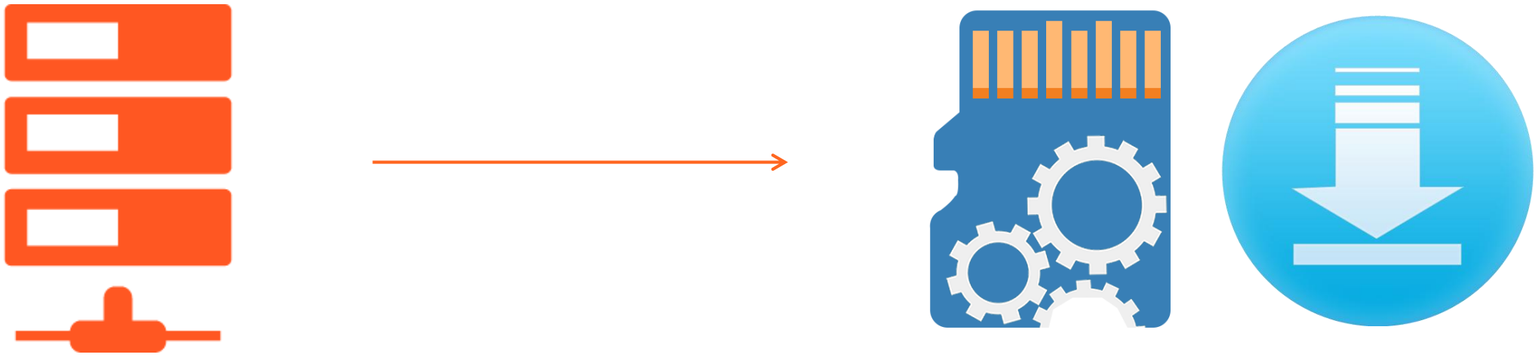
Use of Amazon DynamoDB

With DynamoDB, creating tables in a NoSQL database is easy.



Tables

Storing and fetching any amount of data

DynamoDB service operates fast, delivers the expected performance, and scales flawlessly.

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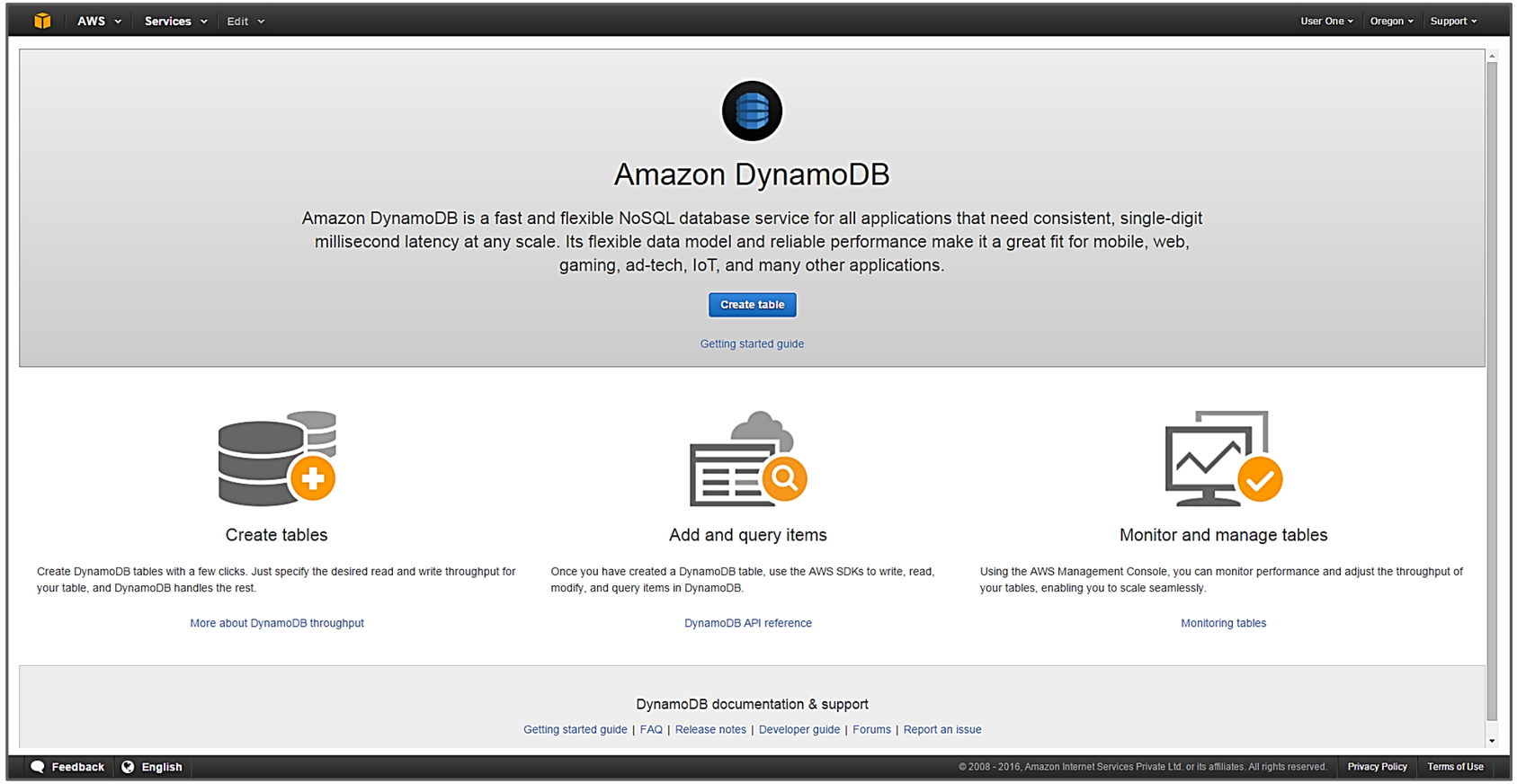
DynamoDB Concepts

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution



Amazon DynamoDB Home Page

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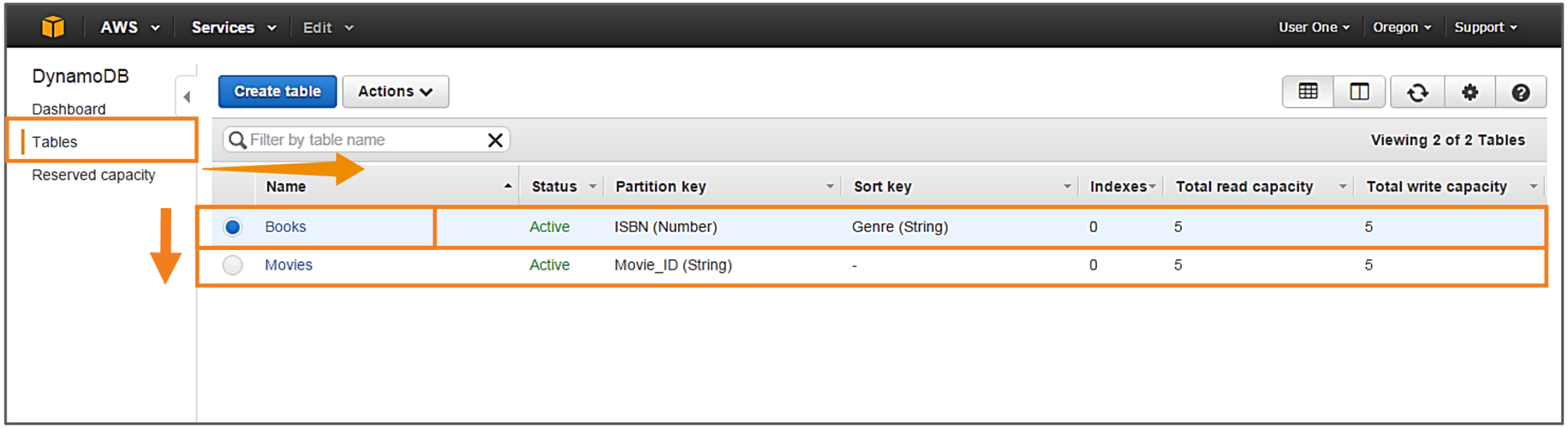
DynamoDB Tables

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution



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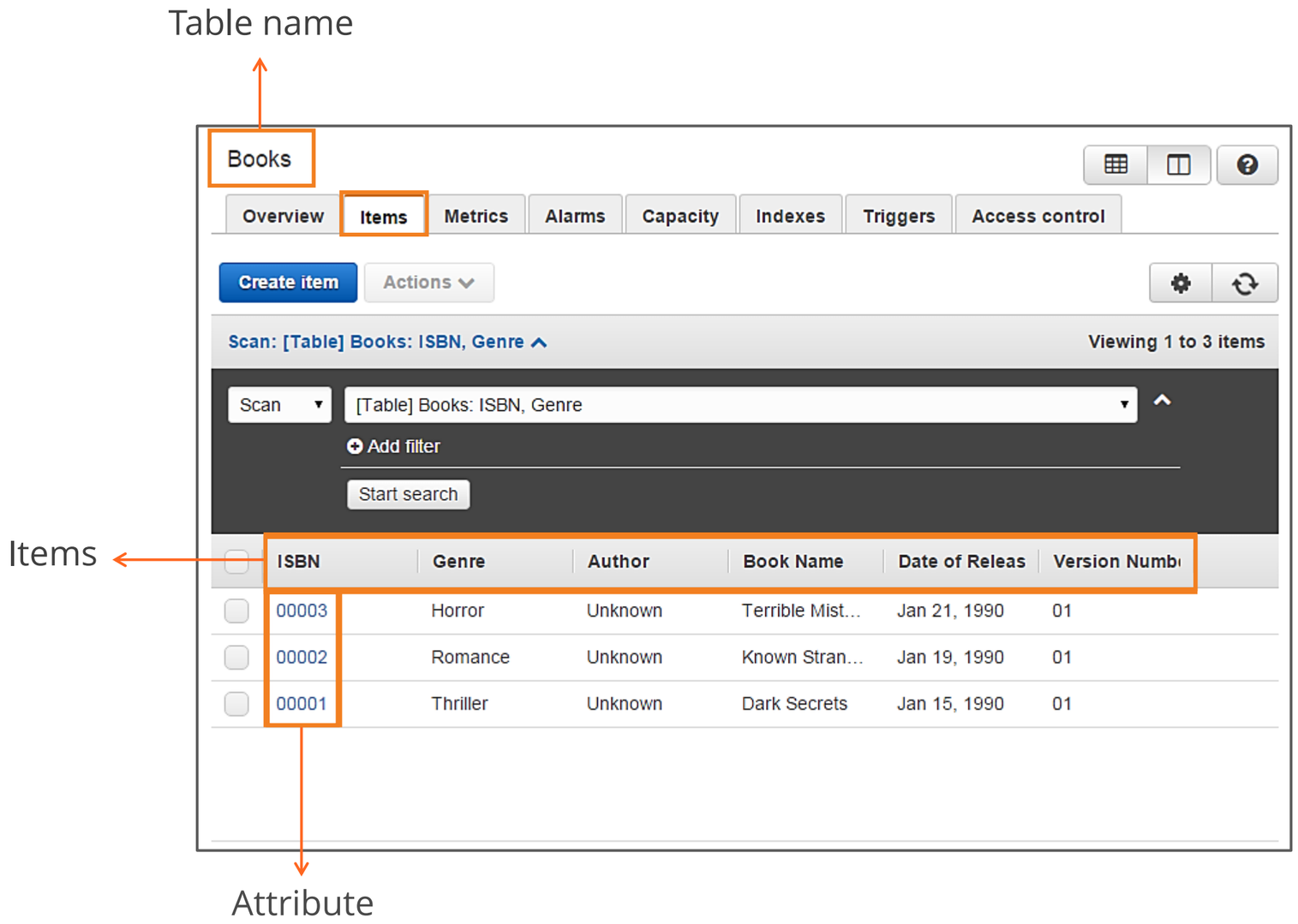
DynamoDB Items and Attributes

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution



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DynamoDB Items and Attributes

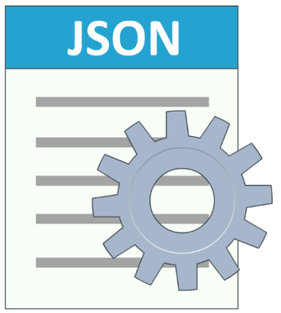
- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

Each attribute of an item is a name-value pair.

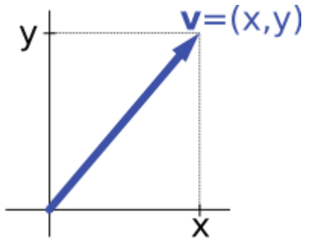
An attribute can be:

001, 002, 003, 004, 005....

Set of values



JSON format



A single value

The size of an item cannot go beyond 400 kilobytes. The size refers to the total length of its attribute values.

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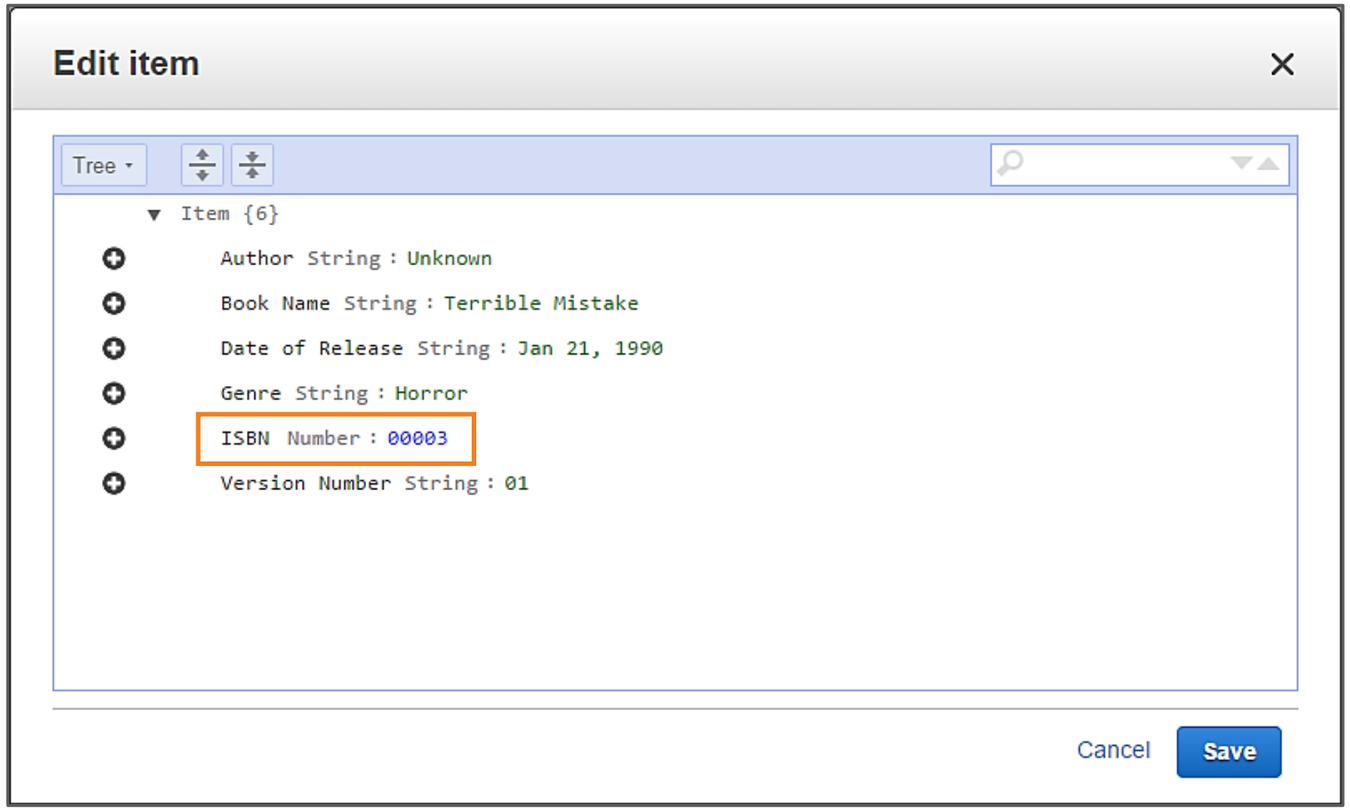
DynamoDB Primary Key

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

A Primary Key refers to the attribute whose value uniquely identifies each item or row so that no two rows have the same Primary Key value.



While adding, deleting, or updating an item, you need to state the value of its Primary Key. DynamoDB requires you to mention the Primary Key attribute, although it is not mandatory for you to define all other attribute names and their data types in advance.

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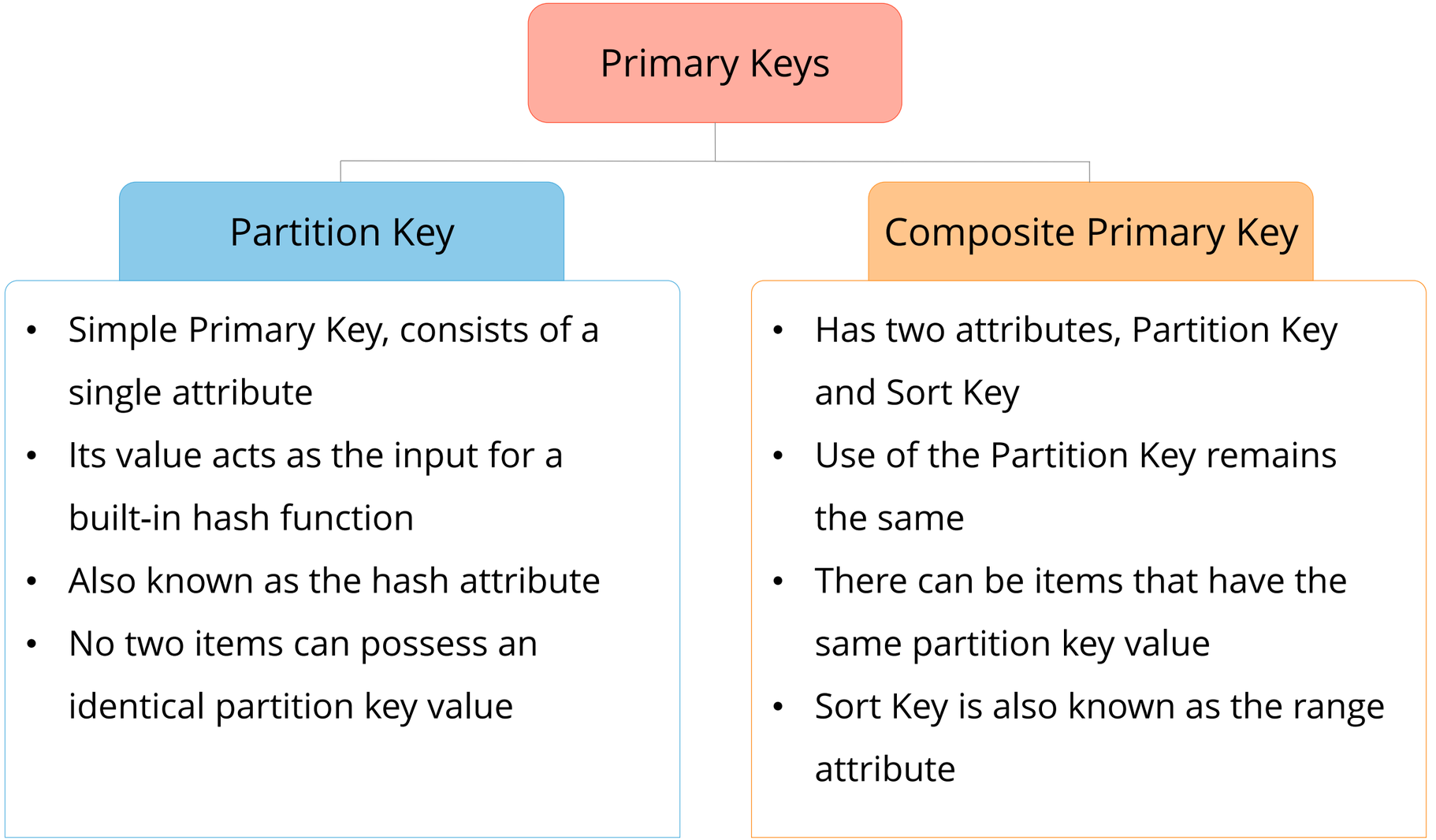
Two Types of Primary Keys

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution



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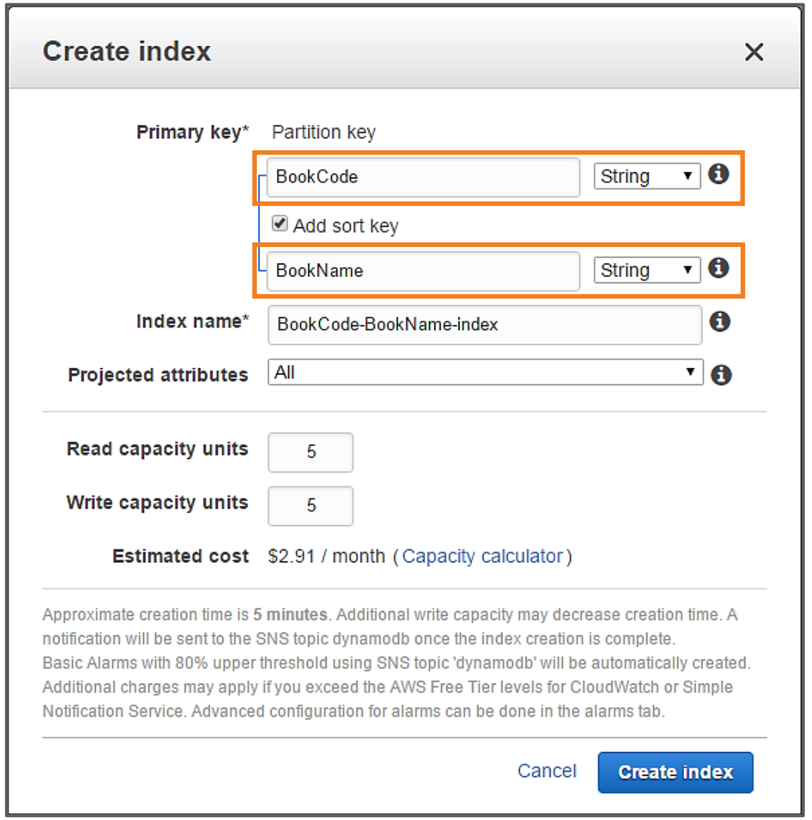
DynamoDB Secondary Indexes

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution



Through this query, you can efficiently retrieve all customers who have brought the specified book of that particular genre. You don't need to go through any other purchases.

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Two Types of Secondary Indexes

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

Global Secondary Index

Has a Partition Key and a Sort Key. These may differ from those already defined for the table.

Local Secondary Index

Has the same Partition Key as the one already defined for the table, but it has a different Sort Key.

You can have up to five local and global secondary indexes per table.

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Three DynamoDB Data Types

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

Scalar Data Types

Number, String, Binary, Boolean, and Null

Document Types

Lists and Maps

Set Data Types

String set, Binary set, and Number set

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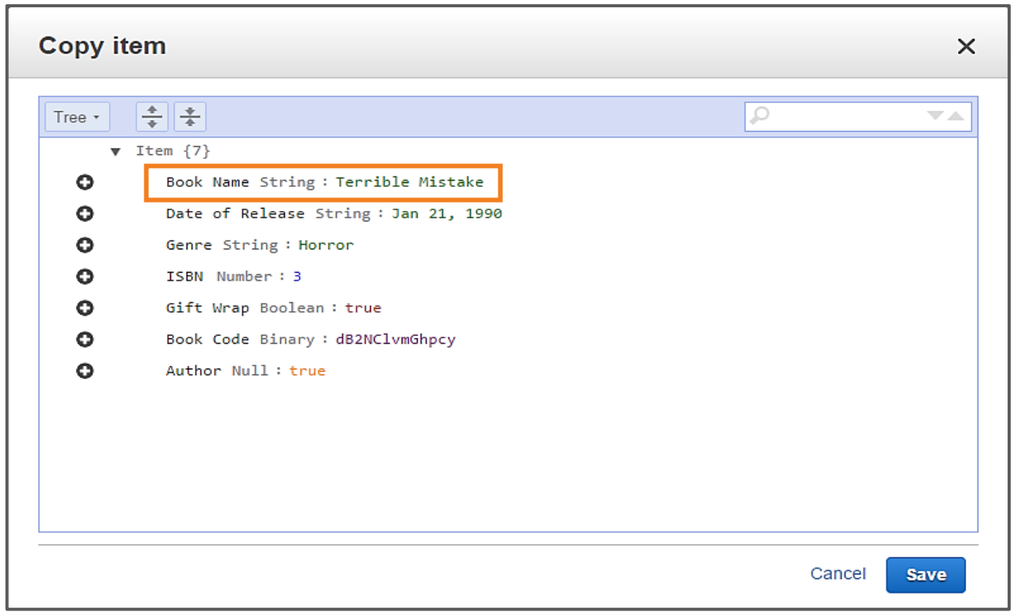
Scalar Data Type—Strings

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

Strings are Unicode characters with following features:

- Stored independently of the platform and software language in use
- Employ Unicode Transformation Format or U-T-F 8 binary encoding
- Each Unicode character has a unique decimal number or a code point
- Binary encoding determines how to transform these into binary numbers for storage purpose
- U-T-F 8 encoding uses up to four blocks, each 8 bits long, to represent a character into its binary state



String

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Scalar Data Type—Strings

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

- No maximum limit for the size of a string value when you assign it to an attribute
- Not applicable to the primary key attribute
- At the time of sorting, string values are compared to the American Standard Code for Information Interchange or ASCII character code values

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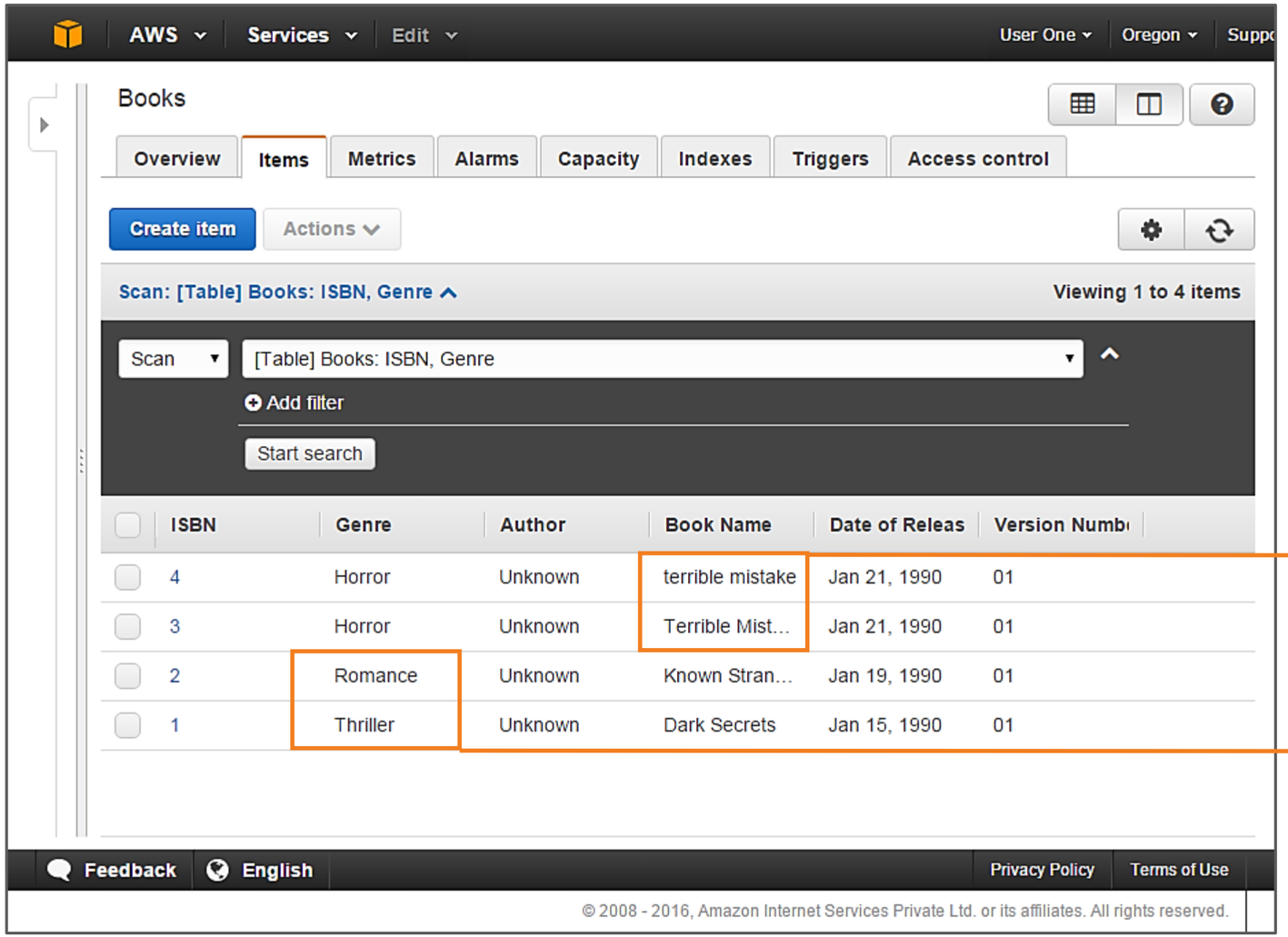
Scalar Data Type—Strings

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution



AS-CII value of "**t**" is greater than that of "**T**."

AS-CII value of "**2**" is greater than that of "**1**."

Sorted String

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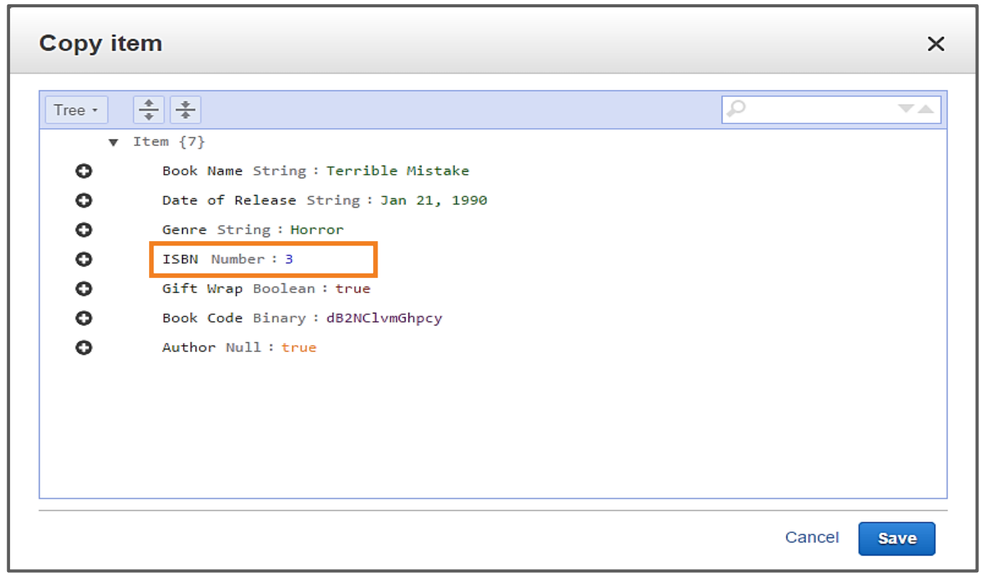
Scalar Data Type—Numbers

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

A number can be zero, positive, or negative with following features:

- Has a variable length but the limit of precision is only up to 38 digits
- If there are any trailing and leading zeroes, they are trimmed
- All numbers are sent as string values to DynamoDB so that the maximum compatibility is ensured across languages
- For mathematical operations, DynamoDB considers all such values as numbers



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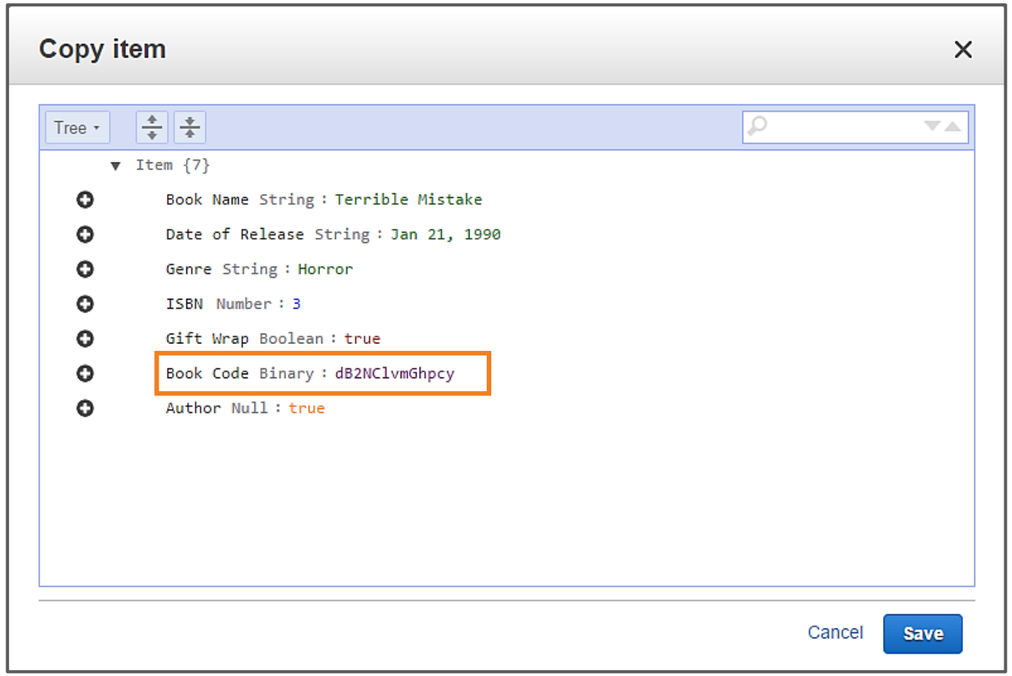
Scalar Data Type—Binary

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

Binary type attributes can have any kind of binary values such as images and compressed data with following features:

- While comparing binary values at the time of processing a query, each byte is treated as unsigned, meaning it is accepted without negative values.
- For processing in DynamoDB, your applications need to encode the binary values by using the Base64 format.
- When DynamoDB obtains this encoded data, it decodes it into an unsigned byte set.
- There is no upper limit to how long a binary value can be, except for the primary key value.



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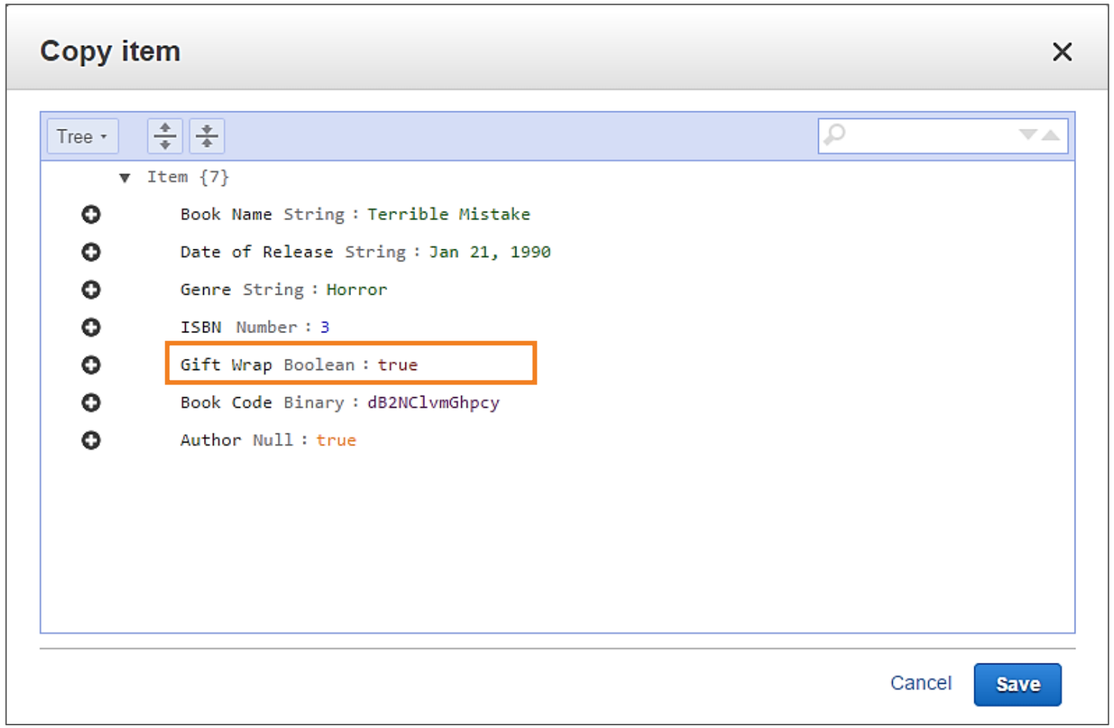
Scalar Data Type—Boolean

A Boolean type attribute can have one of the two values, namely true or false.

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution



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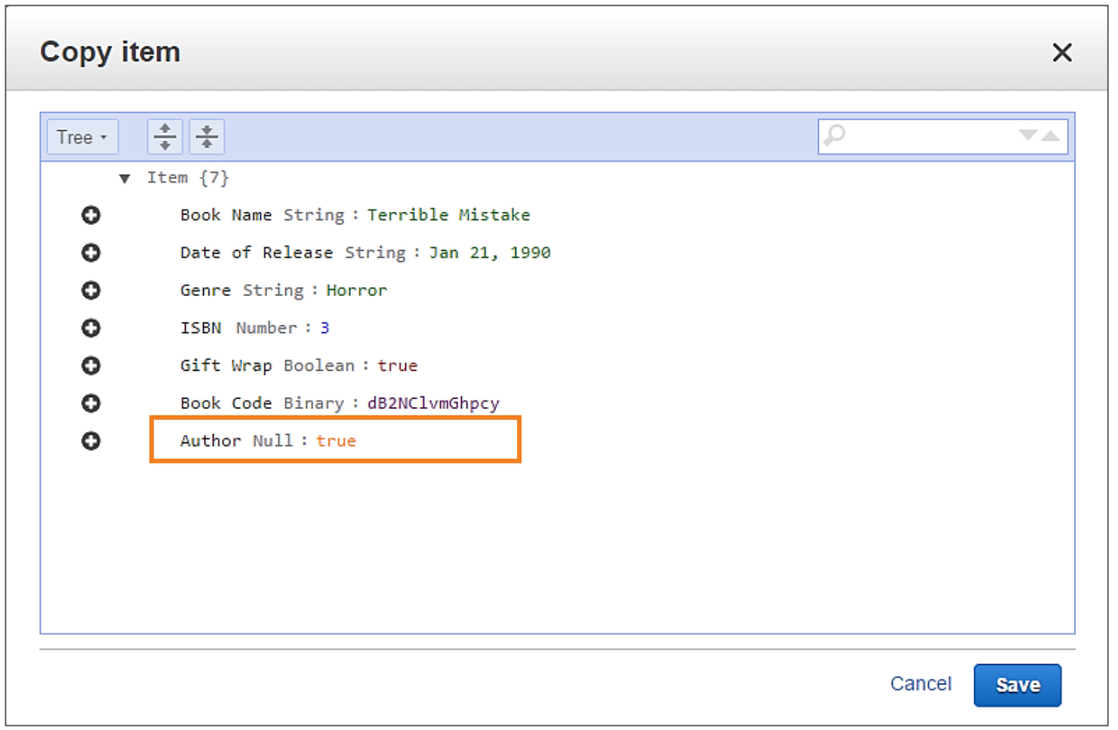
Scalar Data Type—Null

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

The null type attribute indicates an unknown or undefined state with following features:

- The value of such an attribute is always ‘NULL’, which can never be set as a value for a primary key attribute.



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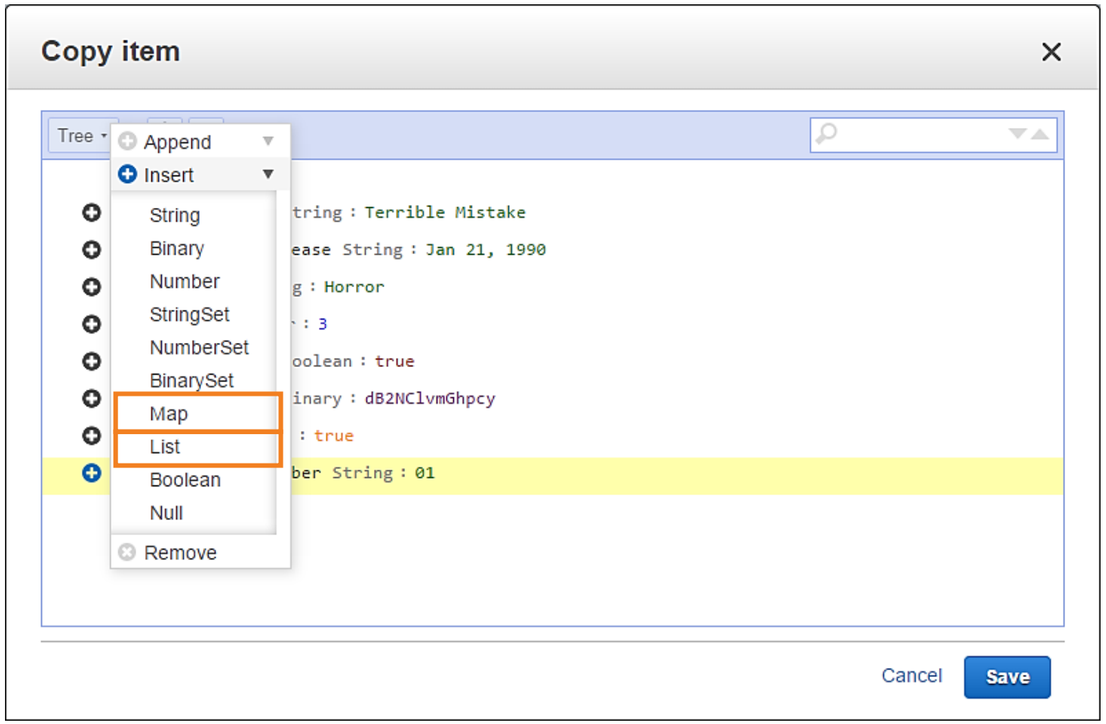
Document Data Types

The document data types include lists and maps with following features:

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution



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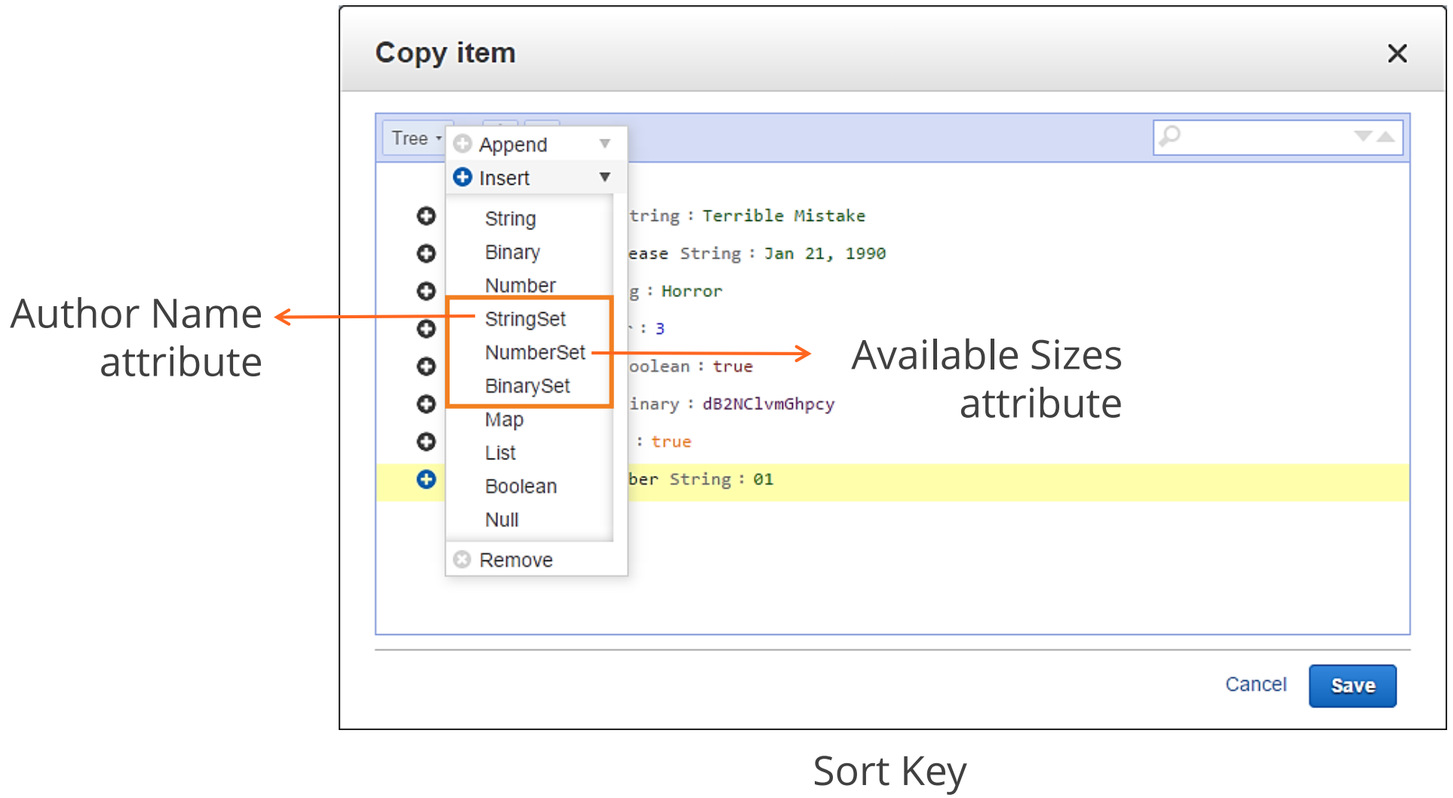
Set Data Types

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

DynamoDB also accepts string sets, binary sets, and number sets with following features:



The values or elements in each of these sets must be unique as you cannot repeat any value in a set. It is possible to have an empty set. Sets do not follow an order, that is, the values are not retrieved in a fixed order.

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Item Distribution

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

DynamoDB stores data in separate partitions. A partition refers to a storage space allocated for a table, which is supported by S-S-Ds and managed fully by DynamoDB.

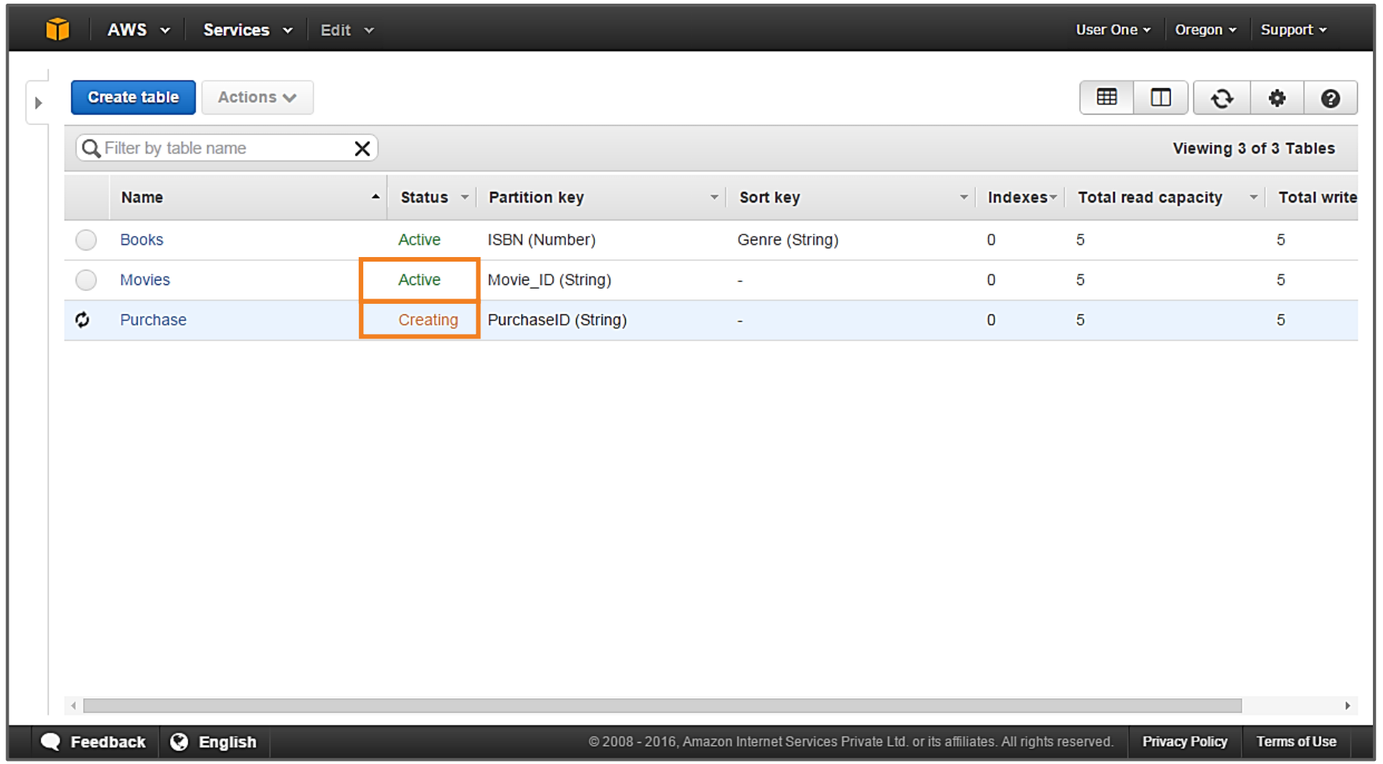

Table in the CREATING State

Once the maximum capacity of this partition is reached, DynamoDB assigns another partition and distributes items between the old and new partitions.

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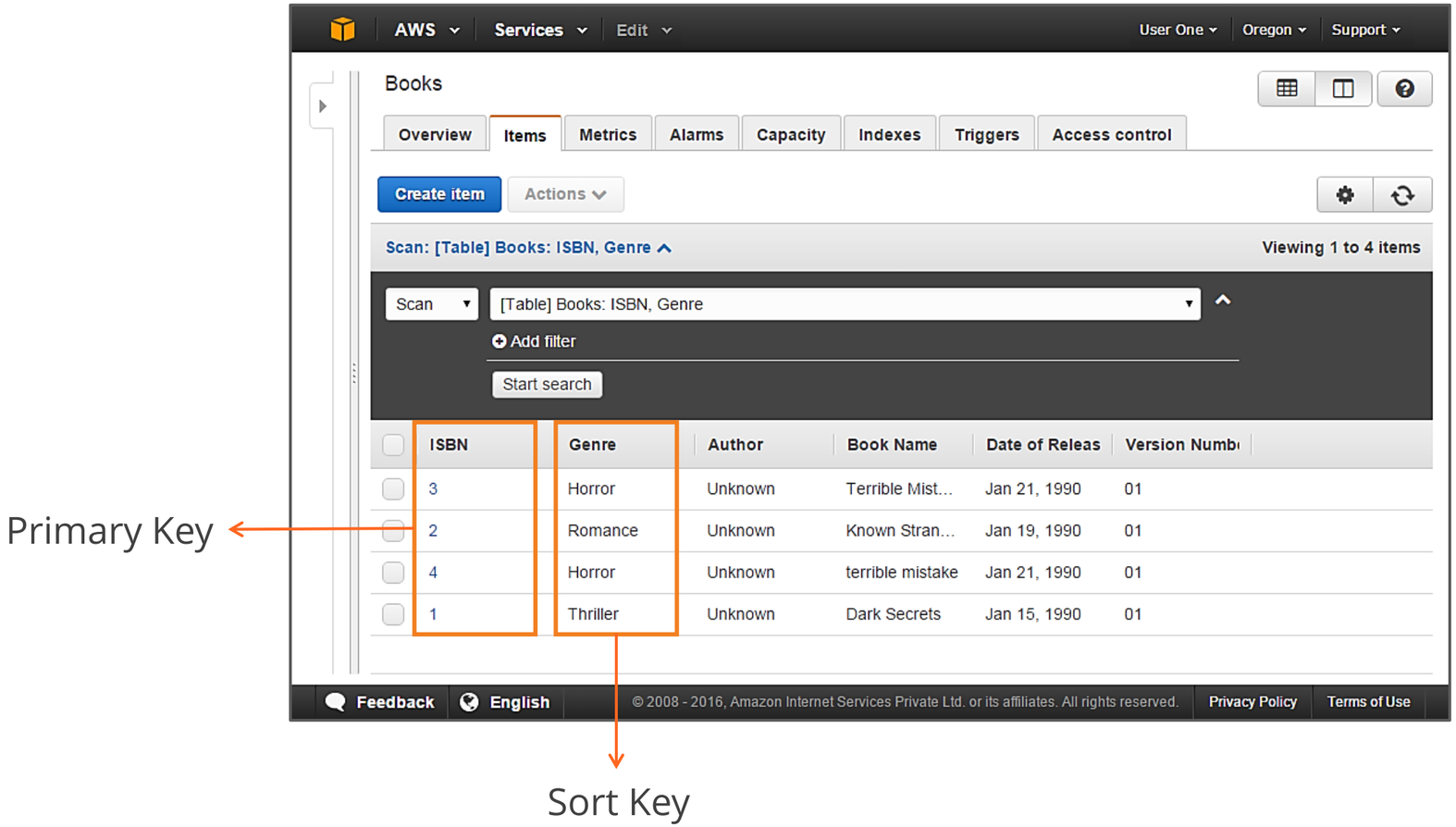
Item Distribution

- Tables
- Items and attributes
- Primary Key
- Secondary indexes
- Data types
- Item distribution

DynamoDB never combines the allocated partitions. It also never deallocates the allocated partitions. If you delete some or all items from the table, the corresponding partitions will still remain allocated to the table.



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Nine DynamoDB Features

Amazon DynamoDB offers the following salient features:

Document Data Model Support

Key-value Data Model Support

Schema-less

Seamless Scaling

Local Development but Global Scaling

DynamoDB allows storing, updating, and querying documents written in the JSON format. These documents are stored directly into tables. Because you can add, retrieve, update, and delete items of a table throughout a graphical interface, there is no need to write new code to perform these tasks for the JSON documents stored in that table.

Strong Consistency, Atomic Counters

Integrated Monitoring

Security

Integration with AWS Data Pipeline

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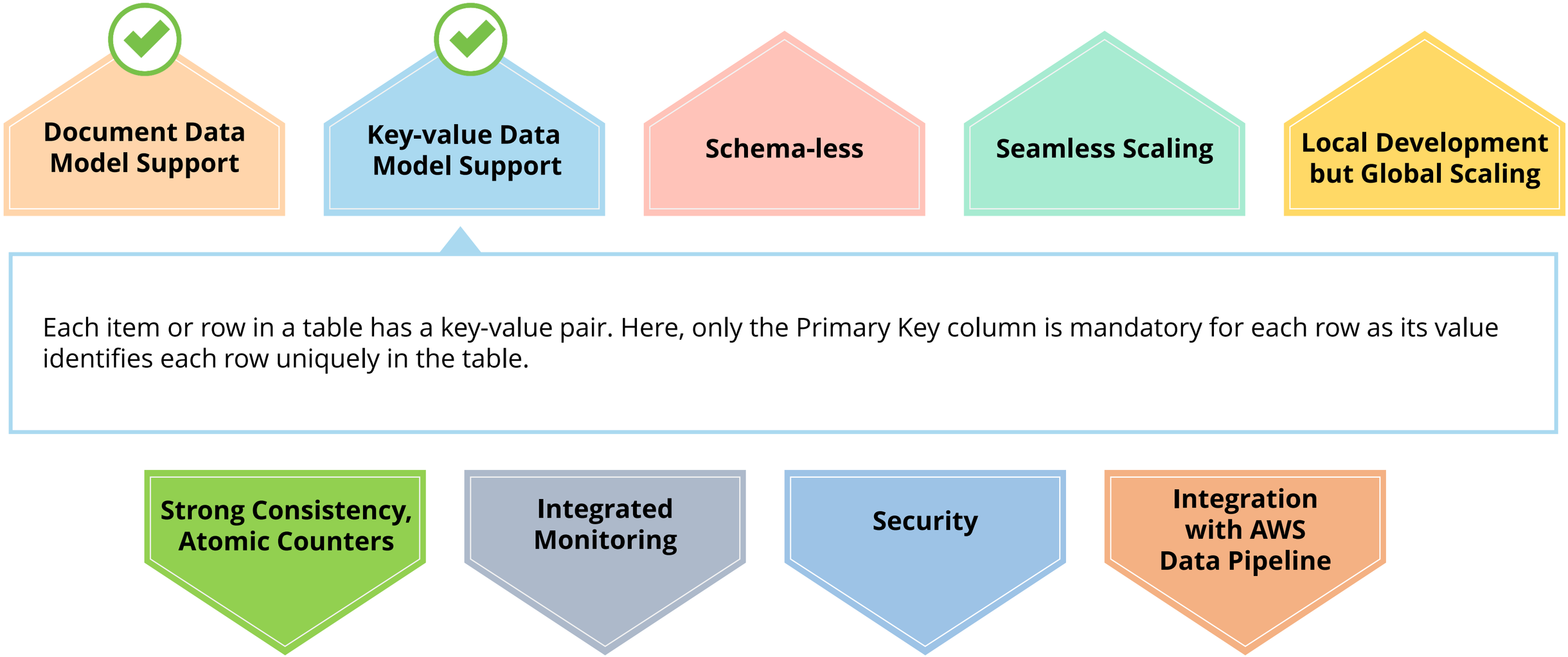
Nine DynamoDB Features

Amazon DynamoDB offers the following salient features:



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Nine DynamoDB Features

Amazon DynamoDB offers the following salient features:

- **Document Data Model Support**
- **Key-value Data Model Support**
- **Schema-less**
- **Seamless Scaling**
- **Local Development but Global Scaling**

DynamoDB has no schema, which means that each row in a table need not have the same attributes or even the same number of attributes. The items can have attribute values of different data types, such as strings, binary values, numbers, and sets.

- **Strong Consistency, Atomic Counters**
- **Integrated Monitoring**
- **Security**
- **Integration with AWS Data Pipeline**

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Nine DynamoDB Features

Amazon DynamoDB offers the following salient features:

- **Document Data Model Support**
- **Key-value Data Model Support**
- **Schema-less**
- **Seamless Scaling**
- **Local Development but Global Scaling**

DynamoDB ensures flawless storage and throughput scaling through both the AWS Management Console and Application Program Interface (API). There is no maximum limit for you to demand the storage size or read or write throughput.

- **Strong Consistency, Atomic Counters**
- **Integrated Monitoring**
- **Security**
- **Integration with AWS Data Pipeline**

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Nine DynamoDB Features

Amazon DynamoDB offers the following salient features:

- **Document Data Model Support**
- **Key-value Data Model Support**
- **Schema-less**
- **Seamless Scaling**
- **Local Development but Global Scaling**

DynamoDB allows you to build and test applications easily on an EC2 instance in the cloud. Once these applications are ready, DynamoDB allows you scale them quickly in the cloud.

- **Strong Consistency, Atomic Counters**
- **Integrated Monitoring**
- **Security**
- **Integration with AWS Data Pipeline**

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Nine DynamoDB Features

Amazon DynamoDB offers the following salient features:

- **Document Data Model Support**
- **Key-value Data Model Support**
- **Schema-less**
- **Seamless Scaling**
- **Local Development but Global Scaling**

As compared with several other non-relational databases, DynamoDB ensures easier development of your database environment. It does so by employing strong consistency on reads so that you can read only the latest values. Atomic counters allow you increase or decrease numerical attributes in the atomic manner, through an A-P-I call.

- **Strong Consistency, Atomic Counters**
- **Integrated Monitoring**
- **Security**
- **Integration with AWS Data Pipeline**

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Nine DynamoDB Features

Amazon DynamoDB offers the following salient features:

- Document Data Model Support
- Key-value Data Model Support
- Schema-less
- Seamless Scaling
- Local Development but Global Scaling

Apart from making major operational metrics available through the AWS Management Console, DynamoDB integrates with CloudWatch to comprehensively monitor your databases.

- Strong Consistency, Atomic Counters
- Integrated Monitoring
- Security
- Integration with AWS Data Pipeline

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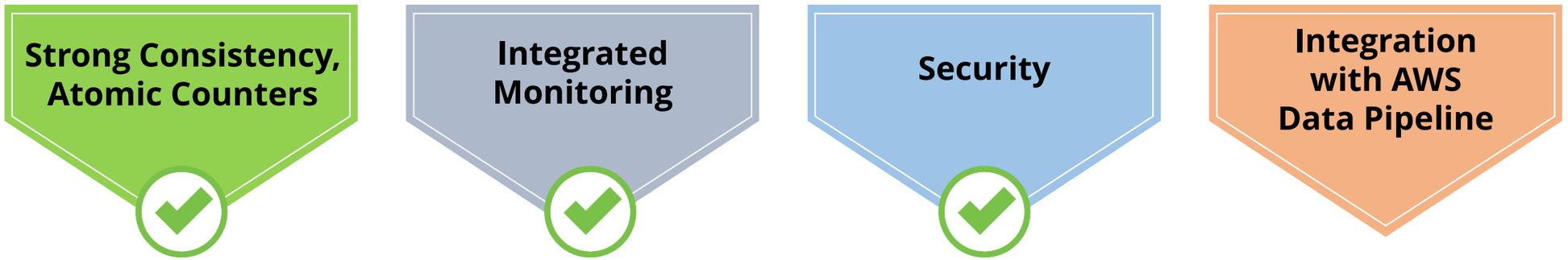
Nine DynamoDB Features

Amazon DynamoDB offers the following salient features:

DynamoDB also integrates with the AWS Identity and Access Management service to control access permissions for your organizational users.



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Nine DynamoDB Features

Amazon DynamoDB offers the following salient features:

- Document Data Model Support
- Key-value Data Model Support
- Schema-less
- Seamless Scaling
- Local Development but Global Scaling

This integration allows you to automatically move and transform data into and out of DynamoDB. You can schedule and run recurring jobs without any kind of programming.

- Strong Consistency, Atomic Counters
- Integrated Monitoring
- Security
- Integration with AWS Data Pipeline

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Five New DynamoDB Features

Streams	Cross-region Replication	Triggers	Free-text Search	Integration with Titan Graph Database
• Is a timed sequence of changes at the item level in a table • Helps track the latest changes or updates in the last 24 hours • Helps take backups, analyze trends, and create innovative applications for replication	• Replicates its tables over several regions, without any intervention • Helps develop globally distributed applications with quicker data migration, better traffic management, lower-latency access, and effortless disaster recovery	• Integrates with Lambda to offer triggers • Helps execute a user-defined task or function when a change occurs at an item level in the desired table	• Offers a quick and easy-to-use search facility • Enables you to search its content, such as keywords, tags, and locations	• Allows efficient storage and navigation through the graphs • Enables you to optimize graphs for quick navigation

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Demo 01—Creating a Table and Adding Items to the Table

(Refer to the E-Learning course: Screen Number – 5.3)

Demonstrate how to create a table and add items to that table.

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Demo 02—Query a Table

(Refer to the E-Learning course: Screen Number – 5.4)

Demonstrate how to query a table.

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Knowledge Check

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KNOWLEDGE CHECK 1

Which service offers NoSQL databases?

a. AWS CloudWatch

b. AWS CloudFormation

c. AWS DynamoDB

d. AWS CloudFront

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KNOWLEDGE CHECK 1

Which service offers NoSQL databases?

a. AWS CloudWatch

b. AWS CloudFormation

c. AWS DynamoDB

d. AWS CloudFront

The correct answer is **c.**

Explanation: Amazon DynamoDB refers to a service that offers NoSQL databases. It operates fast, according to expected performance, and scales flawlessly.

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KNOWLEDGE CHECK 2

Choose the correct types of Secondary Index. *Select all that apply.*

a. Global Secondary Index

b. Alternate Secondary Index

c. Multiple Secondary Index

d. Local Secondary Index

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KNOWLEDGE CHECK 2

Choose the correct types of Secondary Index. *Select all that apply.*

a. Global Secondary Index

b. Alternate Secondary Index

c. Multiple Secondary Index

d. Local Secondary Index

The correct answer is **a and d.**

Explanation: Global secondary index has partition and Sort Keys that may differ from those defined for the table. Local secondary index has the same Partition Key as the one defined in the table but has a different Sort Key.

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Amazon Relational Database Service

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Introduction to Amazon Relational Database Service

Amazon RDS refers to a Web Service aimed at setting up, running, and scaling a relational database automatically in the cloud.

Offers profitable, resizable capacity for a database

Handles time-consuming and tiresome administrative tasks

Free to concentrate on other business tasks

Fully managed service

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Six Popular Database Engines

Oracle

MySQL

Microsoft SQL

PostgreSQL

Maria DB

Amazon Aurora

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Eight Reasons for Using Amazon RDS

Scalability

Makes it easy to scale database resources

01

Handling critical tasks

Handles critical tasks on its own, such as software patching, backups, failure detection, and recovery

02

Fast service

Provides different sizing options for a database server, which are up to 244 Gigabytes and 32 vCPUs

03

Database engine

A familiar database engine can be chosen and used

04

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Eight Reasons for Using Amazon RDS

High availability & reliability

Service copies data synchronously to a reserved instance residing in another Availability Zone and allows taking automatic backups or snapshots whenever you want

05

Tracking performance of relational database instances

Allows tracking by offering the CloudWatch metrics for free

06

Low rates

You pay low rates and only for the resources you use

07

Security and full control

Ensured over who can access what from your relational databases

08

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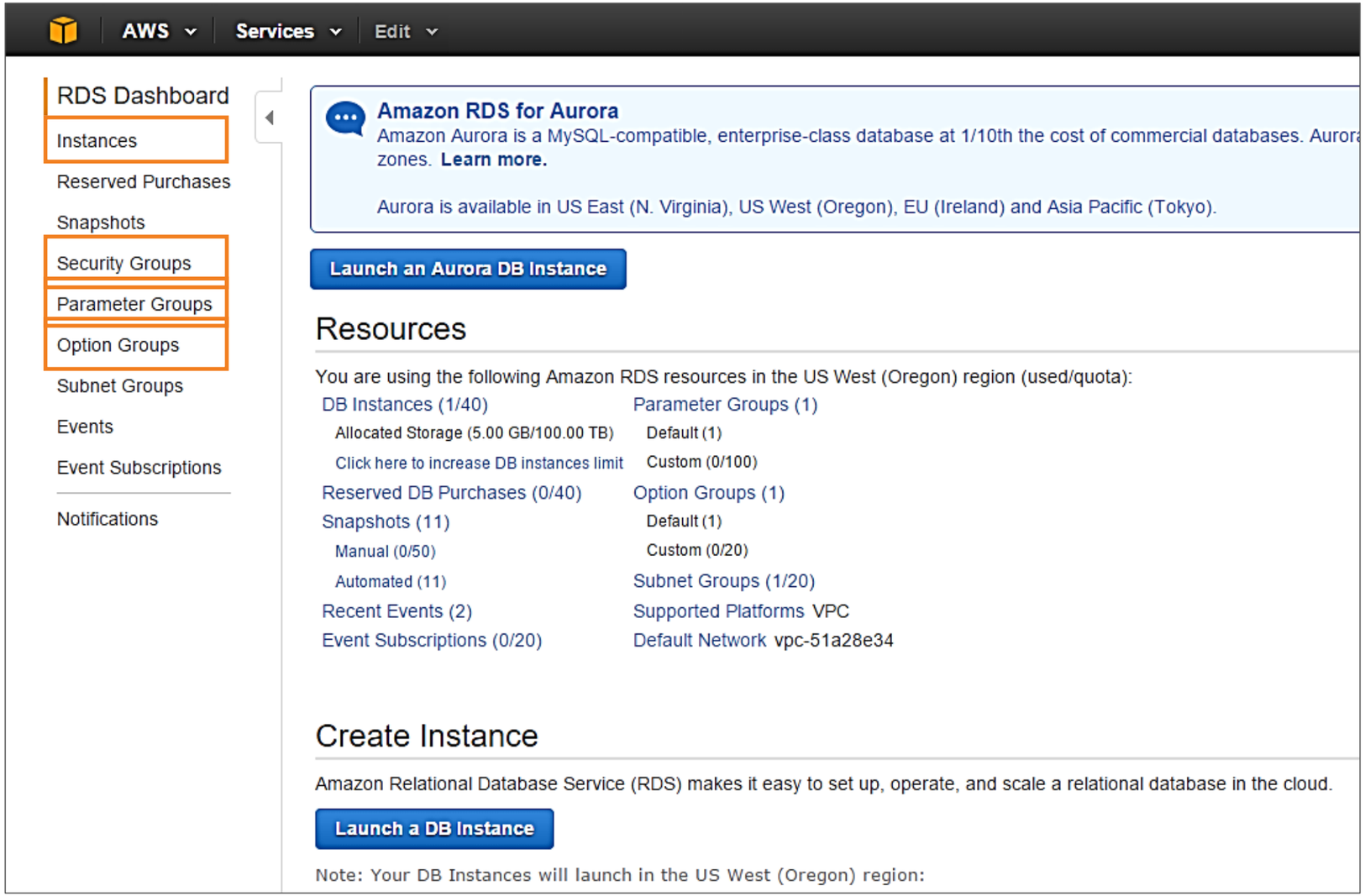
Four Amazon RDS Components



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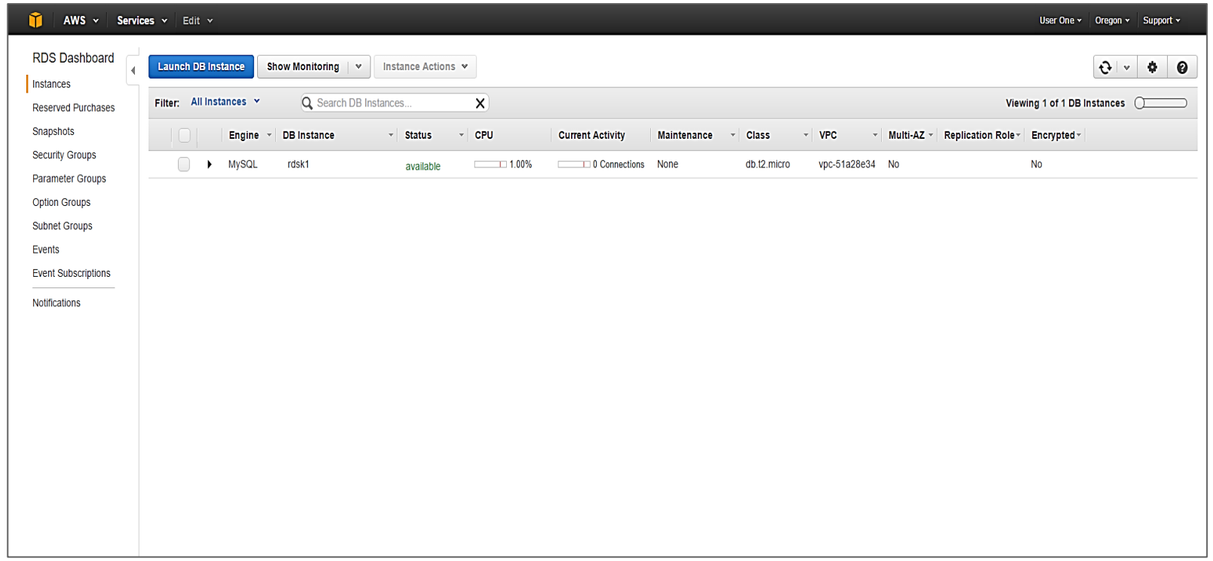
DB Instances

Regarded as the building block of Amazon R-D-S, a DB instance refers to a secluded database environment containing several created databases with following features:

- Can store from five Gigabytes to six Terabytes of data
- Each such instance has a DB engine and a set of parameters to control the database behavior
- At the time of creating the instance, the DB engine is loaded automatically with its own set of features
- You may get new features if you choose the latest version of the engine while creating the instance
- You can make the necessary changes to a DB instance whenever required



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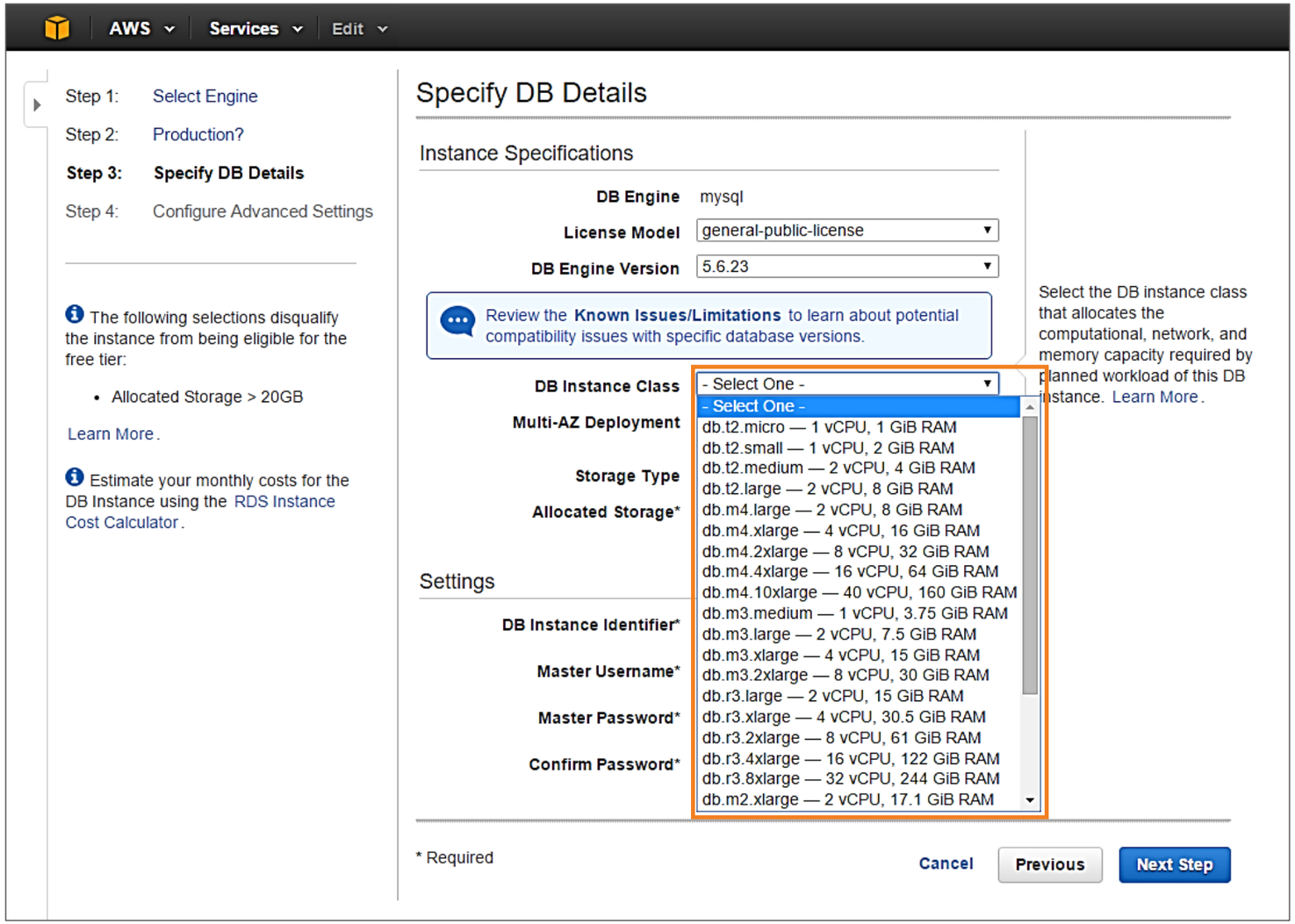
DB Instance Class

The R-D-S service uses a DB instance class to identify the computing and memory capacity of an instance.



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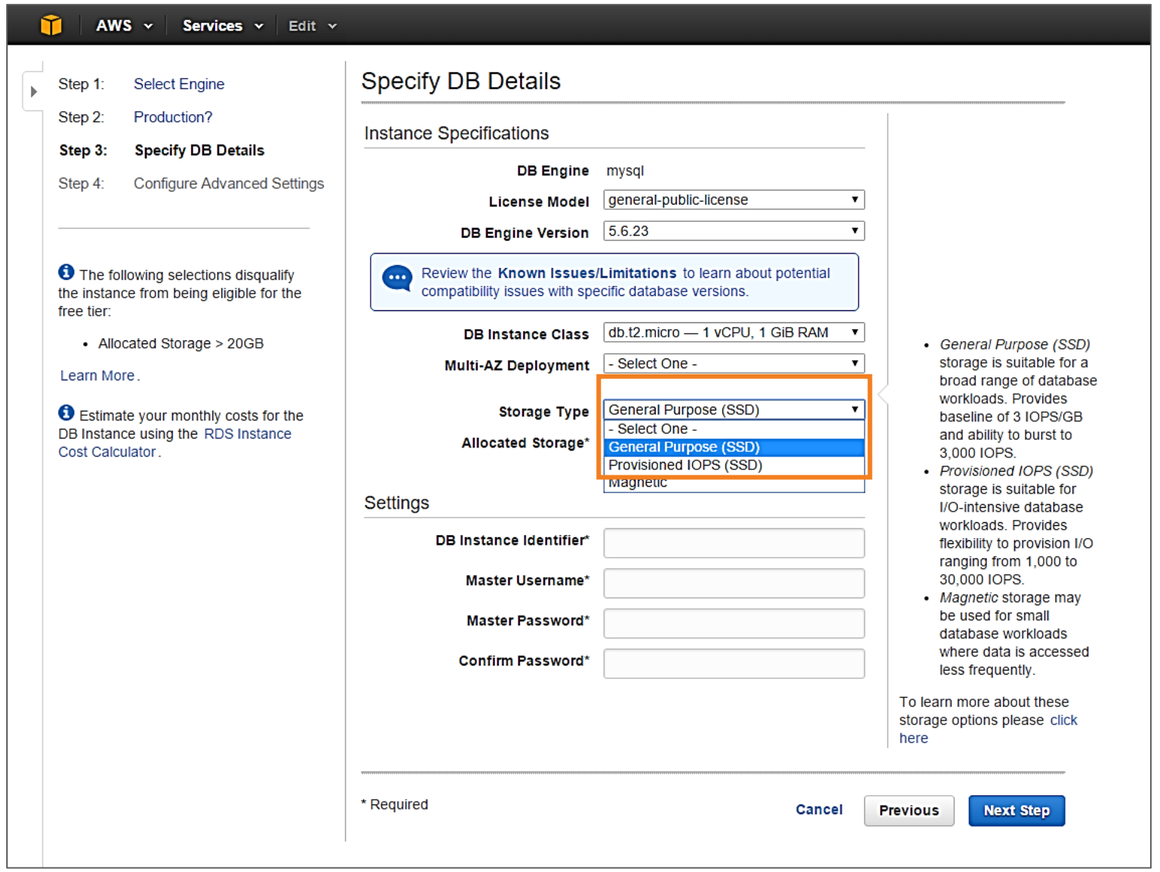
DB Instance Storage Types

Three types of DB Instance Storage:

1. General Purpose S-S-D
2. Provisioned IOPS S-S-D
3. Magnetic



Each of these types is different in terms of price and performance aspects so that you can customize your storage cost and performance according to your database requirements.

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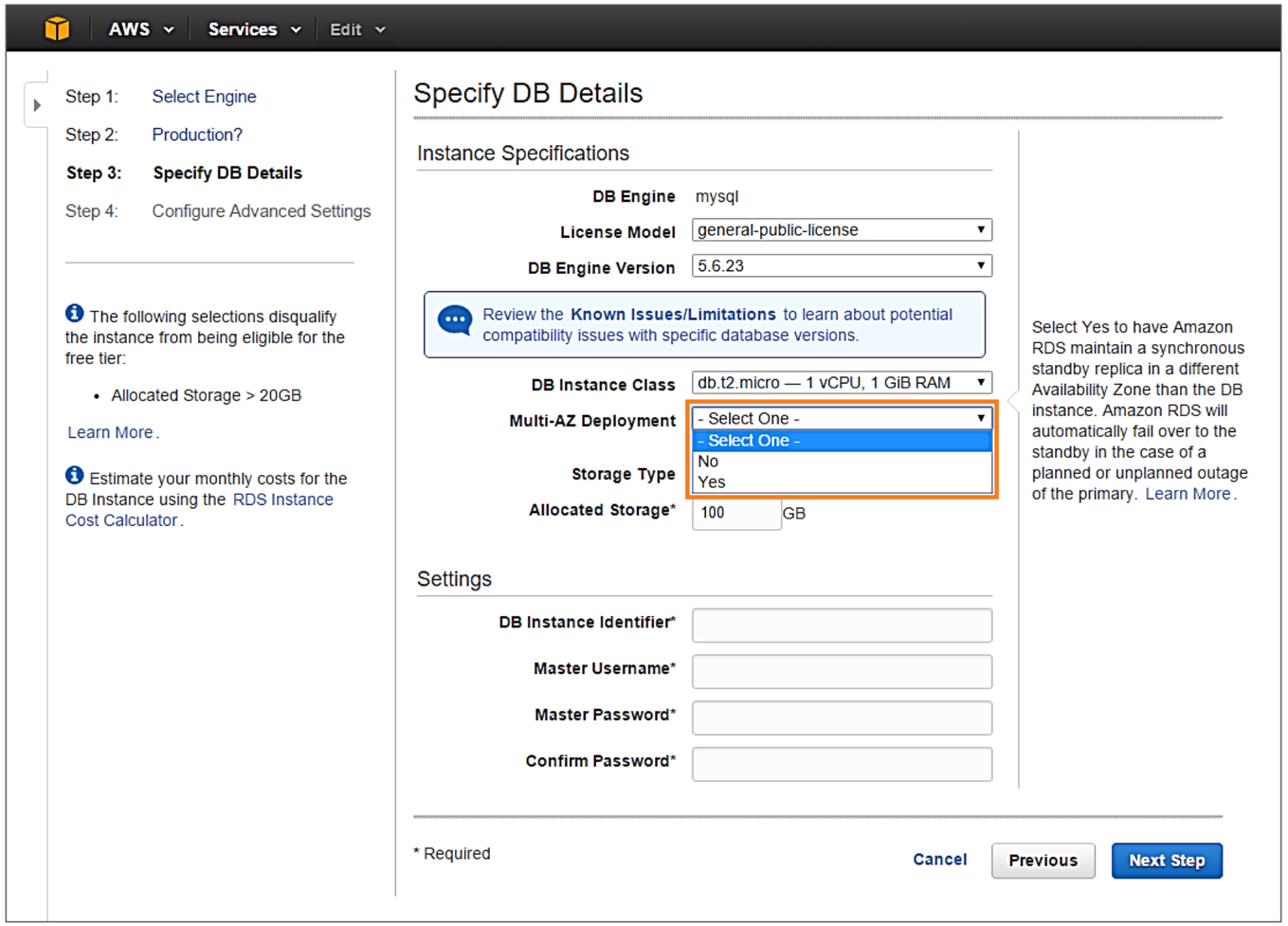
DB Instances in Regions and Availability Zones

Launch the DB instances in different Availability Zones, as it can prevent your applications from being affected by the failure to access a database stored at one location.



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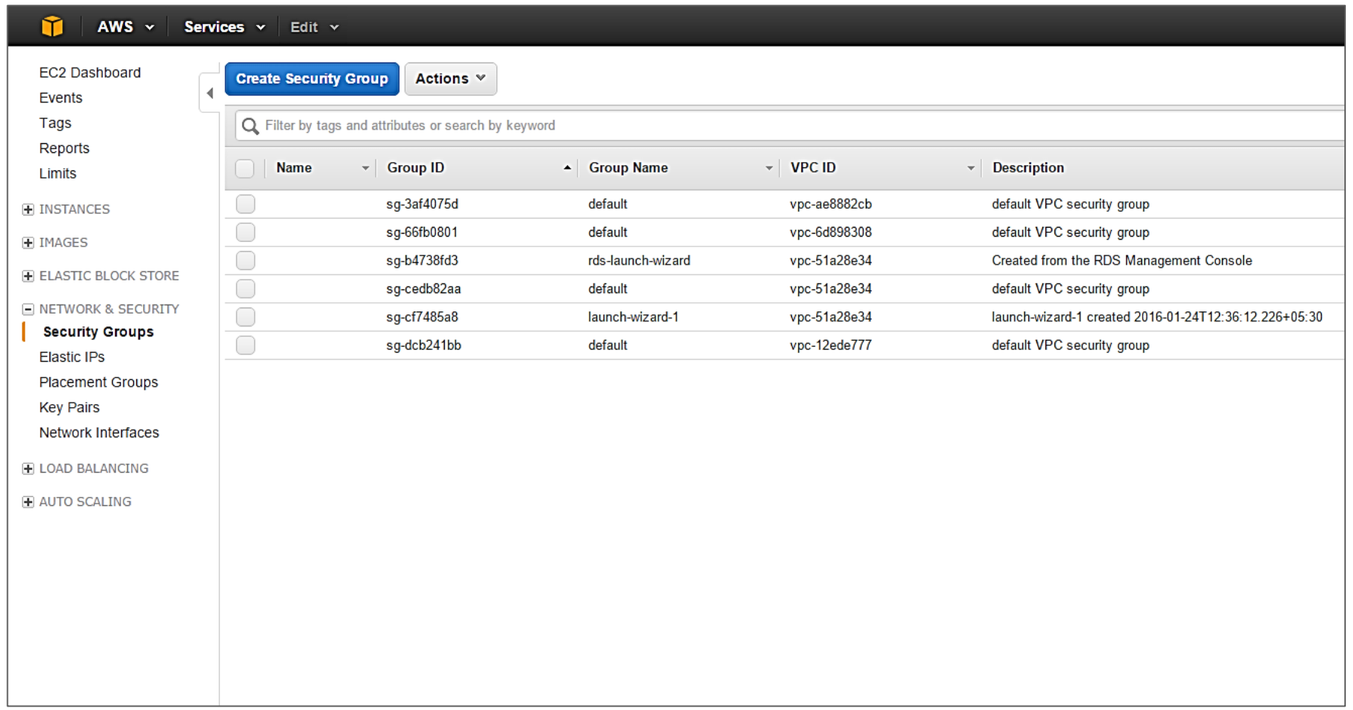
Security Groups

A security group aims to control access to a DB instance. The RDS service utilizes three different security groups:

1. DB security groups for DB instances not in a V-P-C
2. E-C-2 security groups for DB instances
3. V-P-C security groups for DB instances in a V-P-C



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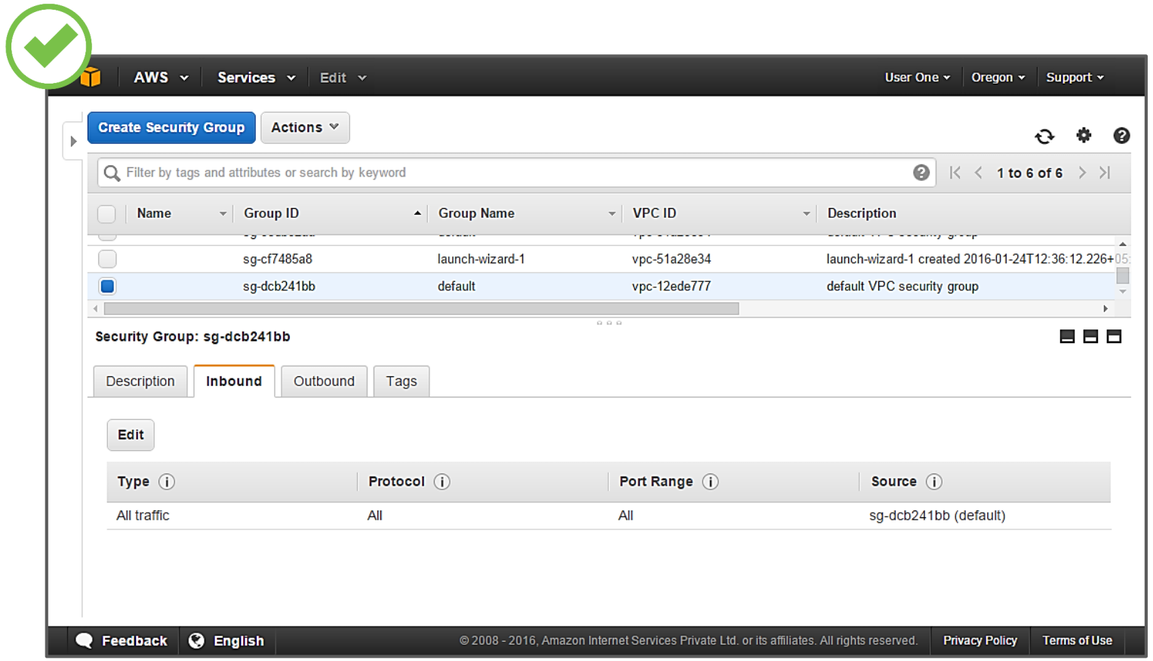
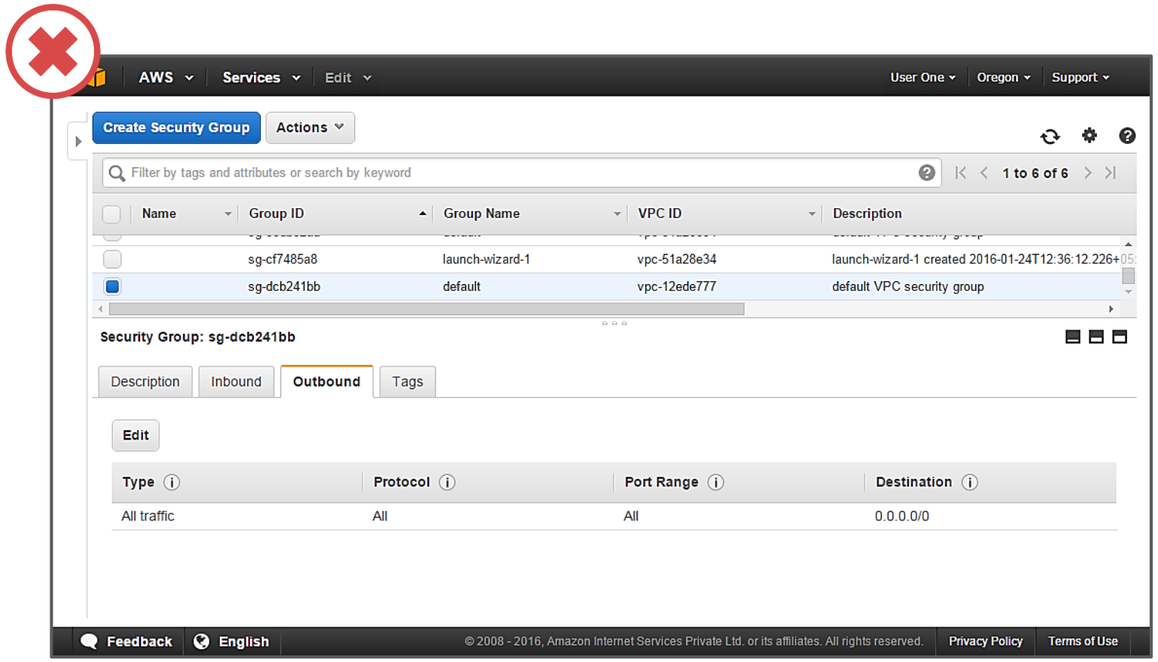
Security Groups

DB security group rules are only for inbound traffic as outbound traffic is currently prohibited for DB instances.



Inbound Traffic



Outbound Traffic

If you use an EC2 security group, you permit incoming traffic from any EC2 instance using that security group.

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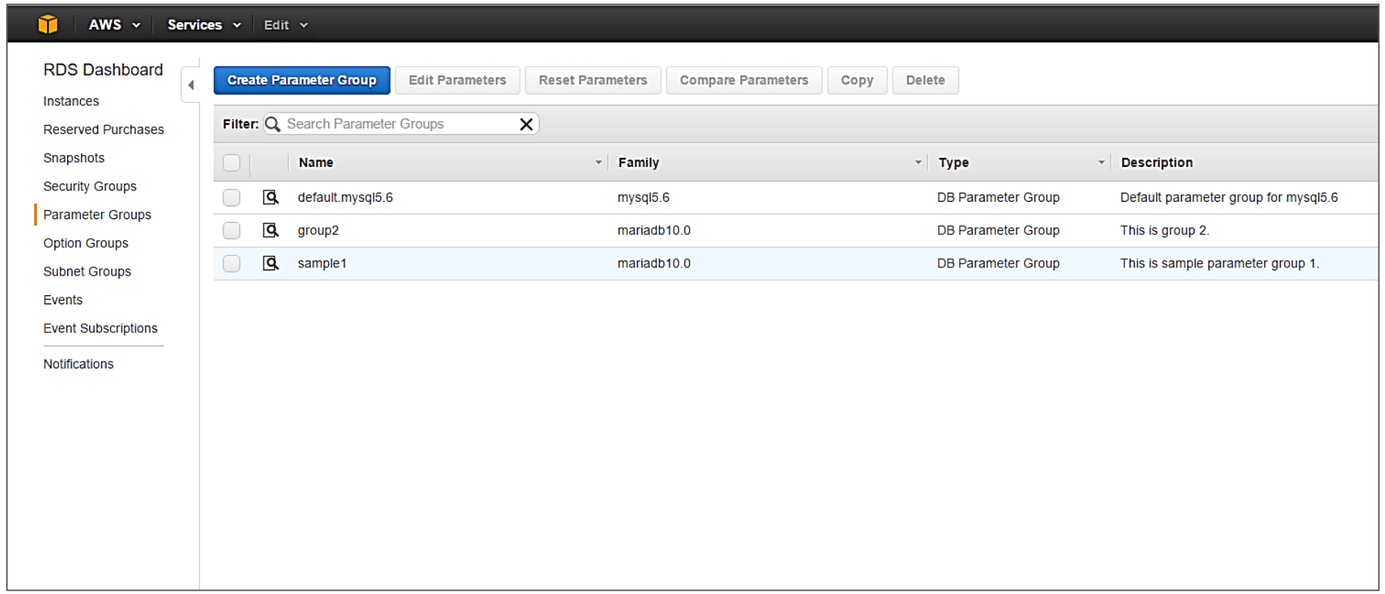
DB Parameter Groups

A DB Parameter Group allows you to specify the configuration of a DB engine.

- It contains engine configuration values that you can apply to one or more DB instances of the same type.
- By default, a parameter group is applied to a DB instance if you do not specify your desired parameter group while creating the instance.



The default parameter group has default settings for a particular database engine and an instance class.

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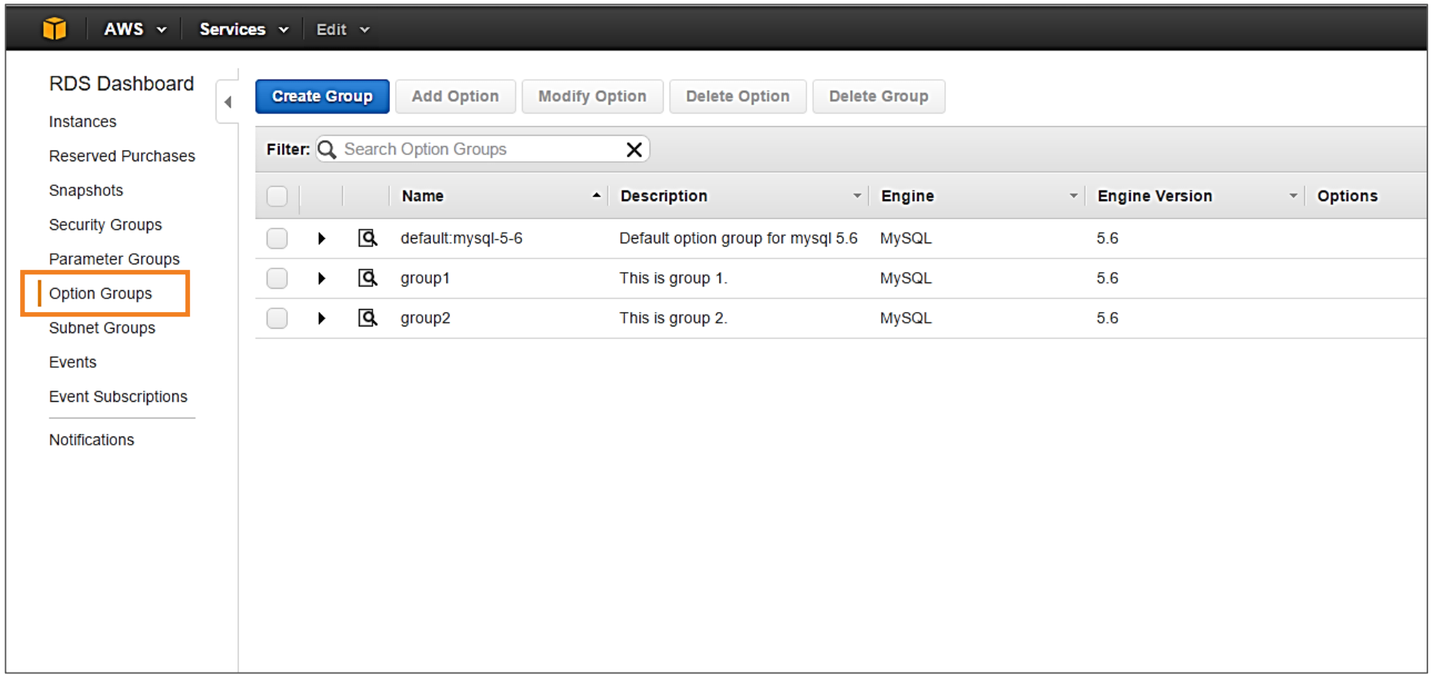
DB Options Groups

A few DB engines provide tools to easily manage the relational databases. Such tools are accessible via the DB option groups.



Currently, the option groups exist only for Microsoft SQL Server, MySQL 5.6, and Oracle DB instances.

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Knowledge Check

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KNOWLEDGE CHECK 1

How does the Amazon Relational Database Service ensure high availability and reliability of a database instance?

a. By using an efficient datacenter

b. By synchronously copying data to a reserved instance

c. By providing high security

d. By using a familiar database engine

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KNOWLEDGE CHECK 1

How does the Amazon Relational Database Service ensure high availability and reliability of a database instance?

a. By using an efficient datacenter

b. By synchronously copying data to a reserved instance

c. By providing high security

d. By using a familiar database engine

The correct answer is **b.**

Explanation: The service copies data synchronously to a reserved instance in another Availability Zone. It allows taking automatic backups or backup snapshots whenever you want.

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KNOWLEDGE CHECK 2

A security group aims to control access to ____ by allowing or denying access to the specified Amazon EC2 instances.

a. a DB instance

b. an availability zone

c. data redundancy

d. default settings

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KNOWLEDGE CHECK 2

A security group aims to control access to ____, by allowing or denying access to the specified Amazon EC2 instances.

a. a DB instance

b. an availability zone

c. data redundancy

d. default settings

The correct answer is **a.**

Explanation: A security group aims to control access to a DB instance by allowing or denying access to the specified Amazon EC2 instances and IP address ranges.

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Demo 03—Executing an RDS-Driven Application

(Refer to the E-Learning course: Screen Number – 5.9)

Demonstrate how to execute an RDS-driven Application.

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Quiz

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QUIZ 1

DynamoDB has no _____, which means that each row need not possess the same columns or attributes.

a. logic

b. pattern

c. designs

d. schema

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QUIZ 1

DynamoDB has no _____, which means that each row need not possess the same columns or attributes.

a. logic

b. pattern

c. designs

d. schema

The correct answer is **d.**

Explanation: DynamoDB has no schema, which means that each row need not possess the same columns or attributes, or even the same number of columns.

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QUIZ 2

From the following, identify the database engines supported by the Relational Database service.

a. NoSQL

b. MySQL

c. Microsoft SQL

d. PostgreSQL

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QUIZ 2	From the following, identify the database engines supported by the Relational Database service.

a. NoSQL

b. MySQL

c. Microsoft SQL

d. PostgreSQL

The correct answer is **b, c, and d.**

Explanation: Relational Database Service supports only six database engines namely, Oracle, MySQL, Microsoft SQL, PostgreSQL, Maria DB, and Amazon Aurora Oracle.

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QUIZ 3

DB instances, Security groups, DB parameter groups, and DB option groups are components of _____.

a. Amazon RDS

b. Amazon Dynamo

c. Amazon CloudFormation

d. Amazon EC2

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QUIZ 3

DB instances, Security groups, DB parameter groups, and DB option groups are components of _____.

a. Amazon RDS

b. Amazon Dynamo

c. Amazon CloudFormation

d. Amazon EC2

The correct answer is **a.**

Explanation: Amazon RDS has the following four components, namely DB instances, Security groups, DB parameter groups, and DB option groups.

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QUIZ 4

In Amazon DynamoDB, number, string, binary, Boolean, and null are _____.

a. scalar data types

b. document types

c. set data types

d. global data types

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QUIZ 4

In Amazon DynamoDB, number, string, binary, Boolean, and null are _____.

a. scalar data types

b. document types

c. set data types

d. global data types

The correct answer is **a.**

Explanation: Amazon DynamoDB supports three major data types, one of which is scalar data types, such as number, string, binary, Boolean, and null.

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QUIZ 5

Strings are _____ with Unicode Transformation Format or UTF 8 binary encoding.

a. Unicode characters

b. Unicode types

c. Unicode blocks

d. Unicode values

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QUIZ 5	Strings are _____ with Unicode Transformation Format or UTF 8 binary encoding.

a. Unicode characters

b. Unicode types

c. Unicode blocks

d. Unicode values

The correct answer is **a.**

Explanation: Strings are Unicode characters with Unicode Transformation Format or UTF 8 binary encoding.

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Key Takeaways

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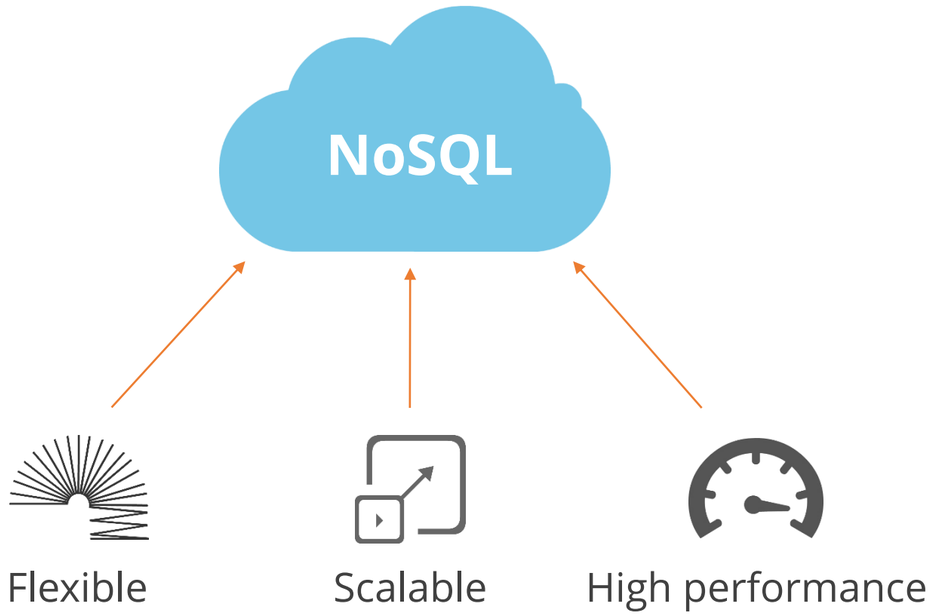
Key Takeaways

Amazon DynamoDB refers to a managed service offering NoSQL databases with high scalability, high availability, and high performance.



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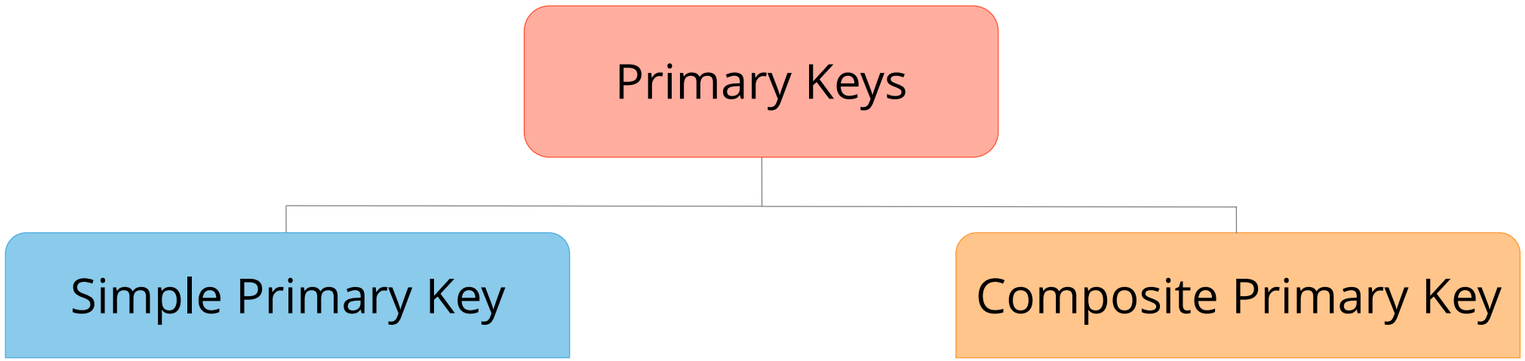
Key Takeaways

A Primary Key refers to the attribute whose value uniquely identifies each item.



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Key Takeaways

Amazon Relational Database Service aims to set, run, and scale a relational database easily in the Cloud.

Offers profitable, resizable capacity for a database

Handles time-consuming and tiresome administrative tasks

Free to concentrate on other business tasks

Fully managed service

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Key Takeaways

Relational Database Service supports six database engines: Oracle, MySQL, Microsoft SQL, PostgreSQL, Maria DB, and Amazon Aurora Oracle.

Oracle

MySQL

Microsoft SQL

PostgreSQL

Maria DB

Amazon Aurora

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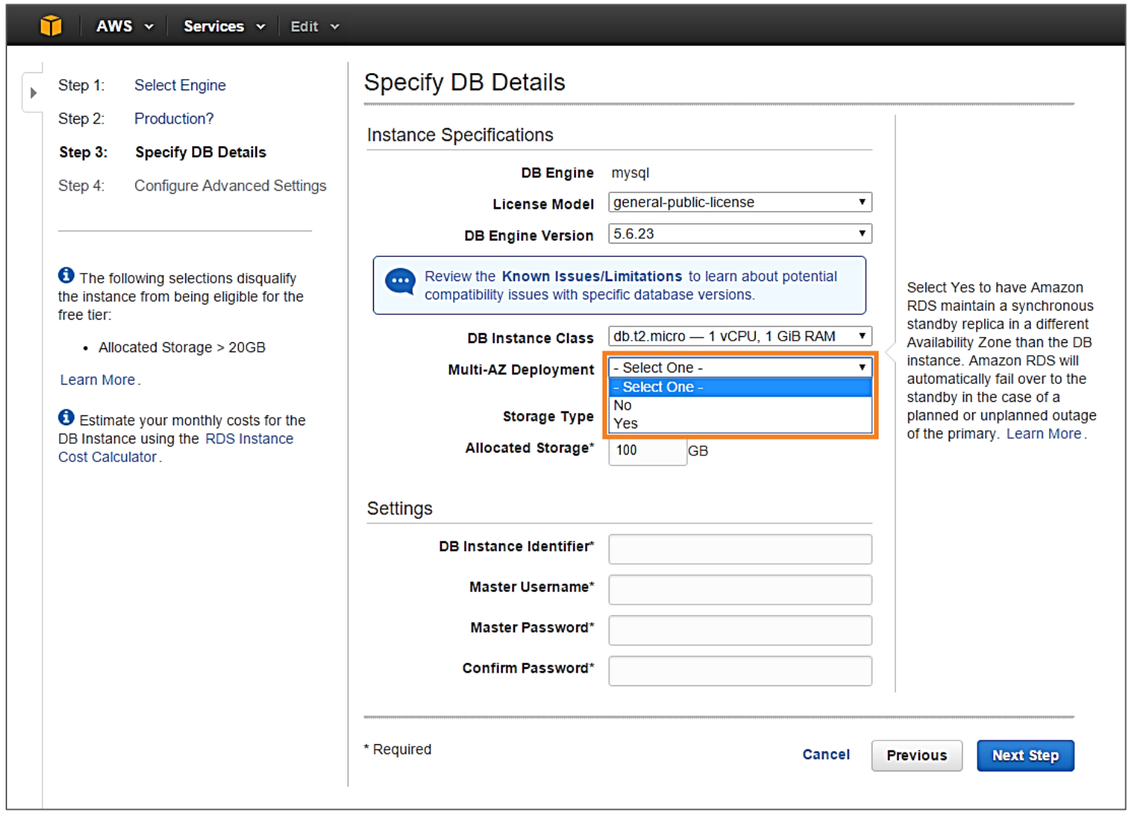
Key Takeaways

You can run a DB instance in several Availability Zones with the Multi-AZ deployment option.



DB Instances in Regions and Availability Zones

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Key Takeaways

Amazon DynamoDB refers to a managed service offering NoSQL databases with high scalability, high availability, and high performance.

A Primary Key refers to the attribute whose value uniquely identifies each item. It can be either a simple primary key or a composite primary key.

Amazon Relational Database Service aims to set, run, and scale a relational database easily in the cloud.

Relational Database Service supports six database engines, namely Oracle, MySQL, Microsoft SQL, PostgreSQL, Maria DB, and Amazon Aurora Oracle.

You can run a DB instance in several Availability Zones with the Multi-AZ deployment option.

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This Concludes 'AWS Managed Services and Database.'

The Next Lesson is 'Deployment and Management.'

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