Amazon DynamoDB

Getting Started Guide

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Amazon DynamoDB: Getting Started Guide

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Getting Started with Amazon DynamoDB

Welcome to the *Amazon DynamoDB Getting Started Guide*. This guide contains hands-on tutorials to help you learn about Amazon DynamoDB. We strongly encourage you to review this guide in this order:

- Become familiar with the basic DynamoDB concepts on this page.
- Work through the Tutorial: Basic DynamoDB Operations (p. 4) section. This tutorial uses the downloadable version of DynamoDB, including an interactive JavaScript shell. This lets you learn about the DynamoDB API for free, without having to pay any fees for throughput, storage, or data transfer.
- If you want to write programs that leverage DynamoDB, work through one of the language-specific tutorials in this Getting Started Guide. The sample code in these tutorials can run against either DynamoDB Local or the Amazon DynamoDB web service.

After you complete the exercises in this guide, we recommend that you read the Amazon DynamoDB Developer Guide. The *Amazon DynamoDB Developer Guide* provides more in-depth information about DynamoDB, including sample code and best practices.

Topics

Introduction to DynamoDB Concepts

This section briefly introduces some of the basic DynamoDB concepts. This helps you as you follow steps in the tutorials.

Tables

Similar to other database management systems, DynamoDB stores data in tables. A *table* is a collection of data. For example, you could create a table named `People`, where you could store information about friends, family, or anyone else of interest. You could also have a `Cars` table to store information about vehicles that people drive.

Items

Each table contains multiple items. An *item* is a group of attributes that is uniquely identifiable among all of the other items. In a `People` table, each item would represent one person. For a `Cars` table, each item represents one vehicle. Items are similar in many ways to rows, records, or tuples in relational database systems. In DynamoDB, there is no limit to the number of items that you can store in a table.

Attributes

Each item is composed of one or more attributes. An *attribute* is a fundamental data element, something that does not need to be broken down any further. A `Department` item might have attributes such as `DepartmentID`, `Name`, `Manager`, and so on. An item in a `People` table could contain attributes such as `PersonID`, `LastName`, `FirstName`, and so on. Attributes in DynamoDB are similar in many ways to fields or columns in other database management systems.

Primary Key

When you create a table, in addition to the table name, you must specify the primary key of the table. As in other databases, a primary key in DynamoDB uniquely identifies each item in the table, so that no two items can have the same key. When you add, update, or delete an item in the table, you must specify the primary key attribute values for that item. The key values are required; you cannot omit them.

DynamoDB supports two different kinds of primary keys:

- **Partition Key—**A simple primary key, composed of one attribute known as the *partition key*. DynamoDB uses the partition key's value as input to an internal hash function; the output from the hash function determines the partition where the item is stored. No two items in a table can have the same partition key value.
- **Partition Key and Sort Key—**A composite primary key, composed of two attributes. The first attribute is the *partition key*, and the second attribute is the *sort key*. DynamoDB uses the partition key value as input to an internal hash function; the output from the hash function determines the partition where the item is stored. All items with the same partition key are stored together, in sorted order by sort key value. It is possible for two items to have the same partition key value, but those two items must have different sort key values.

> **Note**
> The partition key of an item is also known as its *hash attribute*. The term "hash attribute" derives from DynamoDB's usage of an internal hash function to evenly distribute data items across partitions, based on their partition key values.
> The sort key of an item is also known as its *range attribute*. The term "range attribute" derives from the way DynamoDB stores items with the same partition key physically close together, in sorted order by the sort key value.

Secondary Indexes

In DynamoDB, you can read data in a table by providing primary key attribute values. If you want to read the data using non-key attributes, you can use a secondary index to do this. After you create a secondary index on a table, you can read data from the index in much the same way as you do from the table. By using secondary indexes, your applications can use many different query patterns, in addition to accessing the data by primary key values.

For more information, see the following topics in the *Amazon DynamoDB Developer Guide*:

- Data Model Concepts - Tables, Items, and Attributes

- Primary Key
- Secondary Indexes

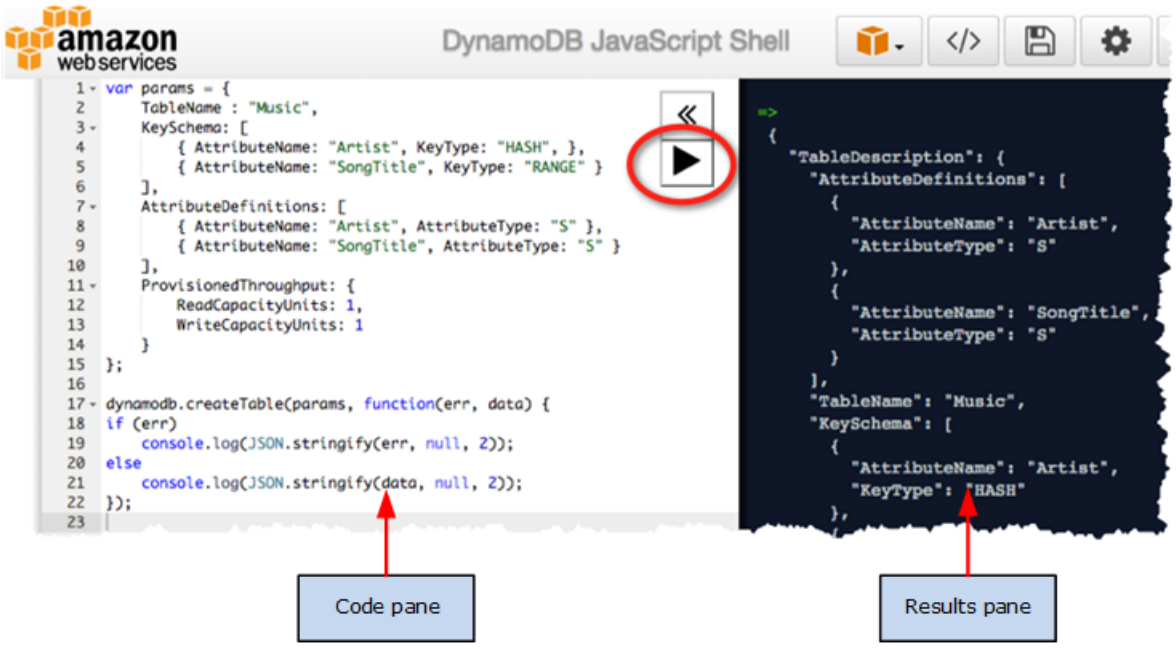
Next Step

Tutorial: Basic DynamoDB Operations (p. 4)

Tutorial: Basic DynamoDB Operations

In this tutorial, you learn the basics of DynamoDB operations. You do this using the downloadable version of DynamoDB, running on your computer.

This edition of DynamoDB includes an interactive JavaScript shell, where you can get hands-on experience with the DynamoDB API:



To use the shell, you enter JavaScript code on the left side, and then click the play button arrow ( ) to run the code. The right side shows you the results.

In this tutorial you create a table called `Music` and perform various operations on it, including add items, modify items, and read items. This exercise provides JavaScript code snippets that you copy and paste into the shell.

When you complete this tutorial, you will have gained hands-on experience with most of the DynamoDB API operations.

Cost: Free.

Prerequisites

Before you begin this tutorial, you need to download and run DynamoDB so that you can access the built-in JavaScript shell.

Download and Run DynamoDB

DynamoDB is available as an executable `.jar` file. It runs on Windows, Linux, Mac OS X, and other platforms that support Java. Follow these steps to download and run DynamoDB on your computer.

1. Download DynamoDB for free using one of these links:

   - *.tar.gz* format: http://dynamodb-local.s3-website-us-west-2.amazonaws.com/dynamodb_local_latest.tar.gz
   - *.zip* format: http://dynamodb-local.s3-website-us-west-2.amazonaws.com/dynamodb_local_latest.zip

   Important
   The downloadable version of DynamoDB may be available in repositories such as Homebrew, yum and APT, but it is not guaranteed to be the latest version. To make sure you have the latest version, use one of the links shown above.
   DynamoDB supports the Java Runtime Engine (JRE) version 6.x or newer; it does not run on older JRE versions.

2. After you have downloaded the archive to your computer, extract the contents and copy the extracted directory to a location of your choice.
3. To start DynamoDB, open a command prompt window, navigate to the directory where you extracted `DynamoDBLocal.jar`, and enter the following command:

   ```
   java -Djava.library.path=./DynamoDBLocal_lib -jar DynamoDBLocal.jar -sharedDb
   ```

   Note
   DynamoDB uses port 8000 by default. If port 8000 is unavailable, this command throws an exception. You can use the `-port` option to specify a different port number. For a complete list of DynamoDB runtime options, including `-port` , type this command:
   `java -Djava.library.path=./DynamoDBLocal_lib -jar DynamoDBLocal.jar -help`
   If you need to stop DynamoDB, you can do so by pressing `Ctrl-C`.

4. You can now access the built-in JavaScript shell.

   Important
   We recommend that you run the DynamoDB JavaScript shell on Firefox or Chrome. If you run the JavaScript shell in other browsers, errors may occur.

   Open a web browser on your computer and go to the following URL: http://localhost:8000/shell

Next Step

- Step 1: Create a Table (p. 6)

Step 1: Create a Table

In this step, you create a table named `Music`. You use the `CreateTable` API operation to do this. The primary key for the table consists of two attributes that are both string type: `Artist` (partition key) and `SongTitle` (sort key).

1. Copy the following code and paste it into the left side of the DynamoDB JavaScript shell window.

```
var params = {
    TableName : "Music",
    KeySchema: [
        { AttributeName: "Artist", KeyType: "HASH" },  //Partition key
        { AttributeName: "SongTitle", KeyType: "RANGE" }  //Sort key
    ],
    AttributeDefinitions: [
        { AttributeName: "Artist", AttributeType: "S" },
        { AttributeName: "SongTitle", AttributeType: "S" }
    ],
    ProvisionedThroughput: {
        ReadCapacityUnits: 1,
        WriteCapacityUnits: 1
    }
};

dynamodb.createTable(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

   In the code, you specify the table name, its primary key attributes and their data types. The `ProvisionedThroughput` parameter is required; however, the downloadable version of DynamoDB ignores it.

2. Click the play button arrow to run the code, as shown in the following screen shot. The response from DynamoDB; is shown in the right side of the window.

In the response, take note of the `TableStatus`. Its value should be `ACTIVE`. This indicates that the `Music` table is ready for use.

In the code snippet, note the following:

- The `params` object holds the parameters for the corresponding DynamoDB API operation.
- The `dynamodb.<operation>` line invokes the operation, with the correct parameters. In the example above, the operation is `createTable`.

Next Step

Step 2: Get Information About Tables (p. 7)

Step 2: Get Information About Tables

DynamoDB stores detailed metadata about your tables, such as table name, its primary key attributes, table status, and provisioned throughput settings. In this section you retrieve information about the music table using the DynamoDB `DescribeTable` operation and also obtain a list of tables using the `ListTables` operation.

Topics

Step 2.1: Retrieve a Table Description

Use the DynamoDB `DescribeTable` operation to view details about a table.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music"
};

dynamodb.describeTable(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. The response from DynamoDB contains a complete description of the table.

Step 2.2: Retrieve a List of Your Tables

Use the `ListTables` API operation to list the names of all of your tables. This operation does not require any parameters.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {};

dynamodb.listTables(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. The response from DynamoDB contains just one table called `Music`.

Next Step

Step 3: Write Items to the Table (p. 8)

Step 3: Write Items to the Table

When you write an item to a DynamoDB table, only the primary key attribute(s) are required. Other than the primary key, the table does not require a schema. In this section, you write an item to a table (`PutItem` operation), write an item conditionally, and also write multiple items in a single operation (`BatchWriteItem` operation).

Topics

Step 3.1: Write a Single Item

Use the `PutItem` API operation to write an item.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music",
    Item: {
        "Artist":"No One You Know",
        "SongTitle":"Call Me Today",
        "AlbumTitle":"Somewhat Famous",
        "Year": 2015,
        "Price": 2.14,
        "Genre": "Country",
        "Tags": {
            "Composers": [
                  "Smith",
                  "Jones",
                  "Davis"
            ],
            "LengthInSeconds": 214
        }
    }
};

docClient.put(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. If the write is successful, the response is an empty map: `{}`

Note the following about the item you just added:

- `Artist` and `SongTitle` are *primary key attributes* (partition key and sort key, respectively). Both are of string type. Every item that you add to the table must have values for these attributes.
- Other attributes are `AlbumTitle` (string), `Year` (number), `Price` (number), `Genre` (string), and `Tags` (map).
- DynamoDB allows you to *nest* attributes within other attributes. The `Tags` map contains two *nested attributes*—`Composers` (list) and `LengthInSeconds` (number).
- `Artist`, `SongTitle`, `AlbumTitle`, `Year`, `Price`, `Genre`, and `Tags` are *top-level attributes* because they are not nested within any other attributes.

For more information, see Data Types in the *Amazon DynamoDB Developer Guide*.

Step 3.2: Perform a Conditional Write

By default, `PutItem` does not check first to see if there is already an item with the same key, it simply overwrites any existing item. If you want to ensure that you do not overwrite an existing item, you can add a `ConditionExpression` parameter. This is a logical condition that must be satisfied in order for the write to succeed.

In this step, you try to write the same item, but this time you specify a condition to see whether an item with the same primary key already exists. The write fails because there is already an item in the table with the same primary key.

1. Modify the `params` object so that it looks like this:

```
var params = {
    TableName: "Music",
    Item: {
        "Artist":"No One You Know",
        "SongTitle":"Call Me Today",
        "AlbumTitle":"Somewhat Famous",
        "Year": 2015,
        "Price": 2.14,
        "Genre": "Country",
        "Tags": {
            "Composers": [
                  "Smith",
                  "Jones",
                  "Davis"
            ],
            "LengthInSeconds": 214
        }
    },
   "ConditionExpression": "attribute_not_exists(Artist) and attribute_not_ex
ists(SongTitle)"
};
```

   Note
   The only difference is the `ConditionExpression` parameter. This prevents you from overwriting the item. if there is already an item in the table with the same primary key values (`No One You Know`, `Call Me Today`).
   For more information, see Condition Expressions in the *Amazon DynamoDB Developer Guide*.

2. Click the play button arrow to run the code.

   The conditional write fails because the item already exists.

Step 3.3: Write Multiple Items

You can use the `BatchWriteItem` operation to perform multiple writes in one step. The following code adds several items, with the required primary key attributes, but different non-key attributes.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    RequestItems: {
        "Music": [
            {
                PutRequest: {
                    Item: {
                        "Artist": "No One You Know",
                        "SongTitle": "My Dog Spot",
                        "AlbumTitle":"Hey Now",
                        "Price": 1.98,
                        "Genre": "Country",
                        "CriticRating": 8.4
                    }
                }
            },
            {
                PutRequest: {
                    Item: {
                        "Artist": "No One You Know",
                        "SongTitle": "Somewhere Down The Road",
                        "AlbumTitle":"Somewhat Famous",
                        "Genre": "Country",
                        "CriticRating": 8.4,
                        "Year": 1984
                    }
                }
            },
            {
                PutRequest: {
                    Item: {
                        "Artist": "The Acme Band",
                        "SongTitle": "Still In Love",
                        "AlbumTitle":"The Buck Starts Here",
                        "Price": 2.47,
                        "Genre": "Rock",
                        "PromotionInfo": {
                            "RadioStationsPlaying":[
                                "KHCR", "KBQX", "WTNR", "WJJH"
                            ],
                            "TourDates": {
                                "Seattle": "20150625",
                                "Cleveland": "20150630"
                            },
                            "Rotation": "Heavy"
                        }
                    }
                }
            },
            {
                PutRequest: {
                    Item: {
                        "Artist": "The Acme Band",
                        "SongTitle": "Look Out, World",
                        "AlbumTitle":"The Buck Starts Here",
                        "Price": 0.99,
                        "Genre": "Rock"
                    }
```

```
                }
            }
        ]
    }
};

docClient.batchWrite(params, function (err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. If the batch write is successful, the response contains the following: `"UnprocessedItems": {}`. This indicates that all of the items in the batch have been written.

Next Step

Step 4: Read an Item Using Its Primary Key (p. 12)

Step 4: Read an Item Using Its Primary Key

DynamoDB provides the `GetItem` operation for retrieving one item at a time. You can retrieve an entire item, or a subset of its attributes.

DynamoDB supports the Map and List attribute types. These attribute types allow you to nest other attributes within them, so that you can store complex documents in an item. You can use `GetItem` to retrieve an entire document, or just some of the nested attributes within that document.

Step 4.1: Read an Item Using GetItem

Use the `GetItem` API operation to read an item. You must provide the primary key of the item you want. DynamoDB then reads the item directly from its physical location in the database.

The following code reads an item from the `Music` table by specifying the primary key.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music",
    Key: {
        "Artist": "No One You Know",
        "SongTitle": "Call Me Today"
    }
};

docClient.get(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
```

```
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. The requested item appears in the response.
3. (Optional) You can change the primary key in the preceding code to retrieve different music items. Let us retrieve different music items from the table.

   Modify the `params` object, using any of the primary key values shown below. Click the play button arrow to run the code, and verify that the correct item is returned in the response.

```
    Key: {
        "Artist": "No One You Know",
        "SongTitle": "My Dog Spot"
    }
```

```
    Key: {
        "Artist": "No One You Know",
        "SongTitle": "Somewhere Down The Road"
    }
```

```
    Key: {
        "Artist": "The Acme Band",
        "SongTitle": "Still In Love"
    }
```

```
    Key: {
        "Artist": "The Acme Band",
        "SongTitle": "Look Out, World"
    }
```

Step 4.2: Retrieve a Subset of Attributes Using a Projection Expression

By default, the `GetItem` API operation returns all of the attributes in the item. To return only some of the attributes, you provide a *projection expression* — a comma-separated string of attribute names that you want to use.

1. In the DynamoDB JavaScript shell window, modify the `params` object so that it looks like this:

```
var params = {
    TableName: "Music",
    Key: {
```

```
        "Artist": "No One You Know",
        "SongTitle": "Call Me Today"
    },
    ProjectionExpression: "AlbumTitle"
};
```

2. Click the play button arrow to run the code. Only one attribute (`AlbumTitle`) appears in the response.

Handling Attribute Names that Are Also Reserved Words

In DynamoDB, you have a great deal of flexibility when it comes to naming your tables and attributes. However, it is possible that a name you choose might conflict with a reserved word. In this situation, you can define an *expression attribute name* and use it in the projection expression.

For the complete list, see Reserved Words in the *Amazon DynamoDB Developer Guide*.

1. Modify the projection expression so that it also includes the `Year` attribute, which is a reserved word and therefore the `GetItem` operation fails:

```
var params = {
    TableName: "Music",
    Key: {
        "Artist": "No One You Know",
        "SongTitle": "Call Me Today"
    },
    ProjectionExpression: "AlbumTitle, Year"
};
```

2. Click the play button arrow to run the code. An error message appears in the response:

```
Invalid ProjectionExpression: Attribute name is a reserved keyword; reserved
keyword: Year
```

3. Modify the `params` object to use a placeholder token (#y) in `ProjectionExpression`, and then define the placeholder in the `ExpressionAttributeNames` parameter.

```
var params = {
    TableName: "Music",
    Key: {
        "Artist": "No One You Know",
        "SongTitle": "Call Me Today"
    },
    ProjectionExpression: "AlbumTitle, #y",
    ExpressionAttributeNames: {"#y": "Year"}
};
```

   In the `ProjectionExpression`, the word `Year` is replaced by the token #y. The # (pound sign) is required, and indicates that this is a placeholder. The `ExpressionAttributeNames` parameter indicates that #y is to be replaced by `Year` at runtime.

4. Click the play button arrow to run the code. The `AlbumTitle` and `Year` attributes appear in the response.

Step 4.3: Retrieve Nested Attributes Using Document Path Notation

DynamoDB supports a map type attribute to store documents. In the `Music` table, we use a map type attribute called `Tags` to store information such as list of music composers, song duration information, and so on. These are nested attributes. You can retrieve entire document, or a subset of these nested attributes by specifying document path notation.

A *document path* tells DynamoDB where to find the attribute, even if it is deeply nested within multiple lists and maps. In a document path, use the following operators to access nested attributes:

- For a list, use square brackets: **[*n*]**, where *n* is the element number. List elements are zero-based, so [0] represents the first element in the list, [1] represents the second, and so on.
- For a map, use a dot: **.** The dot acts as a separator between elements in the map.

1. Modify the `params` object so that it looks like this:

```
var params = {
    TableName: "Music",
    Key: {
        "Artist": "No One You Know",
        "SongTitle": "Call Me Today"
    },
    ProjectionExpression: "AlbumTitle, #y, Tags.Composers[0],
Tags.LengthInSeconds",
    ExpressionAttributeNames: {"#y": "Year"}
};
```

2. Click the play button arrow to run the code. The response contains only the top-level and nested attributes that were specified in `ProjectionExpression`.

Step 4.4: Read Multiple Items Using BatchGetItem

The `GetItem` operation retrieves a single item by its primary key. DynamoDB also supports `BatchGetItem` operation for you to read multiple items in a single request. You specify a list of primary keys for this operation.

The following example retrieves a group of music items. The example also specifies the optional `ProjectionExpression` to retrieve only a subset of the attributes.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    RequestItems: {
        "Music": {
            Keys: [
                {
                    "Artist": "No One You Know",
                    "SongTitle": "My Dog Spot"
                },
                {
```

```
                    "Artist": "No One You Know",
                    "SongTitle": "Somewhere Down The Road"
                },
                {
                    "Artist": "The Acme Band",
                    "SongTitle": "Still In Love"
                },
                {
                    "Artist": "The Acme Band",
                    "SongTitle": "Look Out, World"
                }
            ],
            ProjectionExpression:"PromotionInfo, CriticRating, Price"
        }
    }
};

docClient.batchGet(params, function (err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. The response contains all of the attributes specified in `ProjectionExpression`. If one of the items does not have an attribute, it appears in the response as an empty map: `{}`
3. (Optional) Remove the `ProjectionExpresion` entirely, and retrieve all of the attributes from the items.
4. (Optional) Add a new `ProjectionExpression` that retrieves at least one nested attribute. Use document path notation to do this.

Next Step

Step 5: Query and Scan the Table (p. 16)

Step 5: Query and Scan the Table

DynamoDB supports the `Query` operation on tables that have a composite primary key (partition key and sort key). You can also filter query results.

In addition, DynamoDB also supports the `Scan` operation on a table. This section provides introductory examples of using these operations.

Topics

Step 5.1: Run a Query

This section provides examples of Query operations. The queries are specified against the `Music` table. Remember, the table primary key is made of `Artist` (partition key) and `SongTitle` (sort key).

- Query using only the partition key. For example, find songs by an artist.
- Query using both the partition key and the sort key. For example, find songs by an artist and song title starting with a specific string.
- Filter query results. Find songs by an artist and then return only those songs that have more than three radio stations playing them.

Query Using a Partition Key

Follow these steps to query for songs by an artist. Note that you use the `KeyConditionExpression` to specify the primary key. In this example it specifies only the partition key (`Artist`).

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music",
    KeyConditionExpression: "Artist = :artist",
    ExpressionAttributeValues: {
        ":artist": "No One You Know"
    }
};

docClient.query(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

   In the `KeyConditionExpression`, `:artist` is a token. The token value is provided in the `ExpressionAttributeValues` parameter. The `:` (colon) indicates that this is a placeholder for the value.
2. Click the play button arrow to run the code. Only the songs by the band `No One You Know` are returned.

Query Using Key Attributes

Follow these steps to query for songs by an artist (`The Acme Band`) with song title starting with a specific string (S). Note that you use the `KeyConditionExpression` to specify the primary key. In this example it specifies both the partition key and sort key.

1. Modify the `params` object from Query Using a Partition Key (p. 17) so that it looks like this:

```
var params = {
    TableName: "Music",
    ProjectionExpression: "SongTitle",
```

```
    KeyConditionExpression: "Artist = :artist and begins_with(SongTitle,
:letter)",
    ExpressionAttributeValues: {
        ":artist": "The Acme Band",
        ":letter": "S"
    }
};
```

Note the use of `ProjectionExpression`, which causes the query to return the `SongTitle` attribute only.

2. Click the play button arrow to run the code. Only songs by `The Acme Band`, with titles that begin with the letter `S`, are returned. (There is only one song that meets this criteria in the `Music` table.)

Step 5.2: Filter Query Results

You can filter results of a query by adding the `FilterExpression` parameter. In this example you specify a query to find songs by an artist (`The Acme Band`). The query also specifies the `FilterExpression` to request DynamoDB to return only the song items that are being played on more than three radio stations.

1. Modify the `params` object from Query Using a Partition Key (p. 17) so that it looks like this:

```
var params = {
    TableName: "Music",
    ProjectionExpression: "SongTitle, PromotionInfo.Rotation",
    KeyConditionExpression: "Artist = :artist",
   FilterExpression: "size(PromotionInfo.RadioStationsPlaying) >= :howmany",

    ExpressionAttributeValues: {
        ":artist": "The Acme Band",
        ":howmany": 3
    },
};
```

Note the use of `ProjectionExpression`, which causes the query to return the top-level `SongTitle` attribute and the nested `PromotionInfo.Rotation` attribute.

Also the FilterExpression specifies the size() function. For a list of predefined functions, go to the Expression Reference in the *Amazon DynamoDB Developer Guide*.

2. Click the play button arrow to run the code. The response contains the only song by The Acme Band that is in heavy rotation on at least three radio stations.

Step 5.3: Scan the Table

You can use the `Scan` operation to retrieve all of the items in a table. In the following example you scan the `Music` table.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music"
};

docClient.scan(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. All of the table items appear in the response.

Next Step

Step 6: Work with a Secondary Index (p. 19)

Step 6: Work with a Secondary Index

Without an index, you can query for items based on primary key. You can add indexes to your table depending on your query patterns. DynamoDB supports two different kinds of indexes:

- Global secondary index — an index with a partition key and sort key that can be different from those on the table. You can create or delete a global secondary index on a table at any time.
- Local secondary index — an index that has the same partition key as the primary key of the table, but a different sort key. You can only create a local secondary index when you create a table; when you delete the table, the local secondary index is also deleted.

For more information about these indexes, go to Improving Data Access with Secondary Indexes in DynamoDB in the *Amazon DynamoDB Developer Guide*.

In this step, you add a secondary index to the `Music` table. Then, you then query and scan the index, in the same way as you would query or scan a table. In this tutorial, you create and use a global secondary index.

Topics

Step 6.1: Create a Global Secondary Index

The `Music` table has a primary key made of `Artist` (partition key) and `SongTitle` (sort key). Now suppose you want to query this table by `Genre` and find all of the `Country` songs. Searching on the primary key does not help in this case. To do this, we build a secondary index with `Genre` as the partition key.

To make this interesting, we use the `Price` attribute as the sort key. So you can now run a query to find all `Country` songs with `Price` less than 0.99.

You can add an index at the time that you create a table or later using the `UpdateTable` operation.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music",
    AttributeDefinitions:[
        {AttributeName: "Genre", AttributeType: "S"},
        {AttributeName: "Price", AttributeType: "N"}
    ],
    GlobalSecondaryIndexUpdates: [
        {
            Create: {
                IndexName: "GenreAndPriceIndex",
                KeySchema: [
                    {AttributeName: "Genre", KeyType: "HASH"},  //Partition
 key
                    {AttributeName: "Price", KeyType: "RANGE"},  //Sort key

                ],
                Projection: {
                    "ProjectionType": "ALL"
                },
                ProvisionedThroughput: {
                    "ReadCapacityUnits": 1,"WriteCapacityUnits": 1
                }
            }
        }
    ]
};

dynamodb.updateTable(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

   In the code:

   - `AttributeDefinitions` lists data types of attributes that are later defined as the partition key and sort key of the index.
   - `GlobalSecondaryIndexUpdates` specifies the index operations. You can create index, update index, or delete an index.
   - The `ProvisionedThroughput` parameter is required, but the downloadable version of DynamoDB ignores it.

2. Click the play button arrow to run the code.

   In the response, take note of the `IndexStatus`. Its value should be `CREATING`, which indicates that the index is being built. The new should be available for use within a few seconds.

Step 6.2: Query the Index

Now we use the index to query for all `Country` songs. The index has all of the data you need, so you query the index and not the table.

You use the same `Query` operation to query a table (see Step 5: Query and Scan the Table (p. 16)) or an index on the table. When you query an index you specify both the table name and the index name.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music",
    IndexName: "GenreAndPriceIndex",
    KeyConditionExpression: "Genre = :genre",
    ExpressionAttributeValues: {
        ":genre": "Country"
    },
    ProjectionExpression: "SongTitle, Price"
};

docClient.query(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. Only the `Country` songs are returned.
3. Now let us query for `Country` songs that cost more than two dollars. Here you specify both the partition key and sort key values for index. Modify the `params` object so that it looks like this:

```
var params = {
    TableName: "Music",
    IndexName: "GenreAndPriceIndex",
    KeyConditionExpression: "Genre = :genre and Price > :price",
    ExpressionAttributeValues: {
        ":genre": "Country",
        ":price": 2.00
    },
    ProjectionExpression: "SongTitle, Price"
};
```

4. Click the play button arrow to run the code. This query uses both of the index key attributes (`Genre` and `Price`), returning only the `Country` songs that cost more than 2.00.

Step 6.3: Scan the Index

You can scan an index (using the `Scan` operation) in the same way that you scan a table. When scanning an index, you provide both the table name and index name.

In this example, we scan the entire global secondary index you created, but we'll retrieve specific attributes only.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music",
    IndexName: "GenreAndPriceIndex",
    ProjectionExpression: "Genre, Price, SongTitle, Artist, AlbumTitle"
};

docClient.scan(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. All of the items in the index are returned.
3. (Optional) Note that there are only four items in the index (`Count`), but there are five items in the table. The reason is that one of the items does not have a `Price` attribute, so that item was not included in `GenreAndPriceIndex`.

   Which of the songs in `Music` items does not have a `Price` attribute? Can you determine which one it is?

Next Step

Step 7: Modify Items in the Table (p. 22)

Step 7: Modify Items in the Table

You can modify an item in a table using `UpdateItem` or you can delete an item using the `DeleteItem` operations. You can update item by updating values of existing attributes, add new attributes, or remove existing attributes. You can use keywords in the `UpdateItem` operation such as `Set` and `Remove` to request specific updates.

Topics

Step 7.1: Update an Item

The `UpdateItem` API operation lets you do the following:

- Add more attributes to an item.
- Modify the values of one or more attributes in the item.
- Remove attributes from the item.

To specify which operations to perform, you use an update expression. An *update expression* is a string containing attribute names, operation keywords (such as `SET` and `REMOVE`), and new attribute values. You can combine multiple updates in a single update expression.

For more information, see Reserved Words in the *Amazon DynamoDB Developer Guide*.

By default, `UpdateItem` operation does not return any data (empty response). You can optionally specify the `ReturnValues` parameter to request attribute values as they appeared before or after the update:

- `ALL_OLD` returns all attribute values as they appeared before the update.
- `UPDATED_OLD` returns only the updated attributes as they appeared before the update.
- `ALL_NEW` returns all attribute values as they appear after the update.
- `UPDATED_NEW` returns only the updated attributes as they appeared after the update.

In this example, you perform a couple of updates to an item in the `Music` table.

1. The following example updates a `Music` table item by adding a new `RecordLabel` attribute using the `UpdateExpression` parameter.

   Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music",
    Key: {
        "Artist":"No One You Know",
        "SongTitle":"Call Me Today"
    },
    UpdateExpression: "SET RecordLabel = :label",
    ExpressionAttributeValues: {
        ":label": "Global Records"
    },
    ReturnValues: "ALL_NEW"
};

docClient.update(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. Verify that the item in the response has a `RecordLabel` attribute.
3. We now apply multiple changes to the item using the `UpdateExpression` parameter: Change the price, and remove one of the composers.

   Modify the `params` object so that it looks like this:

```
var params = {
    TableName: "Music",
    Key: {
        "Artist":"No One You Know",
```

```
        "SongTitle":"Call Me Today"
    },
    UpdateExpression:
        "SET Price = :price REMOVE Tags.Composers[2]",
    ExpressionAttributeValues: {
        ":price": 0.89
    },
    ReturnValues: "ALL_NEW"
};
```

4. Click the play button arrow to run the code. Verify that the `UpdateExpression` worked.

Specify a Conditional Write

By default updates are performed unconditionally. You can specify a condition in the `UpdateItem` operation to perform conditional update. For example, you may want to check if an attribute exists before changing its value, or check the existing value and apply an update only if the existing value meets certain criteria.

The `UpdateItem` operation provides `ConditionExpression` parameter for you to specify one or more conditions.

In this example, you add an attribute only if it doesn't already exist.

1. Modify the `params` object from Step 7.1: Update an Item (p. 22) so that it looks like this:

```
var params = {
    TableName: "Music",
    Key: {
        "Artist":"No One You Know",
        "SongTitle":"Call Me Today"
    },
    UpdateExpression: "SET RecordLabel = :label",
    ExpressionAttributeValues: {
        ":label": "New Wave Recordings, Inc."
    },
    ConditionExpression: "attribute_not_exists(RecordLabel)",
    ReturnValues: "ALL_NEW"
};
```

2. Click the play button arrow to run the code. This should fail with response: `The conditional request failed` because the item already has the `RecordLabel` attribute.

Specify an Atomic Counter

DynamoDB supports atomic counters, where you use the `UpdateItem` operation to increment or decrement the value of an existing attribute without interfering with other write requests. (All write requests are applied in the order in which they were received.) For example, a music player application might want to maintain a counter each time song is played. In this case, the application would need to increment this counter regardless of its current value. For more information, go to Atomic Counters in the *Amazon DynamoDB Developer Guide*.

In this example, we first use the `UpdateItem` operation to add an attribute (`Plays`) to keep track of the number of times the song is played. Then, using another `UpdateItem` operation, we increment its value by 1.

1. Modify the `params` object from Step 7.1: Update an Item (p. 22) so that it looks like this:

```
var params = {
    TableName: "Music",
    Key: {
        "Artist":"No One You Know",
        "SongTitle":"Call Me Today"
    },
    UpdateExpression: "SET Plays = :val",
    ExpressionAttributeValues: {
        ":val": 0
    },
    ReturnValues: "UPDATED_NEW"
};
```

2. Click the play button arrow to run the code. The `Plays` attribute is added, and its value (zero) is shown in the response.
3. Now modify the `params` object so that it looks like this:

```
var params = {
    TableName: "Music",
    Key: {
        "Artist":"No One You Know",
        "SongTitle":"Call Me Today"
    },
    UpdateExpression: "SET Plays = Plays + :incr",
    ExpressionAttributeValues: {
        ":incr": 1
    },
    ReturnValues: "UPDATED_NEW"
};
```

4. Click the play button arrow to run the code. The `Plays` attribute is incremented by one.
5. Run the code a few more times. Each time you do this, `Plays` is incremented.

Step 7.2: Delete an Item

You now use the `DeleteItem` API operation to delete an item from the table. Note that this operation is permanent—there is no way to restore an item.

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music",
    Key: {
        Artist: "The Acme Band",
```

```
        SongTitle: "Look Out, World"
    }
};

docClient.delete(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code. The item is deleted.

Specify a Conditional Delete

By default, a delete operation is unconditional. However, you can use the `ConditionExpression` parameter to perform conditional deletes. In this example you delete an item, only if its price is 0.

1. Modify the `params` object so that it looks like this:

```
var params = {
    TableName: "Music",
    Key: {
        Artist: "No One You Know",
        SongTitle: "My Dog Spot"
    },
    ConditionExpression: "Price = :price",
    ExpressionAttributeValues: {
        ":price": 0.00
    }
};
```

2. Click the play button arrow to run the code. The conditional delete fails because the song is not free (`Price` is not 0.00).

Next Step

Step 8: Clean Up (p. 26)

Step 8: Clean Up

In this step, you use the `DeleteTable` API operation to remove the table. When you do this, the `Music` table, `GenreAndPriceIndex`, and all of the data is permanently deleted. This operation cannot be undone.

To delete the table

1. Replace everything in the left side of the DynamoDB JavaScript shell window with the following code:

```
var params = {
    TableName: "Music"
};

dynamodb.deleteTable(params, function(err, data) {
    if (err)
        console.log(JSON.stringify(err, null, 2));
    else
        console.log(JSON.stringify(data, null, 2));
});
```

2. Click the play button arrow to run the code to delete the table.

The table is deleted immediately.

Next Step

Summary (p. 27)

Summary

In this exercise, you downloaded DynamoDB and used the built-in JavaScript shell to learn about various DynamoDB API operations. To learn more, see the following topics in the Amazon DynamoDB Developer Guide:

- Working With Tables
- Working With Items
- Query and Scan
- Secondary Indexes
- Best Practices

Next Steps

For an additional getting-started exercise, work through one of our programming-language specific tutorials:

- Java and DynamoDB (p. 28)
- Node.js and DynamoDB (p. 99)
- Python and DynamoDB (p. 140)

Java and DynamoDB

In this tutorial, you use the AWS SDK for Java to write simple programs to perform the following Amazon DynamoDB operations:

- Create a table called `Movies` and load sample data in JSON format.
- Perform create, read, update, and delete operations on the table.
- Run simple queries.

The SDK for Java offers several programming models for different use cases. In this exercise, the Java code uses the document model that provides a level of abstraction that makes it easier for you to work with JSON documents.

You use the downloadable version of DynamoDB in this tutorial. In the Summary (p. 46), we explain how to run the same code against the DynamoDB web service.

Cost: Free

Prerequisites

Before you begin this tutorial, do the following:

- Download and run DynamoDB on your computer. For more information, see Download and Run DynamoDB (p. 5).
- Sign up for Amazon Web Services and create access keys. You need these credentials to use AWS SDKs. To create an AWS account, go to http://aws.amazon.com/, choose **Create an AWS Account**, and then follow the online instructions.
- Setup the AWS SDK for Java. You need to set up the following:
  - Install a Java development environment. If you are using Eclipse IDE, install the AWS Toolkit for Eclipse.
  - Install the AWS SDK for Java.
  - Setup your AWS security credentials for use with the SDK for Java.

  For instructions, see Getting Started in the *AWS SDK for Java Developer Guide*.

Tip
As you work through this tutorial, you can refer to the SDK for Java documentation in Javadoc format. The Javadocs are available at http://docs.aws.amazon.com/AWSJavaSDK/latest/javadoc/.

We also recommend you review the DynamoDB concepts. For more information, see Introduction to DynamoDB Concepts (p. 1).

Next Step

Step 1: Create a Table (p. 29)

Step 1: Create a Table

In this step, you create a table named `Movies`. The primary key for the table is composed of the following attributes:

- `year` – The partition key. The `ScalarAttributeType` is `N` for number.
- `title` – The sort key. The `ScalarAttributeType` is `S` for string.

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import java.util.Arrays;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.Table;
import com.amazonaws.services.dynamodbv2.model.AttributeDefinition;
import com.amazonaws.services.dynamodbv2.model.KeySchemaElement;
import com.amazonaws.services.dynamodbv2.model.KeyType;
import com.amazonaws.services.dynamodbv2.model.ProvisionedThroughput;
import com.amazonaws.services.dynamodbv2.model.ScalarAttributeType;

public class MoviesCreateTable {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        String tableName = "Movies";

        try {
          System.out.println("Attempting to create table; please wait...");

            Table table = dynamoDB.createTable(tableName,
                Arrays.asList(
                   new KeySchemaElement("year", KeyType.HASH),  //Partition
```

```
 key
                    new KeySchemaElement("title", KeyType.RANGE)), //Sort
key
                    Arrays.asList(
                        new AttributeDefinition("year", ScalarAttribute
Type.N),
                        new AttributeDefinition("title", ScalarAttribute
Type.S)),
                    new ProvisionedThroughput(10L, 10L));
            table.waitForActive();
          System.out.println("Success.  Table status: " + table.getDescrip
tion().getTableStatus());

        } catch (Exception e) {
            System.err.println("Unable to create table: ");
            System.err.println(e.getMessage());
        }

    }
}
```

Note

- You set the endpoint (`client.setEndpoint`) to indicate that you are creating the table in DynamoDB on your computer.
- In the `createTable` call, you specify table name, primary key attributes, and its data types.
- The `ProvisionedThroughput` parameter is required; however, the downloadable version of DynamoDB ignores it. (Provisioned throughput is beyond the scope of this exercise.)

2. Compile and run the program.

To learn more about managing tables, see Working with Tables in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 2: Load Sample Data (p. 30)

Step 2: Load Sample Data

In this step, you populate the `Movies` table with sample data.

Topics

We use a sample data file that contains information about a few thousand movies from the Internet Movie Database (IMDb). The movie data is in JSON format, as shown in the following example. For each movie, there is a `year`, a `title`, and a JSON map named `info`.

```
[
   {
      "year" : ... ,
      "title" : ... ,
      "info" : { ... }
   },
   {
      "year" : ...,
      "title" : ...,
      "info" : { ... }
   },

    ...

]
```

In the JSON data, note the following:

- We use the `year` and `title` as the primary key attribute values for our `Movies` table.
- We store the rest of the `info` values in a single attribute called `info`. This program illustrates how you can store JSON in a DynamoDB attribute.

The following is an example of movie data:

```
{
    "year" : 2013,
    "title" : "Turn It Down, Or Else!",
    "info" : {
        "directors" : [
            "Alice Smith",
            "Bob Jones"
        ],
        "release_date" : "2013-01-18T00:00:00Z",
        "rating" : 6.2,
        "genres" : [
            "Comedy",
            "Drama"
        ],
        "image_url" : "http://ia.media-imdb.com/images/N/O9ER
WAU7FS797AJ7LU8HN09AMUP908RLlo5JF90EWR7LJKQ7@@._V1_SX400_.jpg",
        "plot" : "A rock band plays their music at high volumes, annoying the
neighbors.",
        "rank" : 11,
        "running_time_secs" : 5215,
        "actors" : [
            "David Matthewman",
            "Ann Thomas",
            "Jonathan G. Neff"
       ]
    }
}
```

Step 2.1: Download the Sample Data File

1. Download the sample data archive by clicking this link: moviedata.zip
2. Extract the data file (`moviedata.json`) from the archive.
3. Copy the `moviedata.json` file to your current directory.

Step 2.2: Load the Sample Data Into the Movies Table

After you have downloaded the sample data, you can run the following program to populate the `Movies` table.

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import java.io.File;
import java.util.Iterator;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.Item;
import com.amazonaws.services.dynamodbv2.document.Table;
import com.fasterxml.jackson.core.JsonFactory;
import com.fasterxml.jackson.core.JsonParser;
import com.fasterxml.jackson.databind.JsonNode;
import com.fasterxml.jackson.databind.ObjectMapper;
import com.fasterxml.jackson.databind.node.ObjectNode;

public class MoviesLoadData {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        JsonParser parser = new JsonFactory()
            .createParser(new File("moviedata.json"));

        JsonNode rootNode = new ObjectMapper().readTree(parser);
        Iterator<JsonNode> iter = rootNode.iterator();

        ObjectNode currentNode;

        while (iter.hasNext()) {
            currentNode = (ObjectNode) iter.next();
```

```
            int year = currentNode.path("year").asInt();
            String title = currentNode.path("title").asText();

            try {
                table.putItem(new Item()
                .withPrimaryKey("year", year, "title", title)
                .withJSON("info", currentNode.path("info").toString()));
                System.out.println("PutItem succeeded: " + year + " " +
title);

            } catch (Exception e) {
                System.err.println("Unable to add movie: " + year + " " +
title);
                System.err.println(e.getMessage());
                break;
            }
        }
        parser.close();
    }
}
```

This program uses the open source Jackson library to process JSON. Jackson is included in the AWS SDK for Java. You do not need to install it separately.

2. Compile and run the program.

Next Step

Step 3: Create, Read, Update, and Delete an Item (p. 33)

Step 3: Create, Read, Update, and Delete an Item

In this step, you perform read and write operations on an item in the `Movies` table.

To learn more about reading and writing data, see Working with Items in the *Amazon DynamoDB Developer Guide*.

Topics

Step 3.1: Create a New Item

In this step, you add a new item to the `Movies` table.

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import java.util.HashMap;
import java.util.Map;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.Item;
import com.amazonaws.services.dynamodbv2.document.PrimaryKey;
import com.amazonaws.services.dynamodbv2.document.PutItemOutcome;
import com.amazonaws.services.dynamodbv2.document.Table;

public class MoviesItemOps01 {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        int year = 2015;
        String title = "The Big New Movie";

        final Map<String, Object> infoMap = new HashMap<String, Object>();
        infoMap.put("plot",  "Nothing happens at all.");
        infoMap.put("rating",  0);

        try {
            System.out.println("Adding a new item...");
            PutItemOutcome outcome = table.putItem(new Item()
                .withPrimaryKey("year", year, "title", title)
                .withMap("info", infoMap));

           System.out.println("PutItem succeeded:\n" + outcome.getPutItem
Result());

        } catch (Exception e) {
           System.err.println("Unable to add item: " + year + " " + title);

            System.err.println(e.getMessage());
        }

    }
}
```

Note

The primary key is required. This code adds an item that has primary key (`year`, `title`) and `info` attributes. The `info` attribute stores sample JSON that provides more information about the movie.

2. Compile and run the program.

Step 3.2: Read an Item

In the previous program, you added the following item to the table:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

You can use the `getItem` method to read the item from the `Movies` table. You must specify the primary key values, so you can read any item from `Movies` if you know its `year` and `title`.

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.Item;
import com.amazonaws.services.dynamodbv2.document.Table;
import com.amazonaws.services.dynamodbv2.document.spec.GetItemSpec;

public class MoviesItemOps02 {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        int year = 2015;
        String title = "The Big New Movie";

        GetItemSpec spec = new GetItemSpec()
            .withPrimaryKey("year", year, "title", title);

        try {
            System.out.println("Attempting to read the item...");
            Item outcome = table.getItem(spec);
            System.out.println("GetItem succeeded: " + outcome);

        } catch (Exception e) {
           System.err.println("Unable to read item: " + year + " " + title);

            System.err.println(e.getMessage());
```

```
        }

    }
}
```

2. Compile and run the program.

Step 3.3: Update an Item

You can use the `updateItem` method to modify an existing item. You can update values of existing attributes, add new attributes, or remove attributes.

In this example, you perform the following updates:

- Change the value of the existing attributes (`rating`, `plot`).
- Add a new list attribute (`actors`) to the existing `info` map.

The item changes from:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

To the following:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
           plot: "Everything happens all at once.",
           rating: 5.5,
           actors: ["Larry", "Moe", "Curly"]
   }
}
```

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.
package com.amazonaws.codesamples.gsg;

import java.util.Arrays;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.Table;
```

```
import com.amazonaws.services.dynamodbv2.document.UpdateItemOutcome;
import com.amazonaws.services.dynamodbv2.document.spec.UpdateItemSpec;
import com.amazonaws.services.dynamodbv2.document.utils.ValueMap;
import com.amazonaws.services.dynamodbv2.model.ReturnValue;

public class MoviesItemOps03 {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        int year = 2015;
        String title = "The Big New Movie";

        UpdateItemSpec updateItemSpec = new UpdateItemSpec()
            .withPrimaryKey("year", year, "title", title)
            .withUpdateExpression("set info.rating = :r, info.plot=:p,
info.actors=:a")
            .withValueMap(new ValueMap()
                .withNumber(":r", 5.5)
                .withString(":p", "Everything happens all at once.")
                .withList(":a", Arrays.asList("Larry","Moe","Curly")))
            .withReturnValues(ReturnValue.UPDATED_NEW);

        try {
            System.out.println("Updating the item...");
            UpdateItemOutcome outcome = table.updateItem(updateItemSpec);
            System.out.println("UpdateItem succeeded:\n" + out
come.getItem().toJSONPretty());

        } catch (Exception e) {
            System.err.println("Unable to update item: " + year + " " +
title);
            System.err.println(e.getMessage());
        }
    }
}
```

Note
This program uses an `UpdateExpression` to describe all updates you want to perform on the specified item.
The `ReturnValues` parameter instructs DynamoDB to return only the updated attributes (`UPDATED_NEW`).

2. Compile and run the program.

Step 3.4: Increment an Atomic Counter

DynamoDB supports atomic counters, where you use the `updateItem` method to increment or decrement the value of an existing attribute without interfering with other write requests. (All write requests are applied in the order in which they were received.)

The following program shows how to increment the `rating` for a movie. Each time you run it, the program increments this attribute by one.

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.Table;
import com.amazonaws.services.dynamodbv2.document.UpdateItemOutcome;
import com.amazonaws.services.dynamodbv2.document.spec.UpdateItemSpec;
import com.amazonaws.services.dynamodbv2.document.utils.ValueMap;
import com.amazonaws.services.dynamodbv2.model.ReturnValue;

public class MoviesItemOps04 {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        int year = 2015;
        String title = "The Big New Movie";

        UpdateItemSpec updateItemSpec = new UpdateItemSpec()
            .withPrimaryKey("year", year, "title", title)
            .withUpdateExpression("set info.rating = info.rating + :val")
            .withValueMap(new ValueMap()
            .withNumber(":val", 1))
            .withReturnValues(ReturnValue.UPDATED_NEW);

        try {
            System.out.println("Incrementing an atomic counter...");
            UpdateItemOutcome outcome = table.updateItem(updateItemSpec);
            System.out.println("UpdateItem succeeded:\n" + out
come.getItem().toJSONPretty());

        } catch (Exception e) {
            System.err.println("Unable to update item: " + year + " " +
title);
            System.err.println(e.getMessage());
        }
    }
}
```

2. Compile and run the program.

Step 3.5: Update an Item (Conditionally)

The following program shows how to use `UpdateItem` with a condition. If the condition evaluates to true, the update succeeds; otherwise, the update is not performed.

In this case, the movie item is only updated if there are more than three actors.

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.PrimaryKey;
import com.amazonaws.services.dynamodbv2.document.Table;
import com.amazonaws.services.dynamodbv2.document.UpdateItemOutcome;
import com.amazonaws.services.dynamodbv2.document.spec.UpdateItemSpec;
import com.amazonaws.services.dynamodbv2.document.utils.ValueMap;
import com.amazonaws.services.dynamodbv2.model.ReturnValue;

public class MoviesItemOps05 {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        int year = 2015;
        String title = "The Big New Movie";

        UpdateItemSpec updateItemSpec = new UpdateItemSpec()
            .withPrimaryKey(new PrimaryKey("year", year, "title", title))
            .withUpdateExpression("remove info.actors[0]")
            .withConditionExpression("size(info.actors) > :num")
            .withValueMap(new ValueMap().withNumber(":num", 3))
            .withReturnValues(ReturnValue.UPDATED_NEW);

        // Conditional update (we expect this to fail)
        try {
            System.out.println("Attempting a conditional update...");
            UpdateItemOutcome outcome = table.updateItem(updateItemSpec);
            System.out.println("UpdateItem succeeded:\n" + out
come.getItem().toJSONPretty());

        } catch (Exception e) {
            System.err.println("Unable to update item: " + year + " " +
title);
            System.err.println(e.getMessage());
        }
```

```
    }
}
```

2. Compile and run the program.

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the movie has three actors in it, but the condition is checking for *greater than* three actors.
3. Modify the program so that the `ConditionExpression` looks like this:

   ```
            .withConditionExpression("size(info.actors) >= :num")
   ```

   The condition is now *greater than or equal to 3* instead of *greater than 3*.
4. Compile and run the program. The `UpdateItem` operation should now succeed.

Step 3.6: Delete an Item

You can use the `deleteItem` method to delete one item by specifying its primary key. You can optionally provide a `ConditionExpression` to prevent item deletion if the condition is not met.

In the following example, you try to delete a specific movie item if its rating is 5 or less.

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.PrimaryKey;
import com.amazonaws.services.dynamodbv2.document.Table;
import com.amazonaws.services.dynamodbv2.document.spec.DeleteItemSpec;
import com.amazonaws.services.dynamodbv2.document.utils.ValueMap;

public class MoviesItemOps06 {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        int year = 2015;
        String title = "The Big New Movie";
```

```
        DeleteItemSpec deleteItemSpec = new DeleteItemSpec()
            .withPrimaryKey(new PrimaryKey("year", year, "title", title))
            .withConditionExpression("info.rating <= :val")
            .withValueMap(new ValueMap()
            .withNumber(":val", 5.0));

        // Conditional delete (we expect this to fail)

        try {
            System.out.println("Attempting a conditional delete...");
            table.deleteItem(deleteItemSpec);
            System.out.println("DeleteItem succeeded");
        } catch (Exception e) {
            System.err.println("Unable to delete item: " + year + " " +
title);
            System.err.println(e.getMessage());
        }
    }
}
```

2. Compile and run the program.

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the rating for this particular move is greater than 5.
3. Modify the program to remove the condition in `DeleteItemSpec`.

   ```
           DeleteItemSpec deleteItemSpec = new DeleteItemSpec()
               .withPrimaryKey(new PrimaryKey("year", 2015, "title", "The Big
    New Movie"));
   ```

4. Compile and run the program. Now, the delete succeeds because you removed the condition.

Next Step

Step 4: Query and Scan the Data (p. 41)

Step 4: Query and Scan the Data

You can use the `query` method to retrieve data from a table. You must specify a partition key value; the sort key is optional.

The primary key for the `Movies` table is composed of the following:

- `year` – The partition key. The attribute type is number.
- `title` – The sort key. The attribute type is string.

To find all movies released during a year, you need to specify only the `year`. You can also provide the `title` to retrieve a subset of movies based on some condition (on the sort key). For example, to find movies released in 2014 that have a title starting with the letter "A".

In addition to `query`, there is also a `scan` method that can retrieve all of the table data.

To learn more about querying and scanning data, see Query and Scan in the *Amazon DynamoDB Developer Guide*.

Topics

Step 4.1: Query

The code included in this step performs the following queries:

- Retrieve all movies release in `year` 1985.
- Retrieve all movies released in `year` 1992, with `title` beginning with the letter "A" through the letter "L".

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import java.util.HashMap;
import java.util.Iterator;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.Item;
import com.amazonaws.services.dynamodbv2.document.ItemCollection;
import com.amazonaws.services.dynamodbv2.document.QueryOutcome;
import com.amazonaws.services.dynamodbv2.document.Table;
import com.amazonaws.services.dynamodbv2.document.spec.QuerySpec;
import com.amazonaws.services.dynamodbv2.document.utils.NameMap;

public class MoviesQuery {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        HashMap<String, String> nameMap = new HashMap<String, String>();
        nameMap.put("#yr", "year");
```

```
        HashMap<String, Object> valueMap = new HashMap<String, Object>();
        valueMap.put(":yyyy", 1985);

        QuerySpec querySpec = new QuerySpec()
            .withKeyConditionExpression("#yr = :yyyy")
            .withNameMap(new NameMap().with("#yr", "year"))
            .withValueMap(valueMap);

        ItemCollection<QueryOutcome> items = null;
        Iterator<Item> iterator = null;
        Item item = null;

        try {
            System.out.println("Movies from 1985");
            items = table.query(querySpec);

            iterator = items.iterator();
            while (iterator.hasNext()) {
                item = iterator.next();
                System.out.println(item.getNumber("year") + ": "
                        + item.getString("title"));
            }

        } catch (Exception e) {
            System.err.println("Unable to query movies from 1985");
            System.err.println(e.getMessage());
        }

        valueMap.put(":yyyy", 1992);
        valueMap.put(":letter1", "A");
        valueMap.put(":letter2", "L");

        querySpec
                .withProjectionExpression(
                        "#yr, title, info.genres, info.actors[0]")
                .withKeyConditionExpression(
                     "#yr = :yyyy and title between :letter1 and :letter2")

                .withNameMap(nameMap).withValueMap(valueMap);

        try {
            System.out
                    .println("Movies from 1992 - titles A-L, with genres
and lead actor");
            items = table.query(querySpec);

            iterator = items.iterator();
            while (iterator.hasNext()) {
                item = iterator.next();
                System.out.println(item.getNumber("year") + ": "
                        + item.getString("title") + " " + item.get
Map("info"));
            }

        } catch (Exception e) {
            System.err.println("Unable to query movies from 1992:");
            System.err.println(e.getMessage());
        }
```

```
    }
}
```

Note

- `nameMap` provides name substitution. We use this because `year` is a reserved word in DynamoDB—you cannot use it directly in any expression, including `KeyConditionExpression`. We use the expression attribute name `#yr` to address this.
- `valueMap` provides value substitution. We use this because you cannot use literals in any expression, including `KeyConditionExpression`. We use the expression attribute value `:yyyy` to address this.

First, you create the `querySpec` object, which describes the query parameters, and then you pass the object to the `query` method.

2. Compile and run the program.

Note
The preceding program shows how to query a table by its primary key attributes. In DynamoDB, you can optionally create one or more secondary indexes on a table, and query those indexes in the same way that you query a table. Secondary indexes give your applications additional flexibility by allowing queries on non-key attributes. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Step 4.2: Scan

The `scan` method reads every item in the entire table, and returns all of the data in the table. You can provide an optional `filter_expression`, so that only the items matching your criteria are returned. However, note that the filter is only applied after the entire table has been scanned.

The following program scans the entire `Movies` table, which contains approximately 5,000 items. The scan specifies the optional filter to retrieve only the movies from the 1950s (approximately 100 items), and discard all of the others.

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import java.util.Iterator;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.Item;
import com.amazonaws.services.dynamodbv2.document.ItemCollection;
import com.amazonaws.services.dynamodbv2.document.ScanOutcome;
import com.amazonaws.services.dynamodbv2.document.Table;
import com.amazonaws.services.dynamodbv2.document.spec.ScanSpec;
import com.amazonaws.services.dynamodbv2.document.utils.NameMap;
import com.amazonaws.services.dynamodbv2.document.utils.ValueMap;

public class MoviesScan {
```

```
    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        ScanSpec scanSpec = new ScanSpec()
            .withProjectionExpression("#yr, title, info.rating")
            .withFilterExpression("#yr between :start_yr and :end_yr")
            .withNameMap(new NameMap().with("#yr",  "year"))
            .withValueMap(new ValueMap().withNumber(":start_yr",
1950).withNumber(":end_yr", 1959));

        try {
            ItemCollection<ScanOutcome> items = table.scan(scanSpec);

            Iterator<Item> iter = items.iterator();
            while (iter.hasNext()) {
                Item item = iter.next();
                System.out.println(item.toString());
            }

        } catch (Exception e) {
            System.err.println("Unable to scan the table:");
            System.err.println(e.getMessage());
        }
    }
}
```

In the code, note the following:

- `ProjectionExpression` specifies the attributes you want in the scan result.
- `FilterExpression` specifies a condition that returns only items that satisfy the condition. All other items are discarded.

2. Compile and run the program.

Note
You can also use the `Scan` operation with any secondary indexes that you have created on the table. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 5: (Optional) Delete the Table (p. 45)

Step 5: (Optional) Delete the Table

In this step, you delete the `Movies` table. This is an optional step. If you want, you can keep the `Movies` table and write your own programs to work with the data.

1. Copy the following program into your Java development environment.

```
// Copyright 2012-2015 Amazon.com, Inc. or its affiliates. All Rights Re
served.
// Licensed under the Apache License, Version 2.0.

package com.amazonaws.codesamples.gsg;

import com.amazonaws.services.dynamodbv2.AmazonDynamoDBClient;
import com.amazonaws.services.dynamodbv2.document.DynamoDB;
import com.amazonaws.services.dynamodbv2.document.Table;

public class MoviesDeleteTable {

    public static void main(String[] args) throws Exception {

        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");

        DynamoDB dynamoDB = new DynamoDB(client);

        Table table = dynamoDB.getTable("Movies");

        try {
          System.out.println("Attempting to delete table; please wait...");

            table.delete();
            table.waitForDelete();
            System.out.print("Success.");

        } catch (Exception e) {
            System.err.println("Unable to delete table: ");
            System.err.println(e.getMessage());
        }
    }
}
```

2. Compile and run the program.

Next Step

Summary (p. 46)

Summary

Topics

In this tutorial, you created the `Movies` table in DynamoDB on your computer and performed basic operations. The downloadable version of DynamoDB is useful during application development and testing. However, when you are ready to run your application in a production environment, you need to modify your code so that it uses the Amazon DynamoDB web service.

Using the Amazon DynamoDB Service

You need to change the endpoint in your application in order to use the Amazon DynamoDB service. To do this, add the following import statement to your program:

```
import com.amazonaws.regions.Regions;
```

Next, go to the `AmazonDynamoDBClient` in the code:

```
        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withEndpoint("http://localhost:8000");
```

Now modify the client so that it will access an AWS region instead of a specific endpoint:

```
        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withRegion(Regions.REGION);
```

For example, if you want to access the `us-west-2 region`, you would do this:

```
        AmazonDynamoDBClient client = new AmazonDynamoDBClient()
            .withRegion(Regions.US_WEST_2);
```

Now, instead of using DynamoDB on your computer, the program uses the Amazon DynamoDB web service endpoint in US West (Oregon).

Amazon DynamoDB is available in several regions worldwide. For the complete list of regions and endpoints, see Regions and Endpoints in the *AWS General Reference*. For more information about setting regions and endpoints in your code, see AWS Region Selection in the *AWS SDK for Java Developer Guide*.

The downloadable version of DynamoDB is for development and testing purposes only. By comparison, DynamoDB is a managed service with scalability, availability, and durability features that make it ideal for production usage. The following table contains some other key differences between DynamoDB running on your computer and the Amazon DynamoDB service:

	DynamoDB (downloadable version)	**Amazon DynamoDB (web service)**
Creating a Table	The table is created immediately.	Table creation takes some time, depending on its provisioned throughput settings. DynamoDB allocates sufficient resources to meet your specific read and write capacity requirements.
Provisioned Throughput	The downloadable version of DynamoDB ignores provisioned throughput settings.	Provisioned throughput is a fundamental concept in DynamoDB. The rate at which you can read and write data depends on your provisioned capacity settings. For more information, see Provisioned Throughput in the *Amazon DynamoDB Developer Guide*.

	DynamoDB (downloadable version)	Amazon DynamoDB (web service)
Reading and Writing Data	Reads and writes are performed as fast as possible, without any network overhead.	Read and write activity is regulated by the provisioned throughput settings on the table. To increase the maximum throughput, you must increase the throughput settings on the table. Network latency also affects throughput to an extent.
Deleting a Table	The table is deleted immediately.	Table deletion takes some time, as DynamoDB releases the resources that had been used by the table.

Next Steps

For more information about Amazon DynamoDB, see the Amazon DynamoDB Developer Guide. We recommend the following topics:

Data Model

Provisioned Throughput

Improving Data Access with Secondary Indexes

The *Amazon DynamoDB Developer Guide* also includes the following topics about working with tables, items, and queries:

Working with Tables

Working with Items

Query and Scan Operations in DynamoDB

Best Practices

.NET and DynamoDB

In this tutorial, you use the AWS SDK for .NET to write simple programs to perform the following Amazon DynamoDB operations:

- Create a table called `Movies` using a utility program written in C# and load sample data in JSON format.
- Perform create, read, update, and delete operations on the table.
- Run simple queries.

The DynamoDB module of the AWS SDK for .NET offers several programming models for different use cases. In this exercise, the C# code uses both the document model, which provides a level of abstraction that is often convenient, and also the low-level API, which handles nested attributes more effectively. For information about the document model API, see .NET: Document Model, and for information about the low-level API, see Working with Tables Using the AWS SDK for .NET Low-Level API.

You use the downloadable version of DynamoDB in this tutorial. In the Summary (p. 97), we explain how to run the same code against the DynamoDB service in the cloud.

Cost: Free

Prerequisites

Before you begin this tutorial, you need to do the following:

- Use a computer running a recent version of Microsoft Windows and a current version of Microsoft Visual Studio. If you don't already have Visual Studio installed, you can download a free copy of the Community edition from the Visual Studio website.
- Download and run DynamoDB Local. For more information, see Running DynamoDB on Your Computer.
- Sign up for Amazon Web Services and create access keys. You need these credentials to use AWS SDKs. To create an AWS account, go to http://aws.amazon.com/, choose **Create an AWS Account**, and then follow the online instructions.
- Set up a security profile for DynamoDB in Visual Studio. See the step-by-step instructions for doing this in Creating Example Tables and Uploading Data Using the AWS SDK for .NET.
- In Visual Studio, create a new project called `DynamoDB_intro` using the **Console Application** template in the **Installed/Templates/Visual C#/** node. This is the project you use throughout this Getting Started tutorial.

- Install the NuGet package for the DynamoDB module of the AWS SDK for .NET, version 3 into you new `DynamoDB_intro` project. To do this, open the NuGet Package Manager Console from the Tools menu in Visual Studio and type the following command at the `PM>` prompt:

```
PM> Install-Package AWSSDK.DynamoDBv2
```

Next Step

Step 1: Create a Table (p. 50)

Step 1: Create a Table

The document model in the AWS SDK for .NET does not provide for creating tables, so you have to use the low-level APIs (see Working with Tables Using the AWS SDK for .NET Low-Level API).

In this step, you create a table named `Movies`. The primary key for the table is composed of the following attributes:

- `year` – The partition key. The `AttributeType` is `N` for number.
- `title` – The sort key. The `AttributeType` is `S` for string.

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.IO;

using System.Text;


using Amazon;

using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;

using Amazon.DynamoDBv2.DocumentModel;


namespace DynamoDB_intro

{

  class Program

  {

    public static void Main( string[ ] args )
```

```
    {
      // First, set up a DynamoDB client for DynamoDB Local
      AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig( );
      ddbConfig.ServiceURL = "http://localhost:8000";
      AmazonDynamoDBClient client;
      try { client = new AmazonDynamoDBClient( ddbConfig ); }
      catch( Exception ex )
      {
        Console.WriteLine( "\n Error: failed to create a DynamoDB client;
" + ex.Message );
        goto PauseForDebugWindow;
      }

      // Build a 'CreateTableRequest' for the new table
      CreateTableRequest createRequest = new CreateTableRequest
      {
        TableName = "Movies",
        AttributeDefinitions = new List<AttributeDefinition>( )
        {
          new AttributeDefinition
          {
            AttributeName = "year",
            AttributeType = "N"
          },
          new AttributeDefinition
          {
            AttributeName = "title",
            AttributeType = "S"
          }
```

```
        },
        KeySchema = new List<KeySchemaElement>( )
        {
          new KeySchemaElement
          {
            AttributeName = "year",
            KeyType = "HASH"
          },
          new KeySchemaElement
          {
            AttributeName = "title",
            KeyType = "RANGE"
          }
        },
      };


      // Provisioned-throughput settings are required even though
      // the local test version of DynamoDB ignores them
      createRequest.ProvisionedThroughput = new ProvisionedThroughput( 1,
1 );


      // Using the DynamoDB client, make a synchronous CreateTable request
      CreateTableResponse createResponse;
      try { createResponse = client.CreateTable( createRequest ); }
      catch( Exception ex )
      {
        Console.WriteLine( "\n Error: failed to create the new table; " +
ex.Message );
        goto PauseForDebugWindow;
      }
```

```
      // Report the status of the new table...

      Console.WriteLine( "\n\n Created the \"Movies\" table successfully!\n
    Status of the new table: '{0}'", createResponse.TableDescrip
tion.TableStatus );



      // Keep the console open if in Debug mode...

PauseForDebugWindow:

      Console.Write( "\n\n ...Press any key to continue" );

      Console.ReadKey( );

      Console.WriteLine( );

    }

  }

}
```

Note

- In the `AmazonDynamoDBConfig`, you set the `ServiceURL` to "http://localhost:8000" to create the table in the downloadable test version of DynamoDB running on your computer.
- In the `CreateTableRequest`, you specify the table name, along with primary key attributes and their data types.
- The partition-key portion of the primary key, which determines the logical partition where DynamoDB stores an item, is identified in its `KeySchemaElement` in the `CreateTableRequest` as having `KeyType` "HASH".
- The sort-key portion of the primary key, which determines the ordering of items having the same partition-key value, is identified in its `KeySchemaElement` in the `CreateTableRequest` as having `KeyType` "RANGE".
- The `ProvisionedThroughput` field is required, even though the downloadable test version of DynamoDB ignores it.

2. Compile and run the program.

To learn more about managing tables, see Working with Tables in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 2: Load Sample Data (p. 54)

Step 2: Load Sample Data

In this step, you populate the `Movies` table with sample data.

Topics

We use a sample data file that contains information about a few thousand movies from the Internet Movie Database (IMDb).

The movie data is encoded as JSON. For each movie, the JSON defines a `year` name-value pair, a `title` name-value pair, and a complex `info` object, as shown in the example below:

```
{
    "year" : 2013,
    "title" : "Turn It Down, Or Else!",
    "info" : {
        "directors" : [
            "Alice Smith",
            "Bob Jones"
        ],
        "release_date" : "2013-01-18T00:00:00Z",
        "rating" : 6.2,
        "genres" : [
            "Comedy",
            "Drama"
        ],
        "image_url" : "http://ia.media-imdb.com/images/N/O9ER
WAU7FS797AJ7LU8HN09AMUP908RLlo5JF90EWR7LJKQ7@@._V1_SX400_.jpg",
        "plot" : "A rock band plays their music at high volumes, annoying the
neighbors.",
        "rank" : 11,
        "running_time_secs" : 5215,
        "actors" : [
            "David Matthewman",
            "Ann Thomas",
            "Jonathan G. Neff"
       ]
    }
}
```

Step 2.1: Download the Sample Data File

1. Download the sample data archive by clicking this link: moviedata.zip
2. Extract the data file (`moviedata.json`) from the archive.
3. Copy the`moviedata.json` file to the `bin/Debug` folder of your `DynamoDB_intro` Visual Studio project.

Step 2.2: Load the Sample Data Into the Movies Table

Build a program that loads movie data into the table you created in Step 1 of the Getting Started.

1. This program uses the open source Newtonsoft `Json.NET` library for deserializing JSON data, licensed under the MIT License (MIT) (see https://github.com/JamesNK/Newtonsoft.Json/blob/master/LICENSE.md).

   Load the `Json.NET` library into your project by opening the NuGet Package Manager Console from the Tools menu in Visual Studio and typing the following command at the `PM>` prompt:

```
PM> Install-Package Newtonsoft.Json
```

2. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.IO;

using System.Linq;

using System.Text;


using Amazon;

using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;

using Amazon.DynamoDBv2.DocumentModel;


using Newtonsoft;

using Newtonsoft.Json;

using Newtonsoft.Json.Linq;


namespace DynamoDB_intro

{

  class Program

  {

    public static Table GetTableObject( string tableName )
```

```
    {
      // First, set up a DynamoDB client for DynamoDB Local
      AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig( );
      ddbConfig.ServiceURL = "http://localhost:8000";
      AmazonDynamoDBClient client;
      try { client = new AmazonDynamoDBClient( ddbConfig ); }
      catch( Exception ex )
      {
        Console.WriteLine( "\n Error: failed to create a DynamoDB client;
" + ex.Message );
        return( null );
      }

      // Now, create a Table object for the specified table
      Table table;
      try { table = Table.LoadTable( client, tableName ); }
      catch( Exception ex )
      {
        Console.WriteLine( "\n Error: failed to load the 'Movies' table; "
 + ex.Message );
        return ( null );
      }
      return ( table );
    }

    public static void Main( string[ ] args )
    {
      // First, read in the JSON data from the moviedate.json file
      StreamReader sr    = null;
      JsonTextReader jtr = null ;
```

```
      JArray movieArray  = null;

      try

      {

        sr = new StreamReader( "moviedata.json" );

        jtr = new JsonTextReader( sr );

        movieArray = (JArray) JToken.ReadFrom( jtr );

      }

      catch( Exception ex )

      {

       Console.WriteLine( "\n Error: could not read from the 'moviedata.json'
 file, because: " + ex.Message );

        goto PauseForDebugWindow;

      }

      finally

      {

        if( jtr != null )

          jtr.Close( );

        if( sr != null )

          sr.Close( );

      }



      // Get a Table object for the table that you created in Step 1

      Table table = GetTableObject( "Movies" );

      if( table == null )

        goto PauseForDebugWindow;



      // Load the movie data into the table (this could take some time)

      Console.Write( "\n   Now writing {0:#,##0} movie records from
moviedata.json (might take 15 minutes)...\n   ...completed: ", movie
Array.Count );
```

```
      for( int i = 0, j = 99; i < movieArray.Count; i++ )

      {

        try

        {

          string itemJson = movieArray[i].ToString( );

          Document doc = Document.FromJson( itemJson );

          table.PutItem( doc);

        }

        catch( Exception ex )

        {

          Console.WriteLine( "\nError: Could not write the movie record
#{0:#,##0}, because {1}", i, ex.Message );

          goto PauseForDebugWindow;

        }

        if( i >= j )

        {

          j++;

          Console.Write( "{0,5:#,##0}, ", j );

          if( j % 1000 == 0 )

            Console.Write( "\n                " );

          j += 99;

        }

      }

      Console.WriteLine( "\n   Finished writing all movie records to Dy
namoDB!" );



      // Keep the console open if in Debug mode...

PauseForDebugWindow:

      Console.Write( "\n\n ...Press any key to continue" );

      Console.ReadKey( );
```

```
      Console.WriteLine( );

    }

  }

}
```

3. Now compile the project, leaving it in Debug mode, and run it.

Next Step

Step 3: Create, Read, Update, and Delete an Item (p. 59)

Step 3: Create, Read, Update, and Delete an Item

In this step, you perform read and write operations on an item in the `Movies` table.

To learn more about reading and writing data, see Working with Items in the *Amazon DynamoDB Developer Guide*.

Topics

Step 3.1: Create a New Item

In this step you add a new item to the `Movies` table.

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;


using Amazon;

using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;
```

```
using Amazon.DynamoDBv2.DocumentModel;


namespace DynamoDB_intro
{
    class Program
    {
        static void Main(string[] args)
        {
            // Get a Table object for the table that you created in Step 1
            Table table = GetTableObject("Movies");
            if (table == null)
                goto PauseForDebugWindow;


            // Create a Document representing the movie item to be written
 to the table
            Document document = new Document();
            document["year"] = 2015;
            document["title"] = "The Big New Movie";
            document["info"] = Document.FromJson("{\"plot\" : \"Nothing
happens at all.\",\"rating\" : 0}");


            // Use Table.PutItem to write the document item to the table
            try {
                table.PutItem(document);
                Console.WriteLine("\nPutItem succeeded.\n");
            }
            catch (Exception ex)
            {
                Console.WriteLine("\n Error: Table.PutItem failed because:
 " + ex.Message);
                goto PauseForDebugWindow;
```

```
            }


        // Keep the console open if in Debug mode...
        PauseForDebugWindow:
            Console.Write("\n\n ...Press any key to continue");
            Console.ReadKey();
            Console.WriteLine();
        }


        public static Table GetTableObject(string tableName)
        {
            // First, set up a DynamoDB client for DynamoDB Local
            AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig();
            ddbConfig.ServiceURL = "http://localhost:8000";
            AmazonDynamoDBClient client;
            try { client = new AmazonDynamoDBClient(ddbConfig); }
            catch (Exception ex)
            {
                Console.WriteLine("\n Error: failed to create a DynamoDB
client; " + ex.Message);
                return (null);
            }


            // Now, create a Table object for the specified table
            Table table = null;
            try { table = Table.LoadTable(client, tableName); }
            catch (Exception ex)
            {
                Console.WriteLine("\n Error: failed to load the 'Movies'
table; " + ex.Message);
```

```
                return (null);

            }

            return (table);

        }

    }

}
```

Note
The primary key is required. In this table, the primary key is a composite of both a partition-key attribute (`year`) and a sort-key attribute (`title`).
This code writes an item to the table that has both of the two primary key attributes (`year` + `title`), and a complex `info` attribute that stores more information about the movie.

2. Compile and run the program.

Step 3.2: Read an Item

In the previous program, you added the following item to the table:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

You can use the `GetItem` method to read the item from the `Movies` table. You must specify the primary key values, so you can read any item from `Movies` if you know its `year` and `title`.

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;



using Amazon;

using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;
```

```
using Amazon.DynamoDBv2.DocumentModel;


namespace DynamoDB_intro
{
    class Program
    {
        static void Main(string[] args)
        {
            // Get a Table object for the table that you created in Step 1
            Table table = GetTableObject("Movies");
            if (table == null)
                goto PauseForDebugWindow;


            try {
              Document document = table.GetItem(2015, "The Big New Movie");


                if (document != null)
                    Console.WriteLine("\nGetItem succeeded: \n" + docu
ment.ToJsonPretty());
                else
                    Console.WriteLine("\nGetItem succeeded, but the item
was not found");
            } catch (Exception e) {
                Console.WriteLine(e.Message);
            }


        // Keep the console open if in Debug mode...
        PauseForDebugWindow:
            Console.Write("\n\n ...Press any key to continue");
            Console.ReadKey();
```

```
            Console.WriteLine();
        }

        public static Table GetTableObject(string tableName)
        {
            // First, set up a DynamoDB client for DynamoDB Local
            AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig();
            ddbConfig.ServiceURL = "http://localhost:8000";
            AmazonDynamoDBClient client;
            try { client = new AmazonDynamoDBClient(ddbConfig); }
            catch (Exception ex)
            {
                Console.WriteLine("\n Error: failed to create a DynamoDB
client; " + ex.Message);
                return (null);
            }

            // Now, create a Table object for the specified table
            Table table = null;
            try { table = Table.LoadTable(client, tableName); }
            catch (Exception ex)
            {
                Console.WriteLine("\n Error: failed to load the 'Movies'
table; " + ex.Message);
                return (null);
            }
            return (table);
        }
    }
}
```

2. Compile and run the program.

Step 3.3: Update an Item

You can use the `UpdateItem` method to modify an existing item. You can update values of existing attributes, add new attributes, or remove attributes.

In this example, you perform the following updates:

- Change the value of the existing attributes (`rating`, `plot`).
- Add a new list attribute (`actors`) to the existing `info` map.

The item changes from:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

To the following:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
           plot: "Everything happens all at once.",
           rating: 5.5,
           actors: ["Larry", "Moe", "Curly"]
   }
}
```

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;

using System.Threading.Tasks;



using Amazon;

using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;
```

```
using Amazon.DynamoDBv2.DocumentModel;


namespace DynamoDB_intro
{
  class Program
  {
    static void Main( string[ ] args )
    {
      // Get an AmazonDynamoDBClient for the local database
      AmazonDynamoDBClient client = GetLocalClient( );
      if( client == null )
        goto PauseForDebugWindow;


     // Create an UpdateItemRequest to modify two existing nested attributes

      // and add a new one
      UpdateItemRequest updateRequest = new UpdateItemRequest( )
      {
        TableName = "Movies",
        Key = new Dictionary<string, AttributeValue>
        {
          { "year",  new AttributeValue { N = "2015" } },
          { "title", new AttributeValue { S = "The Big New Movie"}}
        },
        ExpressionAttributeValues = new Dictionary<string, AttributeValue>
        {
          { ":r", new AttributeValue { N = "5.5" } },
         { ":p", new AttributeValue { S = "Everything happens all at once!"
 } },
          { ":a", new AttributeValue { SS = { "Larry","Moe","Curly" } } }
```

```
        },

       UpdateExpression = "SET info.rating = :r, info.plot = :p, info.actors
 = :a",

        ReturnValues = "UPDATED_NEW"

      };



     // Use AmazonDynamoDBClient.UpdateItem to update the specified attrib
utes

      UpdateItemResponse uir = null;

      try { uir = client.UpdateItem( updateRequest ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\nError: UpdateItem failed, because: " +
ex.Message );

        if( uir != null )

         Console.WriteLine( "    Status code was " + uir.HttpStatusCode.To
String( ) );

        goto PauseForDebugWindow;

      }



      // Get the item from the table and display it to validate that the
update succeeded

      DisplayMovieItem( client, "2015", "The Big New Movie" );



      // Keep the console open if in Debug mode...

PauseForDebugWindow:

      Console.Write( "\n\n ...Press any key to continue" );

      Console.ReadKey( );

      Console.WriteLine( );

    }
```

```
    public static AmazonDynamoDBClient GetLocalClient( )

    {

      // First, set up a DynamoDB client for DynamoDB Local

      AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig( );

      ddbConfig.ServiceURL = "http://localhost:8000";

      AmazonDynamoDBClient client;

      try { client = new AmazonDynamoDBClient( ddbConfig ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: failed to create a DynamoDB client;
" + ex.Message );

        return ( null );

      }

      return ( client );

    }



   public static void DisplayMovieItem( AmazonDynamoDBClient client, string
 year, string title )

    {

      // Create Primitives for the HASH and RANGE portions of the primary
key

      Primitive hash  = new Primitive( year, true );

      Primitive range = new Primitive( title, false );



      Table table = null;

      try { table = Table.LoadTable( client, "Movies" ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: failed to load the 'Movies' table; "
 + ex.Message );

        return;
```

```
      }

      Document document = table.GetItem( hash, range );

      Console.WriteLine( "\n The movie record looks like this: \n" + docu
ment.ToJsonPretty( ) );

    }

  }

}
```

Note
Because the Document Model in the AWS SDK for .NET does not support updating nested attributes, we need to use the `AmazonDynamoDBClient.UpdateItem` API instead of `Table.UpdateItem` to update attributes under the top-level `info` attribute.
To do this, we create an `UpdateItemRequest` that specifies the item we want to update and the new values we want to set.

- The `UpdateExpression` is what defines all the updates to be performed on the specified item.
- By setting the `ReturnValues` field to `"UPDATED_NEW"`, we are requesting that DynamoDB return only the updated attributes in the response.

2. Compile and run the program.

Step 3.4: Increment an Atomic Counter

DynamoDB supports atomic counters, where you use the `UpdateItem` method to increment or decrement the value of an existing attribute without interfering with other write requests (all write requests are applied in the order in which they are received).

The following program increments the `rating` for a movie. Each time you run it, the program increments this attribute by one. Once again, it is the `UpdateExpression` that determines what happens:

```
UpdateExpression = "SET info.rating = info.rating + :inc",
```

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;

using System.Threading.Tasks;
```

```
using Amazon;
using Amazon.DynamoDBv2;
using Amazon.DynamoDBv2.Model;
using Amazon.DynamoDBv2.DocumentModel;


namespace DynamoDB_intro
{
  class Program
  {
    static void Main( string[ ] args )
    {
      // Get an AmazonDynamoDBClient for the local database
      AmazonDynamoDBClient client = GetLocalClient( );
      if( client == null )
        goto PauseForDebugWindow;


     // Create an UpdateItemRequest to modify two existing nested attributes

      // and add a new one
      UpdateItemRequest updateRequest = new UpdateItemRequest( )
      {
        TableName = "Movies",
        Key = new Dictionary<string, AttributeValue>
        {
          { "year",  new AttributeValue { N = "2015" } },
          { "title", new AttributeValue { S = "The Big New Movie"}}
        },
        ExpressionAttributeValues = new Dictionary<string, AttributeValue>
        {
          { ":inc", new AttributeValue { N = "1" } }
```

```
        },
        UpdateExpression = "SET info.rating = info.rating + :inc",
        ReturnValues = "UPDATED_NEW"
      };

     // Use AmazonDynamoDBClient.UpdateItem to update the specified attrib
utes
      UpdateItemResponse uir = null;
      try { uir = client.UpdateItem( updateRequest ); }
      catch( Exception ex )
      {
       Console.WriteLine( "\nError: UpdateItem failed, because " + ex.Message
 );
        if( uir != null )
         Console.WriteLine( "    Status code was: " + uir.HttpStatusCode.To
String( ) );
        goto PauseForDebugWindow;
      }

      // Get the item from the table and display it to validate that the
update succeeded
      DisplayMovieItem( client, "2015", "The Big New Movie" );

      // Keep the console open if in Debug mode...
PauseForDebugWindow:
      Console.Write( "\n\n ...Press any key to continue" );
      Console.ReadKey( );
      Console.WriteLine( );
    }

    public static AmazonDynamoDBClient GetLocalClient( )
```

```
    {
      // First, set up a DynamoDB client for DynamoDB Local
      AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig( );
      ddbConfig.ServiceURL = "http://localhost:8000";
      AmazonDynamoDBClient client;
      try { client = new AmazonDynamoDBClient( ddbConfig ); }
      catch( Exception ex )
      {
        Console.WriteLine( "\n Error: failed to create a DynamoDB client;
" + ex.Message );
        return ( null );
      }
      return ( client );
    }


   public static void DisplayMovieItem( AmazonDynamoDBClient client, string
 year, string title )
    {
      // Create Primitives for the HASH and RANGE portions of the primary
key
      Primitive hash  = new Primitive( year, true );
      Primitive range = new Primitive( title, false );


      Table table = null;
      try { table = Table.LoadTable( client, "Movies" ); }
      catch( Exception ex )
      {
        Console.WriteLine( "\n Error: failed to load the 'Movies' table; "
 + ex.Message );
        return;
      }
```

```
      Document document = table.GetItem( hash, range );

      Console.WriteLine( "\n The movie record looks like this: \n" + docu
ment.ToJsonPretty( ) );

    }

  }

}
```

2. Compile and run the program.

Step 3.5: Update an Item (Conditionally)

The following program shows how to use `UpdateItem` with a condition. If the condition evaluates to true, the update succeeds; otherwise, the update is not performed.

In this case, the item is only updated if there are more than three actors.

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;

using System.Threading.Tasks;


using Amazon;

using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;

using Amazon.DynamoDBv2.DocumentModel;


namespace DynamoDB_intro

{

  class Program

  {

    static void Main( string[ ] args )
```

```
    {
      // Get an AmazonDynamoDBClient for the local database
      AmazonDynamoDBClient client = GetLocalClient( );
      if( client == null )
        goto PauseForDebugScreen;


     // Create an UpdateItemRequest to modify two existing nested attributes
      // and add a new one
      UpdateItemRequest updateRequest = new UpdateItemRequest( )
      {
        TableName = "Movies",
        Key = new Dictionary<string, AttributeValue>
        {
          { "year",  new AttributeValue { N = "2015" } },
          { "title", new AttributeValue { S = "The Big New Movie"} }
        },
        ExpressionAttributeValues = new Dictionary<string, AttributeValue>
        {
          { ":n", new AttributeValue { N = "3" } }
        },
        ConditionExpression = "size(info.actors) > :n",
        UpdateExpression = "REMOVE info.actors",
        ReturnValues = "UPDATED_NEW"
      };


     // Use AmazonDynamoDBClient.UpdateItem to update the specified attrib
utes
      UpdateItemResponse uir = null;
      try { uir = client.UpdateItem( updateRequest ); }
```

```
      catch( Exception ex )

      {

        Console.WriteLine( "\nError: UpdateItem failed, because:\n   " +
ex.Message );

        if( uir != null )

         Console.WriteLine( "    Status code was " + uir.HttpStatusCode.To
String( ) );

        goto PauseForDebugScreen;

      }

      if( uir.HttpStatusCode != System.Net.HttpStatusCode.OK )

      {

        goto PauseForDebugScreen;

      }



      // Get the item from the table and display it to validate that the
update succeeded

      DisplayMovieItem( client, "2015", "The Big New Movie" );



      // Keep the console open if running in Debug mode...

PauseForDebugScreen:

      Console.Write( "\n\n ...Press any key to continue" );

      Console.ReadKey( );

      Console.WriteLine( );

    }



    public static AmazonDynamoDBClient GetLocalClient( )

    {

      // First, set up a DynamoDB client for DynamoDB Local

      AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig( );

      ddbConfig.ServiceURL = "http://localhost:8000";
```

```
      AmazonDynamoDBClient client;

      try { client = new AmazonDynamoDBClient( ddbConfig ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: failed to create a DynamoDB client;
" + ex.Message );

        return ( null );

      }

      return ( client );

    }



   public static void DisplayMovieItem( AmazonDynamoDBClient client, string
 year, string title )

    {

      // Create Primitives for the HASH and RANGE portions of the primary
key

      Primitive hash  = new Primitive( year, true );

      Primitive range = new Primitive( title, false );



      Table table = null;

      try { table = Table.LoadTable( client, "Movies" ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: failed to load the 'Movies' table; "
 + ex.Message );

        return;

      }

      Document document = table.GetItem( hash, range );

      Console.WriteLine( "\n The movie record looks like this: \n" + docu
ment.ToJsonPretty( ) );

    }

  }
```

```
}
```

2. Compile and run the program.

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the movie has three actors in it, but the condition is checking for *greater than* three actors.
3. Modify the program so that the number of actors that the `ConditionExpression` uses is 2 instead of 3:

   ```
            { ":n", new AttributeValue { N = "2" } }
   ```

   The condition now specifies that the number of actors must be greater than 2.
4. When you compile and run the program now, the `UpdateItem` operation should succeed.

Step 3.6: Delete an Item

You can use the `Table.DeleteItem` operation to delete an item by specifying its primary key. You can optionally provide a condition in the `DeleteItemOperationConfig` parameter, to prevent item deletion if the condition is not met.

In the following example, you try to delete a specific movie item if its rating is 5 or less.

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;

using System.Threading.Tasks;


using Amazon;

using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;

using Amazon.DynamoDBv2.DocumentModel;


namespace DynamoDB_intro

```

```
{
  class Program
  {
    static void Main( string[ ] args )
    {
      // Get a Table object for the table that you created in Step 1
      Table table = GetTableObject( "Movies" );
      if( table == null )
        return;

      // Create the condition
      DeleteItemOperationConfig opConfig = new DeleteItemOperationConfig(
);
      opConfig.ConditionalExpression = new Expression( );
      opConfig.ConditionalExpression.ExpressionAttributeValues[":val"] =
"5.0";
      opConfig.ConditionalExpression.ExpressionStatement = "info.rating <=
 :val";

      // Delete this item
      try { table.DeleteItem( 2015, "The Big New Movie", opConfig ); }
      catch( Exception ex )
      {
        Console.WriteLine( "\n Error: Could not delete the movie item with
 year={0}, title=\"{1}\"\n   Reason: {2}.",
                           2015, "The Big New Movie", ex.Message );
      }

      // Try to retrieve it, to see if it has been deleted
      Document document = table.GetItem( 2015, "The Big New Movie" );
      if( document == null )
```

```
       Console.WriteLine( "\n The movie item with year={0}, title=\"{1}\"
 has been deleted.",

                           2015, "The Big New Movie" );

     else

      Console.WriteLine( "\nRead back the item: \n" + document.ToJsonPretty(
 ) );



     // Keep the console open if in Debug mode...

     Console.Write( "\n\n ...Press any key to continue" );

     Console.ReadKey( );

     Console.WriteLine( );

   }



   public static Table GetTableObject( string tableName )

   {

     // First, set up a DynamoDB client for DynamoDB Local

     AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig( );

     ddbConfig.ServiceURL = "http://localhost:8000";

     AmazonDynamoDBClient client;

     try { client = new AmazonDynamoDBClient( ddbConfig ); }

     catch( Exception ex )

     {

       Console.WriteLine( "\n Error: failed to create a DynamoDB client;
" + ex.Message );

       return ( null );

     }



     // Now, create a Table object for the specified table

     Table table = null;

     try { table = Table.LoadTable( client, tableName ); }

     catch( Exception ex )
```

```
      {
        Console.WriteLine( "\n Error: failed to load the 'Movies' table; "
 + ex.Message );
        return ( null );
      }
      return ( table );
    }
  }
}
```

2. Compile and run the program.

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the rating for this particular move is greater than 5.
3. Modify the program to remove the `DeleteItemOperationConfig` named `opConfig` from the call to `table.DeleteItem`:

   ```
      try { table.DeleteItem( year, title ); }
   ```

4. Compile and run the program. Now, the delete succeeds because you removed the condition.

Next Step

Step 4: Query and Scan the Data (p. 80)

Step 4: Query and Scan the Data

You can use the `Query` method to retrieve data from a table. You must specify a partition key value; the sort key is optional.

The primary key for the `Movies` table is composed of the following:

- `year` – The partition key. The attribute type is number.
- `title` – The sort key. The attribute type is string.

To find all movies released during a year, you need to specify only the `year` partition-key attribute. You can add the `title` sort-key attribute to retrieve a subset of movies based on some condition (on the sort-key attribute), such as finding movies released in 2014 that have a title starting with the letter "A".

In addition to `Query`, there is also a `Scan` method that can retrieve all of the table data.

To learn more about querying and scanning data, see Query and Scan in the *Amazon DynamoDB Developer Guide*.

Topics

Step 4.1: Query

The C# code included in this step performs the following queries:

- Retrieves all movies release in `year` 1985.
- Retrieves all movies released in `year` 1992, with `title` beginning with the letter "A" through the letter "L".

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;

using System.Threading.Tasks;



using Amazon;

using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;

using Amazon.DynamoDBv2.DocumentModel;



namespace DynamoDB_intro

{

  class Program

  {

    static string commaSep = ", ";

   static string movieFormatString = "    \"{0}\", lead actor: {1}, genres:
 {2}";



    static void Main( string[ ] args )
```

```
    {
      // Get an AmazonDynamoDBClient for the local DynamoDB database
      AmazonDynamoDBClient client = GetLocalClient( );

      // Get a Table object for the table that you created in Step 1
      Table table = GetTableObject( client, "Movies" );
      if( table == null )
        goto PauseForDebugWindow;

      /*-------------------------------------------------------------------
       *  4.1.1:  Call Table.Query to initiate a query for all movies with
       *          year == 1985, using an empty filter expression.
       *-------------------------------------------------------------------*/
      Search search;
      try { search = table.Query( 1985, new Expression( ) ); }
      catch( Exception ex )
      {
        Console.WriteLine( "\n Error: 1985 query failed because: " +
ex.Message );
        goto PauseForDebugWindow;
      }

      // Display the titles of the movies returned by this query
      List<Document> docList = new List<Document>( );
      Console.WriteLine( "\n All movies released in 1985:" +
                         "\n-------------------------------------------
-" );
      do
      {
```

```
        try { docList = search.GetNextSet( ); }
        catch( Exception ex )
        {
          Console.WriteLine( "\n Error: Search.GetNextStep failed because:
 " + ex.Message );
          break;
        }
        foreach( var doc in docList )
          Console.WriteLine( "    " + doc["title"] );
      } while( !search.IsDone );



      /*-----------------------------------------------------------------
-----
       *  4.1.2a:  Call Table.Query to initiate a query for all movies where

       *           year equals 1992 AND title is between "B" and "Hzzz",
       *           returning the lead actor and genres of each.
       *-----------------------------------------------------------------
-----*/
      Primitive y_1992  = new Primitive( "1992", true );
      QueryOperationConfig config = new QueryOperationConfig( );
      config.Filter = new QueryFilter( );
     config.Filter.AddCondition( "year", QueryOperator.Equal, new DynamoD
BEntry[ ] { 1992 } );
      config.Filter.AddCondition( "title", QueryOperator.Between, new Dy
namoDBEntry[ ] { "B", "Hzz" } );
      config.AttributesToGet = new List<string> { "title", "info" };
      config.Select = SelectValues.SpecificAttributes;

      try { search = table.Query( config ); }
      catch( Exception ex )
```

```
      {
        Console.WriteLine( "\n Error: 1992 query failed because: " +
ex.Message );
        goto PauseForDebugWindow;
      }


      // Display the movie information returned by this query
      Console.WriteLine( "\n\n Movies released in 1992 with titles between
 \"B\" and \"Hzz\" (Document Model):" +
                          "\n-------------------------------------------
---------------------------------" );
      docList = new List<Document>( );
      Document infoDoc;
      do
      {
        try { docList = search.GetNextSet( ); }
        catch( Exception ex )
        {
          Console.WriteLine( "\n Error: Search.GetNextStep failed because:
 " + ex.Message );
          break;
        }
        foreach( var doc in docList )
        {
          infoDoc = doc["info"].AsDocument( );
          Console.WriteLine( movieFormatString,
                             doc["title"],
                             infoDoc["actors"].AsArrayOfString( )[0],
                            string.Join( commaSep, infoDoc["genres"].AsAr
rayOfString( ) ) );
        }
```

```
      } while( !search.IsDone );



      /*-----------------------------------------------------------------
-----
       *  4.1.2b:  Call AmazonDynamoDBClient.Query to initiate a query for
 all
       *           movies where year equals 1992 AND title is between M and
 Tzz,
       *           returning the genres and the lead actor of each.
       *-----------------------------------------------------------------
-----*/
      QueryRequest qRequest = new QueryRequest
      {
        TableName = "Movies",
        ExpressionAttributeNames = new Dictionary<string,string>
        {
          { "#yr", "year" }
        },
        ExpressionAttributeValues = new Dictionary<string,AttributeValue>
        {
          { ":y_1992",  new AttributeValue { N = "1992" } },
          { ":M",       new AttributeValue { S = "M"    } },
          { ":Tzz",     new AttributeValue { S = "Tzz"  } }
        },
        KeyConditionExpression = "#yr = :y_1992 and title between :M and
:Tzz",
        ProjectionExpression = "title, info.actors[0], info.genres"
      };


      QueryResponse qResponse;
      try { qResponse = client.Query( qRequest ); }
```

```
      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: Low-level query failed, because: " +
 ex.Message );

        goto PauseForDebugWindow;

      }



      // Display the movie information returned by this query

      Console.WriteLine( "\n\n Movies released in 1992 with titles between
 \"M\" and \"Tzz\" (low-level):" +

                         "\n-------------------------------------------
-----------------------------" );

      foreach( Dictionary<string, AttributeValue> item in qResponse.Items)

      {

        Dictionary<string,AttributeValue> info = item["info"].M;

        Console.WriteLine( movieFormatString,

                         item["title"].S,

                         info["actors"].L[0].S,

                         GetDdbListAsString( info["genres"].L ) );

      }



      // Keep the console open if in Debug mode...

PauseForDebugWindow:

      Console.Write( "\n\n ...Press any key to continue" );

      Console.ReadKey( );

      Console.WriteLine( );

    }



    public static string GetDdbListAsString( List<AttributeValue> strList
)

    {
```

```
  StringBuilder sb = new StringBuilder( );
  string str = null;
  AttributeValue av;
  for( int i = 0; i < strList.Count; i++ )
  {
    av = strList[i];
    if( av.S != null )
      str = av.S;
    else if( av.N != null )
      str = av.N;
    else if( av.SS != null )
      str = string.Join( commaSep, av.SS.ToArray( ) );
    else if( av.NS != null )
      str = string.Join( commaSep, av.NS.ToArray( ) );
    if( str != null )
    {
      if( i > 0 )
        sb.Append( commaSep );
      sb.Append( str );
    }
  }
  return( sb.ToString( ) );
}

public static AmazonDynamoDBClient GetLocalClient( )
{
  // First, set up a DynamoDB client for DynamoDB Local
  AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig( );
  ddbConfig.ServiceURL = "http://localhost:8000";
```

```
      AmazonDynamoDBClient client;

      try { client = new AmazonDynamoDBClient( ddbConfig ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: failed to create a DynamoDB client;
" + ex.Message );

        return ( null );

      }

      return ( client );

    }




    public static Table GetTableObject( AmazonDynamoDBClient client, string
 tableName )

    {

      Table table = null;

      try { table = Table.LoadTable( client, tableName ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: failed to load the 'Movies' table; "
 + ex.Message );

        return ( null );

      }

      return ( table );

    }

  }

}
```

Note

- In the first query, for all movies released in 1985, an empty expression indicates that no filtering on the sort-key part of the primary key is desired.

- In the second query, which uses the AWS SDK for .NET Document Model to query for all movies released in 1992 with titles starting with the letters A through L, we can only query for top-level attributes, and so must retrieve the entire `info` attribute. Our display code then accesses the nested attributes we're interested in.
- In the third query, we use the low-level AWS SDK for .NET API, which gives more control over what is returned. Here, we are able to retrieve only those nested attributes within the `info` attribute that we are interested in, namely `info.genres` and `info.actors[0]`.

2. Compile and run the program.

Note
The preceding program shows how to query a table by its primary key attributes. In DynamoDB, you can also optionally create one or more secondary indexes on a table, and query those indexes in the same way that you query a table. Secondary indexes give your applications additional flexibility by allowing queries on non-key attributes. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Step 4.2: Scan

The `Scan` method reads every item in the entire table, and returns all of the data in the table. You can provide an optional `filter_expression`, so that only the items matching your criteria are returned. However, note that the filter is only applied after the entire table has been scanned.

The following program scans the entire `Movies` table, which contains approximately 5,000 items. The scan specifies the optional filter to retrieve only the movies from the 1950s (approximately 100 items), and discard all of the others.

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Collections.Generic;

using System.Linq;

using System.Text;

using System.Threading.Tasks;



using Amazon;

using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;

using Amazon.DynamoDBv2.DocumentModel;



namespace DynamoDB_intro

{

```

```
  class Program
  {
    static void Main( string[ ] args )
    {
      // Get an AmazonDynamoDBClient for the local DynamoDB database
      AmazonDynamoDBClient client = GetLocalClient( );

      // Get a Table object for the table that you created in Step 1
      Table table = GetTableObject( client, "Movies" );
      if( table == null )
        goto PauseForDebugWindow;



      /*-------------------------------------------------------------------
-----
      *  4.2a:  Call Table.Scan to return the movies released in the 1950's,

       *         displaying title, year, lead actor and lead director.
       *-------------------------------------------------------------------
-----*/
      ScanFilter filter = new ScanFilter( );
     filter.AddCondition( "year", ScanOperator.Between, new DynamoDBEntry[
 ] { 1950, 1959 } );
      ScanOperationConfig config = new ScanOperationConfig
      {
        AttributesToGet = new List<string> { "year, title, info" },
        Filter = filter
      };
      Search search = table.Scan( filter );

      // Display the movie information returned by this query
```

```
      Console.WriteLine( "\n\n Movies released in the 1950's (Document Mod
el):" +

                         "\n-----------------------------------------------
----" );

      List<Document> docList = new List<Document>( );

      Document infoDoc;

      string movieFormatString = "    \"{0}\" ({1})-- lead actor: {2}, lead
 director: {3}";

      do

      {

        try { docList = search.GetNextSet( ); }

        catch( Exception ex )

        {

          Console.WriteLine( "\n Error: Search.GetNextStep failed because:
 " + ex.Message );

          break;

        }

        foreach( var doc in docList )

        {

          infoDoc = doc["info"].AsDocument( );

          Console.WriteLine( movieFormatString,

                             doc["title"],

                             doc["year"],

                             infoDoc["actors"].AsArrayOfString( )[0],

                             infoDoc["directors"].AsArrayOfString( )[0] );

        }

      } while( !search.IsDone );




      /*-----------------------------------------------------------------
-----

      *  4.2b:  Call AmazonDynamoDBClient.Scan to return all movies released
```

```
       *         in the 1960's, only downloading the title, year, lead
       *         actor and lead director attributes.
       *-----------------------------------------------------------------
-----*/
      ScanRequest sRequest = new ScanRequest
      {
        TableName = "Movies",
        ExpressionAttributeNames = new Dictionary<string, string>
        {
          { "#yr", "year" }
        },
        ExpressionAttributeValues = new Dictionary<string, AttributeValue>
        {
          { ":y_a", new AttributeValue { N = "1960" } },
          { ":y_z", new AttributeValue { N = "1969" } },
        },
        FilterExpression = "#yr between :y_a and :y_z",
       ProjectionExpression = "#yr, title, info.actors[0], info.directors[0]"

      };

      ScanResponse sResponse;
      try { sResponse = client.Scan( sRequest ); }
      catch( Exception ex )
      {
        Console.WriteLine( "\n Error: Low-level scan failed, because: " +
ex.Message );
        goto PauseForDebugWindow;
      }
```

```
      // Display the movie information returned by this scan
      Console.WriteLine( "\n\n Movies released in the 1960's (low-level):"
 +
                         "\n-------------------------------------------"
 );
      foreach( Dictionary<string, AttributeValue> item in sResponse.Items
)
      {
        Dictionary<string,AttributeValue> info = item["info"].M;
        Console.WriteLine( movieFormatString,
                         item["title"].S,
                         item["year"].N,
                         info["actors"].L[0].S,
                         info["directors"].L[0].S );
      }
// Keep the console open if in Debug mode...
PauseForDebugWindow:
      Console.Write( "\n\n ...Press any key to continue" );
      Console.ReadKey( );
      Console.WriteLine( );
    }

    public static AmazonDynamoDBClient GetLocalClient( )
    {
      // First, set up a DynamoDB client for DynamoDB Local
      AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig( );
      ddbConfig.ServiceURL = "http://localhost:8000";
      AmazonDynamoDBClient client;
      try { client = new AmazonDynamoDBClient( ddbConfig ); }
      catch( Exception ex )
```

```
      {

        Console.WriteLine( "\n Error: failed to create a DynamoDB client;
" + ex.Message );

        return ( null );

      }

      return ( client );

    }




   public static Table GetTableObject( AmazonDynamoDBClient client, string
 tableName )

    {

      Table table = null;

      try { table = Table.LoadTable( client, tableName ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: failed to load the 'Movies' table; "
 + ex.Message );

        return ( null );

      }

      return ( table );

    }

  }

}
```

In the code, note the following:

- The first scan uses the AWS SDK for .NET Document Model to scan the `Movies` table and return movies released in the 1950's. because the Document Model does not support nested attributes in the `AttributesToGet` field, we must download the entire `info` attribute to have access to the lead actor and director.
- The second scan uses the AWS SDK for .NET low-level API to scan the `Movies` table and return movies released in the 1960's. In this case, we can download only those attribute values in `info` that we are interested in, namely `info.actors[0]` and `info.directors[0]`.

2. Compile and run the program.

Note
You can also use the `Scan` operation with any secondary indexes that you have created on the table. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 5: (Optional) Delete the Table (p. 95)

Step 5: (Optional) Delete the Table

In this step, you delete the `Movies` table. This is an optional step. If you want, you can keep the `Movies` table and write your own programs to work with the data.

1. Copy the following program into the `Program.cs` file, replacing its current contents.

```
using System;

using System.Text;


using Amazon.DynamoDBv2;

using Amazon.DynamoDBv2.Model;


namespace DynamoDB_intro

{

  class Program

  {

    static void Main( string[ ] args )

    {

      // Get an AmazonDynamoDBClient for the local DynamoDB database

      AmazonDynamoDBClient client = GetLocalClient( );


      try { client.DeleteTable( "Movies" ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: the \'Movies\" table could not be de
```

```
leted!\n    Reason: " + ex.Message );

        goto PauseForDebugWindow;

      }

      Console.WriteLine( "\n Deleted the \'Movies\" table successfully!" );



      // Keep the console open if in Debug mode...

PauseForDebugWindow:

      Console.Write( "\n\n ...Press any key to continue" );

      Console.ReadKey( );

      Console.WriteLine( );

    }


    public static AmazonDynamoDBClient GetLocalClient( )

    {

      // First, set up a DynamoDB client for DynamoDB Local

      AmazonDynamoDBConfig ddbConfig = new AmazonDynamoDBConfig( );

      ddbConfig.ServiceURL = "http://localhost:8000";

      AmazonDynamoDBClient client;

      try { client = new AmazonDynamoDBClient( ddbConfig ); }

      catch( Exception ex )

      {

        Console.WriteLine( "\n Error: failed to create a DynamoDB client;
" + ex.Message );

        return ( null );

      }

      return ( client );

    }

  }

}
```

2. Compile and run the program.

Next Step

Summary (p. 97)

Summary

Topics

In this tutorial, you created the `Movies` table in DynamoDB on your computer and performed basic operations. DynamoDB Local is useful during application development and testing. However, when you are ready to run your application in a production environment, you need to modify your code so that it uses the Amazon DynamoDB service.

Using the Amazon DynamoDB Service

You need to change the endpoint in your application in order to use the Amazon DynamoDB service as follows. To do this, first remove the following line:

```
ddbConfig.ServiceURL = "http://localhost:8000";
```

Next, add a new line that specifies the AWS region you want to access:

```
client.Config.RegionEndpoint = RegionEndpoint.REGION;
```

For example, if you want to access the `us-west-2 region`, you would do this:

```
client.Config.RegionEndpoint = RegionEndpoint.US_WEST_2;
```

Now, instead of using DynamoDB Local, the program uses the DynamoDB service endpoint in US West (Oregon).

Amazon DynamoDB is available in several regions worldwide. For the complete list of regions and endpoints, see Regions and Endpoints in the *AWS General Reference*. For more information about setting regions and endpoints in your code, see AWS Region Selection in the *AWS SDK for .NET Developer Guide*.

The downloadable version of DynamoDB is for development and testing purposes only. By comparison, DynamoDB is a managed service with scalability, availability, and durability features that make it ideal for production usage. The following table contains some other key differences between DynamoDB running on your computer and the Amazon DynamoDB service:

	DynamoDB (downloadable version)	Amazon DynamoDB (web service)
Creating a Table	The table is created immediately.	Table creation takes some time, depending on its provisioned throughput settings. DynamoDB allocates sufficient resources to meet your specific read and write capacity requirements.
Provisioned Throughput	The downloadable version of DynamoDB ignores provisioned throughput settings.	Provisioned throughput is a fundamental concept in DynamoDB. The rate at which you can read and write data depends on your provisioned capacity settings. For more information, see Provisioned Throughput in the *Amazon DynamoDB Developer Guide*.
Reading and Writing Data	Reads and writes are performed as fast as possible, without any network overhead.	Read and write activity is regulated by the provisioned throughput settings on the table. To increase the maximum throughput, you must increase the throughput settings on the table. Network latency also affects throughput to an extent.
Deleting a Table	The table is deleted immediately.	Table deletion takes some time, as DynamoDB releases the resources that had been used by the table.

Next Steps

For more information about Amazon DynamoDB, see the Amazon DynamoDB Developer Guide. We recommend the following topics:

Data Model

Provisioned Throughput

Improving Data Access with Secondary Indexes

The *Amazon DynamoDB Developer Guide* also includes the following topics about working with tables, items, and queries:

Working with Tables

Working with Items

Query and Scan Operations in DynamoDB

Best Practices

Node.js and DynamoDB

In this tutorial, you use the AWS SDK for JavaScript in Node.js to write simple programs to perform the following Amazon DynamoDB operations:

- Create a table called `Movies` and load sample data in JSON format.
- Perform create, read, update, and delete operations on the table.
- Run simple queries.

You use the downloadable version of DynamoDB in this tutorial. In the Summary (p. 115), we explain how to run the same code against the DynamoDB web service.

Cost: Free

Prerequisites

Before you begin this tutorial, you need to do the following:

- Download and run DynamoDB on your computer. For more information, see Download and Run DynamoDB (p. 5).
- Sign up for Amazon Web Services and create access keys. You need these credentials to use AWS SDKs. To create an AWS account, go to http://aws.amazon.com/, choose **Create an AWS Account**, and then follow the online instructions.
- Create an AWS credentials file to store your access keys. For more information, see Shared Credentials File in the *AWS SDK for JavaScript in Node.js Getting Started Guide*.
- Set up the AWS SDK for JavaScript in Node.js. You need to do the following:
  - Go to http://nodejs.org and install Node.js.
  - Go to http://aws.amazon.com/sdk-for-node-js and install the AWS SDK for JavaScript in Node.js.

  For more information, see the AWS SDK for JavaScript in Node.js Getting Started Guide.

  Tip
  As you work through this tutorial, you can refer to the AWS SDK for JavaScript in Node.js API Reference.

We also recommend you review the DynamoDB concepts. For more information, see Introduction to DynamoDB Concepts (p. 1).

Next Step

Step 1: Create a Table (p. 100)

Step 1: Create a Table

In this step, you create a table named `Movies`. The primary key for the table is composed of the following attributes:

- `year` – The partition key. The `AttributeType` is `N` for number.
- `title` – The sort key. The `AttributeType` is `S` for string.

1. Copy the following program into a file named `MoviesCreateTable.js`.

```
var AWS = require("aws-sdk");

AWS.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
});

var dynamodb = new AWS.DynamoDB();

var params = {
    TableName : "Movies",
    KeySchema: [
        { AttributeName: "year", KeyType: "HASH"},  //Partition key
        { AttributeName: "title", KeyType: "RANGE" }  //Sort key
    ],
    AttributeDefinitions: [
        { AttributeName: "year", AttributeType: "N" },
        { AttributeName: "title", AttributeType: "S" }
    ],
    ProvisionedThroughput: {
        ReadCapacityUnits: 10,
        WriteCapacityUnits: 10
    }
};

dynamodb.createTable(params, function(err, data) {
    if (err) {
        console.error("Unable to create table. Error JSON:", JSON.stringi
fy(err, null, 2));
    } else {
        console.log("Created table. Table description JSON:", JSON.stringi
fy(data, null, 2));
    }
});
```

Note

- You set the endpoint (`client.setEndpoint`) to indicate that you are creating the table in DynamoDB on your computer.
- In the `createTable` call, you specify table name, primary key attributes, and its data types.
- The `ProvisionedThroughput` parameter is required; however, the downloadable version of DynamoDB ignores it. (Provisioned throughput is beyond the scope of this exercise.)

2. Type the following command to run the program:

```
node MoviesCreateTable.js
```

To learn more about managing tables, see Working with Tables in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 2: Load Sample Data (p. 101)

Step 2: Load Sample Data

In this step, you populate the `Movies` table with sample data.

Topics

We use a sample data file that contains information about a few thousand movies from the Internet Movie Database (IMDb). The movie data is in JSON format, as shown in the following example. For each movie, there is a `year`, a `title`, and a JSON map named `info`.

```
[
   {
      "year" : ... ,
      "title" : ... ,
      "info" : { ... }
   },
   {
      "year" : ...,
      "title" : ...,
      "info" : { ... }
   },

    ...

]
```

In the JSON data, note the following:

- We use the `year` and `title` as the primary key attribute values for our `Movies` table.

- We store the rest of the `info` values in a single attribute called `info`. This program illustrates how you can store JSON in a DynamoDB attribute.

The following is an example of movie data:

```
{
    "year" : 2013,
    "title" : "Turn It Down, Or Else!",
    "info" : {
        "directors" : [
            "Alice Smith",
            "Bob Jones"
        ],
        "release_date" : "2013-01-18T00:00:00Z",
        "rating" : 6.2,
        "genres" : [
            "Comedy",
            "Drama"
        ],
        "image_url" : "http://ia.media-imdb.com/images/N/O9ER
WAU7FS797AJ7LU8HN09AMUP908RLlo5JF90EWR7LJKQ7@@._V1_SX400_.jpg",
        "plot" : "A rock band plays their music at high volumes, annoying the
neighbors.",
        "rank" : 11,
        "running_time_secs" : 5215,
        "actors" : [
            "David Matthewman",
            "Ann Thomas",
            "Jonathan G. Neff"
       ]
    }
}
```

Step 2.1: Download the Sample Data File

1. Download the sample data archive by clicking this link: moviedata.zip
2. Extract the data file (`moviedata.json`) from the archive.
3. Copy the `moviedata.json` file to your current directory.

Step 2.2: Load the Sample Data Into the Movies Table

After you have downloaded the sample data, you can run the following program to populate the `Movies` table.

1. Copy the following program into a file named `MoviesLoadData.js`:

```
var AWS = require("aws-sdk");
var fs = require('fs');

AWS.config.update({
```

```
    region: "us-west-2",
    endpoint: "http://localhost:8000"
});

var docClient = new AWS.DynamoDB.DocumentClient();

console.log("Importing movies into DynamoDB. Please wait.");

var allMovies = JSON.parse(fs.readFileSync('moviedata.json', 'utf8'));
allMovies.forEach(function(movie) {
    var params = {
        TableName: "Movies",
        Item: {
            "year":  movie.year,
            "title": movie.title,
            "info":  movie.info
        }
    };

    docClient.put(params, function(err, data) {
       if (err) {
         console.error("Unable to add movie", movie.title, ". Error JSON:",
 JSON.stringify(err, null, 2));
       } else {
           console.log("PutItem succeeded:", movie.title);
       }
    });
});
```

2. Type the following command to run the program:

   ```
   node MoviesLoadData.js
   ```

Next Step

Step 3: Create, Read, Update, and Delete an Item (p. 103)

Step 3: Create, Read, Update, and Delete an Item

In this step, you perform read and write operations on an item in the `Movies` table.

To learn more about reading and writing data, see Working with Items in the *Amazon DynamoDB Developer Guide*.

Topics

Step 3.1: Create a New Item

In this step, you add a new item to the `Movies` table.

1. Copy the following program into a file named `MoviesItemOps01.js`:

```
var AWS = require("aws-sdk");

AWS.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
});

var docClient = new AWS.DynamoDB.DocumentClient();

var table = "Movies";

var year = 2015;
var title = "The Big New Movie";

var params = {
    TableName:table,
    Item:{
        "year": year,
        "title": title,
        "info":{
            "plot": "Nothing happens at all.",
            "rating": 0
        }
    }
};

console.log("Adding a new item...");
docClient.put(params, function(err, data) {
    if (err) {
       console.error("Unable to add item. Error JSON:", JSON.stringify(err,
 null, 2));
    } else {
        console.log("Added item:", JSON.stringify(data, null, 2));
    }
});
```

   Note
   The primary key is required. This code adds an item that has a primary key (`year`, `title`) and `info` attributes. The `info` attribute stores sample JSON that provides more information about the movie.

2. Type the following command to run the program:

```
node MoviesItemOps01.js
```

Step 3.2: Read an Item

In the previous program, you added the following item to the table:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

You can use the `get` method to read the item from the `Movies` table. You must specify the primary key values, so you can read any item from `Movies` if you know its `year` and `title`.

1. Copy the following program into a file named `MoviesItemOps02.js`:

```
var AWS = require("aws-sdk");

AWS.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
});

var docClient = new AWS.DynamoDB.DocumentClient()

var table = "Movies";

var year = 2015;
var title = "The Big New Movie";

var params = {
    TableName: table,
    Key:{
        "year": year,
        "title": title
    }
};

docClient.get(params, function(err, data) {
    if (err) {
       console.error("Unable to read item. Error JSON:", JSON.stringify(err,
 null, 2));
    } else {
        console.log("GetItem succeeded:", JSON.stringify(data, null, 2));
    }
});
```

2. Type the following command to run the program:

```
node MoviesItemOps02.js
```

Step 3.3: Update an Item

You can use the `update` method to modify an existing item. You can update values of existing attributes, add new attributes, or remove attributes.

In this example, you perform the following updates:

- Change the value of the existing attributes (`rating`, `plot`).
- Add a new list attribute (`actors`) to the existing `info` map.

The item changes from:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

To the following:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
           plot: "Everything happens all at once.",
           rating: 5.5,
           actors: ["Larry", "Moe", "Curly"]
   }
}
```

1. Copy the following program into a file named `MoviesItemOps03.js`:

```
var AWS = require("aws-sdk");

AWS.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
});

var docClient = new AWS.DynamoDB.DocumentClient()

var table = "Movies";

var year = 2015;
var title = "The Big New Movie";

// Update the item, unconditionally,

var params = {
    TableName:table,
    Key:{
        "year": year,
        "title": title
    },
    UpdateExpression: "set info.rating = :r, info.plot=:p, info.actors=:a",

    ExpressionAttributeValues:{
        ":r":5.5,
        ":p":"Everything happens all at once.",
```

```
        ":a":["Larry", "Moe", "Curly"]
    },
    ReturnValues:"UPDATED_NEW"
};

console.log("Updating the item...");
docClient.update(params, function(err, data) {
    if (err) {
        console.error("Unable to update item. Error JSON:", JSON.stringi
fy(err, null, 2));
    } else {
       console.log("UpdateItem succeeded:", JSON.stringify(data, null, 2));

    }
});
```

Note
This program uses `UpdateExpression` to describe all updates you want to perform on the specified item.
The `ReturnValues` parameter instructs DynamoDB to return only the updated attributes (`"UPDATED_NEW"`).

2. Type the following command to run the program:

```
node MoviesItemOps03.js
```

Step 3.4: Increment an Atomic Counter

DynamoDB supports atomic counters, where you use the `update` method to increment or decrement the value of an existing attribute without interfering with other write requests. (All write requests are applied in the order in which they were received.)

The following program shows how to increment the `rating` for a movie. Each time you run it, the program increments this attribute by one.

1. Copy the following program into a file named `MoviesItemOps04.js`:

```
var AWS = require("aws-sdk");

AWS.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
});

var docClient = new AWS.DynamoDB.DocumentClient()

var table = "Movies";

var year = 2015;
var title = "The Big New Movie";

// Increment an atomic counter

var params = {
    TableName:table,
    Key:{
```

```
        "year": year,
        "title": title
    },
    UpdateExpression: "set info.rating = info.rating + :val",
    ExpressionAttributeValues:{
        ":val":1
    },
    ReturnValues:"UPDATED_NEW"
};

console.log("Updating the item...");
docClient.update(params, function(err, data) {
    if (err) {
        console.error("Unable to update item. Error JSON:", JSON.stringi
fy(err, null, 2));
    } else {
       console.log("UpdateItem succeeded:", JSON.stringify(data, null, 2));

    }
});
```

2. Type the following command to run the program:

   ```
   node MoviesItemOps04.js
   ```

Step 3.5: Update an Item (Conditionally)

The following program shows how to use `UpdateItem` with a condition. If the condition evaluates to true, the update succeeds; otherwise, the update is not performed.

In this case, the item is only updated if there are more than three actors.

1. Copy the following program into a file named `MoviesItemOps05.js`:

```
var AWS = require("aws-sdk");

AWS.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
});

var docClient = new AWS.DynamoDB.DocumentClient()

var table = "Movies";

var year = 2015;
var title = "The Big New Movie";

// Conditional update (will fail)

var params = {
    TableName:table,
    Key:{
        "year": year,
        "title": title
```

```
    },
    UpdateExpression: "remove info.actors[0]",
    ConditionExpression: "size(info.actors) > :num",
    ExpressionAttributeValues:{
        ":num":3
    },
    ReturnValues:"UPDATED_NEW"
};

console.log("Attempting a conditional update...");
docClient.update(params, function(err, data) {
    if (err) {
        console.error("Unable to update item. Error JSON:", JSON.stringi
fy(err, null, 2));
    } else {
       console.log("UpdateItem succeeded:", JSON.stringify(data, null, 2));

    }
});
```

2. Type the following command to run the program:

   ```
   node MoviesItemOps05.js
   ```

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the movie has three actors in it, but the condition is checking for *greater than* three actors.
3. Modify the program so that the `ConditionExpression` looks like this:

   ```
   ConditionExpression: "size(info.actors) >= :num",
   ```

   The condition is now *greater than or equal to 3* instead of *greater than 3*.
4. Run the program again. The `updateItem` operation should now succeed.

Step 3.6: Delete an Item

You can use the `delete` method to delete one item by specifying its primary key. You can optionally provide a `ConditionExpression` to prevent item deletion if the condition is not met.

In the following example, you try to delete a specific movie item if its rating is 5 or less.

1. Copy the following program into a file named `MoviesItemOps06.js`:

   ```
   var AWS = require("aws-sdk");

   AWS.config.update({
     region: "us-west-2",
     endpoint: "http://localhost:8000"
   });
   ```

```
var docClient = new AWS.DynamoDB.DocumentClient();

var table = "Movies";

var year = 2015;
var title = "The Big New Movie";

var params = {
    TableName:table,
    Key:{
        "year":year,
        "title":title
    },
    ConditionExpression:"info.rating <= :val",
    ExpressionAttributeValues: {
        ":val": 5.0
    }
};

console.log("Attempting a conditional delete...");
docClient.delete(params, function(err, data) {
    if (err) {
        console.error("Unable to delete item. Error JSON:", JSON.stringi
fy(err, null, 2));
    } else {
       console.log("DeleteItem succeeded:", JSON.stringify(data, null, 2));

    }
});
```

2. Type the following command to run the program:

   ```
   node MoviesItemOps06.js
   ```

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the rating for this particular move is greater than 5.
3. Modify the program to remove the condition from `params`.

   ```
   var params = {
       TableName:table,
       Key:{
           "title":title,
           "year":year
       }
   };
   ```

4. Run the program again. Now, the delete succeeds because you removed the condition.

Next Step

Step 4: Query and Scan the Data (p. 111)

Step 4: Query and Scan the Data

You can use the `query` method to retrieve data from a table. You must specify a partition key value; the sort key is optional.

The primary key for the `Movies` table is composed of the following:

- `year` – The partition key. The attribute type is number.
- `title` – The sort key. The attribute type is string.

To find all movies released during a year, you need to specify only the `year`. You can also provide the `title` to retrieve a subset of movies based on some condition (on the sort key). For example, to find movies released in 2014 that have a title starting with the letter "A".

In addition to `query`, there is also a `scan` method that can retrieve all of the table data.

To learn more about querying and scanning data, see Query and Scan in the *Amazon DynamoDB Developer Guide*.

Query - All Movies Released in a Year

The program included in this step retrieves all movies released in the `year` 1985.

1. Copy the following program into a file named `MoviesQuery01.js`:

```
var AWS = require("aws-sdk");

AWS.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
});

var docClient = new AWS.DynamoDB.DocumentClient();

console.log("Querying for movies from 1985.");

var params = {
    TableName : "Movies",
    KeyConditionExpression: "#yr = :yyyy",
    ExpressionAttributeNames:{
        "#yr": "year"
    },
    ExpressionAttributeValues: {
        ":yyyy":1985
    }
};

docClient.query(params, function(err, data) {
    if (err) {
        console.error("Unable to query. Error:", JSON.stringify(err, null,
 2));
    } else {
        console.log("Query succeeded.");
        data.Items.forEach(function(item) {
            console.log(" -", item.year + ": " + item.title);
```

```
        });
    }
});
```

Note
`ExpressionAttributeNames` provides name substitution. We use this because `year` is a reserved word in DynamoDB—you cannot use it directly in any expression, including `KeyConditionExpression`. We use the expression attribute name `#yr` to address this. `ExpressionAttributeValues` provides value substitution. We use this because you cannot use literals in any expression, including `KeyConditionExpression`. We use the expression attribute value `:yyyy` to address this.

2. Type the following command to run the program:

```
node MoviesQuery01.js
```

Note
The preceding program shows how to query a table by its primary key attributes. In DynamoDB, you can optionally create one or more secondary indexes on a table, and query those indexes in the same way that you query a table. Secondary indexes give your applications additional flexibility by allowing queries on non-key attributes. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Query - All Movies Released in a Year with Certain Titles

The program included in this step retrieves all movies released in `year` 1992, with `title` beginning with the letter "A" through the letter "L".

1. Copy the following program into a file named `MoviesQuery02.js`:

```
var AWS = require("aws-sdk");

AWS.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
});

var docClient = new AWS.DynamoDB.DocumentClient();

console.log("Querying for movies from 1992 - titles A-L, with genres and
lead actor");

var params = {
    TableName : "Movies",
    ProjectionExpression:"#yr, title, info.genres, info.actors[0]",
    KeyConditionExpression: "#yr = :yyyy and title between :letter1 and
:letter2",
    ExpressionAttributeNames:{
        "#yr": "year"
    },
    ExpressionAttributeValues: {
        ":yyyy":1992,
        ":letter1": "A",
        ":letter2": "L"
```

```
    }
};

docClient.query(params, function(err, data) {
    if (err) {
        console.log("Unable to query. Error:", JSON.stringify(err, null,
2));
    } else {
        console.log("Query succeeded.");
        data.Items.forEach(function(item) {
            console.log(" -", item.year + ": " + item.title
            + " ... " + item.info.genres
            + " ... " + item.info.actors[0]);
        });
    }
});
```

2. Type the following command to run the program:

   ```
   node MoviesQuery02.js
   ```

Step 4.2: Scan

The `scan` method reads every item in the entire table, and returns all of the data in the table. You can provide an optional `filter_expression`, so that only the items matching your criteria are returned. However, note that the filter is only applied after the entire table has been scanned.

The following program scans the entire `Movies` table, which contains approximately 5,000 items. The scan specifies the optional filter to retrieve only the movies from the 1950s (approximately 100 items), and discard all of the others.

1. Copy the following program into a file named `MoviesScan.js`:

```
var AWS = require("aws-sdk");

AWS.config.update({
    region: "us-west-2",
    endpoint: "http://localhost:8000"
});

var docClient = new AWS.DynamoDB.DocumentClient();

var params = {
    TableName: "Movies",
    ProjectionExpression: "#yr, title, info.rating",
    FilterExpression: "#yr between :start_yr and :end_yr",
    ExpressionAttributeNames: {
        "#yr": "year",
    },
    ExpressionAttributeValues: {
         ":start_yr": 1950,
         ":end_yr": 1959
    }
```

```
};

console.log("Scanning Movies table.");
docClient.scan(params, onScan);

function onScan(err, data) {
    if (err) {
        console.error("Unable to scan the table. Error JSON:", JSON.string
ify(err, null, 2));
    } else {
        // print all the movies
        console.log("Scan succeeded.");
        data.Items.forEach(function(movie) {
           console.log(
                movie.year + ": ",
                movie.title, "- rating:", movie.info.rating);
        });

        // continue scanning if we have more movies
        if (typeof data.LastEvaluatedKey != "undefined") {
            console.log("Scanning for more...");
            params.ExclusiveStartKey = data.LastEvaluatedKey;
            docClient.scan(params, onScan);
        }
    }
}
```

In the code, note the following:

- `ProjectionExpression` specifies the attributes you want in the scan result.
- `FilterExpression` specifies a condition that returns only items that satisfy the condition. All other items are discarded.

2. Type the following command to run the program:

   ```
   node MoviesScan.js
   ```

   Note
   You can also use the `Scan` operation with any secondary indexes that you have created on the table. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 5: (Optional): Delete the Table (p. 114)

Step 5: (Optional): Delete the Table

In this step, you delete the `Movies` table. This is an optional step. If you want, you can keep the `Movies` table and write your own programs to work with the data.

1. Copy the following program into a file named `MoviesDeleteTable.js`:

```
var AWS = require("aws-sdk");

AWS.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
});

var dynamodb = new AWS.DynamoDB();

var params = {
    TableName : "Movies"
};

dynamodb.deleteTable(params, function(err, data) {
    if (err) {
        console.error("Unable to delete table. Error JSON:", JSON.stringi
fy(err, null, 2));
    } else {
        console.log("Deleted table. Table description JSON:", JSON.stringi
fy(data, null, 2));
    }
});
```

2. Type the following command to run the program:

   ```
   node MoviesDeleteTable.js
   ```

Next Step

Summary (p. 115)

Summary

In this tutorial, you created the `Movies` table in DynamoDB on your computer and performed basic operations. The downloadable version of DynamoDB is useful during application development and testing. However, when you are ready to run your application in a production environment, you want to modify your code so that it uses the Amazon DynamoDB web service.

Using the Amazon DynamoDB Service

You need to change the endpoint in your application in order to use the Amazon DynamoDB service. To do this, modify the code as follows:

```
AWS.config.update({endpoint: "https://dynamodb.aws-region.amazonaws.com"});
```

For example, if you want to use the us-west-2 region, you set the following endpoint:

```
AWS.config.update({endpoint: "https://dynamodb.us-west-2.amazonaws.com"});
```

Now, instead of using DynamoDB on your computer, the program uses the Amazon DynamoDB web service endpoint in US West (Oregon).

Amazon DynamoDB is available in several regions worldwide. For the complete list of regions and endpoints, see Regions and Endpoints in the *AWS General Reference*. For more information on setting regions and endpoints in your code, go to Setting the Region in the *AWS SDK for JavaScript in Node.js API Reference*.

The downloadable version of DynamoDB is for development and testing purposes only. By comparison, DynamoDB is a managed service with scalability, availability, and durability features that make it ideal for production usage. The following table contains some other key differences between DynamoDB running on your computer and the Amazon DynamoDB service:

	DynamoDB (downloadable version)	**Amazon DynamoDB (web service)**
Creating a Table	The table is created immediately.	Table creation takes some time, depending on its provisioned throughput settings. DynamoDB allocates sufficient resources to meet your specific read and write capacity requirements.
Provisioned Throughput	The downloadable version of DynamoDB ignores provisioned throughput settings.	Provisioned throughput is a fundamental concept in DynamoDB. The rate at which you can read and write data depends on your provisioned capacity settings. For more information, see Provisioned Throughput in the *Amazon DynamoDB Developer Guide*.
Reading and Writing Data	Reads and writes are performed as fast as possible, without any network overhead.	Read and write activity is regulated by the provisioned throughput settings on the table. To increase the maximum throughput, you must increase the throughput settings on the table. Network latency also affects throughput to an extent.
Deleting a Table	The table is deleted immediately.	Table deletion takes some time, as DynamoDB releases the resources that had been used by the table.

Next Steps

For more information about Amazon DynamoDB, see the Amazon DynamoDB Developer Guide. We recommend the following topics:

Data Model

Provisioned Throughput

Improving Data Access with Secondary Indexes

The *Amazon DynamoDB Developer Guide* also includes the following topics about working with tables, items, and queries:

- Working with Tables
- Working with Items
- Query and Scan Operations in DynamoDB
- Best Practices

PHP and DynamoDB

In this tutorial, you use the AWS SDK for PHP to write simple programs to perform the following Amazon DynamoDB operations:

- Create a table called `Movies` and load sample data in JSON format.
- Perform create, read, update, and delete operations on the table.
- Run simple queries.

You use the downloadable version of DynamoDB in this tutorial. In the Summary (p. 138), we explain how to run the same code against the DynamoDB service.

Cost: Free

Prerequisites

Before you begin this tutorial, you need to do the following:

- Download and run DynamoDB on your computer. For more information, see Download and Run DynamoDB (p. 5).
- Sign up for Amazon Web Services and create access keys. You need these credentials to use AWS SDKs. To create an AWS account, go to http://aws.amazon.com/, choose **Create an AWS Account**, and then follow the online instructions.
- Create an AWS credentials file. For more information, see Using the AWS credentials file and credential profiles in the *AWS SDK for PHP Getting Started Guide*.
- Set up the AWS SDK for PHP. You need to do the following:
  - Go to http://php.net and install PHP.
  - Go to http://aws.amazon.com/sdk-for-php and install the AWS SDK for PHP.

  For more information, see Getting Started in the *AWS SDK for PHP Getting Started Guide*.

  Tip
  As you work through this tutorial, you can refer to the AWS SDK for PHP Developer Guide. The Amazon DynamoDB section in the *AWS SDK for PHP API Reference* describes the parameters and results for DynamoDB operations.

We also recommend you review the DynamoDB concepts. For more information, see Introduction to DynamoDB Concepts (p. 1).

Next Step

Step 1: Create a Table (p. 119)

Step 1: Create a Table

In this step, you create a table named `Movies`. The primary key for the table is composed of the following two attributes:

- `year` – The partition key. The `AttributeType` is `N` for number.
- `title` – The sort key. The `AttributeType` is `S` for string.

1. Copy the following program into a file named `MoviesCreateTable.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();

$params = [
    'TableName' => 'Movies',
    'KeySchema' => [
        [
            'AttributeName' => 'year',
            'KeyType' => 'HASH'  //Partition key
        ],
        [
            'AttributeName' => 'title',
            'KeyType' => 'RANGE'  //Sort key
        ]
    ],
    'AttributeDefinitions' => [
        [
            'AttributeName' => 'year',
            'AttributeType' => 'N'
        ],
        [
            'AttributeName' => 'title',
            'AttributeType' => 'S'
        ],

    ],
```

```
    'ProvisionedThroughput' => [
        'ReadCapacityUnits' => 10,
        'WriteCapacityUnits' => 10
    ]
];

try {
    $result = $dynamodb->createTable($params);
    echo 'Created table.  Status: ' .
        $result['TableDescription']['TableStatus'] ."\n";

} catch (DynamoDbException $e) {
    echo "Unable to create table:\n";
    echo $e->getMessage() . "\n";
}

?>
```

Note

- You set the endpoint (`'endpoint' => 'http://localhost:8000'`) to indicate that you are creating the table in DynamoDB.
- In the `createTable` call, you specify table name, primary key attributes, and its data types.
- The `ProvisionedThroughput` parameter is required; however, the downloadable version of DynamoDB ignores it. (Provisioned throughput is beyond the scope of this exercise.)

2. Type the following command to run the program:

   ```
   php MoviesCreateTable.php
   ```

To learn more about managing tables, see Working with Tables in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 2: Load Sample Data (p. 120)

Step 2: Load Sample Data

In this step, you populate the `Movies` table with sample data.

Topics

We use a sample data file that contains information about a few thousand movies from the Internet Movie Database (IMDb). The movie data is in JSON format, as shown in the following example. For each movie, there is a `year`, a `title`, and a JSON map named `info`.

```
[
   {
      "year" : ... ,
      "title" : ... ,
      "info" : { ... }
   },
   {
      "year" : ...,
      "title" : ...,
      "info" : { ... }
   },

    ...

]
```

In the JSON data, note the following:

- We use the `year` and `title` as the primary key attribute values for our `Movies` table.
- We store the rest of the `info` values in a single attribute called `info`. This program illustrates how you can store JSON in a DynamoDB attribute.

The following is an example of movie data:

```
{
    "year" : 2013,
    "title" : "Turn It Down, Or Else!",
    "info" : {
        "directors" : [
            "Alice Smith",
            "Bob Jones"
        ],
        "release_date" : "2013-01-18T00:00:00Z",
        "rating" : 6.2,
        "genres" : [
            "Comedy",
            "Drama"
        ],
        "image_url" : "http://ia.media-imdb.com/images/N/O9ER
WAU7FS797AJ7LU8HN09AMUP908RLlo5JF90EWR7LJKQ7@@._V1_SX400_.jpg",
        "plot" : "A rock band plays their music at high volumes, annoying the
neighbors.",
        "rank" : 11,
        "running_time_secs" : 5215,
        "actors" : [
            "David Matthewman",
            "Ann Thomas",
            "Jonathan G. Neff"
       ]
    }
}
```

Step 2.1: Download the Sample Data File

1. Download the sample data archive by clicking this link: moviedata.zip
2. Extract the data file (`moviedata.json`) from the archive.
3. Copy the `moviedata.json` file to your current directory.

Step 2.2: Load the Sample Data Into the Movies Table

After you have downloaded the sample data, you can run the following program to populate the `Movies` table.

1. Copy the following program into a file named `MoviesLoadData.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;
use Aws\DynamoDb\Marshaler;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();
$marshaler = new Marshaler();

$tableName = 'Movies';

$movies = json_decode(file_get_contents('moviedata.json'), true);

foreach ($movies as $movie) {

    $year = $movie['year'];
    $title = $movie['title'];
    $info = $movie['info'];

    $json = json_encode([
        'year' => $year,
        'title' => $title,
        'info' => $info
    ]);

    $params = [
        'TableName' => $tableName,
        'Item' => $marshaler->marshalJson($json)
    ];

    try {
        $result = $dynamodb->putItem($params);
```

```
        echo "Added movie: " . $movie['year'] . " " . $movie['title'] .
"\n";
    } catch (DynamoDbException $e) {
        echo "Unable to add movie:\n";
        echo $e->getMessage() . "\n";
        break;
    }

}

?>
```

Note
The DynamoDB Marshaler class has methods for converting JSON documents and PHP arrays to the DynamoDB format. In this program, `$marshaler->marshalJson($json)` takes a JSON document and converts it into a DynamoDB item.

2. Type the following command to run the program:

```
php MoviesLoadData.php
```

Next Step

Step 3: Create, Read, Update, and Delete an Item (p. 123)

Step 3: Create, Read, Update, and Delete an Item

In this step, you perform read and write operations on an item in the `Movies` table.

To learn more about reading and writing data, see Working with Items in the *Amazon DynamoDB Developer Guide*.

Topics

Step 3.1: Create a New Item

In this step, you add a new item to the `Movies` table.

1. Copy the following program into a file named `MoviesItemOps01.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;
```

```
use Aws\DynamoDb\Marshaler;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();
$marshaler = new Marshaler();

$tableName = 'Movies';

$year = 2015;
$title = 'The Big New Movie';

$item = $marshaler->marshalJson('
    {
        "year": ' . $year . ',
        "title": "' . $title . '",
        "info": {
            "plot": "Nothing happens at all.",
            "rating": 0
        }
    }
');

$params = [
    'TableName' => 'Movies',
    'Item' => $item
];


try {
    $result = $dynamodb->putItem($params);
    echo "Added item: $year - $title\n";

} catch (DynamoDbException $e) {
    echo "Unable to add item:\n";
    echo $e->getMessage() . "\n";
}

?>
```

Note
The primary key is required. This code adds an item that has primary key (`year`, `title`) and `info` attributes. The `info` attribute stores a map that provides more information about the movie.

2. Type the following command to run the program:

   ```
   php MoviesItemOps01.php
   ```

Read an Item

In the previous program, you added the following item to the table:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

You can use the `getItem` method to read the item from the `Movies` table. You must specify the primary key values, so you can read any item from `Movies` if you know its `year` and `title`.

1. Copy the following program into a file named `MoviesItemOps02.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;
use Aws\DynamoDb\Marshaler;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();
$marshaler = new Marshaler();

$tableName = 'Movies';

$year = 2015;
$title = 'The Big New Movie';

$key = $marshaler->marshalJson('
    {
        "year": ' . $year . ',
        "title": "' . $title . '"
    }
');

$params = [
    'TableName' => $tableName,
    'Key' => $key
];

try {
    $result = $dynamodb->getItem($params);
    print_r($result["Item"]);

} catch (DynamoDbException $e) {
    echo "Unable to get item:\n";
    echo $e->getMessage() . "\n";
}
```

```
?>
```

2. Type the following command to run the program:

   ```
   php MoviesItemOps02.php
   ```

Step 3.3: Update an Item

You can use the `updateItem` method to modify an existing item. You can update values of existing attributes, add new attributes, or remove attributes.

In this example, you perform the following updates:

- Change the value of the existing attributes (`rating`, `plot`).
- Add a new list attribute (`actors`) to the existing `info` map.

The item changes from:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

To the following:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
           plot: "Everything happens all at once.",
           rating: 5.5,
           actors: ["Larry", "Moe", "Curly"]
   }
}
```

1. Copy the following program into a file named `MoviesItemOps03.php`.

   ```
   <?php
   require 'vendor/autoload.php';

   date_default_timezone_set('UTC');

   use Aws\DynamoDb\Exception\DynamoDbException;
   use Aws\DynamoDb\Marshaler;

   $sdk = new Aws\Sdk([
       'endpoint'   => 'http://localhost:8000',
   ```

```
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();
$marshaler = new Marshaler();

$tableName = 'Movies';

$year = 2015;
$title = 'The Big New Movie';

$key = $marshaler->marshalJson('
    {
        "year": ' . $year . ',
        "title": "' . $title . '"
    }
');


$eav = $marshaler->marshalJson('
    {
        ":r": 5.5 ,
        ":p": "Everything happens all at once.",
        ":a": [ "Larry", "Moe", "Curly" ]
    }
');

$params = [
    'TableName' => $tableName,
    'Key' => $key,
    'UpdateExpression' =>
        'set info.rating = :r, info.plot=:p, info.actors=:a',
    'ExpressionAttributeValues'=> $eav,
    'ReturnValues' => 'UPDATED_NEW'
];

try {
    $result = $dynamodb->updateItem($params);
    echo "Updated item.\n";
    print_r($result['Attributes']);

} catch (DynamoDbException $e) {
    echo "Unable to update item:\n";
    echo $e->getMessage() . "\n";
}

?>
```

Note

This program uses `UpdateExpression` to describe all updates you want to perform on the specified item.

The `ReturnValues` parameter instructs DynamoDB to return only the updated attributes (`UPDATED_NEW`).

2. Type the following command to run the program:

```
php MoviesItemOps03.php
```

Step 3.4: Increment an Atomic Counter

DynamoDB supports atomic counters, where you use the `updateItem` method to increment or decrement the value of an existing attribute without interfering with other write requests. (All write requests are applied in the order in which they were received.)

The following program shows how to increment the `rating` for a movie. Each time you run it, the program increments this attribute by one.

1. Copy the following program into a file named `MoviesItemOps04.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;
use Aws\DynamoDb\Marshaler;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();
$marshaler = new Marshaler();

$tableName = 'Movies';

$year = 2015;
$title = 'The Big New Movie';

$key = $marshaler->marshalJson('
    {
        "year": ' . $year . ',
        "title": "' . $title . '"
    }
');

$eav = $marshaler->marshalJson('
    {
        ":val": 1
    }
');

$params = [
    'TableName' => $tableName,
    'Key' => $key,
    'UpdateExpression' => 'set info.rating = info.rating + :val',
    'ExpressionAttributeValues'=> $eav,
    'ReturnValues' => 'UPDATED_NEW'
];

try {
    $result = $dynamodb->updateItem($params);
    echo "Updated item. ReturnValues are:\n";
```

```
    print_r($result['Attributes']);

} catch (DynamoDbException $e) {
    echo "Unable to update item:\n";
    echo $e->getMessage() . "\n";
}

?>
```

2. Type the following command to run the program:

   ```
   php MoviesItemOps04.php
   ```

Step 3.5: Update an Item (Conditionally)

The following program shows how to use `UpdateItem` with a condition. If the condition evaluates to true, the update succeeds; otherwise, the update is not performed.

In this case, the item is only updated if there are more than three actors.

1. Copy the following program into a file named `MoviesItemOps05.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;
use Aws\DynamoDb\Marshaler;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();
$marshaler = new Marshaler();

$tableName = 'Movies';

$year = 2015;
$title = 'The Big New Movie';

$key = $marshaler->marshalJson('
    {
        "year": ' . $year . ',
        "title": "' . $title . '"
    }
');

$eav = $marshaler->marshalJson('
    {
        ":num": 3
    }
```

```
');

$params = [
    'TableName' => $tableName,
    'Key' => $key,
    'UpdateExpression' => 'remove info.actors[0]',
    'ConditionExpression' => 'size(info.actors) > :num',
    'ExpressionAttributeValues'=> $eav,
    'ReturnValues' => 'UPDATED_NEW'
];

try {
    $result = $dynamodb->updateItem($params);
    echo "Updated item. ReturnValues are:\n";
    print_r($result['Attributes']);

} catch (DynamoDbException $e) {
    echo "Unable to update item:\n";
    echo $e->getMessage() . "\n";
}

?>
```

2. Type the following command to run the program:

   ```
   php MoviesItemOps05.php
   ```

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the movie has three actors in it, but the condition is checking for *greater than* three actors.
3. Modify the program so that the `ConditionExpression` looks like this:

   ```
   ConditionExpression="size(info.actors) >= :num",
   ```

   The condition is now *greater than or equal to 3* instead of *greater than 3*.
4. Run the program again. The `UpdateItem` operation should now succeed.

Step 3.6: Delete an Item

You can use the `deleteItem` method to delete one item by specifying its primary key. You can optionally provide a `ConditionExpression` to prevent item deletion if the condition is not met.

In the following example, you try to delete a specific movie item if its rating is 5 or less.

1. Copy the following program into a file named `MoviesItemOps06.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');
```

```
use Aws\DynamoDb\Exception\DynamoDbException;
use Aws\DynamoDb\Marshaler;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();
$marshaler = new Marshaler();

$tableName = 'Movies';

$year = 2015;
$title = 'The Big New Movie';

$key = $marshaler->marshalJson('
    {
        "year": ' . $year . ',
        "title": "' . $title . '"
    }
');

$eav = $marshaler->marshalJson('
    {
        ":val": 5
    }
');

$params = [
    'TableName' => $tableName,
    'Key' => $key,
    'ConditionExpression' => 'info.rating <= :val',
    'ExpressionAttributeValues'=> $eav
];

try {
    $result = $dynamodb->deleteItem($params);
    echo "Deleted item.\n";

} catch (DynamoDbException $e) {
    echo "Unable to delete item:\n";
    echo $e->getMessage() . "\n";
}

?>
```

2. Type the following command to run the program:

   ```
   php MoviesItemOps06.php
   ```

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the rating for this particular move is greater than 5.

3. Modify the program to remove the condition:

```
$params = [
    'TableName' => $tableName,
    'Key' => $key
];
```

4. Run the program. Now, the delete succeeds because you removed the condition.

Next Step

Step 4: Query and Scan the Data (p. 132)

Step 4: Query and Scan the Data

You can use the `query` method to retrieve data from a table. You must specify a partition key value; the sort key is optional.

The primary key for the `Movies` table is composed of the following:

- `year` – The partition key. The attribute type is number.
- `title` – The sort key. The attribute type is string.

To find all movies released during a year, you need to specify only the `year`. You can also provide the `title` to retrieve a subset of movies based on some condition (on the sort key). For example, to find movies released in 2014 that have a title starting with the letter "A".

In addition to `query`, there is also a `scan` method that can retrieve all of the table data.

To learn more about querying and scanning data, see Query and Scan in the *Amazon DynamoDB Developer Guide*.

Topics

Query - All Movies Released in a Year

The program included in this step retrieves all movies released in the `year` 1985.

1. Copy the following program into a file named `MoviesQuery01.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;
use Aws\DynamoDb\Marshaler;
```

```
$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();
$marshaler = new Marshaler();

$tableName = 'Movies';

$eav = $marshaler->marshalJson('
    {
        ":yyyy": 1985
    }
');

$params = [
    'TableName' => $tableName,
    'KeyConditionExpression' => '#yr = :yyyy',
    'ExpressionAttributeNames'=> [ '#yr' => 'year' ],
    'ExpressionAttributeValues'=> $eav
];

echo "Querying for movies from 1985.\n";

try {
    $result = $dynamodb->query($params);

    echo "Query succeeded.\n";

    foreach ($result['Items'] as $movie) {
        echo $marshaler->unmarshalValue($movie['year']) . ': ' .
            $marshaler->unmarshalValue($movie['title']) . "\n";
    }

} catch (DynamoDbException $e) {
    echo "Unable to query:\n";
    echo $e->getMessage() . "\n";
}

?>
```

Note

- `ExpressionAttributeNames` provides name substitution. We use this because `year` is a reserved word in DynamoDB—you cannot use it directly in any expression, including `KeyConditionExpression`. We use the expression attribute name `#yr` to address this.
- `ExpressionAttributeValues` provides value substitution. We use this because you cannot use literals in any expression, including `KeyConditionExpression`. We use the expression attribute value `:yyyy` to address this.

2. Type the following command to run the program:

   ```
   php MoviesItemQuery01.php
   ```

Note
The preceding program shows how to query a table by its primary key attributes. In DynamoDB, you can optionally create one or more secondary indexes on a table, and query those indexes in the same way that you query a table. Secondary indexes give your applications additional flexibility by allowing queries on non-key attributes. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Query - All Movies Released in a Year with Certain Titles

The program included in this step retrieves all movies released in `year` 1992, with `title` beginning with the letter "A" through the letter "L".

1. Copy the following program into a file named `MoviesQuery02.php`:

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;
use Aws\DynamoDb\Marshaler;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();
$marshaler = new Marshaler();

$tableName = 'Movies';

$eav = $marshaler->marshalJson('
    {
        ":yyyy":1992,
        ":letter1": "A",
        ":letter2": "L"
    }
');

$params = [
    'TableName' => $tableName,
    'ProjectionExpression' => '#yr, title, info.genres, info.actors[0]',
    'KeyConditionExpression' =>
        '#yr = :yyyy and title between :letter1 and :letter2',
    'ExpressionAttributeNames'=> [ '#yr' => 'year' ],
    'ExpressionAttributeValues'=> $eav
];

echo "Querying for movies from 1992 - titles A-L, with genres and lead act
or\n";

try {
    $result = $dynamodb->query($params);
```

```
    echo "Query succeeded.\n";

    foreach ($result['Items'] as $i) {
        $movie = $marshaler->unmarshalItem($i);
        print $movie['year'] . ': ' . $movie['title'] . ' ... ';

        foreach ($movie['info']['genres'] as $gen) {
            print $gen . ' ';
        }

        echo ' ... ' . $movie['info']['actors'][0] . "\n";
    }

} catch (DynamoDbException $e) {
    echo "Unable to query:\n";
    echo $e->getMessage() . "\n";
}

?>
```

2. Type the following command to run the program:

   ```
   php MoviesQuery02.php
   ```

Step 4.2: Scan

The `scan` method reads every item in the entire table, and returns all of the data in the table. You can provide an optional `filter_expression`, so that only the items matching your criteria are returned. However, note that the filter is only applied after the entire table has been scanned.

The following program scans the entire `Movies` table, which contains approximately 5,000 items. The scan specifies the optional filter to retrieve only the movies from the 1950s (approximately 100 items), and discard all of the others.

1. Copy the following program into a file named `MoviesScan.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;
use Aws\DynamoDb\Marshaler;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();

$marshaler = new Marshaler();
```

```
//Expression attribute values
$eav = $marshaler->marshalJson('
    {
        ":start_yr": 1950,
        ":end_yr": 1959
    }
');

$params = [
    'TableName' => 'Movies',
    'ProjectionExpression' => '#yr, title, info.rating',
    'FilterExpression' => '#yr between :start_yr and :end_yr',
    'ExpressionAttributeNames'=> [ '#yr' => 'year' ],
    'ExpressionAttributeValues'=> $eav
];

echo "Scanning Movies table.\n";

try {
    while (true) {
        $result = $dynamodb->scan($params);

        foreach ($result['Items'] as $i) {
            $movie = $marshaler->unmarshalItem($i);
            echo $movie['year'] . ': ' . $movie['title'];
            echo ' ... ' . $movie['info']['rating']
                . "\n";
        }

        if (isset($result['LastEvaluatedKey'])) {
            $params['ExclusiveStartKey'] = $result['LastEvaluatedKey'];
            echo "Scanning for more...\n";
            $result = $dynamodb->scan($params);
        } else {
            break;
        }
    }

} catch (DynamoDbException $e) {
    echo "Unable to scan:\n";
    echo $e->getMessage() . "\n";
}

?>
```

In the code, note the following:

- `ProjectionExpression` specifies the attributes you want in the scan result.
- `FilterExpression` specifies a condition that returns only items that satisfy the condition. All other items are discarded.

2. Type the following command to run the program:

   ```
   php MoviesScan.php
   ```

Note
You can also use the `Scan` operation with any secondary indexes that you have created on the table. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 5: (Optional) Delete the Table (p. 137)

Step 5: (Optional) Delete the Table

In this step, you delete the `Movies` table. This is an optional step. If you want, you can keep the `Movies` table and write your own programs to work with the data.

1. Copy the following program into a file named `MoviesDeleteTable.php`.

```
<?php
require 'vendor/autoload.php';

date_default_timezone_set('UTC');

use Aws\DynamoDb\Exception\DynamoDbException;

$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);

$dynamodb = $sdk->createDynamoDb();

$params = [
    'TableName' => 'Movies'
];

try {
    $result = $dynamodb->deleteTable($params);
    echo "Deleted table.\n";

} catch (DynamoDbException $e) {
    echo "Unable to delete table:\n";
    echo $e->getMessage() . "\n";
}

?>
```

2. Type the following command to run the program:

```
php MoviesDeleteTable.php
```

Next Step

Summary (p. 138)

Summary

In this tutorial, you created the `Movies` table in DynamoDB on your computer and performed basic operations. The downloadable version of DynamoDB is useful during application development and testing. However, when you are ready to run your application in a production environment, you need to modify your code so that it uses the Amazon DynamoDB web service.

Using the Amazon DynamoDB Service

You need to change the endpoint in your application in order to use the Amazon DynamoDB service. To do this, find the following lines in the code:

```
$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);
```

Now remove the `endpoint` parameter so that the code looks like this:

```
$sdk = new Aws\Sdk([
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);
```

After you remove this line, your code can access the DynamoDB service in the region specified by the `region` config value. For example, the following line specifies that you want to use the US West (Oregon) region:

```
    'region'   => 'us-west-2',
```

Now, instead of using DynamoDB on your computer, the program uses the DynamoDB service endpoint in US West (Oregon).

Amazon DynamoDB is available in several regions worldwide. For the complete list of regions and endpoints, see Regions and Endpoints in the *AWS General Reference*. For more information about setting regions and endpoints in your code, refer to the boto: A Python interface to Amazon Web Services.

The downloadable version of DynamoDB is for development and testing purposes only. By comparison, DynamoDB is a managed service with scalability, availability, and durability features that make it ideal for production usage. The following table contains some other key differences between DynamoDB running on your computer and the Amazon DynamoDB service:

	DynamoDB (downloadable version)	Amazon DynamoDB (web service)
Creating a Table	The table is created immediately.	Table creation takes some time, depending on its provisioned throughput settings. DynamoDB allocates sufficient resources to meet your specific read and write capacity requirements.

	DynamoDB (downloadable version)	Amazon DynamoDB (web service)
Provisioned Throughput	The downloadable version of DynamoDB ignores provisioned throughput settings.	Provisioned throughput is a fundamental concept in DynamoDB. The rate at which you can read and write data depends on your provisioned capacity settings. For more information, see Provisioned Throughput in the *Amazon DynamoDB Developer Guide*.
Reading and Writing Data	Reads and writes are performed as fast as possible, without any network overhead.	Read and write activity is regulated by the provisioned throughput settings on the table. To increase the maximum throughput, you must increase the throughput settings on the table. Network latency also affects throughput to an extent.
Deleting a Table	The table is deleted immediately.	Table deletion takes some time, as DynamoDB releases the resources that had been used by the table.

Next Steps

For more information about Amazon DynamoDB, see the Amazon DynamoDB Developer Guide. We recommend the following topics:

Data Model

Provisioned Throughput

Improving Data Access with Secondary Indexes

The *Amazon DynamoDB Developer Guide* also includes the following topics about working with tables, items, and queries:

Working with Tables

Working with Items

Query and Scan Operations in DynamoDB

Best Practices

Python and DynamoDB

In this tutorial, you use the AWS SDK for Python (Boto 3) to write simple programs to perform the following Amazon DynamoDB operations:

- Create a table called `Movies` and load sample data in JSON format.
- Perform create, read, update, and delete operations on the table.
- Run simple queries.

You use the downloadable version of DynamoDB in this tutorial. In the Summary (p. 156), we explain how to run the same code against the DynamoDB web service.

Cost: Free

Prerequisites

Before you begin this tutorial, you need to do the following:

- Download and run DynamoDB on your computer. For more information, see Download and Run DynamoDB (p. 5).
- Sign up for Amazon Web Services and create access keys. You need these credentials to use AWS SDKs. To create an AWS account, go to http://aws.amazon.com/, choose **Create an AWS Account**, and then follow the online instructions.
- Create an AWS credentials file. For more information, see Configuration in the Boto 3 documentation.
- Install Python 2.6 or later. For more information, see https://www.python.org/downloads.

For instructions, see Quickstart in the Boto 3 documentation.

> **Tip**
> As you work through this tutorial, you can refer to the AWS SDK for Python (Boto) documentation at http://boto.readthedocs.org/en/latest/. The following sections are specific to DynamoDB:
>
> - DynamoDB tutorial
> - DynamoDB low-level client

We also recommend you review the DynamoDB concepts. For more information, see Introduction to DynamoDB Concepts (p. 1).

Next Step

Step 1: Create a Table (p. 141)

Step 1: Create a Table

In this step, you create a table named `Movies`. The primary key for the table is composed of the following attributes:

- `year` – The partition key. The `AttributeType` is `N` for number.
- `title` – The sort key. The `AttributeType` is `S` for string.

1. Copy the following program into a file named `MoviesCreateTable.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3

dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
point_url="http://localhost:8000")


table = dynamodb.create_table(
    TableName='Movies',
    KeySchema=[
        {
            'AttributeName': 'year',
            'KeyType': 'HASH'  #Partition key
        },
        {
            'AttributeName': 'title',
            'KeyType': 'RANGE'  #Sort key
        }
    ],
    AttributeDefinitions=[
        {
            'AttributeName': 'year',
            'AttributeType': 'N'
        },
        {
            'AttributeName': 'title',
            'AttributeType': 'S'
        },

    ],
    ProvisionedThroughput={
        'ReadCapacityUnits': 10,
        'WriteCapacityUnits': 10
    }
)

print("Table status:", table.table_status)
```

Note

- You set the endpoint (`endpoint_url="http://localhost:8000"`) to indicate that you are creating the table in DynamoDB on your computer.
- In the `create_table` call, you specify table name, primary key attributes, and its data types.
- The `ProvisionedThroughput` parameter is required; however, the downloadable version of DynamoDB ignores it. (Provisioned throughput is beyond the scope of this exercise.)
- These examples use the Python 3 style `print` function. The line `from __future__ import print_function` enables Python 3 printing in Python 2.6 and later.

2. Type the following command to run the program:

```
python MoviesCreateTable.py
```

To learn more about managing tables, see Working with Tables in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 2: Load Sample Data (p. 142)

Step 2: Load Sample Data

In this step, you populate the `Movies` table with sample data.

Topics

We use a sample data file that contains information about a few thousand movies from the Internet Movie Database (IMDb). The movie data is in JSON format, as shown in the following example. For each movie, there is a `year`, a `title`, and a JSON map named `info`.

```
[
   {
      "year" : ... ,
      "title" : ... ,
      "info" : { ... }
   },
   {
      "year" : ...,
      "title" : ...,
      "info" : { ... }
   },

    ...

]
```

In the JSON data, note the following:

- We use the `year` and `title` as the primary key attribute values for our `Movies` table.
- We store the rest of the `info` values in a single attribute called `info`. This program illustrates how you can store JSON in a DynamoDB attribute.

The following is an example of movie data:

```
{
    "year" : 2013,
    "title" : "Turn It Down, Or Else!",
    "info" : {
        "directors" : [
            "Alice Smith",
            "Bob Jones"
        ],
        "release_date" : "2013-01-18T00:00:00Z",
        "rating" : 6.2,
        "genres" : [
            "Comedy",
            "Drama"
        ],
        "image_url" : "http://ia.media-imdb.com/images/N/O9ER
WAU7FS797AJ7LU8HN09AMUP908RLlo5JF90EWR7LJKQ7@@._V1_SX400_.jpg",
        "plot" : "A rock band plays their music at high volumes, annoying the
neighbors.",
        "rank" : 11,
        "running_time_secs" : 5215,
        "actors" : [
            "David Matthewman",
            "Ann Thomas",
            "Jonathan G. Neff"
       ]
    }
}
```

Step 2.1: Download the Sample Data File

1. Download the sample data archive by clicking this link: moviedata.zip
2. Extract the data file (`moviedata.json`) from the archive.
3. Copy the `moviedata.json` file to your current directory.

Step 2.2: Load the Sample Data Into the Movies Table

After you have downloaded the sample data, you can run the following program to populate the `Movies` table.

1. Copy the following program into a file named `MoviesLoadData.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
import json
```

```
import decimal

dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')

with open("moviedata.json") as json_file:
    movies = json.load(json_file, parse_float = decimal.Decimal)
    for movie in movies:
        year = int(movie['year'])
        title = movie['title']
        info = movie['info']

        print("Adding movie:", year, title)

        table.put_item(
           Item={
               'year': year,
               'title': title,
               'info': info,
            }
        )
```

2. Type the following command to run the program:

```
python MoviesLoadData.py
```

Next Step

Step 3: Create, Read, Update, and Delete an Item (p. 144)

Step 3: Create, Read, Update, and Delete an Item

In this step, you perform read and write operations on an item in the `Movies` table.

To learn more about reading and writing data, see Working with Items in the *Amazon DynamoDB Developer Guide*.

Topics

Step 3.1: Create a New Item

In this step, you add a new item to the `Movies` table.

1. Copy the following program into a file named `MoviesItemOps01.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
import json
import decimal

# Helper class to convert a DynamoDB item to JSON.
class DecimalEncoder(json.JSONEncoder):
    def default(self, o):
        if isinstance(o, decimal.Decimal):
            if o % 1 > 0:
                return float(o)
            else:
                return int(o)
        return super(DecimalEncoder, self).default(o)

dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')

title = "The Big New Movie"
year = 2015

response = table.put_item(
   Item={
        'year': year,
        'title': title,
        'info': {
            'plot':"Nothing happens at all.",
            'rating': decimal.Decimal(0)
        }
    }
)

print("PutItem succeeded:")
print(json.dumps(response, indent=4, cls=DecimalEncoder))
```

Note

- The primary key is required. This code adds an item that has primary key (`year`, `title`) and `info` attributes. The `info` attribute stores sample JSON that provides more information about the movie.
- The `DecimalEncoder` class is used to print out numbers stored using the `Decimal` class. The Boto SDK uses the `Decimal` class to hold DynamoDB number values.

2. Type the following command to run the program:

   ```
   python MoviesItemOps01.py
   ```

Step 3.2: Read an Item

In the previous program, you added the following item to the table:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

You can use the `get_item` method to read the item from the `Movies` table. You must specify the primary key values, so you can read any item from `Movies` if you know its `year` and `title`.

1. Copy the following program into a file named `MoviesItemOps02.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
import json
import decimal
from boto3.dynamodb.conditions import Key, Attr
from botocore.exceptions import ClientError

# Helper class to convert a DynamoDB item to JSON.
class DecimalEncoder(json.JSONEncoder):
    def default(self, o):
        if isinstance(o, decimal.Decimal):
            if o % 1 > 0:
                return float(o)
            else:
                return int(o)
        return super(DecimalEncoder, self).default(o)

dynamodb = boto3.resource("dynamodb", region_name='us-west-2', end
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')

title = "The Big New Movie"
year = 2015

try:
    response = table.get_item(
        Key={
            'year': year,
            'title': title
        }
    )
except ClientError as e:
    print(e.response['Error']['Message'])
else:
    item = response['Item']
    print("GetItem succeeded:")
    print(json.dumps(item, indent=4, cls=DecimalEncoder))
```

2. Type the following command to run the program:

```
python MoviesItemOps02.py
```

Step 3.3: Update an Item

You can use the `update_item` method to modify an existing item. You can update values of existing attributes, add new attributes, or remove attributes.

In this example, you perform the following updates:

- Change the value of the existing attributes (`rating`, `plot`).
- Add a new list attribute (`actors`) to the existing `info` map.

The item changes from:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

To the following:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
           plot: "Everything happens all at once.",
           rating: 5.5,
           actors: ["Larry", "Moe", "Curly"]
   }
}
```

1. Copy the following program into a file named `MoviesItemOps03.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
import json
import decimal

# Helper class to convert a DynamoDB item to JSON.
class DecimalEncoder(json.JSONEncoder):
    def default(self, o):
        if isinstance(o, decimal.Decimal):
            if o % 1 > 0:
                return float(o)
            else:
                return int(o)
        return super(DecimalEncoder, self).default(o)

dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')
```

```
title = "The Big New Movie"
year = 2015

response = table.update_item(
    Key={
        'year': year,
        'title': title
    },
    UpdateExpression="set info.rating = :r, info.plot=:p, info.actors=:a",
    ExpressionAttributeValues={
        ':r': decimal.Decimal(5.5),
        ':p': "Everything happens all at once.",
        ':a': ["Larry", "Moe", "Curly"]
    },
    ReturnValues="UPDATED_NEW"
)

print("UpdateItem succeeded:")
print(json.dumps(response, indent=4, cls=DecimalEncoder))
```

Note
This program uses `UpdateExpression` to describe all updates you want to perform on the specified item.
The `ReturnValues` parameter instructs DynamoDB to return only the updated attributes (`UPDATED_NEW`).

2. Type the following command to run the program:

```
python MoviesItemOps03.py
```

Step 3.4: Increment an Atomic Counter

DynamoDB supports atomic counters, where you use the `update_item` method to increment or decrement the value of an existing attribute without interfering with other write requests. (All write requests are applied in the order in which they were received.)

The following program shows how to increment the `rating` for a movie. Each time you run it, the program increments this attribute by one.

1. Copy the following program into a file named `MoviesItemOps04.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
import json
import decimal

# Helper class to convert a DynamoDB item to JSON.
class DecimalEncoder(json.JSONEncoder):
    def default(self, o):
        if isinstance(o, decimal.Decimal):
            if o % 1 > 0:
                return float(o)
            else:
                return int(o)
        return super(DecimalEncoder, self).default(o)
```

```
dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')

title = "The Big New Movie"
year = 2015

response = table.update_item(
    Key={
        'year': year,
        'title': title
    },
    UpdateExpression="set info.rating = info.rating + :val",
    ExpressionAttributeValues={
        ':val': decimal.Decimal(1)
    },
    ReturnValues="UPDATED_NEW"
)

print("UpdateItem succeeded:")
print(json.dumps(response, indent=4, cls=DecimalEncoder))
```

2. Type the following command to run the program:

   ```
   python MoviesItemOps04.py
   ```

Step 3.5: Update an Item (Conditionally)

The following program shows how to use `UpdateItem` with a condition. If the condition evaluates to true, the update succeeds; otherwise, the update is not performed.

In this case, the item is only updated if there are more than three actors.

1. Copy the following program into a file named `MoviesItemOps05.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
from botocore.exceptions import ClientError
import json
import decimal

# Helper class to convert a DynamoDB item to JSON.
class DecimalEncoder(json.JSONEncoder):
    def default(self, o):
        if isinstance(o, decimal.Decimal):
            if o % 1 > 0:
                return float(o)
            else:
                return int(o)
        return super(DecimalEncoder, self).default(o)

dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
```

```
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')

title = "The Big New Movie"
year = 2015

# Conditional update (will fail)
print("Attempting conditional update...")

try:
    response = table.update_item(
        Key={
            'year': year,
            'title': title
        },
        UpdateExpression="remove info.actors[0]",
        ConditionExpression="size(info.actors) > :num",
        ExpressionAttributeValues={
            ':num': 3
        },
        ReturnValues="UPDATED_NEW"
    )
except ClientError as e:
    if e.response['Error']['Code'] == "ConditionalCheckFailedException":
        print(e.response['Error']['Message'])
    else:
        raise
else:
    print("UpdateItem succeeded:")
    print(json.dumps(response, indent=4, cls=DecimalEncoder))
```

2. Type the following command to run the program:

   ```
   python MoviesItemOps05.py
   ```

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the movie has three actors in it, but the condition is checking for *greater than* three actors.
3. Modify the program so that the `ConditionExpression` looks like this:

   ```
       ConditionExpression="size(info.actors) >= :num",
   ```

   The condition is now *greater than or equal to 3* instead of *greater than 3*.
4. Run the program again. The `UpdateItem` operation should now succeed.

Step 3.6: Delete an Item

You can use the `delete_item` method to delete one item by specifying its primary key. You can optionally provide a `ConditionExpression` to prevent item deletion if the condition is not met.

In the following example, you try to delete a specific movie item if its rating is 5 or less.

1. Copy the following program into a file named `MoviesItemOps06.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
from botocore.exceptions import ClientError
import json
import decimal

# Helper class to convert a DynamoDB item to JSON.
class DecimalEncoder(json.JSONEncoder):
    def default(self, o):
        if isinstance(o, decimal.Decimal):
            if o % 1 > 0:
                return float(o)
            else:
                return int(o)
        return super(DecimalEncoder, self).default(o)

dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')

title = "The Big New Movie"
year = 2015

print("Attempting a conditional delete...")

try:
    response = table.delete_item(
        Key={
            'year': year,
            'title': title
        },
        ConditionExpression="info.rating <= :val",
        ExpressionAttributeValues= {
            ":val": decimal.Decimal(5)
        }
    )
except ClientError as e:
    if e.response['Error']['Code'] == "ConditionalCheckFailedException":
        print(e.response['Error']['Message'])
    else:
        raise
else:
    print("DeleteItem succeeded:")
    print(json.dumps(response, indent=4, cls=DecimalEncoder))
```

2. Type the following command to run the program:

   ```
   python MoviesItemOps06.py
   ```

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

This is because the rating for this particular move is greater than 5.

3. Now, modify the program to remove the condition in `table.delete_item`.

```
response = table.delete_item(
    Key={
        'year': year,
        'title': title
    }
)
```

4. Run the program. Now, the delete succeeds because you removed the condition.

Next Step

Step 4: Query and Scan the Data (p. 152)

Step 4: Query and Scan the Data

You can use the `query` method to retrieve data from a table. You must specify a partition key value; the sort key is optional.

The primary key for the `Movies` table is composed of the following:

- `year` – The partition key. The attribute type is number.
- `title` – The sort key. The attribute type is string.

To find all movies released during a year, you need to specify only the `year`. You can also provide the `title` to retrieve a subset of movies based on some condition (on the sort key). For example, to find movies released in 2014 that have a title starting with the letter "A".

In addition to `query`, there is also a `scan` method that can retrieve all of the table data.

To learn more about querying and scanning data, see Query and Scan in the *Amazon DynamoDB Developer Guide*.

Topics

Query - All Movies Released in a Year

The program included in this step retrieves all movies released in the `year` 1985.

1. Copy the following program into a file named `MoviesQuery01.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
import json
import decimal
```

```
from boto3.dynamodb.conditions import Key, Attr

# Helper class to convert a DynamoDB item to JSON.
class DecimalEncoder(json.JSONEncoder):
    def default(self, o):
        if isinstance(o, decimal.Decimal):
            if o % 1 > 0:
                return float(o)
            else:
                return int(o)
        return super(DecimalEncoder, self).default(o)

dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')

print("Movies from 1985")

response = table.query(
    KeyConditionExpression=Key('year').eq(1985)
)

for i in response['Items']:
    print(i['year'], ":", i['title'])
```

Note
The Boto 3 SDK constructs a ConditionExpression for you when you use the `Key` and `Attr` functions imported from `boto3.dynamodb.conditions`. You can also specify a ConditionExpression as a string.
For a list of available conditions for DynamoDB, see the DynamoDB Conditions in *AWS SDK for Python (Boto 3) Getting Started*.
For more information, see Condition Expressions in the *Amazon DynamoDB Developer Guide*.

2. Type the following command to run the program:

```
python MoviesItemQuery01.py
```

Note
The preceding program shows how to query a table by its primary key attributes. In DynamoDB, you can optionally create one or more secondary indexes on a table, and query those indexes in the same way that you query a table. Secondary indexes give your applications additional flexibility by allowing queries on non-key attributes. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Query - All Movies Released in a Year with Certain Titles

The program included in this step retrieves all movies released in `year` 1992, with `title` beginning with the letter "A" through the letter "L".

1. Copy the following program into a file named `MoviesQuery02.py`:

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
import json
import decimal
from boto3.dynamodb.conditions import Key, Attr

# Helper class to convert a DynamoDB item to JSON.
class DecimalEncoder(json.JSONEncoder):
    def default(self, o):
        if isinstance(o, decimal.Decimal):
            return str(o)
        return super(DecimalEncoder, self).default(o)

dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')

print("Movies from 1992 - titles A-L, with genres and lead actor")

response = table.query(
    ProjectionExpression="#yr, title, info.genres, info.actors[0]",
   ExpressionAttributeNames={ "#yr": "year" }, # Expression Attribute Names
 for Projection Expression only.
   KeyConditionExpression=Key('year').eq(1992) & Key('title').between('A',
 'L')
)

for i in response[u'Items']:
    print(json.dumps(i, cls=DecimalEncoder))
```

2. Type the following command to run the program:

   ```
   python MoviesQuery02.py
   ```

Step 4.2: Scan

The `scan` method reads every item in the entire table, and returns all of the data in the table. You can provide an optional `filter_expression`, so that only the items matching your criteria are returned. However, note that the filter is only applied after the entire table has been scanned.

The following program scans the entire `Movies` table, which contains approximately 5,000 items. The scan specifies the optional filter to retrieve only the movies from the 1950s (approximately 100 items), and discard all of the others.

1. Copy the following program into a file named `MoviesScan.py`.

```
from __future__ import print_function # Python 2/3 compatibility
import boto3
import json
import decimal
from boto3.dynamodb.conditions import Key, Attr

# Helper class to convert a DynamoDB item to JSON.
class DecimalEncoder(json.JSONEncoder):
```

```
    def default(self, o):
        if isinstance(o, decimal.Decimal):
            if o % 1 > 0:
                return float(o)
            else:
                return int(o)
        return super(DecimalEncoder, self).default(o)

dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
point_url="http://localhost:8000")

table = dynamodb.Table('Movies')

fe = Key('year').between(1950, 1959);
pe = "#yr, title, info.rating"
# Expression Attribute Names for Projection Expression only.
ean = { "#yr": "year", }
esk = None


response = table.scan(
    FilterExpression=fe,
    ProjectionExpression=pe,
    ExpressionAttributeNames=ean
    )

for i in response['Items']:
    print(json.dumps(i, cls=DecimalEncoder))

while 'LastEvaluatedKey' in response:
    response = table.scan(
        ProjectionExpression=pe,
        FilterExpression=fe,
        ExpressionAttributeNames= ean,
        ExclusiveStartKey=response['LastEvaluatedKey']
        )

    for i in response['Items']:
        print(json.dumps(i, cls=DecimalEncoder))
```

In the code, note the following:

- `ProjectionExpression` specifies the attributes you want in the scan result.
- `FilterExpression` specifies a condition that returns only items that satisfy the condition. All other items are discarded.
- The `scan` method returns a subset of the the items each time, called a page. The `LastEvaluatedKey` value in the response is then passed to the `scan` method via the `ExclusiveStartKey` parameter. When the last page is returned, `LastEvaluatedKey` is not part of the response.

Note

- `ExpressionAttributeNames` provides name substitution. We use this because `year` is a reserved word in DynamoDB—you cannot use it directly in any expression, including `KeyConditionExpression`. We use the expression attribute name `#yr` to address this.

- `ExpressionAttributeValues` provides value substitution. We use this because you cannot use literals in any expression, including `KeyConditionExpression`. We use the expression attribute value `:yyyy` to address this.

2. Type the following command to run the program:

   ```
   python MoviesScan.py
   ```

   Note
   You can also use the `Scan` operation with any secondary indexes that you have created on the table. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 5: (Optional) Delete the Table (p. 156)

Step 5: (Optional) Delete the Table

In this step, you delete the `Movies` table. This is an optional step. If you want, you can keep the `Movies` table and write your own programs to work with the data.

1. Copy the following program into a file named `MoviesDeleteTable.py`.

   ```
   from __future__ import print_function # Python 2/3 compatibility
   import boto3

   dynamodb = boto3.resource('dynamodb', region_name='us-west-2', end
   point_url="http://localhost:8000")

   table = dynamodb.Table('Movies')

   table.delete()
   ```

2. Type the following command to run the program:

   ```
   python MoviesDeleteTable.py
   ```

Next Step

Summary (p. 156)

Summary

In this tutorial, you created the `Movies` table in DynamoDB on your computer and performed basic operations. The downloadable version of DynamoDB is useful during application development and testing. However, when you are ready to run your application in a production environment, you need to modify your code so that it uses the Amazon DynamoDB web service.

Moving to the Amazon DynamoDB Service

You need to change the endpoint in your application in order to use the Amazon DynamoDB service. To do this, modify the following line:

```
dynamodb = boto3.resource('dynamodb',endpoint_url="https://dynamodb.aws-region.amazonaws.com")
```

For example, if you want to use the `us-west-2` region, you set the following endpoint:

```
dynamodb = boto3.resource('dynamodb',endpoint_url="https://dynamodb.us-west-2.amazonaws.com")
```

Now, instead of using DynamoDB on your computer, the program uses the DynamoDB service endpoint in US West (Oregon).

Amazon DynamoDB is available in several regions worldwide. For the complete list of regions and endpoints, see Regions and Endpoints in the *AWS General Reference*. For more information on setting regions and endpoints in your code, go to AWS Region Selection in the *AWS SDK for Java Developer Guide*.

The downloadable version of DynamoDB is for development and testing purposes only. By comparison, DynamoDB is a managed service with scalability, availability, and durability features that make it ideal for production usage. The following table contains some other key differences between DynamoDB running on your computer and the Amazon DynamoDB service:

	DynamoDB (downloadable version)	**Amazon DynamoDB (web service)**
Creating a Table	The table is created immediately.	Table creation takes some time, depending on its provisioned throughput settings. DynamoDB allocates sufficient resources to meet your specific read and write capacity requirements.
Provisioned Throughput	The downloadable version of DynamoDB ignores provisioned throughput settings.	Provisioned throughput is a fundamental concept in DynamoDB. The rate at which you can read and write data depends on your provisioned capacity settings. For more information, see Provisioned Throughput in the *Amazon DynamoDB Developer Guide*.
Reading and Writing Data	Reads and writes are performed as fast as possible, without any network overhead.	Read and write activity is regulated by the provisioned throughput settings on the table. To increase the maximum throughput, you must increase the throughput settings on the table. Network latency also affects throughput to an extent.

	DynamoDB (downloadable version)	Amazon DynamoDB (web service)
Deleting a Table	The table is deleted immediately.	Table deletion takes some time, as DynamoDB releases the resources that had been used by the table.

Next Steps

For more information about Amazon DynamoDB, see the Amazon DynamoDB Developer Guide. We recommend the following topics:

Data Model

Provisioned Throughput

Improving Data Access with Secondary Indexes

The *Amazon DynamoDB Developer Guide* also includes the following topics about working with tables, items, and queries:

Working with Tables

Working with Items

Query and Scan Operations in DynamoDB

Best Practices

Ruby and DynamoDB

In this tutorial, you use the AWS SDK for Ruby to write simple programs to perform the following Amazon DynamoDB operations:

- Create a table called `Movies` and load sample data in JSON format.
- Perform create, read, update, and delete operations on the table.
- Run simple queries.

You use the downloadable version of DynamoDB in this tutorial. In the Summary (p. 176), we explain how to run the same code against the DynamoDB service.

Cost: Free

Prerequisites

Before you begin this tutorial, you need to do the following:

- Download and run DynamoDB on your computer. For more information, see Download and Run DynamoDB (p. 5).
- Sign up for Amazon Web Services and create access keys. You need these credentials to use AWS SDKs. To create an AWS account, go to http://aws.amazon.com/, choose **Create an AWS Account**, and then follow the online instructions.
- Create an AWS credentials file. For more information, see Configuration in the *AWS SDK for Ruby API Reference*.
- Set up the AWS SDK for Ruby as follows:
  - Go to https://www.ruby-lang.org/en/documentation/installation/ and install Ruby.
  - Go to http://aws.amazon.com/sdk-for-ruby and install the AWS SDK for Ruby.

  For more information, see Installation in the *AWS SDK for Ruby API Reference*.

  Tip
  As you work through this tutorial, you can refer to the AWS SDK for Ruby API Reference. The DynamoDB section describes the parameters and results for DynamoDB operations.

We also recommend that you review DynamoDB concepts. For more information, see Introduction to DynamoDB Concepts (p. 1).

Next Step

Step 1: Create a Table (p. 160)

Step 1: Create a Table

In this step, you create a table named `Movies`. The primary key for the table is composed of the following two attributes:

- `year` – The partition key. The `attribute_type` is `N` for number.
- `title` – The sort key. The `attribute_type` is `S` for string.

1. Copy the following program into a file named `MoviesCreateTable.rb`:

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

params = {
    table_name: "Movies",
    key_schema: [
        {
            attribute_name: "year",
            key_type: "HASH"  #Partition key
        },
        {
            attribute_name: "title",
            key_type: "RANGE" #Sort key
        }
    ],
    attribute_definitions: [
        {
            attribute_name: "year",
            attribute_type: "N"
        },
        {
            attribute_name: "title",
            attribute_type: "S"
        },

    ],
    provisioned_throughput: {
        read_capacity_units: 10,
        write_capacity_units: 10
  }
}
```

```
begin
    result = dynamodb.create_table(params)
    puts "Created table. Status: " +
        result.table_description.table_status;

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to create table:"
    puts "#{error.message}"
end
```

Note

- You set the endpoint (`endpoint: "http://localhost:8000"`) to indicate that you are creating the table in DynamoDB on your computer.
- In the `create_table` call, you specify table name, primary key attributes, and its data types.
- The `provisioned_throughput` parameter is required; however, the downloadable version of DynamoDB ignores it. (Provisioned throughput is beyond the scope of this exercise.)

2. Type the following command to run the program:

   ```
   ruby MoviesCreateTable.rb
   ```

To learn more about managing tables, see Working with Tables in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 2: Load Sample Data (p. 161)

Step 2: Load Sample Data

In this step, you populate the `Movies` table with sample data.

Topics

We use a sample data file that contains information about a few thousand movies from the Internet Movie Database (IMDb). The movie data is in JSON format, as shown in the following example. For each movie, there is a `year`, a `title`, and a JSON map named `info`.

```
[
   {
      "year" : ... ,
      "title" : ... ,
      "info" : { ... }
   },
   {
      "year" : ...,
```

```
      "title" : ...,
      "info" : { ... }
   },

    ...

]
```

In the JSON data, note the following:

- We use the `year` and `title` as the primary key attribute values for our `Movies` table.
- We store the rest of the `info` values in a single attribute called `info`. This program illustrates how you can store JSON in a DynamoDB attribute.

The following is an example of movie data:

```
{
    "year" : 2013,
    "title" : "Turn It Down, Or Else!",
    "info" : {
        "directors" : [
            "Alice Smith",
            "Bob Jones"
        ],
        "release_date" : "2013-01-18T00:00:00Z",
        "rating" : 6.2,
        "genres" : [
            "Comedy",
            "Drama"
        ],
        "image_url" : "http://ia.media-imdb.com/images/N/O9ER
WAU7FS797AJ7LU8HN09AMUP908RLlo5JF90EWR7LJKQ7@@._V1_SX400_.jpg",
        "plot" : "A rock band plays their music at high volumes, annoying the
neighbors.",
        "rank" : 11,
        "running_time_secs" : 5215,
        "actors" : [
            "David Matthewman",
            "Ann Thomas",
            "Jonathan G. Neff"
       ]
    }
}
```

Step 2.1: Download the Sample Data File

1. Download the sample data archive by clicking this link: moviedata.zip
2. Extract the data file (`moviedata.json`) from the archive.
3. Copy the `moviedata.json` file to your current directory.

Step 2.2: Load the Sample Data Into the Movies Table

After you have downloaded the sample data, you can run the following program to populate the `Movies` table.

1. Copy the following program into a file named `MoviesLoadData.rb`:

```
require "aws-sdk-core"
require "json"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

tableName = 'Movies'

file = File.read('moviedata.json')
movies = JSON.parse(file)
movies.each{|movie|

    params = {
        table_name: tableName,
        item: movie
    }

    begin
        result = dynamodb.put_item(params)
        puts "Added movie: #{movie["year"]} #{movie["title"]}"

    rescue  Aws::DynamoDB::Errors::ServiceError => error
        puts "Unable to add movie:"
        puts "#{error.message}"
    end
}
```

2. Type the following command to run the program:

```
ruby MoviesLoadData.rb
```

Next Step

Step 3: Create, Read, Update, and Delete an Item (p. 163)

Step 3: Create, Read, Update, and Delete an Item

In this step, you perform read and write operations on an item in the `Movies` table.

To learn more about reading and writing data, see Working with Items in the *Amazon DynamoDB Developer Guide*.

Topics

Step 3.1: Create a New Item

In this step, you add a new item to the table.

1. Copy the following program into a file named `MoviesItemOps01.rb`:

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

tableName = 'Movies'

year = 2015
title = "The Big New Movie"

item = {
    year: year,
    title: title,
    info: {
            plot: "Nothing happens at all.",
            rating: 0
    }
}

params = {
    table_name: "Movies",
    item: item
}

begin
    result = dynamodb.put_item(params)
    puts "Added item: #{year}  - #{title}"

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to add item:"
    puts "#{error.message}"
end
```

Note
The primary key is required. This code adds an item that has primary key (`year`, `title`) and `info` attributes. The `info` attribute stores a map that provides more information about the movie.

2. Type the following command to run the program:

```
ruby MoviesItemOps01.rb
```

Step 3.2: Read an Item

In the previous program, you added the following item to the table:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

You can use the `get_item` method to read the item from the `Movies` table. You must specify the primary key values, so you can read any item from `Movies` if you know its `year` and `title`.

1. Copy the following program into a file named `MoviesItemOps02.rb`:

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

tableName = 'Movies'

year = 2015
title = "The Big New Movie"

key = {
    year: year,
    title: title
}

params = {
    table_name: "Movies",
    key: {
        year: year,
        title: title
    }
}

begin
    result = dynamodb.get_item(params)
```

```
    printf "%i - %s\n%s\n%d\n",
        result.item["year"],
        result.item["title"],
        result.item["info"]["plot"],
        result.item["info"]["rating"]

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to read item:"
    puts "#{error.message}"
end
```

2. Type the following command to run the program:

```
ruby MoviesItemOps02.rb
```

Step 3.3: Update an Item

You can use the `update_item` method to modify an existing item. You can update values of existing attributes, add new attributes, or remove attributes.

In this example, you perform the following updates:

- Change the value of the existing attributes (`rating`, `plot`).
- Add a new list attribute (`actors`) to the existing `info` map.

The item changes from:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
        plot: "Nothing happens at all.",
        rating: 0
   }
}
```

To the following:

```
{
   year: 2015,
   title: "The Big New Movie",
   info: {
           plot: "Everything happens all at once.",
           rating: 5.5,
           actors: ["Larry", "Moe", "Curly"]
   }
}
```

1. Copy the following program into a file named `MoviesItemOps03.rb`:

```
require "aws-sdk-core"
```

```
Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

tableName = 'Movies'

year = 2015
title = "The Big New Movie"

params = {
    table_name: "Movies",
    key: {
        year: year,
        title: title
    },
   update_expression: "set info.rating = :r, info.plot=:p, info.actors=:a",

    expression_attribute_values: {
        ":r" => 5.5,
        ":p" => "Everything happens all at once.", # value <Hash,Ar
ray,String,Numeric,Boolean,IO,Set,nil>
        ":a" => ["Larry", "Moe", "Curly"]
    },
    return_values: "UPDATED_NEW"
}

begin
    result = dynamodb.update_item(params)
    puts "Added item: #{year}  - #{title}"

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to add item:"
    puts "#{error.message}"
end
```

Note
This program uses `update_expression` to describe all updates you want to perform on the specified item.
The `return_values` parameter instructs DynamoDB to return only the updated attributes (`UPDATED_NEW`).

2. Type the following command to run the program:

   ```
   ruby MoviesItemOps03.rb
   ```

Step 3.4: Increment an Atomic Counter

DynamoDB supports atomic counters, where you use the `update_item` method to increment or decrement the value of an existing attribute without interfering with other write requests. (All write requests are applied in the order in which they were received.)

The following program shows how to increment the `rating` for a movie. Each time you run it, the program increments this attribute by one.

1. Copy the following program into a file named `MoviesItemOps04.rb`:

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

tableName = 'Movies'

year = 2015
title = "The Big New Movie"

params = {
    table_name: "Movies",
    key: {
        year: year,
        title: title
    },
    update_expression: "set info.rating = info.rating + :val",
    expression_attribute_values: {
        ":val" => 1
    },
    return_values: "UPDATED_NEW"
}

begin
    result = dynamodb.update_item(params)
    puts "Updated item. ReturnValues are:"
    result.attributes["info"].each do |key, value|
        if key == "rating"
            puts "#{key}: #{value.to_f}"
        else
            puts "#{key}: #{value}"
        end
    end
rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to update item:"
    puts "#{error.message}"
end
```

2. Type the following command to run the program:

```
ruby MoviesItemOps04.rb
```

Step 3.5: Update an Item (Conditionally)

The following program shows how to use `update_item` with a condition. If the condition evaluates to true, the update succeeds; otherwise, the update is not performed.

In this case, the item is only updated if there are more than three actors.

1. Copy the following program into a file named `MoviesItemOps05.rb`:

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

tableName = 'Movies'

year = 2015
title = "The Big New Movie"

params = {
    table_name: "Movies",
    key: {
        year: year,
        title: title
    },
    update_expression: "remove info.actors[0]",
    condition_expression: "size(info.actors) > :num",
    expression_attribute_values: {
        ":num" => 3
    },
    return_values: "UPDATED_NEW"
}

begin
    result = dynamodb.update_item(params)
    puts "Updated item. ReturnValues are:"
    result.attributes["info"].each do |key, value|
        if key == "rating"
            puts "#{key}: #{value.to_f}"
        else
            puts "#{key}: #{value}"
        end
    end

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to update item:"
    puts "#{error.message}"
end
```

2. Type the following command to run the program:

   ```
   ruby MoviesItemOps05.rb
   ```

   The program should fail with the following message:

   ```
   The conditional request failed
   ```

   This is because the movie has three actors in it, but the condition is checking for *greater than* three actors.
3. Modify the program so that the `ConditionExpression` looks like this:

```
    condition_expression: "size(info.actors) >= :num",
```

The condition is now *greater than or equal to 3* instead of *greater than 3*.

4. Run the program again. The `update_item` method should now succeed.

Step 3.6: Delete an Item

You can use the `delete_item` method to delete one item by specifying its primary key. You can optionally provide a `condition_expression` to prevent item deletion if the condition is not met.

In the following example, you try to delete a specific movie item if its rating is 5 or less.

1. Copy the following program into a file named `MoviesItemOps06.rb`:

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

tableName = 'Movies'

year = 2015
title = "The Big New Movie"

params = {
    table_name: "Movies",
    key: {
        year: year,
        title: title
    },
    condition_expression: "info.rating <= :val",
    expression_attribute_values: {
        ":val" => 5
    }
}

begin
    result = dynamodb.delete_item(params)
    puts "Deleted item."

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to update item:"
    puts "#{error.message}"
end
```

2. Type the following command to run the program:

   ```
   ruby MoviesItemOps06.rb
   ```

   The program should fail with the following message:

```
The conditional request failed
```

This is because the rating for this particular move is greater than 5.

3. Modify the program to remove the condition:

```
params = {
    table_name: "Movies",
    key: {
        year: year,
        title: title
    }
}
```

4. Run the program. Now, the delete succeeds because you removed the condition.

Next Step

Step 4: Query and Scan the Data (p. 171)

Step 4: Query and Scan the Data

You can use the `query` method to retrieve data from a table. You must specify a partition key value; the sort key is optional.

The primary key for the `Movies` table is composed of the following:

- `year` – The partition key. The attribute type is number.
- `title` – The sort key. The attribute type is string.

To find all movies released during a year, you need to specify only the `year`. You can also provide the `title` to retrieve a subset of movies based on some condition (on the sort key). For example, to find movies released in 2014 that have a title starting with the letter "A".

In addition to `query`, there is also a `scan` method that can retrieve all of the table data.

To learn more about querying and scanning data, see Query and Scan in the *Amazon DynamoDB Developer Guide*.

Query - All Movies Released in a Year

The following program retrieves all movies released in the `year` 1985.

1. Copy the following program into a file named `MoviesQuery01.rb`:

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})
```

```
dynamodb = Aws::DynamoDB::Client.new

tableName = "Movies"

params = {
    table_name: tableName,
    key_condition_expression: "#yr = :yyyy",
    expression_attribute_names: {
        "#yr" => "year"
    },
    expression_attribute_values: {
        ":yyyy" => 1985
    }
}

puts "Querying for movies from 1985.";

begin
    result = dynamodb.query(params)
    puts "Query succeeded."

    result.items.each{|movie|
         puts "#{movie["year"].to_i} #{movie["title"]}"
    }

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to delete table:"
    puts "#{error.message}"
end
```

Note

- `expression_attribute_names` provides name substitution. We use this because `year` is a reserved word in DynamoDB—you cannot use it directly in any expression, including `KeyConditionExpression`. We use the expression attribute name `#yr` to address this.
- `expression_attribute_values` provides value substitution. We use this because you cannot use literals in any expression, including `key_condition_expression`. We use the expression attribute value `:yyyy` to address this.

2. Type the following command to run the program:

```
ruby MoviesItemQuery01.rb
```

Note

The preceding program shows how to query a table by its primary key attributes. In DynamoDB, you can optionally create one or more secondary indexes on a table, and query those indexes in the same way that you query a table. Secondary indexes give your applications additional flexibility by allowing queries on non-key attributes. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Query - All Movies Released in a Year with Certain Titles

The following program retrieves all movies released in `year` 1992, with `title` beginning with the letter "A" through the letter "L".

1. Copy the following program into a file named `MoviesQuery02.rb`:

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

tableName = "Movies"

params = {
    table_name: tableName,
    projection_expression: "#yr, title, info.genres, info.actors[0]",
    key_condition_expression:
        "#yr = :yyyy and title between :letter1 and :letter2",
    expression_attribute_names: {
        "#yr" => "year"
    },
    expression_attribute_values: {
        ":yyyy" => 1992,
        ":letter1" => "A",
        ":letter2" => "L"
    }
}

puts "Querying for movies from 1992 - titles A-L, with genres and lead actor";

begin
    result = dynamodb.query(params)
    puts "Query succeeded."

    result.items.each{|movie|
         print "#{movie["year"].to_i}: #{movie["title"]} ... "

         movie['info']['genres'].each{|gen|
            print gen + " "
         }

         print " ... #{movie["info"]["actors"][0]}\n"
    }

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to delete table:"
    puts "#{error.message}"
end
```

2. Type the following command to run the program:

```
ruby MoviesQuery02.rb
```

Step 4.2: Scan

The `scan` method reads every item in the entire table, and returns all of the data in the table. You can provide an optional `filter_expression`, so that only the items matching your criteria are returned. However, note that the filter is only applied after the entire table has been scanned.

The following program scans the entire `Movies` table, which contains approximately 5,000 items. The scan specifies the optional filter to retrieve only the movies from the 1950s (approximately 100 items), and discard all of the others.

1. Copy the following program into a file named `MoviesScan.rb`:

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

tableName = "Movies"

params = {
    table_name: tableName,
    projection_expression: "#yr, title, info.rating",
    filter_expression: "#yr between :start_yr and :end_yr",
    expression_attribute_names: {"#yr"=> "year"},
    expression_attribute_values: {
        ":start_yr" => 1950,
        ":end_yr" => 1959
    }
}

puts "Scanning Movies table."

begin
    loop do
        result = dynamodb.scan(params)

        result.items.each{|movie|
            puts "#{movie["year"].to_i}: " +
                "#{movie["title"]} ... " +
                "#{movie["info"]["rating"].to_f}"
        }

        break if result.last_evaluated_key.nil?

        puts "Scanning for more..."
        params[:exclusive_start_key] = result.last_evaluated_key
    end

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to scan:"
```

```
    puts "#{error.message}"
end
```

In the code, note the following:

- `projection_expression` specifies the attributes you want in the scan result.
- `filter_expression` specifies a condition that returns only items that satisfy the condition. All other items are discarded.

2. Type the following command to run the program:

```
ruby MoviesScan.rb
```

Note
You can also use the `scan` method with any secondary indexes that you have created on the table. For more information about secondary indexes, see Secondary Indexes in the *Amazon DynamoDB Developer Guide*.

Next Step

Step 5: (Optional) Delete the Table (p. 175)

Step 5: (Optional) Delete the Table

In this step, you delete the `Movies` table. This is an optional step. If you want, you can keep the `Movies` table and write your own programs to work with the data.

1. Copy the following program into a file named `MoviesDeleteTable.rb`.

```
require "aws-sdk-core"

Aws.config.update({
  region: "us-west-2",
  endpoint: "http://localhost:8000"
})

dynamodb = Aws::DynamoDB::Client.new

params = {
    table_name: "Movies"
}

begin
    result = dynamodb.delete_table(params)
    puts "Deleted table."

rescue  Aws::DynamoDB::Errors::ServiceError => error
    puts "Unable to delete table:"
    puts "#{error.message}"
end
```

2. Type the following command to run the program:

```
ruby MoviesDeleteTable.rb
```

Next Step

Summary (p. 176)

Summary

In this tutorial, you created the `Movies` table in DynamoDB on your computer and performed basic operations. The downloadable version of DynamoDB is useful during application development and testing. However, when you are ready to run your application in a production environment, you need to modify your code so that it uses the Amazon DynamoDB web service.

Using the Amazon DynamoDB Service

You need to change the endpoint in your application in order to use the Amazon DynamoDB service. To do this, find the following lines in the code:

```
$sdk = new Aws\Sdk([
    'endpoint'   => 'http://localhost:8000',
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);
```

Now remove the `endpoint` parameter so that the code looks like this:

```
$sdk = new Aws\Sdk([
    'region'   => 'us-west-2',
    'version'  => 'latest'
]);
```

After you remove this line, your code can access the DynamoDB service in the region specified by the `region` config value. For example, the following line specifies that you want to use the US West (Oregon) region:

```
    'region'   => 'us-west-2',
```

Now, instead of using DynamoDB on your computer, the program uses the DynamoDB service endpoint in US West (Oregon).

Amazon DynamoDB is available in several regions worldwide. For the complete list of regions and endpoints, see Regions and Endpoints in the *AWS General Reference*. For more information, refer to the AWS SDK for Ruby Getting Started Guide.

The downloadable version of DynamoDB is for development and testing purposes only. By comparison, DynamoDB is a managed service with scalability, availability, and durability features that make it ideal for production usage. The following table contains some other key differences between DynamoDB running on your computer and the Amazon DynamoDB service:

	DynamoDB (downloadable version)	Amazon DynamoDB (web service)
Creating a Table	The table is created immediately.	Table creation takes some time, depending on its provisioned throughput settings. DynamoDB allocates sufficient resources to meet your specific read and write capacity requirements.
Provisioned Throughput	The downloadable version of DynamoDB ignores provisioned throughput settings.	Provisioned throughput is a fundamental concept in DynamoDB. The rate at which you can read and write data depends on your provisioned capacity settings. For more information, see Provisioned Throughput in the *Amazon DynamoDB Developer Guide*.
Reading and Writing Data	Reads and writes are performed as fast as possible, without any network overhead.	Read and write activity is regulated by the provisioned throughput settings on the table. To increase the maximum throughput, you must increase the throughput settings on the table. Network latency also affects throughput to an extent.
Deleting a Table	The table is deleted immediately.	Table deletion takes some time, as DynamoDB releases the resources that had been used by the table.

Next Steps

For more information about Amazon DynamoDB, see the Amazon DynamoDB Developer Guide. We recommend the following topics:

Data Model

Provisioned Throughput

Improving Data Access with Secondary Indexes

The *Amazon DynamoDB Developer Guide* also includes the following topics about working with tables, items, and queries:

Working with Tables

Working with Items

Query and Scan Operations in DynamoDB

Best Practices