

Developer Guide

AWS SDK for Rust



AWS SDK for Rust: Developer Guide

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Table of Contents

What is the AWS SDK for Rust?	1
Are you a first-time SDK user?	1
Features of the SDK	1
Additional resources	1
Get started	2
Prerequisites	2
Set up AWS access	2
Sign up for an AWS account	2
Create a user with administrative access	3
Grant programmatic AWS account access	4
Create your first SDK app	6
Using the SDK	8
Credentials and Region	8
Credentials	8
Region	9
Environment variables	10
Setting environment variables	10
Credentials environment variables	10
Profile environment variables	13
AWS Region environment variables	14
Miscellaneous environment variables	14
Use clients	14
Create a client	14
Configuration versions	15
Create Lambda functions	16
Step 1: Create new project and add dependencies	16
Step 2: src/main.rs	17
Step 3: Package and upload the app	20
Custom endpoints	22
DynamoDB Local	22
LocalStack	23
Paginating	25
Custom retries	28
Environment variable	28

In a profile	29
In code	29
Logging	30
Basic logging	30
Structured Logging: Tracking spans and events	33
Interpret logs	35
Filter log messages	36
Unit testing	36
Automatically generate mocks using mockall	37
Static replay	41
Code examples	45
Actions and scenarios	45
API Gateway	47
API Gateway Management API	48
Application Auto Scaling	50
Aurora	51
Auto Scaling	200
AWS Batch	234
Amazon Cognito Identity Provider	235
Amazon Cognito Sync	237
Firehose	238
DynamoDB	240
Amazon EBS	255
Amazon EC2	258
Amazon ECR	267
Amazon ECS	269
Amazon EKS	272
AWS Glue	274
IAM	289
AWS IoT	316
Kinesis	319
AWS KMS	327
Lambda	335
MediaLive	378
MediaPackage	379
Amazon Polly	382

QLDB	386
Amazon RDS Data Service	388
Route 53	389
Amazon S3	391
SageMaker	430
Secrets Manager	432
Amazon SES API v2	433
Amazon SNS	450
Amazon SQS	455
AWS STS	460
Systems Manager	462
Cross-service examples	464
Convert text to speech and back to text	464
Create a serverless application to manage photos	465
Detect faces in an image	465
Save EXIF and other image information	466
Security	467
Data protection	467
Compliance Validation	468
Infrastructure Security	470
Enforce a minimum TLS version	470
Crates used by the SDK	473
Smithy crates	473
Crates used with the SDK	473
Other crates	474
Document history	475

What is the AWS SDK for Rust?

Rust is a systems programming language without a garbage collector focused on three goals: safety, speed, and concurrency.

The AWS SDK for Rust (the SDK) provides Rust APIs to interact with Amazon Web Services infrastructure services. Using the SDK, you can build applications on top of Amazon S3, Amazon EC2, DynamoDB, and more.

Topics

- [Are you a first-time SDK user?](#)
- [Features of the SDK](#)
- [Additional resources](#)

Are you a first-time SDK user?

If you are a first-time user of the SDK, we recommend that you begin by reading the next section, [Get started with the AWS SDK for Rust](#).

Features of the SDK

For information about using the SDK and its features, see [Using the AWS SDK for Rust](#).

Additional resources

In addition to this guide, the following are valuable online resources for SDK developers:

- [Rust Programming Language web site](#)
- [AWS SDK for Rust Reference](#)
- [AWS Developer Tools Blog](#)
- GitHub
 - [Documentation Source](#)
 - [SDK Source](#)
- [The AWS Code Sample Catalog](#)

Get started with the AWS SDK for Rust

This chapter describes how to get started with the AWS SDK for Rust (the SDK). It includes information about getting an AWS account, installing the SDK, and creating a "Hello world" code example that lists all of your Amazon DynamoDB (DynamoDB) tables in an AWS Region.

Topics

- [Prerequisites](#)
- [Set up AWS access](#)
- [Create your first SDK app](#)

Prerequisites

Before you can use the SDK, you will need an AWS account and a user in IAM Identity Center with permission to use the AWS services and resources that your application will access.

Set up AWS access

Configure your environment to let your project access AWS services. This section covers creating and configuring your AWS account, preparing IAM Identity Center for use, and setting the environment variables used by the AWS SDK for Rust to fetch your access credentials.

Sign up for an AWS account

If you do not have an AWS account, complete the following steps to create one.

To sign up for an AWS account

1. Open <https://portal.aws.amazon.com/billing/signup>.
2. Follow the online instructions.

Part of the sign-up procedure involves receiving a phone call and entering a verification code on the phone keypad.

When you sign up for an AWS account, an *AWS account root user* is created. The root user has access to all AWS services and resources in the account. As a security best practice, assign

administrative access to a user, and use only the root user to perform [tasks that require root user access](#).

AWS sends you a confirmation email after the sign-up process is complete. At any time, you can view your current account activity and manage your account by going to <https://aws.amazon.com/> and choosing **My Account**.

Create a user with administrative access

After you sign up for an AWS account, secure your AWS account root user, enable AWS IAM Identity Center, and create an administrative user so that you don't use the root user for everyday tasks.

Secure your AWS account root user

1. Sign in to the [AWS Management Console](#) as the account owner by choosing **Root user** and entering your AWS account email address. On the next page, enter your password.

For help signing in by using root user, see [Signing in as the root user](#) in the *AWS Sign-In User Guide*.

2. Turn on multi-factor authentication (MFA) for your root user.

For instructions, see [Enable a virtual MFA device for your AWS account root user \(console\)](#) in the *IAM User Guide*.

Create a user with administrative access

1. Enable IAM Identity Center.

For instructions, see [Enabling AWS IAM Identity Center](#) in the *AWS IAM Identity Center User Guide*.

2. In IAM Identity Center, grant administrative access to a user.

For a tutorial about using the IAM Identity Center directory as your identity source, see [Configure user access with the default IAM Identity Center directory](#) in the *AWS IAM Identity Center User Guide*.

Sign in as the user with administrative access

- To sign in with your IAM Identity Center user, use the sign-in URL that was sent to your email address when you created the IAM Identity Center user.

For help signing in using an IAM Identity Center user, see [Signing in to the AWS access portal](#) in the *AWS Sign-In User Guide*.

Assign access to additional users

- In IAM Identity Center, create a permission set that follows the best practice of applying least-privilege permissions.

For instructions, see [Create a permission set](#) in the *AWS IAM Identity Center User Guide*.

- Assign users to a group, and then assign single sign-on access to the group.

For instructions, see [Add groups](#) in the *AWS IAM Identity Center User Guide*.

Grant programmatic AWS account access

Users need programmatic access if they want to interact with AWS outside of the AWS Management Console. The way to grant programmatic access depends on the type of user that's accessing AWS.

To grant users programmatic access, choose one of the following options.

Which user needs programmatic access?	To	By
Workforce identity (Users managed in IAM Identity Center)	Use temporary credentials to sign programmatic requests to the AWS CLI, AWS SDKs, or AWS APIs.	Following the instructions for the interface that you want to use. <ul style="list-style-type: none"> For the AWS CLI, see Configuring the AWS CLI to use AWS IAM Identity Center in the <i>AWS</i>

Which user needs programmatic access?	To	By
		<p><i>Command Line Interface User Guide.</i></p> <ul style="list-style-type: none"> For AWS SDKs, tools, and AWS APIs, see IAM Identity Center authentication in the <i>AWS SDKs and Tools Reference Guide</i>.
IAM	Use temporary credentials to sign programmatic requests to the AWS CLI, AWS SDKs, or AWS APIs.	Following the instructions in Using temporary credentials with AWS resources in the <i>IAM User Guide</i> .
IAM	(Not recommended) Use long-term credentials to sign programmatic requests to the AWS CLI, AWS SDKs, or AWS APIs.	<p>Following the instructions for the interface that you want to use.</p> <ul style="list-style-type: none"> For the AWS CLI, see Authenticating using IAM user credentials in the <i>AWS Command Line Interface User Guide</i>. For AWS SDKs and tools, see Authenticate using long-term credentials in the <i>AWS SDKs and Tools Reference Guide</i>. For AWS APIs, see Managing access keys for IAM users in the <i>IAM User Guide</i>.

For more advanced cases regarding configuring the credentials and Region, see [The .aws/credentials and .aws/config files](#), [AWS Region](#), and [Using environment variables](#) in the [AWS SDKs and Tools Reference Guide](#).

Create your first SDK app

This procedure creates a Rust app that lists your DynamoDB tables.

1. In a terminal or console window, navigate to a location on your computer where you want to create the app.
2. Run the following command to create a `hello_world` directory and populate it with a skeleton Rust project:

```
$ cargo new hello_world --bin
```

3. Navigate into the `hello_world` directory and use the following command to add the required dependencies to the app:

```
$ cargo add aws-config aws-sdk-dynamodb tokio --features tokio/full
```

These dependencies include the SDK crates that provide configuration features and support for DynamoDB, including the [tokio crate](#), which is used to implement asynchronous I/O operations.

Note

Unless you use a feature like `tokio/full` Tokio will not provide an async runtime. The SDK for Rust requires an async runtime.

4. Update `main.rs` in the `src` directory to contain the following code.

```
use aws_config::meta::region::RegionProviderChain;
use aws_config::BehaviorVersion;
use aws_sdk_dynamodb::{Client, Error};

/// Lists your DynamoDB tables in the default Region or us-east-1 if a default
/// Region isn't set.
#[tokio::main]
async fn main() -> Result<(), Error> {
```

```
    let region_provider = RegionProviderChain::default_provider().or_else("us-
east-1");
    let config = aws_config::defaults(BehaviorVersion::latest())
        .region(region_provider)
        .load()
        .await;
    let client = Client::new(&config);

    let resp = client.list_tables().send().await?;

    println!("Tables:");

    let names = resp.table_names();

    for name in names {
        println!(" {}", name);
    }

    println!();
    println!("Found {} tables", names.len());

    Ok(())
}
```

Note

This example only displays the first page of results. See [the section called “Paginating”](#) to learn how to handle multiple pages of results.

5. Run the program:

```
$ cargo run
```

You should see a list of your table names.

Using the AWS SDK for Rust

This section provides information about the AWS SDK for Rust that spans the AWS services.

Topics

- [Specify your credentials and default Region](#)
- [Environment variables for the AWS SDK for Rust](#)
- [Use a service client in the AWS SDK for Rust](#)
- [Create Lambda functions with AWS SDK for Rust](#)
- [Create custom endpoints for the AWS SDK for Rust](#)
- [Paginating in the SDK for Rust](#)
- [Custom retries for the AWS SDK for Rust](#)
- [Enable logging of AWS SDK for Rust code](#)
- [Test AWS SDK for Rust projects](#)

Specify your credentials and default Region

Before you make an API call using the AWS SDK for Rust (the SDK), you must first obtain credentials and put them where the SDK can find them. You also need to specify the correct AWS Region. There are several ways to do this, depending on your use case and needs.

Provide credentials to the SDK

Two values comprise credentials: an access key ID and a secret access key. If you haven't created these two values, see the [Get started with the AWS SDK for Rust](#) topic for information about retrieving your credentials.

Note

Avoid using a stored access key ID and secret access key as long-term credentials. Instead, your application should use a service such as [Amazon Cognito](#) to obtain a temporary access key ID and secret access key. Then, use them to create a static credential provider to use when creating your service objects.

Once you have your credentials, make sure the SDK can retrieve them from one of the following locations. It will search these locations for credentials and will use the first ones it finds.

- In the environment variables `AWS_ACCESS_KEY_ID` and `AWS_SECRET_ACCESS_KEY`
- In [Web Identity Token credentials](#) from the environment or container (including Amazon EKS)
- [Amazon ECS credentials \(IAM roles for tasks\)](#)
- As entries in the `credentials` file in the `.aws` directory in your home directory (`~/.aws/credentials` on Linux, macOS, and Unix; `%userprofile%\.aws\credentials` on Microsoft Windows):

```
[default]
aws_access_key_id=YOUR-ACCESS-KEY
aws_secret_access_key=YOUR-SECRET-KEY
```

- Using a named profile specified in the `credentials` file via the `AWS_PROFILE` environment variable
- From the [EC2 Instance Metadata Service](#) (IAM Roles attached to an instance)

Specify a Region

Because most resources reside in a specific AWS Region, you must supply the correct Region for the resource when using the SDK.

The SDK looks for Regions in a specific order, similar to how it looks for credentials. The SDK looks in the following order for a default Region:

- In the environment variable `AWS_REGION`.
- As an entry in the `credentials` file in the `.aws` directory in your home directory (`~/.aws/credentials` on Linux, macOS, and Unix; `%userprofile%\.aws\credentials` on Microsoft Windows):

```
[default]
region=YOUR-DEFAULT-REGION
```

- As an entry in the `config` file in the `.aws` directory in your home directory (`~/.aws/config` on Linux, macOS, and Unix; `%userprofile%\.aws\config` on Microsoft Windows):

```
[default]
```

```
region=YOUR-DEFAULT-REGION
```

Environment variables for the AWS SDK for Rust

This section describes the environment variables that the AWS SDK for Rust recognizes.

Setting environment variables

To set the environment variable *MyVar* to *MyValue* in Linux, macOS, or Unix:

```
export MyVar=MyValue
```

To set the environment variable *MyVar* to *MyValue* in Windows:

```
set MyVar=MyValue
```

Warning

Be careful that you don't accidentally include a space in an environment variable, especially when creating a default Region. For example, if you accidentally set the following:

```
export AWS_REGION=" us-west-2"
```

Then when you call an SDK function, you get an error message that there was an invalid character:

```
Unhandled(ConstructionFailure(EndpointResolutionError(InvalidUri(InvalidUriChar))))
```

The remainder of this topic describes the environment variables by type.

Environment variables for credentials

The AWS SDK for Rust recognizes the following environment variables related to credentials.

Environment variables for basic credentials

The SDK recognizes the following environment variables related to basic credentials. For more information, see [Specify your credentials and default Region](#)

AWS_ACCESS_KEY_ID

Your access key ID.

When set, this is the highest priority credential.

AWS_SECRET_ACCESS_KEY

Your secret access key.

AWS_SESSION_TOKEN

A session token.

Used when credentials include a session token.

SECRET_ACCESS_KEY

Alternative variable for secret access key.

For compatibility only. Use `AWS_SECRET_ACCESS_KEY` instead.

Environment variables for ECS/HTTP credentials

The SDK recognizes the following environment variables related to ECS/HTTP credentials.

AWS_CONTAINER_AUTHORIZATION_TOKEN

Authorization token for ECS/HTTP provider.

The value is sent in the `AUTHORIZATION` header, so it must be a valid header value.

AWS_CONTAINER_CREDENTIALS_FULL_URI

Set a full URI (including authority) for container credentials. Cannot be set with `AWS_CONTAINER_CREDENTIALS_RELATIVE_URI`. Must use `HTTPS` or resolve to a loopback address.

Set this environment variable to support your own HTTP credentials loader.

AWS_CONTAINER_CREDENTIALS_RELATIVE_URI

Relative URI for the ECS/HTTP credentials provider. Relative to `http://169.254.170.2`.

This is set by Amazon Elastic Container Service, and rarely set by users.

Environment variables for web identity token/EKS credentials

The SDK recognizes the following environment variables related to web identity token/EKS credentials.

AWS_ROLE_ARN

The ARN of the role to assume using the web identity token.

AWS_ROLE_SESSION_NAME

The session name to use during assume role.

Optional. If not provided, the SDK will generate a default value.

AWS_WEB_IDENTITY_TOKEN_FILE

The token file use by the web identity token provider.

This is set by Amazon ECS, and rarely set by users.

IMDS credentials

The SDK recognizes the following environment variables related to EC2 Instance Metadata Service (IMDS) credentials.

AWS_EC2_METADATA_DISABLED

Disables IMDS.

Profile key: none

If set, the IMDS credential and Region provider are not used as part of the default credentials chain.

AWS_EC2_METADATA_SERVICE_ENDPOINT

Overrides the endpoint used for IMDS.

Profile key: `ec2_metadata_service_endpoint`

For example: `http://myimds`

AWS_EC2_METADATA_SERVICE_ENDPOINT_MODE

Sets the mode used for IDMS: **IPv4** or **IPv6**.

Profile key: `ec2_metadata_service_endpoint_mode`

If `AWS_EC2_METADATA_SERVICE_ENDPOINT` is set, this variable is ignored.

Environment variables for your profile

The SDK recognizes the following environment variables related to your profile.

AWS_CONFIG_FILE

Overrides the default location of the `config` file.

Default location: `~/.aws/config` on Linux, macOS, or Unix; `%userprofile%\aws\config` on Windows.

AWS_PROFILE

Overrides the name of the profile to use for all configuration settings.

Default name: **default**.

AWS_SHARED_CREDENTIALS_FILE

Overrides the location of the `credentials` file.

Default location: Default location: `~/.aws/credentials` on Linux, macOS, or Unix; `%userprofile%\aws\credentials` on Windows.

Home directory resolution

If the `config` file contains a tilde ("`~`"), the SDK attempts home directory resolution. Home directory resolution is used when:

- The tilde is the first character in the path.
- It is immediately followed by a slash ("`/`" on Linux, macOS, or Unix) or backslash ("`\`" on Windows).

When determining the home directory, the following environment variables are checked:

- HOME on all platforms.
- USERPROFILE on Windows.
- The concatenation of HOMEDRIVE and HOMEPATH on Windows (\$HOMEDRIVE\$HOMEPATH.)

Environment variables for AWS Region

The SDK recognizes the following environment variables related to the Region.

AWS_REGION

The Region to use when making and signing requests.

For example: us-east-1. See [Specify a Region](#)

Miscellaneous environment variables

The SDK recognizes the following additional environment variables.

AWS_MAX_ATTEMPTS

The maximum number of total attempts to use when dispatching a request.

Setting this value to 0 is invalid. To disable retries, set this value to 1. The default is 3. For more information, see [Custom retries](#).

AWS_RETRY_MODE

The retry mode to use.

The valid options are STANDARD and ADAPTIVE.

Use a service client in the AWS SDK for Rust

Create a client

This section describes how to create a client, including one in a specific Region.

In most cases, you'll want to create a client that uses the default search path, which looks for credentials and Region in the order described in [Specify your credentials and default Region](#). After it finds a value for an access key, secret key, or Region, it stops searching for that value.

You can also supply a Region with an argument to the client object. Most of the [SDK for Rust code examples](#) use the following construct, which searches for the Region in the search path described previously. If a Region isn't found, this sets the Region to `us-east-1`. `SERVICENAME` is the name of the service, such as `s3` for Amazon Simple Storage Service (Amazon S3).

```
use aws_config::meta::region::RegionProviderChain;
use aws_sdk_SERVICENAME::Client;

let region_provider = RegionProviderChain::default_provider().or_else("us-east-1");
let config = aws_config::from_env_with_version(aws_config::BehaviorVersion::latest())
    .region(region_provider)
    .load()
    .await;
let client = Client::new(&config);
```

Specify default configuration behavior

Rust developers expect and rely upon the robust and predictable behavior the language and its major libraries offer. To help developers using the AWS SDK for Rust get the expected behavior from the SDK, SDK and client configurations are required to include a `BehaviorVersion`. The `BehaviorVersion` specifies the version of the SDK whose defaults are expected. This lets the SDK evolve over time, changing best practices to match new standards and support new features without unexpected adverse impact on your application's behavior.

Note

If you try to configure the SDK or create a client without explicitly specifying a `BehaviorVersion`, the constructor will panic.

For example, imagine that a new version of the SDK is released using a new default retry policy. If your application uses a `BehaviorVersion` matching a previous version of the SDK that used a different default configuration, that configuration is used instead of the new default configuration.

Each time a new version of the AWS SDK for Rust is released, the previous version in `BehaviorVersion` is marked with the Rust `deprecated` attribute and the new version is added.

This causes warnings to occur at compile time, but otherwise lets the build continue as usual. `BehaviorVersion::latest()` is also updated to indicate the new version's default behavior.

In most cases, you should use `BehaviorVersion::latest()` in code or the feature flag `behavior-version-latest` in the `Cargo.toml` file.

Set the behavior version in Cargo.toml

You can specify the behavior version for the SDK and individual modules (such as **aws-sdk-s3** or **aws-sdk-iam**) by including an appropriate feature flag in the `Cargo.toml` file. At this time, only the `latest` version of the SDK is supported in `Cargo.toml`:

```
[dependencies]
aws-config = { version = "1", features = ["behavior-version-latest"] }
aws-sdk-s3 = { version = "1", features = ["behavior-version-latest"] }
```

This snippet from `Cargo.toml` indicates that the project depends on the **aws-config** and **aws-sdk-s3** crates, which both need to be version 1, and should use the latest defaults.

Set the behavior version in code

Your code can change the behavior version as needed by specifying it when configuring the SDK or a client:

```
let config =
    aws_config::from_env_with_version(aws_config::BehaviorVersion::v2023_11_09());
```

This example creates a configuration that uses the environment to configure the SDK but sets the `BehaviorVersion` to `v2023_11_09()`.

Create Lambda functions with AWS SDK for Rust

This section demonstrates how to use the SDK in your Lambda function code.

You can use the SDK from within a Lambda function as you would in any other case, with a few added steps. For further information about setting up a Rust-based Lambda function, see the [aws-lambda-rust-runtime README](#).

Step 1: Create new project and add dependencies

1. Create a new project with **cargo**.

```
cargo new s3-example
```

2. Add the following dependencies to `Cargo.toml`, where *YOUR-NAME* is your name, *YOUR-EMAIL* is your email address, *YOUR-LICENSE* is the license that you use.

Keep in mind that the dependency versions might need to be updated since the publication of this tutorial. You can find the latest version of the SDK on crates.io.

```
[package]
name = "s3-example"
version = "0.1.0"
edition = "2021"
authors = ["YOUR-NAME<YOUR-EMAIL>"]
license = "YOUR-LICENSE"
```

See more keys and their definitions at [The Manifest Format](#).

```
[dependencies]
aws-config = "0.49.0"
aws-sdk-s3 = "0.19.0"
lambda_runtime = "0.6.1"
serde = "1.0.136"
serde_json = "1.0.85"
tokio = { version = "1", features = ["macros"] }
tracing = { version = "0.1", features = ["log"] }
tracing-subscriber = { version = "0.3", default-features = false, features = ["fmt"] }
```

Step 2: `src/main.rs`

This creates an app that receives a request containing some text. Then, the text is stored in Amazon S3 with a name based on the Unix timestamp for when it was received. It will then reply, reporting whether it succeeded or failed. When writing a Lambda function with Rust, you typically need to define the following.

1. A struct that represents the data your Lambda function will receive. This struct must implement `serde::Deserialize`.

2. An async handler function that will perform whatever work you want your Lambda function to be responsible for. This function must have specific inputs and outputs, which are covered in detail later on.
3. A main function that sets up logging and runs your handler function, routing new requests to it.
4. (Optional) A struct that represents data that your Lambda function returns. This is typically a `Result` wrapping either a success response or a failure response. The success response can be anything that implements `serde::Serialize`, while the failure response can be anything that implements `std::fmt::Debug + std::fmt::Display`.

Replace `src/main.rs` with the following code.

```
use aws_config::BehaviorVersion;
use lambda_runtime::{service_fn, Error, LambdaEvent};
use serde::{Deserialize, Serialize};
use std::time::SystemTime;

#[derive(Deserialize)]
struct Request {
    body: String,
}

#[derive(Debug, Serialize)]
struct Response {
    req_id: String,
    body: String,
}

impl std::fmt::Display for Response {
    /// Display the response struct as a JSON string
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        let err_as_json = serde_json::json!(self).to_string();
        write!(f, "{err_as_json}")
    }
}

impl std::error::Error for Response {}

#[tracing::instrument(skip(s3_client, event), fields(req_id =
    %event.context.request_id))]
async fn put_object(
    s3_client: &aws_sdk_s3::Client,
```

```

    bucket_name: &str,
    event: LambdaEvent<Request>,
) -> Result<Response, Error> {
    tracing::info!("handling a request");
    // Generate a filename based on when the request was received.
    let timestamp = SystemTime::now()
        .duration_since(SystemTime::UNIX_EPOCH)
        .map(|n| n.as_secs())
        .expect("SystemTime before UNIX EPOCH, clock might have gone backwards");

    let filename = format!("{timestamp}.txt");
    let response = s3_client
        .put_object()
        .bucket(bucket_name)
        .body(event.payload.body.as_bytes().to_owned().into())
        .key(&filename)
        .content_type("text/plain")
        .send()
        .await;

    match response {
        Ok(_) => {
            tracing::info!(
                filename = %filename,
                "data successfully stored in S3",
            );
            // Return `Response` (it will be serialized to JSON automatically by the
runtime)
            Ok(Response {
                req_id: event.context.request_id,
                body: format!(
                    "the Lambda function has successfully stored your data in S3 with
name '{filename}'"
                ),
            })
        }
        Err(err) => {
            // In case of failure, log a detailed error to CloudWatch.
            tracing::error!(
                err = %err,
                filename = %filename,
                "failed to upload data to S3"
            );
            Err(Box::new(Response {

```



```

        req_id: event.context.request_id,
        body: "The Lambda function encountered an error and your data was not
saved"
            .to_owned(),
    )))
}
}
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        // disable printing the name of the module in every log line.
        .with_target(false)
        // disabling time is handy because CloudWatch will add the ingestion time.
        .without_time()
        .init();

    let bucket_name = std::env::var("BUCKET_NAME")
        .expect("A BUCKET_NAME must be set in this app's Lambda environment
variables.");

    // Initialize the client here to be able to reuse it across
    // different invocations.
    //
    // No extra configuration is needed as long as your Lambda has
    // the necessary permissions attached to its role.
    let config = aws_config::load_defaults(BehaviorVersion::latest()).await;
    let s3_client = aws_sdk_s3::Client::new(&config);

    lambda_runtime::run(service_fn(|event: LambdaEvent<Request>| async {
        put_object(&s3_client, &bucket_name, event).await
    })))
    .await
}

```

Step 3: Package and upload the app

This topic shows you how to package your app and upload it.

To be usable as a Lambda function, your Rust app must be compiled for a Linux target, either `x86_64` or `ARM64`. This typically means cross compiling the app. You might encounter build errors if your app needs a certain dependency that isn't available on your system.

This section uses [Cargo Lambda](#) to build your function. Cargo Lambda is a project maintained by the community that works across Windows, macOS, and Linux. See [Cargo Lambda's installation instructions](#) to learn how to install this tool before continuing with the tutorial.

The advantage of using this project is that you can cross-compile to either Linux target with one single tool.

1. Build the app by running **cargo lambda build** in the project's root directory:

```
cargo lambda build --release --output-format zip
```

2. If you want to compile your app to use Amazon Web Services Graviton, add the `--arm64` flag to the previous command:

```
cargo lambda build --release --output-format zip --arm64
```

These previous commands will create a ZIP file with your application's binary in your app's target directory.

3. Upload **lambda.zip** to your Lambda function using any of the following.
 - The [web console](#)
 - The [AWS Command Line Interface](#)
 - The [AWS Cloud Development Kit \(AWS CDK\)](#)

You've created and deployed a new Rust-based Lambda function that's ready to begin accepting requests. You can use [Amazon API Gateway's Test feature](#) to try it out.

This section has covered the process of building and packaging your app at a high level. If you still have unanswered questions, see the detailed documentation in the [aws-lambda-rust-runtime](#) repo under the [Deployment section](#).

Create custom endpoints for the AWS SDK for Rust

This section describes how to create a custom endpoint. In most cases you use the endpoint that is pre-configured for a service. However, in some cases you must create a custom endpoint to use some non-standard services, or to access a service that the SDK does not yet directly support.

Topics

- [DynamoDB local with the AWS SDK for Rust](#)
- [LocalStack with the AWS SDK for Rust](#)

DynamoDB local with the AWS SDK for Rust

This section describes how to use [Amazon DynamoDB Local](#), which is a local version of the DynamoDB service. You can use DynamoDB Local by providing a static endpoint pointing to `http://localhost:8080`.

You must provide an AWS Region and credentials, but they don't have to be valid. One way to do this is by providing a **localstack** profile in your config file (`~/.aws/config` on macOS and Linux; `%userprofile%.aws\config` on Windows), as shown. Then you set **AWS_PROFILE=localstack** when running your application.

```
[profile localstack]
region = us-east-1
aws_access_key_id = AKIDLOCALSTACK
aws_secret_access_key = localstacksecret
```

All that matters is that all three of these values be available to the DynamoDB service when you create the client object.

The following code example demonstrates how to use DynamoDB Local to retrieve a list of your local tables.

```
use aws_config::BehaviorVersion;
use aws_sdk_dynamodb::{Client, Error};

/// Lists your tables in DynamoDB local.
#[tokio::main]
async fn main() -> Result<(), Error> {
    let config = aws_config::defaults(BehaviorVersion::latest())
```

```
        .test_credentials()
        .load()
        .await;
let dynamodb_local_config = aws_sdk_dynamodb::config::Builder::from(&config)
    // Override the endpoint in the config to use a local dynamodb server.
    .endpoint_url(
        // DynamoDB run locally uses port 8000 by default.
        "http://localhost:8000",
    )
    .build();

let client = Client::from_conf(dynamodb_local_config);

let resp = client.list_tables().send().await?;

println!("Found {} tables", resp.table_names().len());
for name in resp.table_names() {
    println!(" {}", name);
}

Ok(())
}
```

LocalStack with the AWS SDK for Rust

This section describes how you can use [LocalStack](#) with the SDK.

LocalStack is a cloud service emulator that runs in a single container on your computer. You can use the Rust SDK with LocalStack by setting a custom endpoint, as shown in the following code example. The example configures clients for Amazon Simple Queue Service (Amazon SQS) and Amazon Simple Storage Service (Amazon S3) to use the LocalStack endpoint if the LOCALSTACK environment variable is true.

Cargo.toml

Specify the SDK crates in Cargo.toml. Note that this specifies to use the developer preview version of the crates. Check [crates.io](#) for the latest version.

```
[package]
name = "localstack-example"
version = "0.1.0"
authors = ["Doug Schwartz <dougsch@amazon.com>"]
```

```
edition = "2021"

[dependencies]
aws-config = { version = "1.0.1", features = ["behavior-version-latest"] }
aws-sdk-s3 = { version = "1.4.0" }
aws-sdk-sqs = { version = "1.3.0" }
tokio = { version = "1.20.1", features = ["full"] }
http = "0.2"
tracing-subscriber = { version = "0.3.15", features = ["env-filter"] }
```

src/main.rs

```
use aws_config::BehaviorVersion;
use std::error::Error;

#[tokio::main]
async fn main() -> Result<(), Box<dyn Error>> {
    tracing_subscriber::fmt::init();

    let mut shared_config = aws_config::defaults(BehaviorVersion::latest());
    if use_localstack() {
        shared_config = shared_config.endpoint_url(LOCALSTACK_ENDPOINT);
    };
    let shared_config = shared_config.load().await;

    let sqs_client = sqs_client(&shared_config);
    let s3_client = s3_client(&shared_config);

    let resp = s3_client.list_buckets().send().await?;
    let buckets = resp.buckets();
    let num_buckets = buckets.len();

    println!("Buckets:");
    for bucket in buckets {
        println!("  {}", bucket.name().unwrap_or_default());
    }

    println!();
    println!("Found {} buckets.", num_buckets);
    println!();

    let repl = sqs_client.list_queues().send().await?;
    let queues = repl.queue_urls();
```

```
let num_queues = queues.len();

println!("Queue URLs:");
for queue in queues {
    println!("  {}", queue);
}

println!();
println!("Found {} queues.", num_queues);
println!();

if use_localstack() {
    println!("Using the local stack.");
}

Ok(())
}

/// If LOCALSTACK environment variable is true, use LocalStack endpoints.
/// You can use your own method for determining whether to use LocalStack endpoints.
fn use_localstack() -> bool {
    std::env::var("LOCALSTACK").unwrap_or_default() == "true"
}

const LOCALSTACK_ENDPOINT: &str = "http://localhost:4566/";

fn sqs_client(conf: &aws_config::SdkConfig) -> aws_sdk_sqs::Client {
    // Copy config from aws_config::SdkConfig to aws_sdk_sqs::Config
    let sqs_config_builder = aws_sdk_sqs::config::Builder::from(conf);
    aws_sdk_sqs::Client::from_conf(sqs_config_builder.build())
}

fn s3_client(conf: &aws_config::SdkConfig) -> aws_sdk_s3::Client {
    // Copy config from aws_config::SdkConfig to aws_sdk_s3::Config
    let s3_config_builder = aws_sdk_s3::config::Builder::from(conf);
    aws_sdk_s3::Client::from_conf(s3_config_builder.build())
}
```

Paginating in the SDK for Rust

This section describes how to handle cases where an API does not return all of the available objects in a single request. Instead, the API will return a portion of the data and a token to retrieve further

items. This pattern is called **pagination**. AWS SDK for Rust exposes a method on many operations called `into_paginator`. When calling this method before executing the request, you can iterate or collect all items asynchronously. When at the end of a page, AWS SDK for Rust will automatically request the next page of data. Here is an example of using `into_paginator` to list all tables in Amazon DynamoDB, even with a limit on the size of the page.

```
pub async fn list_items(client: &Client, table: &str, page_size: Option<i32>) ->
Result<(), Error> {
    let page_size = page_size.unwrap_or(10);
    let items: Result<Vec<_>, _> = client
        .scan()
        .table_name(table)
        .limit(page_size)
        .into_paginator()
        .items()
        .send()
        .collect()
        .await;

    println!("Items in table (up to {page_size}):");
    for item in items? {
        println!("  {:?}", item);
    }

    Ok(())
}
```

Sometimes, you will want to have more control over paging. In these cases, you should review the documentation for the service you're using to see what properties are used for paging tokens. Here is an example that lists tables and checks the `last_evaluated_table_name` field to determine if the paging has completed.

```
pub async fn list_tables_are_more(client: &Client) -> Result<(), Error> {
    let resp = client.list_tables().limit(10).send().await?;

    println!("Tables:");

    let names = resp.table_names();

    for name in names {
        println!("  {}", name);
    }
}
```

```
println!();
println!("Found {} tables", names.len());

if resp.last_evaluated_table_name.is_some() {
    println!("There are more tables");
}

Ok(())
}
```

To loop through pages of results, you might need to use `mut` variables. Here is the same example, checking the `last_evaluated_table_name` field in a loop to get all pages. It prints `-- more` `--` between each page.

```
let mut resp = client.list_tables().limit(10).send().await?;
let mut names = resp.table_names.unwrap_or_default();
let len = names.len();

let mut num_tables = len;

println!("Tables:");

for name in &names {
    println!(" {}", name);
}

while resp.last_evaluated_table_name.is_some() {
    println!("-- more --");
    resp = client
        .list_tables()
        .limit(10)
        .exclusive_start_table_name(
            resp.last_evaluated_table_name
                .as_deref()
                .unwrap_or_default(),
        )
        .send()
        .await?;

    let mut more_names = resp.table_names.unwrap_or_default();
    num_tables += more_names.len();
}
```



```
    for name in &more_names {
        println!("{}", name);
    }
    names.append(&mut more_names);
}

println!();
println!("Found {} tables", num_tables);

Ok(names)
```

Custom retries for the AWS SDK for Rust

This section describes how to modify the SDK to customize the number of times the SDK attempts a request before abandoning the request.

By default the SDK attempts a request three times before abandoning the request. You can specify the number of attempts by using an environment variable, the credentials file, or as an argument when constructing the client. You must set the maximum number of attempts to a value greater than zero, otherwise, the SDK panics. If you set the maximum number of attempts to 1, the SDK does not retry the request.

Configure retries using an environment variable

Maximum retries

To set the maximum number of retries, set the `AWS_MAX_ATTEMPTS` environment variable to a value greater than zero.

On Linux, macOS, or Unix:

```
$ export AWS_MAX_ATTEMPTS=ATTEMPTS
```

On Windows:

```
C:\> set AWS_MAX_ATTEMPTS=ATTEMPTS
```

Retry mode

To set the retry mode, set the `AWS_RETRY_MODE` environment variable to either `STANDARD` or `ADAPTIVE`.

On Linux, macOS, or Unix:

```
$ export AWS_RETRY_MODE=MODE
```

On Windows:

```
C:\> set AWS_RETRY_MODE=MODE
```

Configure retries using a profile

Configure retries in a profile by setting either or both of the `max_attempts` and `retry_mode` values (~/.aws/config file on Linux, macOS, or Unix; %userprofile%\aws\config file on Windows) as follows:

```
[default]
retry_mode=MODE
max_attempts=ATTEMPTS
```

The value of *ATTEMPTS* is an integer greater than zero. *MODE* is either `STANDARD` or `ADAPTIVE`.

Configure retries in code

You can disable retries when creating the configuration for a client, as shown in the following code example:

```
let shared_config = aws_config::defaults(BehaviorVersion::latest())
    .region(region_provider)
    // Disable retries
    .retry_config(RetryConfig::disabled())
    .load()
    .await;
let client = Client::new(&shared_config);
```

To override the retry configuration for a service client, specify the retry configuration when you create the service client. This is shown in the following code example, where `tries` is a value greater than zero.

```
let shared_config = aws_config::defaults(BehaviorVersion::latest())
    .region(region_provider)
    .load()
    .await;

// Construct an S3 client with customized retry configuration.
let client = Client::from_conf(
    // Start with the shared environment configuration.
    config::Builder::from(&shared_config)
        // Set max attempts.
        // If tries is 1, there are no retries.
        .retry_config(RetryConfig::standard().with_max_attempts(tries))
        .build(),
);
```

Enable logging of AWS SDK for Rust code

The SDK for Rust uses the [tracing](#) framework for logging.

Basic logging

Since tracing works with the facade exposed by the [log](#) crate, you can use crates like [env_logger](#) to see log messages emitted by the SDK.

The first step is to add the **env_logger** crate to your project's **Cargo.toml** file:

```
$ cargo add aws-config aws-sdk-dynamodb tokio --features tokio/full
```

Full code listing

Here is the full listing of **Cargo.toml**, where the version numbers are the latest version of [aws-config](#) and [aws-sdk-dynamodb](#) on [crates.io](#).

```
[package]
authors = [
    "Russell Cohen <rcoh@amazon.com>",
    "Doug Schwartz <dougsch@amazon.com>",
```

```

]
edition = "2021"
name = "logging-example"
version = "0.1.0"

# See more keys and their definitions at https://doc.rust-lang.org/cargo/reference/manifest.html

[dependencies]
aws-config = { version = "1.0.1", features = ["behavior-version-latest"] }
aws-sdk-dynamodb = { version = "1.3.0" }
env_logger = "0.9.0"
clap = { version = "~4.4", features = ["derive"] }
tokio = { version = "1.20.1", features = ["full"] }

```

Then, in your Rust code, initialize the logger in the `main()` function before you call any SDK operation:

```
env_logger::init();
```

Full code listing

```

use aws_config::meta::region::RegionProviderChain;
use aws_config::BehaviorVersion;
use aws_sdk_dynamodb::{config::Region, meta::PKG_VERSION, Client, Error};
use clap::Parser;

#[derive(Debug, Parser)]
struct Opt {
    /// The AWS Region.
    #[structopt(short, long)]
    region: Option<String>,

    /// Whether to display additional information.
    #[structopt(short, long)]
    verbose: bool,
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    env_logger::init();

    let Opt { region, verbose } = Opt::parse();

```

```
let region_provider = RegionProviderChain::first_try(region.map(Region::new))
    .or_default_provider()
    .or_else(Region::new("us-west-2"));

println!();

if verbose {
    println!("DynamoDB client version: {}", PKG_VERSION);
    println!(
        "Region:                {}",
        region_provider.region().await.unwrap().as_ref()
    );

    println!();
}

let shared_config = aws_config::defaults(BehaviorVersion::latest())
    .region(region_provider)
    .load()
    .await;
let client = Client::new(&shared_config);

let resp = client.list_tables().send().await?;

println!("Tables:");

let names = resp.table_names();
let len = names.len();

for name in names {
    println!(" {}", name);
}

println!("Found {} tables", len);
Ok(())
}
```

Control logging

When you run this code, you won't see any logging information. To enable the display of logging information, use the following command, which sets the log level for the **aws_config** crate to debug:

```
$ RUST_LOG=aws_config=debug cargo run
```

You can redirect the logs to the file **log.txt** by using the following command line:

```
$ RUST_LOG=aws_config=debug cargo run 2> log.txt
```

You can specify a log level for multiple crates by separating them with commas:

```
$ RUST_LOG=aws_config=debug,aws_smithy_runtime=trace cargo run my-program
```

This example enables debug-level logging of code in the crate **aws_config**, and tracing of the **aws_smithy_runtime** crate. For more information on configuring **env_logger**, see the [env_logger documentation](#).

Structured Logging: Tracking spans and events

Using **env_logger** is fine for basic logging, however, the SDK also tracks spans and events. To see this more detailed information, we recommend using tracing-specific libraries, such as **tracing_subscriber** or **tracing_appender**.

Add the tracing library to your **Cargo.toml** file:

```
tracing-subscriber = { version = "0.3", features = ["env-filter"] }
```

Then, in your Rust code, initialize the logger in the `main` function before you call any SDK operation:

```
tracing_subscriber::fmt::init();
```

Full code listing

```
use aws_config::meta::region::RegionProviderChain;
use aws_config::BehaviorVersion;
use aws_sdk_dynamodb::{config::Region, meta::PKG_VERSION, Client, Error};
use clap::Parser;

#[derive(Debug, Parser)]
struct Opt {
    /// The AWS Region.
    #[structopt(short, long)]
```

```
    region: Option<String>,

    /// Whether to display additional information.
    #[structopt(short, long)]
    verbose: bool,
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt::init();

    let Opt { region, verbose } = Opt::parse();

    let region_provider = RegionProviderChain::first_try(region.map(Region::new))
        .or_default_provider()
        .or_else(Region::new("us-west-2"));

    println!();

    if verbose {
        println!("DynamoDB client version: {}", PKG_VERSION);
        println!(
            "Region:                {}",
            region_provider.region().await.unwrap().as_ref()
        );

        println!();
    }

    let shared_config = aws_config::defaults(BehaviorVersion::latest())
        .region(region_provider)
        .load()
        .await;
    let client = Client::new(&shared_config);

    let resp = client.list_tables().send().await?;

    println!("Tables:");

    let names = resp.table_names();
    let len = names.len();

    for name in names {
        println!(" {}", name);
    }
}
```

```
    }

    println!("Found {} tables", len);
    Ok(())
}
```

Interpret the log output

If you're using the default log output format (called "full" by the tracing module), the information that you see in the log output looks similar to this:

```
2023-11-14T22:11:05.490815Z INFO invoke{service=s3
  operation=ListBuckets}:try_op:try_attempt:lazy_load_identity:
  aws_smithy_runtime::client::identity::cache::lazy: identity cache miss occurred; added
  new identity (took Ok(118.738µs))
2023-11-14T22:11:05.490849Z DEBUG invoke{service=s3
  operation=ListBuckets}:try_op:try_attempt:
  aws_smithy_runtime::client::identity::cache::lazy: loaded identity
2023-11-14T22:11:05.490868Z TRACE invoke{service=s3
  operation=ListBuckets}:try_op:try_attempt:
  aws_smithy_runtime::client::orchestrator::auth: resolved identity identity=Identity
  { data: Credentials { provider_name: "EnvironmentVariable", access_key_id:
  "AKIAIOSFODNN7EXAMPLE", secret_access_key: "*** redacted ***" }, expiration: None }
2023-11-14T22:11:05.490890Z TRACE invoke{service=s3
  operation=ListBuckets}:try_op:try_attempt:
  aws_smithy_runtime::client::orchestrator::auth: signing request
```

Each line of the log includes the following:

- The log entry's timestamp.
- The log level of the entry. This is a word such as INFO, DEBUG, or TRACE.
- The nested set of [spans](#) from which the log entry was generated, separated by colons (":"). This helps you identify the source of the log entry.
- The Rust module path containing the code that generated the log entry.
- The log message text.

Note

The tracing module's standard output formats use ANSI escape codes to colorize the output. Keep these escape sequences in mind when filtering or searching the output.

Filter log messages

If you use a crate that supports an environment filtering, such as `env_logger` or `tracing_subscriber`, you can filter logs by module.

One way to figure out which modules you need to include in your log output is to log everything, then find the crate name in the log output for the information you need.

The following table describes some of the modules that you can use to filter log messages:

Prefix	Description
<code>aws_smithy_runtime=trace</code>	Request and response wire logging
<code>aws_config=debug</code>	Credentials loading
<code>aws_sigv4=trace</code>	Request signing and canonical requests

For a more complete list of library crates that provide useful logging you can configure, see [???](#).

Test AWS SDK for Rust projects

While there are many ways you can implement unit testing in your AWS SDK for Rust project, there are two that are particularly useful:

- Use [automock](#) from the [mockall](#) crate to create and execute your tests.
- Use the AWS Smithy runtime's `StaticReplayClient` to create a fake HTTP client can be used instead of the standard HTTP client normally used by AWS services. This client returns the HTTP responses that you specify rather than communicating with the service over the network, so tests get known data for testing purposes.

There are other approaches you can take, but these are the recommended best practices.

You can [view the complete code for these examples](#) on GitHub.

Automatically generate mocks using mockall

You can (mostly) automatically generate the mock implementations your tests need by using the popular `mockall` crate and its `automock` attribute.

1. Start by including the needed modules, including the `automock` module from the `mockall` crate:

```
use aws_sdk_s3 as s3;
#[allow(unused_imports)]
use mockall::automock;

use s3::operation::list_objects_v2::{ListObjectsV2Error, ListObjectsV2Output};
```

2. Next, add code that automatically determines which implementation of the application's Amazon S3 wrapper structure to use: the one written to access Amazon S3 over the network, or the mock implementation generated by `mockall`. In this example, the one that's selected is given the name `S3`:

```
#[cfg(test)]
pub use MockS3Impl as S3;
#[cfg(not(test))]
pub use S3Impl as S3;
```

3. The implementation of the Amazon S3 wrapper structure that actually sends requests to AWS is called `S3Impl`. The `dead_code` attribute is used to tell the linter not to report a problem if the `S3Impl` type isn't used, which happens when testing is enabled. The conditional `#[cfg_attr(test, automock)]` is used to indicate that when testing is enabled, the `automock` attribute should be set. This tells `mockall` to generate a mock of `S3Impl` that will be named `MockS3Impl`:

```
#[allow(dead_code)]
pub struct S3Impl {
    inner: s3::Client,
}

#[cfg_attr(test, automock)]
impl S3Impl {
    #[allow(dead_code)]
```

```

pub fn new(inner: s3::Client) -> Self {
    Self { inner }
}

#[allow(dead_code)]
pub async fn list_objects(
    &self,
    bucket: &str,
    prefix: &str,
    continuation_token: Option<String>,
) -> Result<ListObjectsV2Output, s3::error::SdkError<ListObjectsV2Error>> {
    self.inner
        .list_objects_v2()
        .bucket(bucket)
        .prefix(prefix)
        .set_continuation_token(continuation_token)
        .send()
        .await
}
}

```

4. The test functions are in a module named `test`, which is conditionally built if testing is enabled by checking the test attribute:

```

#[cfg(test)]
mod test {
    use super::*;
    use mockall::predicate::eq;

    #[tokio::test]
    async fn test_single_page() {
        let mut mock = MockS3Impl::default();
        mock.expect_list_objects()
            .with(eq("test-bucket"), eq("test-prefix"), eq(None))
            .return_once(|_, _, _| {
                Ok(ListObjectsV2Output::builder()
                    .set_contents(Some(vec![
                        // Mock content for ListObjectsV2 response
                        s3::types::Object::builder().size(5).build(),
                        s3::types::Object::builder().size(2).build(),
                    ]))
                    .build())
            });
    }
}

```

```

    // Run the code we want to test with it
    let size = determine_prefix_file_size(mock, "test-bucket", "test-prefix")
        .await
        .unwrap();

    // Verify we got the correct total size back
    assert_eq!(7, size);
}

#[tokio::test]
async fn test_multiple_pages() {
    // Create the Mock instance with two pages of objects now
    let mut mock = MockS3Impl::default();
    mock.expect_list_objects()
        .with(eq("test-bucket"), eq("test-prefix"), eq(None))
        .return_once(|_, _, _| {
            Ok(ListObjectsV2Output::builder()
                .set_contents(Some(vec![
                    // Mock content for ListObjectsV2 response
                    s3::types::Object::builder().size(5).build(),
                    s3::types::Object::builder().size(2).build(),
                ]))
                .set_next_continuation_token(Some("next".to_string()))
                .build())
        });
    mock.expect_list_objects()
        .with(
            eq("test-bucket"),
            eq("test-prefix"),
            eq(Some("next".to_string()))
        )
        .return_once(|_, _, _| {
            Ok(ListObjectsV2Output::builder()
                .set_contents(Some(vec![
                    // Mock content for ListObjectsV2 response
                    s3::types::Object::builder().size(3).build(),
                    s3::types::Object::builder().size(9).build(),
                ]))
                .build())
        });

    // Run the code we want to test with it
    let size = determine_prefix_file_size(mock, "test-bucket", "test-prefix")

```

```

        .await
        .unwrap();

    assert_eq!(19, size);
}
}

```

The test creates an instance of `MockS3Impl` by calling its `default()` method. Then it uses the mock's `expect_list_objects()` method (which is created automatically by `automock`) to set the expected result when calling the `list_objects()` method for given values of its input parameters.

After the expectations are established, `determine_prefix_file_size()` is called to test the function using the expectations that have been set. The returned value is checked to confirm that it's correct, using an assertion.

5. The `determine_prefix_file_size()` function uses the Amazon S3 wrapper to get the size of the prefix file:

```

#[allow(dead_code)]
pub async fn determine_prefix_file_size(
    // Now we take a reference to our trait object instead of the S3 client
    // s3_list: ListObjectsService,
    s3_list: S3,
    bucket: &str,
    prefix: &str,
) -> Result<usize, s3::Error> {
    let mut next_token: Option<String> = None;
    let mut total_size_bytes = 0;
    loop {
        let result = s3_list
            .list_objects(bucket, prefix, next_token.take())
            .await?;

        // Add up the file sizes we got back
        for object in result.contents() {
            total_size_bytes += object.size().unwrap_or(0) as usize;
        }

        // Handle pagination, and break the loop if there are no more pages
        next_token = result.next_continuation_token.clone();
        if next_token.is_none() {

```

```
        break;
    }
}
Ok(total_size_bytes)
}
```

The type `S3` is used to call the wrapped SDK for Rust functions to support both `S3Impl` and `MockS3Impl` when making HTTP requests. The mock automatically generated by `mockall` reports any test failures when testing is enabled.

Simulate HTTP traffic using static replay

The `aws-smithy-runtime` crate includes a test utility class called `StaticReplayClient`. This HTTP client class can be specified instead of the default HTTP client when creating an AWS service object.

When initializing the `StaticReplayClient`, you provide a list of HTTP request and response pairs as `ReplayEvent` objects. While the test is running, each HTTP request is recorded and the client returns the next HTTP response found in the next `ReplayEvent` in the event list as the HTTP client's response. This lets the test run using known data and without a network connection.

Using static replay

To use static replay, you don't need to use a wrapper. Instead, determine what the actual network traffic should look like for the data your test will use, and provide that traffic data to the `StaticReplayClient` to use each time the SDK issues a request from the AWS service.

Note

There are several ways to collect the expected network traffic, including the AWS CLI and many network traffic analyzers and packet sniffer tools.

- Create a list of `ReplayEvent` objects that specify the expected HTTP requests and the responses that should be returned for them.
- Create a `StaticReplayClient` with the HTTP transaction list created in the previous step.
- Create a configuration object for the AWS client, specifying the `StaticReplayClient` as the `Config` object's `http_client`.

- Create the AWS service client object, specifying the configuration created in the previous step.
- Perform the operations that you want to test, using the service object that's configured to use the `StaticReplayClient`. Each time the SDK sends an API request to AWS, the next response in the list is used.

Note

The next response in the list is always returned, even if the sent request doesn't match the one in the vector of `ReplayEvent` objects.

- When all the desired requests have been made, call the `StaticReplayClient.assert_requests_match()` function to verify that the requests sent by the SDK match the ones in the list of `ReplayEvent` objects.

Example

Let's look at the tests for the same `determine_prefix_file_size()` function in the previous example, but using static replay instead of mocking.

1. The test begins by creating the `ReplayEvent` structures representing each of the HTTP transactions that should take place during the test. Each event contains an HTTP request object and an HTTP response object representing the information that the AWS service would normally reply with. These events are passed into a call to `StaticReplayClient::new()`:

```
let page_1 = ReplayEvent::new(
    http::Request::builder()
        .method("GET")
        .uri("https://test-bucket.s3.us-east-1.amazonaws.com/?list-
type=2&prefix=test-prefix")
        .body(SdkBody::empty())
        .unwrap(),
    http::Response::builder()
        .status(200)
        .body(SdkBody::from(include_str!("./testing/
response_multi_1.xml")))
        .unwrap(),
);
let page_2 = ReplayEvent::new(
    http::Request::builder()
        .method("GET")
```

```

        .uri("https://test-bucket.s3.us-east-1.amazonaws.com/?list-
type=2&prefix=test-prefix&continuation-token=next")
        .body(SdkBody::empty())
        .unwrap(),
        http::Response::builder()
        .status(200)
        .body(SdkBody::from(include_str!("./testing/
response_multi_2.xml")))
        .unwrap(),
    );
    let replay_client = StaticReplayClient::new(vec![page_1, page_2]);

```

The result is stored in `replay_client`. This represents an HTTP client that can then be used by the SDK for Rust by specifying it in the client's configuration.

2. To create the Amazon S3 client, call the client class's `from_conf()` function to create the client using a configuration object:

```

let client: s3::Client = s3::Client::from_conf(
    s3::Config::builder()
        .behavior_version(BehaviorVersion::latest())
        .credentials_provider(make_s3_test_credentials())
        .region(s3::config::Region::new("us-east-1"))
        .http_client(replay_client.clone())
        .build(),
);

```

The configuration object is specified using the builder's `http_client()` method, and the credentials are specified using the `credentials_provider()` method. The credentials are created using a function called `make_s3_test_credentials()`, which returns a fake credentials structure:

```

fn make_s3_test_credentials() -> s3::config::Credentials {
    s3::config::Credentials::new(
        "ATESTCLIENT",
        "astestsecretkey",
        Some("atestsessiontoken".to_string()),
        None,
        "",
    )
}

```


These credentials don't need to be valid because they won't actually be sent to AWS.

3. Run the test by calling the function that needs testing. In this example, that function's name is `determine_prefix_file_size()`. Its first parameter is the Amazon S3 client object to use for its requests. Therefore, specify the client created using the `StaticReplayClient` so requests are handled by that rather than going out over the network:

```
let size = determine_prefix_file_size(client, "test-bucket", "test-prefix")
    .await
    .unwrap();

assert_eq!(19, size);

replay_client.assert_requests_match(&[]);
```

When the call to `determine_prefix_file_size()` is finished, an assert is used to confirm that the returned value matches the expected value. Then, the `StaticReplayClient` method `assert_requests_match()` function is called. This function scans the recorded HTTP requests and confirms that they all match the ones specified in the array of `ReplayEvent` objects provided when creating the replay client.

SDK for Rust code examples

The code examples in this topic show you how to use the AWS SDK for Rust with AWS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Cross-service examples are sample applications that work across multiple AWS services.

Examples

- [Actions and scenarios using SDK for Rust](#)
- [Cross-service examples using SDK for Rust](#)

Actions and scenarios using SDK for Rust

The following code examples show how to perform actions and implement common scenarios by using the AWS SDK for Rust with AWS services.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Services

- [API Gateway examples using SDK for Rust](#)
- [API Gateway Management API examples using SDK for Rust](#)
- [Application Auto Scaling examples using SDK for Rust](#)
- [Aurora examples using SDK for Rust](#)
- [Auto Scaling examples using SDK for Rust](#)

- [AWS Batch examples using SDK for Rust](#)
- [Amazon Cognito Identity Provider examples using SDK for Rust](#)
- [Amazon Cognito Sync examples using SDK for Rust](#)
- [Firehose examples using SDK for Rust](#)
- [DynamoDB examples using SDK for Rust](#)
- [Amazon EBS examples using SDK for Rust](#)
- [Amazon EC2 examples using SDK for Rust](#)
- [Amazon ECR examples using SDK for Rust](#)
- [Amazon ECS examples using SDK for Rust](#)
- [Amazon EKS examples using SDK for Rust](#)
- [AWS Glue examples using SDK for Rust](#)
- [IAM examples using SDK for Rust](#)
- [AWS IoT examples using SDK for Rust](#)
- [Kinesis examples using SDK for Rust](#)
- [AWS KMS examples using SDK for Rust](#)
- [Lambda examples using SDK for Rust](#)
- [MediaLive examples using SDK for Rust](#)
- [MediaPackage examples using SDK for Rust](#)
- [Amazon Polly examples using SDK for Rust](#)
- [QLDB examples using SDK for Rust](#)
- [Amazon RDS Data Service examples using SDK for Rust](#)
- [Route 53 examples using SDK for Rust](#)
- [Amazon S3 examples using SDK for Rust](#)
- [SageMaker examples using SDK for Rust](#)
- [Secrets Manager examples using SDK for Rust](#)
- [Amazon SES API v2 examples using SDK for Rust](#)
- [Amazon SNS examples using SDK for Rust](#)
- [Amazon SQS examples using SDK for Rust](#)
- [AWS STS examples using SDK for Rust](#)

- [Systems Manager examples using SDK for Rust](#)

API Gateway examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with API Gateway.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

GetRestApis

The following code example shows how to use GetRestApis.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Displays the Amazon API Gateway REST APIs in the Region.

```
async fn show_apis(client: &Client) -> Result<(), Error> {
    let resp = client.get_rest_apis().send().await?;

    for api in resp.items() {
```

```
println!("ID:          {}", api.id().unwrap_or_default());
println!("Name:         {}", api.name().unwrap_or_default());
println!("Description: {}", api.description().unwrap_or_default());
println!("Version:       {}", api.version().unwrap_or_default());
println!(
    "Created:        {}",
    api.created_date().unwrap().to_chrono_utc()?
);
println!();
}

Ok(())
}
```

- For API details, see [GetRestApis](#) in *AWS SDK for Rust API reference*.

API Gateway Management API examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with API Gateway Management API.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

PostToConnection

The following code example shows how to use `PostToConnection`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn send_data(
    client: &aws_sdk_apigatewaymanagement::Client,
    con_id: &str,
    data: &str,
) -> Result<(), aws_sdk_apigatewaymanagement::Error> {
    client
        .post_to_connection()
        .connection_id(con_id)
        .data(Blob::new(data))
        .send()
        .await?;

    Ok(())
}

let endpoint_url = format!(
    "https://{api_id}.execute-api.{region}.amazonaws.com/{stage}",
    api_id = api_id,
    region = region,
    stage = stage
);

let shared_config = aws_config::from_env().region(region_provider).load().await;
let api_management_config = config::Builder::from(&shared_config)
    .endpoint_url(endpoint_url)
    .build();
let client = Client::from_conf(api_management_config);
```

- For API details, see [PostToConnection](#) in *AWS SDK for Rust API reference*.

Application Auto Scaling examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Application Auto Scaling.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

DescribeScalingPolicies

The following code example shows how to use `DescribeScalingPolicies`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_policies(client: &Client) -> Result<(), Error> {
    let response = client
        .describe_scaling_policies()
        .service_namespace(ServiceNamespace::Ec2)
        .send()
        .await?;
    println!("Auto Scaling Policies:");
    for policy in response.scaling_policies() {
        println!("{:?}\n", policy);
    }
}
```

```
    }  
    println!("Next token: {:?}", response.next_token());  
  
    Ok(())  
}
```

- For API details, see [DescribeScalingPolicies](#) in *AWS SDK for Rust API reference*.

Aurora examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Aurora.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Get started

Hello Aurora

The following code examples show how to get started using Aurora.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.  
// SPDX-License-Identifier: Apache-2.0  
use aws_sdk_rds::Client;
```



```

#[derive(Debug)]
struct Error(String);
impl std::fmt::Display for Error {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        write!(f, "{}", self.0)
    }
}
impl std::error::Error for Error {}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt::init();
    let sdk_config = aws_config::from_env().load().await;
    let client = Client::new(&sdk_config);

    let describe_db_clusters_output = client
        .describe_db_clusters()
        .send()
        .await
        .map_err(|e| Error(e.to_string()))?;
    println!(
        "Found {} clusters:",
        describe_db_clusters_output.db_clusters().len()
    );
    for cluster in describe_db_clusters_output.db_clusters() {
        let name = cluster.database_name().unwrap_or("Unknown");
        let engine = cluster.engine().unwrap_or("Unknown");
        let id = cluster.db_cluster_identifier().unwrap_or("Unknown");
        let class = cluster.db_cluster_instance_class().unwrap_or("Unknown");
        println!("\tDatabase: {name},");
        println!("\t Engine: {engine},");
        println!("\t      ID: {id},");
        println!("\tInstance: {class},");
    }

    Ok(())
}

```

- For API details, see [DescribeDBClusters](#) in *AWS SDK for Rust API reference*.

Topics

- [Actions](#)
- [Scenarios](#)

Actions

CreateDBCluster

The following code example shows how to use CreateDBCluster.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
// Get a list of allowed engine versions.
rds.DescribeDbEngineVersions(Engine='aurora-mysql', DBParameterGroupFamily=<the
family used to create your parameter group in step 2>)
// Create an Aurora DB cluster database cluster that contains a MySQL database
and uses the parameter group you created.
// Wait for DB cluster to be ready. Call rds.DescribeDBClusters and check for
Status == 'available'.
// Get a list of instance classes available for the selected engine and engine
version. rds.DescribeOrderableDbInstanceOptions(Engine='mysql', EngineVersion=).

// Create a database instance in the cluster.
// Wait for DB instance to be ready. Call rds.DescribeDbInstances and check for
DBInstanceStatus == 'available'.
pub async fn start_cluster_and_instance(&mut self) -> Result<(), ScenarioError>
{
    if self.password.is_none() {
        return Err(ScenarioError::with(
            "Must set Secret Password before starting a cluster",
        ));
    }
    let create_db_cluster = self
        .rds
        .create_db_cluster(
            DB_CLUSTER_IDENTIFIER,
```

```

        DB_CLUSTER_PARAMETER_GROUP_NAME,
        DB_ENGINE,
        self.engine_version.as_deref().expect("engine version"),
        self.username.as_deref().expect("username"),
        self.password
            .replace(SecretString::new("").to_string())
            .expect("password"),
    )
    .await;
if let Err(err) = create_db_cluster {
    return Err(ScenarioError::new(
        "Failed to create DB Cluster with cluster group",
        &err,
    ));
}

self.db_cluster_identifier = create_db_cluster
    .unwrap()
    .db_cluster
    .and_then(|c| c.db_cluster_identifier);

if self.db_cluster_identifier.is_none() {
    return Err(ScenarioError::with("Created DB Cluster missing
Identifier"));
}

info!(
    "Started a db cluster: {}",
    self.db_cluster_identifier
        .as_deref()
        .unwrap_or("Missing ARN")
);

let create_db_instance = self
    .rds
    .create_db_instance(
        self.db_cluster_identifier.as_deref().expect("cluster name"),
        DB_INSTANCE_IDENTIFIER,
        self.instance_class.as_deref().expect("instance class"),
        DB_ENGINE,
    )
    .await;
if let Err(err) = create_db_instance {
    return Err(ScenarioError::new(

```

```
        "Failed to create Instance in DB Cluster",
        &err,
    ));
}

self.db_instance_identifier = create_db_instance
    .unwrap()
    .db_instance
    .and_then(|i| i.db_instance_identifier);

// Cluster creation can take up to 20 minutes to become available
let cluster_max_wait = Duration::from_secs(20 * 60);
let waiter = Waiter::builder().max(cluster_max_wait).build();
while waiter.sleep().await.is_ok() {
    let cluster = self
        .rds
        .describe_db_clusters(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = cluster {
        warn!(?err, "Failed to describe cluster while waiting for ready");
        continue;
    }

    let instance = self
        .rds
        .describe_db_instance(
            self.db_instance_identifier
                .as_deref()
                .expect("instance identifier"),
        )
        .await;
    if let Err(err) = instance {
        return Err(ScenarioError::new(
            "Failed to find instance for cluster",
            &err,
        ));
    }

    let instances_available = instance
```

```

        .unwrap()
        .db_instances()
        .iter()
        .all(|instance| instance.db_instance_status() == Some("Available"));

    let endpoints = self
        .rds
        .describe_db_cluster_endpoints(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = endpoints {
        return Err(ScenarioError::new(
            "Failed to find endpoint for cluster",
            &err,
        ));
    }

    let endpoints_available = endpoints
        .unwrap()
        .db_cluster_endpoints()
        .iter()
        .all(|endpoint| endpoint.status() == Some("available"));

    if instances_available && endpoints_available {
        return Ok(());
    }
}

Err(ScenarioError::with("timed out waiting for cluster"))
}

pub async fn create_db_cluster(
    &self,
    name: &str,
    parameter_group: &str,
    engine: &str,
    version: &str,
    username: &str,
    password: SecretString,
) -> Result<CreateDbClusterOutput, SdkError<CreateDBClusterError>> {

```

```
        self.inner
            .create_db_cluster()
            .db_cluster_identifier(name)
            .db_cluster_parameter_group_name(parameter_group)
            .engine(engine)
            .engine_version(version)
            .master_username(username)
            .master_user_password(password.expose_secret())
            .send()
            .await
    }

#[tokio::test]
async fn test_start_cluster_and_instance() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
            true
        })
        .return_once(|id, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
                .build())
        });

    mock_rds
        .expect_create_db_instance()
        .withf(|cluster, name, class, engine| {
            assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");
            assert_eq!(name, "RustSDKCodeExamplesDBInstance");
            assert_eq!(class, "m5.large");
            assert_eq!(engine, "aurora-mysql");
            true
        })
        .return_once(|cluster, name, class, _| {
            Ok(CreateDbInstanceOutput::builder())
        });
}
```

```

        .db_instance(
            DbInstance::builder()
                .db_cluster_identifier(cluster)
                .db_instance_identifier(name)
                .db_instance_class(class)
                .build(),
        )
        .build()
    });

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|id| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_describe_db_instance()
    .with(eq("RustSDKCodeExamplesDBInstance"))
    .return_once(|name| {
        Ok(DescribeDbInstancesOutput::builder()
            .db_instances(
                DbInstance::builder()
                    .db_instance_identifier(name)
                    .db_instance_status("Available")
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_cluster_endpoints()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|_| {
        Ok(DescribeDbClusterEndpointsOutput::builder()

.db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
            .build())
    });

let mut scenario = AuroraScenario::new(mock_rds);

```

```

scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let create = scenario.start_cluster_and_instance().await;
    assert!(create.is_ok());
    assert!(scenario
        .password
        .replace(SecretString::new("BAD SECRET".into()))
        .unwrap()
        .expose_secret()
        .is_empty());
    assert_eq!(
        scenario.db_cluster_identifier,
        Some("RustSDKCodeExamplesDBCluster".into())
    );
});
tokio::time::advance(Duration::from_secs(1)).await;
tokio::time::resume();
let _ = assertions.await;
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Err(SdkError::service_error(
                CreateDBClusterError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "create db cluster error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_version = Some("aurora-mysql8.0".into());
    scenario.instance_class = Some("m5.large".into());

```



```

    scenario.username = Some("test username".into());
    scenario.password = Some(SecretString::new("test password".into()));

    let create = scenario.start_cluster_and_instance().await;
    assert_matches!(create, Err(ScenarioError { message, context: _}) if message ==
"Failed to create DB Cluster with cluster group")
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_missing_id() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().build())
                .build())
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_version = Some("aurora-mysql8.0".into());
    scenario.instance_class = Some("m5.large".into());
    scenario.username = Some("test username".into());
    scenario.password = Some(SecretString::new("test password".into()));

    let create = scenario.start_cluster_and_instance().await;
    assert_matches!(create, Err(ScenarioError { message, context:_ }) if message ==
"Created DB Cluster missing Identifier");
}

#[tokio::test]
async fn test_start_cluster_and_instance_instance_create_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
        });
}

```

```

        true
    })
    .return_once(|id, _, _, _, _, _| {
        Ok(CreateDbClusterOutput::builder()
            .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_create_db_instance()
    .return_once(|_, _, _, _| {
        Err(SdkError::service_error(
            CreateDBInstanceError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "create db instance error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

let create = scenario.start_cluster_and_instance().await;
assert_matches!(create, Err(ScenarioError { message, context: _ }) if message ==
"Failed to create Instance in DB Cluster")
}

#[tokio::test]
async fn test_start_cluster_and_instance_wait_hiccup() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
        });
}

```

```

        true
    })
    .return_once(|id, _, _, _, _, _| {
        Ok(CreateDbClusterOutput::builder()
            .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_create_db_instance()
    .withf(|cluster, name, class, engine| {
        assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");
        assert_eq!(name, "RustSDKCodeExamplesDBInstance");
        assert_eq!(class, "m5.large");
        assert_eq!(engine, "aurora-mysql");
        true
    })
    .return_once(|cluster, name, class, _| {
        Ok(CreateDbInstanceOutput::builder()
            .db_instance(
                DbInstance::builder()
                    .db_cluster_identifier(cluster)
                    .db_instance_identifier(name)
                    .db_instance_class(class)
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .times(1)
    .returning(|_| {
        Err(SdkError::service_error(
            DescribeDBClustersError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "describe cluster error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    })
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .times(1)

```

```

        .returning(|id| {
            Ok(DescribeDbClustersOutput::builder()
                .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
                .build())
        });

mock_rds.expect_describe_db_instance().return_once(|name| {
    Ok(DescribeDbInstancesOutput::builder()
        .db_instances(
            DbInstance::builder()
                .db_instance_identifier(name)
                .db_instance_status("Available")
                .build(),
        )
        .build())
});

mock_rds
    .expect_describe_db_cluster_endpoints()
    .return_once(|_| {
        Ok(DescribeDbClusterEndpointsOutput::builder()

.db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
                .build())
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let create = scenario.start_cluster_and_instance().await;
    assert!(create.is_ok());
});

tokio::time::advance(Duration::from_secs(1)).await;
tokio::time::advance(Duration::from_secs(1)).await;
tokio::time::resume();
let _ = assertions.await;
}

```

- For API details, see [CreateDBCluster](#) in *AWS SDK for Rust API reference*.

CreateDBClusterParameterGroup

The following code example shows how to use `CreateDBClusterParameterGroup`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
// Select an engine family and create a custom DB cluster parameter group.
rds.CreateDbClusterParameterGroup(DBParameterGroupFamily='aurora-mysql8.0')
pub async fn set_engine(&mut self, engine: &str, version: &str) -> Result<(),
ScenarioError> {
    self.engine_family = Some(engine.to_string());
    self.engine_version = Some(version.to_string());
    let create_db_cluster_parameter_group = self
        .rds
        .create_db_cluster_parameter_group(
            DB_CLUSTER_PARAMETER_GROUP_NAME,
            DB_CLUSTER_PARAMETER_GROUP_DESCRIPTION,
            engine,
        )
        .await;

    match create_db_cluster_parameter_group {
        Ok(CreateDbClusterParameterGroupOutput {
            db_cluster_parameter_group: None,
            ..
        }) => {
            return Err(ScenarioError::with(
                "CreateDBClusterParameterGroup had empty response",
            ));
        }
        Err(error) => {
            if error.code() == Some("DBParameterGroupAlreadyExists") {
```

```

        info!("Cluster Parameter Group already exists, nothing to do");
    } else {
        return Err(ScenarioError::new(
            "Could not create Cluster Parameter Group",
            &error,
        ));
    }
}
_ => {
    info!("Created Cluster Parameter Group");
}
}

Ok(())
}

pub async fn create_db_cluster_parameter_group(
    &self,
    name: &str,
    description: &str,
    family: &str,
) -> Result<CreateDbClusterParameterGroupOutput,
SdkError<CreateDBClusterParameterGroupError>>
{
    self.inner
        .create_db_cluster_parameter_group()
        .db_cluster_parameter_group_name(name)
        .description(description)
        .db_parameter_group_family(family)
        .send()
        .await
}

#[tokio::test]
async fn test_scenario_set_engine() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster_parameter_group()
        .with(
            eq("RustSDKCodeExamplesDBParameterGroup"),
            eq("Parameter Group created by Rust SDK Code Example"),
            eq("aurora-mysql"),
        )
}

```

```

        .return_once(|_, _, _| {
            Ok(CreateDbClusterParameterGroupOutput::builder()

.db_cluster_parameter_group(DbClusterParameterGroup::builder().build())
                .build())
        });

let mut scenario = AuroraScenario::new(mock_rds);

let set_engine = scenario.set_engine("aurora-mysql", "aurora-mysql8.0").await;

assert_eq!(set_engine, Ok(()));
assert_eq!(Some("aurora-mysql"), scenario.engine_family.as_deref());
assert_eq!(Some("aurora-mysql8.0"), scenario.engine_version.as_deref());
}

#[tokio::test]
async fn test_scenario_set_engine_not_create() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster_parameter_group()
        .with(
            eq("RustSDKCodeExamplesDBParameterGroup"),
            eq("Parameter Group created by Rust SDK Code Example"),
            eq("aurora-mysql"),
        )
        .return_once(|_, _, _|
Ok(CreateDbClusterParameterGroupOutput::builder().build()));

    let mut scenario = AuroraScenario::new(mock_rds);

    let set_engine = scenario.set_engine("aurora-mysql", "aurora-mysql8.0").await;

    assert!(set_engine.is_err());
}

#[tokio::test]
async fn test_scenario_set_engine_param_group_exists() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster_parameter_group()
        .withf(|_, _, _| true)

```

```

        .return_once(|_, _, _| {
            Err(SdkError::service_error(
                CreateDBClusterParameterGroupError::DbParameterGroupAlreadyExistsFault(
                    DbParameterGroupAlreadyExistsFault::builder().build(),
                ),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    let mut scenario = AuroraScenario::new(mock_rds);

    let set_engine = scenario.set_engine("aurora-mysql", "aurora-mysql8.0").await;

    assert!(set_engine.is_err());
}

```

- For API details, see [CreateDBClusterParameterGroup](#) in *AWS SDK for Rust API reference*.

CreateDBClusterSnapshot

The following code example shows how to use `CreateDBClusterSnapshot`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

// Get a list of allowed engine versions.
rds.DescribeDbEngineVersions(Engine='aurora-mysql', DBParameterGroupFamily=<the
family used to create your parameter group in step 2>)
// Create an Aurora DB cluster database cluster that contains a MySQL database
and uses the parameter group you created.
// Wait for DB cluster to be ready. Call rds.DescribeDBClusters and check for
Status == 'available'.
// Get a list of instance classes available for the selected engine and engine
version. rds.DescribeOrderableDbInstanceOptions(Engine='mysql', EngineVersion=).

```



```

// Create a database instance in the cluster.
// Wait for DB instance to be ready. Call rds.DescribeDbInstances and check for
DBInstanceStatus == 'available'.
pub async fn start_cluster_and_instance(&mut self) -> Result<(), ScenarioError>
{
    if self.password.is_none() {
        return Err(ScenarioError::with(
            "Must set Secret Password before starting a cluster",
        ));
    }
    let create_db_cluster = self
        .rds
        .create_db_cluster(
            DB_CLUSTER_IDENTIFIER,
            DB_CLUSTER_PARAMETER_GROUP_NAME,
            DB_ENGINE,
            self.engine_version.as_deref().expect("engine version"),
            self.username.as_deref().expect("username"),
            self.password
                .replace(SecretString::new("").to_string())
                .expect("password"),
        )
        .await;
    if let Err(err) = create_db_cluster {
        return Err(ScenarioError::new(
            "Failed to create DB Cluster with cluster group",
            &err,
        ));
    }

    self.db_cluster_identifier = create_db_cluster
        .unwrap()
        .db_cluster
        .and_then(|c| c.db_cluster_identifier);

    if self.db_cluster_identifier.is_none() {
        return Err(ScenarioError::with("Created DB Cluster missing
Identifier"));
    }

    info!(
        "Started a db cluster: {}",
        self.db_cluster_identifier
            .as_deref()

```

```
        .unwrap_or("Missing ARN")
    );

    let create_db_instance = self
        .rds
        .create_db_instance(
            self.db_cluster_identifier.as_deref().expect("cluster name"),
            DB_INSTANCE_IDENTIFIER,
            self.instance_class.as_deref().expect("instance class"),
            DB_ENGINE,
        )
        .await;
    if let Err(err) = create_db_instance {
        return Err(ScenarioError::new(
            "Failed to create Instance in DB Cluster",
            &err,
        ));
    }

    self.db_instance_identifier = create_db_instance
        .unwrap()
        .db_instance
        .and_then(|i| i.db_instance_identifier);

    // Cluster creation can take up to 20 minutes to become available
    let cluster_max_wait = Duration::from_secs(20 * 60);
    let waiter = Waiter::builder().max(cluster_max_wait).build();
    while waiter.sleep().await.is_ok() {
        let cluster = self
            .rds
            .describe_db_clusters(
                self.db_cluster_identifier
                    .as_deref()
                    .expect("cluster identifier"),
            )
            .await;

        if let Err(err) = cluster {
            warn!(?err, "Failed to describe cluster while waiting for ready");
            continue;
        }
    }

    let instance = self
        .rds
```

```
        .describe_db_instance(
            self.db_instance_identifier
                .as_deref()
                .expect("instance identifier"),
        )
        .await;
    if let Err(err) = instance {
        return Err(ScenarioError::new(
            "Failed to find instance for cluster",
            &err,
        ));
    }

    let instances_available = instance
        .unwrap()
        .db_instances()
        .iter()
        .all(|instance| instance.db_instance_status() == Some("Available"));

    let endpoints = self
        .rds
        .describe_db_cluster_endpoints(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = endpoints {
        return Err(ScenarioError::new(
            "Failed to find endpoint for cluster",
            &err,
        ));
    }

    let endpoints_available = endpoints
        .unwrap()
        .db_cluster_endpoints()
        .iter()
        .all(|endpoint| endpoint.status() == Some("available"));

    if instances_available && endpoints_available {
        return Ok(());
    }
}
```

```

    }

    Err(ScenarioError::with("timed out waiting for cluster"))
}

pub async fn snapshot_cluster(
    &self,
    db_cluster_identifier: &str,
    snapshot_name: &str,
) -> Result<CreateDbClusterSnapshotOutput,
SdkError<CreateDBClusterSnapshotError>> {
    self.inner
        .create_db_cluster_snapshot()
        .db_cluster_identifier(db_cluster_identifier)
        .db_cluster_snapshot_identifier(snapshot_name)
        .send()
        .await
}

#[tokio::test]
async fn test_start_cluster_and_instance() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
            true
        })
        .return_once(|id, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
                .build())
        });

    mock_rds
        .expect_create_db_instance()
        .withf(|cluster, name, class, engine| {
            assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");

```

```

        assert_eq!(name, "RustSDKCodeExamplesDBInstance");
        assert_eq!(class, "m5.large");
        assert_eq!(engine, "aurora-mysql");
        true
    })
    .return_once(|cluster, name, class, _| {
        Ok(CreateDbInstanceOutput::builder()
            .db_instance(
                DbInstance::builder()
                    .db_cluster_identifier(cluster)
                    .db_instance_identifier(name)
                    .db_instance_class(class)
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|id| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_describe_db_instance()
    .with(eq("RustSDKCodeExamplesDBInstance"))
    .return_once(|name| {
        Ok(DescribeDbInstancesOutput::builder()
            .db_instances(
                DbInstance::builder()
                    .db_instance_identifier(name)
                    .db_instance_status("Available")
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_cluster_endpoints()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|_| {

```

```

        Ok(DescribeDbClusterEndpointsOutput::builder()

.db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
        .build())
    });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_version = Some("aurora-mysql8.0".into());
    scenario.instance_class = Some("m5.large".into());
    scenario.username = Some("test username".into());
    scenario.password = Some(SecretString::new("test password".into()));

    tokio::time::pause();
    let assertions = tokio::spawn(async move {
        let create = scenario.start_cluster_and_instance().await;
        assert!(create.is_ok());
        assert!(scenario
            .password
            .replace(SecretString::new("BAD SECRET".into()))
            .unwrap()
            .expose_secret()
            .is_empty());
        assert_eq!(
            scenario.db_cluster_identifier,
            Some("RustSDKCodeExamplesDBCluster".into())
        );
    });
    tokio::time::advance(Duration::from_secs(1)).await;
    tokio::time::resume();
    let _ = assertions.await;
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Err(SdkError::service_error(
                CreateDBClusterError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "create db cluster error",
                )))
            )),
        });
}

```

```

        Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
    ))
});

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

let create = scenario.start_cluster_and_instance().await;
assert_matches!(create, Err(ScenarioError { message, context: _}) if message ==
"Failed to create DB Cluster with cluster group")
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_missing_id() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().build())
                .build())
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_version = Some("aurora-mysql8.0".into());
    scenario.instance_class = Some("m5.large".into());
    scenario.username = Some("test username".into());
    scenario.password = Some(SecretString::new("test password".into()));

    let create = scenario.start_cluster_and_instance().await;
    assert_matches!(create, Err(ScenarioError { message, context: _ }) if message ==
"Created DB Cluster missing Identifier");
}

#[tokio::test]
async fn test_start_cluster_and_instance_instance_create_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()

```

```

        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
            true
        })
        .return_once(|id, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
                .build())
        });

mock_rds
    .expect_create_db_instance()
    .return_once(|_, _, _, _| {
        Err(SdkError::service_error(
            CreateDBInstanceError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "create db instance error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

let create = scenario.start_cluster_and_instance().await;
assert_matches!(create, Err(ScenarioError { message, context: _ }) if message ==
"Failed to create Instance in DB Cluster")
}

#[tokio::test]
async fn test_start_cluster_and_instance_wait_hiccup() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()

```



```

        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
            true
        })
        .return_once(|id, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
                .build())
        });

mock_rds
    .expect_create_db_instance()
    .withf(|cluster, name, class, engine| {
        assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");
        assert_eq!(name, "RustSDKCodeExamplesDBInstance");
        assert_eq!(class, "m5.large");
        assert_eq!(engine, "aurora-mysql");
        true
    })
    .return_once(|cluster, name, class, _| {
        Ok(CreateDbInstanceOutput::builder()
            .db_instance(
                DbInstance::builder()
                    .db_cluster_identifier(cluster)
                    .db_instance_identifier(name)
                    .db_instance_class(class)
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .times(1)
    .returning(|_| {
        Err(SdkError::service_error(
            DescribeDBClustersError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
            )))
        ))
    })

```

```

        "describe cluster error",
    )))
    Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
    ))
})
.with(eq("RustSDKCodeExamplesDBCluster"))
.times(1)
.returning(|id| {
    Ok(DescribeDbClustersOutput::builder()
        .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
        .build())
});

mock_rds.expect_describe_db_instance().return_once(|name| {
    Ok(DescribeDbInstancesOutput::builder()
        .db_instances(
            DbInstance::builder()
                .db_instance_identifier(name)
                .db_instance_status("Available")
                .build(),
        )
        .build())
});

mock_rds
    .expect_describe_db_cluster_endpoints()
    .return_once(|_| {
        Ok(DescribeDbClusterEndpointsOutput::builder()
            .db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
            .build())
        });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let create = scenario.start_cluster_and_instance().await;
    assert!(create.is_ok());
});

```

```

    tokio::time::advance(Duration::from_secs(1)).await;
    tokio::time::advance(Duration::from_secs(1)).await;
    tokio::time::resume();
    let _ = assertions.await;
}

```

- For API details, see [CreateDBClusterSnapshot](#) in *AWS SDK for Rust API reference*.

CreateDBInstance

The following code example shows how to use CreateDBInstance.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

    // Get a list of allowed engine versions.
    rds.DescribeDbEngineVersions(Engine='aurora-mysql', DBParameterGroupFamily=<the
family used to create your parameter group in step 2>)
    // Create an Aurora DB cluster database cluster that contains a MySQL database
and uses the parameter group you created.
    // Wait for DB cluster to be ready. Call rds.DescribeDBClusters and check for
Status == 'available'.
    // Get a list of instance classes available for the selected engine and engine
version. rds.DescribeOrderableDbInstanceOptions(Engine='mysql', EngineVersion=).

    // Create a database instance in the cluster.
    // Wait for DB instance to be ready. Call rds.DescribeDbInstances and check for
DBInstanceStatus == 'available'.
    pub async fn start_cluster_and_instance(&mut self) -> Result<(), ScenarioError>
    {
        if self.password.is_none() {
            return Err(ScenarioError::with(
                "Must set Secret Password before starting a cluster",
            ));
        }
    }

```

```
let create_db_cluster = self
    .rds
    .create_db_cluster(
        DB_CLUSTER_IDENTIFIER,
        DB_CLUSTER_PARAMETER_GROUP_NAME,
        DB_ENGINE,
        self.engine_version.as_deref().expect("engine version"),
        self.username.as_deref().expect("username"),
        self.password
            .replace(SecretString::new("").to_string()))
            .expect("password"),
    )
    .await;
if let Err(err) = create_db_cluster {
    return Err(ScenarioError::new(
        "Failed to create DB Cluster with cluster group",
        &err,
    ));
}

self.db_cluster_identifier = create_db_cluster
    .unwrap()
    .db_cluster
    .and_then(|c| c.db_cluster_identifier);

if self.db_cluster_identifier.is_none() {
    return Err(ScenarioError::with("Created DB Cluster missing
Identifier"));
}

info!(
    "Started a db cluster: {}",
    self.db_cluster_identifier
        .as_deref()
        .unwrap_or("Missing ARN")
);

let create_db_instance = self
    .rds
    .create_db_instance(
        self.db_cluster_identifier.as_deref().expect("cluster name"),
        DB_INSTANCE_IDENTIFIER,
        self.instance_class.as_deref().expect("instance class"),
        DB_ENGINE,
```

```
    )
    .await;
if let Err(err) = create_db_instance {
    return Err(ScenarioError::new(
        "Failed to create Instance in DB Cluster",
        &err,
    ));
}

self.db_instance_identifier = create_db_instance
    .unwrap()
    .db_instance
    .and_then(|i| i.db_instance_identifier);

// Cluster creation can take up to 20 minutes to become available
let cluster_max_wait = Duration::from_secs(20 * 60);
let waiter = Waiter::builder().max(cluster_max_wait).build();
while waiter.sleep().await.is_ok() {
    let cluster = self
        .rds
        .describe_db_clusters(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = cluster {
        warn!(?err, "Failed to describe cluster while waiting for ready");
        continue;
    }

    let instance = self
        .rds
        .describe_db_instance(
            self.db_instance_identifier
                .as_deref()
                .expect("instance identifier"),
        )
        .await;
    if let Err(err) = instance {
        return Err(ScenarioError::new(
            "Failed to find instance for cluster",
            &err,
        ));
    }
}
```

```
        ));
    }

    let instances_available = instance
        .unwrap()
        .db_instances()
        .iter()
        .all(|instance| instance.db_instance_status() == Some("Available"));

    let endpoints = self
        .rds
        .describe_db_cluster_endpoints(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = endpoints {
        return Err(ScenarioError::new(
            "Failed to find endpoint for cluster",
            &err,
        ));
    }

    let endpoints_available = endpoints
        .unwrap()
        .db_cluster_endpoints()
        .iter()
        .all(|endpoint| endpoint.status() == Some("available"));

    if instances_available && endpoints_available {
        return Ok(());
    }

    Err(ScenarioError::with("timed out waiting for cluster"))
}

pub async fn create_db_instance(
    &self,
    cluster_name: &str,
    instance_name: &str,
    instance_class: &str,
```

```

        engine: &str,
    ) -> Result<CreateDbInstanceOutput, SdkError<CreateDBInstanceError>> {
        self.inner
            .create_db_instance()
            .db_cluster_identififier(cluster_name)
            .db_instance_identififier(instance_name)
            .db_instance_class(instance_class)
            .engine(engine)
            .send()
            .await
    }

#[tokio::test]
async fn test_start_cluster_and_instance() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
            true
        })
        .return_once(|id, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().db_cluster_identififier(id).build())
                .build())
        });

    mock_rds
        .expect_create_db_instance()
        .withf(|cluster, name, class, engine| {
            assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");
            assert_eq!(name, "RustSDKCodeExamplesDBInstance");
            assert_eq!(class, "m5.large");
            assert_eq!(engine, "aurora-mysql");
            true
        })
        .return_once(|cluster, name, class, _| {
            Ok(CreateDbInstanceOutput::builder()

```

```

        .db_instance(
            DbInstance::builder()
                .db_cluster_identifier(cluster)
                .db_instance_identifier(name)
                .db_instance_class(class)
                .build(),
        )
        .build()
    });

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|id| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_describe_db_instance()
    .with(eq("RustSDKCodeExamplesDBInstance"))
    .return_once(|name| {
        Ok(DescribeDbInstancesOutput::builder()
            .db_instances(
                DbInstance::builder()
                    .db_instance_identifier(name)
                    .db_instance_status("Available")
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_cluster_endpoints()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|_| {
        Ok(DescribeDbClusterEndpointsOutput::builder()

.db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
            .build())
    });

let mut scenario = AuroraScenario::new(mock_rds);

```



```

scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let create = scenario.start_cluster_and_instance().await;
    assert!(create.is_ok());
    assert!(scenario
        .password
        .replace(SecretString::new("BAD SECRET".into()))
        .unwrap()
        .expose_secret()
        .is_empty());
    assert_eq!(
        scenario.db_cluster_identifier,
        Some("RustSDKCodeExamplesDBCluster".into())
    );
});
tokio::time::advance(Duration::from_secs(1)).await;
tokio::time::resume();
let _ = assertions.await;
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Err(SdkError::service_error(
                CreateDBClusterError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "create db cluster error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_version = Some("aurora-mysql8.0".into());
    scenario.instance_class = Some("m5.large".into());

```

```

    scenario.username = Some("test username".into());
    scenario.password = Some(SecretString::new("test password".into()));

    let create = scenario.start_cluster_and_instance().await;
    assert_matches!(create, Err(ScenarioError { message, context: _}) if message ==
"Failed to create DB Cluster with cluster group")
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_missing_id() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().build())
                .build())
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_version = Some("aurora-mysql8.0".into());
    scenario.instance_class = Some("m5.large".into());
    scenario.username = Some("test username".into());
    scenario.password = Some(SecretString::new("test password".into()));

    let create = scenario.start_cluster_and_instance().await;
    assert_matches!(create, Err(ScenarioError { message, context: _ }) if message ==
"Created DB Cluster missing Identifier");
}

#[tokio::test]
async fn test_start_cluster_and_instance_instance_create_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
        });
}

```

```

        true
    })
    .return_once(|id, _, _, _, _, _| {
        Ok(CreateDbClusterOutput::builder()
            .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_create_db_instance()
    .return_once(|_, _, _, _| {
        Err(SdkError::service_error(
            CreateDBInstanceError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "create db instance error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

let create = scenario.start_cluster_and_instance().await;
assert_matches!(create, Err(ScenarioError { message, context: _ }) if message ==
"Failed to create Instance in DB Cluster")
}

#[tokio::test]
async fn test_start_cluster_and_instance_wait_hiccup() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
        });
}

```

```

        true
    })
    .return_once(|id, _, _, _, _, _| {
        Ok(CreateDbClusterOutput::builder()
            .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_create_db_instance()
    .withf(|cluster, name, class, engine| {
        assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");
        assert_eq!(name, "RustSDKCodeExamplesDBInstance");
        assert_eq!(class, "m5.large");
        assert_eq!(engine, "aurora-mysql");
        true
    })
    .return_once(|cluster, name, class, _| {
        Ok(CreateDbInstanceOutput::builder()
            .db_instance(
                DbInstance::builder()
                    .db_cluster_identifier(cluster)
                    .db_instance_identifier(name)
                    .db_instance_class(class)
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .times(1)
    .returning(|_| {
        Err(SdkError::service_error(
            DescribeDBClustersError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "describe cluster error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    })
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .times(1)

```

```

        .returning(|id| {
            Ok(DescribeDbClustersOutput::builder()
                .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
                .build())
        });

mock_rds.expect_describe_db_instance().return_once(|name| {
    Ok(DescribeDbInstancesOutput::builder()
        .db_instances(
            DbInstance::builder()
                .db_instance_identifier(name)
                .db_instance_status("Available")
                .build(),
        )
        .build())
});

mock_rds
    .expect_describe_db_cluster_endpoints()
    .return_once(|_| {
        Ok(DescribeDbClusterEndpointsOutput::builder()

.db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
                .build())
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let create = scenario.start_cluster_and_instance().await;
    assert!(create.is_ok());
});

tokio::time::advance(Duration::from_secs(1)).await;
tokio::time::advance(Duration::from_secs(1)).await;
tokio::time::resume();
let _ = assertions.await;
}

```

- For API details, see [CreateDBInstance](#) in *AWS SDK for Rust API reference*.

DeleteDBCluster

The following code example shows how to use DeleteDBCluster.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn clean_up(self) -> Result<(), Vec<ScenarioError>> {
    let mut clean_up_errors: Vec<ScenarioError> = vec![];

    // Delete the instance. rds.DeleteDbInstance.
    let delete_db_instance = self
        .rds
        .delete_db_instance(
            self.db_instance_identifier
                .as_deref()
                .expect("instance identifier"),
        )
        .await;
    if let Err(err) = delete_db_instance {
        let identifier = self
            .db_instance_identifier
            .as_deref()
            .unwrap_or("Missing Instance Identifier");
        let message = format!("failed to delete db instance {identifier}");
        clean_up_errors.push(ScenarioError::new(message, &err));
    } else {
        // Wait for the instance to delete
        let waiter = Waiter::default();
        while waiter.sleep().await.is_ok() {
            let describe_db_instances = self.rds.describe_db_instances().await;
            if let Err(err) = describe_db_instances {
                clean_up_errors.push(ScenarioError::new(
```

```

        "Failed to check instance state during deletion",
        &err,
    ));
    break;
}
let db_instances = describe_db_instances
    .unwrap()
    .db_instances()
    .iter()
    .filter(|instance| instance.db_cluster_identifier ==
self.db_cluster_identifier)
    .cloned()
    .collect:::<Vec<DbInstance>>();

if db_instances.is_empty() {
    trace!("Delete Instance waited and no instances were found");
    break;
}
match db_instances.first().unwrap().db_instance_status() {
    Some("Deleting") => continue,
    Some(status) => {
        info!("Attempting to delete but instances is in {status}");
        continue;
    }
    None => {
        warn!("No status for DB instance");
        break;
    }
}
}
}

// Delete the DB cluster. rds.DeleteDbCluster.
let delete_db_cluster = self
    .rds
    .delete_db_cluster(
        self.db_cluster_identifier
            .as_deref()
            .expect("cluster identifier"),
    )
    .await;

if let Err(err) = delete_db_cluster {
    let identifier = self

```

```

        .db_cluster_identifier
        .as_deref()
        .unwrap_or("Missing DB Cluster Identifier");
    let message = format!("failed to delete db cluster {identifier}");
    clean_up_errors.push(ScenarioError::new(message, &err));
} else {
    // Wait for the instance and cluster to fully delete.
    rds.DescribeDbInstances and rds.DescribeDbClusters until both are not found.
    let waiter = Waiter::default();
    while waiter.sleep().await.is_ok() {
        let describe_db_clusters = self
            .rds
            .describe_db_clusters(
                self.db_cluster_identifier
                    .as_deref()
                    .expect("cluster identifier"),
            )
            .await;
        if let Err(err) = describe_db_clusters {
            clean_up_errors.push(ScenarioError::new(
                "Failed to check cluster state during deletion",
                &err,
            ));
            break;
        }
        let describe_db_clusters = describe_db_clusters.unwrap();
        let db_clusters = describe_db_clusters.db_clusters();
        if db_clusters.is_empty() {
            trace!("Delete cluster waited and no clusters were found");
            break;
        }
        match db_clusters.first().unwrap().status() {
            Some("Deleting") => continue,
            Some(status) => {
                info!("Attempting to delete but clusters is in {status}");
                continue;
            }
            None => {
                warn!("No status for DB cluster");
                break;
            }
        }
    }
}
}

```



```

// Delete the DB cluster parameter group. rds.DeleteDbClusterParameterGroup.
let delete_db_cluster_parameter_group = self
    .rds
    .delete_db_cluster_parameter_group(
        self.db_cluster_parameter_group
            .map(|g| {
                g.db_cluster_parameter_group_name
                    .unwrap_or_else(||
DB_CLUSTER_PARAMETER_GROUP_NAME.to_string())
            })
            .as_deref()
            .expect("cluster parameter group name"),
    )
    .await;
if let Err(error) = delete_db_cluster_parameter_group {
    clean_up_errors.push(ScenarioError::new(
        "Failed to delete the db cluster parameter group",
        &error,
    ))
}

if clean_up_errors.is_empty() {
    Ok(())
} else {
    Err(clean_up_errors)
}
}

pub async fn delete_db_cluster(
    &self,
    cluster_identifier: &str,
) -> Result<DeleteDbClusterOutput, SdkError<DeleteDBClusterError>> {
    self.inner
        .delete_db_cluster()
        .db_cluster_identifier(cluster_identifier)
        .skip_final_snapshot(true)
        .send()
        .await
}

#[tokio::test]
async fn test_scenario_clean_up() {
    let mut mock_rds = MockRdsImpl::default();

```

```
mock_rds
    .expect_delete_db_instance()
    .with(eq("MockInstance"))
    .return_once(|_| Ok(DeleteDbInstanceOutput::builder().build()));

mock_rds
    .expect_describe_db_instances()
    .with()
    .times(1)
    .returning(|| {
        Ok(DescribeDbInstancesOutput::builder()
            .db_instances(
                DbInstance::builder()
                    .db_cluster_identifier("MockCluster")
                    .db_instance_status("Deleting")
                    .build(),
            )
            .build())
    })
    .with()
    .times(1)
    .returning(|_| Ok(DescribeDbInstancesOutput::builder().build()));

mock_rds
    .expect_delete_db_cluster()
    .with(eq("MockCluster"))
    .return_once(|_| Ok(DeleteDbClusterOutput::builder().build()));

mock_rds
    .expect_describe_db_clusters()
    .with(eq("MockCluster"))
    .times(1)
    .returning(|id| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(
                DbCluster::builder()
                    .db_cluster_identifier(id)
                    .status("Deleting")
                    .build(),
            )
            .build())
    })
    .with(eq("MockCluster"))
```

```

        .times(1)
        .returning(|_| Ok(DescribeDbClustersOutput::builder().build()));

mock_rds
    .expect_delete_db_cluster_parameter_group()
    .with(eq("MockParamGroup"))
    .return_once(|_|
Ok(DeleteDbClusterParameterGroupOutput::builder().build()));

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some(String::from("MockCluster"));
scenario.db_instance_identifier = Some(String::from("MockInstance"));
scenario.db_cluster_parameter_group = Some(
    DbClusterParameterGroup::builder()
        .db_cluster_parameter_group_name("MockParamGroup")
        .build(),
);

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let clean_up = scenario.clean_up().await;
    assert!(clean_up.is_ok());
});

tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances
tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
tokio::time::resume();
let _ = assertions.await;
}

#[tokio::test]
async fn test_scenario_clean_up_errors() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_delete_db_instance()
        .with(eq("MockInstance"))
        .return_once(|_| Ok(DeleteDbInstanceOutput::builder().build()));

```

```
mock_rds
    .expect_describe_db_instances()
    .with()
    .times(1)
    .returning(|| {
        Ok(DescribeDbInstancesOutput::builder()
            .db_instances(
                DbInstance::builder()
                    .db_cluster_identifier("MockCluster")
                    .db_instance_status("Deleting")
                    .build(),
            )
            .build())
    })
    .with()
    .times(1)
    .returning(|| {
        Err(SdkError::service_error(
            DescribeDBInstancesError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "describe db instances error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    });

mock_rds
    .expect_delete_db_cluster()
    .with(eq("MockCluster"))
    .return_once(|_| Ok>DeleteDbClusterOutput::builder().build()));

mock_rds
    .expect_describe_db_clusters()
    .with(eq("MockCluster"))
    .times(1)
    .returning(|id| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(
                DbCluster::builder()
                    .db_cluster_identifier(id)
                    .status("Deleting")
                    .build(),
            )
        )
    })
```

```

        .build()
    })
    .with(eq("MockCluster"))
    .times(1)
    .returning(|_| {
        Err(SdkError::service_error(
            DescribeDBClustersError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "describe db clusters error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    });

mock_rds
    .expect_delete_db_cluster_parameter_group()
    .with(eq("MockParamGroup"))
    .return_once(|_|
Ok(DeleteDbClusterParameterGroupOutput::builder().build()));

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some(String::from("MockCluster"));
scenario.db_instance_identifier = Some(String::from("MockInstance"));
scenario.db_cluster_parameter_group = Some(
    DbClusterParameterGroup::builder()
        .db_cluster_parameter_group_name("MockParamGroup")
        .build(),
);

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let clean_up = scenario.clean_up().await;
    assert!(clean_up.is_err());
    let errs = clean_up.unwrap_err();
    assert_eq!(errs.len(), 2);
    assert_matches!(errs.get(0), Some(ScenarioError {message, context: _}) if
message == "Failed to check instance state during deletion");
    assert_matches!(errs.get(1), Some(ScenarioError {message, context: _}) if
message == "Failed to check cluster state during deletion");
});

tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances

```

```

    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
    tokio::time::resume();
    let _ = assertions.await;
}

```

- For API details, see [DeleteDBCluster](#) in *AWS SDK for Rust API reference*.

DeleteDBClusterParameterGroup

The following code example shows how to use DeleteDBClusterParameterGroup.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

pub async fn clean_up(self) -> Result<(), Vec<ScenarioError>> {
    let mut clean_up_errors: Vec<ScenarioError> = vec![];

    // Delete the instance. rds.DeleteDbInstance.
    let delete_db_instance = self
        .rds
        .delete_db_instance(
            self.db_instance_identifier
                .as_deref()
                .expect("instance identifier"),
        )
        .await;
    if let Err(err) = delete_db_instance {
        let identifier = self
            .db_instance_identifier
            .as_deref()
            .unwrap_or("Missing Instance Identifier");

```

```

        let message = format!("failed to delete db instance {identifier}");
        clean_up_errors.push(ScenarioError::new(message, &err));
    } else {
        // Wait for the instance to delete
        let waiter = Waiter::default();
        while waiter.sleep().await.is_ok() {
            let describe_db_instances = self.rds.describe_db_instances().await;
            if let Err(err) = describe_db_instances {
                clean_up_errors.push(ScenarioError::new(
                    "Failed to check instance state during deletion",
                    &err,
                ));
                break;
            }
            let db_instances = describe_db_instances
                .unwrap()
                .db_instances()
                .iter()
                .filter(|instance| instance.db_cluster_identifier ==
self.db_cluster_identifier)
                .cloned()
                .collect:::<Vec<DbInstance>>();

            if db_instances.is_empty() {
                trace!("Delete Instance waited and no instances were found");
                break;
            }
            match db_instances.first().unwrap().db_instance_status() {
                Some("Deleting") => continue,
                Some(status) => {
                    info!("Attempting to delete but instances is in {status}");
                    continue;
                }
                None => {
                    warn!("No status for DB instance");
                    break;
                }
            }
        }
    }

    // Delete the DB cluster. rds.DeleteDbCluster.
    let delete_db_cluster = self
        .rds

```

```

        .delete_db_cluster(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = delete_db_cluster {
        let identifier = self
            .db_cluster_identifier
            .as_deref()
            .unwrap_or("Missing DB Cluster Identifier");
        let message = format!("failed to delete db cluster {identifier}");
        clean_up_errors.push(ScenarioError::new(message, &err));
    } else {
        // Wait for the instance and cluster to fully delete.
        rds.DescribeDbInstances and rds.DescribeDbClusters until both are not found.
        let waiter = Waiter::default();
        while waiter.sleep().await.is_ok() {
            let describe_db_clusters = self
                .rds
                .describe_db_clusters(
                    self.db_cluster_identifier
                        .as_deref()
                        .expect("cluster identifier"),
                )
                .await;
            if let Err(err) = describe_db_clusters {
                clean_up_errors.push(ScenarioError::new(
                    "Failed to check cluster state during deletion",
                    &err,
                ));
                break;
            }
            let describe_db_clusters = describe_db_clusters.unwrap();
            let db_clusters = describe_db_clusters.db_clusters();
            if db_clusters.is_empty() {
                trace!("Delete cluster waited and no clusters were found");
                break;
            }
            match db_clusters.first().unwrap().status() {
                Some("Deleting") => continue,
                Some(status) => {
                    info!("Attempting to delete but clusters is in {status}");
                }
            }
        }
    }

```



```

        continue;
    }
    None => {
        warn!("No status for DB cluster");
        break;
    }
}
}
}

// Delete the DB cluster parameter group. rds.DeleteDbClusterParameterGroup.
let delete_db_cluster_parameter_group = self
    .rds
    .delete_db_cluster_parameter_group(
        self.db_cluster_parameter_group
            .map(|g| {
                g.db_cluster_parameter_group_name
                    .unwrap_or_else(||
DB_CLUSTER_PARAMETER_GROUP_NAME.to_string())
            })
            .as_deref()
            .expect("cluster parameter group name"),
    )
    .await;
if let Err(error) = delete_db_cluster_parameter_group {
    clean_up_errors.push(ScenarioError::new(
        "Failed to delete the db cluster parameter group",
        &error,
    ))
}

if clean_up_errors.is_empty() {
    Ok(())
} else {
    Err(clean_up_errors)
}
}

pub async fn delete_db_cluster_parameter_group(
    &self,
    name: &str,
) -> Result<DeleteDbClusterParameterGroupOutput,
SdkError<DeleteDBClusterParameterGroupError>>
{

```

```
        self.inner
            .delete_db_cluster_parameter_group()
            .db_cluster_parameter_group_name(name)
            .send()
            .await
    }
}

#[tokio::test]
async fn test_scenario_clean_up() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_delete_db_instance()
        .with(eq("MockInstance"))
        .return_once(|_| Ok(DeleteDbInstanceOutput::builder().build()));

    mock_rds
        .expect_describe_db_instances()
        .with()
        .times(1)
        .returning(|| {
            Ok(DescribeDbInstancesOutput::builder()
                .db_instances(
                    DbInstance::builder()
                        .db_cluster_identifier("MockCluster")
                        .db_instance_status("Deleting")
                        .build(),
                )
                .build())
        })
        .with()
        .times(1)
        .returning(|| Ok(DescribeDbInstancesOutput::builder().build()));

    mock_rds
        .expect_delete_db_cluster()
        .with(eq("MockCluster"))
        .return_once(|_| Ok(DeleteDbClusterOutput::builder().build()));

    mock_rds
        .expect_describe_db_clusters()
        .with(eq("MockCluster"))
        .times(1)
        .returning(|id| {
```

```

        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(
                DbCluster::builder()
                    .db_cluster_identifier(id)
                    .status("Deleting")
                    .build(),
            )
            .build())
    })
    .with(eq("MockCluster"))
    .times(1)
    .returning(|_| Ok(DescribeDbClustersOutput::builder().build()));

mock_rds
    .expect_delete_db_cluster_parameter_group()
    .with(eq("MockParamGroup"))
    .return_once(|_|
Ok(DeleteDbClusterParameterGroupOutput::builder().build()));

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some(String::from("MockCluster"));
scenario.db_instance_identifier = Some(String::from("MockInstance"));
scenario.db_cluster_parameter_group = Some(
    DbClusterParameterGroup::builder()
        .db_cluster_parameter_group_name("MockParamGroup")
        .build(),
);

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let clean_up = scenario.clean_up().await;
    assert!(clean_up.is_ok());
});

tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances
tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
tokio::time::resume();
let _ = assertions.await;

```

```
}

#[tokio::test]
async fn test_scenario_clean_up_errors() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_delete_db_instance()
        .with(eq("MockInstance"))
        .return_once(|_| Ok(DeleteDbInstanceOutput::builder().build()));

    mock_rds
        .expect_describe_db_instances()
        .with()
        .times(1)
        .returning(|| {
            Ok(DescribeDbInstancesOutput::builder()
                .db_instances(
                    DbInstance::builder()
                        .db_cluster_identifier("MockCluster")
                        .db_instance_status("Deleting")
                        .build(),
                )
                .build())
        })
        .with()
        .times(1)
        .returning(|| {
            Err(SdkError::service_error(
                DescribeDBInstancesError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe db instances error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    mock_rds
        .expect_delete_db_cluster()
        .with(eq("MockCluster"))
        .return_once(|_| Ok(DeleteDbClusterOutput::builder().build()));

    mock_rds
        .expect_describe_db_clusters()

```

```

        .with(eq("MockCluster"))
        .times(1)
        .returning(|id| {
            Ok(DescribeDbClustersOutput::builder()
                .db_clusters(
                    DbCluster::builder()
                        .db_cluster_identifier(id)
                        .status("Deleting")
                        .build(),
                )
                .build())
        })
        .with(eq("MockCluster"))
        .times(1)
        .returning(|_| {
            Err(SdkError::service_error(
                DescribeDBClustersError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe db clusters error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    mock_rds
        .expect_delete_db_cluster_parameter_group()
        .with(eq("MockParamGroup"))
        .return_once(|_|
Ok(DeleteDbClusterParameterGroupOutput::builder().build()));

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some(String::from("MockCluster"));
    scenario.db_instance_identifier = Some(String::from("MockInstance"));
    scenario.db_cluster_parameter_group = Some(
        DbClusterParameterGroup::builder()
            .db_cluster_parameter_group_name("MockParamGroup")
            .build(),
    );

    tokio::time::pause();
    let assertions = tokio::spawn(async move {
        let clean_up = scenario.clean_up().await;
        assert!(clean_up.is_err());
        let errs = clean_up.unwrap_err();
    });

```

```

        assert_eq!(errs.len(), 2);
        assert_matches!(errs.get(0), Some(ScenarioError {message, context: _}) if
message == "Failed to check instance state during deletion");
        assert_matches!(errs.get(1), Some(ScenarioError {message, context: _}) if
message == "Failed to check cluster state during deletion");
    });

    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
    tokio::time::resume();
    let _ = assertions.await;
}

```

- For API details, see [DeleteDBClusterParameterGroup](#) in *AWS SDK for Rust API reference*.

DeleteDBInstance

The following code example shows how to use DeleteDBInstance.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

pub async fn clean_up(self) -> Result<(), Vec<ScenarioError>> {
    let mut clean_up_errors: Vec<ScenarioError> = vec![];

    // Delete the instance. rds.DeleteDbInstance.
    let delete_db_instance = self
        .rds
        .delete_db_instance(
            self.db_instance_identifier

```

```

        .as_deref()
        .expect("instance identifier"),
    )
    .await;
if let Err(err) = delete_db_instance {
    let identifier = self
        .db_instance_identifier
        .as_deref()
        .unwrap_or("Missing Instance Identifier");
    let message = format!("failed to delete db instance {identifier}");
    clean_up_errors.push(ScenarioError::new(message, &err));
} else {
    // Wait for the instance to delete
    let waiter = Waiter::default();
    while waiter.sleep().await.is_ok() {
        let describe_db_instances = self.rds.describe_db_instances().await;
        if let Err(err) = describe_db_instances {
            clean_up_errors.push(ScenarioError::new(
                "Failed to check instance state during deletion",
                &err,
            ));
            break;
        }
        let db_instances = describe_db_instances
            .unwrap()
            .db_instances()
            .iter()
            .filter(|instance| instance.db_cluster_identifier ==
self.db_cluster_identifier)
            .cloned()
            .collect:::<Vec<DbInstance>>();

        if db_instances.is_empty() {
            trace!("Delete Instance waited and no instances were found");
            break;
        }
        match db_instances.first().unwrap().db_instance_status() {
            Some("Deleting") => continue,
            Some(status) => {
                info!("Attempting to delete but instances is in {status}");
                continue;
            }
            None => {
                warn!("No status for DB instance");
            }
        }
    }
}

```

```

        break;
    }
}

}

}

// Delete the DB cluster. rds.DeleteDbCluster.
let delete_db_cluster = self
    .rds
    .delete_db_cluster(
        self.db_cluster_identifier
            .as_deref()
            .expect("cluster identifier"),
    )
    .await;

if let Err(err) = delete_db_cluster {
    let identifier = self
        .db_cluster_identifier
        .as_deref()
        .unwrap_or("Missing DB Cluster Identifier");
    let message = format!("failed to delete db cluster {identifier}");
    clean_up_errors.push(ScenarioError::new(message, &err));
} else {
    // Wait for the instance and cluster to fully delete.
    rds.DescribeDbInstances and rds.DescribeDbClusters until both are not found.
    let waiter = Waiter::default();
    while waiter.sleep().await.is_ok() {
        let describe_db_clusters = self
            .rds
            .describe_db_clusters(
                self.db_cluster_identifier
                    .as_deref()
                    .expect("cluster identifier"),
            )
            .await;
        if let Err(err) = describe_db_clusters {
            clean_up_errors.push(ScenarioError::new(
                "Failed to check cluster state during deletion",
                &err,
            ));
            break;
        }
        let describe_db_clusters = describe_db_clusters.unwrap();

```



```

        let db_clusters = describe_db_clusters.db_clusters();
        if db_clusters.is_empty() {
            trace!("Delete cluster waited and no clusters were found");
            break;
        }
        match db_clusters.first().unwrap().status() {
            Some("Deleting") => continue,
            Some(status) => {
                info!("Attempting to delete but clusters is in {status}");
                continue;
            }
            None => {
                warn!("No status for DB cluster");
                break;
            }
        }
    }
}

// Delete the DB cluster parameter group. rds.DeleteDbClusterParameterGroup.
let delete_db_cluster_parameter_group = self
    .rds
    .delete_db_cluster_parameter_group(
        self.db_cluster_parameter_group
            .map(|g| {
                g.db_cluster_parameter_group_name
                    .unwrap_or_else(||
DB_CLUSTER_PARAMETER_GROUP_NAME.to_string())
            })
            .as_deref()
            .expect("cluster parameter group name"),
    )
    .await;
if let Err(error) = delete_db_cluster_parameter_group {
    clean_up_errors.push(ScenarioError::new(
        "Failed to delete the db cluster parameter group",
        &error,
    ))
}

if clean_up_errors.is_empty() {
    Ok(())
} else {
    Err(clean_up_errors)
}

```

```

    }
}

pub async fn delete_db_instance(
    &self,
    instance_identifier: &str,
) -> Result<DeleteDbInstanceOutput, SdkError<DeleteDBInstanceError>> {
    self.inner
        .delete_db_instance()
        .db_instance_identifier(instance_identifier)
        .skip_final_snapshot(true)
        .send()
        .await
}

#[tokio::test]
async fn test_scenario_clean_up() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_delete_db_instance()
        .with(eq("MockInstance"))
        .return_once(|_| Ok(DeleteDbInstanceOutput::builder().build()));

    mock_rds
        .expect_describe_db_instances()
        .with()
        .times(1)
        .returning(|| {
            Ok(DescribeDbInstancesOutput::builder()
                .db_instances(
                    DbInstance::builder()
                        .db_cluster_identifier("MockCluster")
                        .db_instance_status("Deleting")
                        .build(),
                )
                .build())
        })
        .with()
        .times(1)
        .returning(|| Ok(DescribeDbInstancesOutput::builder().build()));

    mock_rds
        .expect_delete_db_cluster()

```

```

        .with(eq("MockCluster"))
        .return_once(|_| Ok>DeleteDbClusterOutput::builder().build()));

mock_rds
    .expect_describe_db_clusters()
    .with(eq("MockCluster"))
    .times(1)
    .returning(|id| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(
                DbCluster::builder()
                    .db_cluster_identifier(id)
                    .status("Deleting")
                    .build(),
            )
            .build())
    })
    .with(eq("MockCluster"))
    .times(1)
    .returning(|_| Ok(DescribeDbClustersOutput::builder().build()));

mock_rds
    .expect_delete_db_cluster_parameter_group()
    .with(eq("MockParamGroup"))
    .return_once(|_|
Ok>DeleteDbClusterParameterGroupOutput::builder().build()));

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some(String::from("MockCluster"));
scenario.db_instance_identifier = Some(String::from("MockInstance"));
scenario.db_cluster_parameter_group = Some(
    DbClusterParameterGroup::builder()
        .db_cluster_parameter_group_name("MockParamGroup")
        .build(),
);

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let clean_up = scenario.clean_up().await;
    assert!(clean_up.is_ok());
});

tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances

```

```

    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
    tokio::time::resume();
    let _ = assertions.await;
}

#[tokio::test]
async fn test_scenario_clean_up_errors() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_delete_db_instance()
        .with(eq("MockInstance"))
        .return_once(|_| Ok(DeleteDbInstanceOutput::builder().build()));

    mock_rds
        .expect_describe_db_instances()
        .with()
        .times(1)
        .returning(|| {
            Ok(DescribeDbInstancesOutput::builder()
                .db_instances(
                    DbInstance::builder()
                        .db_cluster_identifier("MockCluster")
                        .db_instance_status("Deleting")
                        .build(),
                )
                .build())
        })
        .with()
        .times(1)
        .returning(|| {
            Err(SdkError::service_error(
                DescribeDBInstancesError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe db instances error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });
}

```

```

mock_rds
    .expect_delete_db_cluster()
    .with(eq("MockCluster"))
    .return_once(|_| Ok(DeleteDbClusterOutput::builder().build()));

mock_rds
    .expect_describe_db_clusters()
    .with(eq("MockCluster"))
    .times(1)
    .returning(|id| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(
                DbCluster::builder()
                    .db_cluster_identifier(id)
                    .status("Deleting")
                    .build(),
            )
            .build())
    })
    .with(eq("MockCluster"))
    .times(1)
    .returning(|_| {
        Err(SdkError::service_error(
            DescribeDBClustersError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "describe db clusters error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    });

mock_rds
    .expect_delete_db_cluster_parameter_group()
    .with(eq("MockParamGroup"))
    .return_once(|_|
Ok(DeleteDbClusterParameterGroupOutput::builder().build()));

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some(String::from("MockCluster"));
scenario.db_instance_identifier = Some(String::from("MockInstance"));
scenario.db_cluster_parameter_group = Some(
    DbClusterParameterGroup::builder()
        .db_cluster_parameter_group_name("MockParamGroup")

```

```

        .build(),
    );

    tokio::time::pause();
    let assertions = tokio::spawn(async move {
        let clean_up = scenario.clean_up().await;
        assert!(clean_up.is_err());
        let errs = clean_up.unwrap_err();
        assert_eq!(errs.len(), 2);
        assert_matches!(errs.get(0), Some(ScenarioError {message, context: _}) if
message == "Failed to check instance state during deletion");
        assert_matches!(errs.get(1), Some(ScenarioError {message, context: _}) if
message == "Failed to check cluster state during deletion");
    });

    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
    tokio::time::resume();
    let _ = assertions.await;
}

```

- For API details, see [DeleteDBInstance](#) in *AWS SDK for Rust API reference*.

DescribeDBClusterParameters

The following code example shows how to use DescribeDBClusterParameters.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

    // Get the parameter group. rds.DescribeDbClusterParameterGroups
    // Get parameters in the group. This is a long list so you will have to
    paginate. Find the auto_increment_offset and auto_increment_increment parameters
    (by ParameterName). rds.DescribeDbClusterParameters
    // Parse the ParameterName, Description, and AllowedValues values and display
    them.
    pub async fn cluster_parameters(&self) -> Result<Vec<AuroraScenarioParameter>,
ScenarioError> {
        let parameters_output = self
            .rds
            .describe_db_cluster_parameters(DB_CLUSTER_PARAMETER_GROUP_NAME)
            .await;

        if let Err(err) = parameters_output {
            return Err(ScenarioError::new(
                format!("Failed to retrieve parameters for
{DB_CLUSTER_PARAMETER_GROUP_NAME}"),
                &err,
            ));
        }

        let parameters = parameters_output
            .unwrap()
            .into_iter()
            .flat_map(|p| p.parameters.unwrap_or_default().into_iter())
            .filter(|p|
FILTER_PARAMETER_NAMES.contains(p.parameter_name().unwrap_or_default()))
            .map(AuroraScenarioParameter::from)
            .collect:::<Vec<_>>();

        Ok(parameters)
    }

    pub async fn describe_db_cluster_parameters(
        &self,
        name: &str,
    ) -> Result<Vec<DescribeDbClusterParametersOutput>,
SdkError<DescribeDBClusterParametersError>>
    {
        self.inner
            .describe_db_cluster_parameters()
            .db_cluster_parameter_group_name(name)
            .into_paginator()

```

```

        .send()
        .try_collect()
        .await
    }

#[tokio::test]
async fn test_scenario_cluster_parameters() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_db_cluster_parameters()
        .with(eq("RustSDKCodeExamplesDBParameterGroup"))
        .return_once(|_| {
            Ok(vec![DescribeDbClusterParametersOutput::builder()
                .parameters(Parameter::builder().parameter_name("a").build())
                .parameters(Parameter::builder().parameter_name("b").build())
                .parameters(
                    Parameter::builder()
                        .parameter_name("auto_increment_offset")
                        .build(),
                )
                .parameters(Parameter::builder().parameter_name("c").build())
                .parameters(
                    Parameter::builder()
                        .parameter_name("auto_increment_increment")
                        .build(),
                )
                .parameters(Parameter::builder().parameter_name("d").build())
                .build()])
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some("RustSDKCodeExamplesDBCluster".into());

    let params = scenario.cluster_parameters().await.expect("cluster params");
    let names: Vec<String> = params.into_iter().map(|p| p.name).collect();
    assert_eq!(
        names,
        vec!["auto_increment_offset", "auto_increment_increment"]
    );
}

#[tokio::test]
async fn test_scenario_cluster_parameters_error() {

```



```

let mut mock_rds = MockRdsImpl::default();

mock_rds
    .expect_describe_db_cluster_parameters()
    .with(eq("RustSDKCodeExamplesDBParameterGroup"))
    .return_once(|_| {
        Err(SdkError::service_error(
            DescribeDBClusterParametersError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "describe_db_cluster_parameters_error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some("RustSDKCodeExamplesDBCluster".into());
let params = scenario.cluster_parameters().await;
assert_matches!(params, Err(ScenarioError { message, context: _ }) if message ==
"Failed to retrieve parameters for RustSDKCodeExamplesDBParameterGroup");
}

```

- For API details, see [DescribeDBClusterParameters](#) in *AWS SDK for Rust API reference*.

DescribeDBClusters

The following code example shows how to use DescribeDBClusters.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

// Get a list of allowed engine versions.
rds.DescribeDbEngineVersions(Engine='aurora-mysql', DBParameterGroupFamily=<the
family used to create your parameter group in step 2>)
// Create an Aurora DB cluster database cluster that contains a MySQL database
and uses the parameter group you created.

```

```

    // Wait for DB cluster to be ready. Call rds.DescribeDBClusters and check for
    Status == 'available'.
    // Get a list of instance classes available for the selected engine and engine
    version. rds.DescribeOrderableDbInstanceOptions(Engine='mysql', EngineVersion=).

    // Create a database instance in the cluster.
    // Wait for DB instance to be ready. Call rds.DescribeDbInstances and check for
    DBInstanceStatus == 'available'.
    pub async fn start_cluster_and_instance(&mut self) -> Result<(), ScenarioError>
    {
        if self.password.is_none() {
            return Err(ScenarioError::with(
                "Must set Secret Password before starting a cluster",
            ));
        }
        let create_db_cluster = self
            .rds
            .create_db_cluster(
                DB_CLUSTER_IDENTIFIER,
                DB_CLUSTER_PARAMETER_GROUP_NAME,
                DB_ENGINE,
                self.engine_version.as_deref().expect("engine version"),
                self.username.as_deref().expect("username"),
                self.password
                    .replace(SecretString::new("").to_string())
                    .expect("password"),
            )
            .await;
        if let Err(err) = create_db_cluster {
            return Err(ScenarioError::new(
                "Failed to create DB Cluster with cluster group",
                &err,
            ));
        }

        self.db_cluster_identifier = create_db_cluster
            .unwrap()
            .db_cluster
            .and_then(|c| c.db_cluster_identifier);

        if self.db_cluster_identifier.is_none() {
            return Err(ScenarioError::with("Created DB Cluster missing
Identifier"));
        }
    }

```

```
info!(
    "Started a db cluster: {}",
    self.db_cluster_identifier
        .as_deref()
        .unwrap_or("Missing ARN")
);

let create_db_instance = self
    .rds
    .create_db_instance(
        self.db_cluster_identifier.as_deref().expect("cluster name"),
        DB_INSTANCE_IDENTIFIER,
        self.instance_class.as_deref().expect("instance class"),
        DB_ENGINE,
    )
    .await;
if let Err(err) = create_db_instance {
    return Err(ScenarioError::new(
        "Failed to create Instance in DB Cluster",
        &err,
    ));
}

self.db_instance_identifier = create_db_instance
    .unwrap()
    .db_instance
    .and_then(|i| i.db_instance_identifier);

// Cluster creation can take up to 20 minutes to become available
let cluster_max_wait = Duration::from_secs(20 * 60);
let waiter = Waiter::builder().max(cluster_max_wait).build();
while waiter.sleep().await.is_ok() {
    let cluster = self
        .rds
        .describe_db_clusters(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = cluster {
        warn!(?err, "Failed to describe cluster while waiting for ready");
    }
}
```

```
        continue;
    }

    let instance = self
        .rds
        .describe_db_instance(
            self.db_instance_identifier
                .as_deref()
                .expect("instance identifier"),
        )
        .await;
    if let Err(err) = instance {
        return Err(ScenarioError::new(
            "Failed to find instance for cluster",
            &err,
        ));
    }

    let instances_available = instance
        .unwrap()
        .db_instances()
        .iter()
        .all(|instance| instance.db_instance_status() == Some("Available"));

    let endpoints = self
        .rds
        .describe_db_cluster_endpoints(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = endpoints {
        return Err(ScenarioError::new(
            "Failed to find endpoint for cluster",
            &err,
        ));
    }

    let endpoints_available = endpoints
        .unwrap()
        .db_cluster_endpoints()
        .iter()
```

```

        .all(|endpoint| endpoint.status() == Some("available"));

        if instances_available && endpoints_available {
            return Ok(());
        }
    }

    Err(ScenarioError::with("timed out waiting for cluster"))
}

pub async fn describe_db_clusters(
    &self,
    id: &str,
) -> Result<DescribeDbClustersOutput, SdkError<DescribeDBClustersError>> {
    self.inner
        .describe_db_clusters()
        .db_cluster_identifier(id)
        .send()
        .await
}

#[tokio::test]
async fn test_start_cluster_and_instance() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
            true
        })
        .return_once(|id, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
                .build());
        });

    mock_rds
        .expect_create_db_instance()

```

```
.withf(|cluster, name, class, engine| {
    assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");
    assert_eq!(name, "RustSDKCodeExamplesDBInstance");
    assert_eq!(class, "m5.large");
    assert_eq!(engine, "aurora-mysql");
    true
})
.return_once(|cluster, name, class, _| {
    Ok(CreateDbInstanceOutput::builder()
        .db_instance(
            DbInstance::builder()
                .db_cluster_identifier(cluster)
                .db_instance_identifier(name)
                .db_instance_class(class)
                .build(),
        )
        .build())
});

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|id| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_describe_db_instance()
    .with(eq("RustSDKCodeExamplesDBInstance"))
    .return_once(|name| {
        Ok(DescribeDbInstancesOutput::builder()
            .db_instances(
                DbInstance::builder()
                    .db_instance_identifier(name)
                    .db_instance_status("Available")
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_cluster_endpoints()
```

```

        .with(eq("RustSDKCodeExamplesDBCluster"))
        .return_once(|_| {
            Ok(DescribeDbClusterEndpointsOutput::builder()

.db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
                .build())
        });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let create = scenario.start_cluster_and_instance().await;
    assert!(create.is_ok());
    assert!(scenario
        .password
        .replace(SecretString::new("BAD SECRET".into()))
        .unwrap()
        .expose_secret()
        .is_empty());
    assert_eq!(
        scenario.db_cluster_identifier,
        Some("RustSDKCodeExamplesDBCluster".into())
    );
});
tokio::time::advance(Duration::from_secs(1)).await;
tokio::time::resume();
let _ = assertions.await;
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Err(SdkError::service_error(
                CreateDBClusterError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,

```

```

        "create db cluster error",
    )))
    Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
    ))
});

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

let create = scenario.start_cluster_and_instance().await;
assert_matches!(create, Err(ScenarioError { message, context: _}) if message ==
"Failed to create DB Cluster with cluster group")
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_missing_id() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().build())
                .build())
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_version = Some("aurora-mysql8.0".into());
    scenario.instance_class = Some("m5.large".into());
    scenario.username = Some("test username".into());
    scenario.password = Some(SecretString::new("test password".into()));

    let create = scenario.start_cluster_and_instance().await;
    assert_matches!(create, Err(ScenarioError { message, context: _ }) if message ==
"Created DB Cluster missing Identifier");
}

#[tokio::test]
async fn test_start_cluster_and_instance_instance_create_error() {
    let mut mock_rds = MockRdsImpl::default();

```



```

mock_rds
    .expect_create_db_cluster()
    .withf(|id, params, engine, version, username, password| {
        assert_eq!(id, "RustSDKCodeExamplesDBCluster");
        assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
        assert_eq!(engine, "aurora-mysql");
        assert_eq!(version, "aurora-mysql8.0");
        assert_eq!(username, "test username");
        assert_eq!(password.expose_secret(), "test password");
        true
    })
    .return_once(|id, _, _, _, _| {
        Ok(CreateDbClusterOutput::builder()
            .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_create_db_instance()
    .return_once(|_, _, _, _| {
        Err(SdkError::service_error(
            CreateDBInstanceError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "create db instance error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

let create = scenario.start_cluster_and_instance().await;
assert_matches!(create, Err(ScenarioError { message, context: _ }) if message ==
"Failed to create Instance in DB Cluster")
}

#[tokio::test]
async fn test_start_cluster_and_instance_wait_hiccup() {
    let mut mock_rds = MockRdsImpl::default();

```

```

mock_rds
    .expect_create_db_cluster()
    .withf(|id, params, engine, version, username, password| {
        assert_eq!(id, "RustSDKCodeExamplesDBCluster");
        assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
        assert_eq!(engine, "aurora-mysql");
        assert_eq!(version, "aurora-mysql8.0");
        assert_eq!(username, "test username");
        assert_eq!(password.expose_secret(), "test password");
        true
    })
    .return_once(|id, _, _, _, _, _| {
        Ok(CreateDbClusterOutput::builder()
            .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_create_db_instance()
    .withf(|cluster, name, class, engine| {
        assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");
        assert_eq!(name, "RustSDKCodeExamplesDBInstance");
        assert_eq!(class, "m5.large");
        assert_eq!(engine, "aurora-mysql");
        true
    })
    .return_once(|cluster, name, class, _| {
        Ok(CreateDbInstanceOutput::builder()
            .db_instance(
                DbInstance::builder()
                    .db_cluster_identifier(cluster)
                    .db_instance_identifier(name)
                    .db_instance_class(class)
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .times(1)
    .returning(|_| {
        Err(SdkError::service_error(

```

```

        DescribeDBClustersError::unhandled(Box::new(Error::new(
            ErrorKind::Other,
            "describe cluster error",
        ))),
        Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
    ))
})
.with(eq("RustSDKCodeExamplesDBCluster"))
.times(1)
.returning(|id| {
    Ok(DescribeDbClustersOutput::builder()
        .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
        .build())
});

mock_rds.expect_describe_db_instance().return_once(|name| {
    Ok(DescribeDbInstancesOutput::builder()
        .db_instances(
            DbInstance::builder()
                .db_instance_identifier(name)
                .db_instance_status("Available")
                .build(),
        )
        .build())
});

mock_rds
    .expect_describe_db_cluster_endpoints()
    .return_once(|_| {
        Ok(DescribeDbClusterEndpointsOutput::builder()

.db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
        .build())
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let create = scenario.start_cluster_and_instance().await;

```

```

        assert!(create.is_ok());
    });

    tokio::time::advance(Duration::from_secs(1)).await;
    tokio::time::advance(Duration::from_secs(1)).await;
    tokio::time::resume();
    let _ = assertions.await;
}

```

- For API details, see [DescribeDBClusters](#) in *AWS SDK for Rust API reference*.

DescribeDBEngineVersions

The following code example shows how to use DescribeDBEngineVersions.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

// Get available engine families for Aurora MySQL.
rds.DescribeDbEngineVersions(Engine='aurora-mysql') and build a set of the
'DBParameterGroupFamily' field values. I get {aurora-mysql8.0, aurora-mysql5.7}.
pub async fn get_engines(&self) -> Result<HashMap<String, Vec<String>>,
ScenarioError> {
    let describe_db_engine_versions =
self.rds.describe_db_engine_versions(DB_ENGINE).await;
    trace!(versions=?describe_db_engine_versions, "full list of versions");

    if let Err(err) = describe_db_engine_versions {
        return Err(ScenarioError::new(
            "Failed to retrieve DB Engine Versions",
            &err,
        ));
    };

    let version_count = describe_db_engine_versions
        .as_ref()

```

```

        .map(|o| o.db_engine_versions().len())
        .unwrap_or_default();
    info!(version_count, "got list of versions");

    // Create a map of engine families to their available versions.
    let mut versions = HashMap::<String, Vec<String>>::new();
    describe_db_engine_versions
        .unwrap()
        .db_engine_versions()
        .iter()
        .filter_map(
            |v| match (&v.db_parameter_group_family, &v.engine_version) {
                (Some(family), Some(version)) => Some((family.clone(),
version.clone())),
                _ => None,
            },
        )
        .for_each(|(family, version)|
versions.entry(family).or_default().push(version));

    Ok(versions)
}

pub async fn describe_db_engine_versions(
    &self,
    engine: &str,
) -> Result<DescribeDbEngineVersionsOutput,
SdkError<DescribeDBEngineVersionsError>> {
    self.inner
        .describe_db_engine_versions()
        .engine(engine)
        .send()
        .await
}

#[tokio::test]
async fn test_scenario_get_engines() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_db_engine_versions()
        .with(eq("aurora-mysql"))
        .return_once(|_| {
            Ok(DescribeDbEngineVersionsOutput::builder())
        })
}

```

```

        .db_engine_versions(
            DbEngineVersion::builder()
                .db_parameter_group_family("f1")
                .engine_version("f1a")
                .build(),
        )
        .db_engine_versions(
            DbEngineVersion::builder()
                .db_parameter_group_family("f1")
                .engine_version("f1b")
                .build(),
        )
        .db_engine_versions(
            DbEngineVersion::builder()
                .db_parameter_group_family("f2")
                .engine_version("f2a")
                .build(),
        )
        .db_engine_versions(DbEngineVersion::builder().build())
        .build()
    });

let scenario = AuroraScenario::new(mock_rds);

let versions_map = scenario.get_engines().await;

assert_eq!(
    versions_map,
    Ok(HashMap::from([
        ("f1".into(), vec!["f1a".into(), "f1b".into()]),
        ("f2".into(), vec!["f2a".into()])
    ]))
);
}

#[tokio::test]
async fn test_scenario_get_engines_failed() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_db_engine_versions()
        .with(eq("aurora-mysql"))
        .return_once(|_| {
            Err(SdkError::service_error(

```

```

        DescribeDBEngineVersionsError::unhandled(Box::new(Error::new(
            ErrorKind::Other,
            "describe_db_engine_versions error",
        ))),
        Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
    ))
});

let scenario = AuroraScenario::new(mock_rds);

let versions_map = scenario.get_engines().await;
assert_matches!(
    versions_map,
    Err(ScenarioError { message, context: _ }) if message == "Failed to retrieve
DB Engine Versions"
);
}

```

- For API details, see [DescribeDBEngineVersions](#) in *AWS SDK for Rust API reference*.

DescribeDBInstances

The following code example shows how to use DescribeDBInstances.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

pub async fn clean_up(self) -> Result<(), Vec<ScenarioError>> {
    let mut clean_up_errors: Vec<ScenarioError> = vec![];

    // Delete the instance. rds.DeleteDbInstance.
    let delete_db_instance = self
        .rds
        .delete_db_instance(
            self.db_instance_identifier
                .as_deref()

```

```

        .expect("instance identifier"),
    )
    .await;
if let Err(err) = delete_db_instance {
    let identifier = self
        .db_instance_identifier
        .as_deref()
        .unwrap_or("Missing Instance Identifier");
    let message = format!("failed to delete db instance {identifier}");
    clean_up_errors.push(ScenarioError::new(message, &err));
} else {
    // Wait for the instance to delete
    let waiter = Waiter::default();
    while waiter.sleep().await.is_ok() {
        let describe_db_instances = self.rds.describe_db_instances().await;
        if let Err(err) = describe_db_instances {
            clean_up_errors.push(ScenarioError::new(
                "Failed to check instance state during deletion",
                &err,
            ));
            break;
        }
        let db_instances = describe_db_instances
            .unwrap()
            .db_instances()
            .iter()
            .filter(|instance| instance.db_cluster_identifier ==
self.db_cluster_identifier)
            .cloned()
            .collect:::<Vec<DbInstance>>();

        if db_instances.is_empty() {
            trace!("Delete Instance waited and no instances were found");
            break;
        }
        match db_instances.first().unwrap().db_instance_status() {
            Some("Deleting") => continue,
            Some(status) => {
                info!("Attempting to delete but instances is in {status}");
                continue;
            }
            None => {
                warn!("No status for DB instance");
                break;
            }
        }
    }
}

```



```

    }
  }
}

// Delete the DB cluster. rds.DeleteDbCluster.
let delete_db_cluster = self
  .rds
  .delete_db_cluster(
    self.db_cluster_identifier
      .as_deref()
      .expect("cluster identifier"),
  )
  .await;

if let Err(err) = delete_db_cluster {
  let identifier = self
    .db_cluster_identifier
    .as_deref()
    .unwrap_or("Missing DB Cluster Identifier");
  let message = format!("failed to delete db cluster {identifier}");
  clean_up_errors.push(ScenarioError::new(message, &err));
} else {
  // Wait for the instance and cluster to fully delete.
  rds.DescribeDbInstances and rds.DescribeDbClusters until both are not found.
  let waiter = Waiter::default();
  while waiter.sleep().await.is_ok() {
    let describe_db_clusters = self
      .rds
      .describe_db_clusters(
        self.db_cluster_identifier
          .as_deref()
          .expect("cluster identifier"),
      )
      .await;
    if let Err(err) = describe_db_clusters {
      clean_up_errors.push(ScenarioError::new(
        "Failed to check cluster state during deletion",
        &err,
      ));
      break;
    }
    let describe_db_clusters = describe_db_clusters.unwrap();
    let db_clusters = describe_db_clusters.db_clusters();

```

```

        if db_clusters.is_empty() {
            trace!("Delete cluster waited and no clusters were found");
            break;
        }
        match db_clusters.first().unwrap().status() {
            Some("Deleting") => continue,
            Some(status) => {
                info!("Attempting to delete but clusters is in {status}");
                continue;
            }
            None => {
                warn!("No status for DB cluster");
                break;
            }
        }
    }
}

// Delete the DB cluster parameter group. rds.DeleteDbClusterParameterGroup.
let delete_db_cluster_parameter_group = self
    .rds
    .delete_db_cluster_parameter_group(
        self.db_cluster_parameter_group
            .map(|g| {
                g.db_cluster_parameter_group_name
                    .unwrap_or_else(||
DB_CLUSTER_PARAMETER_GROUP_NAME.to_string())
            })
            .as_deref()
            .expect("cluster parameter group name"),
    )
    .await;
if let Err(error) = delete_db_cluster_parameter_group {
    clean_up_errors.push(ScenarioError::new(
        "Failed to delete the db cluster parameter group",
        &error,
    ))
}

if clean_up_errors.is_empty() {
    Ok(())
} else {
    Err(clean_up_errors)
}

```

```
    }

    pub async fn describe_db_instances(
        &self,
    ) -> Result<DescribeDbInstancesOutput, SdkError<DescribeDBInstancesError>> {
        self.inner.describe_db_instances().send().await
    }

#[tokio::test]
async fn test_scenario_clean_up() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_delete_db_instance()
        .with(eq("MockInstance"))
        .return_once(|_| Ok(DeleteDbInstanceOutput::builder().build()));

    mock_rds
        .expect_describe_db_instances()
        .with()
        .times(1)
        .returning(|| {
            Ok(DescribeDbInstancesOutput::builder()
                .db_instances(
                    DbInstance::builder()
                        .db_cluster_identifier("MockCluster")
                        .db_instance_status("Deleting")
                        .build(),
                )
                .build())
        })
        .with()
        .times(1)
        .returning(|| Ok(DescribeDbInstancesOutput::builder().build()));

    mock_rds
        .expect_delete_db_cluster()
        .with(eq("MockCluster"))
        .return_once(|_| Ok(DeleteDbClusterOutput::builder().build()));

    mock_rds
        .expect_describe_db_clusters()
        .with(eq("MockCluster"))
        .times(1)
```

```

        .returning(|id| {
            Ok(DescribeDbClustersOutput::builder()
                .db_clusters(
                    DbCluster::builder()
                        .db_cluster_identifier(id)
                        .status("Deleting")
                        .build(),
                )
                .build())
        })
        .with(eq("MockCluster"))
        .times(1)
        .returning(|_| Ok(DescribeDbClustersOutput::builder().build()));

mock_rds
    .expect_delete_db_cluster_parameter_group()
    .with(eq("MockParamGroup"))
    .return_once(|_|
Ok(DeleteDbClusterParameterGroupOutput::builder().build()));

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some(String::from("MockCluster"));
scenario.db_instance_identifier = Some(String::from("MockInstance"));
scenario.db_cluster_parameter_group = Some(
    DbClusterParameterGroup::builder()
        .db_cluster_parameter_group_name("MockParamGroup")
        .build(),
);

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let clean_up = scenario.clean_up().await;
    assert!(clean_up.is_ok());
});

tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances
tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
tokio::time::resume();

```

```

    let _ = assertions.await;
}

#[tokio::test]
async fn test_scenario_clean_up_errors() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_delete_db_instance()
        .with(eq("MockInstance"))
        .return_once(|_| Ok(DeleteDbInstanceOutput::builder().build()));

    mock_rds
        .expect_describe_db_instances()
        .with()
        .times(1)
        .returning(|| {
            Ok(DescribeDbInstancesOutput::builder()
                .db_instances(
                    DbInstance::builder()
                        .db_cluster_identifier("MockCluster")
                        .db_instance_status("Deleting")
                        .build(),
                )
                .build())
        })
        .with()
        .times(1)
        .returning(|| {
            Err(SdkError::service_error(
                DescribeDBInstancesError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe db instances error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    mock_rds
        .expect_delete_db_cluster()
        .with(eq("MockCluster"))
        .return_once(|_| Ok(DeleteDbClusterOutput::builder().build()));

    mock_rds

```

```

        .expect_describe_db_clusters()
        .with(eq("MockCluster"))
        .times(1)
        .returning(|id| {
            Ok(DescribeDbClustersOutput::builder()
                .db_clusters(
                    DbCluster::builder()
                        .db_cluster_identifier(id)
                        .status("Deleting")
                        .build(),
                )
                .build())
        })
        .with(eq("MockCluster"))
        .times(1)
        .returning(|_| {
            Err(SdkError::service_error(
                DescribeDBClustersError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe db clusters error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    mock_rds
        .expect_delete_db_cluster_parameter_group()
        .with(eq("MockParamGroup"))
        .return_once(|_|
Ok(DeleteDbClusterParameterGroupOutput::builder().build()));

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some(String::from("MockCluster"));
    scenario.db_instance_identifier = Some(String::from("MockInstance"));
    scenario.db_cluster_parameter_group = Some(
        DbClusterParameterGroup::builder()
            .db_cluster_parameter_group_name("MockParamGroup")
            .build(),
    );

    tokio::time::pause();
    let assertions = tokio::spawn(async move {
        let clean_up = scenario.clean_up().await;
        assert!(clean_up.is_err());
    });

```

```

    let errs = clean_up.unwrap_err();
    assert_eq!(errs.len(), 2);
    assert_matches!(errs.get(0), Some(ScenarioError {message, context: _}) if
message == "Failed to check instance state during deletion");
    assert_matches!(errs.get(1), Some(ScenarioError {message, context: _}) if
message == "Failed to check cluster state during deletion");
    });

    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
    tokio::time::resume();
    let _ = assertions.await;
}

```

- For API details, see [DescribeDBInstances](#) in *AWS SDK for Rust API reference*.

DescribeOrderableDBInstanceOptions

The following code example shows how to use `DescribeOrderableDBInstanceOptions`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

pub async fn get_instance_classes(&self) -> Result<Vec<String>, ScenarioError> {
    let describe_orderable_db_instance_options_items = self
        .rds
        .describe_orderable_db_instance_options(
            DB_ENGINE,
            self.engine_version
                .as_ref()
        )
}

```

```

        .expect("engine version for db instance options")
        .as_str(),
    )
    .await;

describe_orderable_db_instance_options_items
    .map(|options| {
        options
            .iter()
            .map(|o| o.db_instance_class().unwrap_or_default().to_string())
            .collect::<Vec<String>>())
    })
    .map_err(|err| ScenarioError::new("Could not get available instance
classes", &err))
}

pub async fn describe_orderable_db_instance_options(
    &self,
    engine: &str,
    engine_version: &str,
) -> Result<Vec<OrderableDbInstanceOption>,
SdkError<DescribeOrderableDBInstanceOptionsError>>
{
    self.inner
        .describe_orderable_db_instance_options()
        .engine(engine)
        .engine_version(engine_version)
        .into_paginator()
        .items()
        .send()
        .try_collect()
        .await
}

#[tokio::test]
async fn test_scenario_get_instance_classes() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster_parameter_group()
        .return_once(|_, _, _| {
            Ok(CreateDbClusterParameterGroupOutput::builder()

.db_cluster_parameter_group(DbClusterParameterGroup::builder().build())

```



```

        .build())
    });

mock_rds
    .expect_describe_orderable_db_instance_options()
    .with(eq("aurora-mysql"), eq("aurora-mysql8.0"))
    .return_once(|_, _| {
        Ok(vec![
            OrderableDbInstanceOption::builder()
                .db_instance_class("t1")
                .build(),
            OrderableDbInstanceOption::builder()
                .db_instance_class("t2")
                .build(),
            OrderableDbInstanceOption::builder()
                .db_instance_class("t3")
                .build(),
        ])
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario
    .set_engine("aurora-mysql", "aurora-mysql8.0")
    .await
    .expect("set engine");

let instance_classes = scenario.get_instance_classes().await;

assert_eq!(
    instance_classes,
    Ok(vec!["t1".into(), "t2".into(), "t3".into()])
);
}

#[tokio::test]
async fn test_scenario_get_instance_classes_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_orderable_db_instance_options()
        .with(eq("aurora-mysql"), eq("aurora-mysql8.0"))
        .return_once(|_, _| {
            Err(SdkError::service_error(

```

```

DescribeOrderableDBInstanceOptionsError::unhandled(Box::new(Error::new(
    ErrorKind::Other,
    "describe_orderable_db_instance_options_error",
))),
Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
))
});

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_family = Some("aurora-mysql".into());
scenario.engine_version = Some("aurora-mysql8.0".into());

let instance_classes = scenario.get_instance_classes().await;

assert_matches!(
    instance_classes,
    Err(ScenarioError {message, context: _}) if message == "Could not get
available instance classes"
);
}

```

- For API details, see [DescribeOrderableDBInstanceOptions](#) in *AWS SDK for Rust API reference*.

ModifyDBClusterParameterGroup

The following code example shows how to use `ModifyDBClusterParameterGroup`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

// Modify both the auto_increment_offset and auto_increment_increment parameters
in one call in the custom parameter group. Set their ParameterValue fields to a new
allowable value. rds.ModifyDbClusterParameterGroup.
pub async fn update_auto_increment(
    &self,

```

```

        offset: u8,
        increment: u8,
    ) -> Result<(), ScenarioError> {
        let modify_db_cluster_parameter_group = self
            .rds
            .modify_db_cluster_parameter_group(
                DB_CLUSTER_PARAMETER_GROUP_NAME,
                vec![
                    Parameter::builder()
                        .parameter_name("auto_increment_offset")
                        .parameter_value(format!("{offset}"))
                        .apply_method(aws_sdk_rds::types::ApplyMethod::Immediate)
                        .build(),
                    Parameter::builder()
                        .parameter_name("auto_increment_increment")
                        .parameter_value(format!("{increment}"))
                        .apply_method(aws_sdk_rds::types::ApplyMethod::Immediate)
                        .build(),
                ],
            )
            .await;

        if let Err(error) = modify_db_cluster_parameter_group {
            return Err(ScenarioError::new(
                "Failed to modify cluster parameter group",
                &error,
            ));
        }

        Ok(())
    }

    pub async fn modify_db_cluster_parameter_group(
        &self,
        name: &str,
        parameters: Vec<Parameter>,
    ) -> Result<ModifyDbClusterParameterGroupOutput,
        SdkError<ModifyDBClusterParameterGroupError>>
    {
        self.inner
            .modify_db_cluster_parameter_group()
            .db_cluster_parameter_group_name(name)
            .set_parameters(Some(parameters))
            .send()
    }

```

```

        .await
    }

#[tokio::test]
async fn test_scenario_update_auto_increment() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_modify_db_cluster_parameter_group()
        .withf(|name, params| {
            assert_eq!(name, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(
                params,
                &vec![
                    Parameter::builder()
                        .parameter_name("auto_increment_offset")
                        .parameter_value("10")
                        .apply_method(aws_sdk_rds::types::ApplyMethod::Immediate)
                        .build(),
                    Parameter::builder()
                        .parameter_name("auto_increment_increment")
                        .parameter_value("20")
                        .apply_method(aws_sdk_rds::types::ApplyMethod::Immediate)
                        .build(),
                ]
            );
            true
        })
        .return_once(|_, _|
Ok(ModifyDbClusterParameterGroupOutput::builder().build()));

    let scenario = AuroraScenario::new(mock_rds);

    scenario
        .update_auto_increment(10, 20)
        .await
        .expect("update auto increment");
}

#[tokio::test]
async fn test_scenario_update_auto_increment_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds

```

```
.expect_modify_db_cluster_parameter_group()
.return_once(|_, _| {
    Err(SdkError::service_error(
        ModifyDBClusterParameterGroupError::unhandled(Box::new(Error::new(
            ErrorKind::Other,
            "modify_db_cluster_parameter_group_error",
        ))),
        Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
    ))
});

let scenario = AuroraScenario::new(mock_rds);

let update = scenario.update_auto_increment(10, 20).await;
assert_matches!(update, Err(ScenarioError { message, context: _}) if message ==
"Failed to modify cluster parameter group");
}
```

- For API details, see [ModifyDBClusterParameterGroup](#) in *AWS SDK for Rust API reference*.

Scenarios

Get started with DB clusters

The following code example shows how to:

- Create a custom Aurora DB cluster parameter group and set parameter values.
- Create a DB cluster that uses the parameter group.
- Create a DB instance that contains a database.
- Take a snapshot of the DB cluster, then clean up resources.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

A library containing the scenario-specific functions for the Aurora scenario.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

use phf::{phf_set, Set};
use secrecy::SecretString;
use std::{collections::HashMap, fmt::Display, time::Duration};

use aws_sdk_rds::{
    error::ProvideErrorMetadata,

    operation::create_db_cluster_parameter_group::CreateDbClusterParameterGroupOutput,
    types::{DbCluster, DbClusterParameterGroup, DbClusterSnapshot, DbInstance,
    Parameter},
};
use sdk_examples_test_utils::waiter::Waiter;
use tracing::{info, trace, warn};

const DB_ENGINE: &str = "aurora-mysql";
const DB_CLUSTER_PARAMETER_GROUP_NAME: &str = "RustSDKCodeExamplesDBParameterGroup";
const DB_CLUSTER_PARAMETER_GROUP_DESCRIPTION: &str =
    "Parameter Group created by Rust SDK Code Example";
const DB_CLUSTER_IDENTIFIER: &str = "RustSDKCodeExamplesDBCluster";
const DB_INSTANCE_IDENTIFIER: &str = "RustSDKCodeExamplesDBInstance";

static FILTER_PARAMETER_NAMES: Set<&'static str> = phf_set! {
    "auto_increment_offset",
    "auto_increment_increment",
};

#[derive(Debug, PartialEq, Eq)]
struct MetadataError {
    message: Option<String>,
    code: Option<String>,
}

impl MetadataError {
    fn from(err: &dyn ProvideErrorMetadata) -> Self {
        MetadataError {
            message: err.message().map(String::from),
            code: err.code().map(String::from),
        }
    }
}
```

```

}

impl Display for MetadataError {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        let display = match (&self.message, &self.code) {
            (None, None) => "Unknown".to_string(),
            (None, Some(code)) => format!("{}", code),
            (Some(message), None) => message.to_string(),
            (Some(message), Some(code)) => format!("{}", message, code),
        };
        write!(f, "{}", display)
    }
}

#[derive(Debug, PartialEq, Eq)]
pub struct ScenarioError {
    message: String,
    context: Option<MetadataError>,
}

impl ScenarioError {
    pub fn with(message: impl Into<String>) -> Self {
        ScenarioError {
            message: message.into(),
            context: None,
        }
    }

    pub fn new(message: impl Into<String>, err: &dyn ProvideErrorMetadata) -> Self {
        ScenarioError {
            message: message.into(),
            context: Some(MetadataError::from(err)),
        }
    }
}

impl std::error::Error for ScenarioError {}
impl Display for ScenarioError {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        match &self.context {
            Some(c) => write!(f, "{}: {}", self.message, c),
            None => write!(f, "{}", self.message),
        }
    }
}

```

```

}

// Parse the ParameterName, Description, and AllowedValues values and display them.
#[derive(Debug)]
pub struct AuroraScenarioParameter {
    name: String,
    allowed_values: String,
    current_value: String,
}

impl Display for AuroraScenarioParameter {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        write!(
            f,
            "{}: {} (allowed: {})",
            self.name, self.current_value, self.allowed_values
        )
    }
}

impl From<aws_sdk_rds::types::Parameter> for AuroraScenarioParameter {
    fn from(value: aws_sdk_rds::types::Parameter) -> Self {
        AuroraScenarioParameter {
            name: value.parameter_name.unwrap_or_default(),
            allowed_values: value.allowed_values.unwrap_or_default(),
            current_value: value.parameter_value.unwrap_or_default(),
        }
    }
}

pub struct AuroraScenario {
    rds: crate::rds::Rds,
    engine_family: Option<String>,
    engine_version: Option<String>,
    instance_class: Option<String>,
    db_cluster_parameter_group: Option<DbClusterParameterGroup>,
    db_cluster_identifier: Option<String>,
    db_instance_identifier: Option<String>,
    username: Option<String>,
    password: Option<SecretString>,
}

impl AuroraScenario {
    pub fn new(client: crate::rds::Rds) -> Self {

```



```

    AuroraScenario {
        rds: client,
        engine_family: None,
        engine_version: None,
        instance_class: None,
        db_cluster_parameter_group: None,
        db_cluster_identifier: None,
        db_instance_identifier: None,
        username: None,
        password: None,
    }
}

// snippet-start:[rust.aurora.get_engines.usage]
// Get available engine families for Aurora MySQL.
rds.DescribeDbEngineVersions(Engine='aurora-mysql') and build a set of the
'DBParameterGroupFamily' field values. I get {aurora-mysql8.0, aurora-mysql5.7}.
pub async fn get_engines(&self) -> Result<HashMap<String, Vec<String>>,
ScenarioError> {
    let describe_db_engine_versions =
self.rds.describe_db_engine_versions(DB_ENGINE).await;
    trace!(versions=?describe_db_engine_versions, "full list of versions");

    if let Err(err) = describe_db_engine_versions {
        return Err(ScenarioError::new(
            "Failed to retrieve DB Engine Versions",
            &err,
        ));
    };

    let version_count = describe_db_engine_versions
        .as_ref()
        .map(|o| o.db_engine_versions().len())
        .unwrap_or_default();
    info!(version_count, "got list of versions");

    // Create a map of engine families to their available versions.
    let mut versions = HashMap:::<String, Vec<String>>::new();
    describe_db_engine_versions
        .unwrap()
        .db_engine_versions()
        .iter()
        .filter_map(
            |v| match (&v.db_parameter_group_family, &v.engine_version) {

```

```

                (Some(family), Some(version)) => Some((family.clone(),
version.clone()))),
                _ => None,
            },
        )
        .for_each(|(family, version)|
versions.entry(family).or_default().push(version));

    Ok(versions)
}
// snippet-end:[rust.aurora.get_engines.usage]

// snippet-start:[rust.aurora.get_instance_classes.usage]
pub async fn get_instance_classes(&self) -> Result<Vec<String>, ScenarioError> {
    let describe_orderable_db_instance_options_items = self
        .rds
        .describe_orderable_db_instance_options(
            DB_ENGINE,
            self.engine_version
                .as_ref()
                .expect("engine version for db instance options")
                .as_str(),
        )
        .await;

    describe_orderable_db_instance_options_items
        .map(|options| {
            options
                .iter()
                .map(|o| o.db_instance_class().unwrap_or_default().to_string())
                .collect:::<Vec<String>>()
        })
        .map_err(|err| ScenarioError::new("Could not get available instance
classes", &err))
    }
// snippet-end:[rust.aurora.get_instance_classes.usage]

// snippet-start:[rust.aurora.set_engine.usage]
// Select an engine family and create a custom DB cluster parameter group.
rds.CreateDbClusterParameterGroup(DBParameterGroupFamily='aurora-mysql8.0')
pub async fn set_engine(&mut self, engine: &str, version: &str) -> Result<(),
ScenarioError> {
    self.engine_family = Some(engine.to_string());
    self.engine_version = Some(version.to_string());
}

```

```

let create_db_cluster_parameter_group = self
    .rds
    .create_db_cluster_parameter_group(
        DB_CLUSTER_PARAMETER_GROUP_NAME,
        DB_CLUSTER_PARAMETER_GROUP_DESCRIPTION,
        engine,
    )
    .await;

match create_db_cluster_parameter_group {
    Ok(CreateDbClusterParameterGroupOutput {
        db_cluster_parameter_group: None,
        ..
    }) => {
        return Err(ScenarioError::with(
            "CreateDBClusterParameterGroup had empty response",
        ));
    }
    Err(error) => {
        if error.code() == Some("DBParameterGroupAlreadyExists") {
            info!("Cluster Parameter Group already exists, nothing to do");
        } else {
            return Err(ScenarioError::new(
                "Could not create Cluster Parameter Group",
                &error,
            ));
        }
    }
    _ => {
        info!("Created Cluster Parameter Group");
    }
}

Ok(())
}
// snippet-end:[rust.aurora.set_engine.usage]

pub fn set_instance_class(&mut self, instance_class: Option<String>) {
    self.instance_class = instance_class;
}

pub fn set_login(&mut self, username: Option<String>, password:
Option<SecretString>) {
    self.username = username;
}

```

```

        self.password = password;
    }

    pub async fn connection_string(&self) -> Result<String, ScenarioError> {
        let cluster = self.get_cluster().await?;
        let endpoint = cluster.endpoint().unwrap_or_default();
        let port = cluster.port().unwrap_or_default();
        let username = cluster.master_username().unwrap_or_default();
        Ok(format!("mysql -h {endpoint} -P {port} -u {username} -p"))
    }

    // snippet-start:[rust.aurora.get_cluster.usage]
    pub async fn get_cluster(&self) -> Result<DbCluster, ScenarioError> {
        let describe_db_clusters_output = self
            .rds
            .describe_db_clusters(
                self.db_cluster_identifier
                    .as_ref()
                    .expect("cluster identifier")
                    .as_str(),
            )
            .await;
        if let Err(err) = describe_db_clusters_output {
            return Err(ScenarioError::new("Failed to get cluster", &err));
        }

        let db_cluster = describe_db_clusters_output
            .unwrap()
            .db_clusters
            .and_then(|output| output.first().cloned());

        db_cluster.ok_or_else(|| ScenarioError::with("Did not find the cluster"))
    }
    // snippet-end:[rust.aurora.get_cluster.usage]

    // snippet-start:[rust.aurora.cluster_parameters.usage]
    // Get the parameter group. rds.DescribeDbClusterParameterGroups
    // Get parameters in the group. This is a long list so you will have to
    paginate. Find the auto_increment_offset and auto_increment_increment parameters
    (by ParameterName). rds.DescribeDbClusterParameters
    // Parse the ParameterName, Description, and AllowedValues values and display
    them.
    pub async fn cluster_parameters(&self) -> Result<Vec<AuroraScenarioParameter>,
    ScenarioError> {

```

```

    let parameters_output = self
        .rds
        .describe_db_cluster_parameters(DB_CLUSTER_PARAMETER_GROUP_NAME)
        .await;

    if let Err(err) = parameters_output {
        return Err(ScenarioError::new(
            format!("Failed to retrieve parameters for
{DB_CLUSTER_PARAMETER_GROUP_NAME}"),
            &err,
        ));
    }

    let parameters = parameters_output
        .unwrap()
        .into_iter()
        .flat_map(|p| p.parameters.unwrap_or_default().into_iter())
        .filter(|p|
FILTER_PARAMETER_NAMES.contains(p.parameter_name().unwrap_or_default()))
        .map(AuroraScenarioParameter::from)
        .collect::<Vec<_>>();

    Ok(parameters)
}
// snippet-end:[rust.aurora.cluster_parameters.usage]

// snippet-start:[rust.aurora.update_auto_increment.usage]
// Modify both the auto_increment_offset and auto_increment_increment parameters
in one call in the custom parameter group. Set their ParameterValue fields to a new
allowable value. rds.ModifyDbClusterParameterGroup.
pub async fn update_auto_increment(
    &self,
    offset: u8,
    increment: u8,
) -> Result<(), ScenarioError> {
    let modify_db_cluster_parameter_group = self
        .rds
        .modify_db_cluster_parameter_group(
            DB_CLUSTER_PARAMETER_GROUP_NAME,
            vec![
                Parameter::builder()
                    .parameter_name("auto_increment_offset")
                    .parameter_value(format!("{offset}"))
                    .apply_method(aws_sdk_rds::types::ApplyMethod::Immediate)

```

```

        .build(),
        Parameter::builder()
            .parameter_name("auto_increment_increment")
            .parameter_value(format!("{increment}"))
            .apply_method(aws_sdk_rds::types::ApplyMethod::Immediate)
            .build(),
    ],
)
.await;

if let Err(error) = modify_db_cluster_parameter_group {
    return Err(ScenarioError::new(
        "Failed to modify cluster parameter group",
        &error,
    ));
}

Ok(())
}
// snippet-end:[rust.aurora.update_auto_increment.usage]

// snippet-start:[rust.aurora.start_cluster_and_instance.usage]
// Get a list of allowed engine versions.
rds.DescribeDbEngineVersions(Engine='aurora-mysql', DBParameterGroupFamily=<the
family used to create your parameter group in step 2>)
// Create an Aurora DB cluster database cluster that contains a MySQL database
and uses the parameter group you created.
// Wait for DB cluster to be ready. Call rds.DescribeDBClusters and check for
Status == 'available'.
// Get a list of instance classes available for the selected engine and engine
version. rds.DescribeOrderableDbInstanceOptions(Engine='mysql', EngineVersion=).

// Create a database instance in the cluster.
// Wait for DB instance to be ready. Call rds.DescribeDbInstances and check for
DBInstanceStatus == 'available'.
pub async fn start_cluster_and_instance(&mut self) -> Result<(), ScenarioError>
{
    if self.password.is_none() {
        return Err(ScenarioError::with(
            "Must set Secret Password before starting a cluster",
        ));
    }
    let create_db_cluster = self
        .rds

```

```
        .create_db_cluster(
            DB_CLUSTER_IDENTIFIER,
            DB_CLUSTER_PARAMETER_GROUP_NAME,
            DB_ENGINE,
            self.engine_version.as_deref().expect("engine version"),
            self.username.as_deref().expect("username"),
            self.password
                .replace(SecretString::new("").to_string()))
                .expect("password"),
        )
        .await;
    if let Err(err) = create_db_cluster {
        return Err(ScenarioError::new(
            "Failed to create DB Cluster with cluster group",
            &err,
        ));
    }

    self.db_cluster_identifier = create_db_cluster
        .unwrap()
        .db_cluster
        .and_then(|c| c.db_cluster_identifier);

    if self.db_cluster_identifier.is_none() {
        return Err(ScenarioError::with("Created DB Cluster missing
Identifier"));
    }

    info!(
        "Started a db cluster: {}",
        self.db_cluster_identifier
            .as_deref()
            .unwrap_or("Missing ARN")
    );

    let create_db_instance = self
        .rds
        .create_db_instance(
            self.db_cluster_identifier.as_deref().expect("cluster name"),
            DB_INSTANCE_IDENTIFIER,
            self.instance_class.as_deref().expect("instance class"),
            DB_ENGINE,
        )
        .await;
```

```
if let Err(err) = create_db_instance {
    return Err(ScenarioError::new(
        "Failed to create Instance in DB Cluster",
        &err,
    ));
}

self.db_instance_identifier = create_db_instance
    .unwrap()
    .db_instance
    .and_then(|i| i.db_instance_identifier);

// Cluster creation can take up to 20 minutes to become available
let cluster_max_wait = Duration::from_secs(20 * 60);
let waiter = Waiter::builder().max(cluster_max_wait).build();
while waiter.sleep().await.is_ok() {
    let cluster = self
        .rds
        .describe_db_clusters(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = cluster {
        warn!(?err, "Failed to describe cluster while waiting for ready");
        continue;
    }

    let instance = self
        .rds
        .describe_db_instance(
            self.db_instance_identifier
                .as_deref()
                .expect("instance identifier"),
        )
        .await;
    if let Err(err) = instance {
        return Err(ScenarioError::new(
            "Failed to find instance for cluster",
            &err,
        ));
    }
}
```



```

    let instances_available = instance
        .unwrap()
        .db_instances()
        .iter()
        .all(|instance| instance.db_instance_status() == Some("Available"));

    let endpoints = self
        .rds
        .describe_db_cluster_endpoints(
            self.db_cluster_identifier
                .as_deref()
                .expect("cluster identifier"),
        )
        .await;

    if let Err(err) = endpoints {
        return Err(ScenarioError::new(
            "Failed to find endpoint for cluster",
            &err,
        ));
    }

    let endpoints_available = endpoints
        .unwrap()
        .db_cluster_endpoints()
        .iter()
        .all(|endpoint| endpoint.status() == Some("available"));

    if instances_available && endpoints_available {
        return Ok(());
    }

    Err(ScenarioError::with("timed out waiting for cluster"))
}
// snippet-end:[rust.aurora.start_cluster_and_instance.usage]

// snippet-start:[rust.aurora.snapshot.usage]
// Create a snapshot of the DB cluster. rds.CreateDbClusterSnapshot.
// Wait for the snapshot to create. rds.DescribeDbClusterSnapshots until Status
== 'available'.
pub async fn snapshot(&self, name: &str) -> Result<DbClusterSnapshot,
ScenarioError> {

```

```

let id = self.db_cluster_identifier.as_deref().unwrap_or_default();
let snapshot = self
    .rds
    .snapshot_cluster(id, format!("{id}_{name}").as_str())
    .await;
match snapshot {
    Ok(output) => match output.db_cluster_snapshot {
        Some(snapshot) => Ok(snapshot),
        None => Err(ScenarioError::with("Missing Snapshot")),
    },
    Err(err) => Err(ScenarioError::new("Failed to create snapshot", &err)),
}
}
// snippet-end:[rust.aurora.snapshot.usage]

// snippet-start:[rust.aurora.clean_up.usage]
pub async fn clean_up(self) -> Result<(), Vec<ScenarioError>> {
    let mut clean_up_errors: Vec<ScenarioError> = vec![];

    // Delete the instance. rds.DeleteDbInstance.
    let delete_db_instance = self
        .rds
        .delete_db_instance(
            self.db_instance_identifier
                .as_deref()
                .expect("instance identifier"),
        )
        .await;
    if let Err(err) = delete_db_instance {
        let identifier = self
            .db_instance_identifier
            .as_deref()
            .unwrap_or("Missing Instance Identifier");
        let message = format!("failed to delete db instance {identifier}");
        clean_up_errors.push(ScenarioError::new(message, &err));
    } else {
        // Wait for the instance to delete
        let waiter = Waiter::default();
        while waiter.sleep().await.is_ok() {
            let describe_db_instances = self.rds.describe_db_instances().await;
            if let Err(err) = describe_db_instances {
                clean_up_errors.push(ScenarioError::new(
                    "Failed to check instance state during deletion",
                    &err,
                ));
            }
        }
    }
}

```

```

        ));
        break;
    }
    let db_instances = describe_db_instances
        .unwrap()
        .db_instances()
        .iter()
        .filter(|instance| instance.db_cluster_identifier ==
self.db_cluster_identifier)
        .cloned()
        .collect::<Vec<DbInstance>>();

    if db_instances.is_empty() {
        trace!("Delete Instance waited and no instances were found");
        break;
    }
    match db_instances.first().unwrap().db_instance_status() {
        Some("Deleting") => continue,
        Some(status) => {
            info!("Attempting to delete but instances is in {status}");
            continue;
        }
        None => {
            warn!("No status for DB instance");
            break;
        }
    }
}
}

// Delete the DB cluster. rds.DeleteDbCluster.
let delete_db_cluster = self
    .rds
    .delete_db_cluster(
        self.db_cluster_identifier
            .as_deref()
            .expect("cluster identifier"),
    )
    .await;

if let Err(err) = delete_db_cluster {
    let identifier = self
        .db_cluster_identifier
        .as_deref()

```

```

        .unwrap_or("Missing DB Cluster Identifier");
        let message = format!("failed to delete db cluster {identifier}");
        clean_up_errors.push(ScenarioError::new(message, &err));
    } else {
        // Wait for the instance and cluster to fully delete.
        rds.DescribeDbInstances and rds.DescribeDbClusters until both are not found.
        let waiter = Waiter::default();
        while waiter.sleep().await.is_ok() {
            let describe_db_clusters = self
                .rds
                .describe_db_clusters(
                    self.db_cluster_identifier
                        .as_deref()
                        .expect("cluster identifier"),
                )
                .await;
            if let Err(err) = describe_db_clusters {
                clean_up_errors.push(ScenarioError::new(
                    "Failed to check cluster state during deletion",
                    &err,
                ));
                break;
            }
            let describe_db_clusters = describe_db_clusters.unwrap();
            let db_clusters = describe_db_clusters.db_clusters();
            if db_clusters.is_empty() {
                trace!("Delete cluster waited and no clusters were found");
                break;
            }
            match db_clusters.first().unwrap().status() {
                Some("Deleting") => continue,
                Some(status) => {
                    info!("Attempting to delete but clusters is in {status}");
                    continue;
                }
                None => {
                    warn!("No status for DB cluster");
                    break;
                }
            }
        }
    }
}

// Delete the DB cluster parameter group. rds.DeleteDbClusterParameterGroup.

```

```

    let delete_db_cluster_parameter_group = self
        .rds
        .delete_db_cluster_parameter_group(
            self.db_cluster_parameter_group
                .map(|g| {
                    g.db_cluster_parameter_group_name
                        .unwrap_or_else(||
DB_CLUSTER_PARAMETER_GROUP_NAME.to_string())
                })
                .as_deref()
                .expect("cluster parameter group name"),
        )
        .await;
    if let Err(error) = delete_db_cluster_parameter_group {
        clean_up_errors.push(ScenarioError::new(
            "Failed to delete the db cluster parameter group",
            &error,
        ))
    }

    if clean_up_errors.is_empty() {
        Ok(())
    } else {
        Err(clean_up_errors)
    }
}
// snippet-end:[rust.aurora.clean_up.usage]
}

#[cfg(test)]
pub mod tests;

```

Tests for the library using automocks around the RDS Client wrapper.

```

// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

use crate::rds::MockRdsImpl;

use super::*;

use std::io::{Error, ErrorKind};

```

```

use assert_matches::assert_matches;
use aws_sdk_rds::{
    error::SdkError,
    operation::{
        create_db_cluster::{CreateDBClusterError, CreateDbClusterOutput},
        create_db_cluster_parameter_group::CreateDBClusterParameterGroupError,
        create_db_cluster_snapshot::{CreateDBClusterSnapshotError,
CreateDbClusterSnapshotOutput},
        create_db_instance::{CreateDBInstanceError, CreateDbInstanceOutput},
        delete_db_cluster::DeleteDbClusterOutput,
        delete_db_cluster_parameter_group::DeleteDbClusterParameterGroupOutput,
        delete_db_instance::DeleteDbInstanceOutput,
        describe_db_cluster_endpoints::DescribeDbClusterEndpointsOutput,
        describe_db_cluster_parameters::{
            DescribeDBClusterParametersError, DescribeDbClusterParametersOutput,
        },
        describe_db_clusters::{DescribeDBClustersError, DescribeDbClustersOutput},
        describe_db_engine_versions::{
            DescribeDBEngineVersionsError, DescribeDbEngineVersionsOutput,
        },
        describe_db_instances::{DescribeDBInstancesError,
DescribeDbInstancesOutput},

describe_orderable_db_instance_options::DescribeOrderableDBInstanceOptionsError,
        modify_db_cluster_parameter_group::{
            ModifyDBClusterParameterGroupError, ModifyDbClusterParameterGroupOutput,
        },
    },
    types::{
        error::DbParameterGroupAlreadyExistsFault, DbClusterEndpoint,
        DbEngineVersion,
        OrderableDbInstanceOption,
    },
};
use aws_smithy_runtime_api::http::{Response, StatusCode};
use aws_smithy_types::body::SdkBody;
use mockall::predicate::eq;
use secrecy::ExposeSecret;

// snippet-start:[rust.aurora.set_engine.test]
#[tokio::test]
async fn test_scenario_set_engine() {
    let mut mock_rds = MockRdsImpl::default();

```

```

mock_rds
    .expect_create_db_cluster_parameter_group()
    .with(
        eq("RustSDKCodeExamplesDBParameterGroup"),
        eq("Parameter Group created by Rust SDK Code Example"),
        eq("aurora-mysql"),
    )
    .return_once(|_, _, _| {
        Ok(CreateDbClusterParameterGroupOutput::builder()

.db_cluster_parameter_group(DbClusterParameterGroup::builder().build())
        .build())
    });

let mut scenario = AuroraScenario::new(mock_rds);

let set_engine = scenario.set_engine("aurora-mysql", "aurora-mysql8.0").await;

assert_eq!(set_engine, Ok(()));
assert_eq!(Some("aurora-mysql"), scenario.engine_family.as_deref());
assert_eq!(Some("aurora-mysql8.0"), scenario.engine_version.as_deref());
}

#[tokio::test]
async fn test_scenario_set_engine_not_create() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster_parameter_group()
        .with(
            eq("RustSDKCodeExamplesDBParameterGroup"),
            eq("Parameter Group created by Rust SDK Code Example"),
            eq("aurora-mysql"),
        )
        .return_once(|_, _, _|
Ok(CreateDbClusterParameterGroupOutput::builder().build()));

    let mut scenario = AuroraScenario::new(mock_rds);

    let set_engine = scenario.set_engine("aurora-mysql", "aurora-mysql8.0").await;

    assert!(set_engine.is_err());
}

```

```

#[tokio::test]
async fn test_scenario_set_engine_param_group_exists() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster_parameter_group()
        .withf(|_, _, _| true)
        .return_once(|_, _, _| {
            Err(SdkError::service_error(
                CreateDBClusterParameterGroupError::DbParameterGroupAlreadyExistsFault(
                    DbParameterGroupAlreadyExistsFault::builder().build(),
                ),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    let mut scenario = AuroraScenario::new(mock_rds);

    let set_engine = scenario.set_engine("aurora-mysql", "aurora-mysql8.0").await;

    assert!(set_engine.is_err());
}
// snippet-end:[rust.aurora.set_engine.test]

// snippet-start:[rust.aurora.get_engines.test]
#[tokio::test]
async fn test_scenario_get_engines() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_db_engine_versions()
        .with(eq("aurora-mysql"))
        .return_once(|_| {
            Ok(DescribeDbEngineVersionsOutput::builder()
                .db_engine_versions(
                    DbEngineVersion::builder()
                        .db_parameter_group_family("f1")
                        .engine_version("f1a")
                        .build(),
                )
                .db_engine_versions(
                    DbEngineVersion::builder()

```



```

        .db_parameter_group_family("f1")
        .engine_version("f1b")
        .build(),
    )
    .db_engine_versions(
        DbEngineVersion::builder()
        .db_parameter_group_family("f2")
        .engine_version("f2a")
        .build(),
    )
    .db_engine_versions(DbEngineVersion::builder().build())
    .build()
});

let scenario = AuroraScenario::new(mock_rds);

let versions_map = scenario.get_engines().await;

assert_eq!(
    versions_map,
    Ok(HashMap::from([
        ("f1".into(), vec!["f1a".into(), "f1b".into()]),
        ("f2".into(), vec!["f2a".into()])
    ]))
);
}

#[tokio::test]
async fn test_scenario_get_engines_failed() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_db_engine_versions()
        .with(eq("aurora-mysql"))
        .return_once(|_| {
            Err(SdkError::service_error(
                DescribeDBEngineVersionsError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe_db_engine_versions error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });
}

```

```

let scenario = AuroraScenario::new(mock_rds);

let versions_map = scenario.get_engines().await;
assert_matches!(
    versions_map,
    Err(ScenarioError { message, context: _ }) if message == "Failed to retrieve
DB Engine Versions"
);
}
// snippet-end:[rust.aurora.get_engines.test]

// snippet-start:[rust.aurora.get_instance_classes.test]
#[tokio::test]
async fn test_scenario_get_instance_classes() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster_parameter_group()
        .return_once(|_, _, _| {
            Ok(CreateDbClusterParameterGroupOutput::builder()

.db_cluster_parameter_group(DbClusterParameterGroup::builder().build())
                .build())
        });

    mock_rds
        .expect_describe_orderable_db_instance_options()
        .with(eq("aurora-mysql"), eq("aurora-mysql8.0"))
        .return_once(|_, _| {
            Ok(vec![
                OrderableDbInstanceOption::builder()
                    .db_instance_class("t1")
                    .build(),
                OrderableDbInstanceOption::builder()
                    .db_instance_class("t2")
                    .build(),
                OrderableDbInstanceOption::builder()
                    .db_instance_class("t3")
                    .build(),
            ])
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario

```

```

        .set_engine("aurora-mysql", "aurora-mysql8.0")
        .await
        .expect("set engine");

let instance_classes = scenario.get_instance_classes().await;

assert_eq!(
    instance_classes,
    Ok(vec!["t1".into(), "t2".into(), "t3".into()])
);
}

#[tokio::test]
async fn test_scenario_get_instance_classes_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_orderable_db_instance_options()
        .with(eq("aurora-mysql"), eq("aurora-mysql8.0"))
        .return_once(|_, _| {
            Err(SdkError::service_error(
                DescribeOrderableDBInstanceOptionsError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe_orderable_db_instance_options_error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_family = Some("aurora-mysql".into());
    scenario.engine_version = Some("aurora-mysql8.0".into());

    let instance_classes = scenario.get_instance_classes().await;

    assert_matches!(
        instance_classes,
        Err(ScenarioError {message, context: _}) if message == "Could not get
available instance classes"
    );
}
// snippet-end:[rust.aurora.get_instance_classes.test]

```

```
// snippet-start:[rust.aurora.get_cluster.test]
#[tokio::test]
async fn test_scenario_get_cluster() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_db_clusters()
        .with(eq("RustSDKCodeExamplesDBCluster"))
        .return_once(|_| {
            Ok(DescribeDbClustersOutput::builder()
                .db_clusters(DbCluster::builder().build())
                .build())
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some("RustSDKCodeExamplesDBCluster".into());
    let cluster = scenario.get_cluster().await;

    assert!(cluster.is_ok());
}

#[tokio::test]
async fn test_scenario_get_cluster_missing_cluster() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster_parameter_group()
        .return_once(|_, _, _| {
            Ok(CreateDbClusterParameterGroupOutput::builder()
                .db_cluster_parameter_group(DbClusterParameterGroup::builder().build())
                .build())
        });

    mock_rds
        .expect_describe_db_clusters()
        .with(eq("RustSDKCodeExamplesDBCluster"))
        .return_once(|_| Ok(DescribeDbClustersOutput::builder().build()));

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some("RustSDKCodeExamplesDBCluster".into());
    let cluster = scenario.get_cluster().await;
```

```

    assert_matches!(cluster, Err(ScenarioError { message, context: _ }) if message
== "Did not find the cluster");
}

#[tokio::test]
async fn test_scenario_get_cluster_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster_parameter_group()
        .return_once(|_, _, _| {
            Ok(CreateDbClusterParameterGroupOutput::builder())

        .db_cluster_parameter_group(DbClusterParameterGroup::builder().build())
            .build()
        });

    mock_rds
        .expect_describe_db_clusters()
        .with(eq("RustSDKCodeExamplesDBCluster"))
        .return_once(|_| {
            Err(SdkError::service_error(
                DescribeDBClustersError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe_db_clusters_error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some("RustSDKCodeExamplesDBCluster".into());
    let cluster = scenario.get_cluster().await;

    assert_matches!(cluster, Err(ScenarioError { message, context: _ }) if message
== "Failed to get cluster");
}
// snippet-end:[rust.aurora.get_cluster.test]

#[tokio::test]
async fn test_scenario_connection_string() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds

```

```

    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|_| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(
                DbCluster::builder()
                    .endpoint("test_endpoint")
                    .port(3306)
                    .master_username("test_username")
                    .build(),
            )
            .build())
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some("RustSDKCodeExamplesDBCluster".into());
let connection_string = scenario.connection_string().await;

assert_eq!(
    connection_string,
    Ok("mysql -h test_endpoint -P 3306 -u test_username -p".into())
);
}

// snippet-start:[rust.aurora.cluster_parameters.test]
#[tokio::test]
async fn test_scenario_cluster_parameters() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_db_cluster_parameters()
        .with(eq("RustSDKCodeExamplesDBParameterGroup"))
        .return_once(|_| {
            Ok(vec![DescribeDbClusterParametersOutput::builder()
                .parameters(Parameter::builder().parameter_name("a").build())
                .parameters(Parameter::builder().parameter_name("b").build())
                .parameters(
                    Parameter::builder()
                        .parameter_name("auto_increment_offset")
                        .build(),
                )
                .parameters(Parameter::builder().parameter_name("c").build())
                .parameters(
                    Parameter::builder()

```

```

        .parameter_name("auto_increment_increment")
        .build(),
    )
    .parameters(Parameter::builder().parameter_name("d").build())
    .build());
});

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some("RustSDKCodeExamplesDBCluster".into());

let params = scenario.cluster_parameters().await.expect("cluster params");
let names: Vec<String> = params.into_iter().map(|p| p.name).collect();
assert_eq!(
    names,
    vec!["auto_increment_offset", "auto_increment_increment"]
);
}

#[tokio::test]
async fn test_scenario_cluster_parameters_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_describe_db_cluster_parameters()
        .with(eq("RustSDKCodeExamplesDBParameterGroup"))
        .return_once(|_| {
            Err(SdkError::service_error(
                DescribeDBClusterParametersError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe_db_cluster_parameters_error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some("RustSDKCodeExamplesDBCluster".into());
    let params = scenario.cluster_parameters().await;
    assert_matches!(params, Err(ScenarioError { message, context: _ }) if message ==
    "Failed to retrieve parameters for RustSDKCodeExamplesDBParameterGroup");
}
// snippet-end:[rust.aurora.cluster_parameters.test]

// snippet-start:[rust.aurora.update_auto_increment.test]

```

```

#[tokio::test]
async fn test_scenario_update_auto_increment() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_modify_db_cluster_parameter_group()
        .withf(|name, params| {
            assert_eq!(name, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(
                params,
                &vec![
                    Parameter::builder()
                        .parameter_name("auto_increment_offset")
                        .parameter_value("10")
                        .apply_method(aws_sdk_rds::types::ApplyMethod::Immediate)
                        .build(),
                    Parameter::builder()
                        .parameter_name("auto_increment_increment")
                        .parameter_value("20")
                        .apply_method(aws_sdk_rds::types::ApplyMethod::Immediate)
                        .build(),
                ]
            );
            true
        })
        .return_once(|_, _|
Ok(ModifyDbClusterParameterGroupOutput::builder().build()));

    let scenario = AuroraScenario::new(mock_rds);

    scenario
        .update_auto_increment(10, 20)
        .await
        .expect("update auto increment");
}

#[tokio::test]
async fn test_scenario_update_auto_increment_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_modify_db_cluster_parameter_group()
        .return_once(|_, _| {
            Err(SdkError::service_error(

```



```

        ModifyDBClusterParameterGroupError::unhandled(Box::new(Error::new(
            ErrorKind::Other,
            "modify_db_cluster_parameter_group_error",
        ))),
        Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
    ))
});

let scenario = AuroraScenario::new(mock_rds);

let update = scenario.update_auto_increment(10, 20).await;
assert_matches!(update, Err(ScenarioError { message, context: _}) if message ==
"Failed to modify cluster parameter group");
}
// snippet-end:[rust.aurora.update_auto_increment.test]

// snippet-start:[rust.aurora.start_cluster_and_instance.test]
#[tokio::test]
async fn test_start_cluster_and_instance() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {
            assert_eq!(id, "RustSDKCodeExamplesDBCluster");
            assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
            assert_eq!(engine, "aurora-mysql");
            assert_eq!(version, "aurora-mysql8.0");
            assert_eq!(username, "test username");
            assert_eq!(password.expose_secret(), "test password");
            true
        })
        .return_once(|id, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
                .build())
        });

    mock_rds
        .expect_create_db_instance()
        .withf(|cluster, name, class, engine| {
            assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");
            assert_eq!(name, "RustSDKCodeExamplesDBInstance");
            assert_eq!(class, "m5.large");
        });
}

```

```
        assert_eq!(engine, "aurora-mysql");
        true
    })
    .return_once(|cluster, name, class, _| {
        Ok(CreateDbInstanceOutput::builder()
            .db_instance(
                DbInstance::builder()
                    .db_cluster_identifier(cluster)
                    .db_instance_identifier(name)
                    .db_instance_class(class)
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|id| {
        Ok(DescribeDbClustersOutput::builder()
            .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_describe_db_instance()
    .with(eq("RustSDKCodeExamplesDBInstance"))
    .return_once(|name| {
        Ok(DescribeDbInstancesOutput::builder()
            .db_instances(
                DbInstance::builder()
                    .db_instance_identifier(name)
                    .db_instance_status("Available")
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_cluster_endpoints()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .return_once(|_| {
        Ok(DescribeDbClusterEndpointsOutput::builder()

```

```

.db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
    .build())
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let create = scenario.start_cluster_and_instance().await;
    assert!(create.is_ok());
    assert!(scenario
        .password
        .replace(SecretString::new("BAD SECRET".into()))
        .unwrap()
        .expose_secret()
        .is_empty());
    assert_eq!(
        scenario.db_cluster_identifier,
        Some("RustSDKCodeExamplesDBCluster".into())
    );
});
tokio::time::advance(Duration::from_secs(1)).await;
tokio::time::resume();
let _ = assertions.await;
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Err(SdkError::service_error(
                CreateDBClusterError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "create db cluster error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });
}

```

```

        ))
    });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_version = Some("aurora-mysql8.0".into());
    scenario.instance_class = Some("m5.large".into());
    scenario.username = Some("test username".into());
    scenario.password = Some(SecretString::new("test password".into()));

    let create = scenario.start_cluster_and_instance().await;
    assert_matches!(create, Err(ScenarioError { message, context: _}) if message ==
"Failed to create DB Cluster with cluster group")
}

#[tokio::test]
async fn test_start_cluster_and_instance_cluster_create_missing_id() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .return_once(|_, _, _, _, _, _| {
            Ok(CreateDbClusterOutput::builder()
                .db_cluster(DbCluster::builder().build())
                .build())
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.engine_version = Some("aurora-mysql8.0".into());
    scenario.instance_class = Some("m5.large".into());
    scenario.username = Some("test username".into());
    scenario.password = Some(SecretString::new("test password".into()));

    let create = scenario.start_cluster_and_instance().await;
    assert_matches!(create, Err(ScenarioError { message, context: _ }) if message ==
"Created DB Cluster missing Identifier");
}

#[tokio::test]
async fn test_start_cluster_and_instance_instance_create_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {

```

```

        assert_eq!(id, "RustSDKCodeExamplesDBCluster");
        assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
        assert_eq!(engine, "aurora-mysql");
        assert_eq!(version, "aurora-mysql8.0");
        assert_eq!(username, "test username");
        assert_eq!(password.expose_secret(), "test password");
        true
    })
    .return_once(|id, _, _, _, _| {
        Ok(CreateDbClusterOutput::builder()
            .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_create_db_instance()
    .return_once(|_, _, _, _| {
        Err(SdkError::service_error(
            CreateDBInstanceError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "create db instance error",
            ))),
            Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
        ))
    });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

let create = scenario.start_cluster_and_instance().await;
assert_matches!(create, Err(ScenarioError { message, context: _ }) if message ==
"Failed to create Instance in DB Cluster")
}

#[tokio::test]
async fn test_start_cluster_and_instance_wait_hiccup() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_create_db_cluster()
        .withf(|id, params, engine, version, username, password| {

```

```

        assert_eq!(id, "RustSDKCodeExamplesDBCluster");
        assert_eq!(params, "RustSDKCodeExamplesDBParameterGroup");
        assert_eq!(engine, "aurora-mysql");
        assert_eq!(version, "aurora-mysql8.0");
        assert_eq!(username, "test username");
        assert_eq!(password.expose_secret(), "test password");
        true
    })
    .return_once(|id, _, _, _, _, _| {
        Ok(CreateDbClusterOutput::builder()
            .db_cluster(DbCluster::builder().db_cluster_identifier(id).build())
            .build())
    });

mock_rds
    .expect_create_db_instance()
    .withf(|cluster, name, class, engine| {
        assert_eq!(cluster, "RustSDKCodeExamplesDBCluster");
        assert_eq!(name, "RustSDKCodeExamplesDBInstance");
        assert_eq!(class, "m5.large");
        assert_eq!(engine, "aurora-mysql");
        true
    })
    .return_once(|cluster, name, class, _| {
        Ok(CreateDbInstanceOutput::builder()
            .db_instance(
                DbInstance::builder()
                    .db_cluster_identifier(cluster)
                    .db_instance_identifier(name)
                    .db_instance_class(class)
                    .build(),
            )
            .build())
    });

mock_rds
    .expect_describe_db_clusters()
    .with(eq("RustSDKCodeExamplesDBCluster"))
    .times(1)
    .returning(|_| {
        Err(SdkError::service_error(
            DescribeDBClustersError::unhandled(Box::new(Error::new(
                ErrorKind::Other,
                "describe cluster error",
            ))),
        ))
    });

```

```

        )))
        Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
    ))
})
.with(eq("RustSDKCodeExamplesDBCluster"))
.times(1)
.returning(|id| {
    Ok(DescribeDbClustersOutput::builder()
        .db_clusters(DbCluster::builder().db_cluster_identifier(id).build())
        .build())
});

mock_rds.expect_describe_db_instance().return_once(|name| {
    Ok(DescribeDbInstancesOutput::builder()
        .db_instances(
            DbInstance::builder()
                .db_instance_identifier(name)
                .db_instance_status("Available")
                .build(),
        )
        .build())
});

mock_rds
    .expect_describe_db_cluster_endpoints()
    .return_once(|_| {
        Ok(DescribeDbClusterEndpointsOutput::builder()
            .db_cluster_endpoints(DbClusterEndpoint::builder().status("available").build())
            .build())
        });

let mut scenario = AuroraScenario::new(mock_rds);
scenario.engine_version = Some("aurora-mysql8.0".into());
scenario.instance_class = Some("m5.large".into());
scenario.username = Some("test username".into());
scenario.password = Some(SecretString::new("test password".into()));

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let create = scenario.start_cluster_and_instance().await;
    assert!(create.is_ok());
});

```

```
    tokio::time::advance(Duration::from_secs(1)).await;
    tokio::time::advance(Duration::from_secs(1)).await;
    tokio::time::resume();
    let _ = assertions.await;
}
// snippet-end:[rust.aurora.start_cluster_and_instance.test]

// snippet-start:[rust.aurora.clean_up.test]
#[tokio::test]
async fn test_scenario_clean_up() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_delete_db_instance()
        .with(eq("MockInstance"))
        .return_once(|_| Ok>DeleteDbInstanceOutput::builder().build()));

    mock_rds
        .expect_describe_db_instances()
        .with()
        .times(1)
        .returning(|| {
            Ok(DescribeDbInstancesOutput::builder()
                .db_instances(
                    DbInstance::builder()
                        .db_cluster_identifier("MockCluster")
                        .db_instance_status("Deleting")
                        .build(),
                )
                .build())
        })
        .with()
        .times(1)
        .returning(|| Ok(DescribeDbInstancesOutput::builder().build()));

    mock_rds
        .expect_delete_db_cluster()
        .with(eq("MockCluster"))
        .return_once(|_| Ok>DeleteDbClusterOutput::builder().build()));

    mock_rds
        .expect_describe_db_clusters()
        .with(eq("MockCluster"))
        .times(1)
```



```

        .returning(|id| {
            Ok(DescribeDbClustersOutput::builder()
                .db_clusters(
                    DbCluster::builder()
                        .db_cluster_identifier(id)
                        .status("Deleting")
                        .build(),
                )
                .build())
        })
        .with(eq("MockCluster"))
        .times(1)
        .returning(|_| Ok(DescribeDbClustersOutput::builder().build()));

mock_rds
    .expect_delete_db_cluster_parameter_group()
    .with(eq("MockParamGroup"))
    .return_once(|_|
Ok(DeleteDbClusterParameterGroupOutput::builder().build()));

let mut scenario = AuroraScenario::new(mock_rds);
scenario.db_cluster_identifier = Some(String::from("MockCluster"));
scenario.db_instance_identifier = Some(String::from("MockInstance"));
scenario.db_cluster_parameter_group = Some(
    DbClusterParameterGroup::builder()
        .db_cluster_parameter_group_name("MockParamGroup")
        .build(),
);

tokio::time::pause();
let assertions = tokio::spawn(async move {
    let clean_up = scenario.clean_up().await;
    assert!(clean_up.is_ok());
});

tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances
tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
tokio::time::resume();

```

```

    let _ = assertions.await;
}

#[tokio::test]
async fn test_scenario_clean_up_errors() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_delete_db_instance()
        .with(eq("MockInstance"))
        .return_once(|_| Ok(DeleteDbInstanceOutput::builder().build()));

    mock_rds
        .expect_describe_db_instances()
        .with()
        .times(1)
        .returning(|| {
            Ok(DescribeDbInstancesOutput::builder()
                .db_instances(
                    DbInstance::builder()
                        .db_cluster_identifier("MockCluster")
                        .db_instance_status("Deleting")
                        .build(),
                )
                .build())
        })
        .with()
        .times(1)
        .returning(|| {
            Err(SdkError::service_error(
                DescribeDBInstancesError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe db instances error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    mock_rds
        .expect_delete_db_cluster()
        .with(eq("MockCluster"))
        .return_once(|_| Ok(DeleteDbClusterOutput::builder().build()));

    mock_rds

```

```

        .expect_describe_db_clusters()
        .with(eq("MockCluster"))
        .times(1)
        .returning(|id| {
            Ok(DescribeDbClustersOutput::builder()
                .db_clusters(
                    DbCluster::builder()
                        .db_cluster_identifier(id)
                        .status("Deleting")
                        .build(),
                )
                .build())
        })
        .with(eq("MockCluster"))
        .times(1)
        .returning(|_| {
            Err(SdkError::service_error(
                DescribeDBClustersError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "describe db clusters error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    mock_rds
        .expect_delete_db_cluster_parameter_group()
        .with(eq("MockParamGroup"))
        .return_once(|_|
Ok(DeleteDbClusterParameterGroupOutput::builder().build()));

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some(String::from("MockCluster"));
    scenario.db_instance_identifier = Some(String::from("MockInstance"));
    scenario.db_cluster_parameter_group = Some(
        DbClusterParameterGroup::builder()
            .db_cluster_parameter_group_name("MockParamGroup")
            .build(),
    );

    tokio::time::pause();
    let assertions = tokio::spawn(async move {
        let clean_up = scenario.clean_up().await;
        assert!(clean_up.is_err());
    });

```

```

        let errs = clean_up.unwrap_err();
        assert_eq!(errs.len(), 2);
        assert_matches!(errs.get(0), Some(ScenarioError {message, context: _}) if
message == "Failed to check instance state during deletion");
        assert_matches!(errs.get(1), Some(ScenarioError {message, context: _}) if
message == "Failed to check cluster state during deletion");
    });

    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Instances
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for first Describe
Cluster
    tokio::time::advance(Duration::from_secs(1)).await; // Wait for second Describe
Cluster
    tokio::time::resume();
    let _ = assertions.await;
}
// snippet-end:[rust.aurora.clean_up.test]

// snippet-start:[rust.aurora.snapshot.test]
#[tokio::test]
async fn test_scenario_snapshot() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_snapshot_cluster()
        .with(eq("MockCluster"), eq("MockCluster_MockSnapshot"))
        .times(1)
        .return_once(|_, _| {
            Ok(CreateDbClusterSnapshotOutput::builder()
                .db_cluster_snapshot(
                    DbClusterSnapshot::builder()
                        .db_cluster_identifier("MockCluster")
                        .db_cluster_snapshot_identifier("MockCluster_MockSnapshot")
                        .build(),
                )
                .build())
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some("MockCluster".into());
    let create_snapshot = scenario.snapshot("MockSnapshot").await;

```

```

    assert!(create_snapshot.is_ok());
}

#[tokio::test]
async fn test_scenario_snapshot_error() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_snapshot_cluster()
        .with(eq("MockCluster"), eq("MockCluster_MockSnapshot"))
        .times(1)
        .return_once(|_, _| {
            Err(SdkError::service_error(
                CreateDBClusterSnapshotError::unhandled(Box::new(Error::new(
                    ErrorKind::Other,
                    "create snapshot error",
                ))),
                Response::new(StatusCode::try_from(400).unwrap(), SdkBody::empty()),
            ))
        });

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some("MockCluster".into());
    let create_snapshot = scenario.snapshot("MockSnapshot").await;
    assert_matches!(create_snapshot, Err(ScenarioError { message, context: _}) if
message == "Failed to create snapshot");
}

#[tokio::test]
async fn test_scenario_snapshot_invalid() {
    let mut mock_rds = MockRdsImpl::default();

    mock_rds
        .expect_snapshot_cluster()
        .with(eq("MockCluster"), eq("MockCluster_MockSnapshot"))
        .times(1)
        .return_once(|_, _| Ok(CreateDbClusterSnapshotOutput::builder().build()));

    let mut scenario = AuroraScenario::new(mock_rds);
    scenario.db_cluster_identifier = Some("MockCluster".into());
    let create_snapshot = scenario.snapshot("MockSnapshot").await;
    assert_matches!(create_snapshot, Err(ScenarioError { message, context: _}) if
message == "Missing Snapshot");
}

```

```
// snippet-end:[rust.aurora.snapshot.test]
```

A binary to run the scenario from front to end, using `inquirer` so that the user can make some decisions.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

use std::fmt::Display;

use anyhow::anyhow;
use aurora_code_examples::{
    aurora_scenario::{AuroraScenario, ScenarioError},
    rds::Rds as RdsClient,
};
use aws_sdk_rds::Client;
use inquire::{validator::StringValidator, CustomUserError};
use secrecy::SecretString;
use tracing::warn;

#[derive(Default, Debug)]
struct Warnings(Vec<String>);

impl Warnings {
    fn new() -> Self {
        Warnings(Vec::with_capacity(5))
    }

    fn push(&mut self, warning: &str, error: ScenarioError) {
        let formatted = format!("{warning}: {error}");
        warn!("{formatted}");
        self.0.push(formatted);
    }

    fn is_empty(&self) -> bool {
        self.0.is_empty()
    }
}

impl Display for Warnings {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        writeln!(f, "Warnings:");
    }
}
```

```

        for warning in &self.0 {
            writeln!(f, "{: >4}- {warning}", "");
        }
        Ok(())
    }
}

fn select(
    prompt: &str,
    choices: Vec<String>,
    error_message: &str,
) -> Result<String, anyhow::Error> {
    inquire::Select::new(prompt, choices)
        .prompt()
        .map_err(|error| anyhow!("{error_message}: {error}"))
}

// Prepare the Aurora Scenario. Prompt for several settings that are optional to the
// Scenario, but that the user should choose for the demo.
// This includes the engine, engine version, and instance class.
async fn prepare_scenario(rds: RdsClient) -> Result<AuroraScenario, anyhow::Error> {
    let mut scenario = AuroraScenario::new(rds);

    // Get available engine families for Aurora MySQL.
    rds.DescribeDbEngineVersions(Engine='aurora-mysql') and build a set of the
    'DBParameterGroupFamily' field values. I get {aurora-mysql8.0, aurora-mysql5.7}.
    let available_engines = scenario.get_engines().await;
    if let Err(error) = available_engines {
        return Err(anyhow!("Failed to get available engines: {}", error));
    }
    let available_engines = available_engines.unwrap();

    // Select an engine family and create a custom DB cluster parameter group.
    rds.CreateDbClusterParameterGroup(DBParameterGroupFamily='aurora-mysql8.0')
    let engine = select(
        "Select an Aurora engine family",
        available_engines.keys().cloned().collect::<Vec<String>>(),
        "Invalid engine selection",
    )?;

    let version = select(
        format!("Select an Aurora engine version for {engine}").as_str(),
        available_engines.get(&engine).cloned().unwrap_or_default(),
        "Invalid engine version selection",
    )?;
}

```

```

    )?;

    let set_engine = scenario.set_engine(engine.as_str(), version.as_str()).await;
    if let Err(error) = set_engine {
        return Err(anyhow!("Could not set engine: {}", error));
    }

    let instance_classes = scenario.get_instance_classes().await;
    match instance_classes {
        Ok(classes) => {
            let instance_class = select(
                format!("Select an Aurora instance class for {engine}").as_str(),
                classes,
                "Invalid instance class selection",
            )?;
            scenario.set_instance_class(Some(instance_class))
        }
        Err(err) => return Err(anyhow!("Failed to get instance classes for engine:
{err}")),
    }

    Ok(scenario)
}

// Prepare the cluster, creating a custom parameter group overriding some group
// parameters based on user input.
async fn prepare_cluster(scenario: &mut AuroraScenario, warnings: &mut Warnings) ->
Result<(), ()> {
    show_parameters(scenario, warnings).await;

    let offset = prompt_number_or_default(warnings, "auto_increment_offset", 5);
    let increment = prompt_number_or_default(warnings, "auto_increment_increment",
3);

    // Modify both the auto_increment_offset and auto_increment_increment parameters
    // in one call in the custom parameter group. Set their ParameterValue fields to a new
    // allowable value. rds.ModifyDbClusterParameterGroup.
    let update_auto_increment = scenario.update_auto_increment(offset,
increment).await;

    if let Err(error) = update_auto_increment {
        warnings.push("Failed to update auto increment", error);
        return Err(());
    }
}

```



```
// Get and display the updated parameters. Specify Source of 'user' to get just
the modified parameters. rds.DescribeDbClusterParameters(Source='user')
show_parameters(scenario, warnings).await;

let username = inquire::Text::new("Username for the database (default
'testuser')")
    .with_default("testuser")
    .with_initial_value("testuser")
    .prompt();

if let Err(error) = username {
    warnings.push(
        "Failed to get username, using default",
        ScenarioError::with(format!("Error from inquirer: {error}")),
    );
    return Err(());
}
let username = username.unwrap();

let password = inquire::Text::new("Password for the database (minimum 8
characters)")
    .with_validator(|i: &str| {
        if i.len() >= 8 {
            Ok(inquire::validator::Validation::Valid)
        } else {
            Ok(inquire::validator::Validation::Invalid(
                "Password must be at least 8 characters".into(),
            ))
        }
    })
    .prompt();

let password: Option<SecretString> = match password {
    Ok(password) => Some(SecretString::from(password)),
    Err(error) => {
        warnings.push(
            "Failed to get password, using none (and not starting a DB)",
            ScenarioError::with(format!("Error from inquirer: {error}")),
        );
        return Err(());
    }
};
```

```

        scenario.set_login(Some(username), password);

        Ok(())
    }

    // Start a single instance in the cluster,
    async fn run_instance(scenario: &mut AuroraScenario) -> Result<(), ScenarioError> {
        // Create an Aurora DB cluster database cluster that contains a MySQL database
        // and uses the parameter group you created.
        // Create a database instance in the cluster.
        // Wait for DB instance to be ready. Call rds.DescribeDbInstances and check for
        DBInstanceStatus == 'available'.
        scenario.start_cluster_and_instance().await?;

        let connection_string = scenario.connection_string().await?;

        println!("Database ready: {connection_string}");

        let _ = inquire::Text::new("Use the database with the connection string. When
        you're finished, press enter key to continue.").prompt();

        // Create a snapshot of the DB cluster. rds.CreateDbClusterSnapshot.
        // Wait for the snapshot to create. rds.DescribeDbClusterSnapshots until Status
        == 'available'.
        let snapshot_name = inquire::Text::new("Provide a name for the snapshot")
            .prompt()
            .unwrap_or(String::from("ScenarioRun"));
        let snapshot = scenario.snapshot(snapshot_name.as_str()).await?;
        println!(
            "Snapshot is available: {}",
            snapshot.db_cluster_snapshot_arn().unwrap_or("Missing ARN")
        );

        Ok(())
    }

#[tokio::main]
async fn main() -> Result<(), anyhow::Error> {
    tracing_subscriber::fmt::init();
    let sdk_config = aws_config::from_env().load().await;
    let client = Client::new(&sdk_config);
    let rds = RdsClient::new(client);
    let mut scenario = prepare_scenario(rds).await?;

```

```

// At this point, the scenario has things in AWS and needs to get cleaned up.
let mut warnings = Warnings::new();

if prepare_cluster(&mut scenario, &mut warnings).await.is_ok() {
    println!("Configured database cluster, starting an instance.");
    if let Err(err) = run_instance(&mut scenario).await {
        warnings.push("Problem running instance", err);
    }
}

// Clean up the instance, cluster, and parameter group, waiting for the instance
and cluster to delete before moving on.
let clean_up = scenario.clean_up().await;
if let Err(errors) = clean_up {
    for error in errors {
        warnings.push("Problem cleaning up scenario", error);
    }
}

if warnings.is_empty() {
    Ok(())
} else {
    println!("There were problems running the scenario:");
    println!("{warnings}");
    Err(anyhow!("There were problems running the scenario"))
}
}

#[derive(Clone)]
struct U8Validator {}
impl StringValidator for U8Validator {
    fn validate(&self, input: &str) -> Result<inquire::validator::Validation,
CustomUserError> {
        if input.parse::<u8>().is_err() {
            Ok(inquire::validator::Validation::Invalid(
                "Can't parse input as number".into(),
            ))
        } else {
            Ok(inquire::validator::Validation::Valid)
        }
    }
}

}

async fn show_parameters(scenario: &AuroraScenario, warnings: &mut Warnings) {

```

```

let parameters = scenario.cluster_parameters().await;

match parameters {
    Ok(parameters) => {
        println!("Current parameters");
        for parameter in parameters {
            println!("\t{parameter}");
        }
    }
    Err(error) => warnings.push("Could not find cluster parameters", error),
}

fn prompt_number_or_default(warnings: &mut Warnings, name: &str, default: u8) -> u8
{
    let input = inquire::Text::new(format!("Updated {name}:").as_str())
        .with_validator(U8Validator {})
        .prompt();

    match input {
        Ok(increment) => match increment.parse::<u8>() {
            Ok(increment) => increment,
            Err(error) => {
                warnings.push(
                    format!("Invalid updated {name} (using {default}
instead)").as_str(),
                    ScenarioError::with(format!("{error}")),
                );
                default
            }
        },
        Err(error) => {
            warnings.push(
                format!("Invalid updated {name} (using {default}
instead)").as_str(),
                ScenarioError::with(format!("{error}")),
            );
            default
        }
    }
}

```

A wrapper around the Amazon RDS service that allows automocking for tests.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

use aws_sdk_rds::{
    error::SdkError,
    operation::{
        create_db_cluster::{CreateDBClusterError, CreateDbClusterOutput},
        create_db_cluster_parameter_group::CreateDBClusterParameterGroupError,
        create_db_cluster_parameter_group::CreateDbClusterParameterGroupOutput,
        create_db_cluster_snapshot::{CreateDBClusterSnapshotError,
CreateDbClusterSnapshotOutput},
        create_db_instance::{CreateDBInstanceError, CreateDbInstanceOutput},
        delete_db_cluster::{DeleteDBClusterError, DeleteDbClusterOutput},
        delete_db_cluster_parameter_group::{
            DeleteDBClusterParameterGroupError, DeleteDbClusterParameterGroupOutput,
        },
        delete_db_instance::{DeleteDBInstanceError, DeleteDbInstanceOutput},
        describe_db_cluster_endpoints::{
            DescribeDBClusterEndpointsError, DescribeDbClusterEndpointsOutput,
        },
        describe_db_cluster_parameters::{
            DescribeDBClusterParametersError, DescribeDbClusterParametersOutput,
        },
        describe_db_clusters::{DescribeDBClustersError, DescribeDbClustersOutput},
        describe_db_engine_versions::{
            DescribeDBEngineVersionsError, DescribeDbEngineVersionsOutput,
        },
        describe_db_instances::{DescribeDBInstancesError,
DescribeDbInstancesOutput},

describe_orderable_db_instance_options::DescribeOrderableDBInstanceOptionsError,
        modify_db_cluster_parameter_group::{
            ModifyDBClusterParameterGroupError, ModifyDbClusterParameterGroupOutput,
        },
    },
    types::{OrderableDbInstanceOption, Parameter},
    Client as RdsClient,
};
use secrecy::{ExposeSecret, SecretString};

#[cfg(test)]
use mockall::automock;
```

```

#[cfg(test)]
pub use MockRdsImpl as Rds;
#[cfg(not(test))]
pub use RdsImpl as Rds;

pub struct RdsImpl {
    pub inner: RdsClient,
}

#[cfg_attr(test, automock)]
impl RdsImpl {
    pub fn new(inner: RdsClient) -> Self {
        RdsImpl { inner }
    }

    // snippet-start:[rust.aurora.describe_db_engine_versions.wrapper]
    pub async fn describe_db_engine_versions(
        &self,
        engine: &str,
    ) -> Result<DescribeDbEngineVersionsOutput,
SdkError<DescribeDBEngineVersionsError>> {
        self.inner
            .describe_db_engine_versions()
            .engine(engine)
            .send()
            .await
    }
    // snippet-end:[rust.aurora.describe_db_engine_versions.wrapper]

    // snippet-start:[rust.aurora.describe_orderable_db_instance_options.wrapper]
    pub async fn describe_orderable_db_instance_options(
        &self,
        engine: &str,
        engine_version: &str,
    ) -> Result<Vec<OrderableDbInstanceOption>,
SdkError<DescribeOrderableDBInstanceOptionsError>>
    {
        self.inner
            .describe_orderable_db_instance_options()
            .engine(engine)
            .engine_version(engine_version)
            .into_paginator()
            .items()
    }

```

```
        .send()
        .try_collect()
        .await
    }
// snippet-end:[rust.aurora.describe_orderable_db_instance_options.wrapper]

// snippet-start:[rust.aurora.create_db_cluster_parameter_group.wrapper]
pub async fn create_db_cluster_parameter_group(
    &self,
    name: &str,
    description: &str,
    family: &str,
) -> Result<CreateDbClusterParameterGroupOutput,
SdkError<CreateDBClusterParameterGroupError>>
{
    self.inner
        .create_db_cluster_parameter_group()
        .db_cluster_parameter_group_name(name)
        .description(description)
        .db_parameter_group_family(family)
        .send()
        .await
}
// snippet-end:[rust.aurora.create_db_cluster_parameter_group.wrapper]

// snippet-start:[rust.aurora.describe_db_clusters.wrapper]
pub async fn describe_db_clusters(
    &self,
    id: &str,
) -> Result<DescribeDbClustersOutput, SdkError<DescribeDBClustersError>> {
    self.inner
        .describe_db_clusters()
        .db_cluster_identifier(id)
        .send()
        .await
}
// snippet-end:[rust.aurora.describe_db_clusters.wrapper]

// snippet-start:[rust.aurora.describe_db_cluster_parameters.wrapper]
pub async fn describe_db_cluster_parameters(
    &self,
    name: &str,
) -> Result<Vec<DescribeDbClusterParametersOutput>,
SdkError<DescribeDBClusterParametersError>>
```

```

    {
        self.inner
            .describe_db_cluster_parameters()
            .db_cluster_parameter_group_name(name)
            .into_paginator()
            .send()
            .try_collect()
            .await
    }
    // snippet-end:[rust.aurora.describe_db_cluster_parameters.wrapper]

    // snippet-start:[rust.aurora.modify_db_cluster_parameter_group.wrapper]
    pub async fn modify_db_cluster_parameter_group(
        &self,
        name: &str,
        parameters: Vec<Parameter>,
    ) -> Result<ModifyDbClusterParameterGroupOutput,
    SdkError<ModifyDBClusterParameterGroupError>>
    {
        self.inner
            .modify_db_cluster_parameter_group()
            .db_cluster_parameter_group_name(name)
            .set_parameters(Some(parameters))
            .send()
            .await
    }
    // snippet-end:[rust.aurora.modify_db_cluster_parameter_group.wrapper]

    // snippet-start:[rust.aurora.create_db_cluster.wrapper]
    pub async fn create_db_cluster(
        &self,
        name: &str,
        parameter_group: &str,
        engine: &str,
        version: &str,
        username: &str,
        password: SecretString,
    ) -> Result<CreateDbClusterOutput, SdkError<CreateDBClusterError>> {
        self.inner
            .create_db_cluster()
            .db_cluster_identifier(name)
            .db_cluster_parameter_group_name(parameter_group)
            .engine(engine)
            .engine_version(version)

```



```
        .master_username(username)
        .master_user_password(password.expose_secret())
        .send()
        .await
    }
// snippet-end:[rust.aurora.create_db_cluster.wrapper]

// snippet-start:[rust.aurora.create_db_instance.wrapper]
pub async fn create_db_instance(
    &self,
    cluster_name: &str,
    instance_name: &str,
    instance_class: &str,
    engine: &str,
) -> Result<CreateDbInstanceOutput, SdkError<CreateDBInstanceError>> {
    self.inner
        .create_db_instance()
        .db_cluster_identifier(cluster_name)
        .db_instance_identifier(instance_name)
        .db_instance_class(instance_class)
        .engine(engine)
        .send()
        .await
    }
// snippet-end:[rust.aurora.create_db_instance.wrapper]

// snippet-start:[rust.aurora.describe_db_instance.wrapper]
pub async fn describe_db_instance(
    &self,
    instance_identifier: &str,
) -> Result<DescribeDbInstancesOutput, SdkError<DescribeDBInstancesError>> {
    self.inner
        .describe_db_instances()
        .db_instance_identifier(instance_identifier)
        .send()
        .await
    }
// snippet-end:[rust.aurora.describe_db_instance.wrapper]

// snippet-start:[rust.aurora.create_db_cluster_snapshot.wrapper]
pub async fn snapshot_cluster(
    &self,
    db_cluster_identifier: &str,
    snapshot_name: &str,
```

```
    ) -> Result<CreateDbClusterSnapshotOutput,
SdkError<CreateDBClusterSnapshotError>> {
        self.inner
            .create_db_cluster_snapshot()
            .db_cluster_identifier(db_cluster_identifier)
            .db_cluster_snapshot_identifier(snapshot_name)
            .send()
            .await
    }
// snippet-end:[rust.aurora.create_db_cluster_snapshot.wrapper]

// snippet-start:[rust.aurora.describe_db_instances.wrapper]
pub async fn describe_db_instances(
    &self,
) -> Result<DescribeDbInstancesOutput, SdkError<DescribeDBInstancesError>> {
    self.inner.describe_db_instances().send().await
}
// snippet-end:[rust.aurora.describe_db_instances.wrapper]

// snippet-start:[rust.aurora.describe_db_cluster_endpoints.wrapper]
pub async fn describe_db_cluster_endpoints(
    &self,
    cluster_identifier: &str,
) -> Result<DescribeDbClusterEndpointsOutput,
SdkError<DescribeDBClusterEndpointsError>> {
    self.inner
        .describe_db_cluster_endpoints()
        .db_cluster_identifier(cluster_identifier)
        .send()
        .await
}
// snippet-end:[rust.aurora.describe_db_cluster_endpoints.wrapper]

// snippet-start:[rust.aurora.delete_db_instance.wrapper]
pub async fn delete_db_instance(
    &self,
    instance_identifier: &str,
) -> Result<DeleteDbInstanceOutput, SdkError<DeleteDBInstanceError>> {
    self.inner
        .delete_db_instance()
        .db_instance_identifier(instance_identifier)
        .skip_final_snapshot(true)
        .send()
        .await
}
```

```

}
// snippet-end:[rust.aurora.delete_db_instance.wrapper]

// snippet-start:[rust.aurora.delete_db_cluster.wrapper]
pub async fn delete_db_cluster(
    &self,
    cluster_identifier: &str,
) -> Result<DeleteDbClusterOutput, SdkError<DeleteDBClusterError>> {
    self.inner
        .delete_db_cluster()
        .db_cluster_identifier(cluster_identifier)
        .skip_final_snapshot(true)
        .send()
        .await
}
// snippet-end:[rust.aurora.delete_db_cluster.wrapper]

// snippet-start:[rust.aurora.delete_db_cluster_parameter_group.wrapper]
pub async fn delete_db_cluster_parameter_group(
    &self,
    name: &str,
) -> Result<DeleteDbClusterParameterGroupOutput,
SdkError<DeleteDBClusterParameterGroupError>>
{
    self.inner
        .delete_db_cluster_parameter_group()
        .db_cluster_parameter_group_name(name)
        .send()
        .await
}
// snippet-end:[rust.aurora.delete_db_cluster_parameter_group.wrapper]
}

```

The Cargo.toml with dependencies used in this scenario.

```

[package]
name = "aurora-code-examples"
authors = [
    "David Souther <dpsouth@amazon.com>",
]
edition = "2021"
version = "0.1.0"

```

```
# See more keys and their definitions at https://doc.rust-lang.org/cargo/reference/manifest.html
```

```
[dependencies]
anyhow = "1.0.75"
assert_matches = "1.5.0"
aws-config = { version = "1.0.1", features = ["behavior-version-latest"] }
aws-smithy-types = { version = "1.0.1" }
aws-smithy-runtime-api = { version = "1.0.1" }
aws-sdk-rds = { version = "1.3.0" }
inquire = "0.6.2"
mockall = "0.11.4"
phf = { version = "0.11.2", features = ["std", "macros"] }
sdk-examples-test-utils = { path = "../..../test-utils" }
secrecy = "0.8.0"
tokio = { version = "1.20.1", features = ["full", "test-util"] }
tracing = "0.1.37"
tracing-subscriber = { version = "0.3.15", features = ["env-filter"] }
```

- For API details, see the following topics in *AWS SDK for Rust API reference*.

- [CreateDBCluster](#)
- [CreateDBClusterParameterGroup](#)
- [CreateDBClusterSnapshot](#)
- [CreateDBInstance](#)
- [DeleteDBCluster](#)
- [DeleteDBClusterParameterGroup](#)
- [DeleteDBInstance](#)
- [DescribeDBClusterParameterGroups](#)
- [DescribeDBClusterParameters](#)
- [DescribeDBClusterSnapshots](#)
- [DescribeDBClusters](#)
- [DescribeDBEngineVersions](#)
- [DescribeDBInstances](#)
- [DescribeOrderableDBInstanceOptions](#)

Auto Scaling examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Auto Scaling.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Get started

Hello Auto Scaling

The following code examples show how to get started using Auto Scaling.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn list_groups(client: &Client) -> Result<(), Error> {
    let resp = client.describe_auto_scaling_groups().send().await?;

    println!("Groups:");

    let groups = resp.auto_scaling_groups();

    for group in groups {
        println!(
            "Name: {}",
            group.auto_scaling_group_name().unwrap_or("Unknown")
        );
    }
}
```

```
println!(
    "Arn:  {}",
    group.auto_scaling_group_arn().unwrap_or("unknown"),
);
println!("Zones: {:?}", group.availability_zones(),);
println!();
}

println!("Found {} group(s)", groups.len());

Ok(())
}
```

- For API details, see [DescribeAutoScalingGroups](#) in *AWS SDK for Rust API reference*.

Topics

- [Actions](#)
- [Scenarios](#)

Actions

CreateAutoScalingGroup

The following code example shows how to use `CreateAutoScalingGroup`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn create_group(client: &Client, name: &str, id: &str) -> Result<(), Error> {
    client
        .create_auto_scaling_group()
        .auto_scaling_group_name(name)
        .instance_id(id)
```

```
        .min_size(1)
        .max_size(5)
        .send()
        .await?;

println!("Created AutoScaling group");

Ok(())
}
```

- For API details, see [CreateAutoScalingGroup](#) in *AWS SDK for Rust API reference*.

DeleteAutoScalingGroup

The following code example shows how to use DeleteAutoScalingGroup.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn delete_group(client: &Client, name: &str, force: bool) -> Result<(), Error>
{
    client
        .delete_auto_scaling_group()
        .auto_scaling_group_name(name)
        .set_force_delete(if force { Some(true) } else { None })
        .send()
        .await?;

println!("Deleted Auto Scaling group");

Ok(())
}
```

- For API details, see [DeleteAutoScalingGroup](#) in *AWS SDK for Rust API reference*.

DescribeAutoScalingGroups

The following code example shows how to use DescribeAutoScalingGroups.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn list_groups(client: &Client) -> Result<(), Error> {
    let resp = client.describe_auto_scaling_groups().send().await?;

    println!("Groups:");

    let groups = resp.auto_scaling_groups();

    for group in groups {
        println!(
            "Name: {}",
            group.auto_scaling_group_name().unwrap_or("Unknown")
        );
        println!(
            "Arn: {}",
            group.auto_scaling_group_arn().unwrap_or("unknown"),
        );
        println!("Zones: {:?}", group.availability_zones(),);
        println!();
    }

    println!("Found {} group(s)", groups.len());

    Ok(())
}
```

- For API details, see [DescribeAutoScalingGroups](#) in *AWS SDK for Rust API reference*.

DescribeAutoScalingInstances

The following code example shows how to use DescribeAutoScalingInstances.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn list_instances(&self) -> Result<Vec<String>, ScenarioError> {
    // The direct way to list instances is by using DescribeAutoScalingGroup's
    // instances property. However, this returns a Vec<Instance>, as opposed to a
    // Vec<AutoScalingInstanceDetails>.
    // Ok(self.get_group().await?.instances.unwrap_or_default().map(|i|
    // i.instance_id.clone().unwrap_or_default()).filter(|id| !id.is_empty()).collect())

    // Alternatively, and for the sake of example, DescribeAutoScalingInstances
    // returns a list that can be filtered by the client.
    self.autoscaling
        .describe_auto_scaling_instances()
        .into_paginator()
        .items()
        .send()
        .try_collect()
        .await
        .map(|items| {
            items
                .into_iter()
                .filter(|i| {
                    i.auto_scaling_group_name.as_deref()
                        == Some(self.auto_scaling_group_name.as_str())
                })
                .map(|i| i.instance_id.unwrap_or_default())
                .filter(|id| !id.is_empty())
                .collect:::<Vec<String>>()
        })
        .map_err(|err| ScenarioError::new("Failed to get list of auto scaling
instances", &err))
}
```

- For API details, see [DescribeAutoScalingInstances](#) in *AWS SDK for Rust API reference*.

DescribeScalingActivities

The following code example shows how to use `DescribeScalingActivities`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn describe_scenario(&self) -> AutoScalingScenarioDescription {
    let group = self
        .autoscaling
        .describe_auto_scaling_groups()
        .auto_scaling_group_names(self.auto_scaling_group_name.clone())
        .send()
        .await
        .map(|s| {
            s.auto_scaling_groups()
                .iter()
                .map(|s| {
                    format!(
                        "{}: {}",
                        s.auto_scaling_group_name().unwrap_or("Unknown"),
                        s.status().unwrap_or("Unknown")
                    )
                })
                .collect:::<Vec<String>>()
        })
        .map_err(|e| {
            ScenarioError::new("Failed to describe auto scaling groups for
scenario", &e)
        });

    let instances = self
```

```

        .list_instances()
        .await
        .map_err(|e| anyhow!("There was an error listing instances: {e}",));

    // 10. DescribeScalingActivities: list the scaling activities that have
    occurred for the group so far.
    // Bonus: use CloudWatch API to get and show some metrics collected for
    the group.
    // CW.ListMetrics with Namespace='AWS/AutoScaling' and
    Dimensions=[{'Name': 'AutoScalingGroupName', 'Value': }]
    // CW.GetMetricStatistics with Statistics='Sum'. Start and End times must
    be in UTC!
    let activities = self
        .autoscaling
        .describe_scaling_activities()
        .auto_scaling_group_name(self.auto_scaling_group_name.clone())
        .into_paginator()
        .items()
        .send()
        .collect::

```

- For API details, see [DescribeScalingActivities](#) in *AWS SDK for Rust API reference*.

DisableMetricsCollection

The following code example shows how to use `DisableMetricsCollection`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
// If this fails it's fine, just means there are extra cloudwatch metrics
events for the scale-down.
let _ = self
    .autoscaling
    .disable_metrics_collection()
    .auto_scaling_group_name(self.auto_scaling_group_name.clone())
    .send()
    .await;
```

- For API details, see [DisableMetricsCollection](#) in *AWS SDK for Rust API reference*.

EnableMetricsCollection

The following code example shows how to use `EnableMetricsCollection`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let enable_metrics_collection = autoscaling
    .enable_metrics_collection()
    .auto_scaling_group_name(auto_scaling_group_name.as_str())
    .granularity("1Minute")
    .set_metrics(Some(vec![
        String::from("GroupMinSize"),
        String::from("GroupMaxSize"),
```

```

        String::from("GroupDesiredCapacity"),
        String::from("GroupInServiceInstances"),
        String::from("GroupTotalInstances"),
    ]))
    .send()
    .await;

```

- For API details, see [EnableMetricsCollection](#) in *AWS SDK for Rust API reference*.

SetDesiredCapacity

The following code example shows how to use SetDesiredCapacity.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

pub async fn scale_desired_capacity(&self, capacity: i32) -> Result<(),
ScenarioError> {
    // 7. SetDesiredCapacity: set desired capacity to 2.
    // Wait for a second instance to launch.
    let update_group = self
        .autoscaling
        .set_desired_capacity()
        .auto_scaling_group_name(self.auto_scaling_group_name.clone())
        .desired_capacity(capacity)
        .send()
        .await;
    if let Err(err) = update_group {
        return Err(ScenarioError::new(
            format!("Failed to update group to desired capacity
({capacity}))").as_str(),
            &err,
        ));
    }
    Ok(())
}

```

```
}

```

- For API details, see [SetDesiredCapacity](#) in *AWS SDK for Rust API reference*.

TerminateInstanceInAutoScalingGroup

The following code example shows how to use `TerminateInstanceInAutoScalingGroup`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn terminate_some_instance(&self) -> Result<(), ScenarioError> {
    // Retrieve a list of instances in the auto scaling group.
    let auto_scaling_group = self.get_group().await?;
    let instances = auto_scaling_group.instances();
    // Or use other logic to find an instance to terminate.
    let instance = instances.first();
    if let Some(instance) = instance {
        let instance_id = if let Some(instance_id) = instance.instance_id() {
            instance_id
        } else {
            return Err(ScenarioError::with("Missing instance id"));
        };
        let termination = self
            .ec2
            .terminate_instances()
            .instance_ids(instance_id)
            .send()
            .await;
        if let Err(err) = termination {
            Err(ScenarioError::new(
                "There was a problem terminating an instance",
                &err,
            ))
        } else {

```

```

        Ok(())
    }
} else {
    Err(ScenarioError::with("There was no instance to terminate"))
}
}

async fn get_group(&self) -> Result<AutoScalingGroup, ScenarioError> {
    let describe_auto_scaling_groups = self
        .autoscaling
        .describe_auto_scaling_groups()
        .auto_scaling_group_names(self.auto_scaling_group_name.clone())
        .send()
        .await;

    if let Err(err) = describe_auto_scaling_groups {
        return Err(ScenarioError::new(
            format!(
                "Failed to get status of autoscaling group {}",
                self.auto_scaling_group_name.clone()
            )
            .as_str(),
            &err,
        ));
    }

    let describe_auto_scaling_groups_output =
describe_auto_scaling_groups.unwrap();
    let auto_scaling_groups =
describe_auto_scaling_groups_output.auto_scaling_groups();
    let auto_scaling_group = auto_scaling_groups.first();

    if auto_scaling_group.is_none() {
        return Err(ScenarioError::with(format!(
            "Could not find autoscaling group {}",
            self.auto_scaling_group_name.clone()
        )));
    }

    Ok(auto_scaling_group.unwrap().clone())
}

```

- For API details, see [TerminateInstanceInAutoScalingGroup](#) in *AWS SDK for Rust API reference*.

UpdateAutoScalingGroup

The following code example shows how to use `UpdateAutoScalingGroup`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn update_group(client: &Client, name: &str, size: i32) -> Result<(), Error> {
    client
        .update_auto_scaling_group()
        .auto_scaling_group_name(name)
        .max_size(size)
        .send()
        .await?;

    println!("Updated AutoScaling group");

    Ok(())
}
```

- For API details, see [UpdateAutoScalingGroup](#) in *AWS SDK for Rust API reference*.

Scenarios

Manage groups and instances

The following code example shows how to:

- Create an Amazon EC2 Auto Scaling group with a launch template and Availability Zones, and get information about running instances.
- Enable Amazon CloudWatch metrics collection.
- Update the group's desired capacity and wait for an instance to start.
- Terminate an instance in the group.
- List scaling activities that occur in response to user requests and capacity changes.

- Get statistics for CloudWatch metrics, then clean up resources.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
[package]
name = "autoscaling-code-examples"
version = "0.1.0"
authors = ["Doug Schwartz <dougsch@amazon.com>", "David Souther
<dpsouth@amazon.com>"]
edition = "2021"

# See more keys and their definitions at https://doc.rust-lang.org/cargo/reference/
manifest.html

[dependencies]
aws-config = { version = "1.0.1", features = ["behavior-version-latest"] }
aws-sdk-autoscaling = { version = "1.3.0" }
aws-sdk-ec2 = { version = "1.3.0" }
aws-types = { version = "1.0.1" }
tokio = { version = "1.20.1", features = ["full"] }
clap = { version = "~4.4", features = ["derive"] }
tracing-subscriber = { version = "0.3.15", features = ["env-filter"] }
anyhow = "1.0.75"
tracing = "0.1.37"
tokio-stream = "0.1.14"

// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

use std::{collections::BTreeSet, fmt::Display};

use anyhow::anyhow;
use autoscaling_code_examples::scenario::{AutoScalingScenario, ScenarioError};
use tracing::{info, warn};

async fn show_scenario_description(scenario: &AutoScalingScenario, event: &str) {
```

```

    let description = scenario.describe_scenario().await;
    info!("DescribeAutoScalingInstances: {event}\n{description}");
}

#[derive(Default, Debug)]
struct Warnings(Vec<String>);

impl Warnings {
    pub fn push(&mut self, warning: &str, error: ScenarioError) {
        let formatted = format!("{warning}: {error}");
        warn!("{formatted}");
        self.0.push(formatted);
    }

    pub fn is_empty(&self) -> bool {
        self.0.is_empty()
    }
}

impl Display for Warnings {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        writeln!(f, "Warnings:");
        for warning in &self.0 {
            writeln!(f, "{: >4}- {warning}", "");
        }
        Ok(())
    }
}

#[tokio::main]
async fn main() -> Result<(), anyhow::Error> {
    tracing_subscriber::fmt::init();

    let shared_config = aws_config::from_env().load().await;

    let mut warnings = Warnings::default();

    // 1. Create an EC2 launch template that you'll use to create an auto scaling
    group. Bonus: use SDK with EC2.CreateLaunchTemplate to create the launch template.
    // 2. CreateAutoScalingGroup: pass it the launch template you created in step 0.
    Give it min/max of 1 instance.
    // 4. EnableMetricsCollection: enable all metrics or a subset.
    let scenario = match AutoScalingScenario::prepare_scenario(&shared_config).await
    {

```

```
Ok(scenario) => scenario,
Err(errs) => {
    let err_str = errs
        .into_iter()
        .map(|e| e.to_string())
        .collect::<Vec<String>>()
        .join(", ");
    return Err( anyhow!("Failed to initialize scenario: {err_str}"));
}
};

info!("Prepared autoscaling scenario:\n{scenario}");

let stable = scenario.wait_for_stable(1).await;
if let Err(err) = stable {
    warnings.push(
        "There was a problem while waiting for group to be stable",
        err,
    );
}

// 3. DescribeAutoScalingInstances: show that one instance has launched.
show_scenario_description(
    &scenario,
    "show that the group was created and one instance has launched",
)
.await;

// 5. UpdateAutoScalingGroup: update max size to 3.
let scale_max_size = scenario.scale_max_size(3).await;
if let Err(err) = scale_max_size {
    warnings.push("There was a problem scaling max size", err);
}

// 6. DescribeAutoScalingGroups: the current state of the group
show_scenario_description(
    &scenario,
    "show the current state of the group after setting max size",
)
.await;

// 7. SetDesiredCapacity: set desired capacity to 2.
let scale_desired_capacity = scenario.scale_desired_capacity(2).await;
if let Err(err) = scale_desired_capacity {
```

```
        warnings.push("There was a problem setting desired capacity", err);
    }

    // Wait for a second instance to launch.
    let stable = scenario.wait_for_stable(2).await;
    if let Err(err) = stable {
        warnings.push(
            "There was a problem while waiting for group to be stable",
            err,
        );
    }

    // 8. DescribeAutoScalingInstances: show that two instances are launched.
    show_scenario_description(
        &scenario,
        "show that two instances are launched after setting desired capacity",
    )
    .await;

    let ids_before = scenario
        .list_instances()
        .await
        .map(|v| v.into_iter().collect:::<BTreeSet<_>>())
        .unwrap_or_default();

    // 9. TerminateInstanceInAutoScalingGroup: terminate one of the instances in the
    group.
    let terminate_some_instance = scenario.terminate_some_instance().await;
    if let Err(err) = terminate_some_instance {
        warnings.push("There was a problem replacing an instance", err);
    }

    let wait_after_terminate = scenario.wait_for_stable(1).await;
    if let Err(err) = wait_after_terminate {
        warnings.push(
            "There was a problem waiting after terminating an instance",
            err,
        );
    }

    let wait_scale_up_after_terminate = scenario.wait_for_stable(2).await;
    if let Err(err) = wait_scale_up_after_terminate {
        warnings.push(
```

```

        "There was a problem waiting for scale up after terminating an
instance",
        err,
    );
}

let ids_after = scenario
    .list_instances()
    .await
    .map(|v| v.into_iter().collect::<BTreeSet<_>>())
    .unwrap_or_default();

let difference = ids_after.intersection(&ids_before).count();
if !(difference == 1 && ids_before.len() == 2 && ids_after.len() == 2) {
    warnings.push(
        "Before and after set not different",
        ScenarioError::with(format!("{}",difference)),
    );
}

// 10. DescribeScalingActivities: list the scaling activities that have occurred
for the group so far.
show_scenario_description(
    &scenario,
    "list the scaling activities that have occurred for the group so far",
)
.await;

// 11. DisableMetricsCollection
let scale_group = scenario.scale_group_to_zero().await;
if let Err(err) = scale_group {
    warnings.push("There was a problem scaling the group to 0", err);
}
show_scenario_description(&scenario, "Scenario scaled to 0").await;

// 12. DeleteAutoScalingGroup (to delete the group you must stop all instances):
// 13. Delete LaunchTemplate.
let clean_scenario = scenario.clean_scenario().await;
if let Err(errs) = clean_scenario {
    for err in errs {
        warnings.push("There was a problem cleaning the scenario", err);
    }
} else {
    info!("The scenario has been cleaned up!");
}

```

```
    }

    if warnings.is_empty() {
        Ok(())
    } else {
        Err(anyhow!(
            "There were warnings during scenario execution:\n{warnings}"
        ))
    }
}

pub mod scenario;

// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

use std::{
    error::Error,
    fmt::{Debug, Display},
    time::{Duration, SystemTime},
};

use anyhow::anyhow;
use aws_config::SdkConfig;
use aws_sdk_autoscaling::{
    error::{DisplayErrorContext, ProvideErrorMetadata},
    types::{Activity, AutoScalingGroup, LaunchTemplateSpecification},
};
use aws_sdk_ec2::types::RequestLaunchTemplateData;
use tracing::trace;

const LAUNCH_TEMPLATE_NAME: &str =
    "SDK_Code_Examples_EC2_Autoscaling_template_from_Rust_SDK";
const AUTOSCALING_GROUP_NAME: &str =
    "SDK_Code_Examples_EC2_Autoscaling_Group_from_Rust_SDK";
const MAX_WAIT: Duration = Duration::from_secs(5 * 60); // Wait at most 25 seconds.
const WAIT_TIME: Duration = Duration::from_millis(500); // Wait half a second at a
    time.

struct Waiter {
    start: SystemTime,
    max: Duration,
}
```

```
impl Waiter {
    fn new() -> Self {
        Waiter {
            start: SystemTime::now(),
            max: MAX_WAIT,
        }
    }
}

async fn sleep(&self) -> Result<(), ScenarioError> {
    if SystemTime::now()
        .duration_since(self.start)
        .unwrap_or(Duration::MAX)
        > self.max
    {
        Err(ScenarioError::with(
            "Exceeded maximum wait duration for stable group",
        ))
    } else {
        tokio::time::sleep(WAIT_TIME).await;
        Ok(())
    }
}
}

pub struct AutoScalingScenario {
    ec2: aws_sdk_ec2::Client,
    autoscaling: aws_sdk_autoscaling::Client,
    launch_template_arn: String,
    auto_scaling_group_name: String,
}

impl Display for AutoScalingScenario {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        f.write_fmt(format_args!(
            "\tLaunch Template ID: {}\n",
            self.launch_template_arn
        ))?;
        f.write_fmt(format_args!(
            "\tScaling Group Name: {}\n",
            self.auto_scaling_group_name
        ))?;

        Ok(())
    }
}
```

```

}

pub struct AutoScalingScenarioDescription {
    group: Result<Vec<String>, ScenarioError>,
    instances: Result<Vec<String>, anyhow::Error>,
    activities: Result<Vec<Activity>, anyhow::Error>,
}

impl Display for AutoScalingScenarioDescription {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        writeln!(f, "\t\t\t\t\t Group status:");
        match &self.group {
            Ok(groups) => {
                for status in groups {
                    writeln!(f, "\t\t\t\t\t- {status}")?;
                }
            }
            Err(e) => writeln!(f, "\t\t\t\t\t! - {e}")?,
        }
        writeln!(f, "\t\t\t\t\t Instances:");
        match &self.instances {
            Ok(instances) => {
                for instance in instances {
                    writeln!(f, "\t\t\t\t\t- {instance}")?;
                }
            }
            Err(e) => writeln!(f, "\t\t\t\t\t! {e}")?,
        }

        writeln!(f, "\t\t\t\t\t Activities:");
        match &self.activities {
            Ok(activities) => {
                for activity in activities {
                    writeln!(
                        f,
                        "\t\t\t\t\t- {} Progress: {}% Status: {:?} End: {:?}"
                        activity.cause().unwrap_or("Unknown"),
                        activity.progress.unwrap_or(-1),
                        activity.status_code(),
                        // activity.status_message().unwrap_or_default()
                        activity.end_time(),
                    )?;
                }
            }
        }
    }
}

```



```

        Err(e) => writeln!(f, "\t\t! {e}")?,
    }

    Ok(())
}

#[derive(Debug)]
struct MetadataError {
    message: Option<String>,
    code: Option<String>,
}

impl MetadataError {
    fn from(err: &dyn ProvideErrorMetadata) -> Self {
        MetadataError {
            message: err.message().map(|s| s.to_string()),
            code: err.code().map(|s| s.to_string()),
        }
    }
}

impl Display for MetadataError {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        let display = match (&self.message, &self.code) {
            (None, None) => "Unknown".to_string(),
            (None, Some(code)) => format!("{code}"),
            (Some(message), None) => message.to_string(),
            (Some(message), Some(code)) => format!("{message} ({code})"),
        };
        write!(f, "{display}")
    }
}

#[derive(Debug)]
pub struct ScenarioError {
    message: String,
    context: Option<MetadataError>,
}

impl ScenarioError {
    pub fn with(message: impl Into<String>) -> Self {
        ScenarioError {
            message: message.into(),
        }
    }
}

```

```

        context: None,
    }
}

pub fn new(message: impl Into<String>, err: &dyn ProvideErrorMetadata) -> Self {
    ScenarioError {
        message: message.into(),
        context: Some(MetadataError::from(err)),
    }
}

impl Error for ScenarioError {
    // While `Error` can capture `source` information about the underlying error,
    // for this example
    // the ScenarioError captures the underlying information in MetadataError and
    // treats it as a
    // single Error from this Crate. In other contexts, it may be appropriate to
    // model the error
    // as including the SdkError as its source.
}

impl Display for ScenarioError {
    fn fmt(&self, f: &mut std::fmt::Formatter<'_>) -> std::fmt::Result {
        match &self.context {
            Some(c) => write!(f, "{}: {}", self.message, c),
            None => write!(f, "{}", self.message),
        }
    }
}

impl AutoScalingScenario {
    pub async fn prepare_scenario(sdk_config: &SdkConfig) -> Result<Self,
    Vec<ScenarioError>> {
        let ec2 = aws_sdk_ec2::Client::new(sdk_config);
        let autoscaling = aws_sdk_autoscaling::Client::new(sdk_config);

        let auto_scaling_group_name = String::from(AUTOSCALING_GROUP_NAME);

        // Before creating any resources, prepare the list of AZs
        let availability_zones = ec2.describe_availability_zones().send().await;
        if let Err(err) = availability_zones {
            return Err(vec![ScenarioError::new("Failed to find AZs", &err)]);
        }
    }
}

```

```

let availability_zones: Vec<String> = availability_zones
    .unwrap()
    .availability_zones
    .unwrap_or_default()
    .iter()
    .take(3)
    .map(|z| z.zone_name.clone().unwrap())
    .collect();

// 1. Create an EC2 launch template that you'll use to create an auto
scaling group. Bonus: use SDK with EC2.CreateLaunchTemplate to create the launch
template.
// * Recommended: InstanceType='t1.micro', ImageId='ami-0ca285d4c2cda3300'
let create_launch_template = ec2
    .create_launch_template()
    .launch_template_name(LAUNCH_TEMPLATE_NAME)
    .launch_template_data(
        RequestLaunchTemplateData::builder()
            .instance_type(aws_sdk_ec2::types::InstanceType::T1Micro)
            .image_id("ami-0ca285d4c2cda3300")
            .build(),
    )
    .send()
    .await
    .map_err(|err| vec![ScenarioError::new("Failed to create launch
template", &err)]?);

let launch_template_arn = match create_launch_template.launch_template {
    Some(launch_template) =>
launch_template.launch_template_id.unwrap_or_default(),
    None => {
        // Try to delete the launch template
        let _ = ec2
            .delete_launch_template()
            .launch_template_name(LAUNCH_TEMPLATE_NAME)
            .send()
            .await;
        return Err(vec![ScenarioError::with("Failed to load launch
template")]);
    }
};

// 2. CreateAutoScalingGroup: pass it the launch template you created in
step 0. Give it min/max of 1 instance.

```

```
// You can use EC2.describe_availability_zones() to get a list of AZs (you
have to specify an AZ when you create the group).
// Wait for instance to launch. Use a waiter if you have one, otherwise
DescribeAutoScalingInstances until LifecycleState='InService'
if let Err(err) = autoscaling
    .create_auto_scaling_group()
    .auto_scaling_group_name(auto_scaling_group_name.as_str())
    .launch_template(
        LaunchTemplateSpecification::builder()
            .launch_template_id(launch_template_arn.clone())
            .version("$Latest")
            .build(),
    )
    .max_size(1)
    .min_size(1)
    .set_availability_zones(Some(availability_zones))
    .send()
    .await
{
    let mut errs = vec![ScenarioError::new(
        "Failed to create autoscaling group",
        &err,
    )];

    if let Err(err) = autoscaling
        .delete_auto_scaling_group()
        .auto_scaling_group_name(auto_scaling_group_name.as_str())
        .send()
        .await
    {
        errs.push(ScenarioError::new(
            "Failed to clean up autoscaling group",
            &err,
        ));
    }

    if let Err(err) = ec2
        .delete_launch_template()
        .launch_template_id(launch_template_arn.clone())
        .send()
        .await
    {
        errs.push(ScenarioError::new(
            "Failed to clean up launch template",
```

```

        &err,
    ));
}
return Err(errs);
}

let scenario = AutoScalingScenario {
    ec2,
    autoscaling: autoscaling.clone(), // Clients are cheap so cloning here
to prevent a move is ok.
    auto_scaling_group_name: auto_scaling_group_name.clone(),
    launch_template_arn,
};

// snippet-start:[rust.auto-scaling.scenario.enable_metrics_collection]
let enable_metrics_collection = autoscaling
    .enable_metrics_collection()
    .auto_scaling_group_name(auto_scaling_group_name.as_str())
    .granularity("1Minute")
    .set_metrics(Some(vec![
        String::from("GroupMinSize"),
        String::from("GroupMaxSize"),
        String::from("GroupDesiredCapacity"),
        String::from("GroupInServiceInstances"),
        String::from("GroupTotalInstances"),
    ]))
    .send()
    .await;
// snippet-end:[rust.auto-scaling.scenario.enable_metrics_collection]

match enable_metrics_collection {
    Ok(_) => Ok(scenario),
    Err(err) => {
        scenario.clean_scenario().await?;
        Err(vec![ScenarioError::new(
            "Failed to enable metrics collections for group",
            &err,
        )])
    }
}
}

pub async fn clean_scenario(self) -> Result<(), Vec<ScenarioError>> {
    let _ = self.wait_for_no_scaling().await;
}

```

```

let delete_group = self
    .autoscaling
    .delete_auto_scaling_group()
    .auto_scaling_group_name(self.auto_scaling_group_name.clone())
    .send()
    .await;

// 14. Delete LaunchTemplate.
let delete_launch_template = self
    .ec2
    .delete_launch_template()
    .launch_template_id(self.launch_template_arn.clone())
    .send()
    .await;

let early_exit = match (delete_group, delete_launch_template) {
    (Ok(_), Ok(_)) => Ok(()),
    (Ok(_), Err(e)) => Err(vec![ScenarioError::new(
        "There was an error cleaning the launch template",
        &e,
    )]),
    (Err(e), Ok(_)) => Err(vec![ScenarioError::new(
        "There was an error cleaning the scale group",
        &e,
    )]),
    (Err(e1), Err(e2)) => Err(vec![
        ScenarioError::new("Multiple error cleaning the scenario Scale
Group", &e1),
        ScenarioError::new("Multiple error cleaning the scenario Launch
Template", &e2),
    ]),
};

if early_exit.is_err() {
    early_exit
} else {
    // Wait for delete_group to finish
    let waiter = Waiter::new();
    let mut errors = Vec::<ScenarioError>::new();
    while errors.len() < 3 {
        if let Err(e) = waiter.sleep().await {
            errors.push(e);
            continue;
        }
    }
}

```

```

        let describe_group = self
            .autoscaling
            .describe_auto_scaling_groups()
            .auto_scaling_group_names(self.auto_scaling_group_name.clone())
            .send()
            .await;
        match describe_group {
            Ok(group) => match group.auto_scaling_groups().first() {
                Some(group) => {
                    if group.status() != Some("Delete in progress") {
                        errors.push(ScenarioError::with(format!(
                            "Group in an unknown state while deleting: {}",
                            group.status().unwrap_or("unknown error")
                        )));
                        return Err(errors);
                    }
                }
                None => return Ok(()),
            },
            Err(err) => {
                errors.push(ScenarioError::new("Failed to describe
autoscaling group during cleanup 3 times, last error", &err));
            }
        }
        if errors.len() > 3 {
            return Err(errors);
        }
    }
    Err(vec![ScenarioError::with(
        "Exited cleanup wait loop without returning success or failing after
three rounds",
    )])
}

// snippet-start:[rust.auto-scaling.scenario.describe_scenario]
pub async fn describe_scenario(&self) -> AutoScalingScenarioDescription {
    let group = self
        .autoscaling
        .describe_auto_scaling_groups()
        .auto_scaling_group_names(self.auto_scaling_group_name.clone())
        .send()
        .await
        .map(|s| {

```

```

        s.auto_scaling_groups()
            .iter()
            .map(|s| {
                format!(
                    "{}: {}",
                    s.auto_scaling_group_name().unwrap_or("Unknown"),
                    s.status().unwrap_or("Unknown")
                )
            })
            .collect:::<Vec<String>>()
    })
    .map_err(|e| {
        ScenarioError::new("Failed to describe auto scaling groups for
scenario", &e)
    });

    let instances = self
        .list_instances()
        .await
        .map_err(|e| anyhow!("There was an error listing instances: {e}"));

    // 10. DescribeScalingActivities: list the scaling activities that have
    occurred for the group so far.
    // Bonus: use CloudWatch API to get and show some metrics collected for
    the group.
    // CW.ListMetrics with Namespace='AWS/AutoScaling' and
    Dimensions=[{'Name': 'AutoScalingGroupName', 'Value': }]
    // CW.GetMetricStatistics with Statistics='Sum'. Start and End times must
    be in UTC!
    let activities = self
        .autoscaling
        .describe_scaling_activities()
        .auto_scaling_group_name(self.auto_scaling_group_name.clone())
        .into_paginator()
        .items()
        .send()
        .collect:::<Result<Vec<_>, _>>()
        .await
        .map_err(|e| {
            anyhow!(
                "There was an error retrieving scaling activities: {}",
                DisplayErrorContext(&e)
            )
        })
    };

```



```

        AutoScalingScenarioDescription {
            group,
            instances,
            activities,
        }
    }
}
// snippet-end:[rust.auto-scaling.scenario.describe_scenario]

// snippet-start:[rust.auto-scaling.scenario.get_group]
async fn get_group(&self) -> Result<AutoScalingGroup, ScenarioError> {
    let describe_auto_scaling_groups = self
        .autoscaling
        .describe_auto_scaling_groups()
        .auto_scaling_group_names(self.auto_scaling_group_name.clone())
        .send()
        .await;

    if let Err(err) = describe_auto_scaling_groups {
        return Err(ScenarioError::new(
            format!(
                "Failed to get status of autoscaling group {}",
                self.auto_scaling_group_name.clone()
            )
            .as_str(),
            &err,
        ));
    }

    let describe_auto_scaling_groups_output =
describe_auto_scaling_groups.unwrap();
    let auto_scaling_groups =
describe_auto_scaling_groups_output.auto_scaling_groups();
    let auto_scaling_group = auto_scaling_groups.first();

    if auto_scaling_group.is_none() {
        return Err(ScenarioError::with(format!(
            "Could not find autoscaling group {}",
            self.auto_scaling_group_name.clone()
        )));
    }

    Ok(auto_scaling_group.unwrap().clone())
}

```

```

// snippet-end:[rust.auto-scaling.scenario.get_group]

pub async fn wait_for_no_scaling(&self) -> Result<(), ScenarioError> {
    let waiter = Waiter::new();
    let mut scaling = true;
    while scaling {
        waiter.sleep().await?;
        let describe_activities = self
            .autoscaling
            .describe_scaling_activities()
            .auto_scaling_group_name(self.auto_scaling_group_name.clone())
            .send()
            .await
            .map_err(|e| {
                ScenarioError::new("Failed to get autoscaling activities for
group", &e)
            })?;
        let activities = describe_activities.activities();
        trace!(
            "Waiting for no scaling found {} activities",
            activities.len()
        );
        scaling = activities.iter().any(|a| a.progress() < Some(100));
    }
    Ok(())
}

pub async fn wait_for_stable(&self, size: usize) -> Result<(), ScenarioError> {
    self.wait_for_no_scaling().await?;

    let mut group = self.get_group().await?;
    let mut count = count_group_instances(&group);

    let waiter = Waiter::new();
    while count != size {
        trace!("Waiting for stable {size} (current: {count})");
        waiter.sleep().await?;
        group = self.get_group().await?;
        count = count_group_instances(&group);
    }

    Ok(())
}

```

```

// snippet-start:[rust.auto-scaling.scenario.list_instances]
pub async fn list_instances(&self) -> Result<Vec<String>, ScenarioError> {
    // The direct way to list instances is by using DescribeAutoScalingGroup's
instances property. However, this returns a Vec<Instance>, as opposed to a
Vec<AutoScalingInstanceDetails>.
    // Ok(self.get_group().await?.instances.unwrap_or_default().map(|i|
i.instance_id.clone().unwrap_or_default()).filter(|id| !id.is_empty()).collect())

    // Alternatively, and for the sake of example, DescribeAutoScalingInstances
returns a list that can be filtered by the client.
    self.autoscaling
        .describe_auto_scaling_instances()
        .into_paginator()
        .items()
        .send()
        .try_collect()
        .await
        .map(|items| {
            items
                .into_iter()
                .filter(|i| {
                    i.auto_scaling_group_name.as_deref()
                        == Some(self.auto_scaling_group_name.as_str())
                })
                .map(|i| i.instance_id.unwrap_or_default())
                .filter(|id| !id.is_empty())
                .collect:::<Vec<String>>()
        })
        .map_err(|err| ScenarioError::new("Failed to get list of auto scaling
instances", &err))
    }
// snippet-end:[rust.auto-scaling.scenario.list_instances]

pub async fn scale_min_size(&self, size: i32) -> Result<(), ScenarioError> {
    let update_group = self
        .autoscaling
        .update_auto_scaling_group()
        .auto_scaling_group_name(self.auto_scaling_group_name.clone())
        .min_size(size)
        .send()
        .await;
    if let Err(err) = update_group {
        return Err(ScenarioError::new(
            format!("Failed to update group to min size ({}))", size).as_str(),

```

```

        &err,
    ));
}
Ok(())
}

pub async fn scale_max_size(&self, size: i32) -> Result<(), ScenarioError> {
    // 5. UpdateAutoScalingGroup: update max size to 3.
    let update_group = self
        .autoscaling
        .update_auto_scaling_group()
        .auto_scaling_group_name(self.auto_scaling_group_name.clone())
        .max_size(size)
        .send()
        .await;
    if let Err(err) = update_group {
        return Err(ScenarioError::new(
            format!("Failed to update group to max size ({size})").as_str(),
            &err,
        ));
    }
    Ok(())
}

// snippet-start:[rust.auto-scaling.scenario.scale_desired_capacity]
pub async fn scale_desired_capacity(&self, capacity: i32) -> Result<(),
ScenarioError> {
    // 7. SetDesiredCapacity: set desired capacity to 2.
    // Wait for a second instance to launch.
    let update_group = self
        .autoscaling
        .set_desired_capacity()
        .auto_scaling_group_name(self.auto_scaling_group_name.clone())
        .desired_capacity(capacity)
        .send()
        .await;
    if let Err(err) = update_group {
        return Err(ScenarioError::new(
            format!("Failed to update group to desired capacity
({capacity}))").as_str(),
            &err,
        ));
    }
    Ok(())
}

```

```

    }
    // snippet-end:[rust.auto-scaling.scenario.scale_desired_capacity]

    pub async fn scale_group_to_zero(&self) -> Result<(), ScenarioError> {
        // snippet-start:[rust.auto-scaling.scenario.disable_metrics_collection]
        // If this fails it's fine, just means there are extra cloudwatch metrics
events for the scale-down.
        let _ = self
            .autoscaling
            .disable_metrics_collection()
            .auto_scaling_group_name(self.auto_scaling_group_name.clone())
            .send()
            .await;
        // snippet-end:[rust.auto-scaling.scenario.disable_metrics_collection]

        // 12. DeleteAutoScalingGroup (to delete the group you must stop all
instances):
        // UpdateAutoScalingGroup with MinSize=0
        let update_group = self
            .autoscaling
            .update_auto_scaling_group()
            .auto_scaling_group_name(self.auto_scaling_group_name.clone())
            .min_size(0)
            .desired_capacity(0)
            .send()
            .await;
        if let Err(err) = update_group {
            return Err(ScenarioError::new(
                "Failed to update group for scaling down&",
                &err,
            ));
        }

        let stable = self.wait_for_stable(0).await;
        if let Err(err) = stable {
            return Err(ScenarioError::with(format!(
                "Error while waiting for group to be stable on scale down: {err}"
            )));
        }

        Ok(())
    }

    // snippet-start:[rust.auto-scaling.scenario.terminate_some_instance]

```

```
pub async fn terminate_some_instance(&self) -> Result<(), ScenarioError> {
    // Retrieve a list of instances in the auto scaling group.
    let auto_scaling_group = self.get_group().await?;
    let instances = auto_scaling_group.instances();
    // Or use other logic to find an instance to terminate.
    let instance = instances.first();
    if let Some(instance) = instance {
        let instance_id = if let Some(instance_id) = instance.instance_id() {
            instance_id
        } else {
            return Err(ScenarioError::with("Missing instance id"));
        };
        let termination = self
            .ec2
            .terminate_instances()
            .instance_ids(instance_id)
            .send()
            .await;
        if let Err(err) = termination {
            Err(ScenarioError::new(
                "There was a problem terminating an instance",
                &err,
            ))
        } else {
            Ok(())
        }
    } else {
        Err(ScenarioError::with("There was no instance to terminate"))
    }
}
// snippet-end:[rust.auto-scaling.scenario.terminate_some_instance]

fn count_group_instances(group: &AutoScalingGroup) -> usize {
    group.instances.as_ref().map(|i| i.len()).unwrap_or(0)
}
```

- For API details, see the following topics in *AWS SDK for Rust API reference*.
 - [CreateAutoScalingGroup](#)
 - [DeleteAutoScalingGroup](#)
 - [DescribeAutoScalingGroups](#)

- [DescribeAutoScalingInstances](#)
- [DescribeScalingActivities](#)
- [DisableMetricsCollection](#)
- [EnableMetricsCollection](#)
- [SetDesiredCapacity](#)
- [TerminateInstanceInAutoScalingGroup](#)
- [UpdateAutoScalingGroup](#)

AWS Batch examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with AWS Batch.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

DescribeComputeEnvironments

The following code example shows how to use `DescribeComputeEnvironments`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_envs(client: &Client) -> Result<(), Error> {
    let rsp = client.describe_compute_environments().send().await?;

    let compute_envs = rsp.compute_environments();
    println!("Found {} compute environments:", compute_envs.len());
    for env in compute_envs {
        let arn = env.compute_environment_arn();
        let name = env.compute_environment_name();

        println!("  Name: {}", name.unwrap_or("Unknown"));
        println!("  ARN:  {}", arn.unwrap_or("Unknown"));
        println!();
    }

    Ok(())
}
```

- For API details, see [DescribeComputeEnvironments](#) in *AWS SDK for Rust API reference*.

Amazon Cognito Identity Provider examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon Cognito Identity Provider.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

ListUserPools

The following code example shows how to use `ListUserPools`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_pools(client: &Client) -> Result<(), Error> {
    let response = client.list_user_pools().max_results(10).send().await?;
    let pools = response.user_pools();
    println!("User pools:");
    for pool in pools {
        println!("  ID:           {}", pool.id().unwrap_or_default());
        println!("  Name:          {}", pool.name().unwrap_or_default());
        println!("  Lambda Config: {:?}", pool.lambda_config().unwrap());
        println!(
            "    Last modified:  {}",
            pool.last_modified_date().unwrap().to_chrono_utc()?
        );
        println!(
            "    Creation date:  {:?}",
            pool.creation_date().unwrap().to_chrono_utc()
        );
        println!();
    }
    println!("Next token: {}", response.next_token().unwrap_or_default());

    Ok(())
}
```

```
}
```

- For API details, see [ListUserPools](#) in *AWS SDK for Rust API reference*.

Amazon Cognito Sync examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon Cognito Sync.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

ListIdentityPoolUsage

The following code example shows how to use ListIdentityPoolUsage.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_pools(client: &Client) -> Result<(), Error> {
```

```
let response = client
    .list_identity_pool_usage()
    .max_results(10)
    .send()
    .await?;

let pools = response.identity_pool_usages();
println!("Identity pools:");

for pool in pools {
    println!(
        " Identity pool ID:   {}",
        pool.identity_pool_id().unwrap_or_default()
    );
    println!(
        " Data storage:         {}",
        pool.data_storage().unwrap_or_default()
    );
    println!(
        " Sync sessions count: {}",
        pool.sync_sessions_count().unwrap_or_default()
    );
    println!(
        " Last modified:        {}",
        pool.last_modified_date().unwrap().to_chrono_utc()?
    );
    println!();
}

println!("Next token: {}", response.next_token().unwrap_or_default());

Ok(())
}
```

- For API details, see [ListIdentityPoolUsage](#) in *AWS SDK for Rust API reference*.

Firehose examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Firehose.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

PutRecordBatch

The following code example shows how to use PutRecordBatch.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn put_record_batch(
    client: &Client,
    stream: &str,
    data: Vec<Record>,
) -> Result<PutRecordBatchOutput, SdkError<PutRecordBatchError>> {
    client
        .put_record_batch()
        .delivery_stream_name(stream)
        .set_records(Some(data))
        .send()
        .await
}
```

- For API details, see [PutRecordBatch](#) in *AWS SDK for Rust API reference*.

DynamoDB examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with DynamoDB.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)
- [Scenarios](#)
- [Serverless examples](#)

Actions

CreateTable

The following code example shows how to use CreateTable.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn create_table(  
    client: &Client,  
    table: &str,
```

```
    key: &str,
) -> Result<CreateTableOutput, Error> {
    let a_name: String = key.into();
    let table_name: String = table.into();

    let ad = AttributeDefinition::builder()
        .attribute_name(&a_name)
        .attribute_type(ScalarAttributeType::S)
        .build()
        .map_err(Error::BuildError)?;

    let ks = KeySchemaElement::builder()
        .attribute_name(&a_name)
        .key_type(KeyType::Hash)
        .build()
        .map_err(Error::BuildError)?;

    let pt = ProvisionedThroughput::builder()
        .read_capacity_units(10)
        .write_capacity_units(5)
        .build()
        .map_err(Error::BuildError)?;

    let create_table_response = client
        .create_table()
        .table_name(table_name)
        .key_schema(ks)
        .attribute_definitions(ad)
        .provisioned_throughput(pt)
        .send()
        .await;

    match create_table_response {
        Ok(out) => {
            println!("Added table {} with key {}", table, key);
            Ok(out)
        }
        Err(e) => {
            eprintln!("Got an error creating table:");
            eprintln!("{}", e);
            Err(Error::unhandled(e))
        }
    }
}
```

- For API details, see [CreateTable](#) in *AWS SDK for Rust API reference*.

DeleteItem

The following code example shows how to use DeleteItem.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn delete_item(
    client: &Client,
    table: &str,
    key: &str,
    value: &str,
) -> Result<DeleteItemOutput, Error> {
    match client
        .delete_item()
        .table_name(table)
        .key(key, AttributeValue::S(value.into()))
        .send()
        .await
    {
        Ok(out) => {
            println!("Deleted item from table");
            Ok(out)
        }
        Err(e) => Err(Error::unhandled(e)),
    }
}
```

- For API details, see [DeleteItem](#) in *AWS SDK for Rust API reference*.

DeleteTable

The following code example shows how to use DeleteTable.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn delete_table(client: &Client, table: &str) -> Result<DeleteTableOutput,
Error> {
    let resp = client.delete_table().table_name(table).send().await;

    match resp {
        Ok(out) => {
            println!("Deleted table");
            Ok(out)
        }
        Err(e) => Err(Error::Unhandled(e.into())),
    }
}
```

- For API details, see [DeleteTable](#) in *AWS SDK for Rust API reference*.

ListTables

The following code example shows how to use ListTables.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).


```
pub async fn list_tables(client: &Client) -> Result<Vec<String>, Error> {
    let paginator = client.list_tables().into_paginator().items().send();
    let table_names = paginator.collect::
```

Determine whether table exists.

```
pub async fn table_exists(client: &Client, table: &str) -> Result<bool, Error> {
    debug!("Checking for table: {table}");
    let table_list = client.list_tables().send().await;

    match table_list {
        Ok(list) => Ok(list.table_names().contains(&table.into())),
        Err(e) => Err(e.into()),
    }
}
```

- For API details, see [ListTables](#) in *AWS SDK for Rust API reference*.

PutItem

The following code example shows how to use PutItem.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn add_item(client: &Client, item: Item, table: &String) ->
Result<ItemOut, Error> {
    let user_av = AttributeValue::S(item.username);
    let type_av = AttributeValue::S(item.p_type);
    let age_av = AttributeValue::S(item.age);
    let first_av = AttributeValue::S(item.first);
    let last_av = AttributeValue::S(item.last);

    let request = client
        .put_item()
        .table_name(table)
        .item("username", user_av)
        .item("account_type", type_av)
        .item("age", age_av)
        .item("first_name", first_av)
        .item("last_name", last_av);

    println!("Executing request [{request:?}] to add item...");

    let resp = request.send().await?;

    let attributes = resp.attributes().unwrap();

    let username = attributes.get("username").cloned();
    let first_name = attributes.get("first_name").cloned();
    let last_name = attributes.get("last_name").cloned();
    let age = attributes.get("age").cloned();
    let p_type = attributes.get("p_type").cloned();

    println!(
        "Added user {:?}, {:?} {:?}, age {:?} as {:?} user",
        username, first_name, last_name, age, p_type
    );

    Ok(ItemOut {
        p_type,
        age,
        username,
        first_name,
        last_name,
    })
}
```

- For API details, see [PutItem](#) in *AWS SDK for Rust API reference*.

Query

The following code example shows how to use Query.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Find the movies made in the specified year.

```
pub async fn movies_in_year(
    client: &Client,
    table_name: &str,
    year: u16,
) -> Result<Vec<Movie>, MovieError> {
    let results = client
        .query()
        .table_name(table_name)
        .key_condition_expression("#yr = :yyyy")
        .expression_attribute_names("#yr", "year")
        .expression_attribute_values(":yyyy", AttributeValue::N(year.to_string()))
        .send()
        .await?;

    if let Some(items) = results.items {
        let movies = items.iter().map(|v| v.into()).collect();
        Ok(movies)
    } else {
        Ok(vec![])
    }
}
```

- For API details, see [Query](#) in *AWS SDK for Rust API reference*.

Scan

The following code example shows how to use Scan.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn list_items(client: &Client, table: &str, page_size: Option<i32>) ->
Result<(), Error> {
    let page_size = page_size.unwrap_or(10);
    let items: Result<Vec<_>, _> = client
        .scan()
        .table_name(table)
        .limit(page_size)
        .into_paginator()
        .items()
        .send()
        .collect()
        .await;

    println!("Items in table (up to {page_size}):");
    for item in items? {
        println!("  {:?}", item);
    }

    Ok(())
}
```

- For API details, see [Scan](#) in *AWS SDK for Rust API reference*.

Scenarios

Query a table using PartiQL

The following code example shows how to:

- Get an item by running a SELECT statement.
- Add an item by running an INSERT statement.
- Update an item by running an UPDATE statement.
- Delete an item by running a DELETE statement.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_table(
    client: &Client,
    table: &str,
    key: &str,
) -> Result<(), SdkError<CreateTableError>> {
    let ad = AttributeDefinition::builder()
        .attribute_name(key)
        .attribute_type(ScalarAttributeType::S)
        .build()
        .expect("creating AttributeDefinition");

    let ks = KeySchemaElement::builder()
        .attribute_name(key)
        .key_type(KeyType::Hash)
        .build()
        .expect("creating KeySchemaElement");

    let pt = ProvisionedThroughput::builder()
        .read_capacity_units(10)
        .write_capacity_units(5)
        .build()
        .expect("creating ProvisionedThroughput");

    match client
        .create_table()
        .table_name(table)
        .key_schema(ks)
```

```

        .attribute_definitions(ad)
        .provisioned_throughput(pt)
        .send()
        .await
    {
        Ok(_) => Ok(()),
        Err(e) => Err(e),
    }
}

async fn add_item(client: &Client, item: Item) -> Result<(),
SdkError<ExecuteStatementError>> {
    match client
        .execute_statement()
        .statement(format!(
            r#"INSERT INTO "{}" VALUE {{
                "{}": ?,
                "account_type": ?,
                "age": ?,
                "first_name": ?,
                "last_name": ?
            }} "#,
            item.table, item.key
        ))
        .set_parameters(Some(vec![
            AttributeValue::S(item.utype),
            AttributeValue::S(item.age),
            AttributeValue::S(item.first_name),
            AttributeValue::S(item.last_name),
        ]))
        .send()
        .await
    {
        Ok(_) => Ok(()),
        Err(e) => Err(e),
    }
}

async fn query_item(client: &Client, item: Item) -> bool {
    match client
        .execute_statement()
        .statement(format!(
            r#"SELECT * FROM "{}" WHERE "{}" = ?"#,
            item.table, item.key
        ))

```

```

    ))
    .set_parameters(Some(vec![AttributeValue::S(item.value)]))
    .send()
    .await
{
    Ok(resp) => {
        if !resp.items().is_empty() {
            println!("Found a matching entry in the table:");
            println!("{:?}", resp.items.unwrap_or_default().pop());
            true
        } else {
            println!("Did not find a match.");
            false
        }
    }
    Err(e) => {
        println!("Got an error querying table:");
        println!("{}", e);
        process::exit(1);
    }
}
}

async fn remove_item(client: &Client, table: &str, key: &str, value: String) ->
Result<(), Error> {
    client
        .execute_statement()
        .statement(format!(r#"DELETE FROM "{table}" WHERE "{key}" = ?"#))
        .set_parameters(Some(vec![AttributeValue::S(value)]))
        .send()
        .await?;

    println!("Deleted item.");

    Ok(())
}

async fn remove_table(client: &Client, table: &str) -> Result<(), Error> {
    client.delete_table().table_name(table).send().await?;

    Ok(())
}

```

- For API details, see [ExecuteStatement](#) in *AWS SDK for Rust API reference*.

Serverless examples

Invoke a Lambda function from a DynamoDB trigger

The following code example shows how to implement a Lambda function that receives an event triggered by receiving records from a DynamoDB stream. The function retrieves the DynamoDB payload and logs the record contents.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming a DynamoDB event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

use lambda_runtime::{service_fn, tracing, Error, LambdaEvent};
use aws_lambda_events::{
    event::dynamodb::{Event, EventRecord},
};

// Built with the following dependencies:
//lambda_runtime = "0.11.1"
//serde_json = "1.0"
//tokio = { version = "1", features = ["macros"] }
//tracing = { version = "0.1", features = ["log"] }
//tracing-subscriber = { version = "0.3", default-features = false, features =
    ["fmt"] }
//aws_lambda_events = "0.15.0"

async fn function_handler(event: LambdaEvent<Event>) ->Result<(), Error> {

    let records = &event.payload.records;
    tracing::info!("event payload: {:?}",records);
```



```
    if records.is_empty() {
        tracing::info!("No records found. Exiting.");
        return Ok(());
    }

    for record in records{
        log_dynamo_dbrecord(record);
    }

    tracing::info!("Dynamo db records processed");

    // Prepare the response
    Ok(())
}

fn log_dynamo_dbrecord(record: &EventRecord)-> Result<(), Error>{
    tracing::info!("EventId: {}", record.event_id);
    tracing::info!("EventName: {}", record.event_name);
    tracing::info!("DynamoDB Record: {:?}" , record.change );
    Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        .with_target(false)
        .without_time()
        .init();

    let func = service_fn(function_handler);
    lambda_runtime::run(func).await?;
    Ok(())
}
```

Reporting batch item failures for Lambda functions with a DynamoDB trigger

The following code example shows how to implement partial batch response for Lambda functions that receive events from a DynamoDB stream. The function reports the batch item failures in the response, signaling to Lambda to retry those messages later.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Reporting DynamoDB batch item failures with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::{
    event::dynamodb::{Event, EventRecord, StreamRecord},
    streams::{DynamoDbBatchItemFailure, DynamoDbEventResponse},
};
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

/// Process the stream record
fn process_record(record: &EventRecord) -> Result<(), Error> {
    let stream_record: &StreamRecord = &record.change;

    // process your stream record here...
    tracing::info!("Data: {:?}", stream_record);

    Ok(())
}

/// Main Lambda handler here...
async fn function_handler(event: LambdaEvent<Event>) ->
Result<DynamoDbEventResponse, Error> {
    let mut response = DynamoDbEventResponse {
        batch_item_failures: vec![],
    };

    let records = &event.payload.records;
```

```

    if records.is_empty() {
        tracing::info!("No records found. Exiting.");
        return Ok(response);
    }

    for record in records {
        tracing::info!("EventId: {}", record.event_id);

        // Couldn't find a sequence number
        if record.change.sequence_number.is_none() {
            response.batch_item_failures.push(DynamoDbBatchItemFailure {
                item_identifier: Some("").to_string(),
            });
            return Ok(response);
        }

        // Process your record here...
        if process_record(record).is_err() {
            response.batch_item_failures.push(DynamoDbBatchItemFailure {
                item_identifier: record.change.sequence_number.clone(),
            });
            /* Since we are working with streams, we can return the failed item
            immediately.
            Lambda will immediately begin to retry processing from this failed item
            onwards. */
            return Ok(response);
        }
    }

    tracing::info!("Successfully processed {} record(s)", records.len());

    Ok(response)
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        // disable printing the name of the module in every log line.
        .with_target(false)
        // disabling time is handy because CloudWatch will add the ingestion time.
        .without_time()
        .init();
}

```

```
run(service_fn(function_handler)).await  
}
```

Amazon EBS examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon EBS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

CompleteSnapshot

The following code example shows how to use CompleteSnapshot.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn finish(client: &Client, id: &str) -> Result<(), Error> {
```

```

    client
        .complete_snapshot()
        .changed_blocks_count(2)
        .snapshot_id(id)
        .send()
        .await?;

    println!("Snapshot ID {}", id);
    println!("The state is 'completed' when all of the modified blocks have been
transferred to Amazon S3.");
    println!("Use the get-snapshot-state code example to get the state of the
snapshot.");

    Ok(())
}

```

- For API details, see [CompleteSnapshot](#) in *AWS SDK for Rust API reference*.

PutSnapshotBlock

The following code example shows how to use PutSnapshotBlock.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn add_block(
    client: &Client,
    id: &str,
    idx: usize,
    block: Vec<u8>,
    checksum: &str,
) -> Result<(), Error> {
    client
        .put_snapshot_block()
        .snapshot_id(id)

```

```
        .block_index(idx as i32)
        .block_data(ByteStream::from(block))
        .checksum(checksum)
        .checksum_algorithm(ChecksumAlgorithm::ChecksumAlgorithmSha256)
        .data_length(EBS_BLOCK_SIZE as i32)
        .send()
        .await?;

    Ok(())
}
```

- For API details, see [PutSnapshotBlock](#) in *AWS SDK for Rust API reference*.

StartSnapshot

The following code example shows how to use StartSnapshot.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn start(client: &Client, description: &str) -> Result<String, Error> {
    let snapshot = client
        .start_snapshot()
        .description(description)
        .encrypted(false)
        .volume_size(1)
        .send()
        .await?;

    Ok(snapshot.snapshot_id.unwrap())
}
```

- For API details, see [StartSnapshot](#) in *AWS SDK for Rust API reference*.

Amazon EC2 examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon EC2.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

DeleteSnapshot

The following code example shows how to use DeleteSnapshot.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn delete_snapshot(client: &Client, id: &str) -> Result<(), Error> {
    client.delete_snapshot().snapshot_id(id).send().await?;

    println!("Deleted");

    Ok(())
}
```

- For API details, see [DeleteSnapshot](#) in *AWS SDK for Rust API reference*.

DescribeImages

The following code example shows how to use DescribeImages.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
// A simple Rust program to list all Amazon images in the currently configured
// region.
#[tokio::main]
async fn main() -> Result<(), Error> {
    let config = aws_config::load_from_env().await;
    let client = Client::new(&config);

    let resp = client.describe_images().owners("amazon").send().await?;

    println!("AWS SDK for Rust v{}", PKG_VERSION);
    println!("Describing Amazon Machine Images (AMIs):");

    let mut images: Vec<_> = resp
        .images()
        .iter()
        .filter(|i| {
            i.description()
                .filter(|i| i.contains("Amazon Linux AMI 2023"))
                .is_some()
        })
        .collect();
    images.sort_by(|a, b| a.description.cmp(&b.description));

    if images.is_empty() {
        println!("No images found.");
    }
}
```



```
        return Ok(());
    }

    for image in images {
        let id = image.image_id().unwrap_or_default();
        let description = image.description().unwrap_or_default();

        println!("{id}: {description}");
    }

    Ok(())
}
```

- For API details, see [DescribeImages](#) in *AWS SDK for Rust API reference*.

DescribeInstanceStatus

The following code example shows how to use `DescribeInstanceStatus`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_all_events(client: &Client) -> Result<(), Error> {
    let resp = client.describe_regions().send().await.unwrap();

    for region in resp.regions.unwrap_or_default() {
        let reg: &'static str = Box::leak(Box::from(region.region_name().unwrap()));
        let region_provider = RegionProviderChain::default_provider().or_else(reg);
        let config = aws_config::from_env().region(region_provider).load().await;
        let new_client = Client::new(&config);

        let resp = new_client.describe_instance_status().send().await;

        println!("Instances in region {}: ", reg);
        println!();
    }
}
```

```

    for status in resp.unwrap().instance_statuses() {
        println!(
            " Events scheduled for instance ID: {}",
            status.instance_id().unwrap_or_default()
        );
        for event in status.events() {
            println!(" Event ID:      {}",
event.instance_event_id().unwrap());
            println!(" Description: {}", event.description().unwrap());
            println!(" Event code:  {}", event.code().unwrap().as_ref());
            println!();
        }
    }
}

Ok(())
}

```

- For API details, see [DescribeInstanceStatus](#) in *AWS SDK for Rust API reference*.

DescribeInstances

The following code example shows how to use DescribeInstances.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn show_state(client: &Client, ids: Option<Vec<String>>) -> Result<(), Error>
{
    let resp = client
        .describe_instances()
        .set_instance_ids(ids)
        .send()
        .await?;
}

```

```
for reservation in resp.reservations() {
    for instance in reservation.instances() {
        println!("Instance ID: {}", instance.instance_id().unwrap());
        println!(
            "State:      {:?}",
            instance.state().unwrap().name().unwrap()
        );
        println!();
    }
}

Ok(())
}
```

- For API details, see [DescribeInstances](#) in *AWS SDK for Rust API reference*.

DescribeRegions

The following code example shows how to use DescribeRegions.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_regions(client: &Client) -> Result<(), Error> {
    let rsp = client.describe_regions().send().await?;

    println!("Regions:");
    for region in rsp.regions() {
        println!("  {}", region.region_name().unwrap());
    }

    Ok(())
}
```

- For API details, see [DescribeRegions](#) in *AWS SDK for Rust API reference*.

DescribeSnapshots

The following code example shows how to use DescribeSnapshots.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Shows the state of a snapshot.

```
async fn show_state(client: &Client, id: &str) -> Result<(), Error> {
    let resp = client
        .describe_snapshots()
        .filters(Filter::builder().name("snapshot-id").values(id).build())
        .send()
        .await?;

    println!(
        "State: {}",
        resp.snapshots().first().unwrap().state().unwrap().as_ref()
    );

    Ok(())
}
```

```
async fn show_snapshots(client: &Client) -> Result<(), Error> {
    // "self" represents your account ID.
    // You can list the snapshots for any account by replacing
    // "self" with that account ID.
    let resp = client.describe_snapshots().owner_ids("self").send().await?;
    let snapshots = resp.snapshots();
    let length = snapshots.len();

    for snapshot in snapshots {
```

```

        println!(
            "ID:          {}",
            snapshot.snapshot_id().unwrap_or_default()
        );
        println!(
            "Description: {}",
            snapshot.description().unwrap_or_default()
        );
        println!("State:          {}", snapshot.state().unwrap().as_ref());
        println!();
    }

    println!();
    println!("Found {} snapshot(s)", length);
    println!();

    Ok(())
}

```

- For API details, see [DescribeSnapshots](#) in *AWS SDK for Rust API reference*.

RebootInstances

The following code example shows how to use RebootInstances.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn reboot_instance(client: &Client, id: &str) -> Result<(), Error> {
    println!("Rebooting instance.");

    client.reboot_instances().instance_ids(id).send().await?;

    client
        .wait_until_instance_stopped()
        .instance_ids(id)

```

```

        .wait(Duration::from_secs(60))
        .await?;
let wait_status_ok = client
    .wait_until_instance_status_ok()
    .instance_ids(id)
    .wait(Duration::from_secs(60))
    .await;

match wait_status_ok {
    Ok(_) => println!("Rebooted instance {id}, it is started with status OK."),
    Err(err) => return Err(err.into()),
}

Ok(())
}

```

- For API details, see [RebootInstances](#) in *AWS SDK for Rust API reference*.

StartInstances

The following code example shows how to use StartInstances.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn start_instance(client: &Client, id: &str) -> Result<(), Error> {
    // start_instance has no unique errors to handle.
    client.start_instances().instance_ids(id).send().await?;

    println!("Waiting for instance to be running");

    let wait_for_running = client
        .wait_until_instance_running()
        .instance_ids(id)
        .wait(Duration::from_secs(60))
        .await;
}

```

```

match wait_for_running {
    Ok(_) => println!("Instance is running"),
    Err(err) => match err {
        WaiterError::ExceededMaxWait(exceeded) => {
            println!(
                "Exceeded max time waiting for instance to start. Exceeded {}s
by {}s.",
                exceeded.max_wait().as_secs(),
                (exceeded.elapsed() - exceeded.max_wait()).as_secs()
            );
            return Ok(());
        }
        _ => return Err(err.into()),
    },
}

println!("Started instance.");

Ok(())
}

```

- For API details, see [StartInstances](#) in *AWS SDK for Rust API reference*.

StopInstances

The following code example shows how to use StopInstances.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn stop_instance(client: &Client, id: &str) -> Result<(), Error> {
    client.stop_instances().instance_ids(id).send().await?;

    println!("Stopping instance...");
}

```

```

let wait = client
    .wait_until_instance_stopped()
    .instance_ids(id)
    .wait(Duration::from_secs(60))
    .await;

match wait {
    Ok(_) => {
        println!("Stopped instance.");
    }
    Err(err) => match err {
        WaiterError::ExceededMaxWait(exceeded) => {
            println!(
                "Exceeded max time waiting for instance to stop. Exceeded {}s by
                {}s",
                exceeded.max_wait().as_secs(),
                (exceeded.elapsed() - exceeded.max_wait()).as_secs()
            )
        }
        _ => return Err(err.into()),
    },
};
Ok(())
}

```

- For API details, see [StopInstances](#) in *AWS SDK for Rust API reference*.

Amazon ECR examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon ECR.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

DescribeRepositories

The following code example shows how to use `DescribeRepositories`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_repos(client: &aws_sdk_ecr::Client) -> Result<(), aws_sdk_ecr::Error>
{
    let rsp = client.describe_repositories().send().await?;

    let repos = rsp.repositories();

    println!("Found {} repositories:", repos.len());

    for repo in repos {
        println!("  ARN: {}", repo.repository_arn().unwrap());
        println!("  Name: {}", repo.repository_name().unwrap());
    }

    Ok(())
}
```

- For API details, see [DescribeRepositories](#) in *AWS SDK for Rust API reference*.

ListImages

The following code example shows how to use `ListImages`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_images(
    client: &aws_sdk_ecr::Client,
    repository: &str,
) -> Result<(), aws_sdk_ecr::Error> {
    let rsp = client
        .list_images()
        .repository_name(repository)
        .send()
        .await?;

    let images = rsp.image_ids();

    println!("found {} images", images.len());

    for image in images {
        println!(
            "image: {}:{}",
            image.image_tag().unwrap(),
            image.image_digest().unwrap()
        );
    }

    Ok(())
}
```

- For API details, see [ListImages](#) in *AWS SDK for Rust API reference*.

Amazon ECS examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon ECS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

CreateCluster

The following code example shows how to use `CreateCluster`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_cluster(client: &aws_sdk_ecs::Client, name: &str) -> Result<(),
aws_sdk_ecs::Error> {
    let cluster = client.create_cluster().cluster_name(name).send().await?;
    println!("cluster created: {:?}", cluster);

    Ok(())
}
```

- For API details, see [CreateCluster](#) in *AWS SDK for Rust API reference*.

DeleteCluster

The following code example shows how to use DeleteCluster.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn remove_cluster(
    client: &aws_sdk_ecs::Client,
    name: &str,
) -> Result<(), aws_sdk_ecs::Error> {
    let cluster_deleted = client.delete_cluster().cluster(name).send().await?;
    println!("cluster deleted: {:?}", cluster_deleted);

    Ok(())
}
```

- For API details, see [DeleteCluster](#) in *AWS SDK for Rust API reference*.

DescribeClusters

The following code example shows how to use DescribeClusters.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_clusters(client: &aws_sdk_ecs::Client) -> Result<(),
aws_sdk_ecs::Error> {
```

```
let resp = client.list_clusters().send().await?;

let cluster_arns = resp.cluster_arns();
println!("Found {} clusters:", cluster_arns.len());

let clusters = client
    .describe_clusters()
    .set_clusters(Some(cluster_arns.into()))
    .send()
    .await?;

for cluster in clusters.clusters() {
    println!("  ARN: {}", cluster.cluster_arn().unwrap());
    println!("  Name: {}", cluster.cluster_name().unwrap());
}

Ok(())
}
```

- For API details, see [DescribeClusters](#) in *AWS SDK for Rust API reference*.

Amazon EKS examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon EKS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

CreateCluster

The following code example shows how to use CreateCluster.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_cluster(
    client: &aws_sdk_eks::Client,
    name: &str,
    arn: &str,
    subnet_ids: Vec<String>,
) -> Result<(), aws_sdk_eks::Error> {
    let cluster = client
        .create_cluster()
        .name(name)
        .role_arn(arn)
        .resources_vpc_config(
            VpcConfigRequest::builder()
                .set_subnet_ids(Some(subnet_ids))
                .build(),
        )
        .send()
        .await?;
    println!("cluster created: {:?}", cluster);

    Ok(())
}
```

- For API details, see [CreateCluster](#) in *AWS SDK for Rust API reference*.

DeleteCluster

The following code example shows how to use DeleteCluster.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn remove_cluster(
    client: &aws_sdk_eks::Client,
    name: &str,
) -> Result<(), aws_sdk_eks::Error> {
    let cluster_deleted = client.delete_cluster().name(name).send().await?;
    println!("cluster deleted: {:?}", cluster_deleted);

    Ok(())
}
```

- For API details, see [DeleteCluster](#) in *AWS SDK for Rust API reference*.

AWS Glue examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with AWS Glue.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Get started

Hello AWS Glue

The following code examples show how to get started using AWS Glue.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let mut list_jobs = glue.list_jobs().into_paginator().send();
while let Some(list_jobs_output) = list_jobs.next().await {
    match list_jobs_output {
        Ok(list_jobs) => {
            let names = list_jobs.job_names();
            info!(?names, "Found these jobs")
        }
        Err(err) => return Err(GlueMvpError::from_glue_sdk(err)),
    }
}
```

- For API details, see [ListJobs](#) in *AWS SDK for Rust API reference*.

Topics

- [Actions](#)
- [Scenarios](#)

Actions

CreateCrawler

The following code example shows how to use CreateCrawler.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).


```
let create_crawler = glue
    .create_crawler()
    .name(self.crawler())
    .database_name(self.database())
    .role(self.iam_role.expose_secret())
    .targets(
        CrawlerTargets::builder()
            .s3_targets(S3Target::builder().path(CRAWLER_TARGET).build())
            .build(),
    )
    .send()
    .await;

match create_crawler {
    Err(err) => {
        let glue_err: aws_sdk_glue::Error = err.into();
        match glue_err {
            aws_sdk_glue::Error::AlreadyExistsException(_) => {
                info!("Using existing crawler");
                Ok(())
            }
            _ => Err(GlueMvpError::GlueSdk(glue_err)),
        }
    }
    Ok(_) => Ok(()),
}??;
```

- For API details, see [CreateCrawler](#) in *AWS SDK for Rust API reference*.

CreateJob

The following code example shows how to use CreateJob.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

let create_job = glue
    .create_job()
    .name(self.job())
    .role(self.iam_role.expose_secret())
    .command(
        JobCommand::builder()
            .name("glueetl")
            .python_version("3")
            .script_location(format!("s3://{}/job.py", self.bucket()))
            .build(),
    )
    .glue_version("3.0")
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;

let job_name = create_job.name().ok_or_else(|| {
    GlueMvpError::Unknown("Did not get job name after creating job".into())
})?;

```

- For API details, see [CreateJob](#) in *AWS SDK for Rust API reference*.

DeleteCrawler

The following code example shows how to use DeleteCrawler.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

glue.delete_crawler()
    .name(self.crawler())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;

```

- For API details, see [DeleteCrawler](#) in *AWS SDK for Rust API reference*.

DeleteDatabase

The following code example shows how to use DeleteDatabase.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
glue.delete_database()
    .name(self.database())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;
```

- For API details, see [DeleteDatabase](#) in *AWS SDK for Rust API reference*.

DeleteJob

The following code example shows how to use DeleteJob.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
glue.delete_job()
    .job_name(self.job())
    .send()
    .await
```

```
.map_err(GlueMvpError::from_glue_sdk)?;
```

- For API details, see [DeleteJob](#) in *AWS SDK for Rust API reference*.

DeleteTable

The following code example shows how to use DeleteTable.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
for t in &self.tables {
    glue.delete_table()
        .name(t.name())
        .database_name(self.database())
        .send()
        .await
        .map_err(GlueMvpError::from_glue_sdk)?;
}
```

- For API details, see [DeleteTable](#) in *AWS SDK for Rust API reference*.

GetCrawler

The following code example shows how to use GetCrawler.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let tmp_crawler = glue
    .get_crawler()
    .name(self.crawler())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;
```

- For API details, see [GetCrawler](#) in *AWS SDK for Rust API reference*.

GetDatabase

The following code example shows how to use GetDatabase.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let database = glue
    .get_database()
    .name(self.database())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?
    .to_owned();
let database = database
    .database()
    .ok_or_else(|| GlueMvpError::Unknown("Could not find
database".into()))?;
```

- For API details, see [GetDatabase](#) in *AWS SDK for Rust API reference*.

GetJobRun

The following code example shows how to use GetJobRun.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let get_job_run = || async {
    Ok:::<JobRun, GlueMvpError>(
        glue.get_job_run()
            .job_name(self.job())
            .run_id(job_run_id.to_string())
            .send()
            .await
            .map_err(GlueMvpError:::from_glue_sdk)?
            .job_run()
            .ok_or_else(|| GlueMvpError:::Unknown("Failed to get
job_run".into()))?
            .to_owned(),
    )
};

let mut job_run = get_job_run().await?;
let mut state =
job_run.job_run_state().unwrap_or(&unknown_state).to_owned();

while matches!(
    state,
    JobRunState:::Starting | JobRunState:::Stopping | JobRunState:::Running
) {
    info!(?state, "Waiting for job to finish");
    tokio::time::sleep(self.wait_delay).await;

    job_run = get_job_run().await?;
    state = job_run.job_run_state().unwrap_or(&unknown_state).to_owned();
}
```

- For API details, see [GetJobRun](#) in *AWS SDK for Rust API reference*.

GetTables

The following code example shows how to use `GetTables`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let tables = glue
    .get_tables()
    .database_name(self.database())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;

let tables = tables.table_list();
```

- For API details, see [GetTables](#) in *AWS SDK for Rust API reference*.

ListJobs

The following code example shows how to use `ListJobs`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let mut list_jobs = glue.list_jobs().into_paginator().send();
while let Some(list_jobs_output) = list_jobs.next().await {
    match list_jobs_output {
        Ok(list_jobs) => {
```

```

        let names = list_jobs.job_names();
        info!(?names, "Found these jobs")
    }
    Err(err) => return Err(GlueMvpError::from_glue_sdk(err)),
}
}

```

- For API details, see [ListJobs](#) in *AWS SDK for Rust API reference*.

StartCrawler

The following code example shows how to use StartCrawler.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

let start_crawler = glue.start_crawler().name(self.crawler()).send().await;

match start_crawler {
    Ok(_) => Ok(()),
    Err(err) => {
        let glue_err: aws_sdk_glue::Error = err.into();
        match glue_err {
            aws_sdk_glue::Error::CrawlerRunningException(_) => Ok(()),
            _ => Err(GlueMvpError::GlueSdk(glue_err)),
        }
    }
}
}??;

```

- For API details, see [StartCrawler](#) in *AWS SDK for Rust API reference*.

StartJobRun

The following code example shows how to use StartJobRun.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let job_run_output = glue
    .start_job_run()
    .job_name(self.job())
    .arguments("--input_database", self.database())
    .arguments(
        "--input_table",
        self.tables
            .first()
            .ok_or_else(|| GlueMvpError::Unknown("Missing crawler
table".into()))?
            .name(),
    )
    .arguments("--output_bucket_url", self.bucket())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;

let job = job_run_output
    .job_run_id()
    .ok_or_else(|| GlueMvpError::Unknown("Missing run id from just started
job".into()))?
    .to_string();
```

- For API details, see [StartJobRun](#) in *AWS SDK for Rust API reference*.

Scenarios

Get started with crawlers and jobs

The following code example shows how to:

- Create a crawler that crawls a public Amazon S3 bucket and generates a database of CSV-formatted metadata.
- List information about databases and tables in your AWS Glue Data Catalog.
- Create a job to extract CSV data from the S3 bucket, transform the data, and load JSON-formatted output into another S3 bucket.
- List information about job runs, view transformed data, and clean up resources.

For more information, see [Tutorial: Getting started with AWS Glue Studio](#).

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Create and run a crawler that crawls a public Amazon Simple Storage Service (Amazon S3) bucket and generates a metadata database that describes the CSV-formatted data it finds.

```
let create_crawler = glue
    .create_crawler()
    .name(self.crawler())
    .database_name(self.database())
    .role(self.iam_role.expose_secret())
    .targets(
        CrawlerTargets::builder()
            .s3_targets(S3Target::builder().path(CRAWLER_TARGET).build())
            .build(),
    )
    .send()
    .await;

match create_crawler {
    Err(err) => {
        let glue_err: aws_sdk_glue::Error = err.into();
        match glue_err {
            aws_sdk_glue::Error::AlreadyExistsException(_) => {
                info!("Using existing crawler");
                Ok(())
            }
        }
    }
}
```

```

        }
        _ => Err(GlueMvpError::GlueSdk(glue_err)),
    }
}
Ok(_) => Ok(()),
}?:

let start_crawler = glue.start_crawler().name(self.crawler()).send().await;

match start_crawler {
    Ok(_) => Ok(()),
    Err(err) => {
        let glue_err: aws_sdk_glue::Error = err.into();
        match glue_err {
            aws_sdk_glue::Error::CrawlerRunningException(_) => Ok(()),
            _ => Err(GlueMvpError::GlueSdk(glue_err)),
        }
    }
}?:

```

List information about databases and tables in your AWS Glue Data Catalog.

```

let database = glue
    .get_database()
    .name(self.database())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?
    .to_owned();
let database = database
    .database()
    .ok_or_else(|| GlueMvpError::Unknown("Could not find
database".into()))?;

let tables = glue
    .get_tables()
    .database_name(self.database())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;

let tables = tables.table_list();

```

Create and run a job that extracts CSV data from the source Amazon S3 bucket, transforms it by removing and renaming fields, and loads JSON-formatted output into another Amazon S3 bucket.

```
let create_job = glue
    .create_job()
    .name(self.job())
    .role(self.iam_role.expose_secret())
    .command(
        JobCommand::builder()
            .name("glueetl")
            .python_version("3")
            .script_location(format!("s3://{}/job.py", self.bucket()))
            .build(),
    )
    .glue_version("3.0")
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;

let job_name = create_job.name().ok_or_else(|| {
    GlueMvpError::Unknown("Did not get job name after creating job".into())
})?;

let job_run_output = glue
    .start_job_run()
    .job_name(self.job())
    .arguments("--input_database", self.database())
    .arguments(
        "--input_table",
        self.tables
            .first()
            .ok_or_else(|| GlueMvpError::Unknown("Missing crawler
table".into()))?
            .name(),
    )
    .arguments("--output_bucket_url", self.bucket())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;
```

```
let job = job_run_output
    .job_run_id()
    .ok_or_else(|| GlueMvpError::Unknown("Missing run id from just started
job".into()))?
    .to_string();
```

Delete all resources created by the demo.

```
glue.delete_job()
    .job_name(self.job())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;

for t in &self.tables {
    glue.delete_table()
        .name(t.name())
        .database_name(self.database())
        .send()
        .await
        .map_err(GlueMvpError::from_glue_sdk)?;
}

glue.delete_database()
    .name(self.database())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;

glue.delete_crawler()
    .name(self.crawler())
    .send()
    .await
    .map_err(GlueMvpError::from_glue_sdk)?;
```

- For API details, see the following topics in *AWS SDK for Rust API reference*.
 - [CreateCrawler](#)
 - [CreateJob](#)
 - [DeleteCrawler](#)

- [DeleteDatabase](#)
- [DeleteJob](#)
- [DeleteTable](#)
- [GetCrawler](#)
- [GetDatabase](#)
- [GetDatabases](#)
- [GetJob](#)
- [GetJobRun](#)
- [GetJobRuns](#)
- [GetTables](#)
- [ListJobs](#)
- [StartCrawler](#)
- [StartJobRun](#)

IAM examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with IAM.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Get started

Hello IAM

The following code examples show how to get started using IAM.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

From `src/bin/hello.rs`.

```
use aws_sdk_iam::error::SdkError;
use aws_sdk_iam::operation::list_policies::ListPoliciesError;
use clap::Parser;

const PATH_PREFIX_HELP: &str = "The path prefix for filtering the results.";

#[derive(Debug, clap::Parser)]
#[command(about)]
struct HelloScenarioArgs {
    #[arg(long, default_value="/", help=PATH_PREFIX_HELP)]
    pub path_prefix: String,
}

#[tokio::main]
async fn main() -> Result<(), SdkError<ListPoliciesError>> {
    let sdk_config = aws_config::load_from_env().await;
    let client = aws_sdk_iam::Client::new(&sdk_config);

    let args = HelloScenarioArgs::parse();

    iam_service::list_policies(client, args.path_prefix).await?;

    Ok(())
}
```

From `src/iam-service-lib.rs`.

```
pub async fn list_policies(
    client: iamClient,
    path_prefix: String,
```

```
) -> Result<Vec<String>, SdkError<ListPoliciesError>> {
    let list_policies = client
        .list_policies()
        .path_prefix(path_prefix)
        .scope(PolicyScopeType::Local)
        .into_paginator()
        .items()
        .send()
        .try_collect()
        .await?;

    let policy_names = list_policies
        .into_iter()
        .map(|p| {
            let name = p
                .policy_name
                .unwrap_or_else(|| "Missing Policy Name".to_string());
            println!("{}", name);
            name
        })
        .collect();

    Ok(policy_names)
}
```

- For API details, see [ListPolicies](#) in *AWS SDK for Rust API reference*.

Topics

- [Actions](#)
- [Scenarios](#)

Actions

AttachRolePolicy

The following code example shows how to use `AttachRolePolicy`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn attach_role_policy(
    client: &iamClient,
    role: &Role,
    policy: &Policy,
) -> Result<AttachRolePolicyOutput, SdkError<AttachRolePolicyError>> {
    client
        .attach_role_policy()
        .role_name(role.role_name())
        .policy_arn(policy.arn().unwrap_or_default())
        .send()
        .await
}
```

- For API details, see [AttachRolePolicy](#) in *AWS SDK for Rust API reference*.

AttachUserPolicy

The following code example shows how to use `AttachUserPolicy`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn attach_user_policy(
    client: &iamClient,
    user_name: &str,
```

```

    policy_arn: &str,
) -> Result<(), iamError> {
    client
        .attach_user_policy()
        .user_name(user_name)
        .policy_arn(policy_arn)
        .send()
        .await?;

    Ok(())
}

```

- For API details, see [AttachUserPolicy](#) in *AWS SDK for Rust API reference*.

CreateAccessKey

The following code example shows how to use CreateAccessKey.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

pub async fn create_access_key(client: &iamClient, user_name: &str) ->
Result<AccessKey, iamError> {
    let mut tries: i32 = 0;
    let max_tries: i32 = 10;

    let response: Result<CreateAccessKeyOutput, SdkError<CreateAccessKeyError>> =
loop {
    match client.create_access_key().user_name(user_name).send().await {
        Ok(inner_response) => {
            break Ok(inner_response);
        }
        Err(e) => {
            tries += 1;
            if tries > max_tries {

```

```
                break Err(e);
            }
            sleep(Duration::from_secs(2)).await;
        }
    }
};

Ok(response.unwrap().access_key.unwrap())
}
```

- For API details, see [CreateAccessKey](#) in *AWS SDK for Rust API reference*.

CreatePolicy

The following code example shows how to use `CreatePolicy`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn create_policy(
    client: &iamClient,
    policy_name: &str,
    policy_document: &str,
) -> Result<Policy, iamError> {
    let policy = client
        .create_policy()
        .policy_name(policy_name)
        .policy_document(policy_document)
        .send()
        .await?;
    Ok(policy.policy.unwrap())
}
```

- For API details, see [CreatePolicy](#) in *AWS SDK for Rust API reference*.

CreateRole

The following code example shows how to use CreateRole.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn create_role(
    client: &iamClient,
    role_name: &str,
    role_policy_document: &str,
) -> Result<Role, iamError> {
    let response: CreateRoleOutput = loop {
        if let Ok(response) = client
            .create_role()
            .role_name(role_name)
            .assume_role_policy_document(role_policy_document)
            .send()
            .await
        {
            break response;
        }
    };

    Ok(response.role.unwrap())
}
```

- For API details, see [CreateRole](#) in *AWS SDK for Rust API reference*.

CreateServiceLinkedRole

The following code example shows how to use CreateServiceLinkedRole.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn create_service_linked_role(
    client: &iamClient,
    aws_service_name: String,
    custom_suffix: Option<String>,
    description: Option<String>,
) -> Result<CreateServiceLinkedRoleOutput, SdkError<CreateServiceLinkedRoleError>> {
    let response = client
        .create_service_linked_role()
        .aws_service_name(aws_service_name)
        .set_custom_suffix(custom_suffix)
        .set_description(description)
        .send()
        .await?;

    Ok(response)
}
```

- For API details, see [CreateServiceLinkedRole](#) in *AWS SDK for Rust API reference*.

CreateUser

The following code example shows how to use CreateUser.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn create_user(client: &iamClient, user_name: &str) -> Result<User, iamError> {
    let response = client.create_user().user_name(user_name).send().await?;

    Ok(response.user.unwrap())
}
```

- For API details, see [CreateUser](#) in *AWS SDK for Rust API reference*.

DeleteAccessKey

The following code example shows how to use DeleteAccessKey.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn delete_access_key(
    client: &iamClient,
    user: &User,
    key: &AccessKey,
) -> Result<(), iamError> {
    loop {
        match client
            .delete_access_key()
            .user_name(user.user_name())
            .access_key_id(key.access_key_id())
            .send()
            .await
        {
            Ok(_) => {
                break;
            }
            Err(e) => {
                println!("Can't delete the access key: {:?} ", e);
                sleep(Duration::from_secs(2)).await;
            }
        }
    }
}
```

```
    }  
  }  
}  
Ok::<(), ()>  
}
```

- For API details, see [DeleteAccessKey](#) in *AWS SDK for Rust API reference*.

DeletePolicy

The following code example shows how to use DeletePolicy.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn delete_policy(client: &iamClient, policy: Policy) -> Result<(),  
iamError> {  
  client  
    .delete_policy()  
    .policy_arn(policy.arn.unwrap())  
    .send()  
    .await?;  
  Ok::<(), ()>  
}
```

- For API details, see [DeletePolicy](#) in *AWS SDK for Rust API reference*.

DeleteRole

The following code example shows how to use DeleteRole.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn delete_role(client: &iamClient, role: &Role) -> Result<(), iamError> {
    let role = role.clone();
    while client
        .delete_role()
        .role_name(role.role_name())
        .send()
        .await
        .is_err()
    {
        sleep(Duration::from_secs(2)).await;
    }
    Ok(())
}
```

- For API details, see [DeleteRole](#) in *AWS SDK for Rust API reference*.

DeleteServiceLinkedRole

The following code example shows how to use DeleteServiceLinkedRole.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn delete_service_linked_role(
    client: &iamClient,
```



```

    role_name: &str,
) -> Result<(), iamError> {
    client
        .delete_service_linked_role()
        .role_name(role_name)
        .send()
        .await?;

    Ok(())
}

```

- For API details, see [DeleteServiceLinkedRole](#) in *AWS SDK for Rust API reference*.

DeleteUser

The following code example shows how to use DeleteUser.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

pub async fn delete_user(client: &iamClient, user: &User) -> Result<(),
SdkError<DeleteUserError>> {
    let user = user.clone();
    let mut tries: i32 = 0;
    let max_tries: i32 = 10;

    let response: Result<(), SdkError<DeleteUserError>> = loop {
        match client
            .delete_user()
            .user_name(user.user_name())
            .send()
            .await
        {
            {
                Ok(_) => {
                    break Ok(());
                }
            }
        }
    }
}

```

```
    }
    Err(e) => {
        tries += 1;
        if tries > max_tries {
            break Err(e);
        }
        sleep(Duration::from_secs(2)).await;
    }
}
};

response
}
```

- For API details, see [DeleteUser](#) in *AWS SDK for Rust API reference*.

DeleteUserPolicy

The following code example shows how to use DeleteUserPolicy.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn delete_user_policy(
    client: &iamClient,
    user: &User,
    policy_name: &str,
) -> Result<(), SdkError<DeleteUserPolicyError>> {
    client
        .delete_user_policy()
        .user_name(user.user_name())
        .policy_name(policy_name)
        .send()
        .await?;
```

```
    Ok(())  
}
```

- For API details, see [DeleteUserPolicy](#) in *AWS SDK for Rust API reference*.

DetachRolePolicy

The following code example shows how to use DetachRolePolicy.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn detach_role_policy(  
    client: &iamClient,  
    role_name: &str,  
    policy_arn: &str,  
) -> Result<(), iamError> {  
    client  
        .detach_role_policy()  
        .role_name(role_name)  
        .policy_arn(policy_arn)  
        .send()  
        .await?;  
  
    Ok(())  
}
```

- For API details, see [DetachRolePolicy](#) in *AWS SDK for Rust API reference*.

DetachUserPolicy

The following code example shows how to use DetachUserPolicy.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn detach_user_policy(
    client: &iamClient,
    user_name: &str,
    policy_arn: &str,
) -> Result<(), iamError> {
    client
        .detach_user_policy()
        .user_name(user_name)
        .policy_arn(policy_arn)
        .send()
        .await?;

    Ok(())
}
```

- For API details, see [DetachUserPolicy](#) in *AWS SDK for Rust API reference*.

GetAccountPasswordPolicy

The following code example shows how to use `GetAccountPasswordPolicy`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn get_account_password_policy(
```

```
    client: &iamClient,
) -> Result<GetAccountPasswordPolicyOutput, SdkError<GetAccountPasswordPolicyError>>
{
    let response = client.get_account_password_policy().send().await?;

    Ok(response)
}
```

- For API details, see [GetAccountPasswordPolicy](#) in *AWS SDK for Rust API reference*.

GetRole

The following code example shows how to use GetRole.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn get_role(
    client: &iamClient,
    role_name: String,
) -> Result<GetRoleOutput, SdkError<GetRoleError>> {
    let response = client.get_role().role_name(role_name).send().await?;
    Ok(response)
}
```

- For API details, see [GetRole](#) in *AWS SDK for Rust API reference*.

ListAttachedRolePolicies

The following code example shows how to use ListAttachedRolePolicies.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn list_attached_role_policies(
    client: &iamClient,
    role_name: String,
    path_prefix: Option<String>,
    marker: Option<String>,
    max_items: Option<i32>,
) -> Result<ListAttachedRolePoliciesOutput, SdkError<ListAttachedRolePoliciesError>>
{
    let response = client
        .list_attached_role_policies()
        .role_name(role_name)
        .set_path_prefix(path_prefix)
        .set_marker(marker)
        .set_max_items(max_items)
        .send()
        .await?;

    Ok(response)
}
```

- For API details, see [ListAttachedRolePolicies](#) in *AWS SDK for Rust API reference*.

ListGroups

The following code example shows how to use ListGroups.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn list_groups(
    client: &iamClient,
    path_prefix: Option<String>,
    marker: Option<String>,
    max_items: Option<i32>,
) -> Result<ListGroupsOutput, SdkError<ListGroupsError>> {
    let response = client
        .list_groups()
        .set_path_prefix(path_prefix)
        .set_marker(marker)
        .set_max_items(max_items)
        .send()
        .await?;

    Ok(response)
}
```

- For API details, see [ListGroups](#) in *AWS SDK for Rust API reference*.

ListPolicies

The following code example shows how to use ListPolicies.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn list_policies(
    client: iamClient,
    path_prefix: String,
) -> Result<Vec<String>, SdkError<ListPoliciesError>> {
    let list_policies = client
        .list_policies()
        .path_prefix(path_prefix)
        .scope(PolicyScopeType::Local)
        .into_paginator()
        .items()
        .send()
        .try_collect()
        .await?;

    let policy_names = list_policies
        .into_iter()
        .map(|p| {
            let name = p
                .policy_name
                .unwrap_or_else(|| "Missing Policy Name".to_string());
            println!("{}", name);
            name
        })
        .collect();

    Ok(policy_names)
}
```

- For API details, see [ListPolicies](#) in *AWS SDK for Rust API reference*.

ListRolePolicies

The following code example shows how to use ListRolePolicies.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).


```
pub async fn list_role_policies(
    client: &iamClient,
    role_name: &str,
    marker: Option<String>,
    max_items: Option<i32>,
) -> Result<ListRolePoliciesOutput, SdkError<ListRolePoliciesError>> {
    let response = client
        .list_role_policies()
        .role_name(role_name)
        .set_marker(marker)
        .set_max_items(max_items)
        .send()
        .await?;

    Ok(response)
}
```

- For API details, see [ListRolePolicies](#) in *AWS SDK for Rust API reference*.

ListRoles

The following code example shows how to use ListRoles.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn list_roles(
    client: &iamClient,
    path_prefix: Option<String>,
    marker: Option<String>,
    max_items: Option<i32>,
) -> Result<ListRolesOutput, SdkError<ListRolesError>> {
    let response = client
        .list_roles()
        .set_path_prefix(path_prefix)
```

```
        .set_marker(marker)
        .set_max_items(max_items)
        .send()
        .await?;
    Ok(response)
}
```

- For API details, see [ListRoles](#) in *AWS SDK for Rust API reference*.

ListSAMLProviders

The following code example shows how to use `ListSAMLProviders`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn list_saml_providers(
    client: &Client,
) -> Result<ListSamlProvidersOutput, SdkError<ListSAMLProvidersError>> {
    let response = client.list_saml_providers().send().await?;

    Ok(response)
}
```

- For API details, see [ListSAMLProviders](#) in *AWS SDK for Rust API reference*.

ListUsers

The following code example shows how to use `ListUsers`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn list_users(
    client: &iamClient,
    path_prefix: Option<String>,
    marker: Option<String>,
    max_items: Option<i32>,
) -> Result<ListUsersOutput, SdkError<ListUsersError>> {
    let response = client
        .list_users()
        .set_path_prefix(path_prefix)
        .set_marker(marker)
        .set_max_items(max_items)
        .send()
        .await?;
    Ok(response)
}
```

- For API details, see [ListUsers](#) in *AWS SDK for Rust API reference*.

Scenarios

Create a user and assume a role

The following code example shows how to create a user and assume a role.

Warning

To avoid security risks, don't use IAM users for authentication when developing purpose-built software or working with real data. Instead, use federation with an identity provider such as [AWS IAM Identity Center](#).

- Create a user with no permissions.
- Create a role that grants permission to list Amazon S3 buckets for the account.
- Add a policy to let the user assume the role.
- Assume the role and list S3 buckets using temporary credentials, then clean up resources.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
use aws_config::meta::region::RegionProviderChain;
use aws_sdk_iam::Error as iamError;
use aws_sdk_iam::{config::Credentials as iamCredentials, config::Region, Client as iamClient};
use aws_sdk_s3::Client as s3Client;
use aws_sdk_sts::Client as stsClient;
use tokio::time::{sleep, Duration};
use uuid::Uuid;

#[tokio::main]
async fn main() -> Result<(), iamError> {
    let (client, uuid, list_all_buckets_policy_document, inline_policy_document) =
        initialize_variables().await;

    if let Err(e) = run_iam_operations(
        client,
        uuid,
        list_all_buckets_policy_document,
        inline_policy_document,
    )
    .await
    {
        println!("{:?}", e);
    }

    Ok(())
}
```

```

}

async fn initialize_variables() -> (iamClient, String, String, String) {
    let region_provider = RegionProviderChain::first_try(Region::new("us-west-2"));

    let shared_config = aws_config::from_env().region(region_provider).load().await;
    let client = iam_client::new(&shared_config);
    let uuid = Uuid::new_v4().to_string();

    let list_all_buckets_policy_document = "{
        \"Version\": \"2012-10-17\",
        \"Statement\": [{
            \"Effect\": \"Allow\",
            \"Action\": \"s3:ListAllMyBuckets\",
            \"Resource\": \"arn:aws:s3::*\"}]
    }"
    .to_string();
    let inline_policy_document = "{
        \"Version\": \"2012-10-17\",
        \"Statement\": [{
            \"Effect\": \"Allow\",
            \"Action\": \"sts:AssumeRole\",
            \"Resource\": \"{}\"}]
    }"
    .to_string();

    (
        client,
        uuid,
        list_all_buckets_policy_document,
        inline_policy_document,
    )
}

async fn run_iam_operations(
    client: iam_client,
    uuid: String,
    list_all_buckets_policy_document: String,
    inline_policy_document: String,
) -> Result<(), iamError> {
    let user = iam_service::create_user(&client, &format!("{}", "iam_demo_user_",
    uuid)).await?;
    println!("Created the user with the name: {}", user.user_name());
    let key = iam_service::create_access_key(&client, user.user_name()).await?;
}

```

```

let assume_role_policy_document = "{
    \"Version\": \"2012-10-17\",
    \"Statement\": [{
        \"Effect\": \"Allow\",
        \"Principal\": {\"AWS\": \"{}\"},
        \"Action\": \"sts:AssumeRole\"
    }]
}"
.to_string()
.replace("{}", user.arn());

let assume_role_role = iam_service::create_role(
    &client,
    &format!("{}", "iam_demo_role_", uuid),
    &assume_role_policy_document,
)
.await?;
println!("Created the role with the ARN: {}", assume_role_role.arn());

let list_all_buckets_policy = iam_service::create_policy(
    &client,
    &format!("{}", "iam_demo_policy_", uuid),
    &list_all_buckets_policy_document,
)
.await?;
println!(
    "Created policy: {}",
    list_all_buckets_policy.policy_name.as_ref().unwrap()
);

let attach_role_policy_result =
    iam_service::attach_role_policy(&client, &assume_role_role,
&list_all_buckets_policy)
        .await?;
println!(
    "Attached the policy to the role: {:?}",
    attach_role_policy_result
);

let inline_policy_name = format!("{}", "iam_demo_inline_policy_", uuid);
let inline_policy_document = inline_policy_document.replace("{}",
assume_role_role.arn());

```

```

    iam_service::create_user_policy(&client, &user, &inline_policy_name,
    &inline_policy_document)
        .await?;
    println!("Created inline policy.");

    //First, fail to list the buckets with the user.
    let creds = iamCredentials::from_keys(key.access_key_id(),
    key.secret_access_key(), None);
    let fail_config = aws_config::from_env()
        .credentials_provider(creds.clone())
        .load()
        .await;
    println!("Fail config: {:?}", fail_config);
    let fail_client: s3Client = s3Client::new(&fail_config);
    match fail_client.list_buckets().send().await {
        Ok(e) => {
            println!("This should not run. {:?}", e);
        }
        Err(e) => {
            println!("Successfully failed with error: {:?}", e)
        }
    }

    let sts_config = aws_config::from_env()
        .credentials_provider(creds.clone())
        .load()
        .await;
    let sts_client: stsClient = stsClient::new(&sts_config);
    sleep(Duration::from_secs(10)).await;
    let assumed_role = sts_client
        .assume_role()
        .role_arn(assume_role_role.arn())
        .role_session_name(&format!("{}", "iam_demo_assumerole_session_", uuid))
        .send()
        .await;
    println!("Assumed role: {:?}", assumed_role);
    sleep(Duration::from_secs(10)).await;

    let assumed_credentials = iamCredentials::from_keys(
        assumed_role
            .as_ref()
            .unwrap()
            .credentials
            .as_ref()

```

```

        .unwrap()
        .access_key_id(),
    assumed_role
        .as_ref()
        .unwrap()
        .credentials
        .as_ref()
        .unwrap()
        .secret_access_key(),
    Some(
        assumed_role
            .as_ref()
            .unwrap()
            .credentials
            .as_ref()
            .unwrap()
            .session_token
            .clone(),
    ),
);

let succeed_config = aws_config::from_env()
    .credentials_provider(assumed_credentials)
    .load()
    .await;
println!("succeed config: {:?}", succeed_config);
let succeed_client: s3Client = s3Client::new(&succeed_config);
sleep(Duration::from_secs(10)).await;
match succeed_client.list_buckets().send().await {
    Ok(_) => {
        println!("This should now run successfully.")
    }
    Err(e) => {
        println!("This should not run. {:?}", e);
        panic!()
    }
}

//Clean up.
iam_service::detach_role_policy(
    &client,
    assume_role_role.role_name(),
    list_all_buckets_policy.arn().unwrap_or_default(),
)

```



```
.await?;
iam_service::delete_policy(&client, list_all_buckets_policy).await?;
iam_service::delete_role(&client, &assume_role_role).await?;
println!("Deleted role {}", assume_role_role.role_name());
iam_service::delete_access_key(&client, &user, &key).await?;
println!("Deleted key for {}", key.user_name());
iam_service::delete_user_policy(&client, &user, &inline_policy_name).await?;
println!("Deleted inline user policy: {}", inline_policy_name);
iam_service::delete_user(&client, &user).await?;
println!("Deleted user {}", user.user_name());

Ok(())
}
```

- For API details, see the following topics in *AWS SDK for Rust API reference*.
 - [AttachRolePolicy](#)
 - [CreateAccessKey](#)
 - [CreatePolicy](#)
 - [CreateRole](#)
 - [CreateUser](#)
 - [DeleteAccessKey](#)
 - [DeletePolicy](#)
 - [DeleteRole](#)
 - [DeleteUser](#)
 - [DeleteUserPolicy](#)
 - [DetachRolePolicy](#)
 - [PutUserPolicy](#)

AWS IoT examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with AWS IoT.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

DescribeEndpoint

The following code example shows how to use `DescribeEndpoint`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_address(client: &Client, endpoint_type: &str) -> Result<(), Error> {
    let resp = client
        .describe_endpoint()
        .endpoint_type(endpoint_type)
        .send()
        .await?;

    println!("Endpoint address: {}", resp.endpoint_address.unwrap());

    println!();

    Ok(())
}
```

- For API details, see [DescribeEndpoint](#) in *AWS SDK for Rust API reference*.

ListThings

The following code example shows how to use ListThings.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_things(client: &Client) -> Result<(), Error> {
    let resp = client.list_things().send().await?;

    println!("Things:");

    for thing in resp.things.unwrap() {
        println!(
            " Name: {}",
            thing.thing_name.as_deref().unwrap_or_default()
        );
        println!(
            " Type: {}",
            thing.thing_type_name.as_deref().unwrap_or_default()
        );
        println!(
            " ARN: {}",
            thing.thing_arn.as_deref().unwrap_or_default()
        );
        println!();
    }

    println!();

    Ok(())
}
```

- For API details, see [ListThings](#) in *AWS SDK for Rust API reference*.

Kinesis examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Kinesis.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)
- [Serverless examples](#)

Actions

CreateStream

The following code example shows how to use `CreateStream`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_stream(client: &Client, stream: &str) -> Result<(), Error> {
    client
        .create_stream()
        .stream_name(stream)
        .shard_count(4)
```

```
        .send()
        .await?;

    println!("Created stream");

    Ok(())
}
```

- For API details, see [CreateStream](#) in *AWS SDK for Rust API reference*.

DeleteStream

The following code example shows how to use DeleteStream.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn remove_stream(client: &Client, stream: &str) -> Result<(), Error> {
    client.delete_stream().stream_name(stream).send().await?;

    println!("Deleted stream.");

    Ok(())
}
```

- For API details, see [DeleteStream](#) in *AWS SDK for Rust API reference*.

DescribeStream

The following code example shows how to use DescribeStream.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_stream(client: &Client, stream: &str) -> Result<(), Error> {
    let resp = client.describe_stream().stream_name(stream).send().await?;

    let desc = resp.stream_description.unwrap();

    println!("Stream description:");
    println!("  Name:           {:?}", desc.stream_name());
    println!("  Status:         {:?}", desc.stream_status());
    println!("  Open shards:    {:?}", desc.shards.len());
    println!("  Retention (hours): {:?}", desc.retention_period_hours());
    println!("  Encryption:     {:?}", desc.encryption_type.unwrap());

    Ok(())
}
```

- For API details, see [DescribeStream](#) in *AWS SDK for Rust API reference*.

ListStreams

The following code example shows how to use `ListStreams`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_streams(client: &Client) -> Result<(), Error> {
```

```
let resp = client.list_streams().send().await?;

println!("Stream names:");

let streams = resp.stream_names;
for stream in &streams {
    println!(" {}", stream);
}

println!("Found {} stream(s)", streams.len());

Ok(())
}
```

- For API details, see [ListStreams](#) in *AWS SDK for Rust API reference*.

PutRecord

The following code example shows how to use PutRecord.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn add_record(client: &Client, stream: &str, key: &str, data: &str) ->
Result<(), Error> {
    let blob = Blob::new(data);

    client
        .put_record()
        .data(blob)
        .partition_key(key)
        .stream_name(stream)
        .send()
        .await?;
```

```
println!("Put data into stream.");

Ok(())
}
```

- For API details, see [PutRecord](#) in *AWS SDK for Rust API reference*.

Serverless examples

Invoke a Lambda function from a Kinesis trigger

The following code example shows how to implement a Lambda function that receives an event triggered by receiving records from a Kinesis stream. The function retrieves the Kinesis payload, decodes from Base64, and logs the record contents.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming an Kinesis event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::event::kinesis::KinesisEvent;
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

async fn function_handler(event: LambdaEvent<KinesisEvent>) -> Result<(), Error> {
    if event.payload.records.is_empty() {
        tracing::info!("No records found. Exiting.");
        return Ok(());
    }

    event.payload.records.iter().for_each(|record| {
        tracing::info!("EventId:
{}", record.event_id.as_deref().unwrap_or_default());
```



```
    let record_data = std::str::from_utf8(&record.kinesis.data);

    match record_data {
        Ok(data) => {
            // log the record data
            tracing::info!("Data: {}", data);
        }
        Err(e) => {
            tracing::error!("Error: {}", e);
        }
    }
});

tracing::info!(
    "Successfully processed {} records",
    event.payload.records.len()
);

Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        // disable printing the name of the module in every log line.
        .with_target(false)
        // disabling time is handy because CloudWatch will add the ingestion time.
        .without_time()
        .init();

    run(service_fn(function_handler)).await
}
```

Reporting batch item failures for Lambda functions with a Kinesis trigger

The following code example shows how to implement partial batch response for Lambda functions that receive events from a Kinesis stream. The function reports the batch item failures in the response, signaling to Lambda to retry those messages later.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Reporting Kinesis batch item failures with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::{
    event::kinesis::KinesisEvent,
    kinesis::KinesisEventRecord,
    streams::{KinesisBatchItemFailure, KinesisEventResponse},
};
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

async fn function_handler(event: LambdaEvent<KinesisEvent>) ->
Result<KinesisEventResponse, Error> {
    let mut response = KinesisEventResponse {
        batch_item_failures: vec![],
    };

    if event.payload.records.is_empty() {
        tracing::info!("No records found. Exiting.");
        return Ok(response);
    }

    for record in &event.payload.records {
        tracing::info!(
            "EventId: {}",
            record.event_id.as_deref().unwrap_or_default()
        );

        let record_processing_result = process_record(record);

        if record_processing_result.is_err() {
            response.batch_item_failures.push(KinesisBatchItemFailure {
                item_identifier: record.kinesis.sequence_number.clone(),
            });
        }
    }
}
```

```
        /* Since we are working with streams, we can return the failed item
immediately.
        Lambda will immediately begin to retry processing from this failed item
onwards. */
        return Ok(response);
    }
}

tracing::info!(
    "Successfully processed {} records",
    event.payload.records.len()
);

Ok(response)
}

fn process_record(record: &KinesisEventRecord) -> Result<(), Error> {
    let record_data = std::str::from_utf8(record.kinesis.data.as_slice());

    if let Some(err) = record_data.err() {
        tracing::error!("Error: {}", err);
        return Err(Error::from(err));
    }

    let record_data = record_data.unwrap_or_default();

    // do something interesting with the data
    tracing::info!("Data: {}", record_data);

    Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        // disable printing the name of the module in every log line.
        .with_target(false)
        // disabling time is handy because CloudWatch will add the ingestion time.
        .without_time()
        .init();

    run(service_fn(function_handler)).await
}
```

```
}
```

AWS KMS examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with AWS KMS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

CreateKey

The following code example shows how to use CreateKey.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_key(client: &Client) -> Result<(), Error> {  
    let resp = client.create_key().send().await?;  
  
    let id = resp.key_metadata.as_ref().unwrap().key_id();  
}
```

```
println!("Key: {}", id);

Ok(())
}
```

- For API details, see [CreateKey](#) in *AWS SDK for Rust API reference*.

Decrypt

The following code example shows how to use Decrypt.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn decrypt_key(client: &Client, key: &str, filename: &str) -> Result<(),
Error> {
    // Open input text file and get contents as a string
    // input is a base-64 encoded string, so decode it:
    let data = fs::read_to_string(filename)
        .map(|input| {
            base64::decode(input).expect("Input file does not contain valid base 64
characters.")
        })
        .map(Blob::new);

    let resp = client
        .decrypt()
        .key_id(key)
        .ciphertext_blob(data.unwrap())
        .send()
        .await?;

    let inner = resp.plaintext.unwrap();
    let bytes = inner.as_ref();
```

```
let s = String::from_utf8(bytes.to_vec()).expect("Could not convert to UTF-8");

println!();
println!("Decoded string:");
println!("{}", s);

Ok(())
}
```

- For API details, see [Decrypt](#) in *AWS SDK for Rust API reference*.

Encrypt

The following code example shows how to use Encrypt.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn encrypt_string(
    verbose: bool,
    client: &Client,
    text: &str,
    key: &str,
    out_file: &str,
) -> Result<(), Error> {
    let blob = Blob::new(text.as_bytes());

    let resp = client.encrypt().key_id(key).plaintext(blob).send().await?;

    // Did we get an encrypted blob?
    let blob = resp.ciphertext_blob.expect("Could not get encrypted text");
    let bytes = blob.as_ref();

    let s = base64::encode(bytes);
```

```

let mut ofile = File::create(out_file).expect("unable to create file");
ofile.write_all(s.as_bytes()).expect("unable to write");

if verbose {
    println!("Wrote the following to {:?}", out_file);
    println!("{}", s);
}

Ok(())
}

```

- For API details, see [Encrypt](#) in *AWS SDK for Rust API reference*.

GenerateDataKey

The following code example shows how to use `GenerateDataKey`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn make_key(client: &Client, key: &str) -> Result<(), Error> {
    let resp = client
        .generate_data_key()
        .key_id(key)
        .key_spec(DataKeySpec::Aes256)
        .send()
        .await?;

    // Did we get an encrypted blob?
    let blob = resp.ciphertext_blob.expect("Could not get encrypted text");
    let bytes = blob.as_ref();

    let s = base64::encode(bytes);

    println();
    println!("Data key:");
}

```

```
println!("{}", s);

Ok(())
}
```

- For API details, see [GenerateDataKey](#) in *AWS SDK for Rust API reference*.

GenerateDataKeyWithoutPlaintext

The following code example shows how to use `GenerateDataKeyWithoutPlaintext`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_key(client: &Client, key: &str) -> Result<(), Error> {
    let resp = client
        .generate_data_key_without_plaintext()
        .key_id(key)
        .key_spec(DataKeySpec::Aes256)
        .send()
        .await?;

    // Did we get an encrypted blob?
    let blob = resp.ciphertext_blob.expect("Could not get encrypted text");
    let bytes = blob.as_ref();

    let s = base64::encode(bytes);

    println();
    println("Data key:");
    println!("{}", s);

    Ok(())
}
```


- For API details, see [GenerateDataKeyWithoutPlaintext](#) in *AWS SDK for Rust API reference*.

GenerateRandom

The following code example shows how to use `GenerateRandom`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_string(client: &Client, length: i32) -> Result<(), Error> {
    let resp = client
        .generate_random()
        .number_of_bytes(length)
        .send()
        .await?;

    // Did we get an encrypted blob?
    let blob = resp.plaintext.expect("Could not get encrypted text");
    let bytes = blob.as_ref();

    let s = base64::encode(bytes);

    println!();
    println!("Data key:");
    println!("{}", s);

    Ok(())
}
```

- For API details, see [GenerateRandom](#) in *AWS SDK for Rust API reference*.

ListKeys

The following code example shows how to use `ListKeys`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_keys(client: &Client) -> Result<(), Error> {
    let resp = client.list_keys().send().await?;

    let keys = resp.keys.unwrap_or_default();

    let len = keys.len();

    for key in keys {
        println!("Key ARN: {}", key.key_arn.as_deref().unwrap_or_default());
    }

    println!();
    println!("Found {} keys", len);

    Ok(())
}
```

- For API details, see [ListKeys](#) in *AWS SDK for Rust API reference*.

ReEncrypt

The following code example shows how to use ReEncrypt.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn reencrypt_string(
    verbose: bool,
    client: &Client,
    input_file: &str,
    output_file: &str,
    first_key: &str,
    new_key: &str,
) -> Result<(), Error> {
    // Get blob from input file
    // Open input text file and get contents as a string
    // input is a base-64 encoded string, so decode it:
    let data = fs::read_to_string(input_file)
        .map(|input_file| base64::decode(input_file).expect("invalid base 64"))
        .map(Blob::new);

    let resp = client
        .re_encrypt()
        .ciphertext_blob(data.unwrap())
        .source_key_id(first_key)
        .destination_key_id(new_key)
        .send()
        .await?;

    // Did we get an encrypted blob?
    let blob = resp.ciphertext_blob.expect("Could not get encrypted text");
    let bytes = blob.as_ref();

    let s = base64::encode(bytes);
    let o = &output_file;

    let mut ofile = File::create(o).expect("unable to create file");
    ofile.write_all(s.as_bytes()).expect("unable to write");

    if verbose {
        println!("Wrote the following to {:}", output_file);
        println!("{}", s);
    } else {
        println!("Wrote base64-encoded output to {}", output_file);
    }

    Ok(())
}
```

- For API details, see [ReEncrypt](#) in *AWS SDK for Rust API reference*.

Lambda examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Lambda.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)
- [Scenarios](#)
- [Serverless examples](#)

Actions

CreateFunction

The following code example shows how to use `CreateFunction`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
/**
 * Create a function, uploading from a zip file.
 */
```

```

    pub async fn create_function(&self, zip_file: PathBuf) -> Result<String,
anyhow::Error> {
        let code = self.prepare_function(zip_file, None).await?;

        let key = code.s3_key().unwrap().to_string();

        let role = self.create_role().await.map_err(|e| anyhow!(e))?;

        info!("Created iam role, waiting 15s for it to become active");
        tokio::time::sleep(Duration::from_secs(15)).await;

        info!("Creating lambda function {}", self.lambda_name);
        let _ = self
            .lambda_client
            .create_function()
            .function_name(self.lambda_name.clone())
            .code(code)
            .role(role.arn())
            .runtime(aws_sdk_lambda::types::Runtime::Providedal2)
            .handler("_unused")
            .send()
            .await
            .map_err(anyhow::Error::from)?;

        self.wait_for_function_ready().await?;

        self.lambda_client
            .publish_version()
            .function_name(self.lambda_name.clone())
            .send()
            .await?;

        Ok(key)
    }

    /**
     * Upload function code from a path to a zip file.
     * The zip file must have an AL2 Linux-compatible binary called `bootstrap`.
     * The easiest way to create such a zip is to use `cargo lambda build --output-
format Zip`.
     */
    async fn prepare_function(
        &self,
        zip_file: PathBuf,

```

```

        key: Option<String>,
    ) -> Result<FunctionCode, anyhow::Error> {
        let body = ByteStream::from_path(zip_file).await?;

        let key = key.unwrap_or_else(|| format!("{}_code", self.lambda_name));

        info!("Uploading function code to s3://{}/{}", self.bucket, key);
        let _ = self
            .s3_client
            .put_object()
            .bucket(self.bucket.clone())
            .key(key.clone())
            .body(body)
            .send()
            .await?;

        Ok(FunctionCode::builder()
            .s3_bucket(self.bucket.clone())
            .s3_key(key)
            .build())
    }

```

- For API details, see [CreateFunction](#) in *AWS SDK for Rust API reference*.

DeleteFunction

The following code example shows how to use DeleteFunction.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

/** Delete a function and its role, and if possible or necessary, its associated
code object and bucket. */
pub async fn delete_function(
    &self,
    location: Option<String>,

```

```
) -> (
    Result<DeleteFunctionOutput, anyhow::Error>,
    Result<DeleteRoleOutput, anyhow::Error>,
    Option<Result<DeleteObjectOutput, anyhow::Error>>,
) {
    info!("Deleting lambda function {}", self.lambda_name);
    let delete_function = self
        .lambda_client
        .delete_function()
        .function_name(self.lambda_name.clone())
        .send()
        .await
        .map_err(anyhow::Error::from);

    info!("Deleting iam role {}", self.role_name);
    let delete_role = self
        .iam_client
        .delete_role()
        .role_name(self.role_name.clone())
        .send()
        .await
        .map_err(anyhow::Error::from);

    let delete_object: Option<Result<DeleteObjectOutput, anyhow::Error>> =
        if let Some(location) = location {
            info!("Deleting object {location}");
            Some(
                self.s3_client
                    .delete_object()
                    .bucket(self.bucket.clone())
                    .key(location)
                    .send()
                    .await
                    .map_err(anyhow::Error::from),
            )
        } else {
            info!(?location, "Skipping delete object");
            None
        };

    (delete_function, delete_role, delete_object)
}
```

- For API details, see [DeleteFunction](#) in *AWS SDK for Rust API reference*.

GetFunction

The following code example shows how to use `GetFunction`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
/** Get the Lambda function with this Manager's name. */
pub async fn get_function(&self) -> Result<GetFunctionOutput, anyhow::Error> {
    info!("Getting lambda function");
    self.lambda_client
        .get_function()
        .function_name(self.lambda_name.clone())
        .send()
        .await
        .map_err(anyhow::Error::from)
}
```

- For API details, see [GetFunction](#) in *AWS SDK for Rust API reference*.

Invoke

The following code example shows how to use `Invoke`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).


```
/** Invoke the lambda function using calculator InvokeArgs. */
pub async fn invoke(&self, args: InvokeArgs) -> Result<InvokeOutput,
anyhow::Error> {
    info!(?args, "Invoking {}", self.lambda_name);
    let payload = serde_json::to_string(&args)?;
    debug!(?payload, "Sending payload");
    self.lambda_client
        .invoke()
        .function_name(self.lambda_name.clone())
        .payload(Blob::new(payload))
        .send()
        .await
        .map_err(anyhow::Error::from)
}

fn log_invoke_output(invoker: &InvokeOutput, message: &str) {
    if let Some(payload) = invoker.payload().cloned() {
        let payload = String::from_utf8(payload.into_inner());
        info!(?payload, message);
    } else {
        info!("Could not extract payload")
    }
    if let Some(logs) = invoker.log_result() {
        debug!(?logs, "Invoked function logs")
    } else {
        debug!("Invoked function had no logs")
    }
}
```

- For API details, see [Invoke](#) in *AWS SDK for Rust API reference*.

ListFunctions

The following code example shows how to use `ListFunctions`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
/** List all Lambda functions in the current Region. */
pub async fn list_functions(&self) -> Result<ListFunctionsOutput, anyhow::Error>
{
    info!("Listing lambda functions");
    self.lambda_client
        .list_functions()
        .send()
        .await
        .map_err(anyhow::Error::from)
}
```

- For API details, see [ListFunctions](#) in *AWS SDK for Rust API reference*.

UpdateFunctionCode

The following code example shows how to use UpdateFunctionCode.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
/** Given a Path to a zip file, update the function's code and wait for the
update to finish. */
pub async fn update_function_code(
    &self,
    zip_file: PathBuf,
    key: String,
```

```

) -> Result<UpdateFunctionCodeOutput, anyhow::Error> {
    let function_code = self.prepare_function(zip_file, Some(key)).await?;

    info!("Updating code for {}", self.lambda_name);
    let update = self
        .lambda_client
        .update_function_code()
        .function_name(self.lambda_name.clone())
        .s3_bucket(self.bucket.clone())
        .s3_key(function_code.s3_key().unwrap().to_string())
        .send()
        .await
        .map_err(anyhow::Error::from)?;

    self.wait_for_function_ready().await?;

    Ok(update)
}

/**
 * Upload function code from a path to a zip file.
 * The zip file must have an AL2 Linux-compatible binary called `bootstrap`.
 * The easiest way to create such a zip is to use `cargo lambda build --output-
format Zip`.
 */
async fn prepare_function(
    &self,
    zip_file: PathBuf,
    key: Option<String>,
) -> Result<FunctionCode, anyhow::Error> {
    let body = ByteStream::from_path(zip_file).await?;

    let key = key.unwrap_or_else(|| format!("{}_code", self.lambda_name));

    info!("Uploading function code to s3://{}/{}", self.bucket, key);
    let _ = self
        .s3_client
        .put_object()
        .bucket(self.bucket.clone())
        .key(key.clone())
        .body(body)
        .send()
        .await?;

```

```
Ok(FunctionCode::builder()
    .s3_bucket(self.bucket.clone())
    .s3_key(key)
    .build())
}
```

- For API details, see [UpdateFunctionCode](#) in *AWS SDK for Rust API reference*.

UpdateFunctionConfiguration

The following code example shows how to use UpdateFunctionConfiguration.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
/** Update the environment for a function. */
pub async fn update_function_configuration(
    &self,
    environment: Environment,
) -> Result<UpdateFunctionConfigurationOutput, anyhow::Error> {
    info!(
        ?environment,
        "Updating environment for {}", self.lambda_name
    );
    let updated = self
        .lambda_client
        .update_function_configuration()
        .function_name(self.lambda_name.clone())
        .environment(environment)
        .send()
        .await
        .map_err(anyhow::Error::from)?;

    self.wait_for_function_ready().await?;

    Ok(updated)
}
```

```
}
```

- For API details, see [UpdateFunctionConfiguration](#) in *AWS SDK for Rust API reference*.

Scenarios

Get started with functions

The following code example shows how to:

- Create an IAM role and Lambda function, then upload handler code.
- Invoke the function with a single parameter and get results.
- Update the function code and configure with an environment variable.
- Invoke the function with new parameters and get results. Display the returned execution log.
- List the functions for your account, then clean up resources.

For more information, see [Create a Lambda function with the console](#).

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

The Cargo.toml with dependencies used in this scenario.

```
[package]
name = "lambda-code-examples"
version = "0.1.0"
edition = "2021"

# See more keys and their definitions at https://doc.rust-lang.org/cargo/reference/manifest.html

[dependencies]
aws-config = { version = "1.0.1", features = ["behavior-version-latest"] }
```

```
aws-sdk-ec2 = { version = "1.3.0" }
aws-sdk-iam = { version = "1.3.0" }
aws-sdk-lambda = { version = "1.3.0" }
aws-sdk-s3 = { version = "1.4.0" }
aws-smithy-types = { version = "1.0.1" }
aws-types = { version = "1.0.1" }
clap = { version = "~4.4", features = ["derive"] }
tokio = { version = "1.20.1", features = ["full"] }
tracing-subscriber = { version = "0.3.15", features = ["env-filter"] }
tracing = "0.1.37"
serde_json = "1.0.94"
anyhow = "1.0.71"
uuid = { version = "1.3.3", features = ["v4"] }
lambda_runtime = "0.8.0"
serde = "1.0.164"
```

A collection of utilities that streamline calling Lambda for this scenario. This file is `src/ations.rs` in the crate.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

use anyhow::anyhow;
use aws_sdk_iam::operation::{create_role::CreateRoleError,
delete_role::DeleteRoleOutput};
use aws_sdk_lambda::{
    operation::{
        delete_function::DeleteFunctionOutput, get_function::GetFunctionOutput,
        invoke::InvokeOutput, list_functions::ListFunctionsOutput,
        update_function_code::UpdateFunctionCodeOutput,
        update_function_configuration::UpdateFunctionConfigurationOutput,
    },
    primitives::ByteStream,
    types::{Environment, FunctionCode, LastUpdateStatus, State},
};
use aws_sdk_s3::{
    error::ErrorMetadata,
    operation::{delete_bucket::DeleteBucketOutput,
delete_object::DeleteObjectOutput},
    types::CreateBucketConfiguration,
};
use aws_smithy_types::Blob;
```

```

use serde::{ser::SerializeMap, Serialize};
use std::{path::PathBuf, str::FromStr, time::Duration};
use tracing::{debug, info, warn};

/* Operation describes */
#[derive(Clone, Copy, Debug, Serialize)]
pub enum Operation {
    #[serde(rename = "plus")]
    Plus,
    #[serde(rename = "minus")]
    Minus,
    #[serde(rename = "times")]
    Times,
    #[serde(rename = "divided-by")]
    DividedBy,
}

impl FromStr for Operation {
    type Err = anyhow::Error;

    fn from_str(s: &str) -> Result<Self, Self::Err> {
        match s {
            "plus" => Ok(Operation::Plus),
            "minus" => Ok(Operation::Minus),
            "times" => Ok(Operation::Times),
            "divided-by" => Ok(Operation::DividedBy),
            _ => Err(anyhow!("Unknown operation {s}")),
        }
    }
}

impl ToString for Operation {
    fn to_string(&self) -> String {
        match self {
            Operation::Plus => "plus".to_string(),
            Operation::Minus => "minus".to_string(),
            Operation::Times => "times".to_string(),
            Operation::DividedBy => "divided-by".to_string(),
        }
    }
}

/**
 * InvokeArgs will be serialized as JSON and sent to the AWS Lambda handler.

```

```

    */
#[derive(Debug)]
pub enum InvokeArgs {
    Increment(i32),
    Arithmetic(Operation, i32, i32),
}

impl Serialize for InvokeArgs {
    fn serialize<S>(&self, serializer: S) -> Result<S::Ok, S::Error>
    where
        S: serde::Serializer,
    {
        match self {
            InvokeArgs::Increment(i) => serializer.serialize_i32(*i),
            InvokeArgs::Arithmetic(o, i, j) => {
                let mut map: S::SerializeMap = serializer.serialize_map(Some(3))?;
                map.serialize_key(&"op".to_string())?;
                map.serialize_value(&o.to_string())?;
                map.serialize_key(&"i".to_string())?;
                map.serialize_value(&i)?;
                map.serialize_key(&"j".to_string())?;
                map.serialize_value(&j)?;
                map.end()
            }
        }
    }
}

/** A policy document allowing Lambda to execute this function on the account's
    behalf. */
const ROLE_POLICY_DOCUMENT: &str = r#" {
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Principal": { "Service": "lambda.amazonaws.com" },
            "Action": "sts:AssumeRole"
        }
    ]
} "#;

/**
 * A LambdaManager gathers all the resources necessary to run the Lambda example
    scenario.

```



```
* This includes instantiated aws_sdk clients and details of resource names.
*/
pub struct LambdaManager {
    iam_client: aws_sdk_iam::Client,
    lambda_client: aws_sdk_lambda::Client,
    s3_client: aws_sdk_s3::Client,
    lambda_name: String,
    role_name: String,
    bucket: String,
    own_bucket: bool,
}

// These unit type structs provide nominal typing on top of String parameters for
// LambdaManager::new
pub struct LambdaName(pub String);
pub struct RoleName(pub String);
pub struct Bucket(pub String);
pub struct OwnBucket(pub bool);

impl LambdaManager {
    pub fn new(
        iam_client: aws_sdk_iam::Client,
        lambda_client: aws_sdk_lambda::Client,
        s3_client: aws_sdk_s3::Client,
        lambda_name: LambdaName,
        role_name: RoleName,
        bucket: Bucket,
        own_bucket: OwnBucket,
    ) -> Self {
        Self {
            iam_client,
            lambda_client,
            s3_client,
            lambda_name: lambda_name.0,
            role_name: role_name.0,
            bucket: bucket.0,
            own_bucket: own_bucket.0,
        }
    }
}

/**
 * Load the AWS configuration from the environment.
 * Look up lambda_name and bucket if none are given, or generate a random name
if not present in the environment.
```

```

    * If the bucket name is provided, the caller needs to have created the bucket.
    * If the bucket name is generated, it will be created.
    */
    pub async fn load_from_env(lambda_name: Option<String>, bucket: Option<String>)
-> Self {
        let sdk_config = aws_config::load_from_env().await;
        let lambda_name = LambdaName(lambda_name.unwrap_or_else(|| {
            std::env::var("LAMBDA_NAME").unwrap_or_else(|_|
"rust_lambda_example".to_string())
        }));
        let role_name = RoleName(format!("{}",_role", lambda_name.0));
        let (bucket, own_bucket) =
            match bucket {
                Some(bucket) => (Bucket(bucket), false),
                None => (
                    Bucket(std::env::var("LAMBDA_BUCKET").unwrap_or_else(|_| {
                        format!("rust-lambda-example-{}", uuid::Uuid::new_v4())
                    })),
                    true,
                ),
            };

        let s3_client = aws_sdk_s3::Client::new(&sdk_config);

        if own_bucket {
            info!("Creating bucket for demo: {}", bucket.0);
            s3_client
                .create_bucket()
                .bucket(bucket.0.clone())
                .create_bucket_configuration(
                    CreateBucketConfiguration::builder()

.location_constraint(aws_sdk_s3::types::BucketLocationConstraint::from(
                    sdk_config.region().unwrap().as_ref(),
                ))
                .build(),
            )
                .send()
                .await
                .unwrap();
        }

        Self::new(
            aws_sdk_iam::Client::new(&sdk_config),

```

```

        aws_sdk_lambda::Client::new(&sdk_config),
        s3_client,
        lambda_name,
        role_name,
        bucket,
        OwnBucket(own_bucket),
    )
}

// snippet-start:[lambda.rust.scenario.prepare_function]
/**
 * Upload function code from a path to a zip file.
 * The zip file must have an AL2 Linux-compatible binary called `bootstrap`.
 * The easiest way to create such a zip is to use `cargo lambda build --output-format Zip`.
 */
async fn prepare_function(
    &self,
    zip_file: PathBuf,
    key: Option<String>,
) -> Result<FunctionCode, anyhow::Error> {
    let body = ByteStream::from_path(zip_file).await?;

    let key = key.unwrap_or_else(|| format!("{}_code", self.lambda_name));

    info!("Uploading function code to s3://{}/{}", self.bucket, key);
    let _ = self
        .s3_client
        .put_object()
        .bucket(self.bucket.clone())
        .key(key.clone())
        .body(body)
        .send()
        .await?;

    Ok(FunctionCode::builder()
        .s3_bucket(self.bucket.clone())
        .s3_key(key)
        .build())
}
// snippet-end:[lambda.rust.scenario.prepare_function]

// snippet-start:[lambda.rust.scenario.create_function]
/**

```

```

    * Create a function, uploading from a zip file.
    */
    pub async fn create_function(&self, zip_file: PathBuf) -> Result<String,
anyhow::Error> {
        let code = self.prepare_function(zip_file, None).await?;

        let key = code.s3_key().unwrap().to_string();

        let role = self.create_role().await.map_err(|e| anyhow!(e))?;

        info!("Created iam role, waiting 15s for it to become active");
        tokio::time::sleep(Duration::from_secs(15)).await;

        info!("Creating lambda function {}", self.lambda_name);
        let _ = self
            .lambda_client
            .create_function()
            .function_name(self.lambda_name.clone())
            .code(code)
            .role(role.arn())
            .runtime(aws_sdk_lambda::types::Runtime::ProvidedAl2)
            .handler("_unused")
            .send()
            .await
            .map_err(anyhow::Error::from)?;

        self.wait_for_function_ready().await?;

        self.lambda_client
            .publish_version()
            .function_name(self.lambda_name.clone())
            .send()
            .await?;

        Ok(key)
    }
    // snippet-end:[lambda.rust.scenario.create_function]

    /**
    * Create an IAM execution role for the managed Lambda function.
    * If the role already exists, use that instead.
    */
    async fn create_role(&self) -> Result<aws_sdk_iam::types::Role, CreateRoleError>
    {

```

```

    info!("Creating execution role for function");
    let get_role = self
        .iam_client
        .get_role()
        .role_name(self.role_name.clone())
        .send()
        .await;
    if let Ok(get_role) = get_role {
        if let Some(role) = get_role.role {
            return Ok(role);
        }
    }

    let create_role = self
        .iam_client
        .create_role()
        .role_name(self.role_name.clone())
        .assume_role_policy_document(ROLE_POLICY_DOCUMENT)
        .send()
        .await;

    match create_role {
        Ok(create_role) => match create_role.role {
            Some(role) => Ok(role),
            None => Err(CreateRoleError::generic(
                ErrorMetadata::builder()
                    .message("CreateRole returned empty success")
                    .build(),
            )),
        },
        Err(err) => Err(err.into_service_error()),
    }
}

/**
 * Poll `is_function_ready` with a 1-second delay. It returns when the function
 is ready or when there's an error checking the function's state.
 */
pub async fn wait_for_function_ready(&self) -> Result<(), anyhow::Error> {
    info!("Waiting for function");
    while !self.is_function_ready(None).await? {
        info!("Function is not ready, sleeping 1s");
        tokio::time::sleep(Duration::from_secs(1)).await;
    }
}

```

```

    Ok(())
}

/**
 * Check if a Lambda function is ready to be invoked.
 * A Lambda function is ready for this scenario when its state is active and its
LastUpdateStatus is Successful.
 * Additionally, if a sha256 is provided, the function must have that as its
current code hash.
 * Any missing properties or failed requests will be reported as an Err.
 */
async fn is_function_ready(
    &self,
    expected_code_sha256: Option<&str>,
) -> Result<bool, anyhow::Error> {
    match self.get_function().await {
        Ok(func) => {
            if let Some(config) = func.configuration() {
                if let Some(state) = config.state() {
                    info!(?state, "Checking if function is active");
                    if !matches!(state, State::Active) {
                        return Ok(false);
                    }
                }
            }
            match config.last_update_status() {
                Some(last_update_status) => {
                    info!(?last_update_status, "Checking if function is
ready");

                    match last_update_status {
                        LastUpdateStatus::Successful => {
                            // continue
                        }
                        LastUpdateStatus::Failed |
LastUpdateStatus::InProgress => {
                            return Ok(false);
                        }
                        unknown => {
                            warn!(
                                status_variant = unknown.as_str(),
                                "LastUpdateStatus unknown"
                            );
                            return Err(anyhow!(
                                "Unknown LastUpdateStatus, fn config is
{config:?}")

```

```

        ));
    }
}
None => {
    warn!("Missing last update status");
    return Ok(false);
}
};
if expected_code_sha256.is_none() {
    return Ok(true);
}
if let Some(code_sha256) = config.code_sha256() {
    return Ok(code_sha256 ==
expected_code_sha256.unwrap_or_default());
}
}
Err(e) => {
    warn!(?e, "Could not get function while waiting");
}
}
Ok(false)
}

// snippet-start:[lambda.rust.scenario.get_function]
/** Get the Lambda function with this Manager's name. */
pub async fn get_function(&self) -> Result<GetFunctionOutput, anyhow::Error> {
    info!("Getting lambda function");
    self.lambda_client
        .get_function()
        .function_name(self.lambda_name.clone())
        .send()
        .await
        .map_err(anyhow::Error::from)
}
// snippet-end:[lambda.rust.scenario.get_function]

// snippet-start:[lambda.rust.scenario.list_functions]
/** List all Lambda functions in the current Region. */
pub async fn list_functions(&self) -> Result<ListFunctionsOutput, anyhow::Error>
{
    info!("Listing lambda functions");
    self.lambda_client

```

```

        .list_functions()
        .send()
        .await
        .map_err(anyhow::Error::from)
    }
    // snippet-end:[lambda.rust.scenario.list_functions]

    // snippet-start:[lambda.rust.scenario.invoke]
    /** Invoke the lambda function using calculator InvokeArgs. */
    pub async fn invoke(&self, args: InvokeArgs) -> Result<InvokeOutput,
anyhow::Error> {
        info!(?args, "Invoking {}", self.lambda_name);
        let payload = serde_json::to_string(&args)?;
        debug!(?payload, "Sending payload");
        self.lambda_client
            .invoke()
            .function_name(self.lambda_name.clone())
            .payload(Blob::new(payload))
            .send()
            .await
            .map_err(anyhow::Error::from)
    }
    // snippet-end:[lambda.rust.scenario.invoke]

    // snippet-start:[lambda.rust.scenario.update_function_code]
    /** Given a Path to a zip file, update the function's code and wait for the
update to finish. */
    pub async fn update_function_code(
        &self,
        zip_file: PathBuf,
        key: String,
    ) -> Result<UpdateFunctionCodeOutput, anyhow::Error> {
        let function_code = self.prepare_function(zip_file, Some(key)).await?;

        info!("Updating code for {}", self.lambda_name);
        let update = self
            .lambda_client
            .update_function_code()
            .function_name(self.lambda_name.clone())
            .s3_bucket(self.bucket.clone())
            .s3_key(function_code.s3_key().unwrap().to_string())
            .send()
            .await
            .map_err(anyhow::Error::from)?;
    }

```



```
        self.wait_for_function_ready().await?;

        Ok(update)
    }
    // snippet-end:[lambda.rust.scenario.update_function_code]

    // snippet-start:[lambda.rust.scenario.update_function_configuration]
    /** Update the environment for a function. */
    pub async fn update_function_configuration(
        &self,
        environment: Environment,
    ) -> Result<UpdateFunctionConfigurationOutput, anyhow::Error> {
        info!(
            ?environment,
            "Updating environment for {}", self.lambda_name
        );
        let updated = self
            .lambda_client
            .update_function_configuration()
            .function_name(self.lambda_name.clone())
            .environment(environment)
            .send()
            .await
            .map_err(anyhow::Error::from)?;

        self.wait_for_function_ready().await?;

        Ok(updated)
    }
    // snippet-end:[lambda.rust.scenario.update_function_configuration]

    // snippet-start:[lambda.rust.scenario.delete_function]
    /** Delete a function and its role, and if possible or necessary, its associated
    code object and bucket. */
    pub async fn delete_function(
        &self,
        location: Option<String>,
    ) -> (
        Result<DeleteFunctionOutput, anyhow::Error>,
        Result<DeleteRoleOutput, anyhow::Error>,
        Option<Result<DeleteObjectOutput, anyhow::Error>>,
    ) {
        info!("Deleting lambda function {}", self.lambda_name);
```

```

    let delete_function = self
        .lambda_client
        .delete_function()
        .function_name(self.lambda_name.clone())
        .send()
        .await
        .map_err(anyhow::Error::from);

    info!("Deleting iam role {}", self.role_name);
    let delete_role = self
        .iam_client
        .delete_role()
        .role_name(self.role_name.clone())
        .send()
        .await
        .map_err(anyhow::Error::from);

    let delete_object: Option<Result<DeleteObjectOutput, anyhow::Error>> =
        if let Some(location) = location {
            info!("Deleting object {location}");
            Some(
                self.s3_client
                    .delete_object()
                    .bucket(self.bucket.clone())
                    .key(location)
                    .send()
                    .await
                    .map_err(anyhow::Error::from),
            )
        } else {
            info!(?location, "Skipping delete object");
            None
        };

    (delete_function, delete_role, delete_object)
}
// snippet-end:[lambda.rust.scenario.delete_function]

pub async fn cleanup(
    &self,
    location: Option<String>,
) -> (
    (
        Result<DeleteFunctionOutput, anyhow::Error>,

```

```

        Result<DeleteRoleOutput, anyhow::Error>,
        Option<Result<DeleteObjectOutput, anyhow::Error>>,
    ),
    Option<Result<DeleteBucketOutput, anyhow::Error>>,
) {
    let delete_function = self.delete_function(location).await;

    let delete_bucket = if self.own_bucket {
        info!("Deleting bucket {}", self.bucket);
        if delete_function.2.is_none() ||
delete_function.2.as_ref().unwrap().is_ok() {
            Some(
                self.s3_client
                    .delete_bucket()
                    .bucket(self.bucket.clone())
                    .send()
                    .await
                    .map_err(anyhow::Error::from),
            )
        } else {
            None
        }
    } else {
        info!("No bucket to clean up");
        None
    };

    (delete_function, delete_bucket)
}
}

/**
 * Testing occurs primarily as an integration test running the `scenario` bin
 * successfully.
 * Each action relies deeply on the internal workings and state of Amazon Simple
 * Storage Service (Amazon S3), Lambda, and IAM working together.
 * It is therefore infeasible to mock the clients to test the individual actions.
 */
#[cfg(test)]
mod test {
    use super::{InvokeArgs, Operation};
    use serde_json::json;

```

```
    /** Make sure that the JSON output of serializing InvokeArgs is what's expected
    by the calculator. */
    #[test]
    fn test_serialize() {
        assert_eq!(json!(InvokeArgs::Increment(5)), 5);
        assert_eq!(
            json!(InvokeArgs::Arithmetic(Operation::Plus, 5, 7)).to_string(),
            r#"{"op":"plus","i":5,"j":7}"#.to_string(),
        );
    }
}
```

A binary to run the scenario from front to end, using command line flags to control some behavior. This file is `src/bin/scenario.rs` in the crate.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

/*
## Service actions

Service actions wrap the SDK call, taking a client and any specific parameters
necessary for the call.

* CreateFunction
* GetFunction
* ListFunctions
* Invoke
* UpdateFunctionCode
* UpdateFunctionConfiguration
* DeleteFunction

## Scenario

A scenario runs at a command prompt and prints output to the user on the result
of each service action. A scenario can run in one of two ways: straight through,
printing out progress as it goes, or as an interactive question/answer script.

## Getting started with functions

Use an SDK to manage AWS Lambda functions: create a function, invoke it, update its
code, invoke it again, view its output and logs, and delete it.
```

This scenario uses two Lambda handlers:

`_Note: Handlers don't use AWS SDK API calls._`

The increment handler is straightforward:

1. It accepts a number, increments it, and returns the new value.
2. It performs simple logging of the result.

The arithmetic handler is more complex:

1. It accepts a set of actions ['plus', 'minus', 'times', 'divided-by'] and two numbers, and returns the result of the calculation.
2. It uses an environment variable to control log level (such as DEBUG, INFO, WARNING, ERROR).

It logs a few things at different levels, such as:

- * DEBUG: Full event data.
- * INFO: The calculation result.
- * WARN~ING~: When a divide by zero error occurs.
- * This will be the typical ``RUST_LOG`` variable.

The steps of the scenario are:

1. Create an AWS Identity and Access Management (IAM) role that meets the following requirements:
 - * Has an `assume_role` policy that grants `'lambda.amazonaws.com'` the `'sts:AssumeRole'` action.
 - * Attaches the `'arn:aws:iam::aws:policy/service-role/AWSLambdaBasicExecutionRole'` managed role.
 - * `_You must wait for ~10 seconds after the role is created before you can use it!_`
2. Create a function (`CreateFunction`) for the increment handler by packaging it as a zip and doing one of the following:
 - * Adding it with `CreateFunction Code.ZipFile`.
 - * `--or--`
 - * Uploading it to Amazon Simple Storage Service (Amazon S3) and adding it with `CreateFunction Code.S3Bucket/S3Key`.
 - * `_Note: Zipping the file does not have to be done in code._`
 - * If you have a waiter, use it to wait until the function is active. Otherwise, call `GetFunction` until State is Active.
3. Invoke the function with a number and print the result.
4. Update the function (`UpdateFunctionCode`) to the arithmetic handler by packaging it as a zip and doing one of the following:
 - * Adding it with `UpdateFunctionCode ZipFile`.
 - * `--or--`

- * Uploading it to Amazon S3 and adding it with UpdateFunctionCode S3Bucket/S3Key.
- 5. Call GetFunction until Configuration.LastUpdateStatus is 'Successful' (or 'Failed').
- 6. Update the environment variable by calling UpdateFunctionConfiguration and pass it a log level, such as:
 - * Environment={'Variables': {'RUST_LOG': 'TRACE'}}
- 7. Invoke the function with an action from the list and a couple of values. Include LogType='Tail' to get logs in the result. Print the result of the calculation and the log.
- 8. [Optional] Invoke the function to provoke a divide-by-zero error and show the log result.
- 9. List all functions for the account, using pagination (ListFunctions).
- 10. Delete the function (DeleteFunction).
- 11. Delete the role.

Each step should use the function created in Service Actions to abstract calling the SDK.

```
*/
```

```
use aws_sdk_lambda::{operation::invoke::InvokeOutput, types::Environment};
use clap::Parser;
use std::{collections::HashMap, path::PathBuf};
use tracing::{debug, info, warn};
use tracing_subscriber::EnvFilter;

use lambda_code_examples::actions::{
    InvokeArgs::{Arithmetic, Increment},
    LambdaManager, Operation,
};

#[derive(Debug, Parser)]
pub struct Opt {
    /// The AWS Region.
    #[structopt(short, long)]
    pub region: Option<String>,

    // The bucket to use for the FunctionCode.
    #[structopt(short, long)]
    pub bucket: Option<String>,

    // The name of the Lambda function.
    #[structopt(short, long)]
    pub lambda_name: Option<String>,
```

```
// The number to increment.
#[structopt(short, long, default_value = "12")]
pub inc: i32,

// The left operand.
#[structopt(long, default_value = "19")]
pub num_a: i32,

// The right operand.
#[structopt(long, default_value = "23")]
pub num_b: i32,

// The arithmetic operation.
#[structopt(short, long, default_value = "plus")]
pub operation: Operation,

#[structopt(long)]
pub cleanup: Option<bool>,

#[structopt(long)]
pub no_cleanup: Option<bool>,
}

fn code_path(lambda: &str) -> PathBuf {
    PathBuf::from(format!("../target/lambda/{lambda}/bootstrap.zip"))
}

// snippet-start:[lambda.rust.scenario.log_invoke_output]
fn log_invoke_output(invoke: &InvokeOutput, message: &str) {
    if let Some(payload) = invoke.payload().cloned() {
        let payload = String::from_utf8(payload.into_inner());
        info!(?payload, message);
    } else {
        info!("Could not extract payload")
    }
    if let Some(logs) = invoke.log_result() {
        debug!(?logs, "Invoked function logs")
    } else {
        debug!("Invoked function had no logs")
    }
}
// snippet-end:[lambda.rust.scenario.log_invoke_output]
```

```
async fn main_block(
    opt: &Opt,
    manager: &LambdaManager,
    code_location: String,
) -> Result<(), anyhow::Error> {
    let invoke = manager.invoke(Increment(opt.inc)).await?;
    log_invoke_output(&invoke, "Invoked function configured as increment");

    let update_code = manager
        .update_function_code(code_path("arithmetic"), code_location.clone())
        .await?;

    let code_sha256 = update_code.code_sha256().unwrap_or("Unknown SHA");
    info!(?code_sha256, "Updated function code with arithmetic.zip");

    let arithmetic_args = Arithmetic(opt.operation, opt.num_a, opt.num_b);
    let invoke = manager.invoke(arithmetic_args).await?;
    log_invoke_output(&invoke, "Invoked function configured as arithmetic");

    let update = manager
        .update_function_configuration(
            Environment::builder()
                .set_variables(Some(HashMap::from([
                    ("RUST_LOG".to_string(), "trace".to_string()),
                ])))
                .build(),
        )
        .await?;
    let updated_environment = update.environment();
    info!(?updated_environment, "Updated function configuration");

    let invoke = manager
        .invoke(Arithmetic(opt.operation, opt.num_a, opt.num_b))
        .await?;
    log_invoke_output(
        &invoke,
        "Invoked function configured as arithmetic with increased logging",
    );

    let invoke = manager
        .invoke(Arithmetic(Operation::DividedBy, opt.num_a, 0))
        .await?;
    log_invoke_output(
```



```

        &invoke,
        "Invoked function configured as arithmetic with divide by zero",
    );

    Ok::<(), anyhow::Error>(( ))
}

#[tokio::main]
async fn main() {
    tracing_subscriber::fmt()
        .without_time()
        .with_file(true)
        .with_line_number(true)
        .with_env_filter(EnvFilter::from_default_env())
        .init();

    let opt = Opt::parse();
    let manager = LambdaManager::load_from_env(opt.lambda_name.clone(),
opt.bucket.clone()).await;

    let key = match manager.create_function(code_path("increment")).await {
        Ok(init) => {
            info!(?init, "Created function, initially with increment.zip");
            let run_block = main_block(&opt, &manager, init.clone()).await;
            info!(?run_block, "Finished running example, cleaning up");
            Some(init)
        }
        Err(err) => {
            warn!(?err, "Error happened when initializing function");
            None
        }
    };

    if Some(false) == opt.cleanup || Some(true) == opt.no_cleanup {
        info!("Skipping cleanup")
    } else {
        let delete = manager.cleanup(key).await;
        info!(?delete, "Deleted function & cleaned up resources");
    }
}

```

- For API details, see the following topics in *AWS SDK for Rust API reference*.

- [CreateFunction](#)
- [DeleteFunction](#)
- [GetFunction](#)
- [Invoke](#)
- [ListFunctions](#)
- [UpdateFunctionCode](#)
- [UpdateFunctionConfiguration](#)

Serverless examples

Invoke a Lambda function from a Kinesis trigger

The following code example shows how to implement a Lambda function that receives an event triggered by receiving records from a Kinesis stream. The function retrieves the Kinesis payload, decodes from Base64, and logs the record contents.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming an Kinesis event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::event::kinesis::KinesisEvent;
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

async fn function_handler(event: LambdaEvent<KinesisEvent>) -> Result<(), Error> {
    if event.payload.records.is_empty() {
        tracing::info!("No records found. Exiting.");
        return Ok(());
    }

    event.payload.records.iter().for_each(|record| {
```

```

        tracing::info!("EventId:
{}",&record.event_id.as_deref().unwrap_or_default());

        let record_data = std::str::from_utf8(&record.kinesis.data);

        match record_data {
            Ok(data) => {
                // log the record data
                tracing::info!("Data: {}", data);
            }
            Err(e) => {
                tracing::error!("Error: {}", e);
            }
        }
    });

    tracing::info!(
        "Successfully processed {} records",
        event.payload.records.len()
    );

    Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        // disable printing the name of the module in every log line.
        .with_target(false)
        // disabling time is handy because CloudWatch will add the ingestion time.
        .without_time()
        .init();

    run(service_fn(function_handler)).await
}

```

Invoke a Lambda function from a DynamoDB trigger

The following code example shows how to implement a Lambda function that receives an event triggered by receiving records from a DynamoDB stream. The function retrieves the DynamoDB payload and logs the record contents.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming a DynamoDB event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

use lambda_runtime::{service_fn, tracing, Error, LambdaEvent};
use aws_lambda_events::{
    event::dynamodb::{Event, EventRecord},
};

// Built with the following dependencies:
//lambda_runtime = "0.11.1"
//serde_json = "1.0"
//tokio = { version = "1", features = ["macros"] }
//tracing = { version = "0.1", features = ["log"] }
//tracing-subscriber = { version = "0.3", default-features = false, features =
    ["fmt"] }
//aws_lambda_events = "0.15.0"

async fn function_handler(event: LambdaEvent<Event>) ->Result<(), Error> {

    let records = &event.payload.records;
    tracing::info!("event payload: {:?}",records);
    if records.is_empty() {
        tracing::info!("No records found. Exiting.");
        return Ok(());
    }

    for record in records{
        log_dynamo_dbrecord(record);
    }

    tracing::info!("Dynamo db records processed");
}
```

```
// Prepare the response
Ok(())

}

fn log_dynamo_dbrecord(record: &EventRecord)-> Result<(), Error>{
    tracing::info!("EventId: {}", record.event_id);
    tracing::info!("EventName: {}", record.event_name);
    tracing::info!("DynamoDB Record: {:?}", record.change );
    Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        .with_target(false)
        .without_time()
        .init();

    let func = service_fn(function_handler);
    lambda_runtime::run(func).await?;
    Ok(())
}
```

Invoke a Lambda function from an Amazon S3 trigger

The following code example shows how to implement a Lambda function that receives an event triggered by uploading an object to an S3 bucket. The function retrieves the S3 bucket name and object key from the event parameter and calls the Amazon S3 API to retrieve and log the content type of the object.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming an S3 event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::event::s3::S3Event;
use aws_sdk_s3::{Client};
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

/// Main function
#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        .with_target(false)
        .without_time()
        .init();

    // Initialize the AWS SDK for Rust
    let config = aws_config::load_from_env().await;
    let s3_client = Client::new(&config);

    let res = run(service_fn(|request: LambdaEvent<S3Event>| {
        function_handler(&s3_client, request)
    })).await;

    res
}

async fn function_handler(
    s3_client: &Client,
    evt: LambdaEvent<S3Event>
) -> Result<(), Error> {
    tracing::info!(records = ?evt.payload.records.len(), "Received request from
SQS");

    if evt.payload.records.len() == 0 {
        tracing::info!("Empty S3 event received");
    }

    let bucket = evt.payload.records[0].s3.bucket.name.as_ref().expect("Bucket name
to exist");
    let key = evt.payload.records[0].s3.object.key.as_ref().expect("Object key to
exist");
```

```
tracing::info!("Request is for {} and object {}", bucket, key);

let s3_get_object_result = s3_client
    .get_object()
    .bucket(bucket)
    .key(key)
    .send()
    .await;

match s3_get_object_result {
    Ok(_) => tracing::info!("S3 Get Object success, the s3GetObjectResult
contains a 'body' property of type ByteStream"),
    Err(_) => tracing::info!("Failure with S3 Get Object request")
}

Ok(())
}
```

Invoke a Lambda function from an Amazon SNS trigger

The following code example shows how to implement a Lambda function that receives an event triggered by receiving messages from an SNS topic. The function retrieves the messages from the event parameter and logs the content of each message.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming an SNS event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::event::sns::SnsEvent;
use aws_lambda_events::sns::SnsRecord;
use lambda_runtime::{run, service_fn, Error, LambdaEvent};
use tracing::info;
```

```
// Built with the following dependencies:
// aws_lambda_events = { version = "0.10.0", default-features = false, features =
  ["sns"] }
// lambda_runtime = "0.8.1"
// tokio = { version = "1", features = ["macros"] }
// tracing = { version = "0.1", features = ["log"] }
// tracing-subscriber = { version = "0.3", default-features = false, features =
  ["fmt"] }

async fn function_handler(event: LambdaEvent<SnsEvent>) -> Result<(), Error> {
    for event in event.payload.records {
        process_record(&event)?;
    }

    Ok(())
}

fn process_record(record: &SnsRecord) -> Result<(), Error> {
    info!("Processing SNS Message: {}", record.sns.message);

    // Implement your record handling code here.

    Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        .with_target(false)
        .without_time()
        .init();

    run(service_fn(function_handler)).await
}
```

Invoke a Lambda function from an Amazon SQS trigger

The following code example shows how to implement a Lambda function that receives an event triggered by receiving messages from an SQS queue. The function retrieves the messages from the event parameter and logs the content of each message.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming an SQS event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::event::sqs::SqsEvent;
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

async fn function_handler(event: LambdaEvent<SqsEvent>) -> Result<(), Error> {
    event.payload.records.iter().for_each(|record| {
        // process the record
        tracing::info!("Message body: {}",
            record.body.as_deref().unwrap_or_default());
    });

    Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        // disable printing the name of the module in every log line.
        .with_target(false)
        // disabling time is handy because CloudWatch will add the ingestion time.
        .without_time()
        .init();

    run(service_fn(function_handler)).await
}
```

Reporting batch item failures for Lambda functions with a Kinesis trigger

The following code example shows how to implement partial batch response for Lambda functions that receive events from a Kinesis stream. The function reports the batch item failures in the response, signaling to Lambda to retry those messages later.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Reporting Kinesis batch item failures with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::{
    event::kinesis::KinesisEvent,
    kinesis::KinesisEventRecord,
    streams::{KinesisBatchItemFailure, KinesisEventResponse},
};
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

async fn function_handler(event: LambdaEvent<KinesisEvent>) ->
    Result<KinesisEventResponse, Error> {
    let mut response = KinesisEventResponse {
        batch_item_failures: vec![],
    };

    if event.payload.records.is_empty() {
        tracing::info!("No records found. Exiting.");
        return Ok(response);
    }

    for record in &event.payload.records {
        tracing::info!(
            "EventId: {}",
            record.event_id.as_deref().unwrap_or_default()
        );
    }
}
```

```

    let record_processing_result = process_record(record);

    if record_processing_result.is_err() {
        response.batch_item_failures.push(KinesisBatchItemFailure {
            item_identifier: record.kinesis.sequence_number.clone(),
        });
        /* Since we are working with streams, we can return the failed item
immediately.
        Lambda will immediately begin to retry processing from this failed item
onwards. */
        return Ok(response);
    }
}

tracing::info!(
    "Successfully processed {} records",
    event.payload.records.len()
);

Ok(response)
}

fn process_record(record: &KinesisEventRecord) -> Result<(), Error> {
    let record_data = std::str::from_utf8(record.kinesis.data.as_slice());

    if let Some(err) = record_data.err() {
        tracing::error!("Error: {}", err);
        return Err(Error::from(err));
    }

    let record_data = record_data.unwrap_or_default();

    // do something interesting with the data
    tracing::info!("Data: {}", record_data);

    Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        // disable printing the name of the module in every log line.
        .with_target(false)

```

```
        // disabling time is handy because CloudWatch will add the ingestion time.
        .without_time()
        .init();

    run(service_fn(function_handler)).await
}
```

Reporting batch item failures for Lambda functions with a DynamoDB trigger

The following code example shows how to implement partial batch response for Lambda functions that receive events from a DynamoDB stream. The function reports the batch item failures in the response, signaling to Lambda to retry those messages later.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Reporting DynamoDB batch item failures with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::{
    event::dynamodb::{Event, EventRecord, StreamRecord},
    streams::{DynamoDbBatchItemFailure, DynamoDbEventResponse},
};
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

/// Process the stream record
fn process_record(record: &EventRecord) -> Result<(), Error> {
    let stream_record: &StreamRecord = &record.change;

    // process your stream record here...
    tracing::info!("Data: {:?}", stream_record);

    Ok(())
}
```

```
/// Main Lambda handler here...
async fn function_handler(event: LambdaEvent<Event>) ->
Result<DynamoDbEventResponse, Error> {
    let mut response = DynamoDbEventResponse {
        batch_item_failures: vec![],
    };

    let records = &event.payload.records;

    if records.is_empty() {
        tracing::info!("No records found. Exiting.");
        return Ok(response);
    }

    for record in records {
        tracing::info!("EventId: {}", record.event_id);

        // Couldn't find a sequence number
        if record.change.sequence_number.is_none() {
            response.batch_item_failures.push(DynamoDbBatchItemFailure {
                item_identifier: Some("").to_string(),
            });
            return Ok(response);
        }

        // Process your record here...
        if process_record(record).is_err() {
            response.batch_item_failures.push(DynamoDbBatchItemFailure {
                item_identifier: record.change.sequence_number.clone(),
            });
            /* Since we are working with streams, we can return the failed item
            immediately.
            Lambda will immediately begin to retry processing from this failed item
            onwards. */
            return Ok(response);
        }
    }

    tracing::info!("Successfully processed {} record(s)", records.len());

    Ok(response)
}

#[tokio::main]
```

```
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        // disable printing the name of the module in every log line.
        .with_target(false)
        // disabling time is handy because CloudWatch will add the ingestion time.
        .without_time()
        .init();

    run(service_fn(function_handler)).await
}
```

Reporting batch item failures for Lambda functions with an Amazon SQS trigger

The following code example shows how to implement partial batch response for Lambda functions that receive events from an SQS queue. The function reports the batch item failures in the response, signaling to Lambda to retry those messages later.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Reporting SQS batch item failures with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::{
    event::sqs::{SqsBatchResponse, SqsEvent},
    sqs::{BatchItemFailure, SqsMessage},
};
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

async fn process_record(_: &SqsMessage) -> Result<(), Error> {
    Err(Error::from("Error processing message"))
}
```

```
async fn function_handler(event: LambdaEvent<SqsEvent>) -> Result<SqsBatchResponse,
Error> {
    let mut batch_item_failures = Vec::new();
    for record in event.payload.records {
        match process_record(&record).await {
            Ok(_) => (),
            Err(_) => batch_item_failures.push(BatchItemFailure {
                item_identifier: record.message_id.unwrap(),
            }),
        }
    }

    Ok(SqsBatchResponse {
        batch_item_failures,
    })
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    run(service_fn(function_handler)).await
}
```

MediaLive examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with MediaLive.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

ListInputs

The following code example shows how to use `ListInputs`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

List your MediaLive input names and ARNs in the Region.

```
async fn show_inputs(client: &Client) -> Result<(), Error> {
    let input_list = client.list_inputs().send().await?;

    for i in input_list.inputs() {
        let input_arn = i.arn().unwrap_or_default();
        let input_name = i.name().unwrap_or_default();

        println!("Input Name : {}", input_name);
        println!("Input ARN : {}", input_arn);
        println!();
    }

    Ok(())
}
```

- For API details, see [ListInputs](#) in *AWS SDK for Rust API reference*.

MediaPackage examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with MediaPackage.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

ListChannels

The following code example shows how to use `ListChannels`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

List channel ARNs and descriptions.

```
async fn show_channels(client: &Client) -> Result<(), Error> {
    let list_channels = client.list_channels().send().await?;

    println!("Channels:");

    for c in list_channels.channels() {
        let description = c.description().unwrap_or_default();
        let arn = c.arn().unwrap_or_default();

        println!(" Description : {}", description);
        println!(" ARN :          {}", arn);
    }
}
```

```
        println!();
    }

    Ok(())
}
```

- For API details, see [ListChannels](#) in *AWS SDK for Rust API reference*.

ListOriginEndpoints

The following code example shows how to use `ListOriginEndpoints`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

List your endpoint descriptions and URLs.

```
async fn show_endpoints(client: &Client) -> Result<(), Error> {
    let or_endpoints = client.list_origin_endpoints().send().await?;

    println!("Endpoints:");

    for e in or_endpoints.origin_endpoints() {
        let endpoint_url = e.url().unwrap_or_default();
        let endpoint_description = e.description().unwrap_or_default();
        println!("  Description: {}", endpoint_description);
        println!("  URL :          {}", endpoint_url);
        println!();
    }

    Ok(())
}
```

- For API details, see [ListOriginEndpoints](#) in *AWS SDK for Rust API reference*.

Amazon Polly examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon Polly.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

DescribeVoices

The following code example shows how to use `DescribeVoices`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn list_voices(client: &Client) -> Result<(), Error> {
    let resp = client.describe_voices().send().await?;

    println!("Voices:");

    let voices = resp.voices();
    for voice in voices {
        println!(" Name:      {}", voice.name().unwrap_or("No name!"));
        println!(
```

```

        " Language: {}",
        voice.language_name().unwrap_or("No language!")
    );

    println!();
}

println!("Found {} voices", voices.len());

Ok(())
}

```

- For API details, see [DescribeVoices](#) in *AWS SDK for Rust API reference*.

ListLexicons

The following code example shows how to use ListLexicons.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn show_lexicons(client: &Client) -> Result<(), Error> {
    let resp = client.list_lexicons().send().await?;

    println!("Lexicons:");

    let lexicons = resp.lexicons();

    for lexicon in lexicons {
        println!(" Name:      {}", lexicon.name().unwrap_or_default());
        println!(
            " Language: {:?}\n",
            lexicon
                .attributes()
                .as_ref()
                .map(|attrib| attrib

```

```

        .language_code
        .as_ref()
        .expect("languages must have language codes"))
        .expect("languages must have attributes")
    );
}

println!();
println!("Found {} lexicons.", lexicons.len());
println!();

Ok(())
}

```

- For API details, see [ListLexicons](#) in *AWS SDK for Rust API reference*.

PutLexicon

The following code example shows how to use PutLexicon.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn make_lexicon(client: &Client, name: &str, from: &str, to: &str) ->
Result<(), Error> {
    let content = format!("<?xml version=\"1.0\" encoding=\"UTF-8\"?>
<lexicon version=\"1.0\" xmlns=\"http://www.w3.org/2005/01/pronunciation-lexicon
\" xmlns:xsi=\"http://www.w3.org/2001/XMLSchema-instance\"
xsi:schemaLocation=\"http://www.w3.org/2005/01/pronunciation-lexicon http://
www.w3.org/TR/2007/CR-pronunciation-lexicon-20071212/pls.xsd\"
alphabet=\"ipa\" xml:lang=\"en-US\">
<lexeme><grapheme>{}</grapheme><alias>{}</alias></lexeme>
</lexicon>", from, to);

    client
        .put_lexicon()

```

```
        .name(name)
        .content(content)
        .send()
        .await?;

println!("Added lexicon");

Ok(())
}
```

- For API details, see [PutLexicon](#) in *AWS SDK for Rust API reference*.

SynthesizeSpeech

The following code example shows how to use SynthesizeSpeech.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn synthesize(client: &Client, filename: &str) -> Result<(), Error> {
    let content = fs::read_to_string(filename);

    let resp = client
        .synthesize_speech()
        .output_format(OutputFormat::Mp3)
        .text(content.unwrap())
        .voice_id(VoiceId::Joanna)
        .send()
        .await?;

    // Get MP3 data from response and save it
    let mut blob = resp
        .audio_stream
        .collect()
        .await
        .expect("failed to read data");
}
```

```
let parts: Vec<&str> = filename.split('.').collect();
let out_file = format!("{}", String::from(parts[0]), ".mp3");

let mut file = tokio::fs::File::create(out_file)
    .await
    .expect("failed to create file");

file.write_all_buf(&mut blob)
    .await
    .expect("failed to write to file");

Ok(())
}
```

- For API details, see [SynthesizeSpeech](#) in *AWS SDK for Rust API reference*.

QLDB examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with QLDB.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

CreateLedger

The following code example shows how to use CreateLedger.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_ledger(client: &Client, ledger: &str) -> Result<(), Error> {
    let result = client
        .create_ledger()
        .name(ledger)
        .permissions_mode(PermissionsMode::AllowAll)
        .send()
        .await?;

    println!("ARN: {}", result.arn().unwrap());

    Ok(())
}
```

- For API details, see [CreateLedger](#) in *AWS SDK for Rust API reference*.

ListLedgers

The following code example shows how to use `ListLedgers`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_ledgers(client: &QLDBClient) -> Result<(), Error> {
    let mut pages = client.list_ledgers().into_paginator().page_size(2).send();
```



```
while let Some(page) = pages.next().await {
    println!("* {:?}", page); //Prints an entire page of ledgers.
    for ledger in page.unwrap().ledgers() {
        println!("* {:?}", ledger); //Prints the LedgerSummary of a single
ledger.
    }
}

Ok(())
}
```

- For API details, see [ListLedgers](#) in *AWS SDK for Rust API reference*.

Amazon RDS Data Service examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon RDS Data Service.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

ExecuteStatement

The following code example shows how to use `ExecuteStatement`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn query_cluster(
    client: &Client,
    cluster_arn: &str,
    query: &str,
    secret_arn: &str,
) -> Result<(), Error> {
    let st = client
        .execute_statement()
        .resource_arn(cluster_arn)
        .database("postgres") // Do not confuse this with db instance name
        .sql(query)
        .secret_arn(secret_arn);

    let result = st.send().await?;

    println!("{:?}", result);
    println!();

    Ok(())
}
```

- For API details, see [ExecuteStatement](#) in *AWS SDK for Rust API reference*.

Route 53 examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Route 53.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

ListHostedZones

The following code example shows how to use `ListHostedZones`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_host_info(client: &aws_sdk_route53::Client) -> Result<(),
aws_sdk_route53::Error> {
    let hosted_zone_count = client.get_hosted_zone_count().send().await?;

    println!(
        "Number of hosted zones in region : {}",
        hosted_zone_count.hosted_zone_count(),
    );

    let hosted_zones = client.list_hosted_zones().send().await?;

    println!("Zones:");

    for hz in hosted_zones.hosted_zones() {
        let zone_name = hz.name();
        let zone_id = hz.id();
```

```
        println!("  ID :  {}", zone_id);
        println!("  Name : {}", zone_name);
        println!();
    }

    Ok(())
}
```

- For API details, see [ListHostedZones](#) in *AWS SDK for Rust API reference*.

Amazon S3 examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon S3.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)
- [Scenarios](#)
- [Serverless examples](#)

Actions

CompleteMultipartUpload

The following code example shows how to use CompleteMultipartUpload.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let _complete_multipart_upload_res = client
    .complete_multipart_upload()
    .bucket(&bucket_name)
    .key(&key)
    .multipart_upload(completed_multipart_upload)
    .upload_id(upload_id)
    .send()
    .await
    .unwrap();
```

- For API details, see [CompleteMultipartUpload](#) in *AWS SDK for Rust API reference*.

CopyObject

The following code example shows how to use CopyObject.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn copy_object(
    client: &Client,
    bucket_name: &str,
    object_key: &str,
    target_key: &str,
) -> Result<CopyObjectOutput, SdkError<CopyObjectError>> {
    let mut source_bucket_and_object: String = "".to_owned();
```

```

source_bucket_and_object.push_str(bucket_name);
source_bucket_and_object.push('/');
source_bucket_and_object.push_str(object_key);

client
    .copy_object()
    .copy_source(source_bucket_and_object)
    .bucket(bucket_name)
    .key(target_key)
    .send()
    .await
}

```

- For API details, see [CopyObject](#) in *AWS SDK for Rust API reference*.

CreateBucket

The following code example shows how to use CreateBucket.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

pub async fn create_bucket(
    client: &Client,
    bucket_name: &str,
    region: &str,
) -> Result<CreateBucketOutput, SdkError<CreateBucketError>> {
    let constraint = BucketLocationConstraint::from(region);
    let cfg = CreateBucketConfiguration::builder()
        .location_constraint(constraint)
        .build();
    client
        .create_bucket()
        .create_bucket_configuration(cfg)
        .bucket(bucket_name)
        .send()
}

```

```
        .await  
    }  
}
```

- For API details, see [CreateBucket](#) in *AWS SDK for Rust API reference*.

CreateMultipartUpload

The following code example shows how to use `CreateMultipartUpload`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let multipart_upload_res: CreateMultipartUploadOutput = client  
    .create_multipart_upload()  
    .bucket(&bucket_name)  
    .key(&key)  
    .send()  
    .await  
    .unwrap();
```

- For API details, see [CreateMultipartUpload](#) in *AWS SDK for Rust API reference*.

DeleteBucket

The following code example shows how to use `DeleteBucket`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn delete_bucket(client: &Client, bucket_name: &str) -> Result<(), Error>
{
    client.delete_bucket().bucket(bucket_name).send().await?;
    println!("Bucket deleted");
    Ok(())
}
```

- For API details, see [DeleteBucket](#) in *AWS SDK for Rust API reference*.

DeleteObject

The following code example shows how to use DeleteObject.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn remove_object(client: &Client, bucket: &str, key: &str) -> Result<(),
Error> {
    client
        .delete_object()
        .bucket(bucket)
        .key(key)
        .send()
        .await?;

    println!("Object deleted.");

    Ok(())
}
```

- For API details, see [DeleteObject](#) in *AWS SDK for Rust API reference*.

DeleteObjects

The following code example shows how to use DeleteObjects.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn delete_objects(client: &Client, bucket_name: &str) ->
Result<Vec<String>, Error> {
    let objects = client.list_objects_v2().bucket(bucket_name).send().await?;

    let mut delete_objects: Vec<ObjectIdentifier> = vec![];
    for obj in objects.contents() {
        let obj_id = ObjectIdentifier::builder()
            .set_key(Some(obj.key().unwrap().to_string()))
            .build()
            .map_err(Error::from)?;
        delete_objects.push(obj_id);
    }

    let return_keys = delete_objects.iter().map(|o| o.key.clone()).collect();

    if !delete_objects.is_empty() {
        client
            .delete_objects()
            .bucket(bucket_name)
            .delete(
                Delete::builder()
                    .set_objects(Some(delete_objects))
                    .build()
                    .map_err(Error::from)?,
            )
            .send()
            .await?;
    }

    let objects: ListObjectsV2Output =
client.list_objects_v2().bucket(bucket_name).send().await?;
```

```
eprintln!("{objects:?}");

match objects.key_count {
    Some(0) => Ok(return_keys),
    _ => Err(Error::unhandled(
        "There were still objects left in the bucket.",
    )),
}
}
```

- For API details, see [DeleteObjects](#) in *AWS SDK for Rust API reference*.

GetBucketLocation

The following code example shows how to use `GetBucketLocation`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_buckets(strict: bool, client: &Client, region: &str) -> Result<(),
Error> {
    let resp = client.list_buckets().send().await?;
    let buckets = resp.buckets();
    let num_buckets = buckets.len();

    let mut in_region = 0;

    for bucket in buckets {
        if strict {
            let r = client
                .get_bucket_location()
                .bucket(bucket.name().unwrap_or_default())
                .send()
                .await?;
```

```

        if r.location_constraint().unwrap().as_ref() == region {
            println!("{}", bucket.name().unwrap_or_default());
            in_region += 1;
        }
    } else {
        println!("{}", bucket.name().unwrap_or_default());
    }
}

println!();
if strict {
    println!(
        "Found {} buckets in the {} region out of a total of {} buckets.",
        in_region, region, num_buckets
    );
} else {
    println!("Found {} buckets in all regions.", num_buckets);
}

Ok(())
}

```

- For API details, see [GetBucketLocation](#) in *AWS SDK for Rust API reference*.

GetObject

The following code example shows how to use `GetObject`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn get_object(client: Client, opt: Opt) -> Result<usize, anyhow::Error> {
    trace!("bucket:      {}", opt.bucket);
    trace!("object:     {}", opt.object);
}

```

```
trace!("destination: {}", opt.destination.display());

let mut file = File::create(opt.destination.clone())?;

let mut object = client
    .get_object()
    .bucket(opt.bucket)
    .key(opt.object)
    .send()
    .await?;

let mut byte_count = 0_usize;
while let Some(bytes) = object.body.try_next().await? {
    let bytes_len = bytes.len();
    file.write_all(&bytes)?;
    trace!("Intermediate write of {bytes_len}");
    byte_count += bytes_len;
}

Ok(byte_count)
}
```

- For API details, see [GetObject](#) in *AWS SDK for Rust API reference*.

ListBuckets

The following code example shows how to use ListBuckets.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_buckets(strict: bool, client: &Client, region: &str) -> Result<(),
Error> {
    let resp = client.list_buckets().send().await?;
    let buckets = resp.buckets();
}
```

```
let num_buckets = buckets.len();

let mut in_region = 0;

for bucket in buckets {
    if strict {
        let r = client
            .get_bucket_location()
            .bucket(bucket.name().unwrap_or_default())
            .send()
            .await?;

        if r.location_constraint().unwrap().as_ref() == region {
            println!("{}", bucket.name().unwrap_or_default());
            in_region += 1;
        }
    } else {
        println!("{}", bucket.name().unwrap_or_default());
    }
}

println!();
if strict {
    println!(
        "Found {} buckets in the {} region out of a total of {} buckets.",
        in_region, region, num_buckets
    );
} else {
    println!("Found {} buckets in all regions.", num_buckets);
}

Ok(())
}
```

- For API details, see [ListBuckets](#) in *AWS SDK for Rust API reference*.

ListObjectVersions

The following code example shows how to use `ListObjectVersions`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_versions(client: &Client, bucket: &str) -> Result<(), Error> {
    let resp = client.list_object_versions().bucket(bucket).send().await?;

    for version in resp.versions() {
        println!("{}", version.key().unwrap_or_default());
        println!(" version ID: {}", version.version_id().unwrap_or_default());
        println!();
    }

    Ok(())
}
```

- For API details, see [ListObjectVersions](#) in *AWS SDK for Rust API reference*.

ListObjectsV2

The following code example shows how to use ListObjectsV2.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
pub async fn list_objects(client: &Client, bucket: &str) -> Result<(), Error> {
    let mut response = client
        .list_objects_v2()
        .bucket(bucket.to_owned())
        .max_keys(10) // In this example, go 10 at a time.
}
```

```

        .into_paginator()
        .send();

while let Some(result) = response.next().await {
    match result {
        Ok(output) => {
            for object in output.contents() {
                println!(" - {}", object.key().unwrap_or("Unknown"));
            }
        }
        Err(err) => {
            eprintln!("{err:?}")
        }
    }
}

Ok(())
}

```

- For API details, see [ListObjectsV2](#) in *AWS SDK for Rust API reference*.

PutObject

The following code example shows how to use PutObject.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

pub async fn upload_object(
    client: &Client,
    bucket_name: &str,
    file_name: &str,
    key: &str,
) -> Result<PutObjectOutput, SdkError<PutObjectError>> {
    let body = ByteStream::from_path(Path::new(file_name)).await;
    client

```

```
        .put_object()
        .bucket(bucket_name)
        .key(key)
        .body(body.unwrap())
        .send()
        .await
    }
```

- For API details, see [PutObject](#) in *AWS SDK for Rust API reference*.

UploadPart

The following code example shows how to use UploadPart.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
let upload_part_res = client
    .upload_part()
    .key(&key)
    .bucket(&bucket_name)
    .upload_id(upload_id)
    .body(stream)
    .part_number(part_number)
    .send()
    .await?;
upload_parts.push(
    CompletedPart::builder()
        .e_tag(upload_part_res.e_tag.unwrap_or_default())
        .part_number(part_number)
        .build(),
);

let completed_multipart_upload: CompletedMultipartUpload =
    CompletedMultipartUpload::builder()
        .set_parts(Some(upload_parts))
```



```
.build();
```

- For API details, see [UploadPart](#) in *AWS SDK for Rust API reference*.

Scenarios

Create a presigned URL

The following code example shows how to create a presigned URL for Amazon S3 and upload an object.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Create presigning requests to GET and PUT S3 objects.

```
async fn get_object(
    client: &Client,
    bucket: &str,
    object: &str,
    expires_in: u64,
) -> Result<(), Box<dyn Error>> {
    let expires_in = Duration::from_secs(expires_in);
    let presigned_request = client
        .get_object()
        .bucket(bucket)
        .key(object)
        .presigned(PresigningConfig::expires_in(expires_in)?)
        .await?;

    println!("Object URI: {}", presigned_request.uri());

    Ok(())
}

async fn put_object(
```

```
    client: &Client,
    bucket: &str,
    object: &str,
    expires_in: u64,
) -> Result<(), Box<dyn Error>> {
    let expires_in = Duration::from_secs(expires_in);

    let presigned_request = client
        .put_object()
        .bucket(bucket)
        .key(object)
        .presigned(PresigningConfig::expires_in(expires_in)?)
        .await?;

    println!("Object URI: {}", presigned_request.uri());

    Ok(())
}
```

Get an object from a bucket if it has been modified

The following code example shows how to read data from an object in an S3 bucket, but only if that bucket has not been modified since the last retrieval time.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
use aws_sdk_s3::{
    error::SdkError,
    operation::head_object::HeadObjectError,
    primitives::{ByteStream, DateTime, DateTimeFormat},
    Client, Error,
};
use tracing::{error, warn};
```

```
const KEY: &str = "key";
const BODY: &str = "Hello, world!";

/// Demonstrate how `if-modified-since` reports that matching objects haven't
/// changed.
///
/// # Steps
/// - Create a bucket.
/// - Put an object in the bucket.
/// - Get the bucket headers.
/// - Get the bucket headers again but only if modified.
/// - Delete the bucket.
#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt::init();

    // Get a new UUID to use when creating a unique bucket name.
    let uuid = uuid::Uuid::new_v4();

    // Load the AWS configuration from the environment.
    let client = Client::new(&aws_config::load_from_env().await);

    // Generate a unique bucket name using the previously generated UUID.
    // Then create a new bucket with that name.
    let bucket_name = format!("if-modified-since-{{uuid}}");
    client
        .create_bucket()
        .bucket(bucket_name.clone())
        .send()
        .await?;

    // Create a new object in the bucket whose name is `KEY` and whose
    // contents are `BODY`.
    let put_object_output = client
        .put_object()
        .bucket(bucket_name.as_str())
        .key(KEY)
        .body(ByteStream::from_static(BODY.as_bytes()))
        .send()
        .await;

    // If the `PutObject` succeeded, get the eTag string from it. Otherwise,
    // report an error and return an empty string.
    let e_tag_1 = match put_object_output {
```

```

    Ok(put_object) => put_object.e_tag.unwrap(),
    Err(err) => {
        error!("{err:?}");
        String::new()
    }
};

// Request the object's headers.
let head_object_output = client
    .head_object()
    .bucket(bucket_name.as_str())
    .key(KEY)
    .send()
    .await;

// If the `HeadObject` request succeeded, create a tuple containing the
// values of the headers `last-modified` and `etag`. If the request
// failed, return the error in a tuple instead.
let (last_modified, e_tag_2) = match head_object_output {
    Ok(head_object) => (
        Ok(head_object.last_modified().cloned().unwrap()),
        head_object.e_tag.unwrap(),
    ),
    Err(err) => (Err(err), String::new()),
};

warn!("last modified: {last_modified:?}");
assert_eq!(
    e_tag_1, e_tag_2,
    "PutObject and first GetObject had differing eTags"
);

println!("First value of last_modified: {last_modified:?}");
println!("First tag: {}\n", e_tag_1);

// Send a second `HeadObject` request. This time, the `if_modified_since`
// option is specified, giving the `last_modified` value returned by the
// first call to `HeadObject`.
//
// Since the object hasn't been changed, and there are no other objects in
// the bucket, there should be no matching objects.

let head_object_output = client
    .head_object()

```

```

        .bucket(bucket_name.as_str())
        .key(KEY)
        .if_modified_since(last_modified.unwrap())
        .send()
        .await;

// If the `HeadObject` request succeeded, the result is a tuple containing
// the `last_modified` and `e_tag_1` properties. This is _not_ the expected
// result.
//
// The _expected_ result of the second call to `HeadObject` is an
// SdkError::ServiceError` containing the HTTP error response. If that's
// the case and the HTTP status is 304 (not modified), the output is a
// tuple containing the values of the HTTP `last-modified` and `etag`
// headers.
//
// If any other HTTP error occurred, the error is returned as an
// SdkError::ServiceError`.

let (last_modified, e_tag_2): (Result<DateTime, SdkError<HeadObjectError>>,
String) =
    match head_object_output {
        Ok(head_object) => (
            Ok(head_object.last_modified().cloned().unwrap()),
            head_object.e_tag.unwrap(),
        ),
        Err(err) => match err {
            SdkError::ServiceError(err) => {
                // Get the raw HTTP response. If its status is 304, the
                // object has not changed. This is the expected code path.
                let http = err.raw();
                match http.status().as_u16() {
                    // If the HTTP status is 304: Not Modified, return a
                    // tuple containing the values of the HTTP
                    // `last-modified` and `etag` headers.
                    304 => (
                        Ok(DateTime::from_str(
                            http.headers().get("last-modified").unwrap(),
                            DateTimeFormat::HttpDate,
                        )
                            .unwrap()),
                        http.headers().get("etag").map(|t| t.into()).unwrap(),
                    ),
                    // Any other HTTP status code is returned as an

```

```

        // `SdkError::ServiceError`.
        _ => (Err(SdkError::ServiceError(err)), String::new()),
    }
}
// Any other kind of error is returned in a tuple containing the
// error and an empty string.
_ => (Err(err), String::new()),
},
};

warn!("last modified: {last_modified:?}");
assert_eq!(
    e_tag_1, e_tag_2,
    "PutObject and second HeadObject had different eTags"
);

println!("Second value of last modified: {last_modified:?}");
println!("Second tag: {}", e_tag_2);

// Clean up by deleting the object and the bucket.
client
    .delete_object()
    .bucket(bucket_name.as_str())
    .key(KEY)
    .send()
    .await?;

client
    .delete_bucket()
    .bucket(bucket_name.as_str())
    .send()
    .await?;

Ok(())
}

```

- For API details, see [GetObject](#) in *AWS SDK for Rust API reference*.

Get started with buckets and objects

The following code example shows how to:

- Create a bucket and upload a file to it.
- Download an object from a bucket.
- Copy an object to a subfolder in a bucket.
- List the objects in a bucket.
- Delete the bucket objects and the bucket.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Code for the binary crate which runs the scenario.

```
use aws_config::meta::region::RegionProviderChain;
use aws_sdk_s3::{config::Region, Client};
use s3_service::error::Error;
use uuid::Uuid;

#[tokio::main]
async fn main() -> Result<(), Error> {
    let (region, client, bucket_name, file_name, key, target_key) =
        initialize_variables().await;

    if let Err(e) = run_s3_operations(region, client, bucket_name, file_name, key,
        target_key).await
    {
        println!("{:?}", e);
    };

    Ok(())
}

async fn initialize_variables() -> (Region, Client, String, String, String, String)
{
```

```

let region_provider = RegionProviderChain::first_try(Region::new("us-west-2"));
let region = region_provider.region().await.unwrap();

let shared_config = aws_config::from_env().region(region_provider).load().await;
let client = Client::new(&shared_config);

let bucket_name = format!("doc-example-bucket-{}", Uuid::new_v4());

let file_name = "s3/testfile.txt".to_string();
let key = "test file key name".to_string();
let target_key = "target_key".to_string();

(region, client, bucket_name, file_name, key, target_key)
}

async fn run_s3_operations(
    region: Region,
    client: Client,
    bucket_name: String,
    file_name: String,
    key: String,
    target_key: String,
) -> Result<(), Error> {
    s3_service::create_bucket(&client, &bucket_name, region.as_ref()).await?;
    s3_service::upload_object(&client, &bucket_name, &file_name, &key).await?;
    let _object = s3_service::download_object(&client, &bucket_name, &key).await;
    s3_service::copy_object(&client, &bucket_name, &key, &target_key).await?;
    s3_service::list_objects(&client, &bucket_name).await?;
    s3_service::delete_objects(&client, &bucket_name).await?;
    s3_service::delete_bucket(&client, &bucket_name).await?;

    Ok(())
}

```

A library crate with common actions called by the binary.

```

use aws_sdk_s3::operation::{
    copy_object::{CopyObjectError, CopyObjectOutput},
    create_bucket::{CreateBucketError, CreateBucketOutput},
    get_object::{GetObjectError, GetObjectOutput},
}

```



```

    list_objects_v2::ListObjectsV2Output,
    put_object::{PutObjectError, PutObjectOutput},
};
use aws_sdk_s3::types::{
    BucketLocationConstraint, CreateBucketConfiguration, Delete, ObjectIdentifier,
};
use aws_sdk_s3::{error::SdkError, primitives::ByteStream, Client};
use error::Error;
use std::path::Path;
use std::str;

pub mod error;

pub async fn delete_bucket(client: &Client, bucket_name: &str) -> Result<(), Error>
{
    client.delete_bucket().bucket(bucket_name).send().await?;
    println!("Bucket deleted");
    Ok(())
}

pub async fn delete_objects(client: &Client, bucket_name: &str) ->
Result<Vec<String>, Error> {
    let objects = client.list_objects_v2().bucket(bucket_name).send().await?;

    let mut delete_objects: Vec<ObjectIdentifier> = vec![];
    for obj in objects.contents() {
        let obj_id = ObjectIdentifier::builder()
            .set_key(Some(obj.key().unwrap().to_string()))
            .build()
            .map_err(Error::from)?;
        delete_objects.push(obj_id);
    }

    let return_keys = delete_objects.iter().map(|o| o.key.clone()).collect();

    if !delete_objects.is_empty() {
        client
            .delete_objects()
            .bucket(bucket_name)
            .delete(
                Delete::builder()
                    .set_objects(Some(delete_objects))
                    .build()
            )
            .map_err(Error::from)?,
    }
}

```

```

        )
        .send()
        .await?;
    }

    let objects: ListObjectsV2Output =
client.list_objects_v2().bucket(bucket_name).send().await?;

    eprintln!("{objects:?}");

    match objects.key_count {
        Some(0) => Ok(return_keys),
        _ => Err(Error::unhandled(
            "There were still objects left in the bucket.",
        )),
    }
}

pub async fn list_objects(client: &Client, bucket: &str) -> Result<(), Error> {
    let mut response = client
        .list_objects_v2()
        .bucket(bucket.to_owned())
        .max_keys(10) // In this example, go 10 at a time.
        .into_paginator()
        .send();

    while let Some(result) = response.next().await {
        match result {
            Ok(output) => {
                for object in output.contents() {
                    println!(" - {}", object.key().unwrap_or("Unknown"));
                }
            }
            Err(err) => {
                eprintln!("{err:?}")
            }
        }
    }

    Ok(())
}

pub async fn copy_object(
    client: &Client,

```

```
    bucket_name: &str,
    object_key: &str,
    target_key: &str,
) -> Result<CopyObjectOutput, SdkError<CopyObjectError>> {
    let mut source_bucket_and_object: String = "".to_owned();
    source_bucket_and_object.push_str(bucket_name);
    source_bucket_and_object.push('/');
    source_bucket_and_object.push_str(object_key);

    client
        .copy_object()
        .copy_source(source_bucket_and_object)
        .bucket(bucket_name)
        .key(target_key)
        .send()
        .await
}

pub async fn download_object(
    client: &Client,
    bucket_name: &str,
    key: &str,
) -> Result<GetObjectOutput, SdkError<GetObjectError>> {
    client
        .get_object()
        .bucket(bucket_name)
        .key(key)
        .send()
        .await
}

pub async fn upload_object(
    client: &Client,
    bucket_name: &str,
    file_name: &str,
    key: &str,
) -> Result<PutObjectOutput, SdkError<PutObjectError>> {
    let body = ByteStream::from_path(Path::new(file_name)).await;
    client
        .put_object()
        .bucket(bucket_name)
        .key(key)
        .body(body.unwrap())
        .send()
}
```

```
        .await
    }

pub async fn create_bucket(
    client: &Client,
    bucket_name: &str,
    region: &str,
) -> Result<CreateBucketOutput, SdkError<CreateBucketError>> {
    let constraint = BucketLocationConstraint::from(region);
    let cfg = CreateBucketConfiguration::builder()
        .location_constraint(constraint)
        .build();
    client
        .create_bucket()
        .create_bucket_configuration(cfg)
        .bucket(bucket_name)
        .send()
        .await
    }
}
```

- For API details, see the following topics in *AWS SDK for Rust API reference*.
 - [CopyObject](#)
 - [CreateBucket](#)
 - [DeleteBucket](#)
 - [DeleteObjects](#)
 - [GetObject](#)
 - [ListObjectsV2](#)
 - [PutObject](#)

Unit and integration test with an SDK

The following code example shows how to examples for best-practice techniques when writing unit and integration tests using an AWS SDK.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Cargo.toml for testing examples.

```
[package]
name = "testing-examples"
version = "0.1.0"
authors = [
  "John Disanti <jdisanti@amazon.com>",
  "Doug Schwartz <dougsch@amazon.com>",
]
edition = "2021"

# snippet-start:[testing.rust.Cargo.toml]
[dependencies]
async-trait = "0.1.51"
aws-config = { version = "1.0.1", features = ["behavior-version-latest"] }
aws-credential-types = { version = "1.0.1", features = [ "hardcoded-credentials", ] }
aws-sdk-s3 = { version = "1.4.0" }
aws-smithy-types = { version = "1.0.1" }
aws-smithy-runtime = { version = "1.0.1", features = ["test-util"] }
aws-smithy-runtime-api = { version = "1.0.1", features = ["test-util"] }
aws-types = { version = "1.0.1" }
clap = { version = "~4.4", features = ["derive"] }
http = "0.2.9"
mockall = "0.11.4"
serde_json = "1"
tokio = { version = "1.20.1", features = ["full"] }
tracing-subscriber = { version = "0.3.15", features = ["env-filter"] }
# snippet-end:[testing.rust.Cargo.toml]

[[bin]]
name = "main"
path = "src/main.rs"
```

Unit testing example using automock and a service wrapper.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

// snippet-start:[testing.rust.wrapper]
// snippet-start:[testing.rust.wrapper-uses]
use aws_sdk_s3 as s3;
#[allow(unused_imports)]
use mockall::automock;

use s3::operation::list_objects_v2::{ListObjectsV2Error, ListObjectsV2Output};
// snippet-end:[testing.rust.wrapper-uses]

// snippet-start:[testing.rust.wrapper-which-impl]
#[cfg(test)]
pub use MockS3Impl as S3;
#[cfg(not(test))]
pub use S3Impl as S3;
// snippet-end:[testing.rust.wrapper-which-impl]

// snippet-start:[testing.rust.wrapper-impl]
#[allow(dead_code)]
pub struct S3Impl {
    inner: s3::Client,
}

#[cfg_attr(test, automock)]
impl S3Impl {
    #[allow(dead_code)]
    pub fn new(inner: s3::Client) -> Self {
        Self { inner }
    }

    #[allow(dead_code)]
    pub async fn list_objects(
        &self,
        bucket: &str,
        prefix: &str,
        continuation_token: Option<String>,
    ) -> Result<ListObjectsV2Output, s3::error::SdkError<ListObjectsV2Error>> {
        self.inner
            .list_objects_v2()
            .bucket(bucket)
    }
}

```

```

        .prefix(prefix)
        .set_continuation_token(continuation_token)
        .send()
        .await
    }
}
// snippet-end:[testing.rust.wrapper-impl]

// snippet-start:[testing.rust.wrapper-func]
#[allow(dead_code)]
pub async fn determine_prefix_file_size(
    // Now we take a reference to our trait object instead of the S3 client
    // s3_list: ListObjectsService,
    s3_list: S3,
    bucket: &str,
    prefix: &str,
) -> Result<usize, s3::Error> {
    let mut next_token: Option<String> = None;
    let mut total_size_bytes = 0;
    loop {
        let result = s3_list
            .list_objects(bucket, prefix, next_token.take())
            .await?;

        // Add up the file sizes we got back
        for object in result.contents() {
            total_size_bytes += object.size().unwrap_or(0) as usize;
        }

        // Handle pagination, and break the loop if there are no more pages
        next_token = result.next_continuation_token.clone();
        if next_token.is_none() {
            break;
        }
    }
    Ok(total_size_bytes)
}
// snippet-end:[testing.rust.wrapper-func]
// snippet-end:[testing.rust.wrapper]

// snippet-start:[testing.rust.wrapper-test-mod]
#[cfg(test)]
mod test {
    // snippet-start:[testing.rust.wrapper-tests]

```

```

use super::*;
use mockall::predicate::eq;

// snippet-start:[testing.rust.wrapper-test-single]
#[tokio::test]
async fn test_single_page() {
    let mut mock = MockS3Impl::default();
    mock.expect_list_objects()
        .with(eq("test-bucket"), eq("test-prefix"), eq(None))
        .return_once(|_, _, _| {
            Ok(ListObjectsV2Output::builder()
                .set_contents(Some(vec![
                    // Mock content for ListObjectsV2 response
                    s3::types::Object::builder().size(5).build(),
                    s3::types::Object::builder().size(2).build(),
                ]))
                .build())
        });

    // Run the code we want to test with it
    let size = determine_prefix_file_size(mock, "test-bucket", "test-prefix")
        .await
        .unwrap();

    // Verify we got the correct total size back
    assert_eq!(7, size);
}
// snippet-end:[testing.rust.wrapper-test-single]

// snippet-start:[testing.rust.wrapper-test-multiple]
#[tokio::test]
async fn test_multiple_pages() {
    // Create the Mock instance with two pages of objects now
    let mut mock = MockS3Impl::default();
    mock.expect_list_objects()
        .with(eq("test-bucket"), eq("test-prefix"), eq(None))
        .return_once(|_, _, _| {
            Ok(ListObjectsV2Output::builder()
                .set_contents(Some(vec![
                    // Mock content for ListObjectsV2 response
                    s3::types::Object::builder().size(5).build(),
                    s3::types::Object::builder().size(2).build(),
                ]))
                .set_next_continuation_token(Some("next".to_string()))
            )
        });
}

```



```

        .build())
    });
    mock.expect_list_objects()
        .with(
            eq("test-bucket"),
            eq("test-prefix"),
            eq(Some("next".to_string()))),
    )
    .return_once(|_, _, _| {
        Ok(ListObjectsV2Output::builder()
            .set_contents(Some(vec![
                // Mock content for ListObjectsV2 response
                s3::types::Object::builder().size(3).build(),
                s3::types::Object::builder().size(9).build(),
            ]))
            .build())
    });

    // Run the code we want to test with it
    let size = determine_prefix_file_size(mock, "test-bucket", "test-prefix")
        .await
        .unwrap();

    assert_eq!(19, size);
}
// snippet-end:[testing.rust.wrapper-test-multiple]
// snippet-end:[testing.rust.wrapper-tests]
}
// snippet-end:[testing.rust.wrapper-test-mod]

```

Integration testing example using StaticReplayClient.

```

// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0

// snippet-start:[testing.rust.replay-uses]
use aws_sdk_s3 as s3;
// snippet-end:[testing.rust.replay-uses]

#[allow(dead_code)]
// snippet-start:[testing.rust.replay]
pub async fn determine_prefix_file_size(

```

```

// Now we take a reference to our trait object instead of the S3 client
// s3_list: ListObjectsService,
s3: s3::Client,
bucket: &str,
prefix: &str,
) -> Result<usize, s3::Error> {
    let mut next_token: Option<String> = None;
    let mut total_size_bytes = 0;
    loop {
        let result = s3
            .list_objects_v2()
            .prefix(prefix)
            .bucket(bucket)
            .set_continuation_token(next_token.take())
            .send()
            .await?;

        // Add up the file sizes we got back
        for object in result.contents() {
            total_size_bytes += object.size().unwrap_or(0) as usize;
        }

        // Handle pagination, and break the loop if there are no more pages
        next_token = result.next_continuation_token.clone();
        if next_token.is_none() {
            break;
        }
    }
    Ok(total_size_bytes)
}
// snippet-end:[testing.rust.replay]

#[allow(dead_code)]
// snippet-start:[testing.rust.replay-tests]
// snippet-start:[testing.rust.replay-make-credentials]
fn make_s3_test_credentials() -> s3::config::Credentials {
    s3::config::Credentials::new(
        "ATESTCLIENT",
        "atestsecretkey",
        Some("atestsessiontoken".to_string()),
        None,
        "",
    )
}

```

```

// snippet-end:[testing.rust.replay-make-credentials]

// snippet-start:[testing.rust.replay-test-module]
#[cfg(test)]
mod test {
    // snippet-start:[testing.rust.replay-test-single]
    use super::*;
    use aws_config::BehaviorVersion;
    use aws_sdk_s3 as s3;
    use aws_smithy_runtime::client::http::test_util::{ReplayEvent,
StaticReplayClient};
    use aws_smithy_types::body::SdkBody;

    #[tokio::test]
    async fn test_single_page() {
        let page_1 = ReplayEvent::new(
            http::Request::builder()
                .method("GET")
                .uri("https://test-bucket.s3.us-east-1.amazonaws.com/?list-
type=2&prefix=test-prefix")
                .body(SdkBody::empty())
                .unwrap(),
            http::Response::builder()
                .status(200)
                .body(SdkBody::from(include_str!("./testing/response_1.xml")))
                .unwrap(),
        );
        let replay_client = StaticReplayClient::new(vec![page_1]);
        let client: s3::Client = s3::Client::from_conf(
            s3::Config::builder()
                .behavior_version(BehaviorVersion::latest())
                .credentials_provider(make_s3_test_credentials())
                .region(s3::config::Region::new("us-east-1"))
                .http_client(replay_client.clone())
                .build(),
        );

        // Run the code we want to test with it
        let size = determine_prefix_file_size(client, "test-bucket", "test-prefix")
            .await
            .unwrap();

        // Verify we got the correct total size back
        assert_eq!(7, size);
    }
}

```

```

        replay_client.assert_requests_match(&[]);
    }
    // snippet-end:[testing.rust.replay-test-single]

    // snippet-start:[testing.rust.replay-test-multiple]
    #[tokio::test]
    async fn test_multiple_pages() {
        // snippet-start:[testing.rust.replay-create-replay]
        let page_1 = ReplayEvent::new(
            http::Request::builder()
                .method("GET")
                .uri("https://test-bucket.s3.us-east-1.amazonaws.com/?list-
type=2&prefix=test-prefix")
                .body(SdkBody::empty())
                .unwrap(),
            http::Response::builder()
                .status(200)
                .body(SdkBody::from(include_str!("./testing/
response_multi_1.xml")))
                .unwrap(),
        );
        let page_2 = ReplayEvent::new(
            http::Request::builder()
                .method("GET")
                .uri("https://test-bucket.s3.us-east-1.amazonaws.com/?list-
type=2&prefix=test-prefix&continuation-token=next")
                .body(SdkBody::empty())
                .unwrap(),
            http::Response::builder()
                .status(200)
                .body(SdkBody::from(include_str!("./testing/
response_multi_2.xml")))
                .unwrap(),
        );
        let replay_client = StaticReplayClient::new(vec![page_1, page_2]);
        // snippet-end:[testing.rust.replay-create-replay]
        // snippet-start:[testing.rust.replay-create-client]
        let client: s3::Client = s3::Client::from_conf(
            s3::Config::builder()
                .behavior_version(BehaviorVersion::latest())
                .credentials_provider(make_s3_test_credentials())
                .region(s3::config::Region::new("us-east-1"))
                .http_client(replay_client.clone())
                .build(),
        );
    }
}

```

```
);
// snippet-end:[testing.rust.replay-create-client]

// Run the code we want to test with it
// snippet-start:[testing.rust.replay-test-and-verify]
let size = determine_prefix_file_size(client, "test-bucket", "test-prefix")
    .await
    .unwrap();

assert_eq!(19, size);

replay_client.assert_requests_match(&[]);
// snippet-end:[testing.rust.replay-test-and-verify]
}
// snippet-end:[testing.rust.replay-test-multiple]
}
// snippet-end:[testing.rust.replay-tests]
// snippet-end:[testing.rust.replay-test-module]
```

Upload or download large files

The following code example shows how to upload or download large files to and from Amazon S3.

For more information, see [Uploading an object using multipart upload](#).

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
use std::fs::File;
use std::io::prelude::*;
use std::path::Path;

use aws_config::meta::region::RegionProviderChain;
use aws_sdk_s3::error::DisplayErrorContext;
use aws_sdk_s3::operation::{
```

```

    create_multipart_upload::CreateMultipartUploadOutput,
    get_object::GetObjectOutput,
};
use aws_sdk_s3::types::{CompletedMultipartUpload, CompletedPart};
use aws_sdk_s3::{config::Region, Client as S3Client};
use aws_smithy_types::byte_stream::{ByteStream, Length};
use rand::distributions::Alphanumeric;
use rand::{thread_rng, Rng};
use s3_service::error::Error;
use std::process;
use uuid::Uuid;

//In bytes, minimum chunk size of 5MB. Increase CHUNK_SIZE to send larger chunks.
const CHUNK_SIZE: u64 = 1024 * 1024 * 5;
const MAX_CHUNKS: u64 = 10000;

#[tokio::main]
pub async fn main() {
    if let Err(err) = run_example().await {
        eprintln!("Error: {}", DisplayErrorContext(err));
        process::exit(1);
    }
}

async fn run_example() -> Result<(), Error> {
    let shared_config = aws_config::load_from_env().await;
    let client = S3Client::new(&shared_config);

    let bucket_name = format!("doc-example-bucket-{}", Uuid::new_v4());
    let region_provider = RegionProviderChain::first_try(Region::new("us-west-2"));
    let region = region_provider.region().await.unwrap();
    s3_service::create_bucket(&client, &bucket_name, region.as_ref()).await?;

    let key = "sample.txt".to_string();
    let multipart_upload_res: CreateMultipartUploadOutput = client
        .create_multipart_upload()
        .bucket(&bucket_name)
        .key(&key)
        .send()
        .await
        .unwrap();
    let upload_id = multipart_upload_res.upload_id().unwrap();

    //Create a file of random characters for the upload.

```

```
let mut file = File::create(&key).expect("Could not create sample file.");
// Loop until the file is 5 chunks.
while file.metadata().unwrap().len() <= CHUNK_SIZE * 4 {
    let rand_string: String = thread_rng()
        .sample_iter(&Alphanumeric)
        .take(256)
        .map(char::from)
        .collect();
    let return_string: String = "\n".to_string();
    file.write_all(rand_string.as_ref())
        .expect("Error writing to file.");
    file.write_all(return_string.as_ref())
        .expect("Error writing to file.");
}

let path = Path::new(&key);
let file_size = tokio::fs::metadata(path)
    .await
    .expect("it exists I swear")
    .len();

let mut chunk_count = (file_size / CHUNK_SIZE) + 1;
let mut size_of_last_chunk = file_size % CHUNK_SIZE;
if size_of_last_chunk == 0 {
    size_of_last_chunk = CHUNK_SIZE;
    chunk_count -= 1;
}

if file_size == 0 {
    panic!("Bad file size.");
}
if chunk_count > MAX_CHUNKS {
    panic!("Too many chunks! Try increasing your chunk size.")
}

let mut upload_parts: Vec<CompletedPart> = Vec::new();

for chunk_index in 0..chunk_count {
    let this_chunk = if chunk_count - 1 == chunk_index {
        size_of_last_chunk
    } else {
        CHUNK_SIZE
    };
    let stream = ByteStream::read_from()
```

```

        .path(path)
        .offset(chunk_index * CHUNK_SIZE)
        .length(Length::Exact(this_chunk))
        .build()
        .await
        .unwrap();
//Chunk index needs to start at 0, but part numbers start at 1.
let part_number = (chunk_index as i32) + 1;
let upload_part_res = client
    .upload_part()
    .key(&key)
    .bucket(&bucket_name)
    .upload_id(upload_id)
    .body(stream)
    .part_number(part_number)
    .send()
    .await?;
upload_parts.push(
    CompletedPart::builder()
        .e_tag(upload_part_res.e_tag.unwrap_or_default())
        .part_number(part_number)
        .build(),
);
}
let completed_multipart_upload: CompletedMultipartUpload =
CompletedMultipartUpload::builder()
    .set_parts(Some(upload_parts))
    .build();

let _complete_multipart_upload_res = client
    .complete_multipart_upload()
    .bucket(&bucket_name)
    .key(&key)
    .multipart_upload(completed_multipart_upload)
    .upload_id(upload_id)
    .send()
    .await
    .unwrap();

let data: GetObjectOutput = s3_service::download_object(&client, &bucket_name,
&key).await?;
let data_length: u64 = data
    .content_length()
    .unwrap_or_default()

```



```
        .try_into()
        .unwrap();
    if file.metadata().unwrap().len() == data_length {
        println!("Data lengths match.");
    } else {
        println!("The data was not the same size!");
    }

    s3_service::delete_objects(&client, &bucket_name)
        .await
        .expect("Error emptying bucket.");
    s3_service::delete_bucket(&client, &bucket_name)
        .await
        .expect("Error deleting bucket.");

    Ok(())
}
```

Serverless examples

Invoke a Lambda function from an Amazon S3 trigger

The following code example shows how to implement a Lambda function that receives an event triggered by uploading an object to an S3 bucket. The function retrieves the S3 bucket name and object key from the event parameter and calls the Amazon S3 API to retrieve and log the content type of the object.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming an S3 event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::event::s3::S3Event;
```

```
use aws_sdk_s3::{Client};
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

/// Main function
#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        .with_target(false)
        .without_time()
        .init();

    // Initialize the AWS SDK for Rust
    let config = aws_config::load_from_env().await;
    let s3_client = Client::new(&config);

    let res = run(service_fn(|request: LambdaEvent<S3Event>| {
        function_handler(&s3_client, request)
    })).await;

    res
}

async fn function_handler(
    s3_client: &Client,
    evt: LambdaEvent<S3Event>
) -> Result<(), Error> {
    tracing::info!(records = ?evt.payload.records.len(), "Received request from
SQS");

    if evt.payload.records.len() == 0 {
        tracing::info!("Empty S3 event received");
    }

    let bucket = evt.payload.records[0].s3.bucket.name.as_ref().expect("Bucket name
to exist");
    let key = evt.payload.records[0].s3.object.key.as_ref().expect("Object key to
exist");

    tracing::info!("Request is for {} and object {}", bucket, key);

    let s3_get_object_result = s3_client
        .get_object()
```

```
        .bucket(bucket)
        .key(key)
        .send()
        .await;

    match s3_get_object_result {
        Ok(_) => tracing::info!("S3 Get Object success, the s3GetObjectResult
contains a 'body' property of type ByteStream"),
        Err(_) => tracing::info!("Failure with S3 Get Object request")
    }

    Ok(())
}
```

SageMaker examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with SageMaker.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

ListNotebookInstances

The following code example shows how to use ListNotebookInstances.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_instances(client: &Client) -> Result<(), Error> {
    let notebooks = client.list_notebook_instances().send().await?;

    println!("Notebooks:");

    for n in notebooks.notebook_instances() {
        let n_instance_type = n.instance_type().unwrap();
        let n_status = n.notebook_instance_status().unwrap();
        let n_name = n.notebook_instance_name();

        println!("  Name :           {}", n_name.unwrap_or("Unknown"));
        println!("  Status :          {}", n_status.as_ref());
        println!("  Instance Type : {}", n_instance_type.as_ref());
        println!();
    }

    Ok(())
}
```

- For API details, see [ListNotebookInstances](#) in *AWS SDK for Rust API reference*.

ListTrainingJobs

The following code example shows how to use ListTrainingJobs.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

async fn show_jobs(client: &Client) -> Result<(), Error> {
    let job_details = client.list_training_jobs().send().await?;

    println!("Jobs:");

    for j in job_details.training_job_summaries() {
        let name = j.training_job_name().unwrap_or("Unknown");
        let creation_time = j.creation_time().expect("creation
time").to_chrono_utc()?;
        let training_end_time = j
            .training_end_time()
            .expect("Training end time")
            .to_chrono_utc()?;

        let status = j.training_job_status().expect("training status");
        let duration = training_end_time - creation_time;

        println!("  Name:                {}", name);
        println!(
            "    Creation date/time: {}",
            creation_time.format("%Y-%m-%d@%H:%M:%S")
        );
        println!("  Duration (seconds): {}", duration.num_seconds());
        println!("  Status:                {:?}" , status);

        println!();
    }

    Ok(())
}

```

- For API details, see [ListTrainingJobs](#) in *AWS SDK for Rust API reference*.

Secrets Manager examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Secrets Manager.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

GetSecretValue

The following code example shows how to use `GetSecretValue`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_secret(client: &Client, name: &str) -> Result<(), Error> {
    let resp = client.get_secret_value().secret_id(name).send().await?;

    println!("Value: {}", resp.secret_string().unwrap_or("No value!"));

    Ok(())
}
```

- For API details, see [GetSecretValue](#) in *AWS SDK for Rust API reference*.

Amazon SES API v2 examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon SES API v2.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)
- [Scenarios](#)

Actions

CreateContact

The following code example shows how to use CreateContact.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn add_contact(client: &Client, list: &str, email: &str) -> Result<(), Error>
{
    client
        .create_contact()
        .contact_list_name(list)
        .email_address(email)
        .send()
        .await?;

    println!("Created contact");
}
```

```
    Ok(())  
}
```

- For API details, see [CreateContact](#) in *AWS SDK for Rust API reference*.

CreateContactList

The following code example shows how to use CreateContactList.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_list(client: &Client, contact_list: &str) -> Result<(), Error> {  
    client  
        .create_contact_list()  
        .contact_list_name(contact_list)  
        .send()  
        .await?;  
  
    println!("Created contact list.");  
  
    Ok(())  
}
```

- For API details, see [CreateContactList](#) in *AWS SDK for Rust API reference*.

CreateEmailIdentity

The following code example shows how to use CreateEmailIdentity.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
match self
  .client
  .create_email_identity()
  .email_identity(self.verified_email.clone())
  .send()
  .await
{
  Ok(_) => writeln!(self.stdout, "Email identity created successfully.")?,
  Err(e) => match e.into_service_error() {
    CreateEmailIdentityError::AlreadyExistsException(_) => {
      writeln!(
        self.stdout,
        "Email identity already exists, skipping creation."
      )?;
    }
    e => return Err( anyhow!("Error creating email identity: {}", e) ),
  },
}
```

- For API details, see [CreateEmailIdentity](#) in *AWS SDK for Rust API reference*.

CreateEmailTemplate

The following code example shows how to use `CreateEmailTemplate`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```

let template_html =
    std::fs::read_to_string("../resources/newsletter/coupon-
newsletter.html")
        .unwrap_or_else(|_| "Missing coupon-newsletter.html".to_string());
let template_text =
    std::fs::read_to_string("../resources/newsletter/coupon-newsletter.txt")
        .unwrap_or_else(|_| "Missing coupon-newsletter.txt".to_string());

// Create the email template
let template_content = EmailTemplateContent::builder()
    .subject("Weekly Coupons Newsletter")
    .html(template_html)
    .text(template_text)
    .build();

match self
    .client
    .create_email_template()
    .template_name(TEMPLATE_NAME)
    .template_content(template_content)
    .send()
    .await
{
    Ok(_) => writeln!(self.stdout, "Email template created successfully.")?,
    Err(e) => match e.into_service_error() {
        CreateEmailTemplateError::AlreadyExistsException(_) => {
            writeln!(
                self.stdout,
                "Email template already exists, skipping creation."
            )?;
        }
        e => return Err( anyhow!("Error creating email template: {}", e)),
    },
}

```

- For API details, see [CreateEmailTemplate](#) in *AWS SDK for Rust API reference*.

DeleteContactList

The following code example shows how to use DeleteContactList.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
match self
    .client
    .delete_contact_list()
    .contact_list_name(CONTACT_LIST_NAME)
    .send()
    .await
{
    Ok(_) => writeln!(self.stdout, "Contact list deleted successfully.")?,
    Err(e) => return Err(anyhow!("Error deleting contact list: {e}")),
}
```

- For API details, see [DeleteContactList](#) in *AWS SDK for Rust API reference*.

DeleteEmailIdentity

The following code example shows how to use DeleteEmailIdentity.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
match self
    .client
    .delete_email_identity()
    .email_identity(self.verified_email.clone())
    .send()
```

```
        .await
    {
        Ok(_) => writeln!(self.stdout, "Email identity deleted
successfully.")?,
        Err(e) => {
            return Err(anyhow!("Error deleting email identity: {}", e));
        }
    }
}
```

- For API details, see [DeleteEmailIdentity](#) in *AWS SDK for Rust API reference*.

DeleteEmailTemplate

The following code example shows how to use DeleteEmailTemplate.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
match self
    .client
    .delete_email_template()
    .template_name(TEMPLATE_NAME)
    .send()
    .await
{
    Ok(_) => writeln!(self.stdout, "Email template deleted successfully.")?,
    Err(e) => {
        return Err(anyhow!("Error deleting email template: {e}"));
    }
}
```

- For API details, see [DeleteEmailTemplate](#) in *AWS SDK for Rust API reference*.

GetEmailIdentity

The following code example shows how to use `GetEmailIdentity`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Determines whether an email address has been verified.

```
async fn is_verified(client: &Client, email: &str) -> Result<(), Error> {
    let resp = client
        .get_email_identity()
        .email_identity(email)
        .send()
        .await?;

    if resp.verified_for_sending_status() {
        println!("The address is verified");
    } else {
        println!("The address is not verified");
    }

    Ok(())
}
```

- For API details, see [GetEmailIdentity](#) in *AWS SDK for Rust API reference*.

ListContactLists

The following code example shows how to use `ListContactLists`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_lists(client: &Client) -> Result<(), Error> {
    let resp = client.list_contact_lists().send().await?;

    println!("Contact lists:");

    for list in resp.contact_lists() {
        println!("  {}", list.contact_list_name().unwrap_or_default());
    }

    Ok(())
}
```

- For API details, see [ListContactLists](#) in *AWS SDK for Rust API reference*.

ListContacts

The following code example shows how to use ListContacts.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_contacts(client: &Client, list: &str) -> Result<(), Error> {
    let resp = client
        .list_contacts()
        .contact_list_name(list)
        .send()
```

```
        .await?;

println!("Contacts:");

for contact in resp.contacts() {
    println!("  {}", contact.email_address().unwrap_or_default());
}

Ok(())
}
```

- For API details, see [ListContacts](#) in *AWS SDK for Rust API reference*.

SendEmail

The following code example shows how to use SendEmail.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Sends a message to all members of the contact list.

```
async fn send_message(
    client: &Client,
    list: &str,
    from: &str,
    subject: &str,
    message: &str,
) -> Result<(), Error> {
    // Get list of email addresses from contact list.
    let resp = client
        .list_contacts()
        .contact_list_name(list)
        .send()
        .await?;
```

```
let contacts = resp.contacts();

let cs: Vec<String> = contacts
    .iter()
    .map(|i| i.email_address().unwrap_or_default().to_string())
    .collect();

let mut dest: Destination = Destination::builder().build();
dest.to_addresses = Some(cs);
let subject_content = Content::builder()
    .data(subject)
    .charset("UTF-8")
    .build()
    .expect("building Content");
let body_content = Content::builder()
    .data(message)
    .charset("UTF-8")
    .build()
    .expect("building Content");
let body = Body::builder().text(body_content).build();

let msg = Message::builder()
    .subject(subject_content)
    .body(body)
    .build();

let email_content = EmailContent::builder().simple(msg).build();

client
    .send_email()
    .from_email_address(from)
    .destination(dest)
    .content(email_content)
    .send()
    .await?;

println!("Email sent to list");

Ok(())
}
```

Sends a message to all members of the contact list using a template.


```

    let coupons = std::fs::read_to_string("../resources/newsletter/
sample_coupons.json")
        .unwrap_or_else(|_| r#"{"coupons":[]}"#.to_string());
    let email_content = EmailContent::builder()
        .template(
            Template::builder()
                .template_name(TEMPLATE_NAME)
                .template_data(coupons)
                .build(),
        )
        .build();

    match self
        .client
        .send_email()
        .from_email_address(self.verified_email.clone())

    .destination(Destination::builder().to_addresses(email.clone()).build())
        .content(email_content)
        .list_management_options(
            ListManagementOptions::builder()
                .contact_list_name(CONTACT_LIST_NAME)
                .build()?,
        )
        .send()
        .await
    {
        Ok(output) => {
            if let Some(message_id) = output.message_id {
                writeln!(
                    self.stdout,
                    "Newsletter sent to {} with message ID {}",
                    email, message_id
                )?;
            } else {
                writeln!(self.stdout, "Newsletter sent to {}", email)?;
            }
        }
        Err(e) => return Err( anyhow!("Error sending newsletter to {}: {}",
email, e)),
    }

```

- For API details, see [SendEmail](#) in *AWS SDK for Rust API reference*.

Scenarios

Newsletter workflow

The following code example shows how to Amazon SES API v2 newsletter workflow.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
match self
    .client
    .create_contact_list()
    .contact_list_name(CONTACT_LIST_NAME)
    .send()
    .await
{
    Ok(_) => writeln!(self.stdout, "Contact list created successfully.")?,
    Err(e) => match e.into_service_error() {
        CreateContactListError::AlreadyExistsException(_) => {
            writeln!(
                self.stdout,
                "Contact list already exists, skipping creation."
            )?;
        }
        e => return Err(anyhow!("Error creating contact list: {}", e)),
    },
}

match self
    .client
    .create_contact()
    .contact_list_name(CONTACT_LIST_NAME)
    .email_address(email.clone())
    .send()
    .await
```

```

    {
        Ok(_) => writeln!(self.stdout, "Contact created for {}", email)?,
        Err(e) => match e.into_service_error() {
            CreateContactError::AlreadyExistsException(_) => writeln!(
                self.stdout,
                "Contact already exists for {}, skipping creation.",
                email
            )?,
            e => return Err(anyhow!("Error creating contact for {}: {}",
email, e)),
        },
    }

    let contacts: Vec<Contact> = match self
        .client
        .list_contacts()
        .contact_list_name(CONTACT_LIST_NAME)
        .send()
        .await
    {
        Ok(list_contacts_output) => {
            list_contacts_output.contacts.unwrap().into_iter().collect()
        }
        Err(e) => {
            return Err(anyhow!(
                "Error retrieving contact list {}: {}",
                CONTACT_LIST_NAME,
                e
            ))
        }
    };

    let coupons = std::fs::read_to_string("../resources/newsletter/
sample_coupons.json")
        .unwrap_or_else(|_| r#"{"coupons": []}"#.to_string());
    let email_content = EmailContent::builder()
        .template(
            Template::builder()
                .template_name(TEMPLATE_NAME)
                .template_data(coupons)
                .build(),
        )
        .build();

```

```

        match self
            .client
            .send_email()
            .from_email_address(self.verified_email.clone())

        .destination(Destination::builder().to_addresses(email.clone()).build())
        .content(email_content)
        .list_management_options(
            ListManagementOptions::builder()
                .contact_list_name(CONTACT_LIST_NAME)
                .build()?,
        )
        .send()
        .await
    {
        Ok(output) => {
            if let Some(message_id) = output.message_id {
                writeln!(
                    self.stdout,
                    "Newsletter sent to {} with message ID {}",
                    email, message_id
                )?;
            } else {
                writeln!(self.stdout, "Newsletter sent to {}", email)?;
            }
        }
        Err(e) => return Err( anyhow!("Error sending newsletter to {}: {}",
email, e)),
    }

    match self
        .client
        .create_email_identity()
        .email_identity(self.verified_email.clone())
        .send()
        .await
    {
        Ok(_) => writeln!(self.stdout, "Email identity created successfully.")?,
        Err(e) => match e.into_service_error() {
            CreateEmailIdentityError::AlreadyExistsException(_) => {
                writeln!(
                    self.stdout,
                    "Email identity already exists, skipping creation."
                )?;
            }
        }
    }

```

```

        }
        e => return Err(anyhow!("Error creating email identity: {}", e)),
    },
}

let template_html =
    std::fs::read_to_string("../resources/newsletter/coupon-
newsletter.html")
        .unwrap_or_else(|_| "Missing coupon-newsletter.html".to_string());
let template_text =
    std::fs::read_to_string("../resources/newsletter/coupon-newsletter.txt")
        .unwrap_or_else(|_| "Missing coupon-newsletter.txt".to_string());

// Create the email template
let template_content = EmailTemplateContent::builder()
    .subject("Weekly Coupons Newsletter")
    .html(template_html)
    .text(template_text)
    .build();

match self
    .client
    .create_email_template()
    .template_name(TEMPLATE_NAME)
    .template_content(template_content)
    .send()
    .await
{
    Ok(_) => writeln!(self.stdout, "Email template created successfully.")?,
    Err(e) => match e.into_service_error() {
        CreateEmailTemplateError::AlreadyExistsException(_) => {
            writeln!(
                self.stdout,
                "Email template already exists, skipping creation."
            )?;
        }
        e => return Err(anyhow!("Error creating email template: {}", e)),
    },
}

match self
    .client
    .delete_contact_list()
    .contact_list_name(CONTACT_LIST_NAME)

```

```
        .send()
        .await
    {
        Ok(_) => writeln!(self.stdout, "Contact list deleted successfully.")?,
        Err(e) => return Err(anyhow!("Error deleting contact list: {e}")),
    }

    match self
        .client
        .delete_email_identity()
        .email_identity(self.verified_email.clone())
        .send()
        .await
    {
        Ok(_) => writeln!(self.stdout, "Email identity deleted
successfully.")?,
        Err(e) => {
            return Err(anyhow!("Error deleting email identity: {}", e));
        }
    }

    match self
        .client
        .delete_email_template()
        .template_name(TEMPLATE_NAME)
        .send()
        .await
    {
        Ok(_) => writeln!(self.stdout, "Email template deleted successfully.")?,
        Err(e) => {
            return Err(anyhow!("Error deleting email template: {e}"));
        }
    }
}
```

- For API details, see the following topics in *AWS SDK for Rust API reference*.

- [CreateContact](#)
- [CreateContactList](#)
- [CreateEmailIdentity](#)
- [CreateEmailTemplate](#)
- [DeleteContactList](#)

- [DeleteEmailIdentity](#)
- [DeleteEmailTemplate](#)
- [ListContacts](#)
- [SendEmail.simple](#)
- [SendEmail.template](#)

Amazon SNS examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon SNS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)
- [Serverless examples](#)

Actions

CreateTopic

The following code example shows how to use CreateTopic.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_topic(client: &Client, topic_name: &str) -> Result<(), Error> {
    let resp = client.create_topic().name(topic_name).send().await?;

    println!(
        "Created topic with ARN: {}",
        resp.topic_arn().unwrap_or_default()
    );

    Ok(())
}
```

- For API details, see [CreateTopic](#) in *AWS SDK for Rust API reference*.

ListTopics

The following code example shows how to use `ListTopics`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_topics(client: &Client) -> Result<(), Error> {
    let resp = client.list_topics().send().await?;

    println!("Topic ARNs:");

    for topic in resp.topics() {
        println!("{}", topic.topic_arn().unwrap_or_default());
    }

    Ok(())
}
```

- For API details, see [ListTopics](#) in *AWS SDK for Rust API reference*.

Publish

The following code example shows how to use Publish.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn subscribe_and_publish(
    client: &Client,
    topic_arn: &str,
    email_address: &str,
) -> Result<(), Error> {
    println!("Receiving on topic with ARN: `{}`", topic_arn);

    let rsp = client
        .subscribe()
        .topic_arn(topic_arn)
        .protocol("email")
        .endpoint(email_address)
        .send()
        .await?;

    println!("Added a subscription: {:?}", rsp);

    let rsp = client
        .publish()
        .topic_arn(topic_arn)
        .message("hello sns!")
        .send()
        .await?;

    println!("Published message: {:?}", rsp);

    Ok(())
}
```

- For API details, see [Publish](#) in *AWS SDK for Rust API reference*.

Subscribe

The following code example shows how to use `Subscribe`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Subscribe an email address to a topic.

```
async fn subscribe_and_publish(
    client: &Client,
    topic_arn: &str,
    email_address: &str,
) -> Result<(), Error> {
    println!("Receiving on topic with ARN: `{}`", topic_arn);

    let rsp = client
        .subscribe()
        .topic_arn(topic_arn)
        .protocol("email")
        .endpoint(email_address)
        .send()
        .await?;

    println!("Added a subscription: {:?}", rsp);

    let rsp = client
        .publish()
        .topic_arn(topic_arn)
        .message("hello sns!")
        .send()
        .await?;

    println!("Published message: {:?}", rsp);
}
```

```
    Ok(())
}
```

- For API details, see [Subscribe](#) in *AWS SDK for Rust API reference*.

Serverless examples

Invoke a Lambda function from an Amazon SNS trigger

The following code example shows how to implement a Lambda function that receives an event triggered by receiving messages from an SNS topic. The function retrieves the messages from the event parameter and logs the content of each message.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming an SNS event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::event::sns::SnsEvent;
use aws_lambda_events::sns::SnsRecord;
use lambda_runtime::{run, service_fn, Error, LambdaEvent};
use tracing::info;

// Built with the following dependencies:
// aws_lambda_events = { version = "0.10.0", default-features = false, features =
//   ["sns"] }
// lambda_runtime = "0.8.1"
// tokio = { version = "1", features = ["macros"] }
// tracing = { version = "0.1", features = ["log"] }
// tracing-subscriber = { version = "0.3", default-features = false, features =
//   ["fmt"] }

async fn function_handler(event: LambdaEvent<SnsEvent>) -> Result<(), Error> {
```

```
    for event in event.payload.records {
        process_record(&event)?;
    }

    Ok(())
}

fn process_record(record: &SnsRecord) -> Result<(), Error> {
    info!("Processing SNS Message: {}", record.sns.message);

    // Implement your record handling code here.

    Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        .with_target(false)
        .without_time()
        .init();

    run(service_fn(function_handler)).await
}
```

Amazon SQS examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Amazon SQS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)
- [Serverless examples](#)

Actions

ListQueues

The following code example shows how to use `ListQueues`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

Retrieve the first Amazon SQS queue listed in the Region.

```
async fn find_first_queue(client: &Client) -> Result<String, Error> {
    let queues = client.list_queues().send().await?;
    let queue_urls = queues.queue_urls();
    Ok(queue_urls
        .first()
        .expect("No queues in this account and Region. Create a queue to proceed.")
        .to_string())
}
```

- For API details, see [ListQueues](#) in *AWS SDK for Rust API reference*.

ReceiveMessage

The following code example shows how to use `ReceiveMessage`.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn receive(client: &Client, queue_url: &String) -> Result<(), Error> {
    let rcv_message_output =
        client.receive_message().queue_url(queue_url).send().await?;

    println!("Messages from queue with url: {}", queue_url);

    for message in rcv_message_output.messages.unwrap_or_default() {
        println!("Got the message: {:#?}", message);
    }

    Ok(())
}
```

- For API details, see [ReceiveMessage](#) in *AWS SDK for Rust API reference*.

SendMessage

The following code example shows how to use SendMessage.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn send(client: &Client, queue_url: &String, message: &SQSMessage) ->
    Result<(), Error> {
    println!("Sending message to queue with URL: {}", queue_url);
```

```
let rsp = client
    .send_message()
    .queue_url(queue_url)
    .message_body(&message.body)
    // If the queue is FIFO, you need to set .message_deduplication_id
    // and message_group_id or configure the queue for
ContentBasedDeduplication.
    .send()
    .await?;

println!("Send message to the queue: {:#?}", rsp);

Ok(())
}
```

- For API details, see [SendMessage](#) in *AWS SDK for Rust API reference*.

Serverless examples

Invoke a Lambda function from an Amazon SQS trigger

The following code example shows how to implement a Lambda function that receives an event triggered by receiving messages from an SQS queue. The function retrieves the messages from the event parameter and logs the content of each message.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Consuming an SQS event with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::event::sqs::SqsEvent;
use lambda_runtime::{run, service_fn, Error, LambdaEvent};
```

```
async fn function_handler(event: LambdaEvent<SqsEvent>) -> Result<(), Error> {
    event.payload.records.iter().for_each(|record| {
        // process the record
        tracing::info!("Message body: {}",
            record.body.as_deref().unwrap_or_default())
    });

    Ok(())
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    tracing_subscriber::fmt()
        .with_max_level(tracing::Level::INFO)
        // disable printing the name of the module in every log line.
        .with_target(false)
        // disabling time is handy because CloudWatch will add the ingestion time.
        .without_time()
        .init();

    run(service_fn(function_handler)).await
}
```

Reporting batch item failures for Lambda functions with an Amazon SQS trigger

The following code example shows how to implement partial batch response for Lambda functions that receive events from an SQS queue. The function reports the batch item failures in the response, signaling to Lambda to retry those messages later.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [Serverless examples](#) repository.

Reporting SQS batch item failures with Lambda using Rust.

```
// Copyright Amazon.com, Inc. or its affiliates. All Rights Reserved.
```



```
// SPDX-License-Identifier: Apache-2.0
use aws_lambda_events::{
    event::sqs::{SqsBatchResponse, SqsEvent},
    sqs::{BatchItemFailure, SqsMessage},
};
use lambda_runtime::{run, service_fn, Error, LambdaEvent};

async fn process_record(_: &SqsMessage) -> Result<(), Error> {
    Err(Error::from("Error processing message"))
}

async fn function_handler(event: LambdaEvent<SqsEvent>) -> Result<SqsBatchResponse,
Error> {
    let mut batch_item_failures = Vec::new();
    for record in event.payload.records {
        match process_record(&record).await {
            Ok(_) => (),
            Err(_) => batch_item_failures.push(BatchItemFailure {
                item_identifier: record.message_id.unwrap(),
            }),
        }
    }

    Ok(SqsBatchResponse {
        batch_item_failures,
    })
}

#[tokio::main]
async fn main() -> Result<(), Error> {
    run(service_fn(function_handler)).await
}
```

AWS STS examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with AWS STS.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

AssumeRole

The following code example shows how to use AssumeRole.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn assume_role(config: &SdkConfig, role_name: String, session_name:
Option<String>) {
    let provider = aws_config::sts::AssumeRoleProvider::builder(role_name)
        .session_name(session_name.unwrap_or("rust_sdk_example_session".into()))
        .configure(config)
        .build()
        .await;

    let local_config = aws_config::from_env()
        .credentials_provider(provider)
        .load()
        .await;
    let client = Client::new(&local_config);
    let req = client.get_caller_identity();
    let resp = req.send().await;
    match resp {
        Ok(e) => {
            println!("UserID :           {}", e.user_id().unwrap_or_default());
```

```
        println!("Account:          {}", e.account().unwrap_or_default());
        println!("Arn      :          {}", e.arn().unwrap_or_default());
    }
    Err(e) => println!("{:?}", e),
}
}
```

- For API details, see [AssumeRole](#) in *AWS SDK for Rust API reference*.

Systems Manager examples using SDK for Rust

The following code examples show you how to perform actions and implement common scenarios by using the AWS SDK for Rust with Systems Manager.

Actions are code excerpts from larger programs and must be run in context. While actions show you how to call individual service functions, you can see actions in context in their related scenarios and cross-service examples.

Scenarios are code examples that show you how to accomplish a specific task by calling multiple functions within the same service.

Each example includes a link to GitHub, where you can find instructions on how to set up and run the code in context.

Topics

- [Actions](#)

Actions

DescribeParameters

The following code example shows how to use DescribeParameters.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn show_parameters(client: &Client) -> Result<(), Error> {
    let resp = client.describe_parameters().send().await?;

    for param in resp.parameters() {
        println!("{}", param.name().unwrap_or_default());
    }

    Ok(())
}
```

- For API details, see [DescribeParameters](#) in *AWS SDK for Rust API reference*.

PutParameter

The following code example shows how to use PutParameter.

SDK for Rust

Note

There's more on GitHub. Find the complete example and learn how to set up and run in the [AWS Code Examples Repository](#).

```
async fn make_parameter(
    client: &Client,
    name: &str,
    value: &str,
    description: &str,
) -> Result<(), Error> {
    let resp = client
        .put_parameter()
        .overwrite(true)
        .r#type(ParameterType::String)
        .name(name)
        .value(value)
        .description(description)
        .send()
        .await?;
```

```
println!("Success! Parameter now has version: {}", resp.version());

Ok(())
}
```

- For API details, see [PutParameter](#) in *AWS SDK for Rust API reference*.

Cross-service examples using SDK for Rust

The following sample applications use the AWS SDK for Rust to work across multiple AWS services.

Cross-service examples target an advanced level of experience to help you start building applications.

Examples

- [Convert text to speech and back to text using an AWS SDK](#)
- [Create a photo asset management application that lets users manage photos using labels](#)
- [Detect faces in an image using an AWS SDK](#)
- [Save EXIF and other image information using an AWS SDK](#)

Convert text to speech and back to text using an AWS SDK

SDK for Rust

Use Amazon Polly to synthesize a plain text (UTF-8) input file to an audio file, upload the audio file to an Amazon S3 bucket, use Amazon Transcribe to convert that audio file to text, and display the text.

For complete source code and instructions on how to set up and run, see the full example on [GitHub](#).

Services used in this example

- Amazon Polly
- Amazon S3
- Amazon Transcribe

Create a photo asset management application that lets users manage photos using labels

SDK for Rust

Shows how to develop a photo asset management application that detects labels in images using Amazon Rekognition and stores them for later retrieval.

For complete source code and instructions on how to set up and run, see the full example on [GitHub](#).

For a deep dive into the origin of this example see the post on [AWS Community](#).

Services used in this example

- API Gateway
- DynamoDB
- Lambda
- Amazon Rekognition
- Amazon S3
- Amazon SNS

Detect faces in an image using an AWS SDK

SDK for Rust

Save the image in an Amazon S3 bucket with an **uploads** prefix, use Amazon Rekognition to detect facial details, such as age range, gender, and emotion (smiling, etc.), and display those details.

For complete source code and instructions on how to set up and run, see the full example on [GitHub](#).

Services used in this example

- Amazon Rekognition
- Amazon S3

Save EXIF and other image information using an AWS SDK

SDK for Rust

Get EXIF information from a JPG, JPEG, or PNG file, upload the image file to an Amazon S3 bucket, use Amazon Rekognition to identify the three top attributes (*labels* in Amazon Rekognition) in the file, and add the EXIF and label information to a Amazon DynamoDB table in the Region.

For complete source code and instructions on how to set up and run, see the full example on [GitHub](#).

Services used in this example

- DynamoDB
- Amazon Rekognition
- Amazon S3

Security for this AWS Product or Service

Cloud security at Amazon Web Services (AWS) is the highest priority. As an AWS customer, you benefit from a data center and network architecture that is built to meet the requirements of the most security-sensitive organizations. Security is a shared responsibility between AWS and you. The [Shared Responsibility Model](#) describes this as Security of the Cloud and Security in the Cloud.

Security of the Cloud – AWS is responsible for protecting the infrastructure that runs all of the services offered in the AWS Cloud and providing you with services that you can use securely. Our security responsibility is the highest priority at AWS, and the effectiveness of our security is regularly tested and verified by third-party auditors as part of the [AWS Compliance Programs](#).

Security in the Cloud – Your responsibility is determined by the AWS service you are using, and other factors including the sensitivity of your data, your organization's requirements, and applicable laws and regulations.

This AWS product or service follows the [shared responsibility model](#) through the specific Amazon Web Services (AWS) services it supports. For AWS service security information, see the [AWS service security documentation page](#) and [AWS services that are in scope of AWS compliance efforts by compliance program](#).

Topics

- [Data protection in this AWS Product or Service](#)
- [Compliance Validation for this AWS Product or Service](#)
- [Infrastructure Security for this AWS Product or Service](#)
- [Enforce a minimum TLS version in the AWS SDK for Rust](#)

Data protection in this AWS Product or Service

The AWS [shared responsibility model](#) applies to data protection in this AWS product or service. As described in this model, AWS is responsible for protecting the global infrastructure that runs all of the AWS Cloud. You are responsible for maintaining control over your content that is hosted on this infrastructure. You are also responsible for the security configuration and management tasks for the AWS services that you use. For more information about data privacy, see the [Data Privacy FAQ](#). For information about data protection in Europe, see the [AWS Shared Responsibility Model and GDPR](#) blog post on the *AWS Security Blog*.

For data protection purposes, we recommend that you protect AWS account credentials and set up individual users with AWS IAM Identity Center or AWS Identity and Access Management (IAM). That way, each user is given only the permissions necessary to fulfill their job duties. We also recommend that you secure your data in the following ways:

- Use multi-factor authentication (MFA) with each account.
- Use SSL/TLS to communicate with AWS resources. We require TLS 1.2 and recommend TLS 1.3.
- Set up API and user activity logging with AWS CloudTrail.
- Use AWS encryption solutions, along with all default security controls within AWS services.
- Use advanced managed security services such as Amazon Macie, which assists in discovering and securing sensitive data that is stored in Amazon S3.
- If you require FIPS 140-2 validated cryptographic modules when accessing AWS through a command line interface or an API, use a FIPS endpoint. For more information about the available FIPS endpoints, see [Federal Information Processing Standard \(FIPS\) 140-2](#).

We strongly recommend that you never put confidential or sensitive information, such as your customers' email addresses, into tags or free-form text fields such as a **Name** field. This includes when you work with this AWS product or service or other AWS services using the console, API, AWS CLI, or AWS SDKs. Any data that you enter into tags or free-form text fields used for names may be used for billing or diagnostic logs. If you provide a URL to an external server, we strongly recommend that you do not include credentials information in the URL to validate your request to that server.


Compliance Validation for this AWS Product or Service

To learn whether an AWS service is within the scope of specific compliance programs, see [AWS services in Scope by Compliance Program](#) and choose the compliance program that you are interested in. For general information, see [AWS Compliance Programs](#).

You can download third-party audit reports using AWS Artifact. For more information, see [Downloading Reports in AWS Artifact](#).

Your compliance responsibility when using AWS services is determined by the sensitivity of your data, your company's compliance objectives, and applicable laws and regulations. AWS provides the following resources to help with compliance:

- [Security and Compliance Quick Start Guides](#) – These deployment guides discuss architectural considerations and provide steps for deploying baseline environments on AWS that are security and compliance focused.
- [Architecting for HIPAA Security and Compliance on Amazon Web Services](#) – This whitepaper describes how companies can use AWS to create HIPAA-eligible applications.

 **Note**

Not all AWS services are HIPAA eligible. For more information, see the [HIPAA Eligible Services Reference](#).

- [AWS Compliance Resources](#) – This collection of workbooks and guides might apply to your industry and location.
- [AWS Customer Compliance Guides](#) – Understand the shared responsibility model through the lens of compliance. The guides summarize the best practices for securing AWS services and map the guidance to security controls across multiple frameworks (including National Institute of Standards and Technology (NIST), Payment Card Industry Security Standards Council (PCI), and International Organization for Standardization (ISO)).
- [Evaluating Resources with Rules](#) in the *AWS Config Developer Guide* – The AWS Config service assesses how well your resource configurations comply with internal practices, industry guidelines, and regulations.
- [AWS Security Hub](#) – This AWS service provides a comprehensive view of your security state within AWS. Security Hub uses security controls to evaluate your AWS resources and to check your compliance against security industry standards and best practices. For a list of supported services and controls, see [Security Hub controls reference](#).
- [Amazon GuardDuty](#) – This AWS service detects potential threats to your AWS accounts, workloads, containers, and data by monitoring your environment for suspicious and malicious activities. GuardDuty can help you address various compliance requirements, like PCI DSS, by meeting intrusion detection requirements mandated by certain compliance frameworks.
- [AWS Audit Manager](#) – This AWS service helps you continuously audit your AWS usage to simplify how you manage risk and compliance with regulations and industry standards.

This AWS product or service follows the [shared responsibility model](#) through the specific Amazon Web Services (AWS) services it supports. For AWS service security information, see the [AWS service](#)

[security documentation page](#) and [AWS services that are in scope of AWS compliance efforts by compliance program](#).

Infrastructure Security for this AWS Product or Service

This AWS product or service uses managed services, and therefore is protected by the AWS global network security. For information about AWS security services and how AWS protects infrastructure, see [AWS Cloud Security](#). To design your AWS environment using the best practices for infrastructure security, see [Infrastructure Protection](#) in *Security Pillar AWS Well-Architected Framework*.

You use AWS published API calls to access this AWS Product or Service through the network. Clients must support the following:

- Transport Layer Security (TLS). We require TLS 1.2 and recommend TLS 1.3.
- Cipher suites with perfect forward secrecy (PFS) such as DHE (Ephemeral Diffie-Hellman) or ECDHE (Elliptic Curve Ephemeral Diffie-Hellman). Most modern systems such as Java 7 and later support these modes.

Additionally, requests must be signed by using an access key ID and a secret access key that is associated with an IAM principal. Or you can use the [AWS Security Token Service](#) (AWS STS) to generate temporary security credentials to sign requests.

This AWS product or service follows the [shared responsibility model](#) through the specific Amazon Web Services (AWS) services it supports. For AWS service security information, see the [AWS service security documentation page](#) and [AWS services that are in scope of AWS compliance efforts by compliance program](#).

Enforce a minimum TLS version in the AWS SDK for Rust

The AWS SDK for Rust uses TLS to increase security when communicating with AWS services. The SDK enforces a minimum TLS version of 1.2 by default. By default, the SDK also negotiates the highest version of TLS available to both the client application and the service. For example, the SDK might be able to negotiate TLS 1.3.

A particular TLS version can be enforced in the application by providing manual configuration of the TCP connector that the SDK uses. To illustrate this, the following example shows you how to enforce TLS 1.3.

Note

Some AWS services do not yet support TLS 1.3, so enforcing this version might affect SDK interoperability. We recommend testing this configuration with each service before production deployment.

```
pub async fn connect_via_tls_13() -> Result<(), Error> {
    println!("Attempting to connect to KMS using TLS 1.3: ");

    // Let webpki load the Mozilla root certificates.
    let mut root_store = RootCertStore::empty();
    root_store.add_server_trust_anchors(webpki_roots::TLS_SERVER_ROOTS.0.iter().map(|
ta| {
        rustls::OwnedTrustAnchor::from_subject_spki_name_constraints(
            ta.subject,
            ta.spki,
            ta.name_constraints,
        )
    }));

    // The .with_protocol_versions call is where we set TLS1.3. You can add
rustls::version::TLS12 or replace them both with rustls::ALL_VERSIONS
    let config = rustls::ClientConfig::builder()
        .with_safe_default_cipher_suites()
        .with_safe_default_kx_groups()
        .with_protocol_versions(&[&rustls::version::TLS13])
        .expect("It looks like your system doesn't support TLS1.3")
        .with_root_certificates(root_store)
        .with_no_client_auth();

    // Finish setup of the rustls connector.
    let rustls_connector = hyper_rustls::HttpsConnectorBuilder::new()
        .with_tls_config(config)
        .https_only()
        .enable_http1()
        .enable_http2()
        .build();

    // See https://github.com/aws-labs/smithy-rs/discussions/3022 for the
HyperClientBuilder
    let http_client = HyperClientBuilder::new().build(rustls_connector);
```

```
let shared_conf = aws_config::defaults(BehaviorVersion::latest())
    .http_client(http_client)
    .load()
    .await;

let kms_client = aws_sdk_kms::Client::new(&shared_conf);
let response = kms_client.list_keys().send().await?;

println!("{:?}", response);

Ok(())
}
```

Appendix: Rust crates used by the SDK

This appendix contains advanced information about the crates used by the AWS SDK for Rust. This includes the Smithy components it uses, crates you might need to use under certain build circumstances, and other information.

Smithy crates

The AWS SDK for Rust is based on [Smithy](#), like most of the AWS SDKs. Smithy is a language used to describe the data types and functions offered by the SDK. These models are then used to help build the SDK itself.

When looking at versions of the SDK for Rust crates and those of its Smithy dependencies, it might be helpful to know that these crates all use [standard semantic version numbering](#).

For additional detailed information about Smithy crates for Rust, see [Smithy Rust Design](#).

Crates used with the SDK for Rust

There are a number of Smithy crates published by AWS. Some of these are relevant to SDK for Rust users, while others are implementation details:

`aws-smithy-async`

Include this crate if you're not using Tokio for asynchronous functionality.

`aws-smithy-runtime`

Includes building blocks required by all AWS SDKs.

`aws-smithy-runtime-api`

Underlying interfaces used by the SDK.

`aws-smithy-types`

Types re-exported from other AWS SDKs. Use this if you use multiple SDKs.

`aws-smithy-types-convert`

Utility functions for moving in and out of `aws-smithy-types`.

Other crates

The following crates exist, but you should not need to know anything about them:

Server-related crates that SDK for Rust users don't need:

- `aws-smithy-http-server`
- `aws-smithy-http-server-python`

Crates that contain under-the-hood code that SDK users don't need to use:

- `aws-smithy-checksum-callbacks`
- `aws-smithy-eventstream`
- `aws-smithy-http`
- `aws-smithy-protocol-test`
- `aws-smithy-query`
- `aws-smithy-json`
- `aws-smithy-xml`

Crates that are unsupported and will go away in the future:

- `aws-smithy-client`
- `aws-smithy-http-auth`
- `aws-smithy-http-tower`

Document history

This topic describes important changes to the AWS SDK for Rust Developer Guide over the course of its history.

Change	Description	Date
General availability of the AWS SDK for Rust	Updated the guide to include new security information, new and updated code examples, new details on unit testing with examples, and other new and updated content for the new General Availability release of the SDK.	November 27, 2023
Enforcing a minimum TLS version	Added information about how to enforce a version of TLS in the SDK.	May 4, 2022
AWS SDK for Rust developer preview release	Developer preview release	December 2, 2021