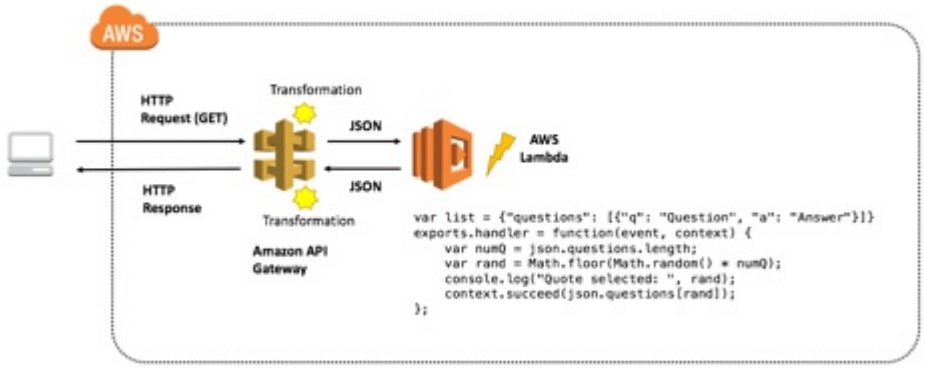
Introduction to Amazon API Gateway

Overview

In this lab, you will create a simple FAQ micro-service. The micro-service will return a JSON object containing a random question and answer pair using an **Amazon API Gateway** endpoint that invokes an **AWS Lambda** function. Here is the architecture pattern for the micro-service:



Topics covered

By the end of this lab you will be able to:

- Create an AWS Lambda function
- Create an Amazon API Gateway endpoints
- Debug API Gateway and Lambda with Amazon CloudWatch

Prerequisites

Some programming experience and familiarity with application development will be helpful, but not necessary to run the lab. You should however have completed the *Introduction to AWS Lambda* self-paced lab before this doing lab.

Other AWS Services

Other AWS Services than the ones needed for this lab are disabled by IAM policy during your access time in this lab. In addition, the capabilities of the services used in this lab are limited to what is

required by the lab and in some cases are even further limited as an intentional aspect of the lab design. Expect errors when accessing other services or performing actions beyond those provided in this lab guide.

Technical Concepts

Microservice Architecture

*"The **microservice architectural style** is an approach to developing a single application as a **suite of small services**, each running in its own process and communicating with lightweight mechanisms, often an HTTP resource API. These services are built around business capabilities and independently deployable by fully automated deployment machinery. There is a bare minimum of centralized management of these services, which may be written in different programming languages and use different data storage technologies."* -- James Lewis and Martin Fowler

The idea of a microservices architecture is to take a large, complex system and break it down into **independent, decoupled services that are easy to manage and extend**. This enables developers to meet their key
design goals like extensibility, availability and maintainability.

Amazon API Gateway and AWS Lambda provide the perfect combination of web services to effortlessly build, deliver and maintain a suite of microservices that can be the foundation of complex software systems.

In this lab, you will learn how to develop, deploy and debug a simple microservice that represents one part of a much larger system. It will consist of two pieces: the RESTful API and the function that is executed when a user hits the endpoint.

Application Programming Interface (API)

An **application programming interface** is a set of instructions that defines how developers interface with an application. The idea behind an API is to create a **standardized approach** to interfacing the various services provided by an application. An API is designed to be used with a **Software Development Kit (SDKs)**, which is a collection of tools that allows developers to easily create downstream applications based on the API.

API-First Strategy

Many software organizations are adopting an **API-First strategy**, where each service within their stack is first and always released as an API. When designing a service, it is hard to know all of the various applications that may want to utilize the service. For instance, the FAQ service in this lab would be ideal to seed FAQ pages on an external website. However, it is feasible to think that a cloud education company would also want to ingest the FAQ within their training materials for flash cards or training documents. If it was simply a static website, the ingestion process for the education company would be very difficult. By providing an API that can be *consumed in a standardized format*, the microservice is enabling the development of an ecosystem around the service, and use-cases that were not initially considered.

RESTful API

Representational state transfer (REST) refers to architectures that follow six constraints:

- **Separation of concerns** via a client-server model.
- **State** is stored entirely on the client and the communication between the client and server is **stateless**.
- The client will **cache** data to improve network efficiency.
- There is a uniform interface (in the form of an **API**) between the server and client.
- As complexity is added into the system, **layers** are introduced. There may be multiple layers of RESTful components.
- Follows a **code-on-demand** pattern, where code can be downloaded on the fly (in our case implemented in Lambda) and changed without having to update clients.

This lab is following a RESTful model. Clients send requests to backend Lambda functions (server). The logic of service is encapsulated within the Lambda function and it is providing a uniform interface for clients to use.

Best Practices for Building a RESTful API

A key goal of building an API is to help establish an **ecosystem of innovation** around your set of services. Therefore, it is important to
make your API intuitive and easy-to-use. Here is a common naming and method scheme to follow:

Operation	URL	Function
`GET`	/questions	Returns all of the questions
`GET`	/questions/17	Returns the question number 17
`POST`	/questions	Creates a new question
`PUT`	/questions/17	Updates question number 17
`PATCH`	/questions/17	Partially updates question number 17
`DELETE`	/questions/17	Deletes question number 17

Notice how to get a specific question, the API endpoint is *NOT* */question/name* but instead */questions/identifier*. This enables the API designer to provide functionality to return groups of questions (could be all questions) with the */questions* endpoint as well as single record responses with the */questions/identifier*. For more information, see the additional resources section at the end of this lab guide.

A few good examples of RESTful APIs to look at are:

- The White House
- Spotify

Amazon API Gateway and AWS Lambda

A microservice using Amazon API Gateway consists of a **defined resource** and **associated methods** (GET, POST, PUT, etc.)

in API
Gatew ay as w ell as the **backend target**. In this lab, the backend target w ill be a Lambda function. How ever, the backend target could be another HTTP endpoint (a third-party API or listening w eb server), an AWS service proxy or a mock integration to be used as a placeholder.

Amazon API Gateway

API Gatew ay is a managed service provided by AWS that makes creating, deploying and maintaining APIs easy. API Gatew ay includes features to:

- Transform the body and headers of incoming API requests to match backend systems
- Transform the body and headers of the outgoing API responses to match API requirements
- Control API access via Amazon Identity and Access Management
- Create and apply API keys for third-party development
- Enable Amazon CloudWatch integration for API monitoring
- Cache API responses via Amazon CloudFront for faster response times
- Deploy an API to multiple stages, allow ing easy differentiation betw een development, test, production as w ell as versioning
- Connect custom domains to an API
- Define models to help standardize your API request and response transformations

Amazon API Gateway and AWS Lambda Terminology

- **Resource:** Represented as a URL endpoint and path. For example, *api.mysite.com/questions*. You can associate HTTP methods w ith resources and define different backend targets for each method. In a microservices architecture, a resource w ould represent a single microservice w ithin your system.
- **Method:** In API Gatew ay, a method is identified by the combination of a resource path and an HTTP verb, such as GET, POST, and DELETE.
- **Method Request:** The method request settings in API gatew ay store the methods authorization settings and define the URL Query String parameters and HTTP Request Headers that are received from the client.
- **Integration Request:** The integration request settings define the backend target used w ith the method. It is also w here you can define mapping templates, to transform the incoming request to match w hat the backend target is expecting.
- **Integration Response:** The integration response settings is w here the mappings are defined betw een the response from the backend target and the method response in API Gatew ay. You can also transform the data that is returned from your backend target to fit w hat your end users and applications are expecting.
- **Method Response:** The method response settings define the method response types, their headers and content types.
- **Model:** In API Gatew ay, a model defines the format, also know n as the schema or shape, of some data. You create and use models to make it easier to create mapping templates. Because API Gatew ay is designed to w ork primarily w ith JavaScript Object Notation (JSON)-formatted data, API Gatew ay uses JSON Schema to define the expected schema of the data.

- **Stage:** In API Gateway, a stage defines the path through which an API deployment is accessible. This is commonly used to deviate between versions, as well as development vs production endpoints, etc.
- **Blueprint:** A Lambda blueprint is an example lambda function that can be used as a base to build out new Lambda functions.

Start Lab

- Open https://808477742599.signin.aws.amazon.com/console
- Enter login credentials

Task 1: Create a Lambda Function

3. In the **AWS Management Console**, on the Services menu, click **Lambda**.

4. Click **Create a function**

Blueprints are code templates for writing Lambda functions. Blueprints are provided for standard Lambda triggers such as creating Alexa skills and processing Amazon Kinesis Firehose streams. This lab provides you with a pre-written Lambda function, so you will create your function by using **Author from scratch**.

5. Below **Author from scratch**, Configure:

    - **Function name:** `FAQ`
    - **Runtime:** *Node.js 8.10*
    - Expand **Choose or create an execution role**
    - **Execution role:** *Use an existing role*
    - **Existing role:** *lambda-basic-execution*
    - Click **Create function**

A page will be displayed with your function configuration.

6. Scroll down to the **Function code** section and delete all of the code that appears in the code editor.

7. Copy the code shown below and paste it into the index.js tab.

```
var json = {
  "service": "lambda",
  "reference": "https://aws.amazon.com/lambda/faqs/",
  "questions": [{
    "q": "What is AWS Lambda?",
    "a": "AWS Lambda lets you run code without provisioning or managing servers. You pay only for the compute time you con
  },{
   "q":"What events can trigger an AWS Lambda function?",
   "a":"You can use AWS Lambda to respond to table updates in Amazon DynamoDB, modifications to objects in Amazon S3 bucke
  },{
   "q":"When should I use AWS Lambda versus Amazon EC2?",
   "a":"Amazon Web Services offers a set of compute services to meet a range of needs. Amazon EC2 offers flexibility, with
  },{
    "q":"What kind of code can run on AWS Lambda?",
    "a":"AWS Lambda offers an easy way to accomplish many activities in the cloud. For example, you can use AWS Lambda to
  },{
    "q":"What languages does AWS Lambda support?",
    "a":"AWS Lambda supports code written in Node.js (JavaScript), Python, and Java (Java 8 compatible). Your code can inc
```

```
    },{
      "q":"Can I access the infrastructure that AWS Lambda runs on?",
      "a":"No. AWS Lambda operates the compute infrastructure on your behalf, allowing it to perform health checks, apply se
    },{
      "q":"How does AWS Lambda isolate my code?",
      "a":"Each AWS Lambda function runs in its own isolated environment, with its own resources and file system view. AWS L
    },{
      "q":"How does AWS Lambda secure my code?",
      "a":"AWS Lambda stores code in Amazon S3 and encrypts it at rest. AWS Lambda performs additional integrity checks whil
    },{
      "q":"What is an AWS Lambda function?",
      "a":"The code you run on AWS Lambda is uploaded as a Lambda function. Each function has associated configuration infor
    },{
      "q":"Will AWS Lambda reuse function instances?",
      "a":"To improve performance, AWS Lambda may choose to retain an instance of your function and reuse it to serve a subs
    },{
      "q":"What if I need scratch space on disk for my AWS Lambda function?",
      "a":"Each Lambda function receives 500MB of non-persistent disk space in its own /tmp directory."
    },{
      "q":"Why must AWS Lambda functions be stateless?",
      "a":"Keeping functions stateless enables AWS Lambda to rapidly launch as many copies of the function as needed to scal
    },{
      "q":"Can I use threads and processes in my AWS Lambda function code?",
      "a":"Yes. AWS Lambda allows you to use normal language and operating system features, such as creating additional thre
    },{
      "q":"What restrictions apply to AWS Lambda function code?",
      "a":"Lambda attempts to impose few restrictions on normal language and operating system activities, but there are a fe
    },{
      "q":"How do I create an AWS Lambda function using the Lambda console?",
      "a":"You can author the code for your function using the inline editor in the AWS Lambda console. You can also package
    },{
      "q":"How do I create an AWS Lambda function using the Lambda CLI?",
      "a":"You can package the code (and any dependent libraries) as a ZIP and upload it using the AWS CLI from your local e
    },{
      "q":"Which versions of Python are supported?",
      "a":"Lambda provides a Python 2.7-compatible runtime to execute your Lambda functions. Lambda will include the latest
    },{
      "q":"How do I compile my AWS Lambda function Java code?",
      "a":"You can use standard tools like Maven or Gradle to compile your Lambda function. Your build process should mimic
    },{
      "q":"What is the JVM environment Lambda uses for execution of my function?",
      "a":"Lambda provides the Amazon Linux build of openjdk 1.8."
    }
    ]
}

exports.handler = function(event, context) {
    var rand = Math.floor(Math.random() * json.questions.length);
    console.log("Quote selected: ", rand);

    var response = {
        body: JSON.stringify(json.questions[rand])
    };
    console.log(response);
    context.succeed(response);
};
```

Examine the code. It is performs the following steps:

- Defines a list of Frequently Asked Questions (FAQs)
- Returns a random FAQ

1. Scroll down to the **Basic settings** section.

2. For **Description**, enter: `Provide a random FAQ`

AWS Lambda functions can be **triggered** automatically by activities
such as data being received by Amazon Kinesis or data being updated in

an Amazon DynamoDB database. For this lab, you will trigger the Lambda function whenever a call is made to API Gateway.

10. Scroll up to the **Designer** section.

11. Under **Add triggers**, click **API Gateway**.

You will create an API Gateway endpoint.

An API endpoint refers to a host name of the API. The API endpoint can be edge-optimized or regional, depending on where the majority of your API traffic originates from. You choose a specific endpoint type when creating an API.

12. In the **Configure triggers** section configure:

    - **API:** *Create a new API*
    - **Security:** *Open*
    - Expand **Additional settings**
    - **API name:** `FAQ-API`
    - **Deployment stage:** `myDeployment`

13. At the bottom right-side of the screen, click Add.

14. Click Save at the top right corner.

You have successfully created the Lambda function. This has also created a default API Gateway that will trigger the Lambda function.

Task 2: Test the Lambda function

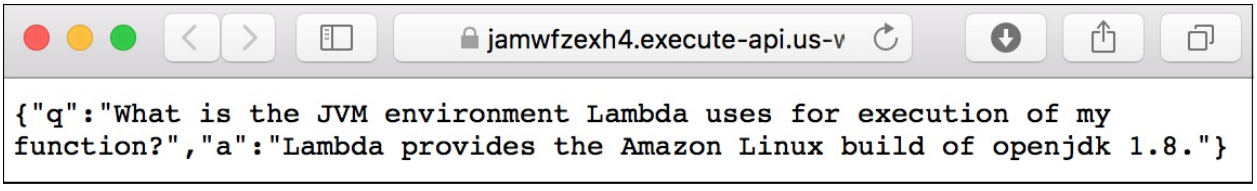
You will be presented with the FAQ Lambda function page.

15. Under **API Gateway**, click the right arrow to view the details of your API.

16. Copy the **API endpoint** to your clipboard, then:

- In a new browser tab, paste the **API endpoint**
- Press **Enter** to go to the URL

A new browser tab will open. You should see a random FAQ entry, such as:



The Lambda function can also be tested in isolation.

17. Close the FAQ browser tab and return to the web browser tab showing the Lambda Management Console.

18. At the top of the screen, Click Test then configure:

- **Event name:** `BasicTest`
- Delete the provided keys and values, retaining an empty **{}** to represent an empty JSON object:

```
{}
```

19. At the bottom of the screen, click Create

20. At the top of screen, Click Test

21. In the **Execution result: succeeded** window, expand ** **Details**.

The output shows the FAQ entry wrapped inside a *body* parameter.

Below the Execution result are two columns. The *Summary* displays the total execution time for the Lambda function and the resources consumed. The *Log output* displays logging information. In this section, you will see any console logging as well as any error messages.

22. Click the **Monitoring** tab.

23. Click **View logs in CloudWatch**

24. Click on one of the log streams.

You will be presented with the same event data that was displayed in the Lambda Management Console. Examine the contents of each line to view the log information.

Conclusion

Congratulations! You have completed this lab and have successfully created a microservice with Amazon API Gateway and AWS Lambda. You now know how to:

- Create an AWS Lambda function
- Create an Amazon API Gateway endpoints
- Debug API Gateway and Lambda with Amazon CloudWatch

End Lab

Follow these steps to close the console, end your lab, and evaluate the experience.

25. Return to the AWS Management Console.

26. On the navigation bar, click **<yourusername\>@<AccountNumber\>**, and then click **Sign Out**.