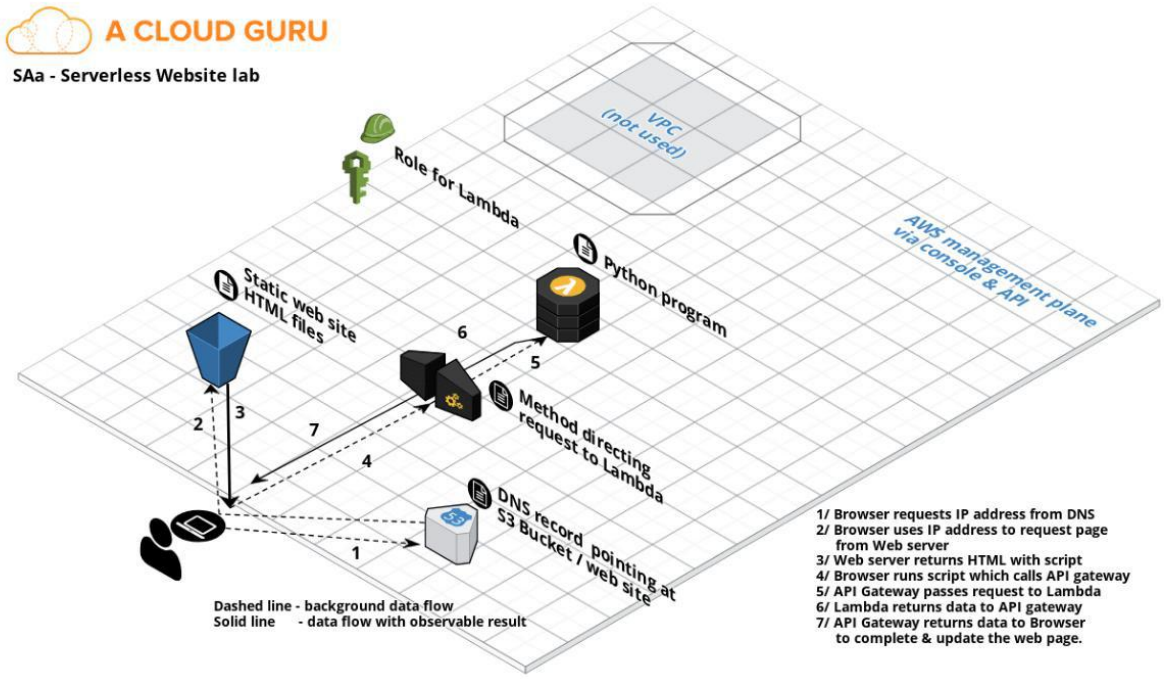
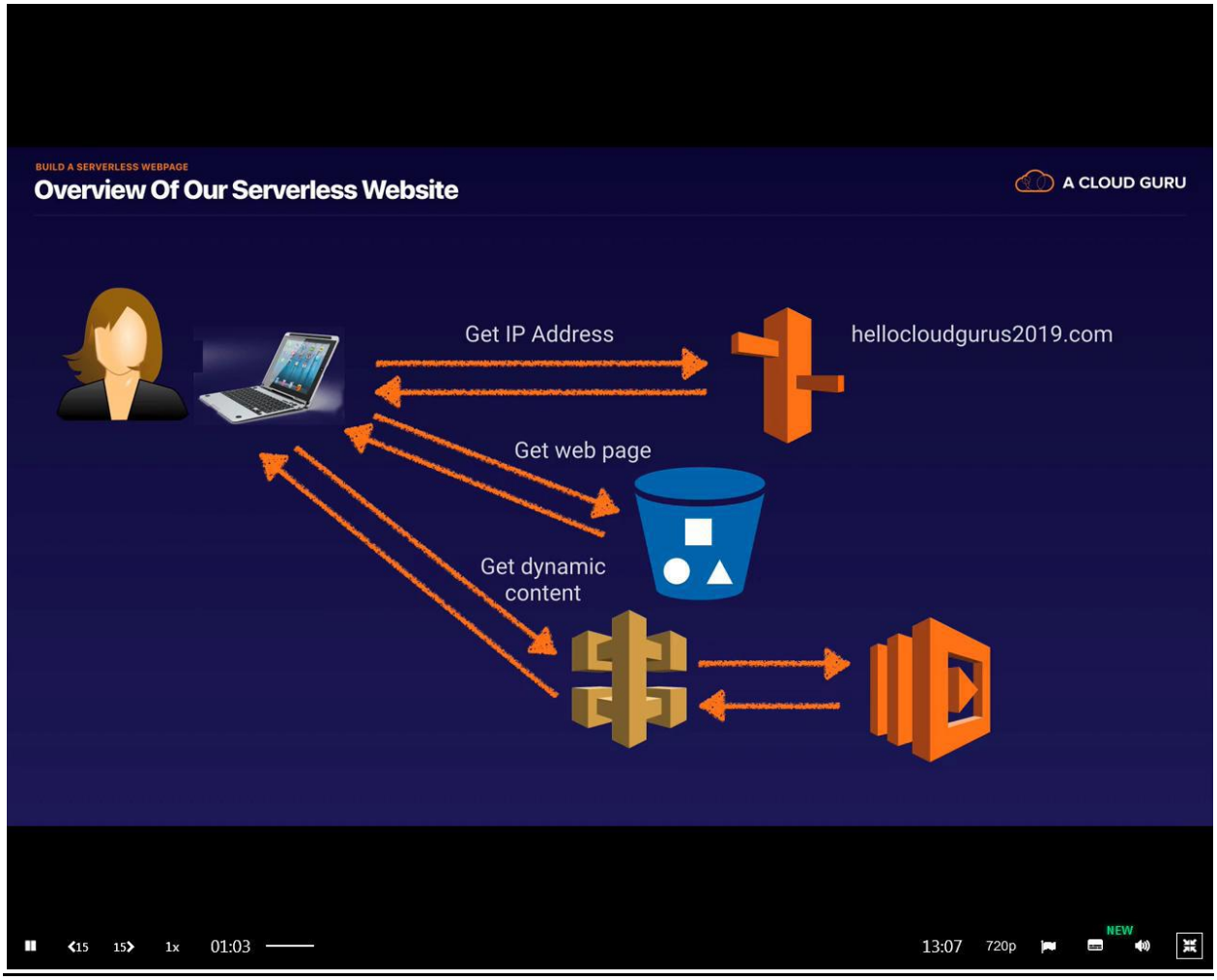
Build a Serverless Web page with API Gateway & Lambda

Architecture Involved:



Desired Result:

Our user types our website URL into their browser and hits enter. Our user is essentially sending a query to Route53 (Amazon's Domain Name System), which will respond back with the bucket address for our website (because as you will see, we are hosting our webpage using an S3 bucket). Our user will be directed to our index.html page. On our index.html page we will have a button which will prompt dynamic content. When the button is clicked, a request is sent through API Gateway, which sends the request to a Lambda function. The lambda function will take the data and return a result to API Gateway, which will then return the result to our user.



Section 1) Let's create our Lambda function

Login to the AWS console

Select the region that you want. For this project I selected the Singapore region.

Click **Services** and then click **Lambda** (which is located under compute)

Click the **Create function** button

Select **Author from scratch**

Name: MyFirstLambdaFunction ← give your function a name

Runtime: ✓Python 3.8 ← select Python 3.8 (the latest version of Python)

Role: ✓Create a new role from AWS policy templates ← select create a new role from AWS policy templates

Role name: MyLambdaExecutionRole ← give your role a name

Policy templates: ✓Simple microservice permissions

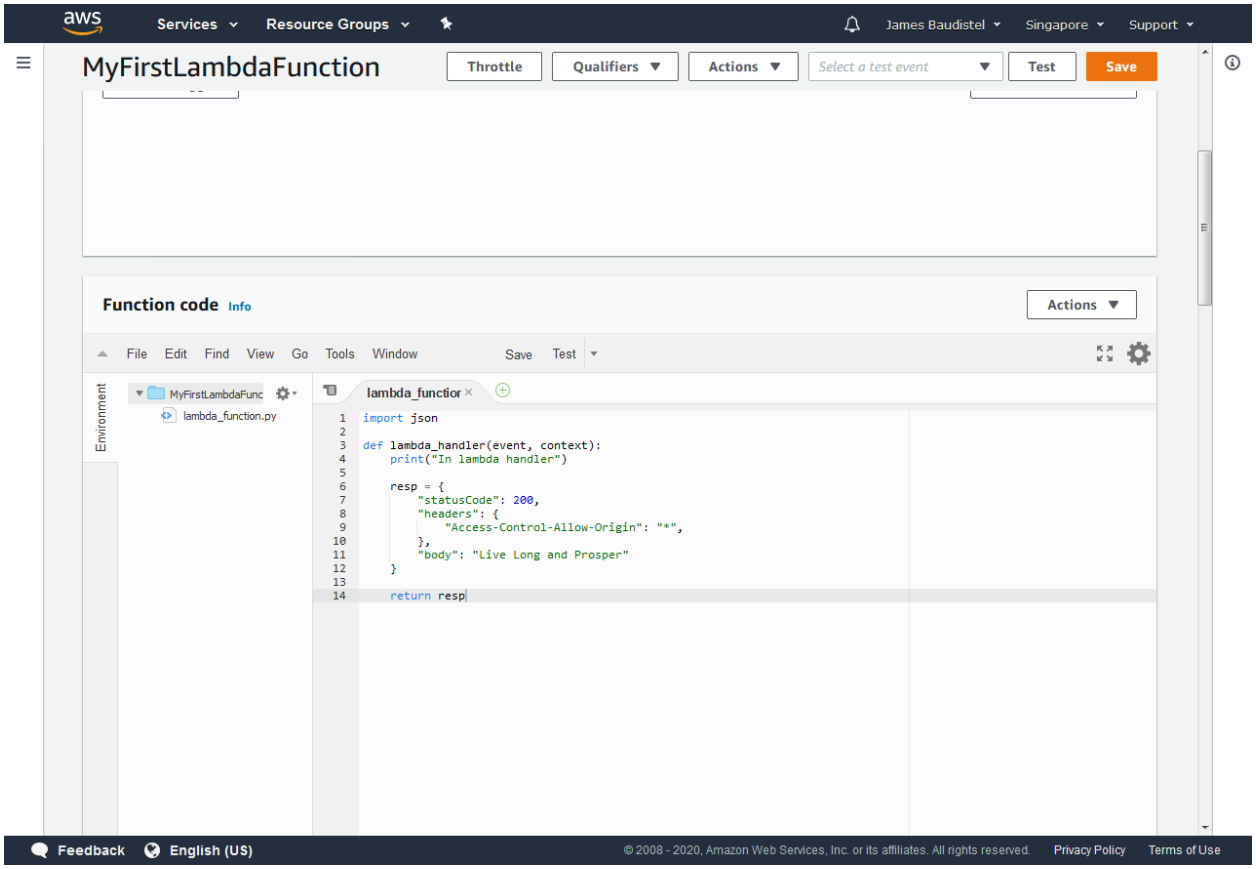
Click **Create function**

Copy the python code below:

```
import json


def lambda_handler(event, context):
    print("In lambda handler")


    resp = {
        "statusCode": 200,
        "headers": {
            "Access-Control-Allow-Origin": "*",
        },
        "body": "Live Long and Prosper"
    }


    return resp
```

Delete the code that is initially present in the **Function code** section and instead paste the copied code into the **Function code** section:

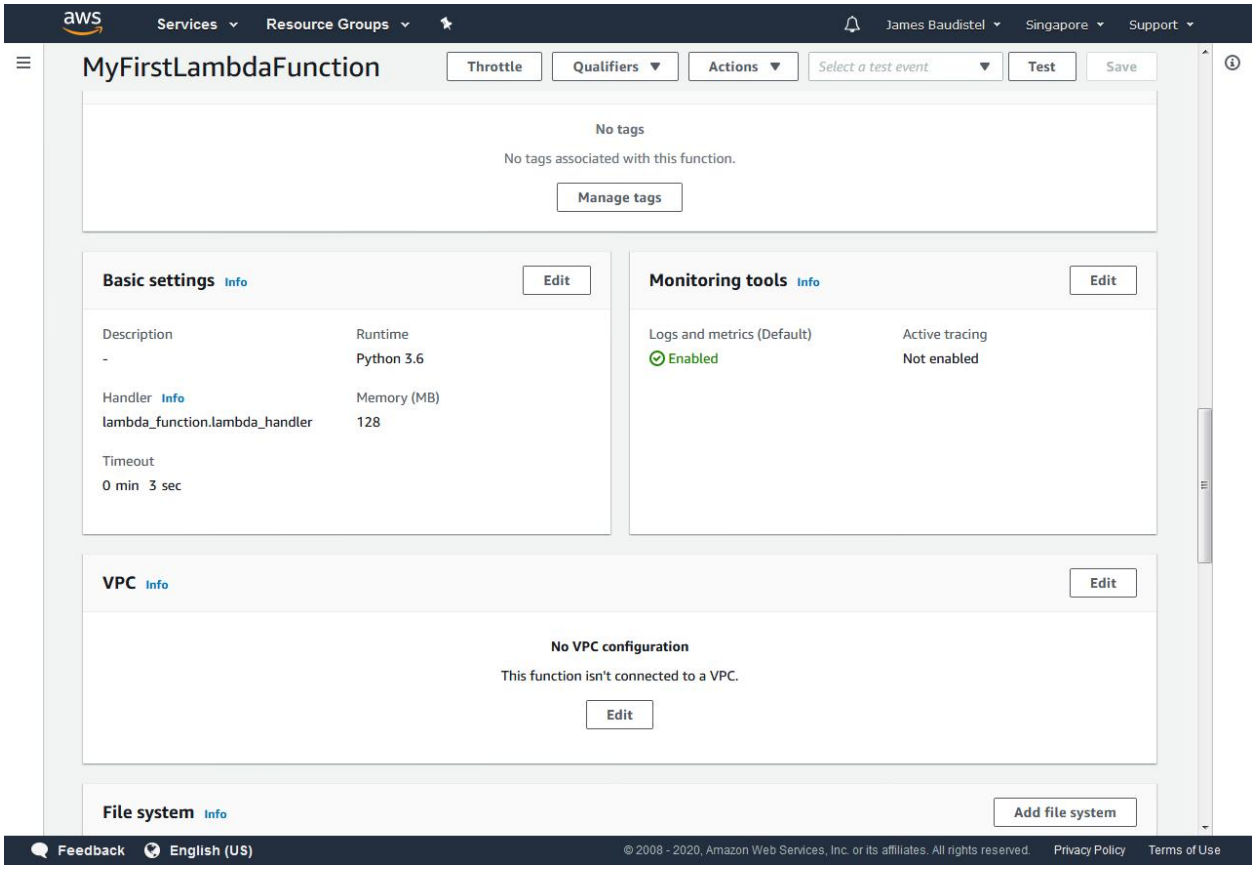
See the below screenshot for clarification



Then click **File** and click **Save**

Also, click **Save** located next to where it says Test ←do not forget this step ★ alternatively you can click the orange save button. The orange button should then turn grey and become unclickable.

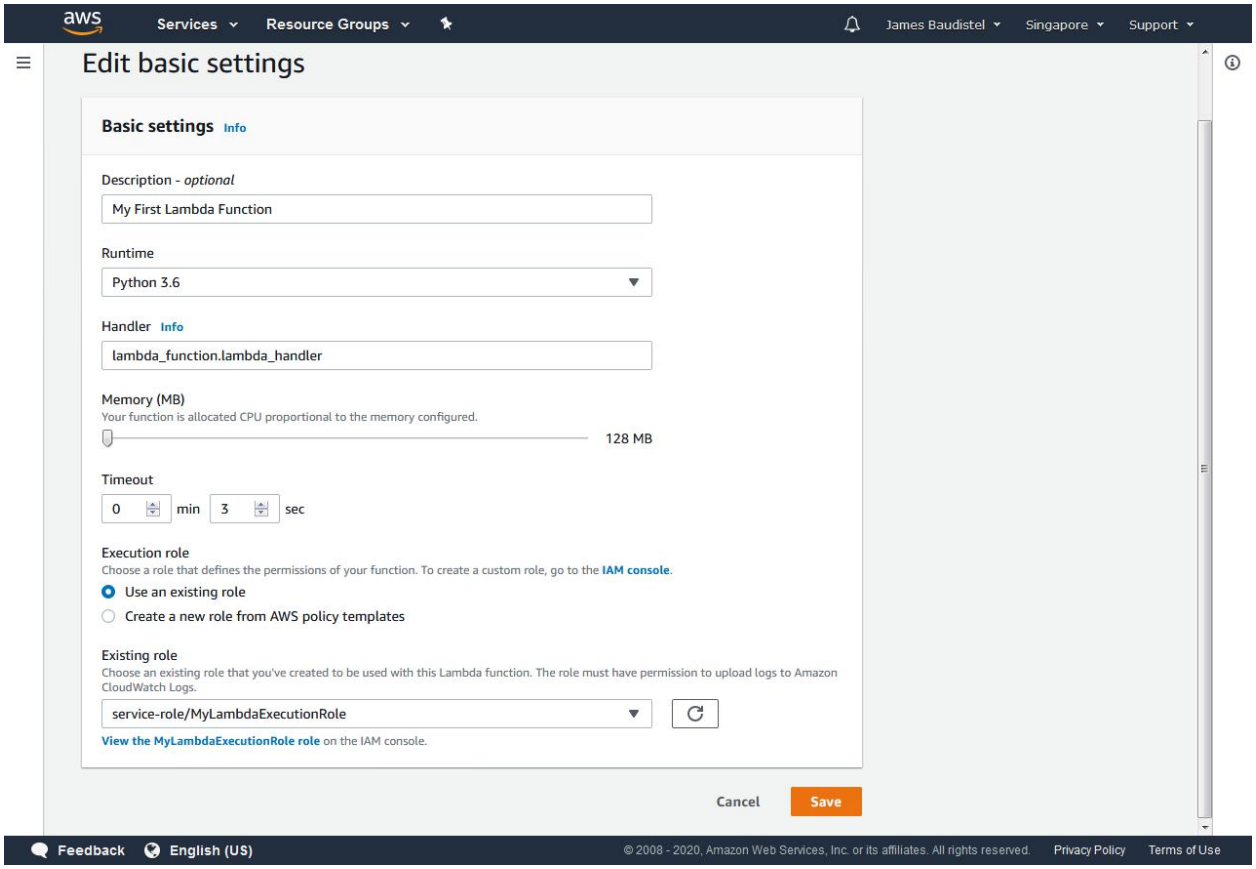
Scroll down to where it says Basic settings and click Edit (see screenshot)



Description: My First Lambda Function ←give it a description

Then click the orange save button

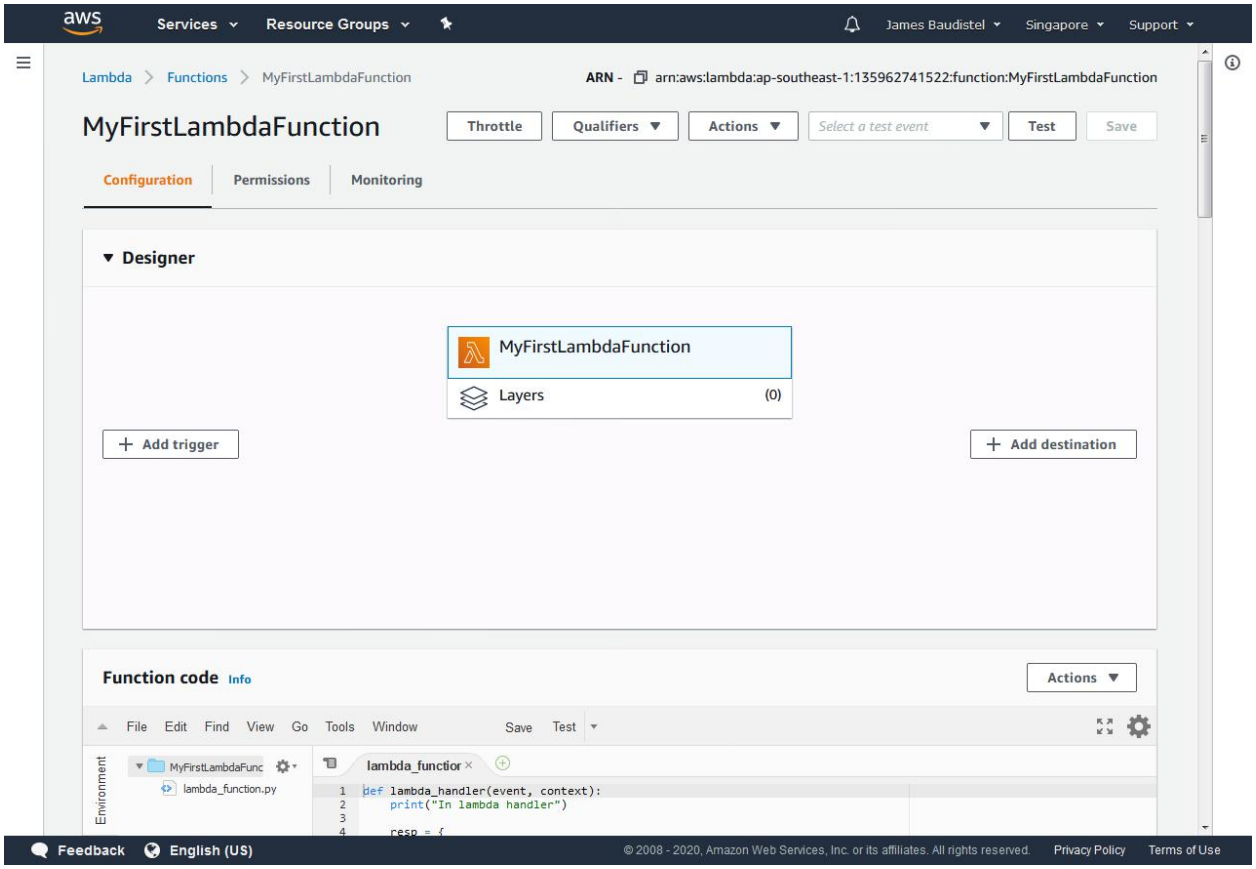
(see screenshot below)



Now let's configure a trigger for our function:

Click the **Add trigger** button

(See the screenshot below)



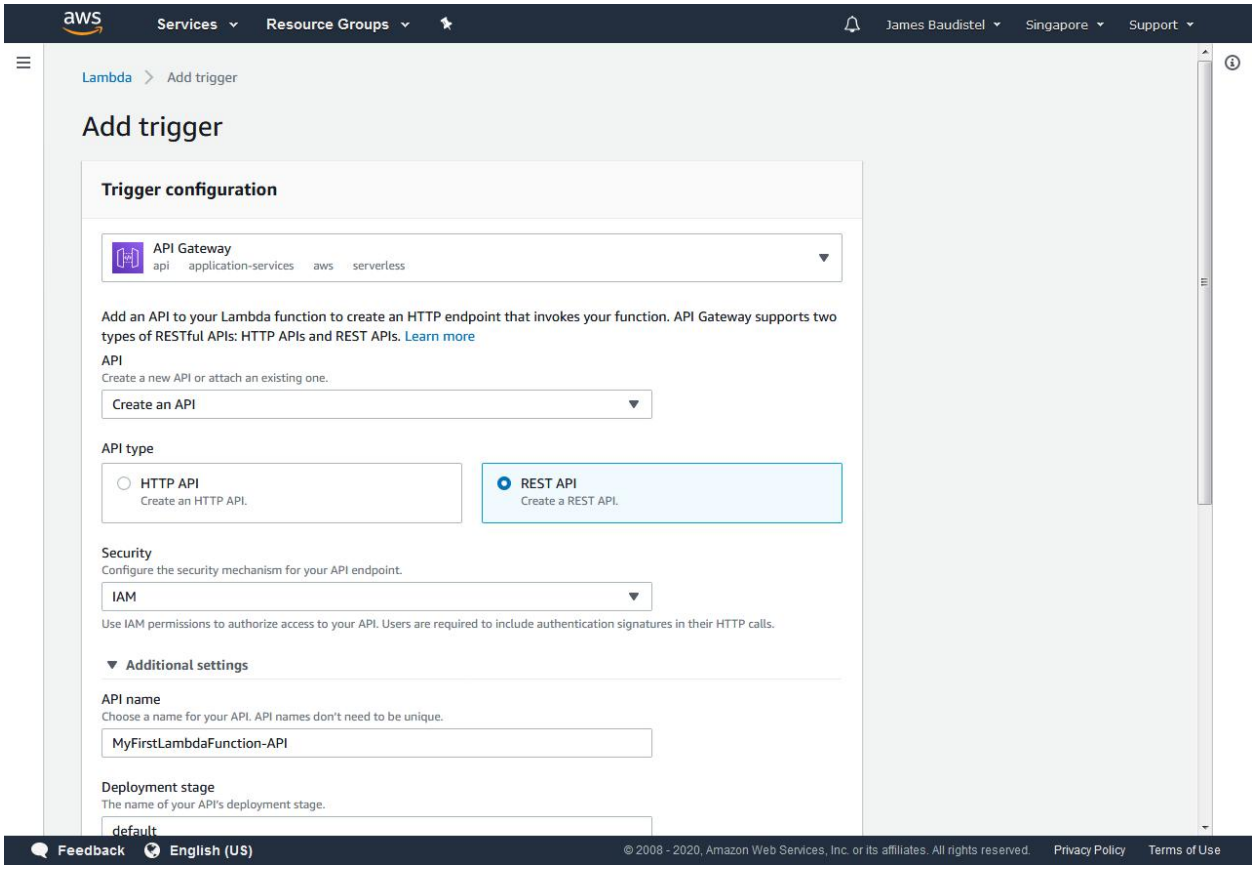
Trigger Configuration: ✓API Gateway ← select API Gateway as the trigger for your lambda function

API: ✓Create an API ← select Create an API because we want to create a new one

API type: ✓Rest API ←select Rest API

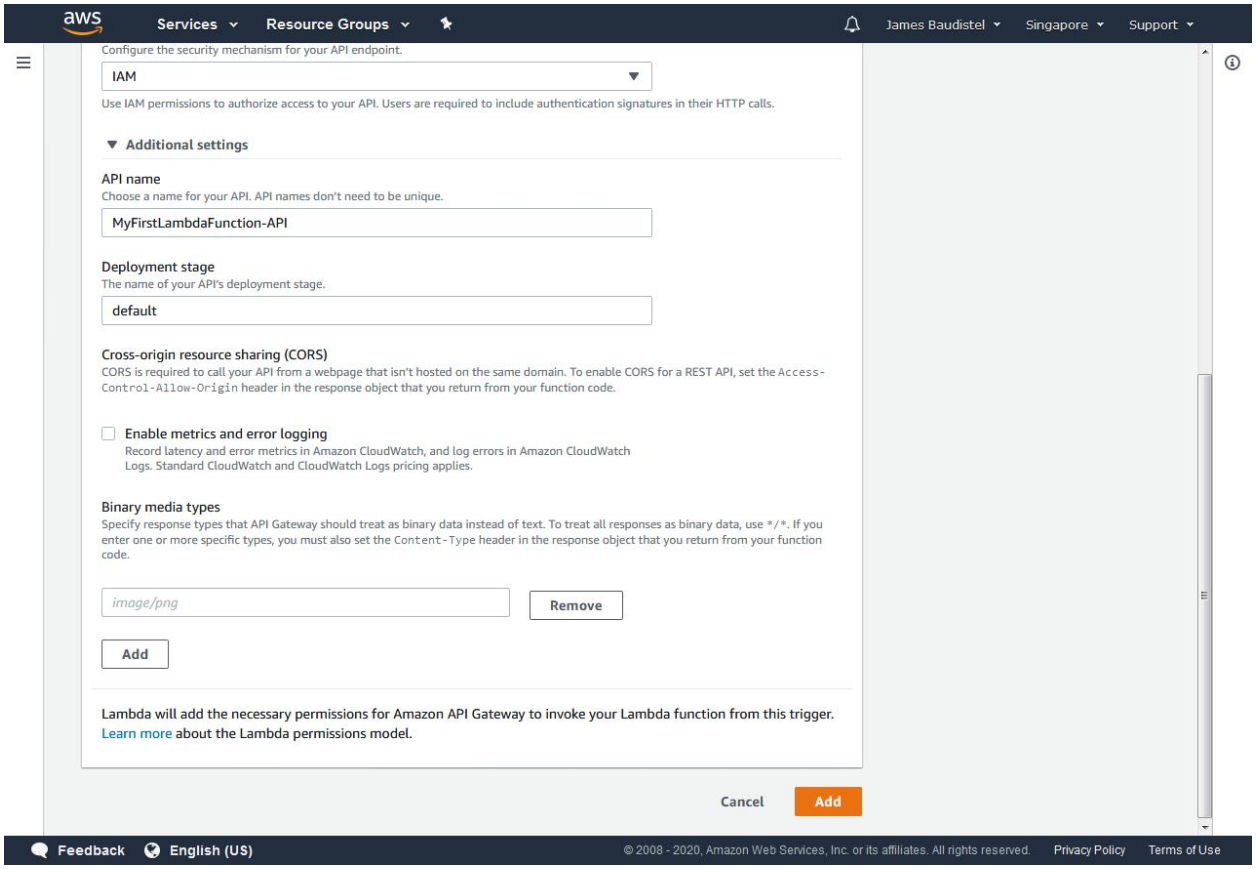
Security: ✓IAM ←select IAM

(See the screenshot below for clarification)



Now scroll down and click the **Add** button at the bottom of the page

(see the below screenshot)

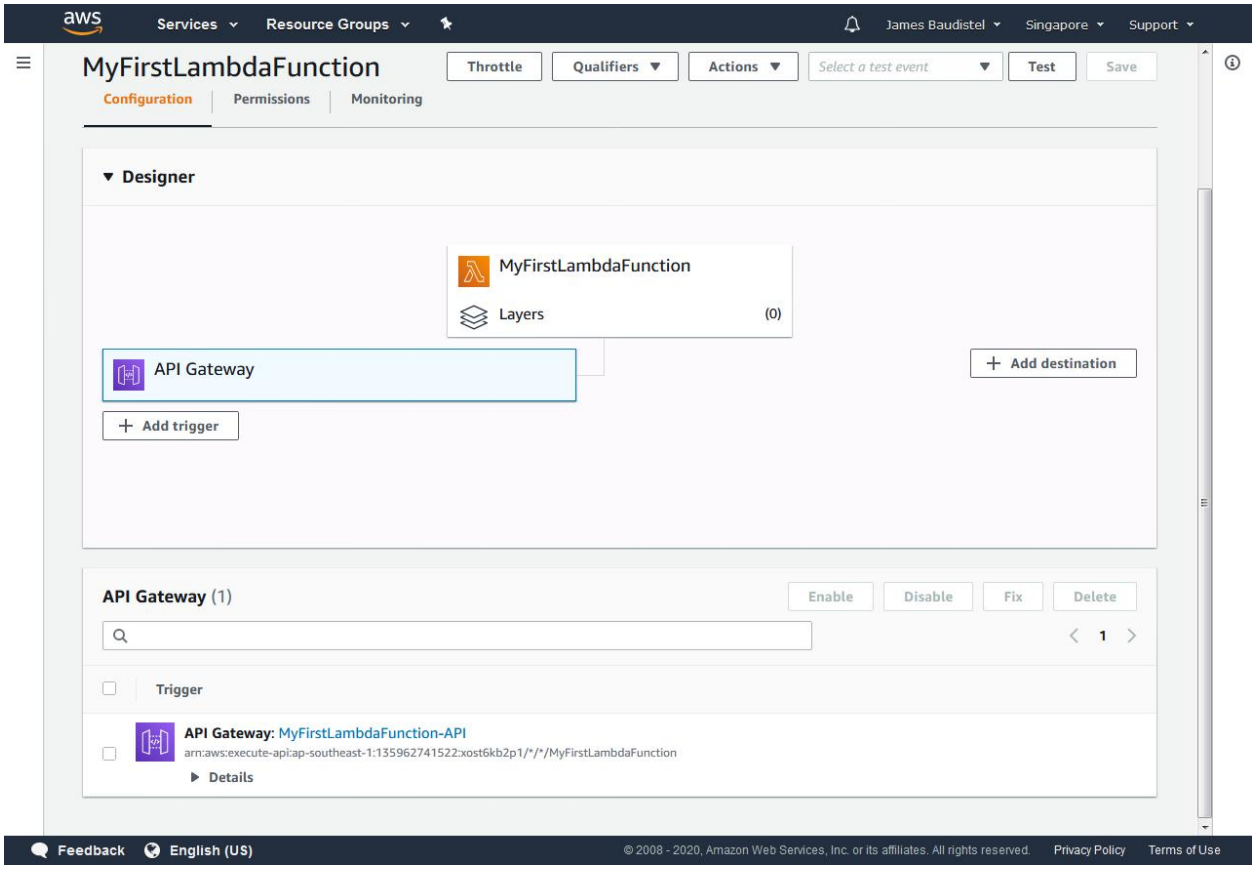


The trigger MyFirstLambdaFunction-API was successfully added to function MyFirstLambdaFunction. The function is now receiving events from the trigger.

In otherwords, our API Gateway is now a trigger for the Lambda function we created. It has created a new API endpoint.

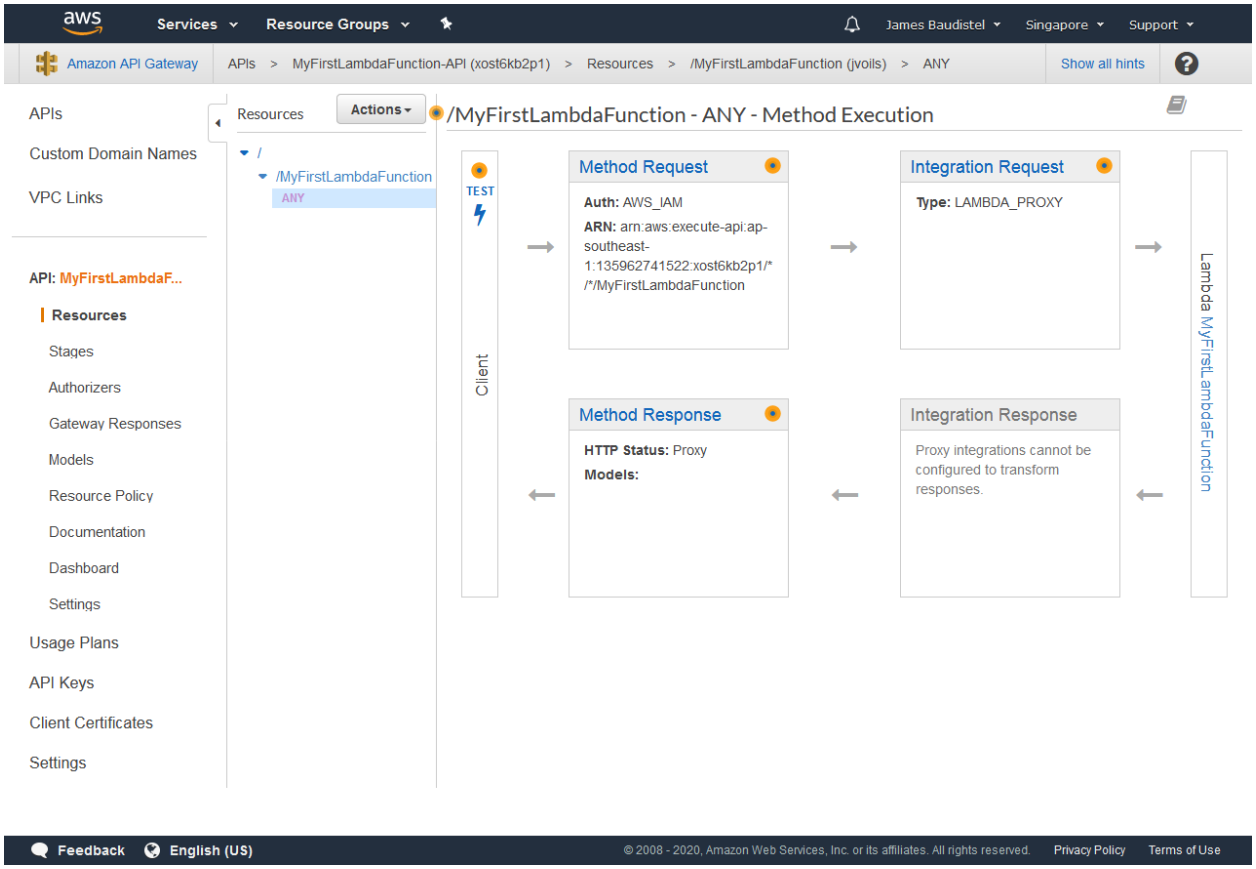
Scroll down and click **MyFirstLambdaFunction-API**

(per the screenshot below)



This will open up API Gateway

(per the screenshot below)



Select **ANY** and then click the **Actions** button and click **Delete Method**

Then click **Actions** and click **Create Method** and then Select **GET** (because we want to create a Get request) and click the ✓checkmark symbol to confirm your selection

Integration Type: Lambda Function

Use Lambda Proxy Integration: ✓ ← select that you want to Use Lambda Proxy Integration

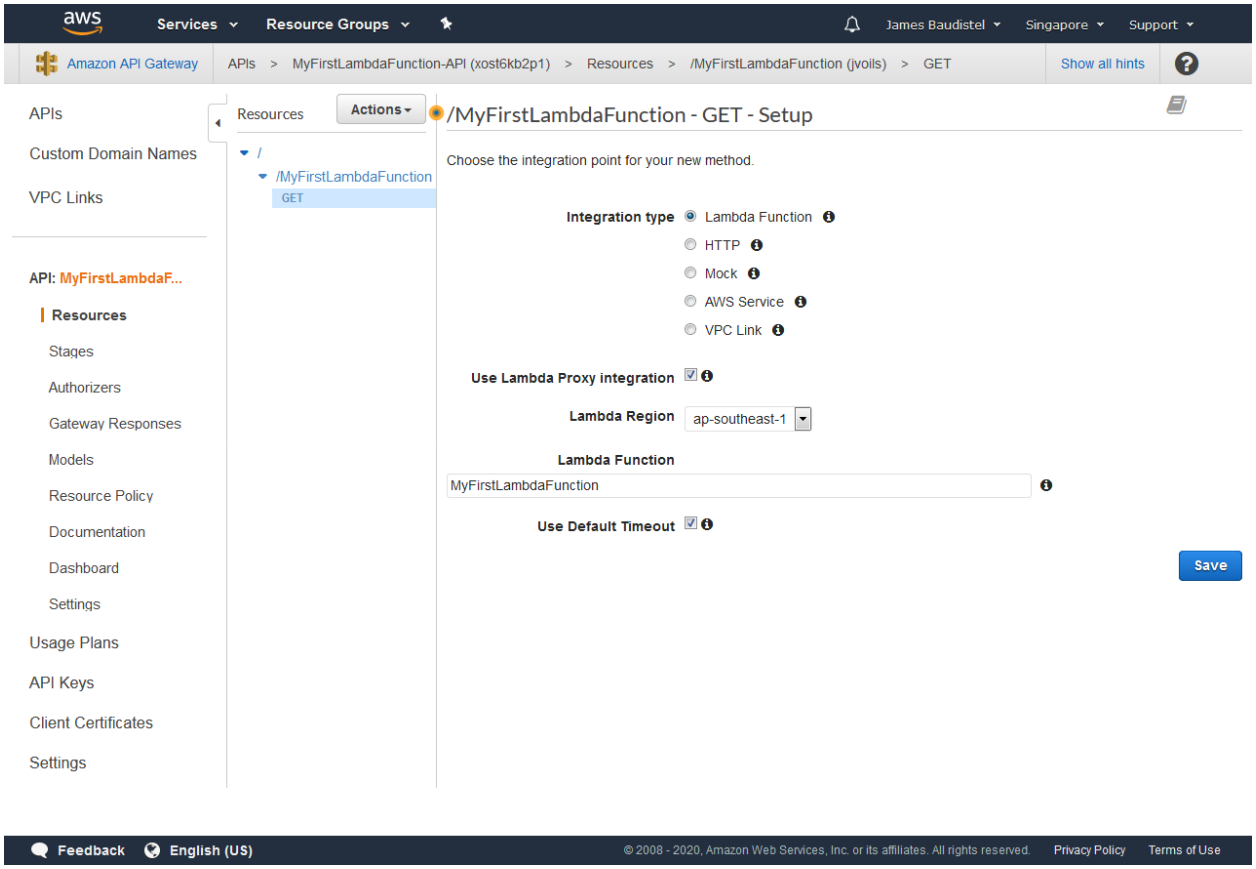
Lambda Region: ap-southeast-1 ← choose the region from which you created your lambda function. I created my function in the Singapore region, hence ap-southeast-1

Lambda Function: MyFirstLambdaFunction ← type the name of our function which is MyFirstLambdaFunction (it will likely prompt once you start typing)

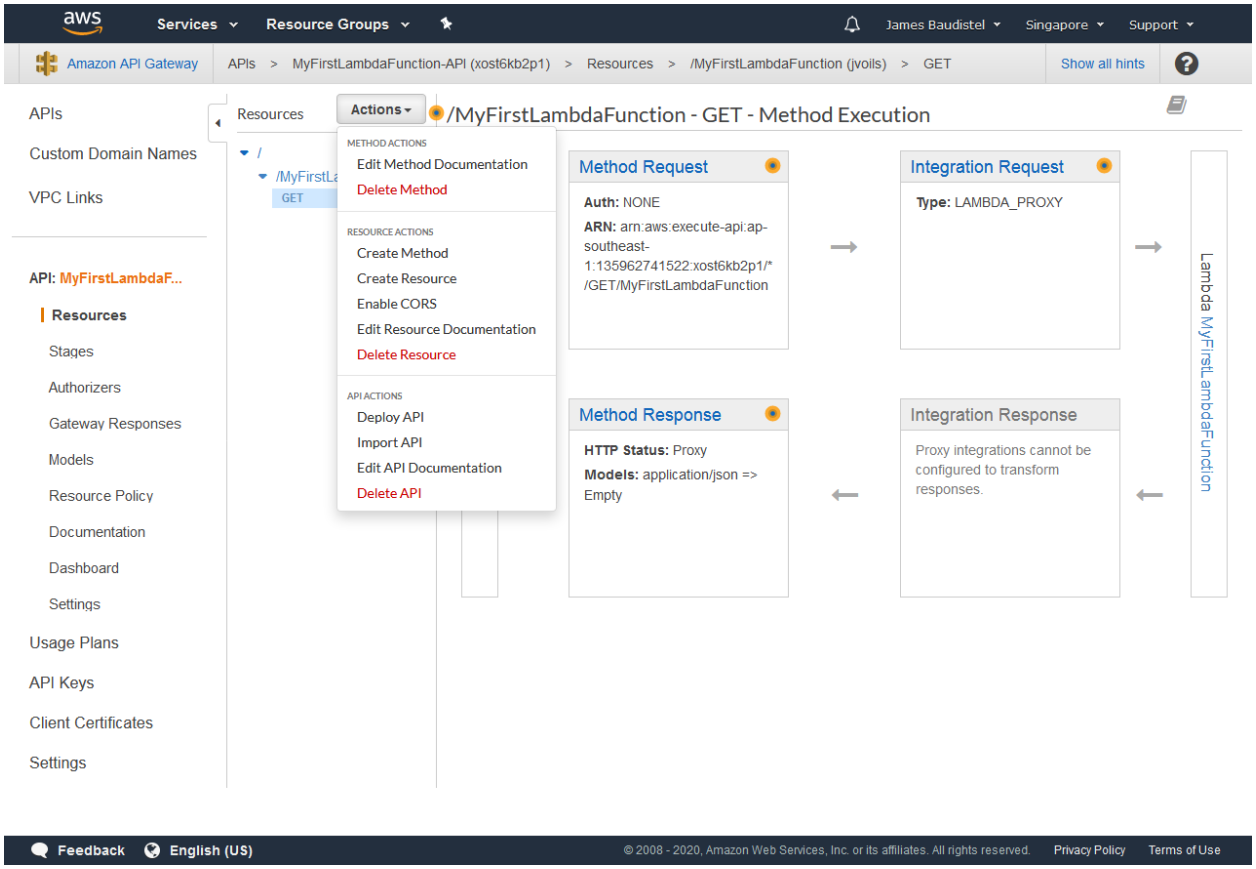
Then click **Save** (This will give API Gateway permission to invoke the Lambda function)

Then click **OK**

(See the below screenshot for clarification)



Make sure GET is highlighted and then click Actions and click Deploy API (per the screenshot below)



Deployment Stage: ✓Default ← select default

Deployment Description: MyProdDeployment ←give the deployment a description

Then click **Deploy**

★Important Step★

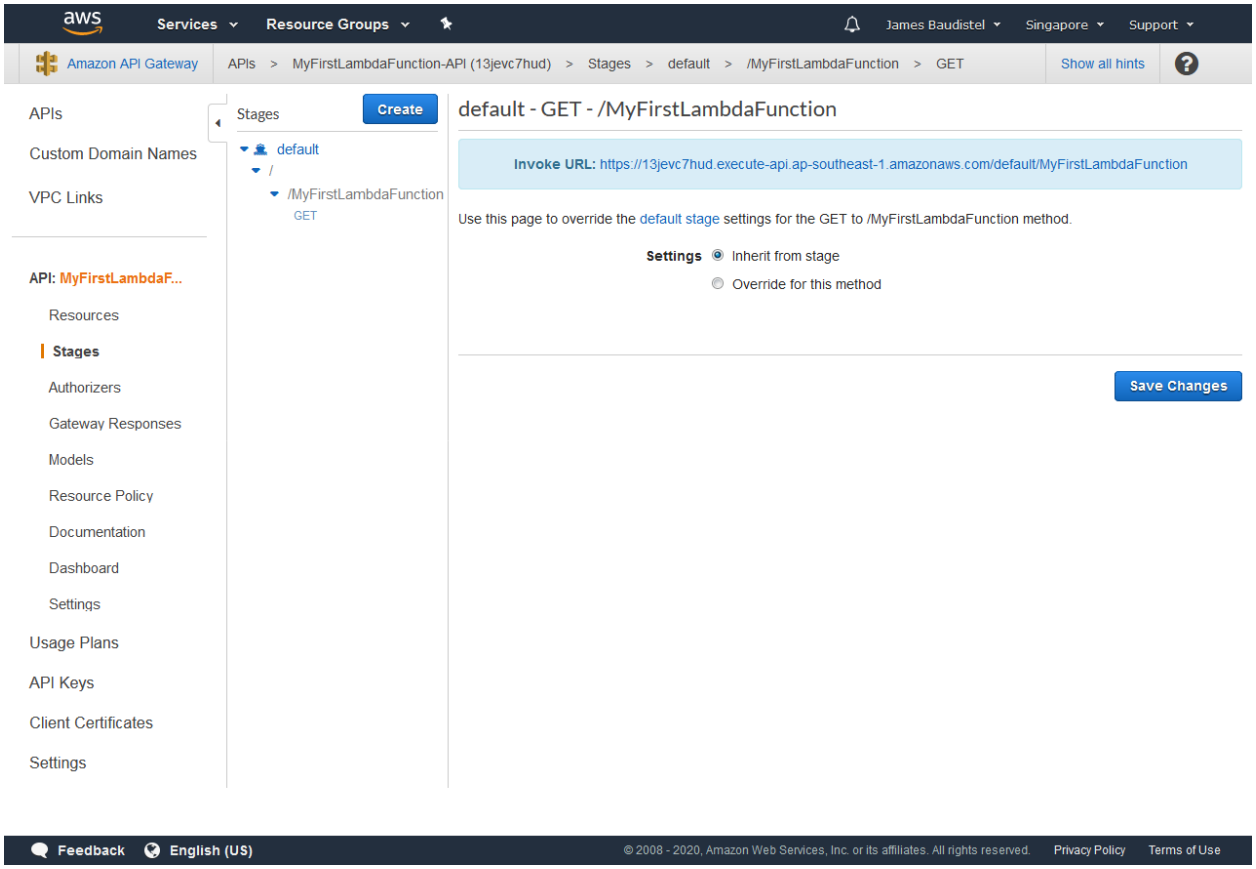
Now click **default** and Click **GET ← make sure to do this step before your proceed ★★★**

Then click the Invoke URL (which should say something like

https://xost6kb2p1.execute-api.ap-southeast-1.amazonaws.com/default/MyFirstLambdaFunction

)

(See the screenshot below for clarification)



Upon clicking on the Invoke URL, your screen should say Live Long and Prosper

Now copy that Invoke URL link into your clipboard and paste it into a new notepad file just so you have it for later when we need it. It should look something like this (but yours will be slightly different):

https://13jevc7hud.execute-api.ap-southeast-1.amazonaws.com/default/MyFirstLambdaFunction

Now using a code editor such as Visual Studio Code, Brackets, etc. create a file called index.html and paste in the following code:

```
<!DOCTYPE html>

<html>

 <head>

  <script>
```

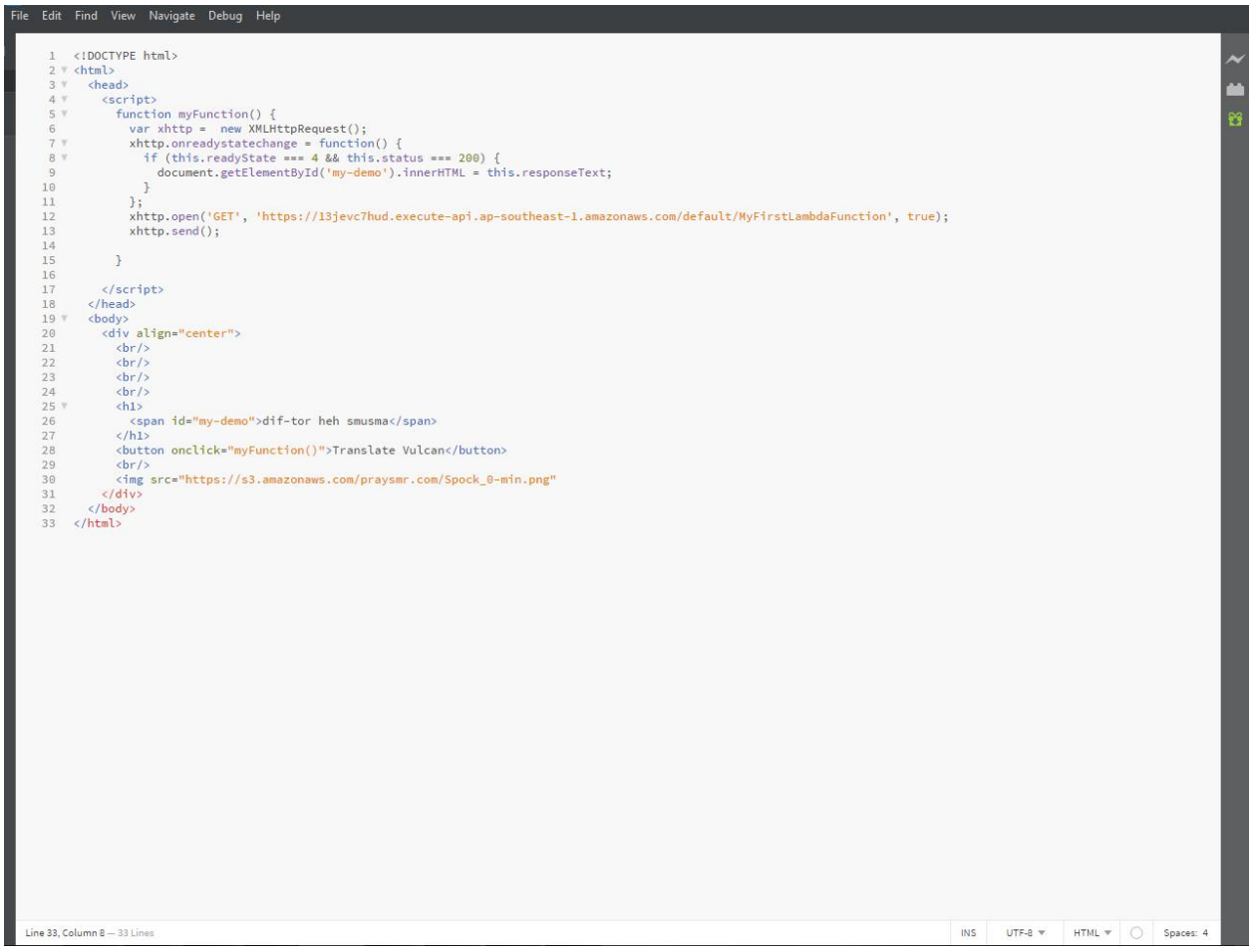
```
  function myFunction() {
    var xhttp =  new XMLHttpRequest();
    xhttp.onreadystatechange = function() {
      if (this.readyState === 4 && this.status === 200) {
        document.getElementById('my-demo').innerHTML = this.responseText;
      }
    };
    xhttp.open('GET', 'YOUR API ENDPOINT HERE', true);
    xhttp.send();

  }

 </script>
</head>
<body>
 <div align="center">
  <br/>
  <br/>
  <br/>
  <br/>
  <h1>
   <span id="my-demo">dif-tor heh smusma</span>
  </h1>
  <button onclick="myFunction()">Translate Vulcan</button>
  <br/>
```

```
    <img src="https://s3.amazonaws.com/praysmr.com/Spock_0-min.png"
  </div>
 </body>
</html>
```

★★★Important Note: On Line 12 of the code, where it says 'Put Your Endpoint API here', replace that with the invoke URL that you copied. Make sure your invoke URL is surrounded by single quotes. It will look similar to this:

xhttp.open('GET', 'https://13jevc7hud.execute-api.ap-southeast-1.amazonaws.com/default/MyFirstLambdaFunction', true);

★★★See the below screenshot for clarification and note line 12 in particular. That is where you paste your invoke URL surrounded by single quotes.



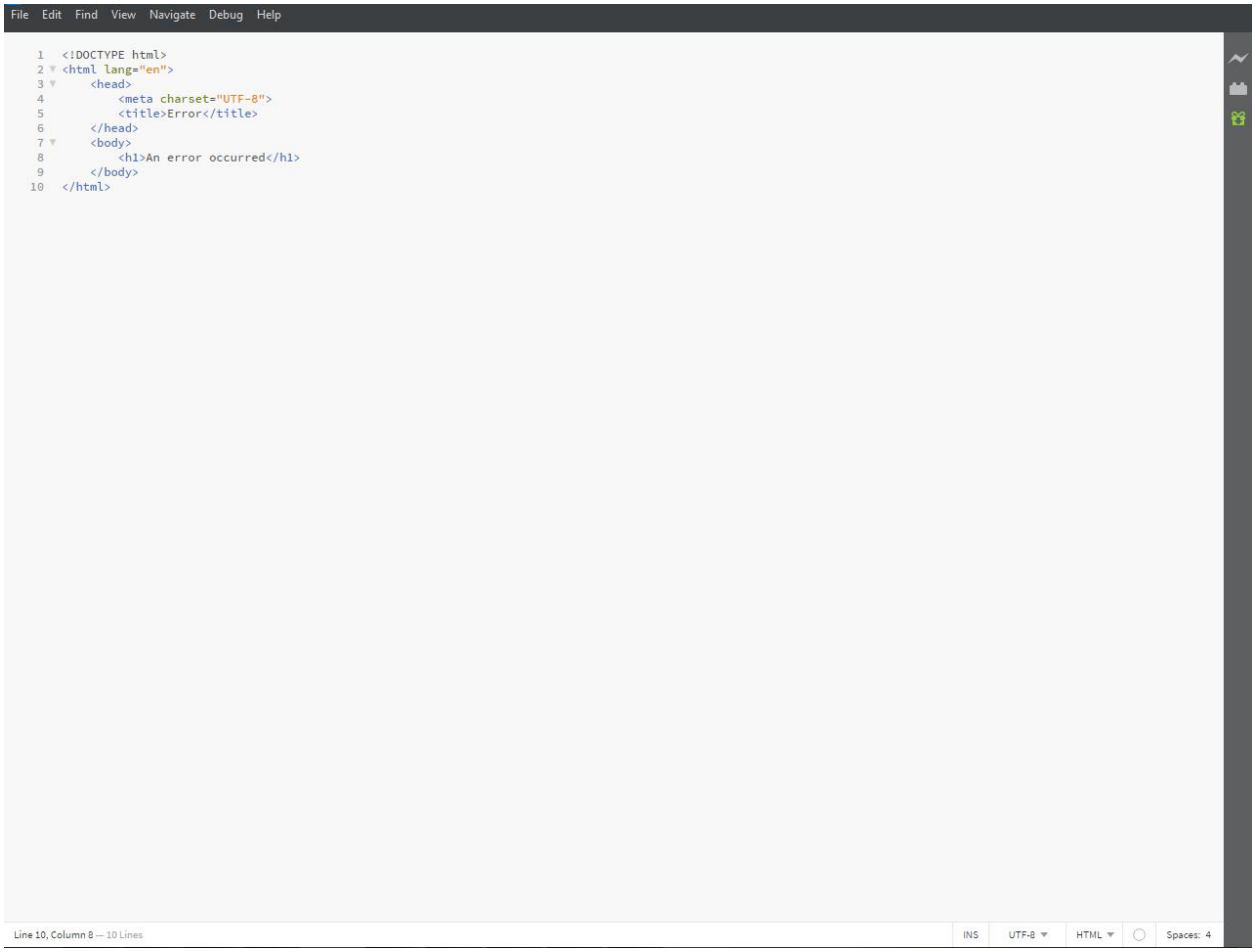
Now save the file that we just created. ★Make sure it is saved as index.html

Now let's create an error.html page in case our user types the url with an incorrect path

Create a file called error.html using a code editor such as VSC or Brackets and paste in the following code.

```
<!DOCTYPE html>

<html lang="en">

  <head>

    <meta charset="UTF-8">

    <title>Error</title>

  </head>

  <body>

    <h1>An error occurred</h1>

  </body>

</html>
```

★See the below screenshot for clarification



★Make sure it is saved as error.html

Section 2) Now we will purchase a domain name (this costs about $12)

(If you do not want to purchase a domain name feel free to skip this step, but make sure to create a bucket in S3 as described in this Section. If you do not purchase a domain name, then the name you give to the bucket you create in this section will NOT matter)

Go to the AWS console

Click **Services** and Click **Route 53** which is located under Networking and Content Delivery

Go to Register Domain and type in the domain you would like to purchase and then click the **check** button to see if it is available.

★★★If the domain name is available you want to also make sure that the bucket name is available in S3. So click **Services**, then click **S3**. Then click **Create bucket.** If the URL you are trying to purchase is

m3mes.com then name your bucket m3mes.com ← make sure to name your bucket **EXACTLY** the same as the URL you are going to purchase (including the .com portion)!!! So if your domain is going to be **m3mes.com** then you need to create a bucket name called **m3mes.com**

(If you do not want to purchase a domain name then you can name your bucket whatever you want so long as it's available)

Then select a region for your bucket and click **create**.

Once you have created your bucket, click **Services** and click **Route 53**. Type in the domain name you wish to purchase and click check. If it is available, it will be in your shopping cart. Then scroll down and click **Continue** (in order to continue with the checkout process). Simply follow the prompts to complete the transaction.

Section 3) Once you have your new domain name go back to S3 by clicking **Services** and then click **S3.**

Click the bucket you created in Section 2 of this lesson. Then click the **permissions** tab. Then click the **Block public access** tab.

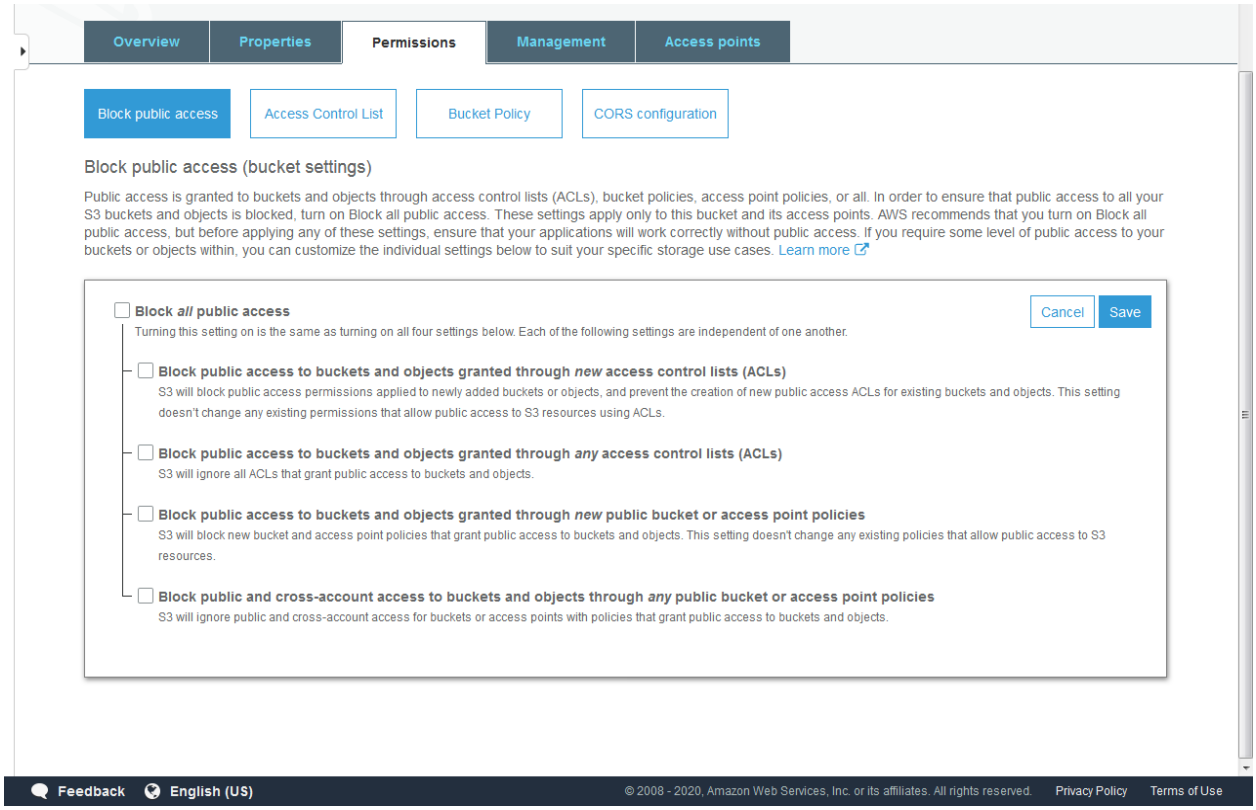
Click **Edit**

Uncheck the box that says Block all public access (because we want the public to be able to access our site)

Then click **Save**

Type confirm (to confirm) and click **Confirm**

(See the screenshot below for clarification)



Once that is complete, click the **Permissions** tab again and click the **Bucket Policy** button. As your bucket policy, paste in the following JSON code:

```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "PublicReadGetObject",
      "Effect": "Allow",
      "Principal": "*",
      "Action": "s3:GetObject",
      "Resource": "YOUR ARN HERE/*"
    }
  ]
}
```

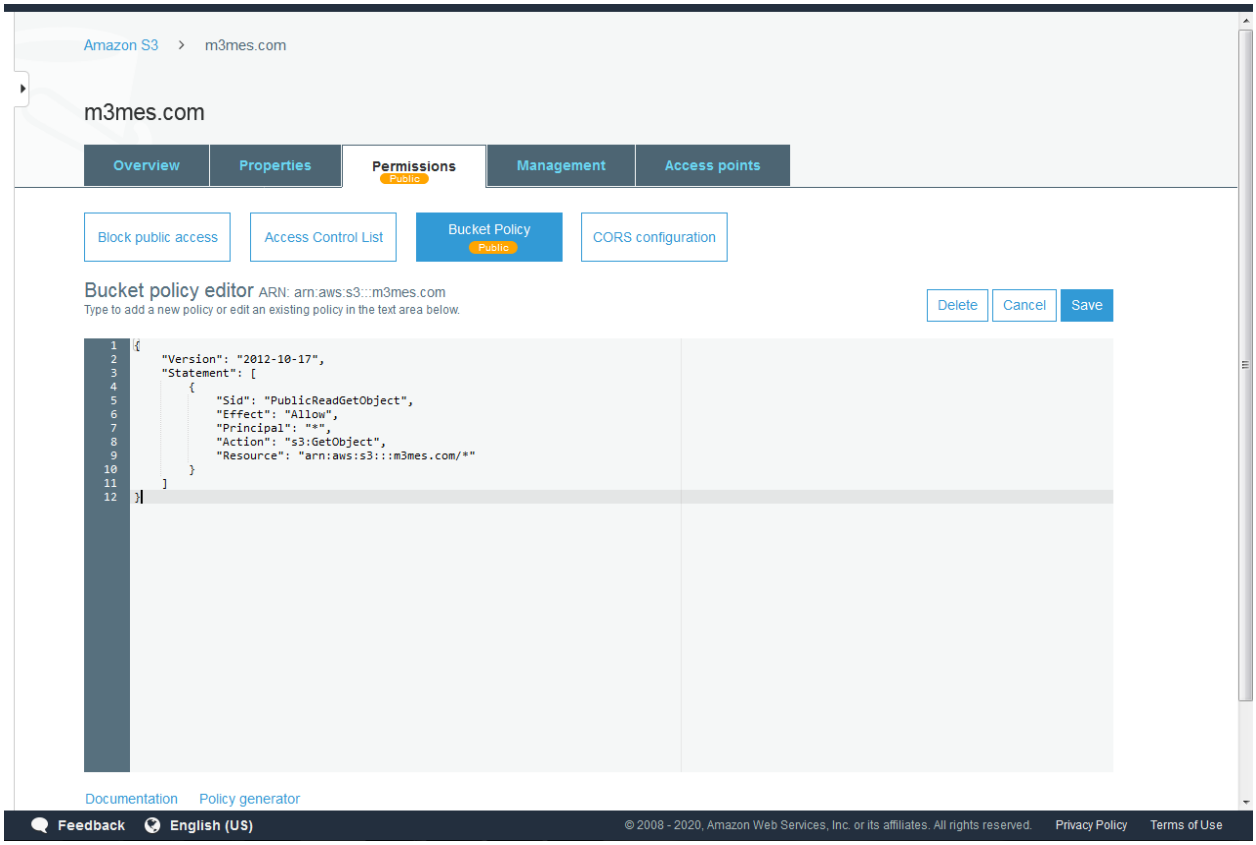
★★★On line 9 of the code where it says YOUR ARN HERE replace it with the ARN of the bucket you created. The ARN is located just below the Block public access tab where it says **Bucket policy editor**. So for the bucket that I created called m3mes.com the ARN is arn:aws:s3:::m3mes.com

Thus, line 9 of our JSON code will say **"Resource": "arn:aws:s3:::m3mes.com/*"**

(Your ARN will be different because your bucket name is different than the one I created)

Then click **Save** (and the word **public** will appear on your Bucket Policy button as well as on the Permissions tab)

★★★See the screenshot below for clarification and make sure to change line 9 of the JSON code to have your ARN (with a forward slash and asterisk at the end and surrounded by double quotes).



Now click the **Overview** Tab

Click **Upload**

Then click **Add files**

Select the index.html file as well as the error.html file that you created earlier and then click **upload**. Or upload each file one at a time. (See the below screenshot for clarification)

Once your files have been uploaded to your bucket,

Click the **Properties** tab and click **Static Website Hosting**

✓**Use this bucket to host a website** ← Select Use this bucket to host a website

Index document: index.html ← type index.html

Error document: error.html ←type error.html

Then click **Save**

Click the **Overview** tab and click your **index.html** file

Scroll down to where it says **Object URL**

Then click on the Object URL or alternatively copy the Object URL and paste it into a new browser tab.

Your Object URL should look something likethe following:
https://s3.amazonaws.com/m3mes.com/index.html

(although it will be different because your bucket name will be different)

Once you are at your URL you can test the lambda function by clicking the **Translate Vulcan** button

Section 4) If you bought a domain name we can hook up our domain name to the s3 bucket.

Click **Services** and click **Route 53**. Then click **Hosted Zones**.

Click your domain name and then click the **Create record** button (★leave the existing records alone)

Click **Simple Routing Policy** and click **Next**

Click **Define simple record**

Value/Route Traffic To: ✓Alias to S3 website endpoint ←select Alias to S3 website

Choose Region: ✓Select the Region that you created your S3 bucket in

Choose S3 bucket: ✓Select the S3 bucket that you created

Record Type: A – Routes traffic to an ipv4 address and some AWS resources ← choose an A record (aka an Alias record)

Then click **Define simple record**

Then click **Create records**

You will now be able to visit your domain name, as it is now linked to your S3 bucket.

Then you can test your lambda function by clicking the **Translate Vulcan** button.

Mission complete!!! Below are important concepts and exam questions pertaining to Lambda and API Gateway.

Lambda Cheat Sheet

-Lambdas are serverless **functions.** You upload your code and it runs without you managing or provisioning any servers.

-Lambda is **serverless.** You don't need to worry about underlying architecture.

-Lambda is a good fit for short running tasks where you don't need to customize the OS environment. If you need long running tasks (>15 mins) and a Custom OS environment than consider using **Fargate.**

-There are **7 runtime language environments** officially supported by Lambda**: Ruby, Python, Java, NodeJS, C#, Powershell and Go**

-You pay per invocation (The **duration** and **the amount of memory used**) rounded up to the nearest 100 milliseconds and you pay based on amount of requests. First 1M requests per month are free

-You can adjust the duration timeout for up to **15 mins** and memory up to **3008 MB**

-You can trigger Lambdas from the SDK or multiple AWS services such as S3, API Gateway, DynamoDB

-Lambdas by default run in No VPC. To interact with some services you need to have your Lambda in the same VPC e.g. so in the case of RDS you would have to have your lambda in the same vpc as rds

-Lambda can scale to 1000 concurrent functions in seconds (1000 is the default, you can increase with AWS Service Limit increase)

-Lambdas have **Cold Starts.** If a function has not been recently executed there will be a delay.

API Gateway Cheat Sheet

-API Gateway is a solution for creating secure APIs in your cloud environment at any scale

-Create APIs that act as a front door for applications to access data, business logic, or functionality from back end services.

-API Gateway throttles api endpoints at **10,000** requests per second (can be increased via service request through AWS support)

-Stages allow you to have multiple published versions of your API e.g. prod, staging, QA

-Each Stage has an **invoke URL** which is the endpoint you use to interact with your API

-You can use a custom domain for your invoke URL

-You need to publish your API via Deploy API action. You choose which Stage you want publish your API.

-Resources are URLs eg /projects

-Resources can have child resources e.g. /projects/-id-/edit

-You defined multiples Methods on your Resources e.g. GET, POST, DELETE

-CORS issues are common with API Gateway, CORS can be enabled on all or individual endpoints

-Caching improves latency and reduces the amount of calls made to your endpoint

-Same Origin Policies help to prevent XSS attacks

-Same Origin Policies ignore tools like postman or curl

-CORS is always enforced by the client aka the browser

-You can require Authorization to your API via AWS Cognito or a custom Lambda

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Practice Questions

The pharmaceutical company you work for has an aggressive schedule to bring a number of new products to market. You'd like to provide a library of metabolism assessment functions to application developers across the various teams so that each one doesn't have to write their own. Which AWS compute solution will be the most cost-effective to host this library?

A) Amazon EC2 Spot Instances

B) AWS Lambda
C) Amazon Elastic Container Service
D) Amazon EC2 Reserved Instances

Explanation:

A microservices architecture provides the most cost-effective environment for a library of code, and the serverless nature of AWS Lambda allows you to do that with zero administration. You could host your microservices on Elastic Container Service, but the serverless nature of Lambda makes it more cost-effective. EC2 Spot and Reserved Instances provide lower cost options to EC2 On-Demand, but not lower than Lambda executions.
Resources

Answer: B) AWS Lambda

A startup clothing retailer has begun designing their online ordering application. The user interface will require presentation of four different screens to complete an order (product selection, shopping cart, payment, order confirmation). Orders can contain multiple line items. The application backend will need to scale seamlessly for seasonal spikes in demand. Which architecture will provide the most elastic and highest performing solution?

A) Deploy EC2 instances, each with the capability to process all the steps of the ordering process. Submit interim order information to the backend after each ordering step and store it on EBS volumes for persistence. Implement Auto Scaling to handle the fluctuations in demand
B) Store all interim order information in browser cookies and submit it to a single EC2 instance at the end of the ordering process. Implement Auto Scaling to handle the fluctuations in demand
C) Deploy a different Lambda function to process each step of the ordering process. Submit interim order information to the backend after each ordering step and store it in Amazon DynamoDB. Index the data with a transaction ID cookie stored in the browserSelected
D) Use a single Lambda function with the capability to process all the steps of the ordering process. Submit interim order information to the backend after each ordering step and store it in an Amazon RDS database. Keep track of order state in a database table

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Explanation:
Deploying individual Lambda functions with different order processing capabilities provides scalability and performance at an atomic function level. A deployment package that includes all of the order processing logic will take longer to cold-start. DynamoDB will provide faster overall performance for interim order data than RDS. Storing all interim order data in browser cookies is not feasible, especially if the order contains multiple line items
Resources Serverless Web Application
Answer: C