AWS Starter Kit

Introduction

Welcome to Hack@Brown's cloud starter kit! We will be using Amazon Web Services (AWS) as our cloud platform. This guide will take you through three different services and explain what they are and how they can be used.

Note: There are other cloud services besides AWS such as Google Cloud, Microsoft Azure, IBM Cloud, etc., but for the sake of this tutorial, we will be using AWS.

Overview

This is a quick overview of the three services to give you an idea of what each one is about.

S3
- S3 is an online, bulk storage services for all types of files that are accessible from most devices
- Provides reliable, durable storage that you can access from anywhere via the internet
- Allows you to store and retrieve any amount of data, like images, videos, or backups, as objects

EC2
- EC2 is a virtual computing environment, known as *instances*. It is essentially a virtual server that is run on Amazon's cloud resources
- Launch virtual machines with custom configurations as needed, without upfront hardware investments
- Run any application, from simple websites to complex machine learning algorithms, on scalable virtual servers
-

Lambda
- AWS Lambda is a compute service that lets you run code without provisioning or managing servers
- Automatically runs your code when triggered by specific events, like HTTP requests or file uploads
- Automatically scales to handle any number of requests, making it ideal for unpredictable or variable workloads

Setup

The first step is to create a free account on AWS. Follow this link and the steps that they outline to set up a free AWS account.

Note: It will ask you for a payment method, but it will not charge you as long as you do not exceed the free tier usage policy. Read more about the free tier usage policy here.

S3

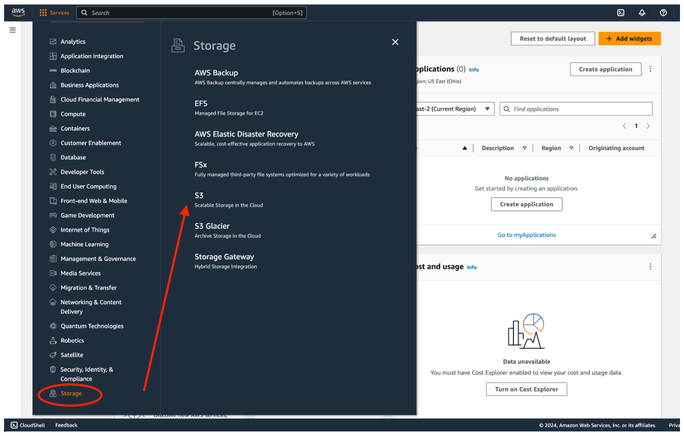
What is S3?

AWS S3 is a simple storage service. Generally, it is an online, bulk storage service for all types of files that are accessible from most devices. In Amazon's words, S3 is a "simple web service that you can use to store and retrieve any amount of data, at any time, from anywhere on the web. It gives any user access to the same highly scalable, reliable, fast, inexpensive infrastructure that Amazon uses to run its own global network of websites. The service aims to maximize benefits of scale and to pass those benefits on to users."

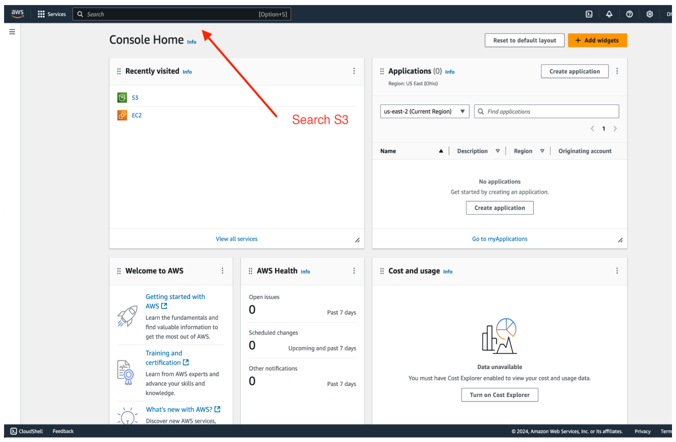
The free tier of S3 includes 5GB of Amazon S3 standard storage, 20,000 get requests, 2,000 put requests, and 15GB of data transfer out each month for one year.

Navigating the AWS console

You can access S3 under Storage when you click on their Services tab. Alternatively, you could directly search for S3 in their search bar!



Services → Storage → S3



Searching S3 with the search bar

Once you get to the S3 Console, you'll notice that you have the option to create buckets. The lowest, or root level folders, are called buckets. Within buckets, you can store objects or subfolders, which can also store objects. Objects are just files, and can be stored in these buckets or subfolders.

Creating a Bucket

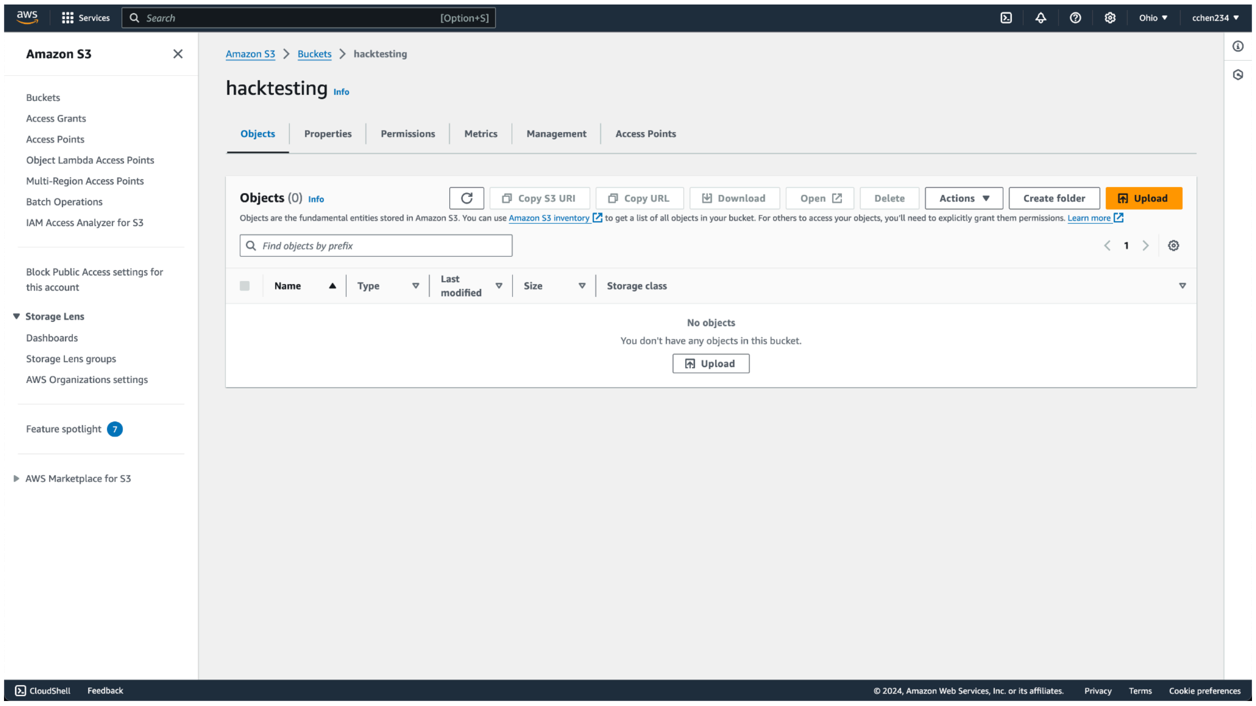
Bucket names must

- Be 3 to 62 characters long
- Be unique across ALL of AWS
- Only contain lowercase letters, numbers, and hyphens
- Not have the format of an IP address (e.g., 123.456.7.8)

When you create a bucket from the S3 console, you may or may not be prompted to specify the geographic region that it will occupy. Any data uploaded to that bucket will be stored in a data center in that region. The best practice is to select the region that is located physically closest to where you are. However, if you are creating a service to provide data to customers in a different region, you should create the bucket in that region.

Creating folders, uploading objects

Once you have created a bucket, you can click on the bucket name in your console to create or upload files and objects.



Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more

No objects

You don't have any objects in this bucket.

In the top right corner of the middle console, you can choose to either create a folder (which you may want to do for more organization/subdivision of content) or to immediately upload an object. Folders do not need to follow the same naming conventions as buckets. You can think of the bucket as a file directory. You can add files to the bucket as you want, or create more subdirectories within the root directory!

Object Durability and Availability
Durability is the percent chance over one year that a file stored in S3 will NOT be lost, corrupted, or deleted. Availability is the percentage over a one year time period that an object stored in S3 will be accessible (able to be downloaded, modified, etc.).

Viewing Properties
When you click on a bucket, in your new bucket console, you have the option to view the properties of the bucket at the top dashboard. The top section of Properties displays general information about the bucket, including its name, region, creation date, and owner. However, there are other important properties that are worth discussing.

Storage Classes
Storage classes are the general classification assigned to an object in S3. Each storage class differs in storage cost, object availability, object durability, and frequency of access to the object. Each object is assigned the standard class by default, but you can choose between Standard, RRS, and S3-IA in the 'Intelligent-Tiering Archive configurations' section of properties. Here are the different storage classes:

- **Standard:** Although it is the default class, it is the most expensive. It has 99.999999999% object durability and 99.99% object availability. Best for objects that you frequently access (on a daily basis) or objects that are extremely important and need high durability
- **Reduced Redundancy Storage (RRS):** Designed for non-critical, reproducible objects and is less expensive than Standard. This is because it only has 99.99% object durability, though it also has 99.9% object availability. Best for backups or files that can be reproduced
- **Infrequent Access (S3-IA):** Designed for objects that are not accessed as frequently, but need to be immediately available when you do need access. Like Standard, it has 99.999999999% durability, but only 99.90% availability. It is less expensive than both Standard and RRS. Best for objects that you need infrequently, but need a guarantee of quick access when you need it
- **Glacier:** Designed for long-term storage, and as the name implies, it may take hours for objects stored in Glacier to be retrieved. It has 99.999999999% durability and is the cheapest S3 storage class. Best for large, archival storage. To move an object to the Glacier class, you need to use object life cycles. The change to Glacier may take 1-2 days

Object Lifecycles
Object lifecycles are a set of rules that automate the migration of an object's storage classes to a different storage class (or deletion), based on a specific time interval. By using an object lifecycle, you can automate the process of changing a file's storage class to meet your usage needs (that you know will change overtime) in order to minimize your S3 storage costs.

- To create a lifecycle policy, navigate to the bucket's management page (in the same dashboard as the properties)
- Follow the lifecycle management console to create new lifecycles or edit existing ones

Permissions
Allows you to control who can view, access, and use specific buckets and objects. Navigate to the bucket's permission page (in the same dashboard as the properties). From here, you can change your bucket policies, block public access (bucket settings), change object ownership, edit the general access control list (ACL), and edit cross-origin resource sharing (CORS).

Object Versioning
This allows you to keep track of and store all old/new version of an object so that you can access and use an older version if you need to. You could think of this as an analogous version of revision history in Google Docs!

- Versioning is either ON or OFF (default). Once versioning is on, you can "suspend" versioning, but not fully turn it off. Suspending versioning only prevents versioning going forward, so all previous objects with version will still maintain their older versions. Versioning can only be set on the bucket level and applies to all objects in the bucket
- To enable versioning, navigate to the bucket's properties and find the bucket versioning console. By default, versioning is off, so you can press the "Edit" button and click "Enable" to enable it
- You can reupload the object without worrying about moving the older version. You will need to specify the storage class of that object again, or else the new version will be set to Standard by default. If you suspend versioning and upload then reupload a new object, the older versions will not be saved
- To view the version of an object, in the bucket or folder where the object is contained, select the object by clicking in the horizontal space to the right of teh object (without clicking on its name). In the top middle bar to the right of "Versions," select "Show." Now you can see a list of the previous versions of that object

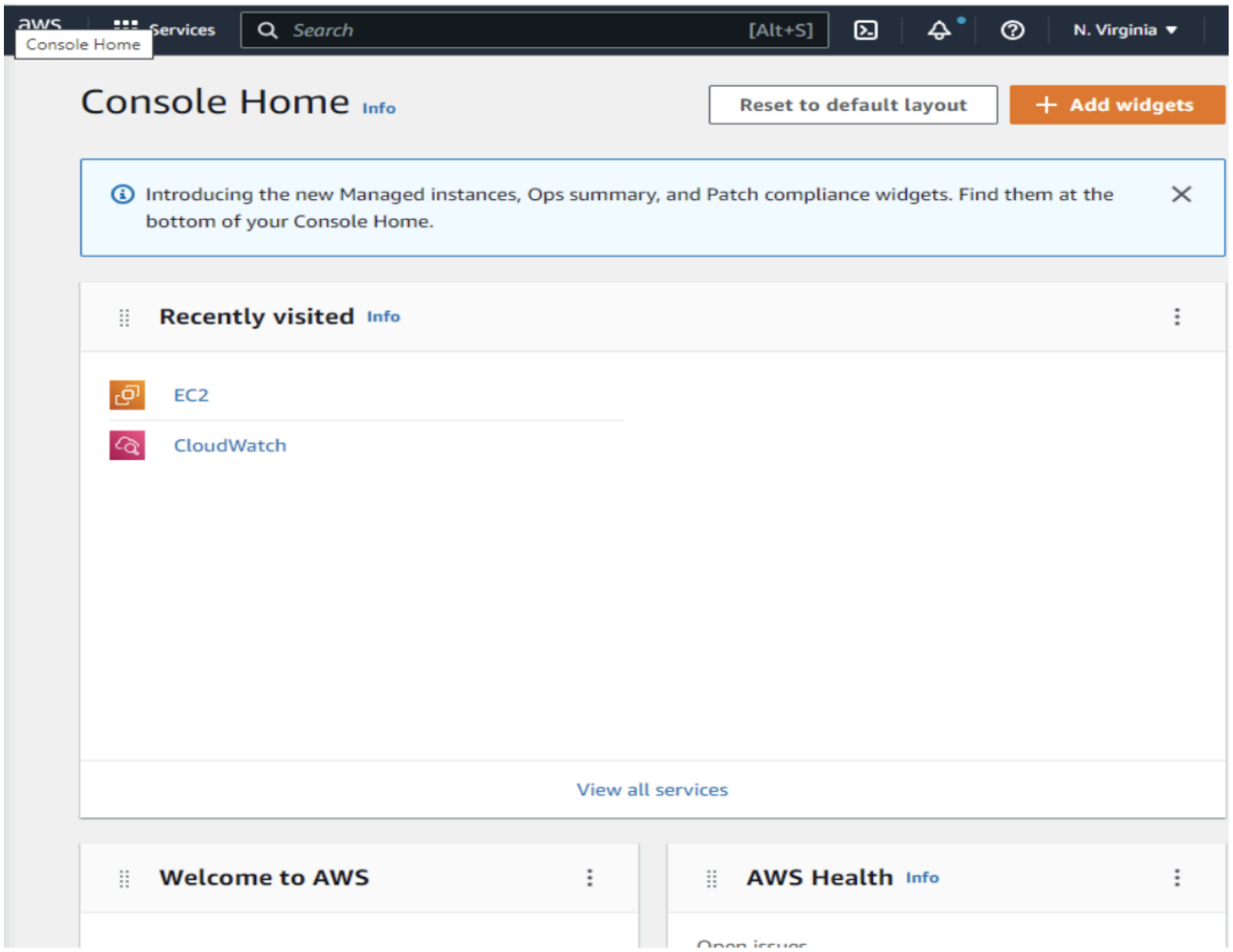
EC2

What is EC2?

AWS EC2 (Elastic Compute Cloud) provides virtual computing environments called instances. These instances function as virtual servers that run on Amazon's cloud infrastructure, allowing you to launch and manage applications without needing physical hardware. You can choose from various instance types, which offer different configurations of CPU, memory, storage, and networking capabilities, depending on your specific needs. To make setup easier, EC2 provides Amazon Machine Images (AMIs)—preconfigured templates that contain everything your server needs, including the operating system, libraries, and additional software. EC2 offers flexibility in scaling and customizing resources, whether you need a small server for testing or a large one for production workloads.

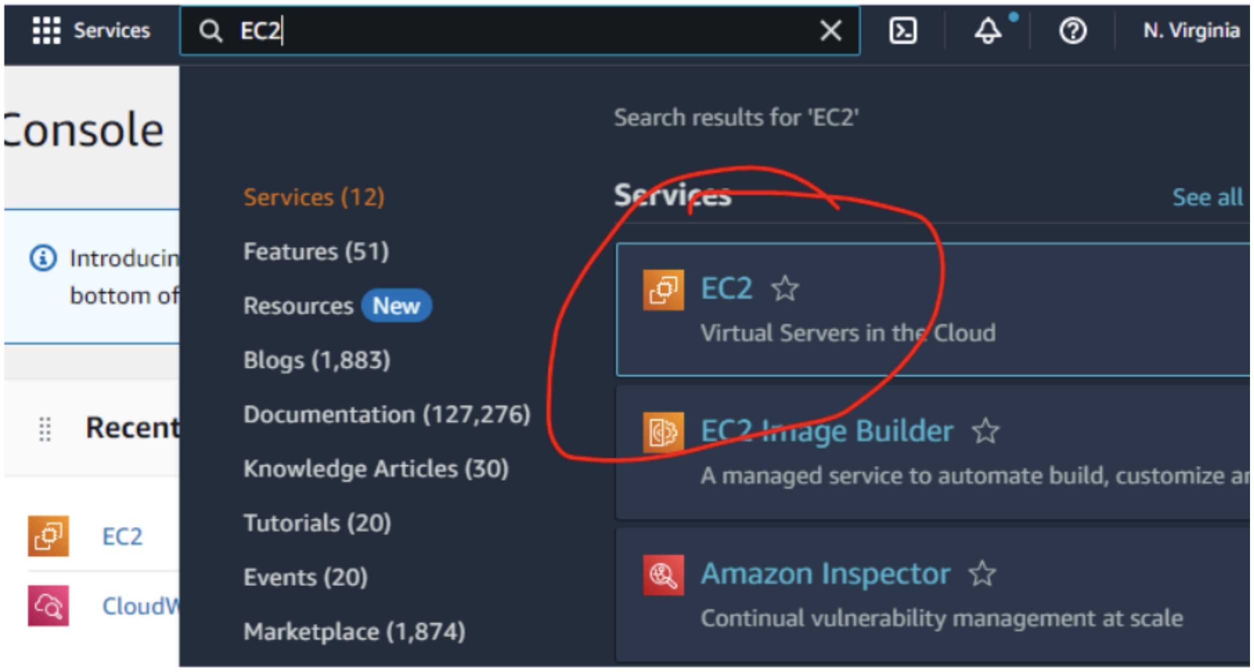
Launching an Instance (GUIDE)

First go to the AWS console:

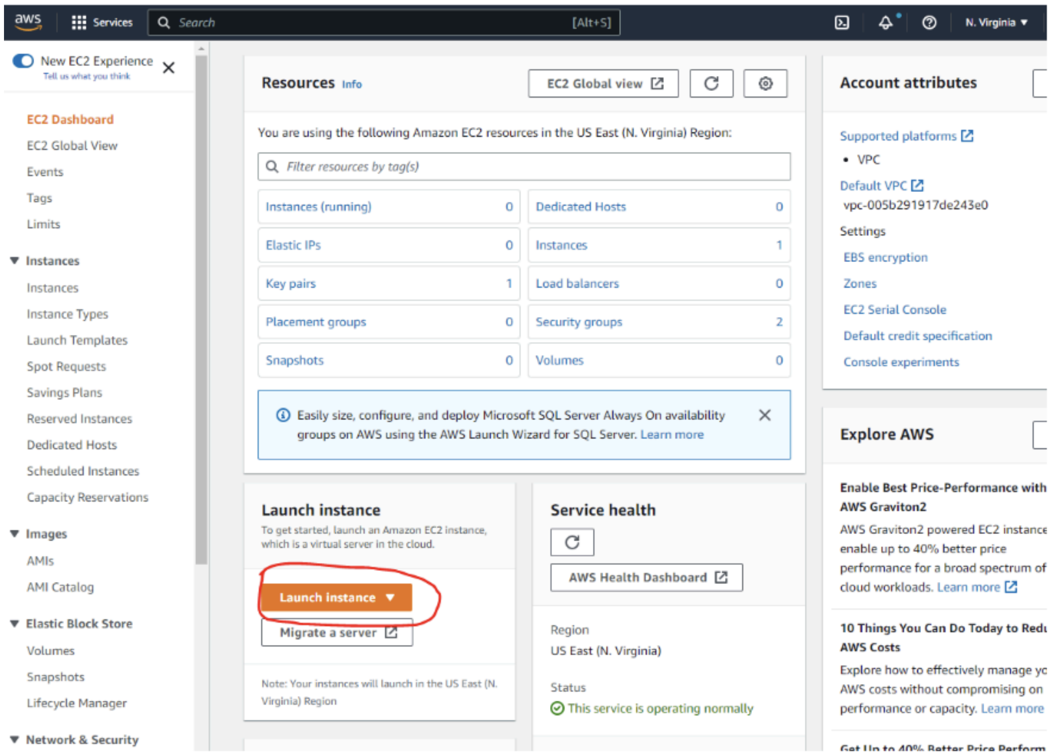


Introducing the new Managed instances, Ops summary, and Patch compliance widgets. Find them at the bottom of your Console Home.

Then type “EC2” in the search bar at the top and navigate to that page.



Then click on the “Launch Instance” button.



You are using the following Amazon EC2 resources in the US East (N. Virginia) Region:

Instances (running)	0	Dedicated Hosts	0
Elastic IPs	0	Instances	1
Key pairs	1	Load balancers	0
Placement groups	0	Security groups	2
Snapshots	0	Volumes	0

Easily size, configure, and deploy Microsoft SQL Server Always On availability groups on AWS using the AWS Launch Wizard for SQL Server. Learn more

Launch instance

To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.

Note: Your instances will launch in the US East (N. Virginia) Region

Region
US East (N. Virginia)

Status
This service is operating normally

VPC
vpc-005b291917de243e0

Enable Best Price-Performance with AWS Graviton2

AWS Graviton2 powered EC2 instance enable up to 40% better price performance for a broad spectrum of cloud workloads. Learn more

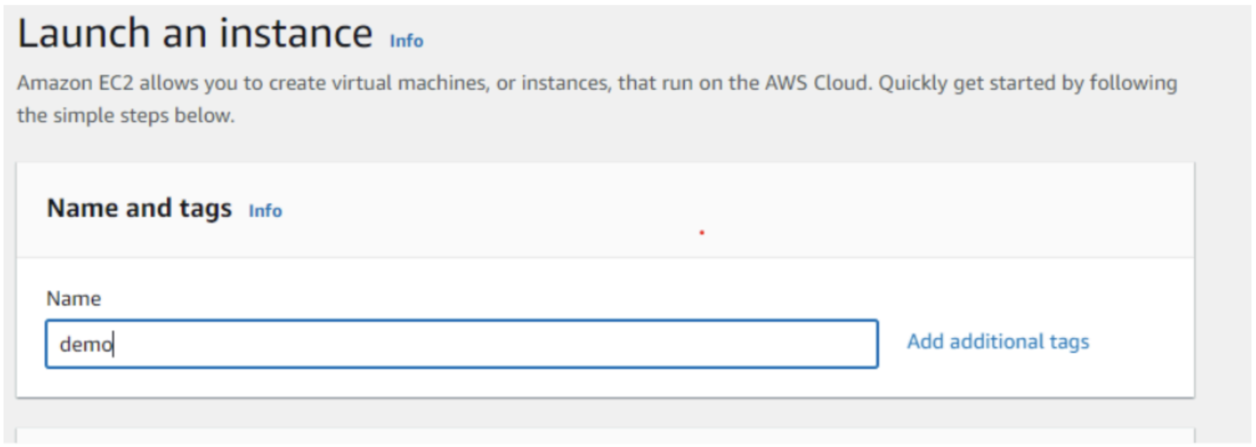
10 Things You Can Do Today to Redu AWS Costs

Explore how to effectively manage yo AWS costs without compromising on performance or capacity. Learn more

Get Up to 40% Better Price Perform

You will then be taken to a form to fill out to launch an instance. Here are a few steps for filling out the form:

1) The first thing that will need to be filled out is the name of your instance



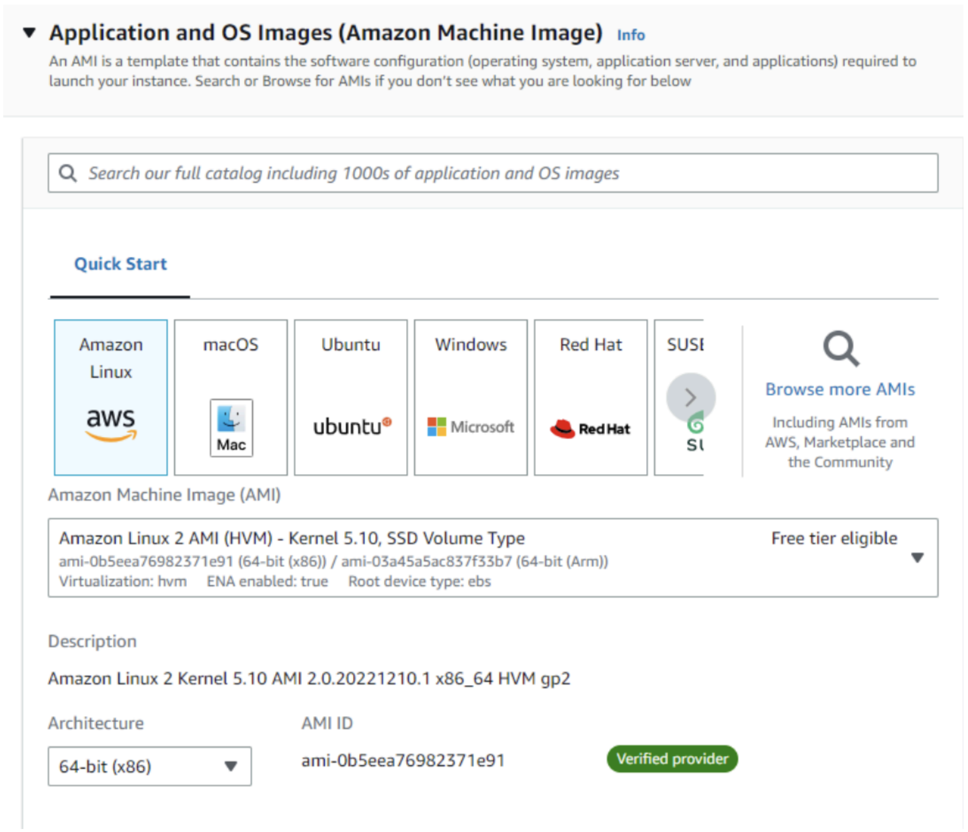
Launch an instance Info

Amazon EC2 allows you to create virtual machines, or instances, that run on the AWS Cloud. Quickly get started by following the simple steps below.

Name and tags Info

Name: demo

2) Then you will be asked to choose an Amazon Image machine. For this tutorial, we will be using the Amazon Linux image because it is free tier eligible. There are other images that are free as well that you can look into, but please be sure to choose the free tiers in order to not be charged money



Application and OS Images (Amazon Machine Image) Info

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. Search or Browse for AMIs if you don't see what you are looking for below

Search our full catalog including 1000s of application and OS images
Quick Start
Amazon Linux
macOS
Ubuntu
Windows
Red Hat
SUSE
Browse more AMIs
Including AMIs from AWS, Marketplace and the Community

Amazon Machine Image (AMI)

Amazon Linux 2 AMI (HVM) - Kernel 5.10, SSD Volume Type — Free tier eligible
ami-0b5eea76982371e91 (64-bit (x86)) / ami-03a45a5ac837f33b7 (64-bit (Arm))
Virtualization: hvm ENA enabled: true Root device type: ebs

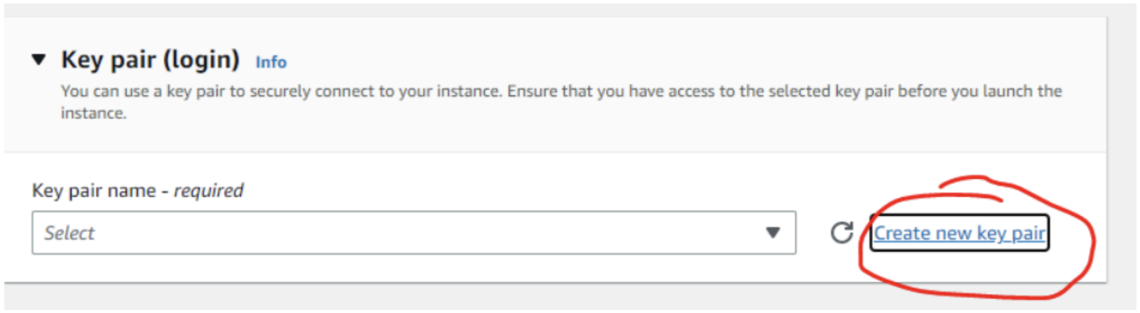
Description

Amazon Linux 2 Kernel 5.10 AMI 2.0.20221210.1 x86_64 HVM gp2

Architecture: 64-bit (x86)

AMI ID: ami-0b5eea76982371e91 Verified provider

3) For instance type, we can use the **t2.micro** because it is also in the free tier
4) We will need to specify a key pair (login) in order to connect to your instance later on
   a) Click on “Create a new key pair”



Key pair (login) Info

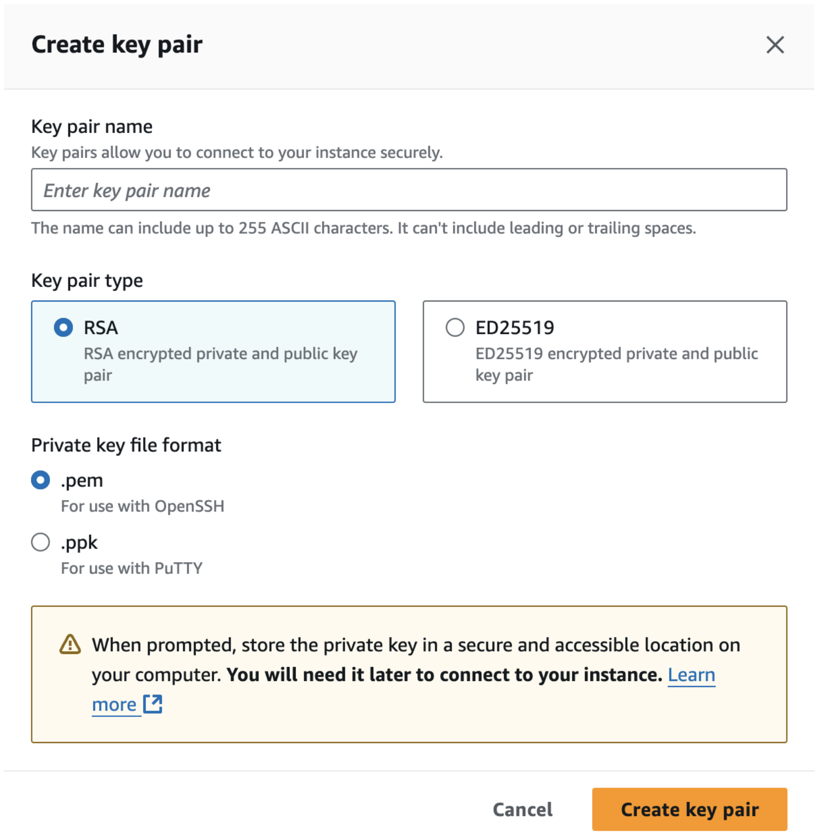
You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.

Key pair name - *required*

Select

Create new key pair

b) Create a new name for your pair, select “RSA,” and choose either the **.pem** or the **.ppk** format, depending on what software you have



Create key pair

Key pair name

Key pairs allow you to connect to your instance securely.

Enter key pair name

The name can include up to 255 ASCII characters. It can't include leading or trailing spaces.

Key pair type

[✓ RSA] RSA encrypted private and public key pair

ED25519 ED25519 encrypted private and public key pair

Private key file format

[✓ .pem] For use with OpenSSH

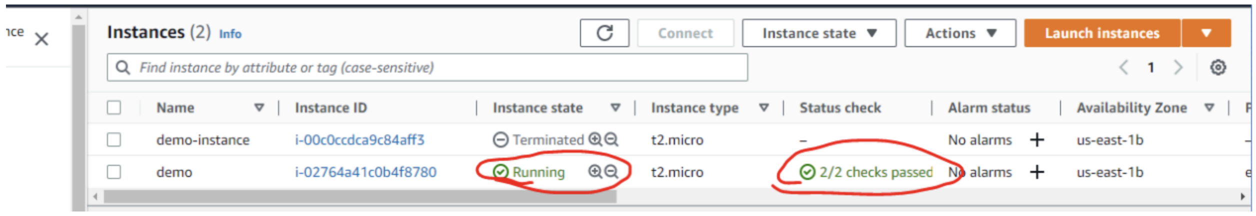
.ppk For use with PuTTY

When prompted, store the private key in a secure and accessible location on your computer. **You will need it later to connect to your instance.** Learn more

Cancel | Create key pair

5) For network settings, you can leave everything as it is. The service will automatically create a new security group that will allow SSH traffic from any IP address
6) You can adjust the storage as long as it remains within the free tier
7) Finally, click “Launch Instance”

It will take some time for the instance to get up and running. You can view all your instances by clicking on the instances tab on the left side navigation panel.



Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone
demo-instance	i-00c0ccdca9c84aff3	Terminated	t2.micro	–	No alarms	us-east-1b
demo	i-02764a41c0b4f8780	Running	t2.micro	2/2 checks passed	No alarms	us-east-1b

When you see that the instance is running and all the checks have passed, then it is ready to be used!

Connecting to your instance:

- Depending on which OS you have (Windows / MacOS / etc.)
    - There are different ways to connect your instance
    - For windows, please follow this documentation
    - For other devices, please follow this documentation

Terminate/Stopping your instance:

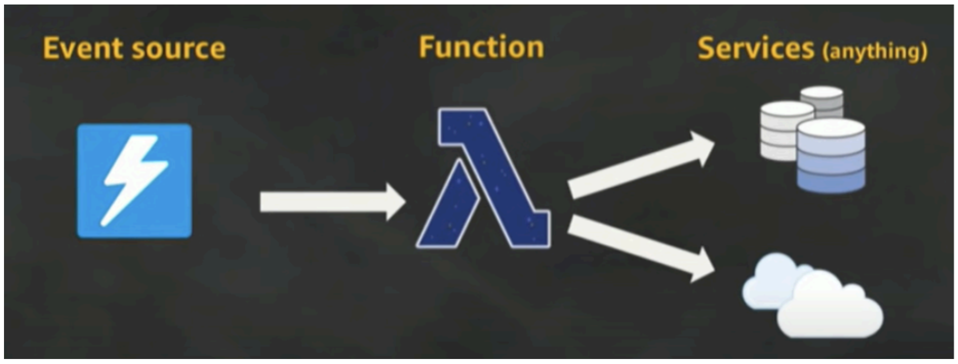
When you are done using the instance, make sure to delete it or stop it so it does not keep running and potentially cost money!

Lambda

What is Lambda?

- AWS Lambda is a compute service that lets you run code without provisioning or managing servers
- With Lambda, you can run code for virtually any type of application or backend service. All you need to do is supply your code in one of the languages that Lambda supports
- You organize your code into Lambda functions. Lambda runs your function only when needed and scales automatically, from a few requests per day to thousands per second

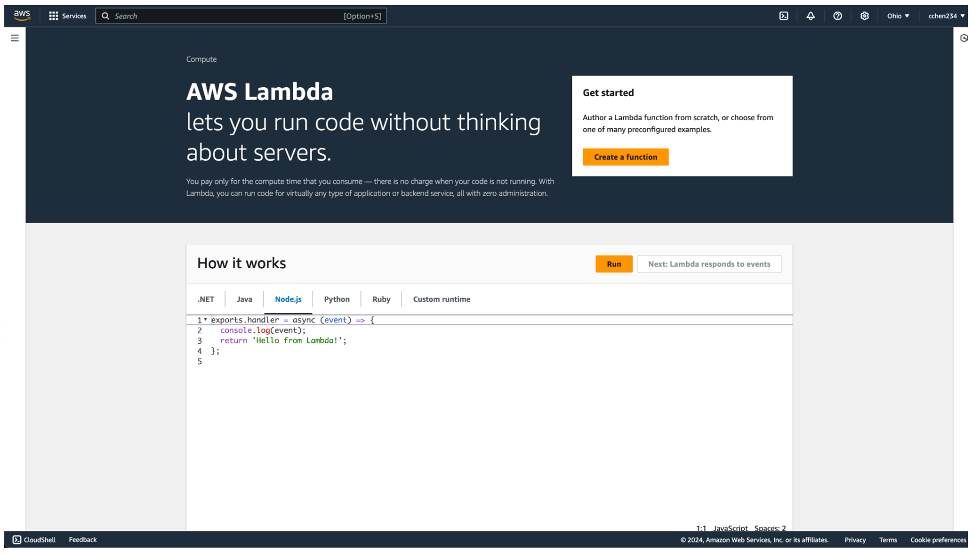
AWS Lambda works by executing functions in response to event triggers. These events can come from a variety of sources, such as a file upload to Amazon S3, an API call through API Gateway, or changes in a database. Once triggered, Lambda automatically runs the code you have specified in your function, without the need to manage or provision servers. The code execution is fully managed by AWS, scaling automatically based on the number of incoming events. After the code completes its task, Lambda returns the output to the designated destination, such as an S3 bucket, an API response, or even another AWS service. This makes Lambda ideal for automating tasks, handling real-time data processing, or building serverless applications.



How to use Lambda:

In this demo, we will be explaining how to trigger a Lambda function by uploading a file to an S3 bucket.

First, go to the Lambda console by searching “Lambda” in the search bar at the top. Then click on “Create a Function” on the homepage.


Compute

AWS Lambda
lets you run code without thinking about servers.

You pay only for the compute time that you consume — there is no charge when your code is not running. With Lambda, you can run code for virtually any type of application or backend service, all with zero administration.

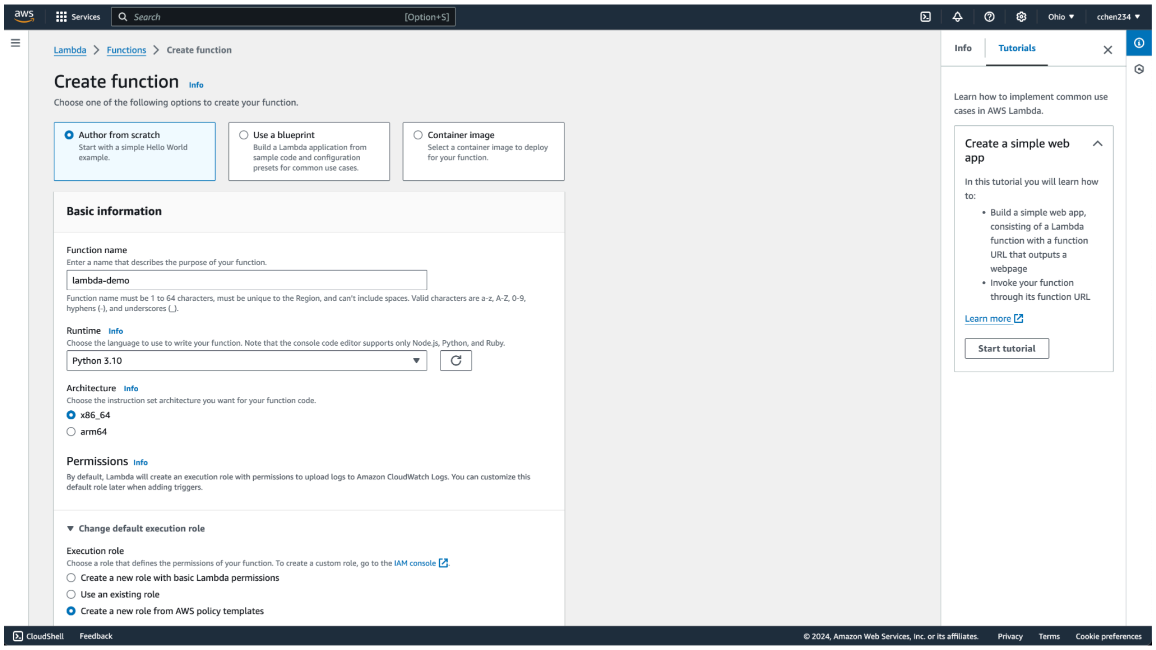
Get started

Author a Lambda function from scratch, or choose from one of many preconfigured examples.

How it works

```
exports.handler = async (event) => {
  console.log(event);
  return 'Hello from Lambda!';
};
```

We will now demo how to create a custom Lambda function from scratch. Feel free to follow the tutorials that Amazon may list on the side as well!


Lambda > Functions > Create function

Create function

Choose one of the following options to create your function.

[✓ Author from scratch] Start with a simple Hello World example.
Use a blueprint — Build a Lambda application from sample code and configuration presets for common use cases.
Container image — Select a container image to deploy for your function.

Basic information

Function name
Enter a name that describes the purpose of your function.
lambda-demo
Function name must be 1 to 64 characters, must be unique to the Region, and can't include spaces. Valid characters are a-z, A-Z, 0-9, hyphens (-), and underscores (_).

Runtime
Choose the language to use to write your function. Note that the console code editor supports only Node.js, Python, and Ruby.
Python 3.10

Architecture
Choose the instruction set architecture you want for your function code.
[✓ x86_64]
arm64

Permissions
By default, Lambda will create an execution role with permissions to upload logs to Amazon CloudWatch Logs. You can customize this default role later when adding triggers.

Change default execution role

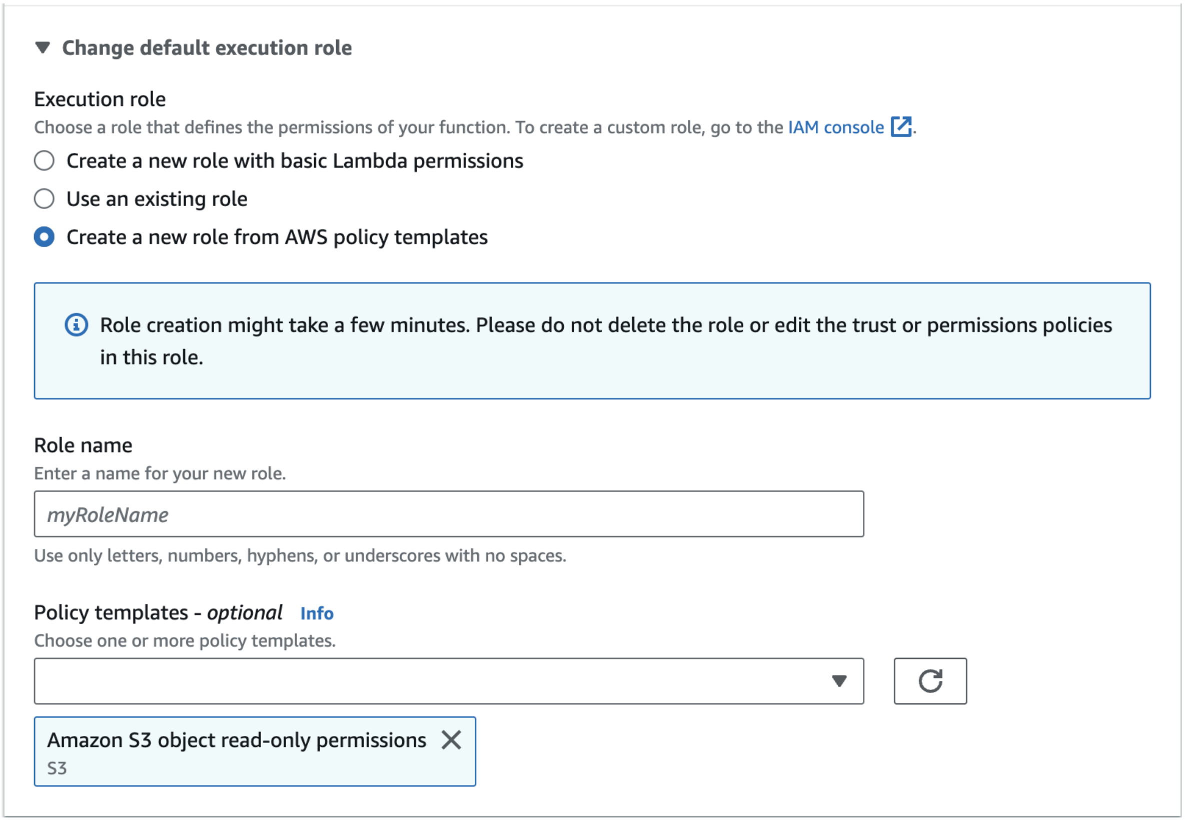
Execution role
Choose a role that defines the permissions of your function. To create a custom role, go to the IAM console.
Create a new role with basic Lambda permissions
Use an existing role
[✓ Create a new role from AWS policy templates]

Learn how to implement common use cases in AWS Lambda.

Create a simple web app

In this tutorial you will learn how to:
- Build a simple web app, consisting of a Lambda function with a function URL that outputs a webpage
- Invoke your function through its function URL

1) First, give your function a name, for example, “lambda-demo”
2) Then, select your coding environment under Runtime. For the sake of this demo, we will select Python 3.10 .
3) Then, select your architecture
4) Since we are going to need to access a S3 bucket, we are going to need to create a new permission group



▼ Change default execution role

Execution role

Choose a role that defines the permissions of your function. To create a custom role, go to the IAM console.

- Create a new role with basic Lambda permissions
- Use an existing role
- [✓ Create a new role from AWS policy templates]

Role creation might take a few minutes. Please do not delete the role or edit the trust or permissions policies in this role.

Role name

Enter a name for your new role.

myRoleName

Use only letters, numbers, hyphens, or underscores with no spaces.

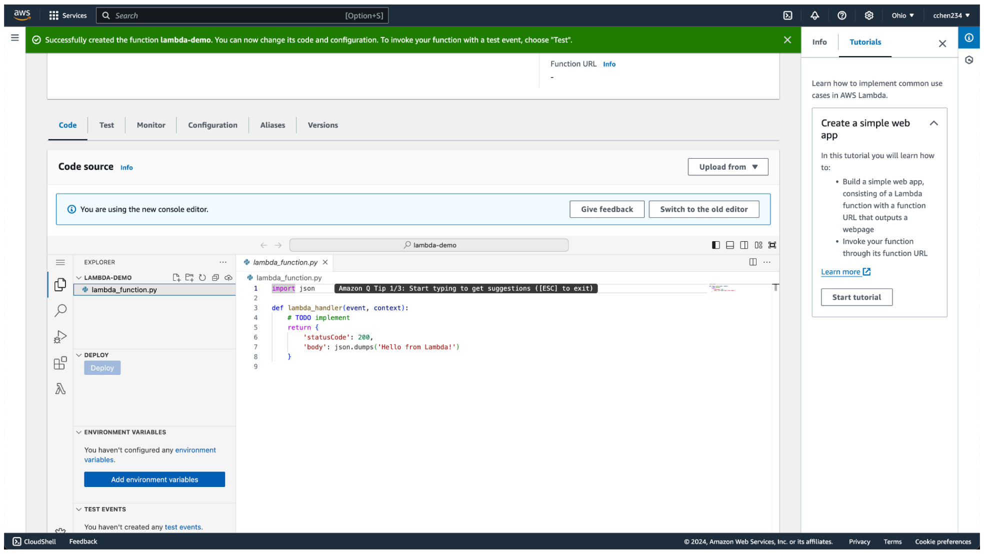
Policy templates - *optional* Info

Choose one or more policy templates.

Amazon S3 object read-only permissions
S3

a) Click on the “Change default execution role” dropdown
b) Select “Create a new role from AWS policy templates”
c) Then, give the role a name
d) Select “Amazon S3 object read-only permissions”
e) Press create function

5) You will be brought to a page that looks like this



Successfully created the function **lambda-demo**. You can now change its code and configuration. To invoke your function with a test event, choose "Test".

Function URL Info
-

Code source Info

You are using the new console editor.

ENVIRONMENT VARIABLES

You haven't configured any environment variables.

TEST EVENTS

You haven't created any test events.

lambda_function.py

```
import json    Amazon Q Tip 1/3: Start typing to get suggestions ([ESC] to exit)

def lambda_handler(event, context):
    # TODO implement
    return {
        'statusCode': 200,
        'body': json.dumps('Hello from Lambda!')
    }
```

Learn how to implement common use cases in AWS Lambda.

Create a simple web app

In this tutorial you will learn how to:

- Build a simple web app, consisting of a Lambda function with a function URL that outputs a webpage
- Invoke your function through its function URL

Learn more

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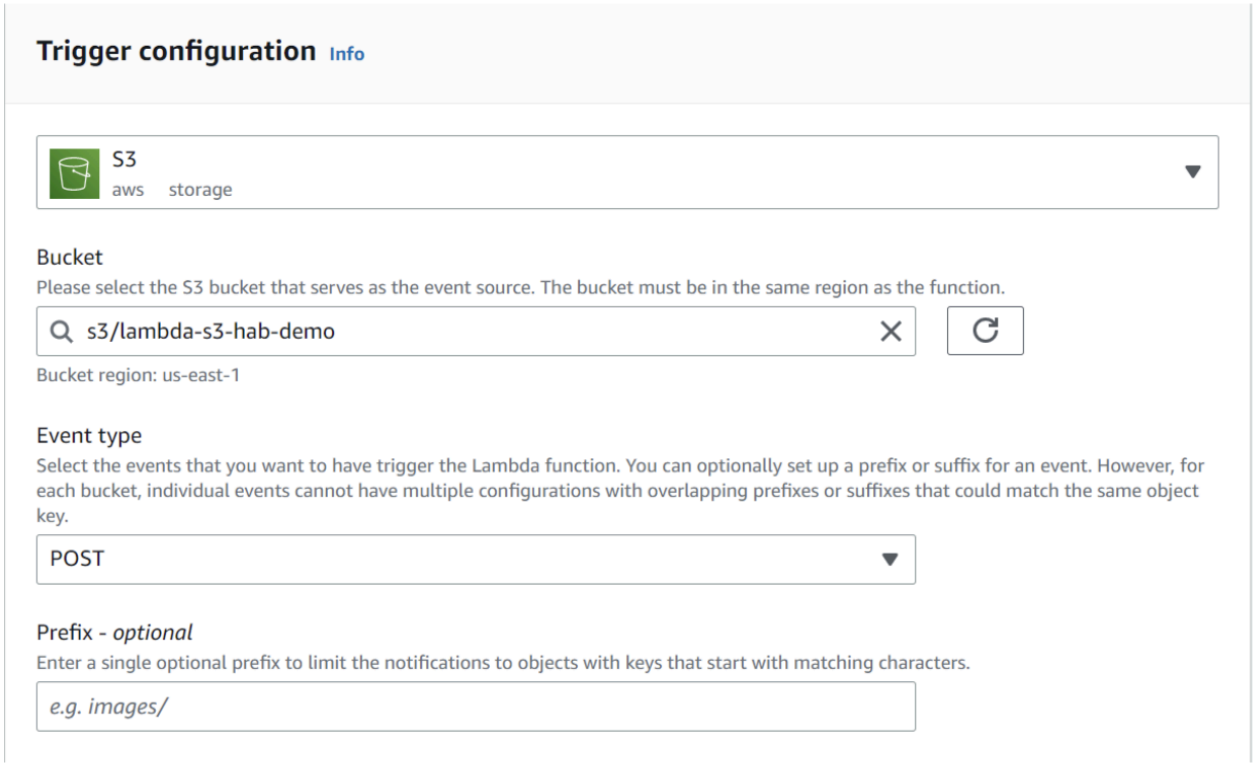
6) To add the S3 trigger, press the “add trigger” button

7) You will be brought to a separate page
   a) Choose “S3” as the source event”
   b) Select a bucket (if you do not have a bucket, please create one)
   c) Select the event type “POST”
   d) You can also add prefixes if you have a subfolder within your bucket or suffixes if you want to specify file types that trigger the lambda function
   e) Press “Create”



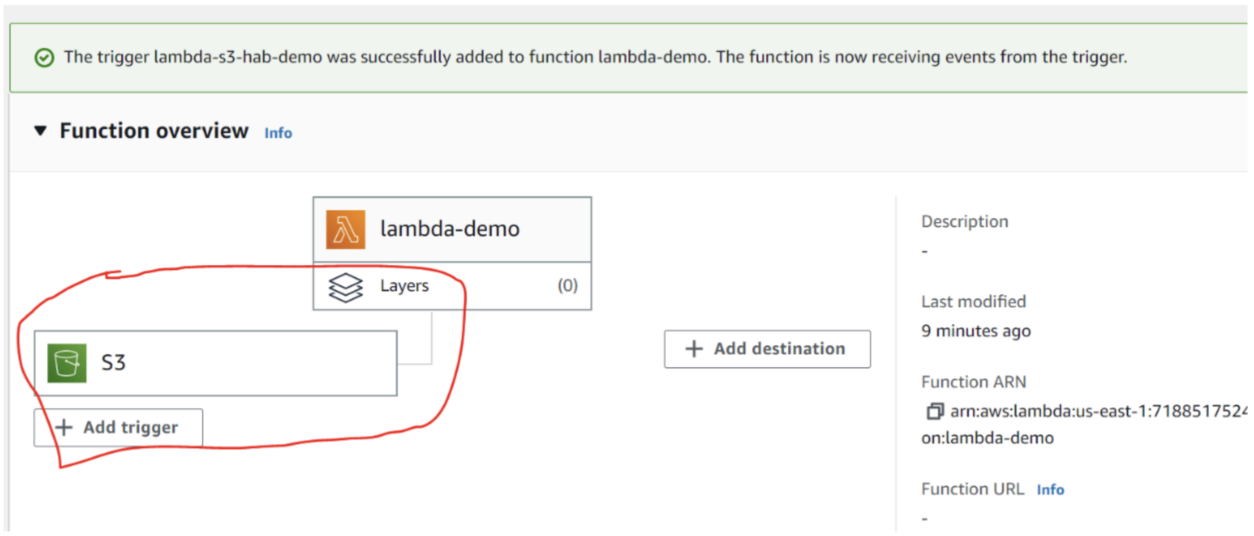
Trigger configuration Info

S3
aws storage

Bucket
Please select the S3 bucket that serves as the event source. The bucket must be in the same region as the function.
s3/lambda-s3-hab-demo
Bucket region: us-east-1

Event type
Select the events that you want to have trigger the Lambda function. You can optionally set up a prefix or suffix for an event. However, for each bucket, individual events cannot have multiple configurations with overlapping prefixes or suffixes that could match the same object key.
POST

Prefix - *optional*
Enter a single optional prefix to limit the notifications to objects with keys that start with matching characters.
e.g. images/



The trigger lambda-s3-hab-demo was successfully added to function lambda-demo. The function is now receiving events from the trigger.

Function overview Info

Description
-
Last modified
9 minutes ago
Function ARN
arn:aws:lambda:us-east-1:7188517524
on:lambda-demo
Function URL Info
-

8) Before we go on, it is important to understand what an S3 event actually looks like. Below is the information that gets sent to Lambda when an S3 event is processed. The

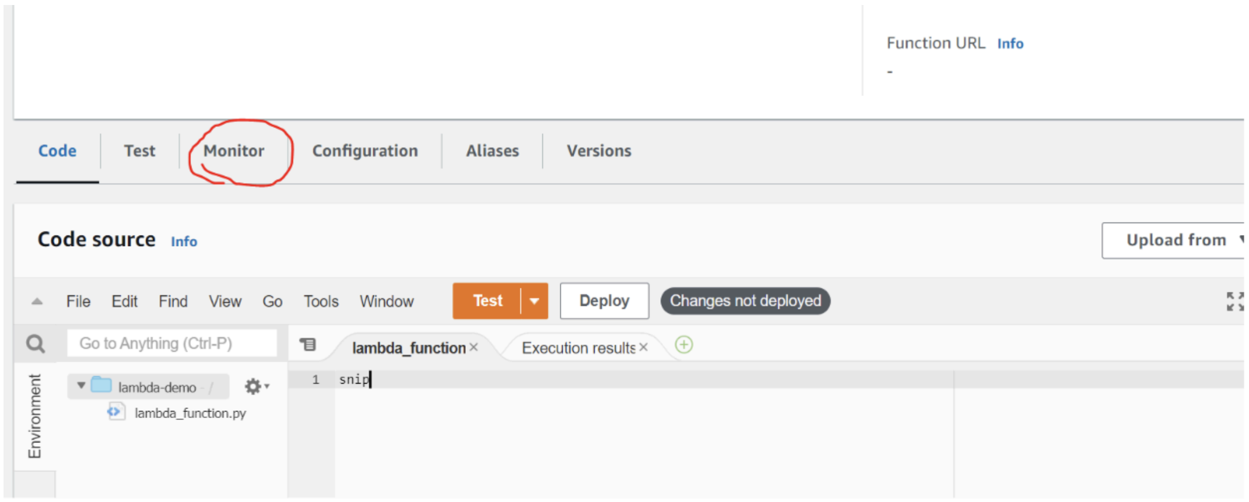
fields that will be important to us are the bucket name and key. The bucket name will be the bucket that has the uploaded file and the key will actually be the name of the uploaded file.

```
"Records": [
  {
    "eventVersion": "2.0",
    "eventSource": "aws:s3",
    "awsRegion": "us-east-1",
    "eventTime": "1970-01-01T00:00:00.000Z",
    "eventName": "ObjectCreated:Put",
    "userIdentity": {
      "principalId": "EXAMPLE"
    },
    "requestParameters": {
      "sourceIPAddress": "127.0.0.1"
    },
    "responseElements": {
      "x-amz-request-id": "EXAMPLE123456789",
      "x-amz-id-2":
"EXAMPLE123/5678abcdefghijklambdaisawesome/mnopqrstuvwxyzABCDEFGH"
    },
    "s3": {
      "s3SchemaVersion": "1.0",
      "configurationId": "testConfigRule",
      "bucket": {
        "name": "example-bucket",
        "ownerIdentity": {
          "principalId": "EXAMPLE"
        },
        "arn": "arn:aws:s3:::example-bucket"
      },
      "object": {
        "key": "test%2Fkey",
        "size": 1024,
        "eTag": "0123456789abcdef0123456789abcdef",
        "sequencer": "0A1B2C3D4E5F678901"
      }
    }
  }
]
```

9) For the code section, here is the Python code for processing the csv file that will be uploaded
10) Next, here is a link to the csv file to download

a) After downloading the link, go to the S3 using the search bar and upload the file into the bucket that you selected for the trigger

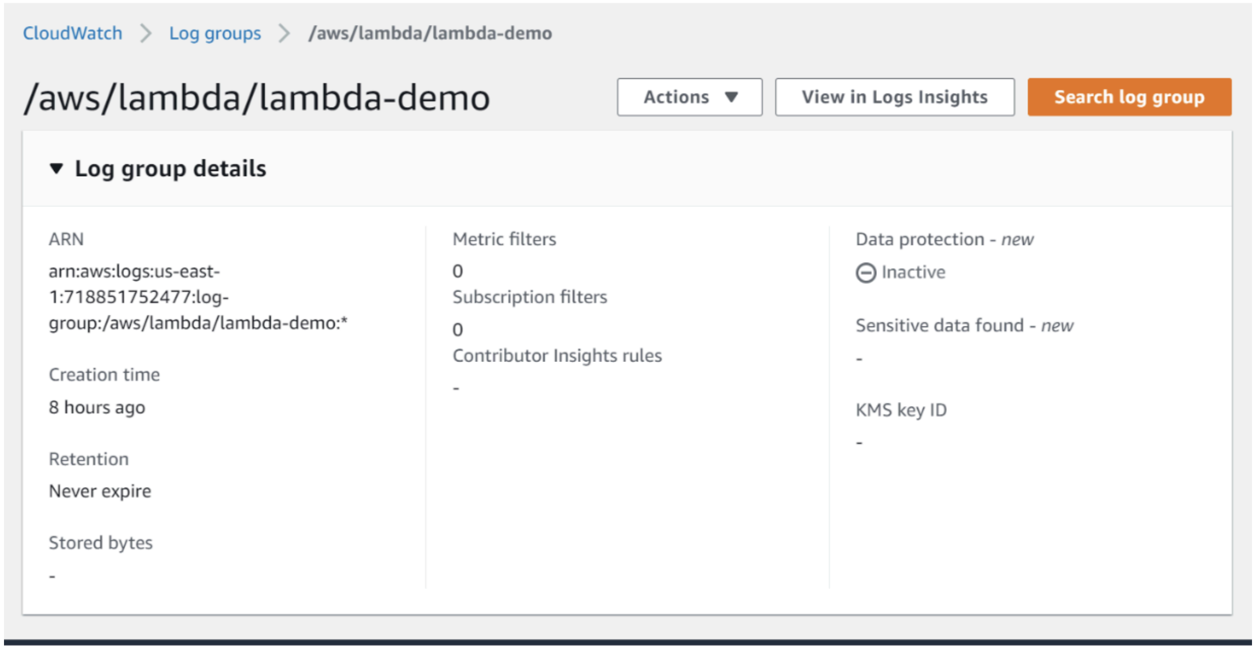
11) Then, after you uploaded the file go back to Lambda, and at the bottom of the page, you should see a monitor tab



```
snip
```

12) Click on this tab and then click on the button that says “View Cloudwatch Logs”

13) It will take you to a page that looks like this



/aws/lambda/lambda-demo

Log group details

ARN
arn:aws:logs:us-east-1:718851752477:log-group:/aws/lambda/lambda-demo:*

Creation time
8 hours ago

Retention
Never expire

Stored bytes
-

Metric filters
0

Subscription filters
0

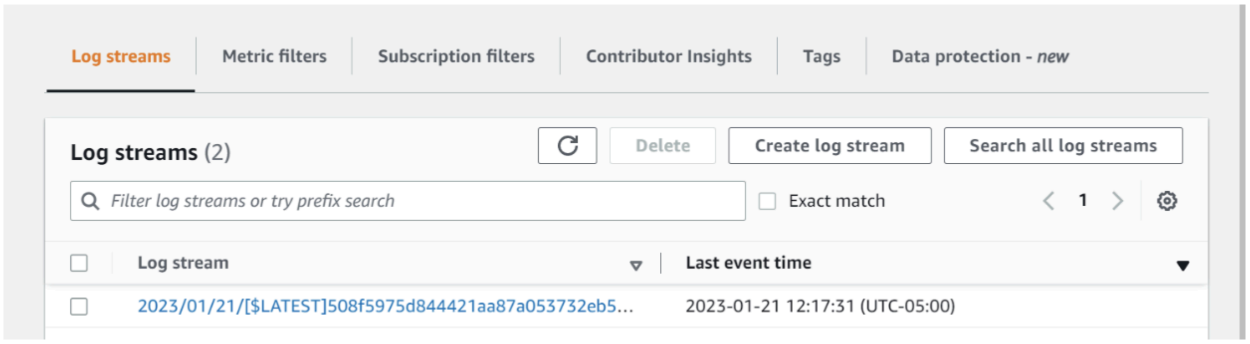
Contributor Insights rules
-

Data protection - *new*
Inactive

Sensitive data found - *new*
-

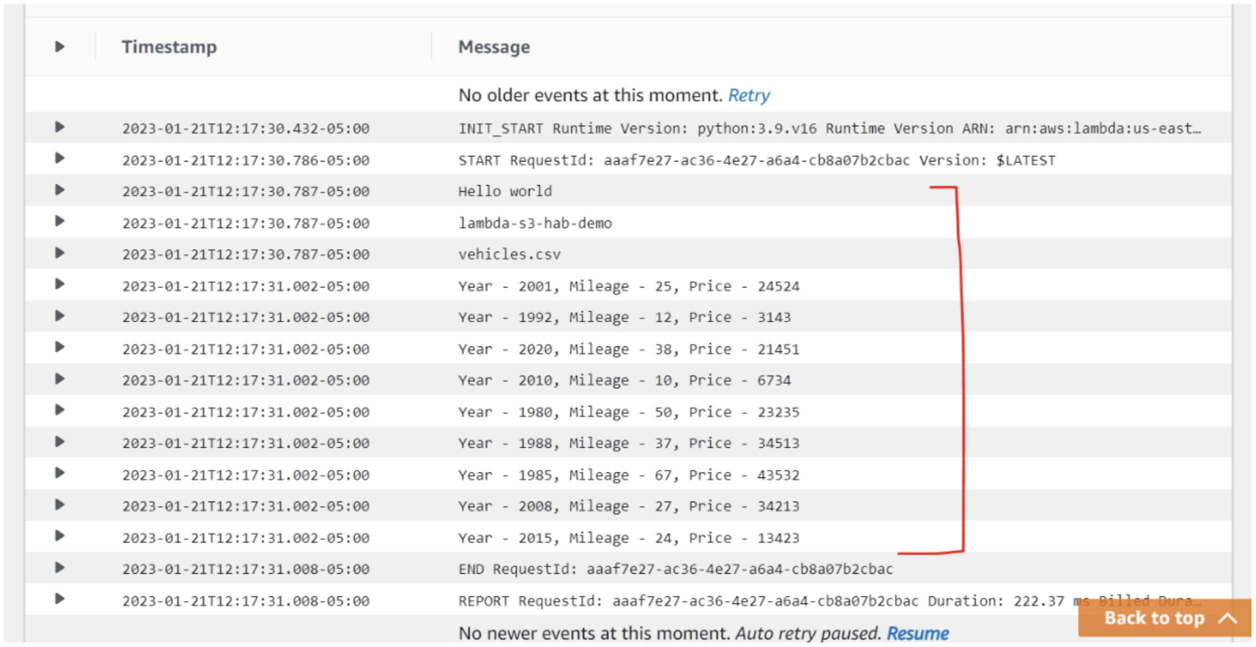
KMS key ID
-

14) At the very bottom of the page, you will see a log streams tab. Click on the most recent log stream which should have been triggered by the S3 event



Log stream	Last event time
2023/01/21/[$LATEST]508f5975d844421aa87a053732eb5...	2023-01-21 12:17:31 (UTC-05:00)

15) You should see something like this in the logs, where the output of the data processing is printed in the logs, meaning that the Lambda function was triggered and our data has been processed



```
Timestamp                       Message
                                No older events at this moment. Retry
2023-01-21T12:17:30.432-05:00   INIT_START Runtime Version: python:3.9.v16 Runtime Version ARN: arn:aws:lambda:us-east…
2023-01-21T12:17:30.786-05:00   START RequestId: aaaf7e27-ac36-4e27-a6a4-cb8a07b2cbac Version: $LATEST
2023-01-21T12:17:30.787-05:00   Hello world
2023-01-21T12:17:30.787-05:00   lambda-s3-hab-demo
2023-01-21T12:17:30.787-05:00   vehicles.csv
2023-01-21T12:17:31.002-05:00   Year - 2001, Mileage - 25, Price - 24524
2023-01-21T12:17:31.002-05:00   Year - 1992, Mileage - 12, Price - 3143
2023-01-21T12:17:31.002-05:00   Year - 2020, Mileage - 38, Price - 21451
2023-01-21T12:17:31.002-05:00   Year - 2010, Mileage - 10, Price - 6734
2023-01-21T12:17:31.002-05:00   Year - 1980, Mileage - 50, Price - 23235
2023-01-21T12:17:31.002-05:00   Year - 1988, Mileage - 37, Price - 34513
2023-01-21T12:17:31.002-05:00   Year - 1985, Mileage - 67, Price - 43532
2023-01-21T12:17:31.002-05:00   Year - 2008, Mileage - 27, Price - 34213
2023-01-21T12:17:31.002-05:00   Year - 2015, Mileage - 24, Price - 13423
2023-01-21T12:17:31.008-05:00   END RequestId: aaaf7e27-ac36-4e27-a6a4-cb8a07b2cbac
2023-01-21T12:17:31.008-05:00   REPORT RequestId: aaaf7e27-ac36-4e27-a6a4-cb8a07b2cbac Duration: 222.37 ms Billed Dura…
                                No newer events at this moment. Auto retry paused. Resume
```

Congrats! You finished our demo.

Please reach out to the Hack@Brown team if you have any questions on the content in this starter kit!