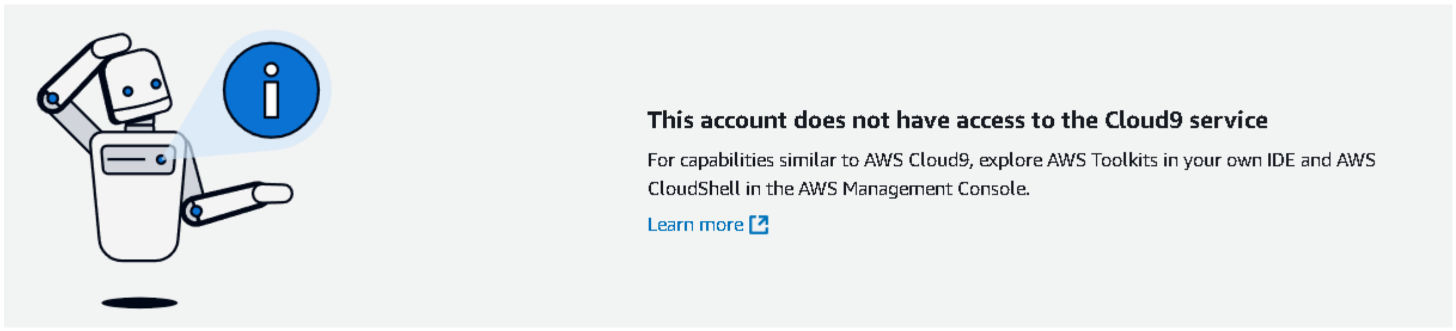
AdvDevOps Case Study 12: Serverless Logging with S3 and Lambda

Name: Soham Satpute
Roll No: 52/D15A

- **Concepts Used**: AWS Lambda, S3, and AWS Cloud9.
- **Problem Statement**: "Set up a Lambda function using AWS Cloud9 that triggers when a text file is uploaded to an S3 bucket. The Lambda function should read the file's content and log it."
- **Tasks**:
  - Create a Lambda function in Python using AWS Cloud9.
  - Configure an S3 bucket as the trigger for the Lambda function.
  - Upload a text file to the S3 bucket and verify that the Lambda function logs the content.

Note:
AWS **Cloud9** has been **discontinued**, so we will now use **EC2** for our development environment.


This account does not have access to the Cloud9 service

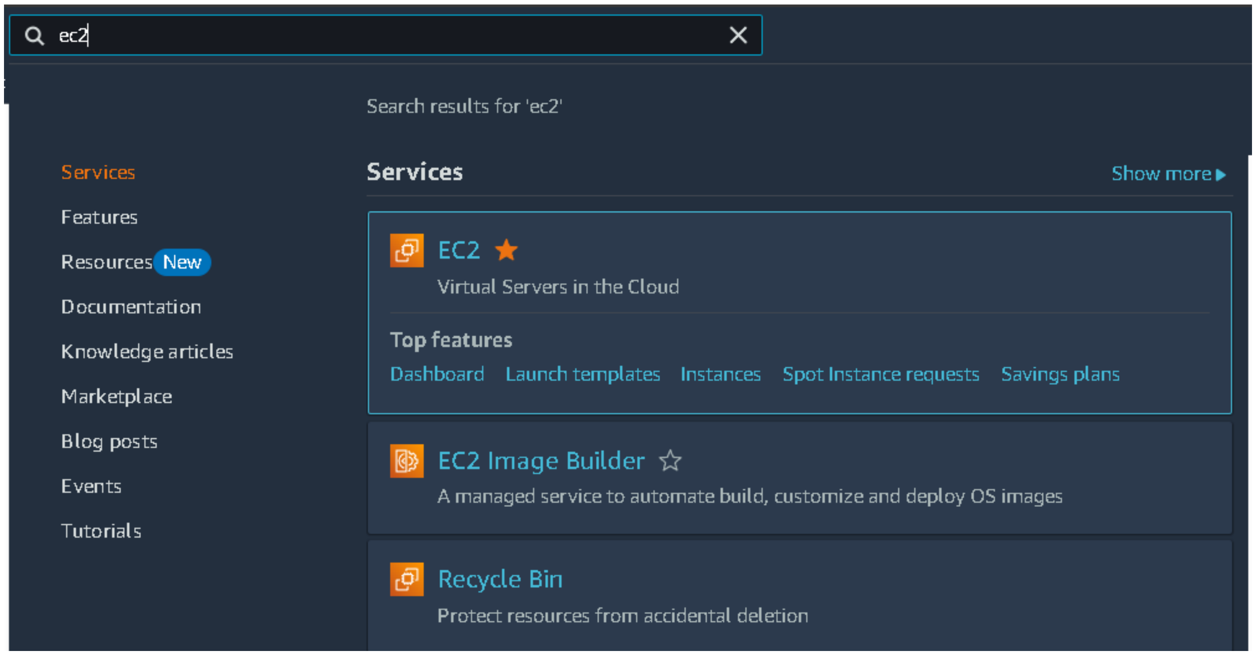
For capabilities similar to AWS Cloud9, explore AWS Toolkits in your own IDE and AWS CloudShell in the AWS Management Console.

Learn more

STEPS:

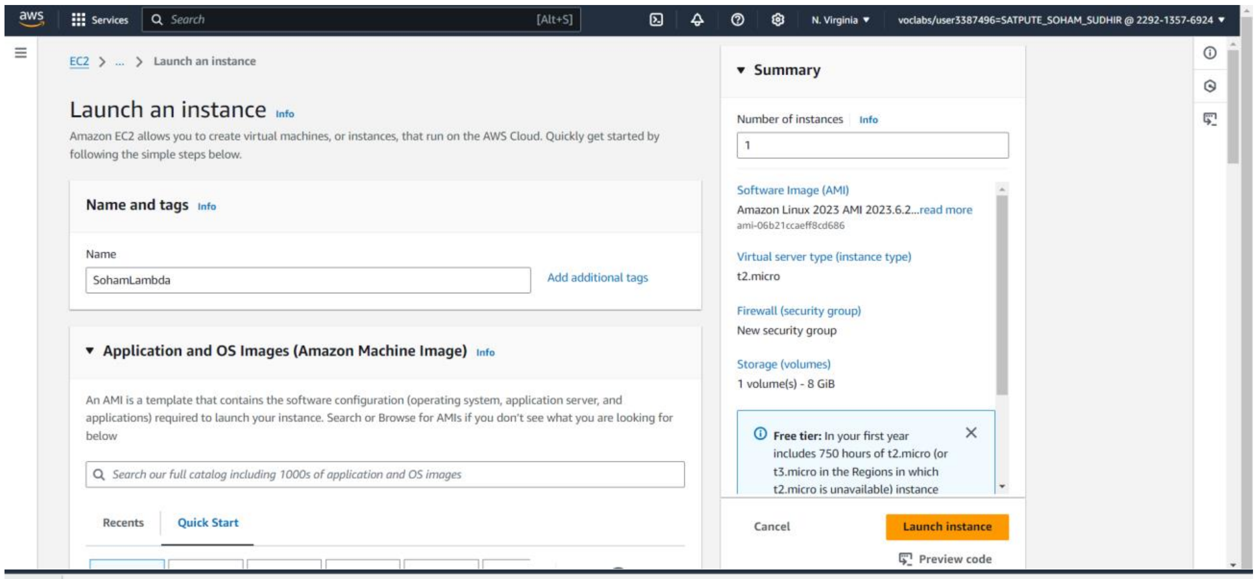
1. Launch an EC2 Instance

1.1 Login to AWS Console and go to EC2 service.



1.2 Click on "Launch Instance".

- AMI: Choose Amazon Linux 2.
- Instance Type: Select t2.micro (eligible for free tier).
- Key Pair: Create a new key pair (or select an existing one). You'll need this for SSH access.
- Network Settings:
    - Choose default VPC.
    - Security Group: Create a new security group:
        - Inbound Rules:
            - SSH (TCP port 22): Allow from your IP.
            - HTTP (TCP port 80): Optional, allows browser access.
            - HTTPS (TCP port 443): Optional, for secure traffic.
        - Outbound Rules:
            - Allow all outbound traffic (default).

- 

aws Services Search [Alt+S] N. Virginia voclabs/user3387496=SATPUTE_SOHAM_SUDHIR @ 2292-1357-6924

EC2 > ... > Launch an 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: SohamLambda   Add additional tags

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

Recents   Quick Start

Summary

Number of instances Info: 1

Software Image (AMI): Amazon Linux 2023 AMI 2023.6.2...read more ami-06b21ccaeff8cd686

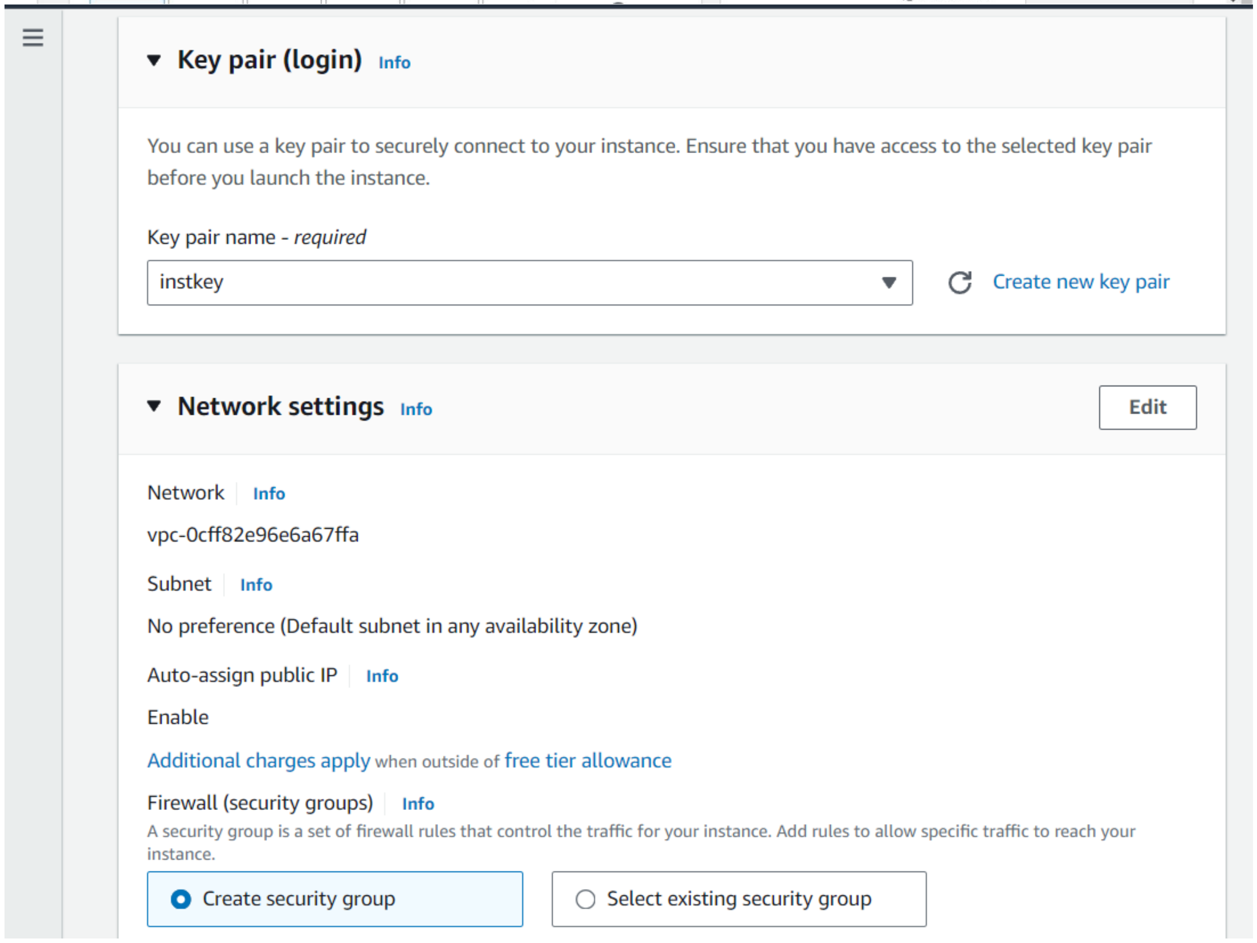
Virtual server type (instance type): t2.micro

Firewall (security group): New security group

Storage (volumes): 1 volume(s) - 8 GiB

Free tier: In your first year includes 750 hours of t2.micro (or t3.micro in the Regions in which t2.micro is unavailable) instance

Cancel   Launch instance   Preview code

- 

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*: instkey   Create new key pair

Network settings Info   Edit

Network Info: vpc-0cff82e96e6a67ffa

Subnet Info: No preference (Default subnet in any availability zone)

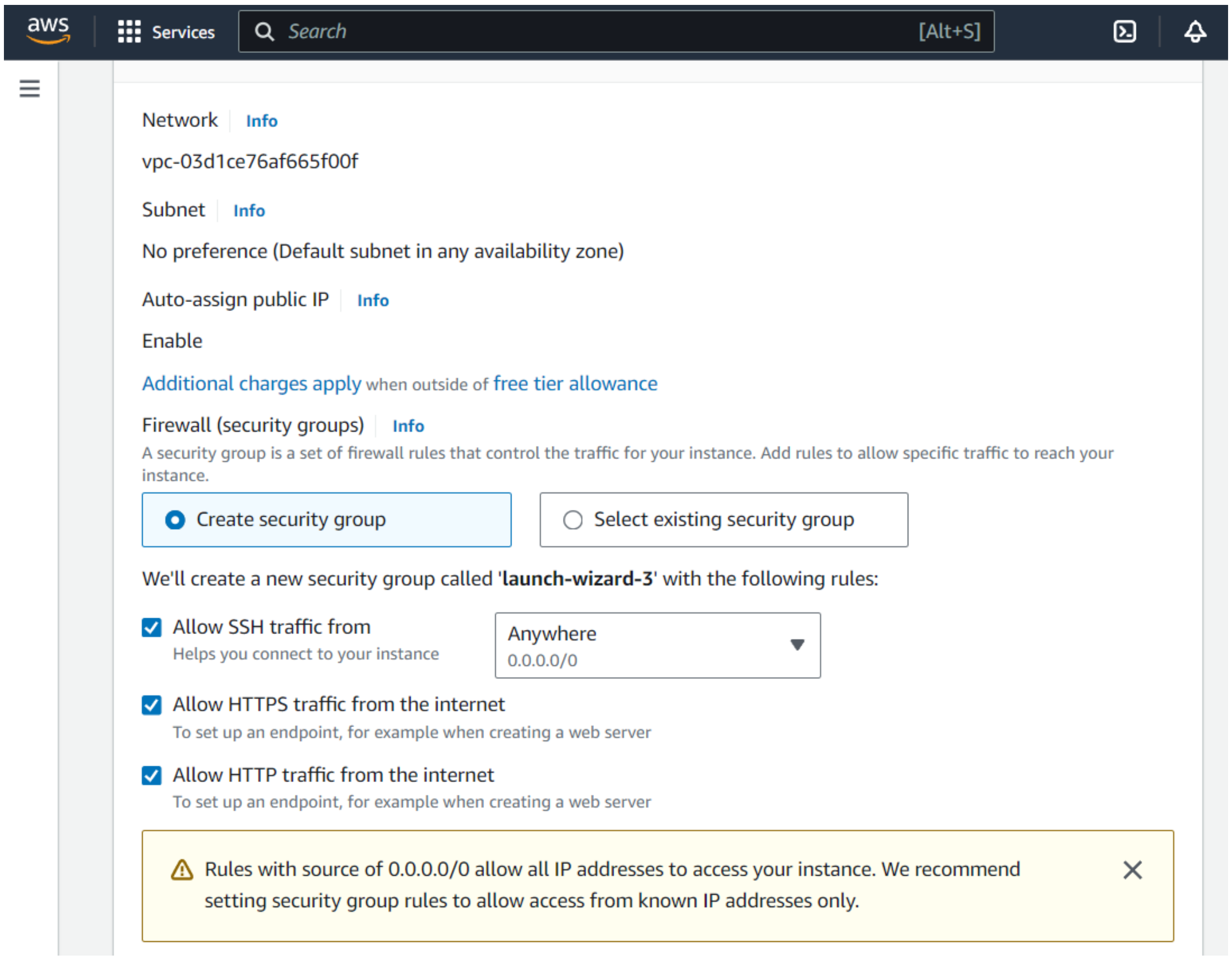
Auto-assign public IP Info: Enable

Additional charges apply when outside of free tier allowance

Firewall (security groups) Info

A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

[✓ Create security group]   Select existing security group



Network Info

vpc-03d1ce76af665f00f

Subnet Info

No preference (Default subnet in any availability zone)

Auto-assign public IP Info

Enable

Additional charges apply when outside of free tier allowance

Firewall (security groups) Info

A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

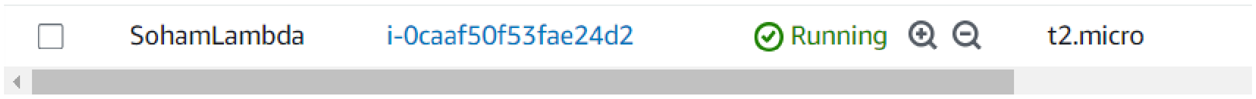
[✓ Create security group] Select existing security group

We'll create a new security group called '**launch-wizard-3**' with the following rules:

- [✓] Allow SSH traffic from — Anywhere 0.0.0.0/0
  Helps you connect to your instance
- [✓] Allow HTTPS traffic from the internet
  To set up an endpoint, for example when creating a web server
- [✓] Allow HTTP traffic from the internet
  To set up an endpoint, for example when creating a web server

Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.

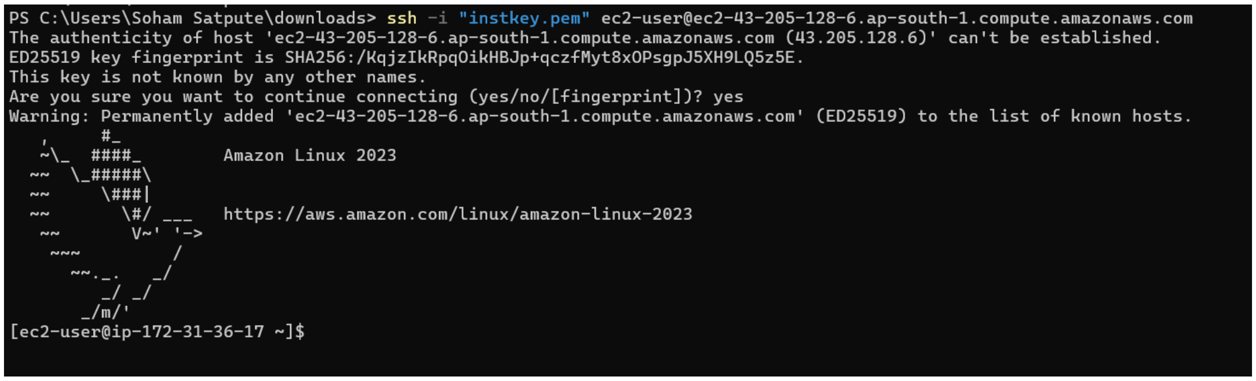
1.3 Launch the instance and wait for it to be ready.



☐	SohamLambda	i-0caaf50f53fae24d2	Running	t2.micro

1.4 Connect to the EC2 instance via SSH:

```
ssh -i <your-key.pem> ec2-user@<your-ec2-public-dns>
```

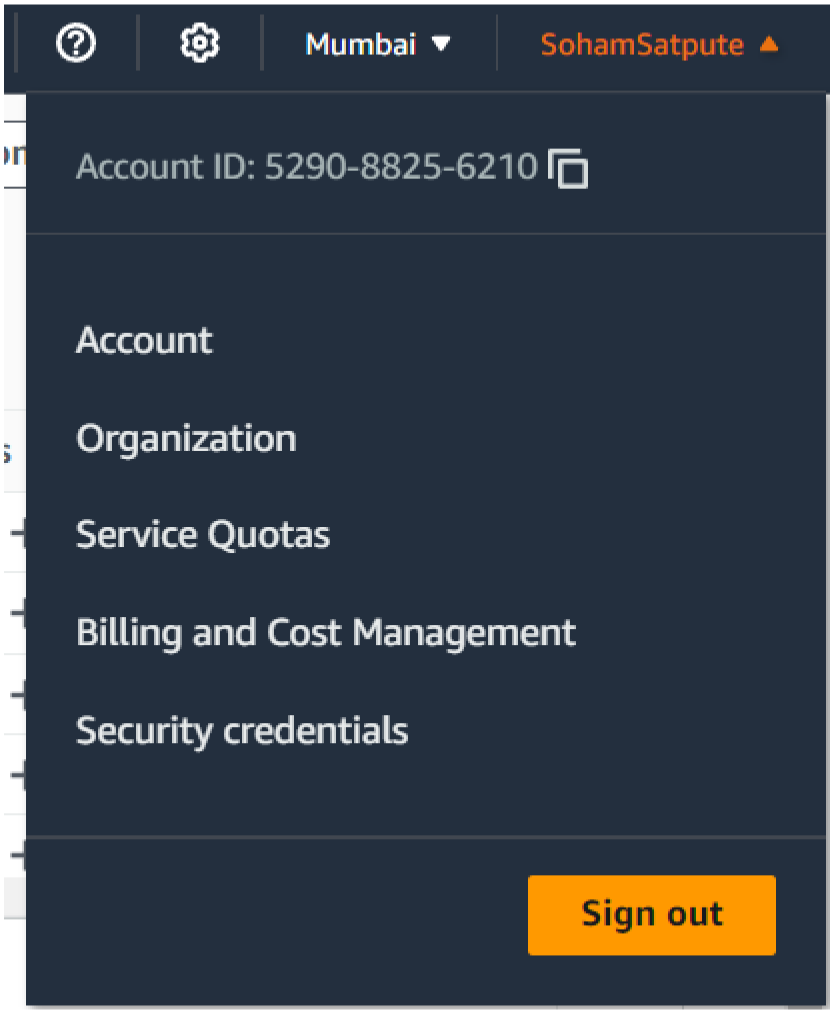


```
PS C:\Users\Soham Satpute\downloads> ssh -i "instkey.pem" ec2-user@ec2-43-205-128-6.ap-south-1.compute.amazonaws.com
The authenticity of host 'ec2-43-205-128-6.ap-south-1.compute.amazonaws.com (43.205.128.6)' can't be established.
ED25519 key fingerprint is SHA256:/KqjzIkRpqOikHBJp+qczfMyt8xOPsgpJ5XH9LQ5z5E.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'ec2-43-205-128-6.ap-south-1.compute.amazonaws.com' (ED25519) to the list of known hosts.
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
[ec2-user@ip-172-31-36-17 ~]$
```

2. Create Access keys for Root user

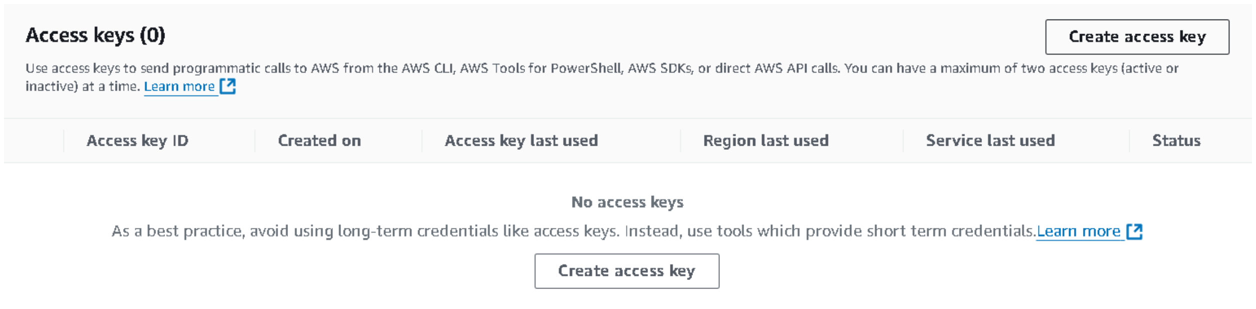
2.1 **Access the Root User Security Credentials**:

- In the top-right corner of AWS Management Console, click on your account name or email address, and then click **Security Credentials** from the dropdown menu.



2.2 **Manage Root Access Keys**:

- Scroll down to the **Access keys for the root account** section.
- If you don't have any existing access keys, click on **Create New Access Key**.
    - This will generate an **Access Key ID** and a **Secret Access Key** for your root user.
- **Download** the keys or **copy** them immediately. You won't be able to see the **Secret Access Key** again after closing this page.

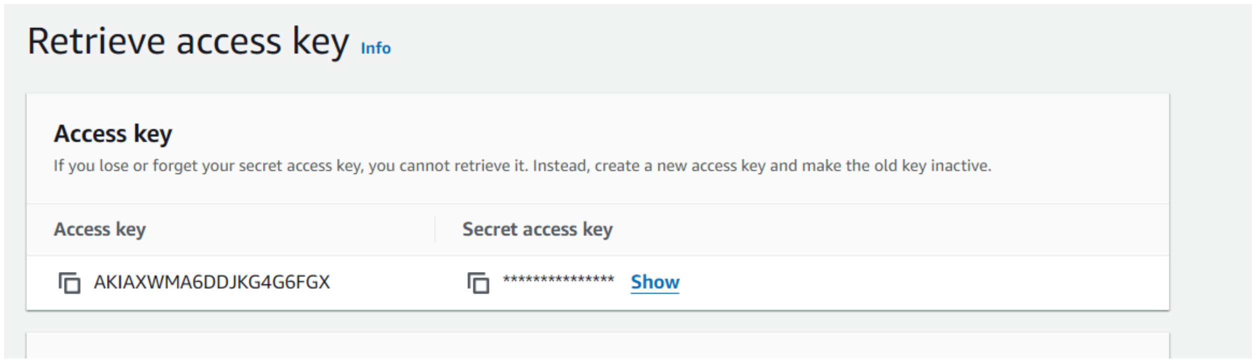

Access keys (0)

Use access keys to send programmatic calls to AWS from the AWS CLI, AWS Tools for PowerShell, AWS SDKs, or direct AWS API calls. You can have a maximum of two access keys (active or inactive) at a time. Learn more

Access key ID	Created on	Access key last used	Region last used	Service last used	Status

No access keys

As a best practice, avoid using long-term credentials like access keys. Instead, use tools which provide short term credentials. Learn more


Retrieve access key Info

Access key

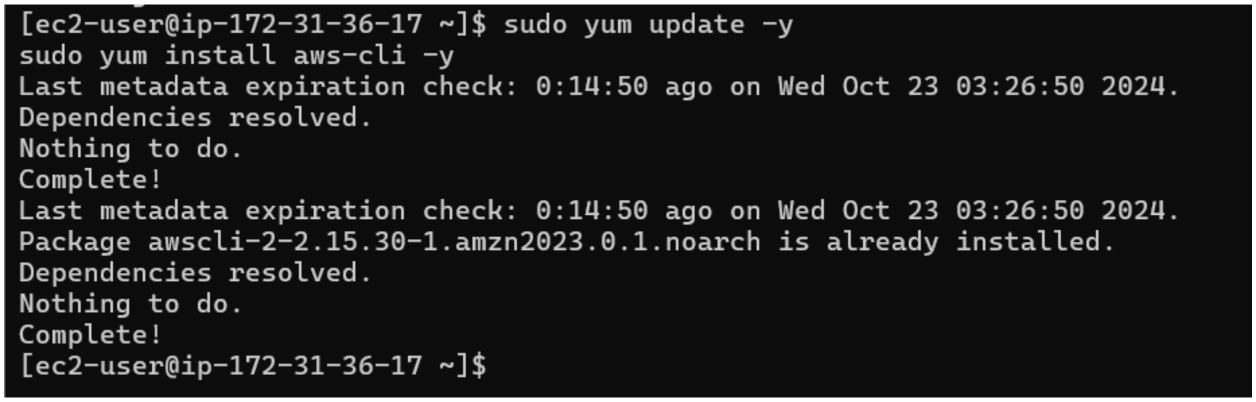
If you lose or forget your secret access key, you cannot retrieve it. Instead, create a new access key and make the old key inactive.

Access key	Secret access key
AKIAXWMA6DDJKG4G6FGX	*************** Show

3. Install AWS CLI and Configure EC2

3.1 Update packages and install AWS CLI:

sudo yum update -y
sudo yum install aws-cli -y

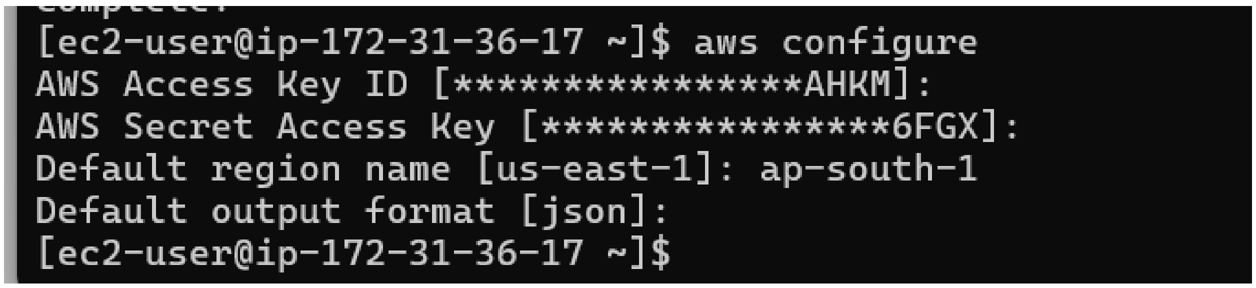

```
[ec2-user@ip-172-31-36-17 ~]$ sudo yum update -y
sudo yum install aws-cli -y
Last metadata expiration check: 0:14:50 ago on Wed Oct 23 03:26:50 2024.
Dependencies resolved.
Nothing to do.
Complete!
Last metadata expiration check: 0:14:50 ago on Wed Oct 23 03:26:50 2024.
Package awscli-2-2.15.30-1.amzn2023.0.1.noarch is already installed.
Dependencies resolved.
Nothing to do.
Complete!
[ec2-user@ip-172-31-36-17 ~]$
```

3.2 Configure AWS CLI:

aws configure

Enter your:

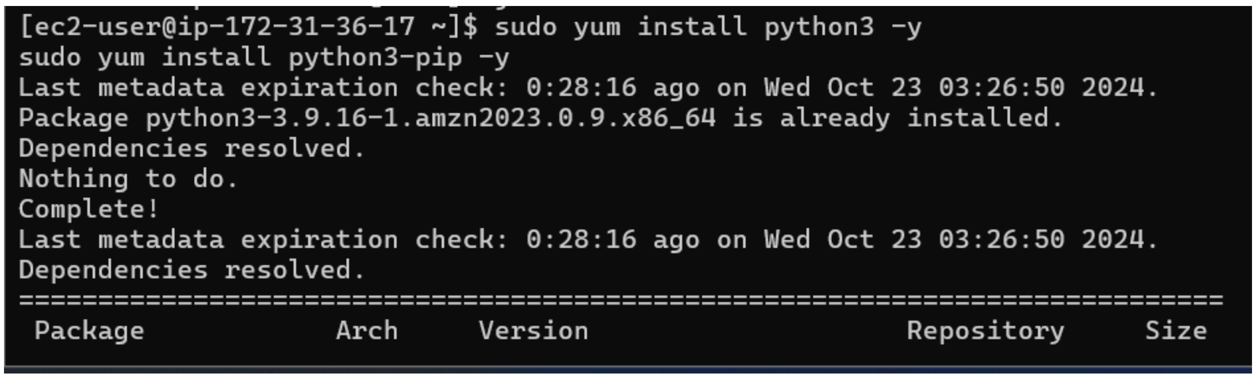
- AWS **Access Key ID**
- AWS **Secret Access Key**
- Region (e.g., `us-east-1`)
- Output format: `json`



```
[ec2-user@ip-172-31-36-17 ~]$ aws configure
AWS Access Key ID [****************AHKM]:
AWS Secret Access Key [****************6FGX]:
Default region name [us-east-1]: ap-south-1
Default output format [json]:
[ec2-user@ip-172-31-36-17 ~]$
```

3.3 **Install Python and pip** (since Lambda uses Python):

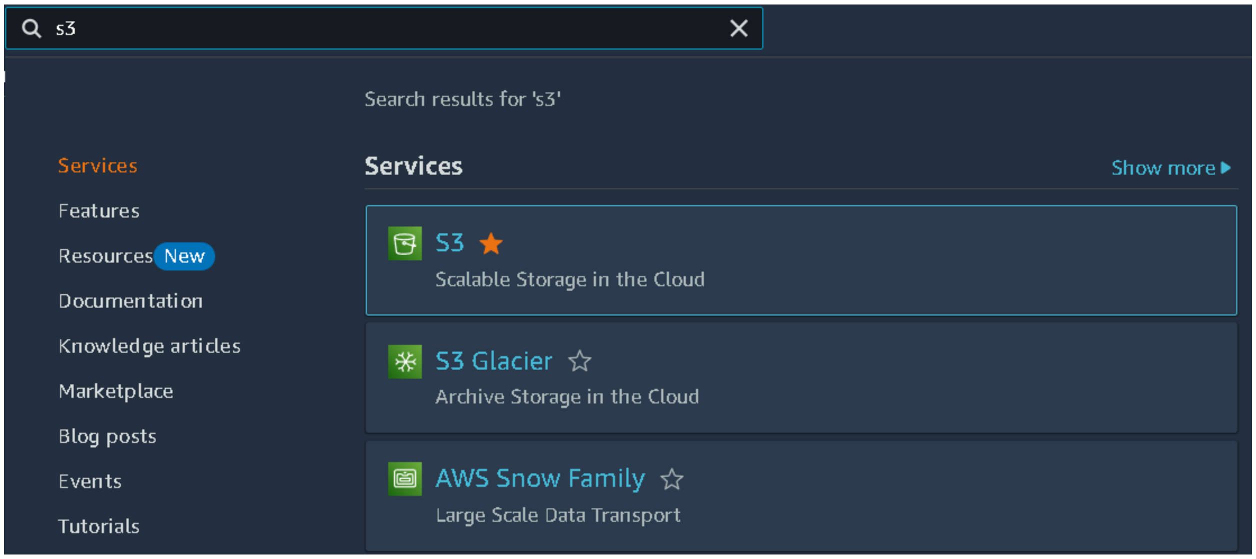
sudo yum install python3 -y
sudo yum install python3-pip -y



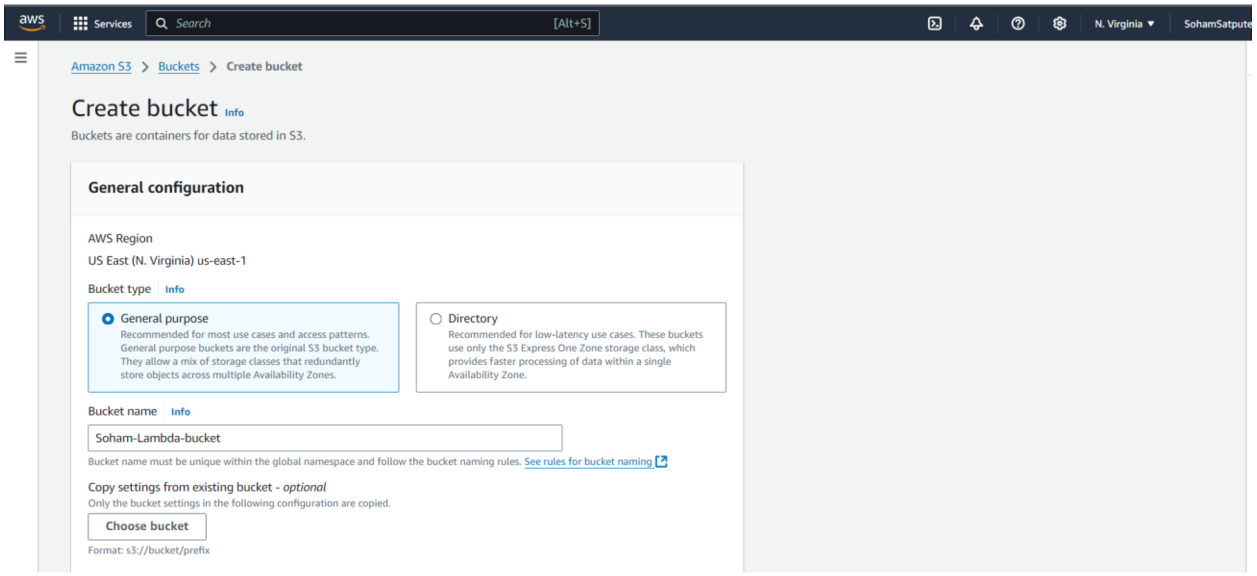
```
[ec2-user@ip-172-31-36-17 ~]$ sudo yum install python3 -y
sudo yum install python3-pip -y
Last metadata expiration check: 0:28:16 ago on Wed Oct 23 03:26:50 2024.
Package python3-3.9.16-1.amzn2023.0.9.x86_64 is already installed.
Dependencies resolved.
Nothing to do.
Complete!
Last metadata expiration check: 0:28:16 ago on Wed Oct 23 03:26:50 2024.
Dependencies resolved.
============================================================================
 Package              Arch      Version                    Repository    Size
```

4. Create and S3 Bucket

4.1 In the AWS Management Console, go to **S3**.



4.2 Click **Create bucket**:

- **Bucket Name**: Give a unique name (e.g., `lambda-s3-trigger-bucket`).
- **Region**: Keep the same as your AWS Configuration (e.g., `us-east-1`).
- Keep other settings default.
- 

Create bucket Info

Buckets are containers for data stored in S3.

General configuration

AWS Region

US East (N. Virginia) us-east-1

Bucket type Info

[✓ General purpose]
Recommended for most use cases and access patterns. General purpose buckets are the original S3 bucket type. They allow a mix of storage classes that redundantly store objects across multiple Availability Zones.

Directory
Recommended for low-latency use cases. These buckets use only the S3 Express One Zone storage class, which provides faster processing of data within a single Availability Zone.

Bucket name Info

Soham-Lambda-bucket

Bucket name must be unique within the global namespace and follow the bucket naming rules. See rules for bucket naming

Copy settings from existing bucket - *optional*

Only the bucket settings in the following configuration are copied.

Choose bucket

Format: s3://bucket/prefix

5. Create the Lambda Function code.

5.1 **On your EC2 instance**, create the Python Lambda function code:

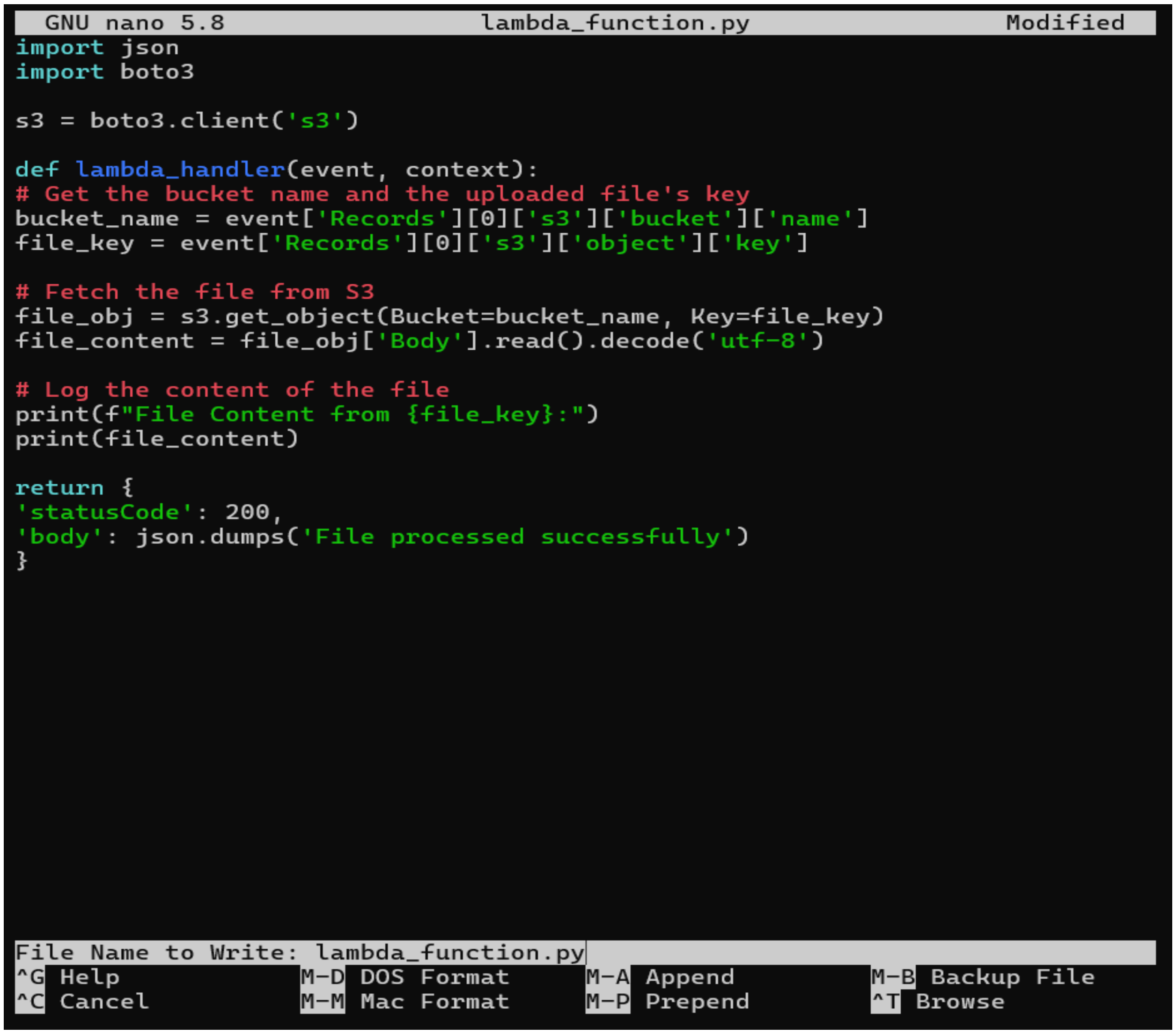
```
nano lambda_function.py
```

```
[ec2-user@ip-172-31-33-47 ~]$ nano lambda_function.py
```

5.2 **Write the following Lambda function** to read the uploaded file from S3:

```
import json
import boto3

s3 = boto3.client('s3')

def lambda_handler(event, context):
    # Get the bucket name and the uploaded file's key
    bucket_name = event['Records'][0]['s3']['bucket']['name']
    file_key = event['Records'][0]['s3']['object']['key']

    # Fetch the file from S3
    file_obj = s3.get_object(Bucket=bucket_name, Key=file_key)
    file_content = file_obj['Body'].read().decode('utf-8')

    # Log the content of the file
    print(f"File Content from {file_key}:")
    print(file_content)

    return {
        'statusCode': 200,
        'body': json.dumps('File processed successfully')
    }
```

5.3 Press `Ctrl+X`, then `Y`, and hit `Enter`.

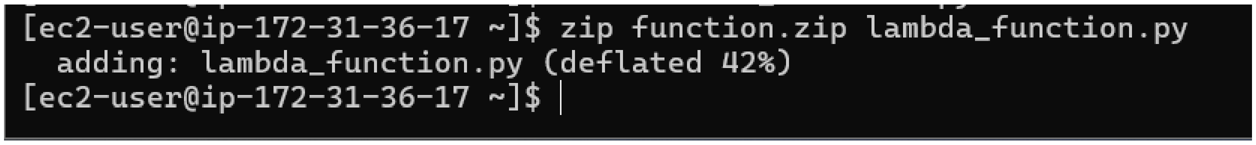


```
  GNU nano 5.8                    lambda_function.py                   Modified
import json
import boto3

s3 = boto3.client('s3')

def lambda_handler(event, context):
# Get the bucket name and the uploaded file's key
bucket_name = event['Records'][0]['s3']['bucket']['name']
file_key = event['Records'][0]['s3']['object']['key']

# Fetch the file from S3
file_obj = s3.get_object(Bucket=bucket_name, Key=file_key)
file_content = file_obj['Body'].read().decode('utf-8')

# Log the content of the file
print(f"File Content from {file_key}:")
print(file_content)

return {
'statusCode': 200,
'body': json.dumps('File processed successfully')
}

File Name to Write: lambda_function.py
^G Help                M-D DOS Format       M-A Append          M-B Backup File
^C Cancel              M-M Mac Format       M-P Prepend         ^T Browse
```

6. Deploy the Lambda function from EC2

6.1 Package the Lambda function:

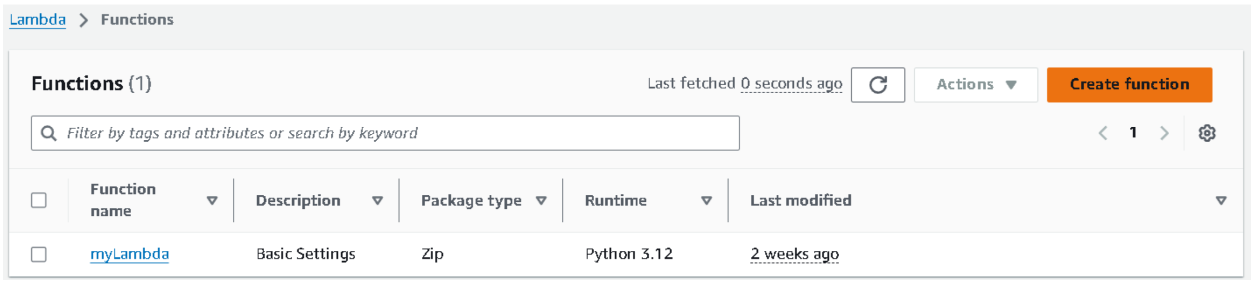
zip function.zip lambda_function.py



```
[ec2-user@ip-172-31-36-17 ~]$ zip function.zip lambda_function.py
  adding: lambda_function.py (deflated 42%)
[ec2-user@ip-172-31-36-17 ~]$ 
```

6.2 **Create a Lambda function in AWS Console**:

- Go to **Lambda** > **Create Function**.



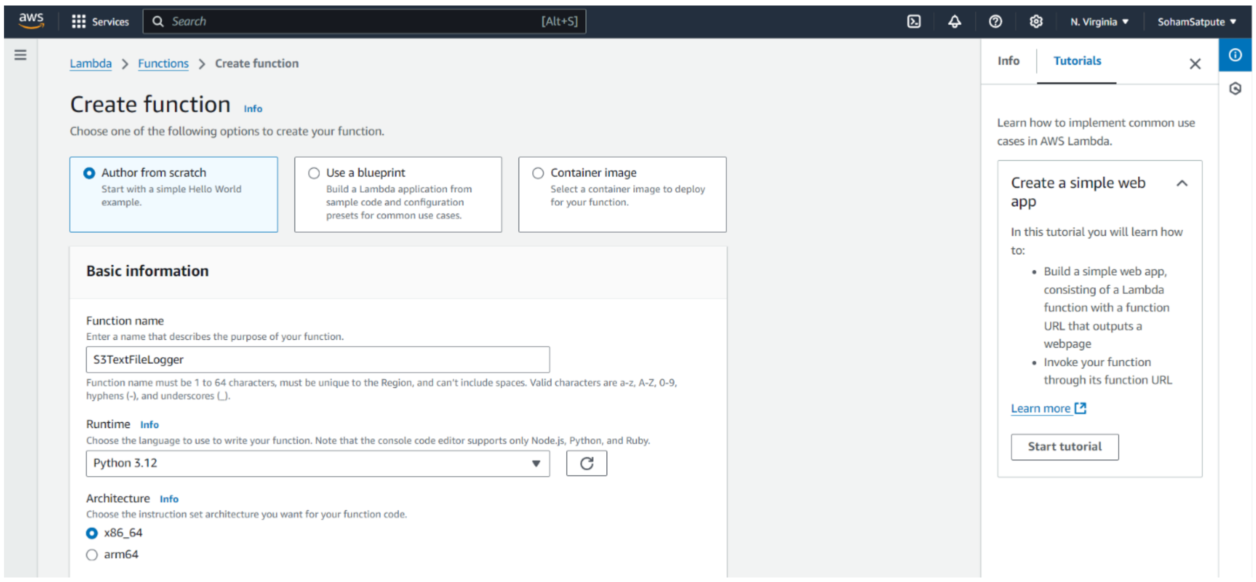
Lambda > Functions

Functions (1) — Last fetched 0 seconds ago

Filter by tags and attributes or search by keyword

	Function name	Description	Package type	Runtime	Last modified
☐	myLambda	Basic Settings	Zip	Python 3.12	2 weeks ago

- Choose **Author from Scratch**:
  - **Function Name**: `S3TextFileLogger`
  - **Runtime**: Python 3.12
  - **Execution Role**: Select "Create a new role with basic Lambda permissions."



Lambda > Functions > Create function

Create function Info

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.
S3TextFileLogger
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 Info
Choose the language to use to write your function. Note that the console code editor supports only Node.js, Python, and Ruby.
Python 3.12

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

Info | Tutorials

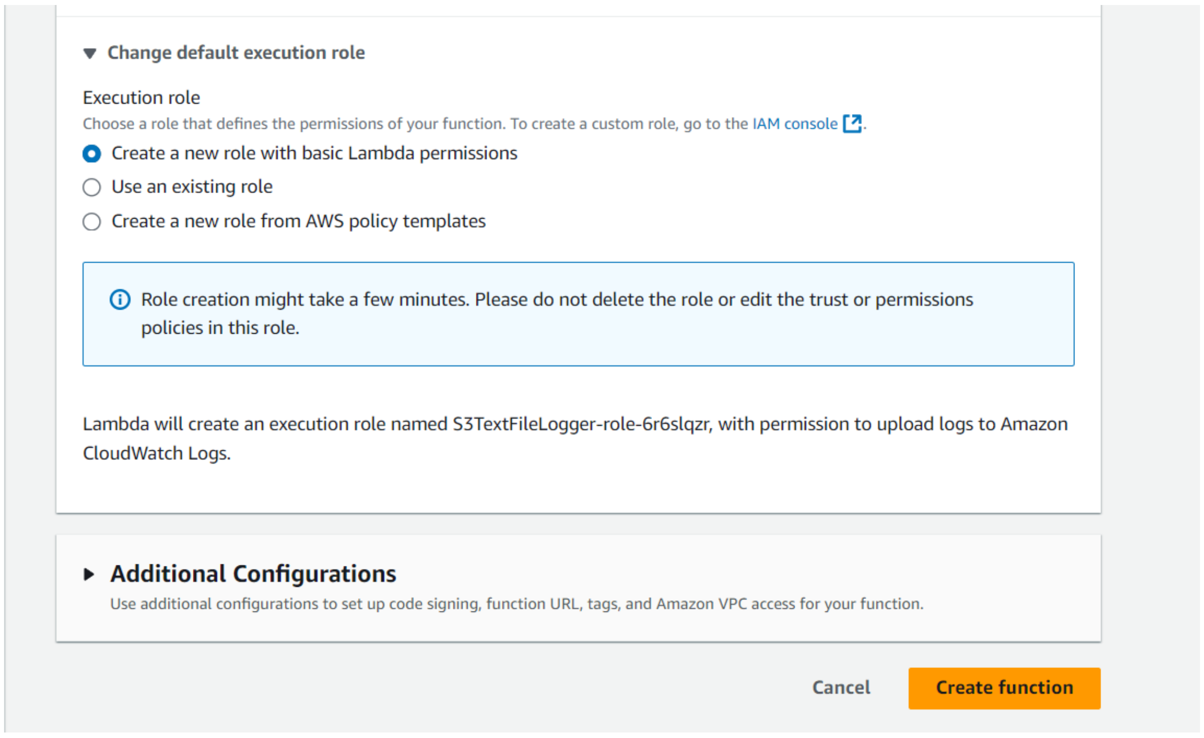
Learn how to implement common use cases in AWS Lambda.

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

-



▼ 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

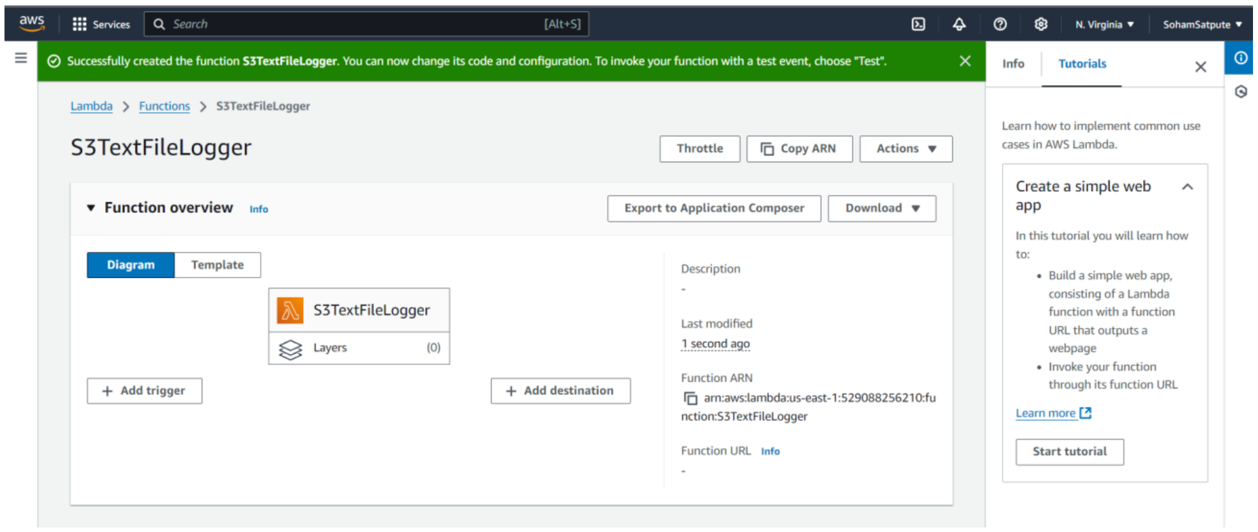
Role creation might take a few minutes. Please do not delete the role or edit the trust or permissions policies in this role.

Lambda will create an execution role named S3TextFileLogger-role-6r6slqzr, with permission to upload logs to Amazon CloudWatch Logs.

▶ Additional Configurations

Use additional configurations to set up code signing, function URL, tags, and Amazon VPC access for your function.

- Click **Create Function**.



Successfully created the function **S3TextFileLogger**. You can now change its code and configuration. To invoke your function with a test event, choose "Test".

Lambda > Functions > S3TextFileLogger

S3TextFileLogger

Description
-

Last modified
1 second ago

Function ARN
arn:aws:lambda:us-east-1:529088256210:function:S3TextFileLogger

Function URL Info
-

Learn how to implement common use cases in AWS Lambda.

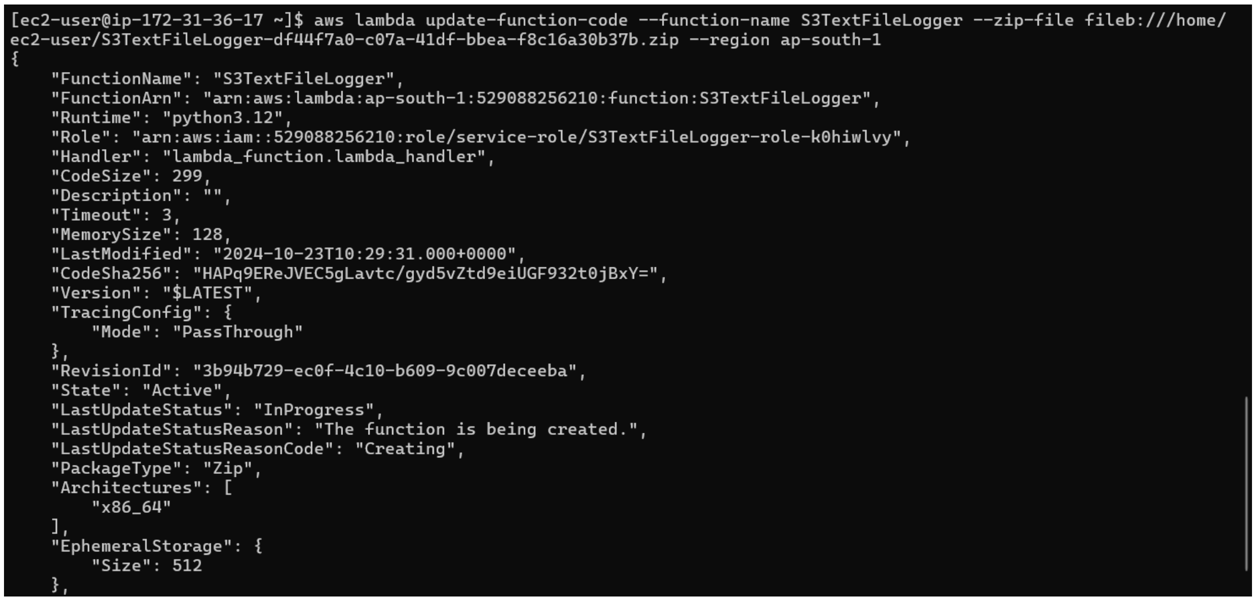
Create a simple web app

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

-

6.3 Upload the function code from EC2 using the AWS CLI:

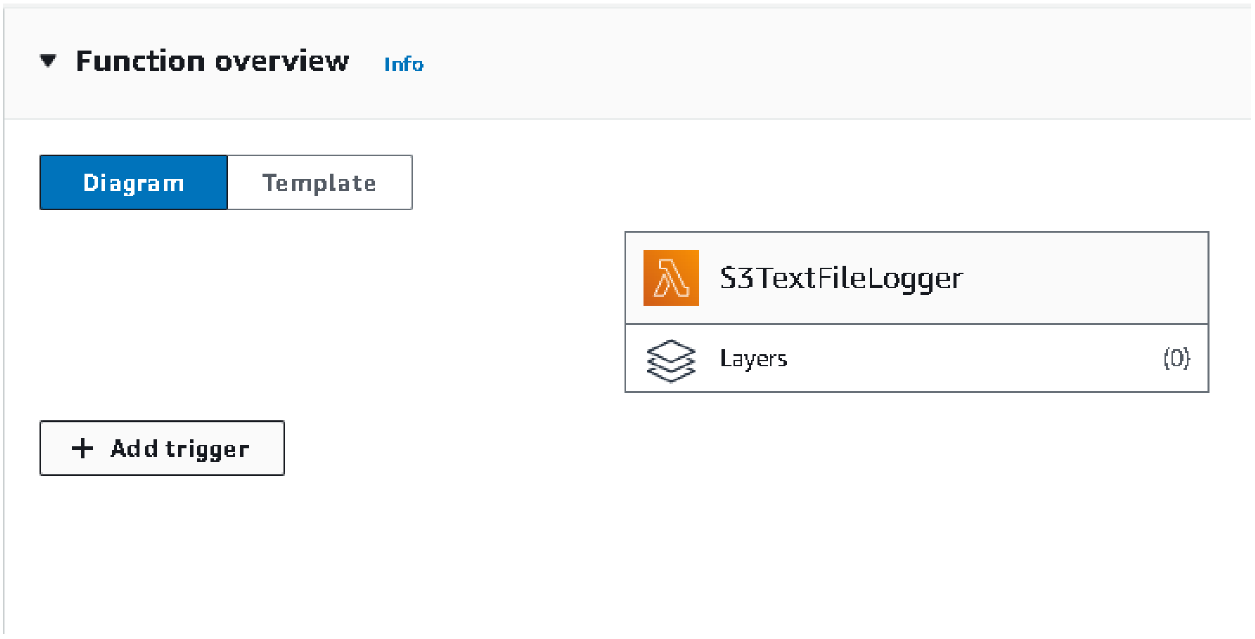
aws lambda update-function-code --function-name S3TextFileLogger --zip-file fileb://function.zip



```
[ec2-user@ip-172-31-36-17 ~]$ aws lambda update-function-code --function-name S3TextFileLogger --zip-file fileb:///home/
ec2-user/S3TextFileLogger-df44f7a0-c07a-41df-bbea-f8c16a30b37b.zip --region ap-south-1
{
    "FunctionName": "S3TextFileLogger",
    "FunctionArn": "arn:aws:lambda:ap-south-1:529088256210:function:S3TextFileLogger",
    "Runtime": "python3.12",
    "Role": "arn:aws:iam::529088256210:role/service-role/S3TextFileLogger-role-k0hiwlvy",
    "Handler": "lambda_function.lambda_handler",
    "CodeSize": 299,
    "Description": "",
    "Timeout": 3,
    "MemorySize": 128,
    "LastModified": "2024-10-23T10:29:31.000+0000",
    "CodeSha256": "HAPq9EReJVEC5gLavtc/gyd5vZtd9eiUGF932t0jBxY=",
    "Version": "$LATEST",
    "TracingConfig": {
        "Mode": "PassThrough"
    },
    "RevisionId": "3b94b729-ec0f-4c10-b609-9c007deceeba",
    "State": "Active",
    "LastUpdateStatus": "InProgress",
    "LastUpdateStatusReason": "The function is being created.",
    "LastUpdateStatusReasonCode": "Creating",
    "PackageType": "Zip",
    "Architectures": [
        "x86_64"
    ],
    "EphemeralStorage": {
        "Size": 512
    },
```

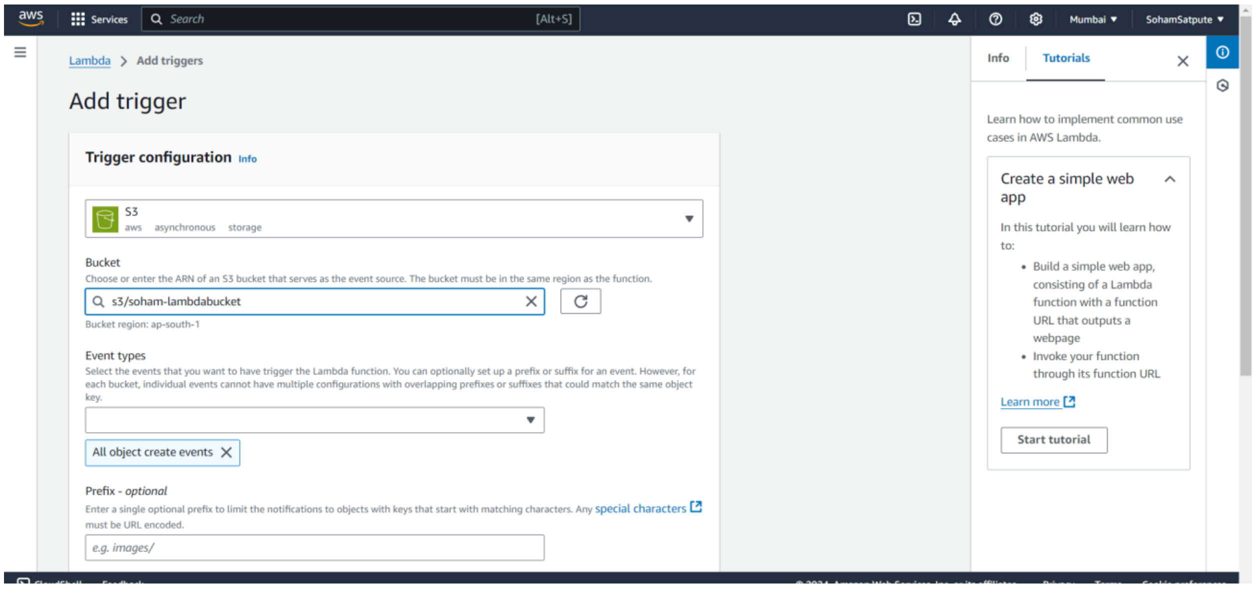
7. Configure S3 as the Trigger

7.1 **In Lambda console**, go to the **Function Overview** section and click **Add Trigger**.



7.2 Choose **S3** as the trigger:

- Select your bucket (`lambda-s3-trigger-bucket`).
- **Event type**: Choose **All object create events**.



Add trigger

Trigger configuration Info

S3
aws asynchronous storage

Bucket
Choose or enter the ARN of an S3 bucket that serves as the event source. The bucket must be in the same region as the function.
s3/soham-lambdabucket
Bucket region: ap-south-1

Event types
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.
All object create events

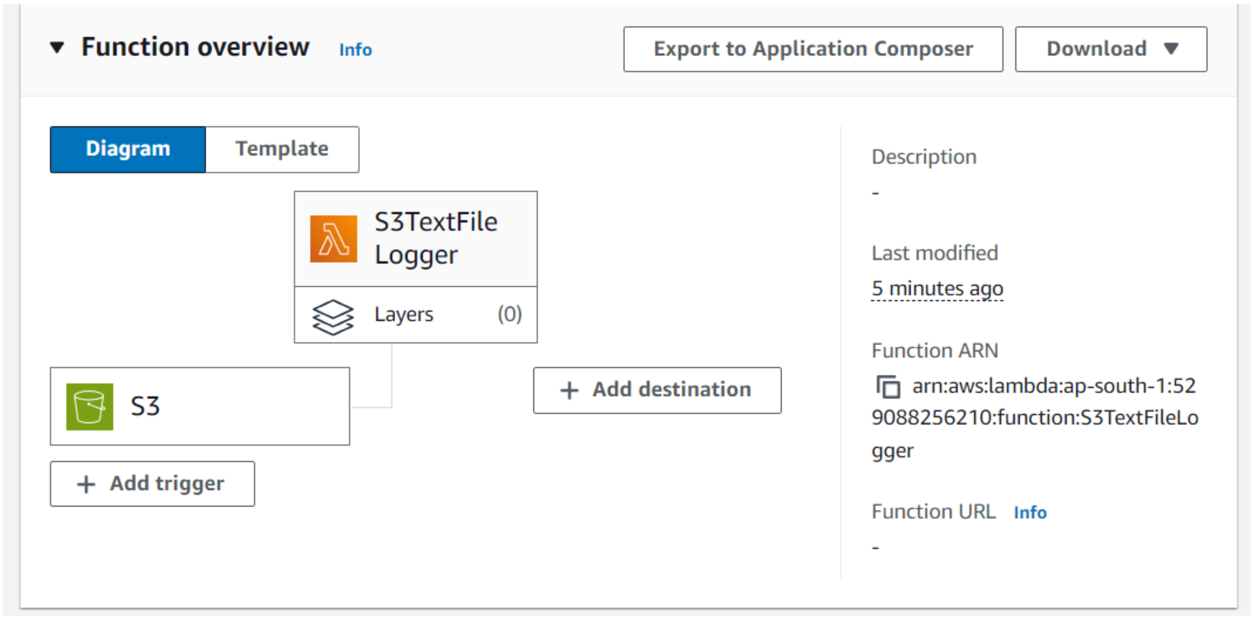
Prefix - *optional*
Enter a single optional prefix to limit the notifications to objects with keys that start with matching characters. Any special characters must be URL encoded.
e.g. images/

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

7.3 Click **Add** to enable the trigger.



Description
-

Last modified
5 minutes ago

Function ARN
arn:aws:lambda:ap-south-1:529088256210:function:S3TextFileLogger

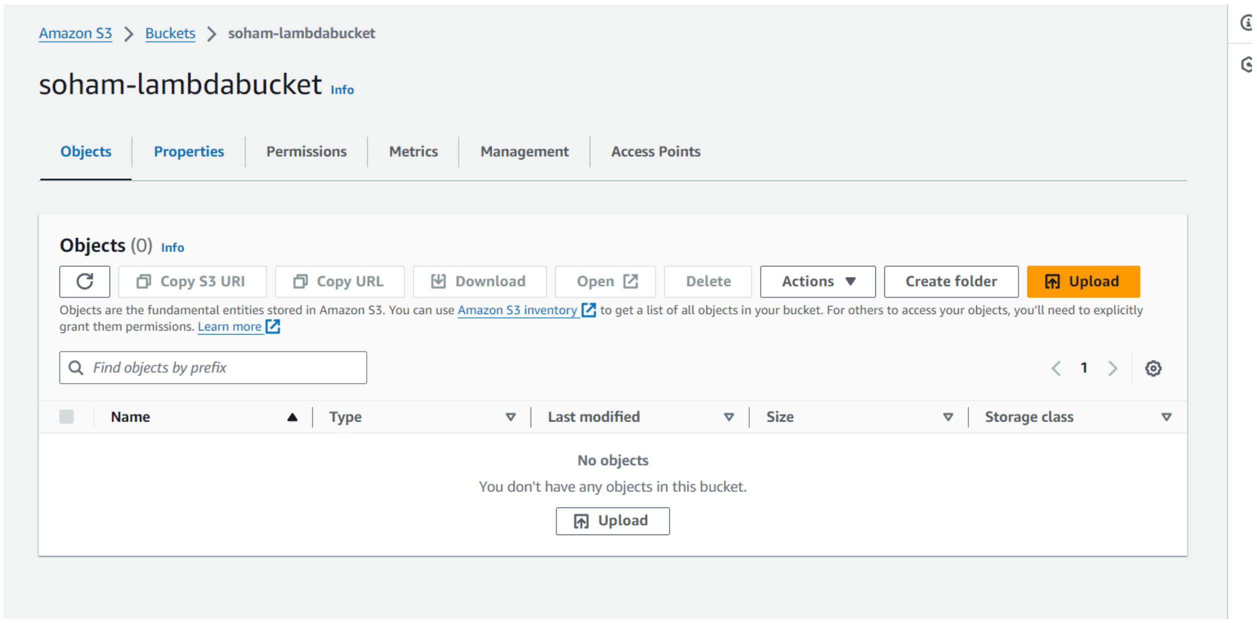
Function URL Info
-

8. Upload a File and Test

8.1 Create a text file in your local host with some content.

```
C:\Users\Soham Satpute>echo I am Soham Satpute of D15A, 52 > C:\soham22\test.txt
```

8.2 **Upload a text file** to your S3 bucket:

- Go to **S3** > your bucket > **Upload**.
- 

  Amazon S3 > Buckets > soham-lambdabucket

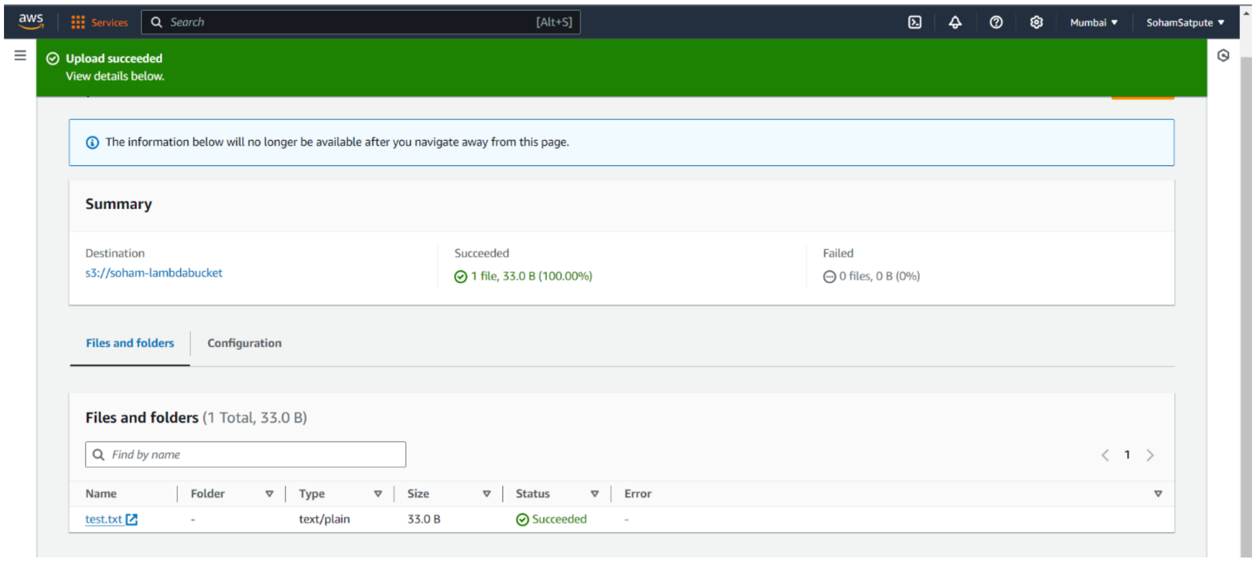
  soham-lambdabucket Info

  Objects (0) Info

  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

Name	Type	Last modified	Size	Storage class

  No objects
  You don't have any objects in this bucket.

- Upload a `.txt` file with some content (e.g., `hello.txt`)
- 

  Upload succeeded
  View details below.

  The information below will no longer be available after you navigate away from this page.

  Summary

Destination	Succeeded	Failed
s3://soham-lambdabucket	1 file, 33.0 B (100.00%)	0 files, 0 B (0%)

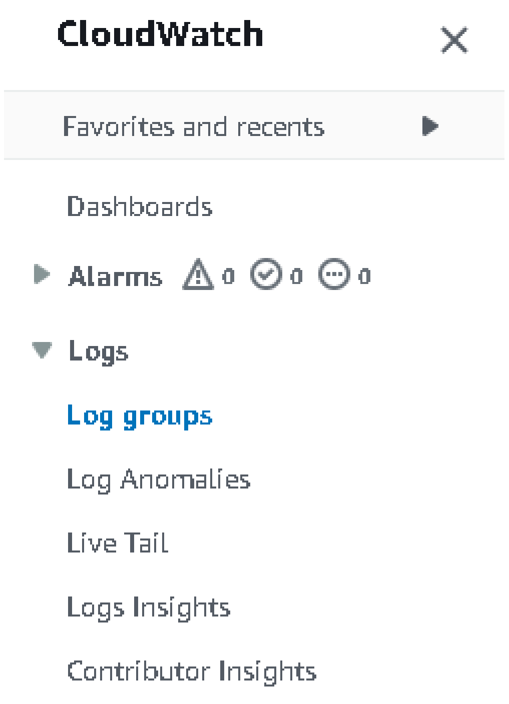
  Files and folders (1 Total, 33.0 B)

Name	Folder	Type	Size	Status	Error
test.txt	-	text/plain	33.0 B	Succeeded	-

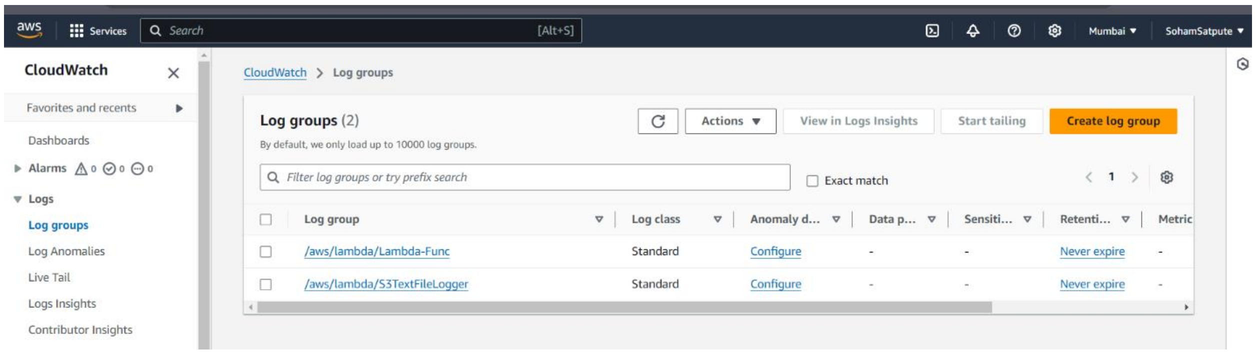
The Lambda function will automatically run when the file is uploaded.

9. Check Logs in CloudWatch

9.1 In the AWS Console, go to **CloudWatch** > **Logs**.



9.2 Under **Log Groups**, find the log group for your Lambda function (`/aws/lambda/S3TextFileLogger`).

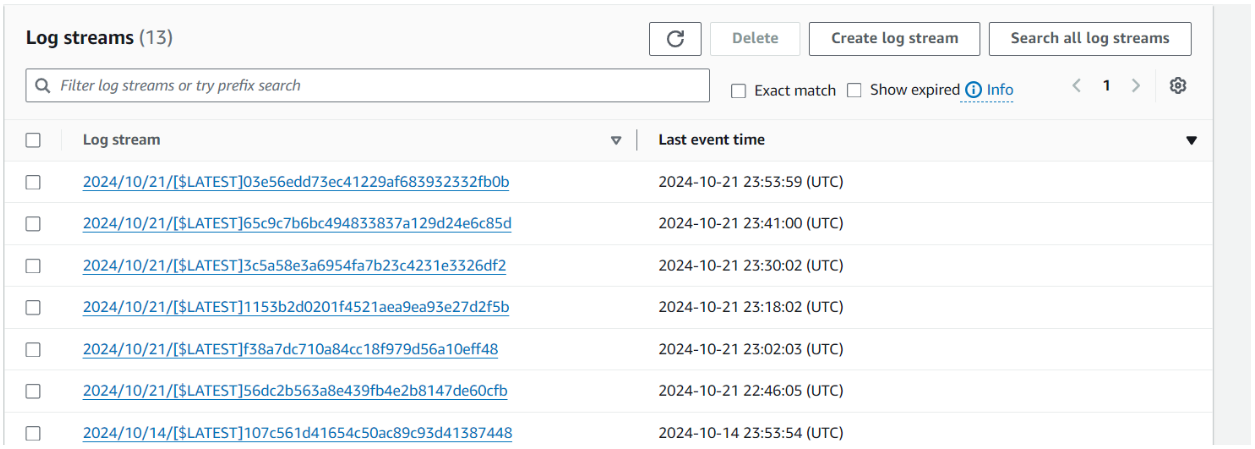


Log groups (2)

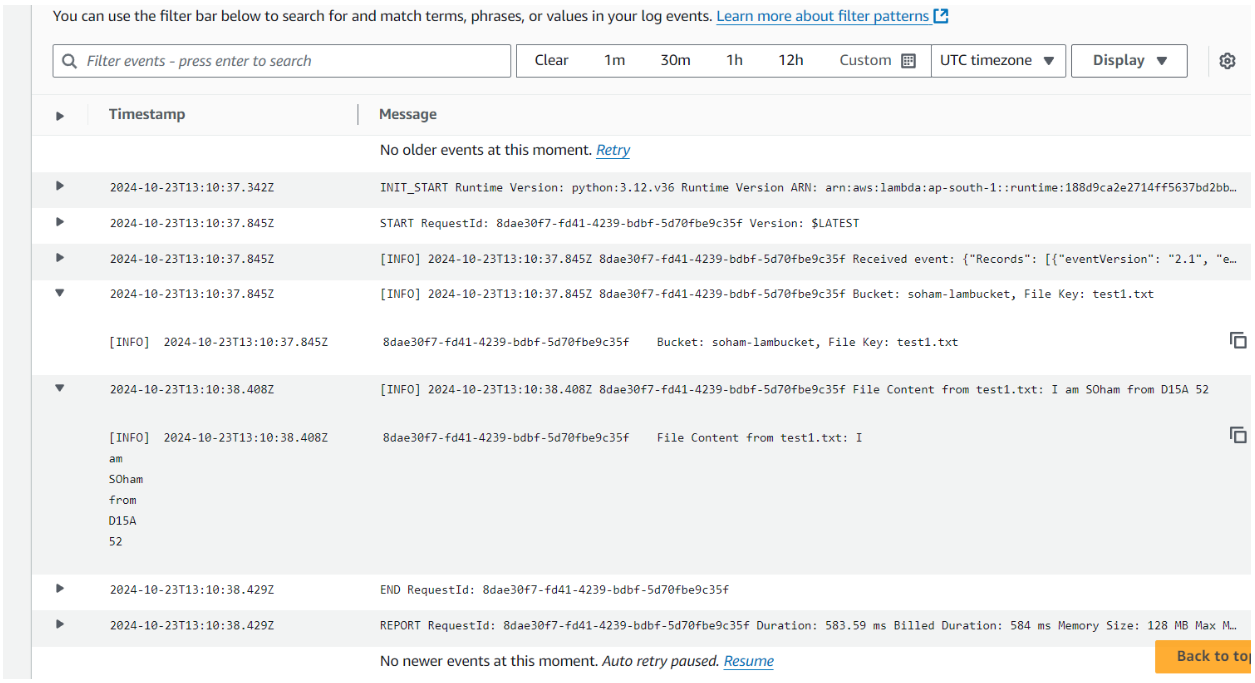
By default, we only load up to 10000 log groups.

Log group	Log class	Anomaly d...	Data p...	Sensiti...	Retenti...	Metric
/aws/lambda/Lambda-Func	Standard	Configure	-	-	Never expire	-
/aws/lambda/S3TextFileLogger	Standard	Configure	-	-	Never expire	-

9.3 Open the latest log stream to see the file content logged by the Lambda function.



Log stream	Last event time
2024/10/21/[$LATEST]03e56edd73ec41229af683932332fb0b	2024-10-21 23:53:59 (UTC)
2024/10/21/[$LATEST]65c9c7b6bc494833837a129d24e6c85d	2024-10-21 23:41:00 (UTC)
2024/10/21/[$LATEST]3c5a58e3a6954fa7b23c4231e3326df2	2024-10-21 23:30:02 (UTC)
2024/10/21/[$LATEST]1153b2d0201f4521aea9ea93e27d2f5b	2024-10-21 23:18:02 (UTC)
2024/10/21/[$LATEST]f38a7dc710a84cc18f979d56a10eff48	2024-10-21 23:02:03 (UTC)
2024/10/21/[$LATEST]56dc2b563a8e439fb4e2b8147de60cfb	2024-10-21 22:46:05 (UTC)
2024/10/14/[$LATEST]107c561d41654c50ac89c93d41387448	2024-10-14 23:53:54 (UTC)


You can use the filter bar below to search for and match terms, phrases, or values in your log events. Learn more about filter patterns

```
Timestamp                  Message
                           No older events at this moment. Retry
2024-10-23T13:10:37.342Z   INIT_START Runtime Version: python:3.12.v36 Runtime Version ARN: arn:aws:lambda:ap-south-1::runtime:188d9ca2e2714ff5637bd2bb…
2024-10-23T13:10:37.845Z   START RequestId: 8dae30f7-fd41-4239-bdbf-5d70fbe9c35f Version: $LATEST
2024-10-23T13:10:37.845Z   [INFO] 2024-10-23T13:10:37.845Z 8dae30f7-fd41-4239-bdbf-5d70fbe9c35f Received event: {"Records": [{"eventVersion": "2.1", "e…
2024-10-23T13:10:37.845Z   [INFO] 2024-10-23T13:10:37.845Z 8dae30f7-fd41-4239-bdbf-5d70fbe9c35f Bucket: soham-lambucket, File Key: test1.txt

    [INFO]  2024-10-23T13:10:37.845Z      8dae30f7-fd41-4239-bdbf-5d70fbe9c35f    Bucket: soham-lambucket, File Key: test1.txt

2024-10-23T13:10:38.408Z   [INFO] 2024-10-23T13:10:38.408Z 8dae30f7-fd41-4239-bdbf-5d70fbe9c35f File Content from test1.txt: I am SOham from D15A 52

    [INFO]  2024-10-23T13:10:38.408Z      8dae30f7-fd41-4239-bdbf-5d70fbe9c35f    File Content from test1.txt: I
    am
    SOham
    from
    D15A
    52

2024-10-23T13:10:38.429Z   END RequestId: 8dae30f7-fd41-4239-bdbf-5d70fbe9c35f
2024-10-23T13:10:38.429Z   REPORT RequestId: 8dae30f7-fd41-4239-bdbf-5d70fbe9c35f Duration: 583.59 ms Billed Duration: 584 ms Memory Size: 128 MB Max M…
                           No newer events at this moment. Auto retry paused. Resume
```