

**Vivekanand Education Society's Institute of Technology, Chembur, Mumbai,
Department of Technology,
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Advance DevOps Practical Examination

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Case Study:16

Event-Driven Image Processing

Problem Statement: "Create an AWS Lambda function that automatically resizes an image when it is uploaded to an S3 bucket. The resized image should be stored in a different S3 bucket."

Theory:

Amazon S3 (Simple Storage Service)

Amazon S3 is a highly durable and scalable object storage service designed to store and retrieve any amount of data from anywhere on the web. It organizes data into **buckets** (similar to folders) and **objects** (individual data items, typically files). Each object is identified by a unique key within the bucket.

Key features:

- **Durability and Availability:** S3 provides 99.999999999% (11 9's) durability by redundantly storing objects across multiple devices in multiple Availability Zones.
- **Scalability:** Automatically scales to handle growing data volumes without upfront provisioning or capacity management.
- **Security:** Supports encryption (both in transit and at rest), along with comprehensive access control policies via IAM.

- **Storage Classes:** Offers a variety of storage classes (Standard, Intelligent-Tiering, Glacier, etc.) for different use cases, balancing cost and retrieval time.
- **Lifecycle Management:** Allows automatic transition of objects between different storage classes or deletion based on defined rules.

Common use cases for S3 include:

- Data backups and disaster recovery.
- Static website hosting.
- Big data analytics.
- Storing media files and serving them to users.

AWS Lambda

AWS Lambda is a **serverless** compute service that runs code in response to defined triggers, such as an HTTP request or an upload to an S3 bucket. Lambda takes care of provisioning and managing the underlying infrastructure, allowing developers to focus on writing and deploying code.

Key concepts:

- **Event-driven architecture:** Lambda responds to triggers from various AWS services like S3, DynamoDB, or CloudWatch Events. It can also be invoked through APIs using Amazon API Gateway.
- **No infrastructure management:** Lambda automatically scales to accommodate the number of incoming requests, handling thousands of concurrent executions.
- **Pay-per-use:** You only pay for the compute time (measured in milliseconds) when the function runs, along with any memory allocated to the function.
- **Runtime flexibility:** Supports multiple languages (Node.js, Python, Ruby, Java, Go, etc.) and custom runtimes.

Use cases:

- Data processing (e.g., resizing images, log analysis).
- Real-time file processing (e.g., uploading data to S3 and triggering Lambda to process it).
- Backends for mobile, web, and IoT applications.

IAM (Identity and Access Management)

IAM enables secure management of access to AWS resources by creating policies that define **who** can access certain resources and **what** actions they can perform.

Key components:

- **Users:** Individual identities with specific credentials.
- **Groups:** A collection of users, allowing common policies to be applied to all members.
- **Roles:** Temporary credentials used to delegate access to AWS services (e.g., EC2 accessing S3).
- **Policies:** Documents that define the permissions (allow or deny) granted to users, groups, or roles. Policies are written in JSON format.

IAM provides **fine-grained access control**, enforcing the principle of least privilege, which ensures that users and applications have the minimum necessary permissions to perform their tasks.

IAM also integrates with:

- **MFA (Multi-Factor Authentication)** for stronger security.
- **Identity Federation**, allowing external identities (like Google or corporate directories) to access AWS.

Additional Concepts:

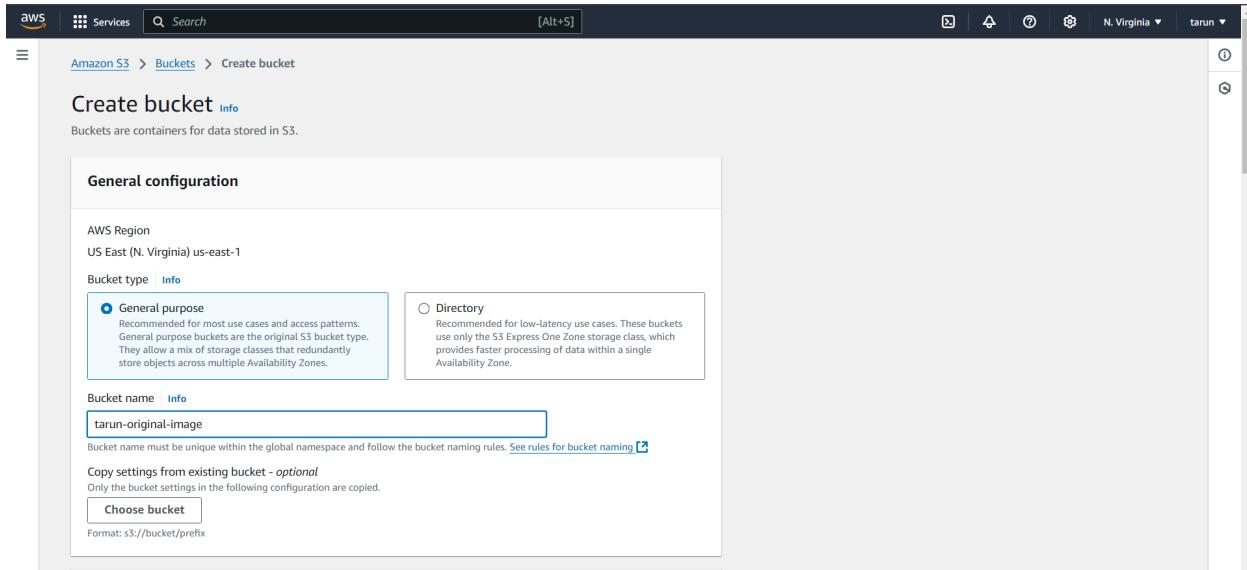
- **CloudWatch:** Monitors AWS resources and applications, providing logging, alarms, and metrics. It can trigger Lambda functions based on these alarms or thresholds.
- **SNS (Simple Notification Service):** Allows sending notifications based on events from AWS services, such as Lambda function invocations or S3 bucket activity.

Step-by-Step Implementation:

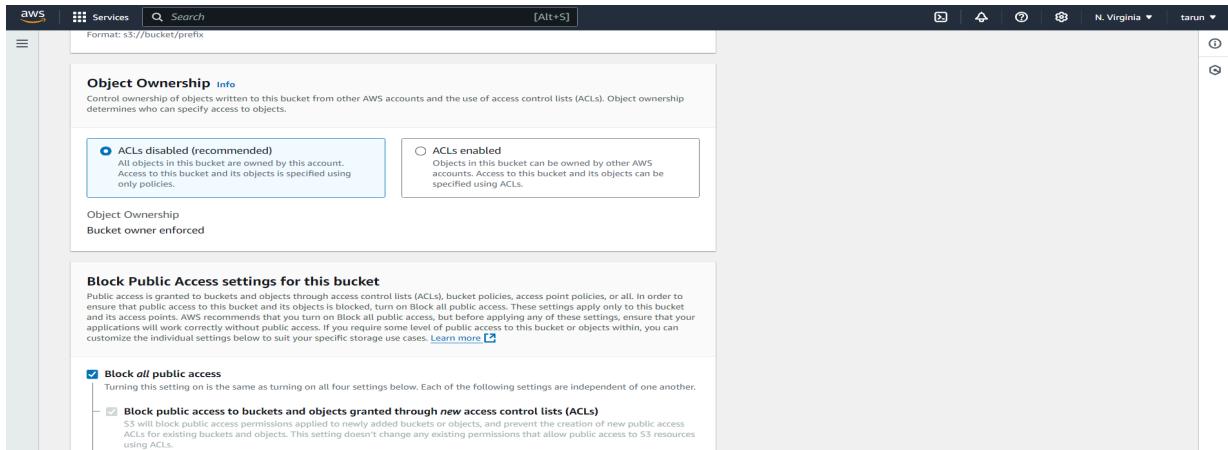
1.) Creating S3 Buckets:-

- 1.) Sign into AWS Management Console
- 2.) Search S3 Service or access it from the Console itself
- 3.) Click on Create Bucket
- 4.) Give a name to the bucket. This is the bucket which will contain the original image

which has not been resized by our Lambda function. Here I have given the name **tarun-original-image**.



5.) Keep the default Configurations



Bucket Versioning

Versioning is a means of keeping multiple variants of an object in the same bucket. You can use versioning to preserve, retrieve, and restore every version of every object stored in your Amazon S3 bucket. With versioning, you can easily recover from both unintended user actions and application failures. [Learn more](#)

Bucket Versioning

Disable

Enable

Tags - optional (0)

You can use bucket tags to track storage costs and organize buckets. [Learn more](#)

No tags associated with this bucket.

[Add tag](#)

Default encryption [Info](#)

Server-side encryption is automatically applied to new objects stored in this bucket.

Encryption type [Info](#)

Server-side encryption with Amazon S3 managed keys (SSE-S3)

Server-side encryption with AWS Key Management Service keys (SSE-KMS)

Dual-layer server-side encryption with AWS Key Management Service keys (DSSE-KMS)

Secure your objects with two separate layers of encryption. For details on pricing, see DSSE-KMS pricing on the Storage tab of the [Amazon S3 pricing page](#).

Default encryption [Info](#)

Server-side encryption is automatically applied to new objects stored in this bucket.

Encryption type [Info](#)

Server-side encryption with Amazon S3 managed keys (SSE-S3)

Server-side encryption with AWS Key Management Service keys (SSE-KMS)

Dual-layer server-side encryption with AWS Key Management Service keys (DSSE-KMS)

Secure your objects with two separate layers of encryption. For details on pricing, see DSSE-KMS pricing on the Storage tab of the [Amazon S3 pricing page](#).

Bucket Key

Using an S3 Bucket Key for SSE-KMS reduces encryption costs by lowering calls to AWS KMS. S3 Bucket Keys aren't supported for DSSE-KMS. [Learn more](#)

Disable

Enable

Advanced settings

After creating the bucket, you can upload files and folders to the bucket, and configure additional bucket settings.

[Cancel](#) [Create bucket](#)

6.) Click on 'Create Bucket' to finalize and create the original image bucket.

7.) Repeat the same procedure to create a bucket to store the resized image. Here I have given the bucket name **tarun-resized-image**.

The screenshot shows the AWS S3 buckets page. At the top, a green banner indicates "Successfully created bucket 'tarun-original-image'". Below this, the "General purpose buckets" tab is selected. A table lists three buckets:

Name	AWS Region	IAM Access Analyzer	Creation date
elasticbeanstalk-us-east-1-904233117622	US East (N. Virginia) us-east-1	View analyzer for us-east-1	October 17, 2024, 14:10:38 (UTC+05:30)
tarun-original-image	US East (N. Virginia) us-east-1	View analyzer for us-east-1	October 23, 2024, 17:45:40 (UTC+05:30)
tarunassi1	US East (N. Virginia) us-east-1	View analyzer for us-east-1	October 17, 2024, 20:17:14 (UTC+05:30)

The screenshot shows the "Create bucket" wizard. Step 1: General configuration. It asks for the AWS Region (US East (N. Virginia) us-east-1) and Bucket type (General purpose). The "General purpose" option is selected. Other options like "Directory" are shown with their descriptions. The bucket name is set to "tarun-resized-image".

The screenshot shows the AWS S3 buckets page. At the top, a green banner indicates "Successfully created bucket 'tarun-resized-image'". Below this, the "General purpose buckets" tab is selected. A table lists four buckets:

Name	AWS Region	IAM Access Analyzer	Creation date
elasticbeanstalk-us-east-1-904233117622	US East (N. Virginia) us-east-1	View analyzer for us-east-1	October 17, 2024, 14:10:38 (UTC+05:30)
tarun-original-image	US East (N. Virginia) us-east-1	View analyzer for us-east-1	October 23, 2024, 17:45:40 (UTC+05:30)
tarun-resized-image	US East (N. Virginia) us-east-1	View analyzer for us-east-1	October 23, 2024, 17:46:42 (UTC+05:30)
tarunassi1	US East (N. Virginia) us-east-1	View analyzer for us-east-1	October 17, 2024, 20:17:14 (UTC+05:30)

8.) Now both the buckets have been created.

2.) Upload Image to original image bucket:-

1.) Select your original image bucket.

2.) Select the Upload option and Drag and Drop the image which you want to use for the test case of our code. Here I have uploaded an image named axolotl.jpg.

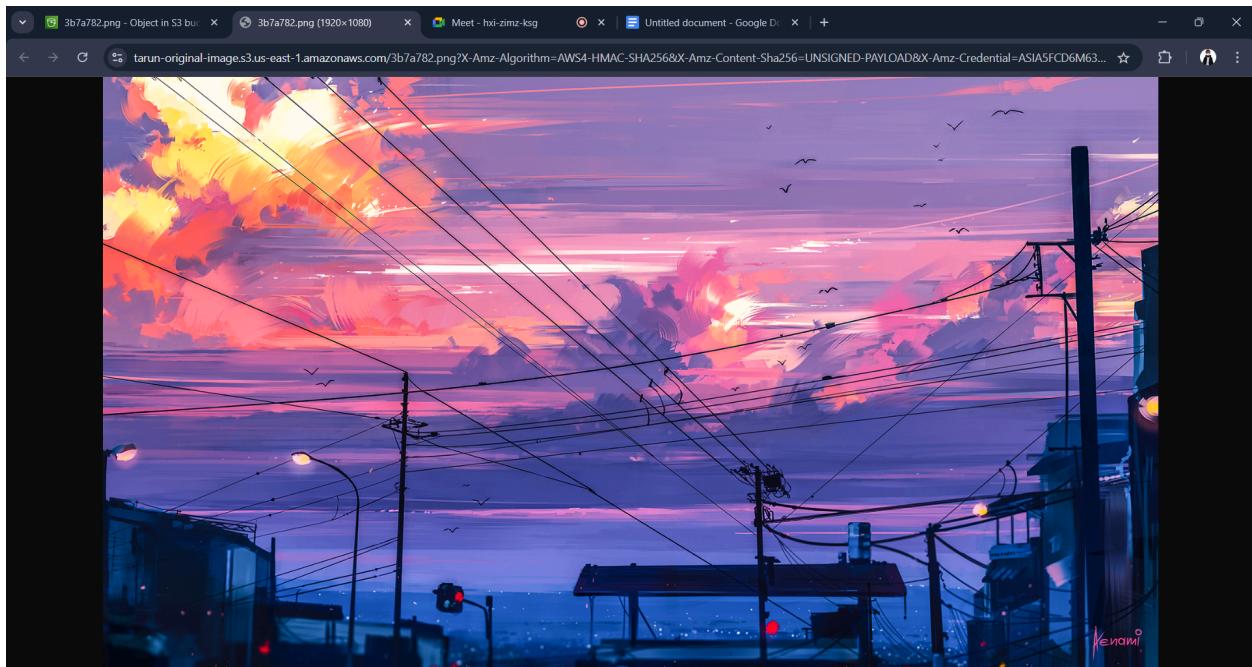
The screenshot shows the 'Upload' interface in the Amazon S3 console. The path is: Amazon S3 > Buckets > tarun-original-image > Upload. A large central area has a dashed border with the instruction: "Drag and drop files and folders you want to upload here, or choose Add files or Add folder." Below this is a table titled "Files and folders (1 Total, 2.9 MB)". It contains one item: "3b7a782.png" (image/png). There are "Remove", "Add files", and "Add folder" buttons above the table. A search bar labeled "Find by name" is also present.

The screenshot shows the "Upload: status" page in the AWS S3 console. At the top, it says "Upload succeeded". The main section is titled "Summary" and shows the destination as "s3://tarun-original-image". Under "Succeeded", it lists "1 file, 2.9 MB (100.00%)". Under "Failed", it lists "0 files, 0 B (0%)". Below this is a "Files and folders" table with one entry: "3b7a782.png" (image/png) which is "Succeeded".

3.) The image has been uploaded to the original image bucket.

4.) Select the image and click Open option to view the Image in Browser.

5.) The dimensions of the image in the original image bucket(1920 X 1080 Here).



3.) Creating IAM Role for Lambda function:-

- 1.) Go to the IAM Console from the AWS Management Console.
- 2.) Select 'Create a new Role' and select **Use Case as Lambda**.

The screenshot shows the AWS IAM 'Create New Role' wizard, Step 2: Trusted entity type. The 'AWS service' option is selected. The 'Use case' section shows 'Lambda' selected as the service.

3.) Give a name to Your role and create a role without attaching any policies for now.

Step 1
Select trusted entity

Step 2
Add permissions

Step 3
Name, review, and create

Name, review, and create

Role details

Role name
Enter a meaningful name to identify this role.
death-role

Description
Add a short explanation for this role.
Allows Lambda functions to call AWS services on your behalf. This is me doing before my practical exam.

Step 1: Select trusted entities

Trust policy

```
1 | {
2 |   "Version": "2012-10-17",
3 |   "Statement": [
4 |     {
5 |       "Effect": "Allow",
6 |       "Action": [
7 |         "lambda:InvokeFunction"
8 |       ]
9 |     }
10 |   ]
11 | }
```

Role death-role created.

IAM > Roles

Roles (4) Info

An IAM role is an identity you can create that has specific permissions with credentials that are valid for short durations. Roles can be assumed by entities that you trust.

<input type="checkbox"/> Role name	▲ Trusted entities	Last activity
aws-elasticbeanstalk-service-role	AWS Service: elasticbeanstalk	-
AWSServiceRoleForSupport	AWS Service: support (Service-Linker)	-
AWSServiceRoleForTrustedAdvisor	AWS Service: trustedadvisor (Service)	-
death-role	AWS Service: lambda	-

4.) Select the role created . Here I had created the role 'Lambda Role**'.**

5.) Scroll Down to view Permissions.

6.) Click on Add permissions and Select 'Create a Inline Policy**' Option. On the create policy window select **JSON** Option and replace the default JSON with this policy:-**

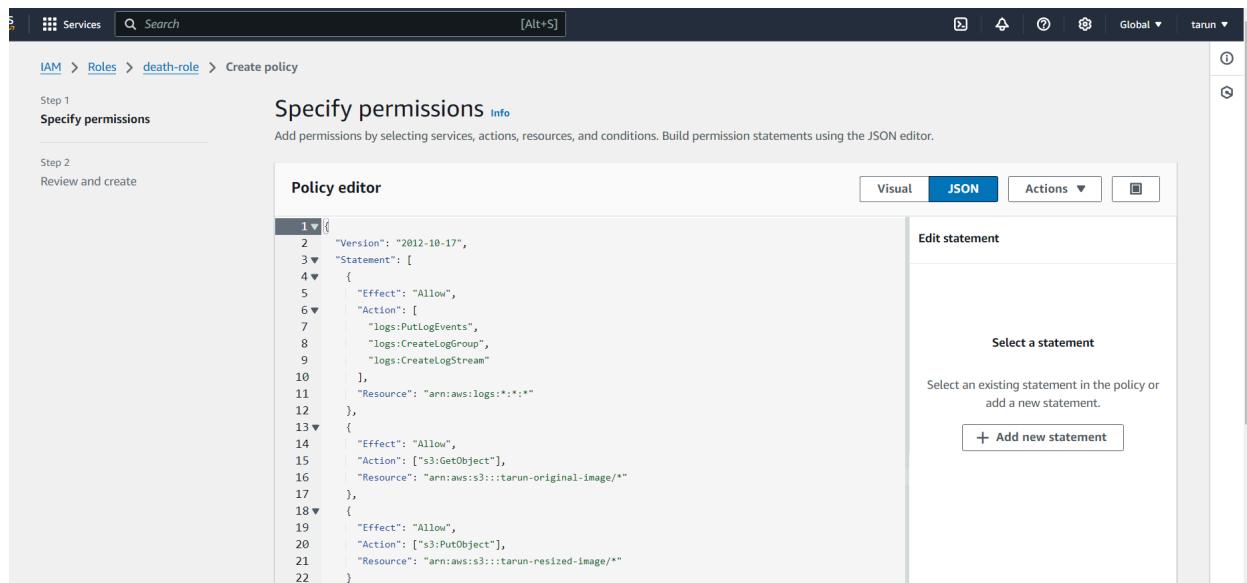
```
{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Effect": "Allow",
      "Action": [
        "lambda:InvokeFunction"
      ]
    }
  ]
}
```

```

"logs:PutLogEvents",
"logs>CreateLogGroup",
"logs>CreateLogStream"
],
"Resource": "arn:aws:logs:*::*"
},
{
"Effect": "Allow",
"Action": ["s3:GetObject"],
"Resource": "arn:aws:s3:::BUCKET_NAME/*"
},
{
"Effect": "Allow",
"Action": ["s3:PutObject"],
"Resource": "arn:aws:s3:::DEST_BUCKET/*"
}
]
}

```

Here BUCKET_NAME = source bucket(tarun-original-image)
 DEST_BUCKET = destination bucket(tarun-resized-image)



The screenshot shows the AWS IAM Policy Editor interface. The top navigation bar includes 'Services', 'Search' (with a placeholder '[Alt+S]'), and a global dropdown for 'tarun'. Below the navigation is a breadcrumb trail: 'IAM > Roles > death-role > Create policy'. The main area is titled 'Specify permissions' with an 'Info' link. A note below says 'Add permissions by selecting services, actions, resources, and conditions. Build permission statements using the JSON editor.' On the left, a sidebar shows 'Step 1: Specify permissions' and 'Step 2: Review and create'. The central 'Policy editor' section displays the following JSON code:

```

1  {
2    "Version": "2012-10-17",
3    "Statement": [
4      {
5        "Effect": "Allow",
6        "Action": [
7          "logs:PutLogEvents",
8          "logs>CreateLogGroup",
9          "logs>CreateLogStream"
10         ],
11        "Resource": "arn:aws:logs:*::*"
12      },
13      {
14        "Effect": "Allow",
15        "Action": ["s3:GetObject"],
16        "Resource": "arn:aws:s3:::tarun-original-image/*"
17      },
18      {
19        "Effect": "Allow",
20        "Action": ["s3:PutObject"],
21        "Resource": "arn:aws:s3:::tarun-resized-image/*"
22      }
    ]
  }

```

To the right of the JSON editor is a sidebar with tabs for 'Edit statement', 'Select a statement', and a button '+ Add new statement'.

7.) Give the policy a name and click on create policy. After doing this the policy will automatically be attached to your IAM Role. Here I had given the policy name casestudy and it had automatically attached to LambdaRole on creation.

The screenshot shows the 'Review and create' step of creating an IAM policy. The policy name is 'resized-policy'. It defines two permissions: 'Allow' for 'CloudWatch Logs' with 'Limited: Write' access level and 'region' resource, and 'Allow' for 'S3' with 'Limited: Read, Write' access level and 'Multiple' resource. There is a search bar and an 'Edit' button.

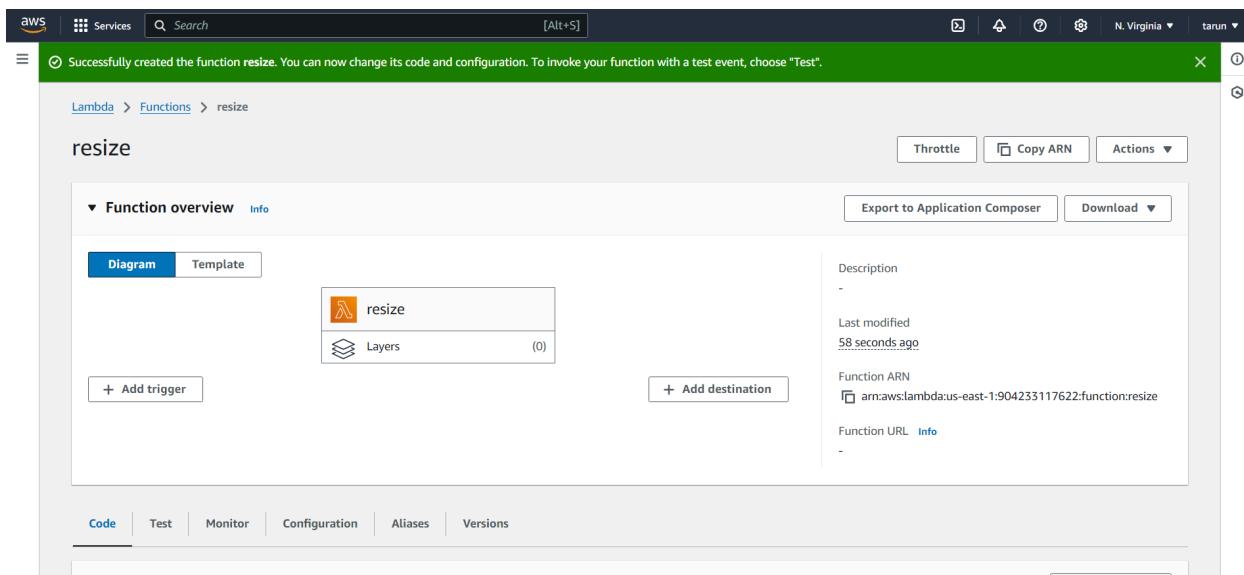
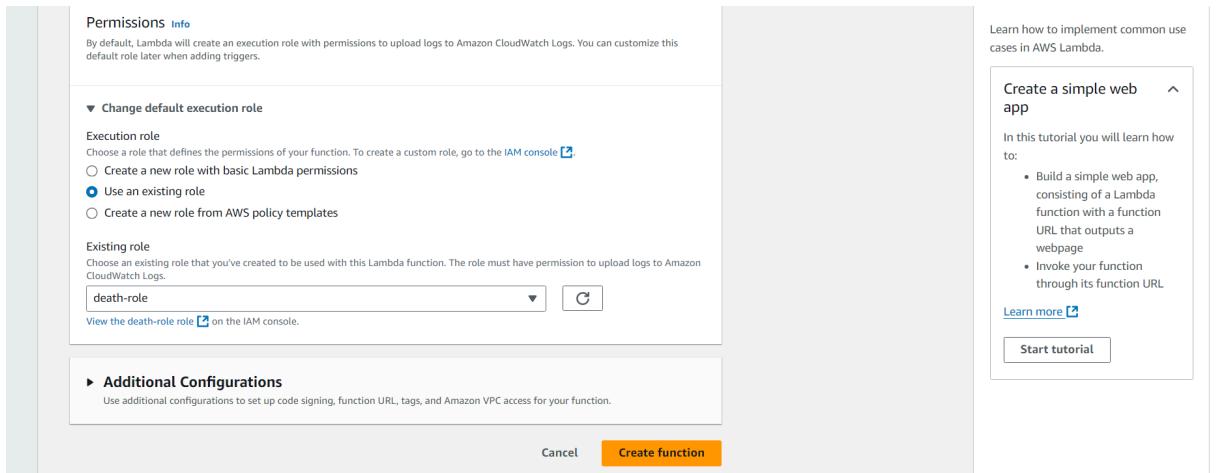
4.) Creating a Lambda Function for resizing:-

1.) Select 'Create Function' Option.

2.) Give a name to your Function and select a Runtime Environment. Here I have given the function name 'image-resizer' and selected the Runtime Environment as Node.js 18.x.

The screenshot shows the 'Create function' interface. Under 'Basic information', the function name is 'resize', runtime is 'Node.js 18.x', and architecture is 'x86_64'. On the right, there is a 'Tutorials' sidebar with a 'Create a simple web app' section.

3.) Now Click on 'Change Default Execution Role' in Basic Information below Permissions and Select 'Use an existing Role' Option and select the role created in Step 3.

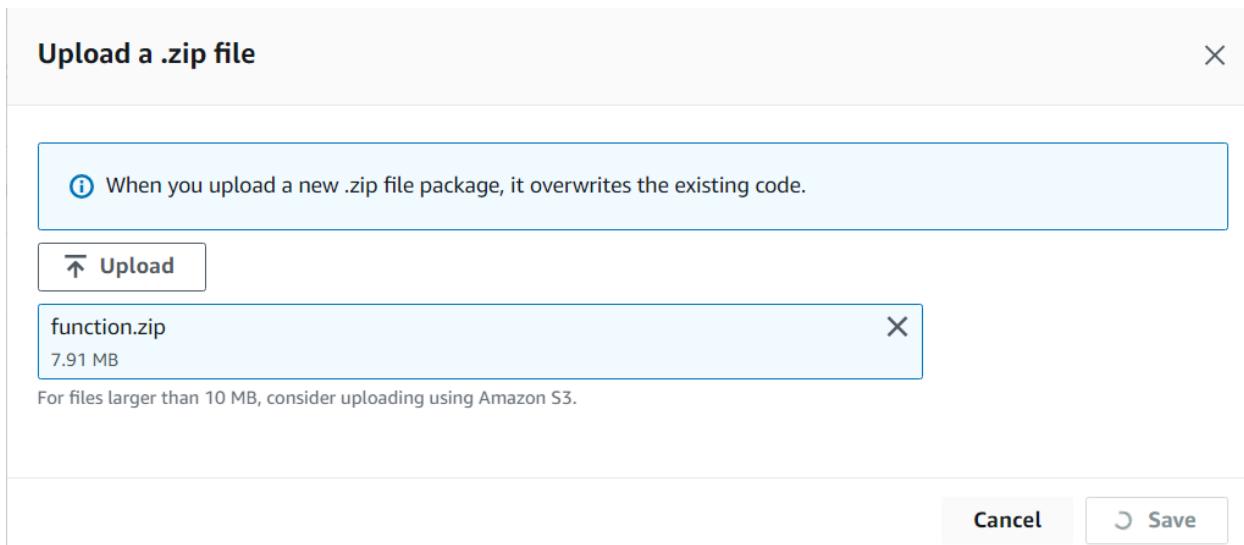


4.) Now after the function has been created select **upload from** Option in the Code Section of the created Lambda Function. Here image-resizer. Select **.zip file** option.

To download the Zip file follow this link:-

<https://github.com/nikitadev-yt/image-resizer-lambda>

And download function.zip from the above repository. It has all the dependencies included to function properly.



5.) Now go to the Configurations Section of the function and select the '**Environment variables**' option and Edit . Add the variable as shown

The screenshot shows the 'Edit environment variables' dialog. The path is Lambda > Functions > resize > Edit environment variables. The 'Environment variables' section shows a single entry: Key 'DEST_BUCKET' with Value 'tarun-resized-image'. There is an 'Add environment variable' button and a 'Remove' button. A link to 'Encryption configuration' is also visible. At the bottom are 'Cancel' and 'Save' buttons.

Instead of tarun-resized-image put your bucket name where you want to store the resized image.

5.) Testing the Lambda function:-

- 1.) Go to the Test section of the Lambda function.
- 2.) Keep the rest of the configurations default and just change the template to **S3-Put** .

3.) In the Event JSON of the S3-Put Template change example-bucket (**near name and arn in S3 Section of the JSON file**) to your original image bucket and key(**in object section**) to the image which you had uploaded in Step 2 for testing. Here I have changed the example - bucket to karan-original-bucket and key to axolotl.jpg.

The screenshot shows the AWS Lambda Configuration page for a function named "Successfully updated the function resize". The "Configuration" tab is selected. On the left, there's a sidebar with "General configuration", "Triggers", "Permissions", "Destinations", "Function URL", and "Environment variables". The "Environment variables" tab is active, showing one entry: "Key": "DEST_BUCKET", "Value": "tarun-resized-image". There's also a "Find environment variables" search bar and a "Edit" button.

The screenshot shows the AWS Lambda Test page for the "s3-put" test case. The "Event JSON" section displays the following JSON code:

```

0     "eventName": "ObjectCreated.Put",
1     "userIdentity": {
2       "principalId": "EXAMPLE"
3     },
4     "requestParameters": {
5       "sourceIPAddress": "127.0.0.1"
6     },
7     "responseElements": {
8       "x-amz-request-id": "EXAMPLE123456789",
9       "x-amz-id-2": "EXAMPLE123/5678abcdefghijklmabaisawesome/mnopqrstuvwxyzABCDEFGH"
10      },
11      "s3": {
12        "s3SchemaVersion": "1.0",
13        "configurationId": "testConfigRule",
14        "bucket": {
15          "name": "tarun-original-image",
16          "ownerIdentity": {
17            "principalId": "EXAMPLE"
18          },
19          "arn": "arn:aws:s3:::tarun-original-image"
20        },
21        "object": {
22          "key": "3b7a782.png",
23          "size": 1024,
24          "eTag": "0123456789abcdef0123456789abcdef",
25          "sequencer": "0A1B2C3D4E5F678901"
26        }
27      }
28    }
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6.) Add Lambda Trigger:-

- 1.) Select Add Trigger on the Lambda Function Page.
- 2.) Select S3 in the Configuration and select your original image bucket(source bucket) so that whenever an Image is uploaded on that bucket the function is triggered and the Image is resized and stored on the resized image bucket.
- 3.) Keep Rest of the configurations Default.

Trigger configuration [Info](#)

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.
 [X](#) [C](#)
Bucket region: us-east-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 [X](#)

Prefix - optional
Enter a single optional prefix to limit the notifications to objects with keys that start with matching characters. Any special characters [?C](#) must be URL encoded.

resize

The trigger tarun-original-image was successfully added to function resize. The function is now receiving events from the trigger.

Function overview [Info](#)

Diagram **Template**

resize

S3

+ Add trigger

Description

Last modified
5 minutes ago

Function ARN
[arn:aws:lambda:us-east-1:904233117622:function:resize](#)

Function URL [Info](#)

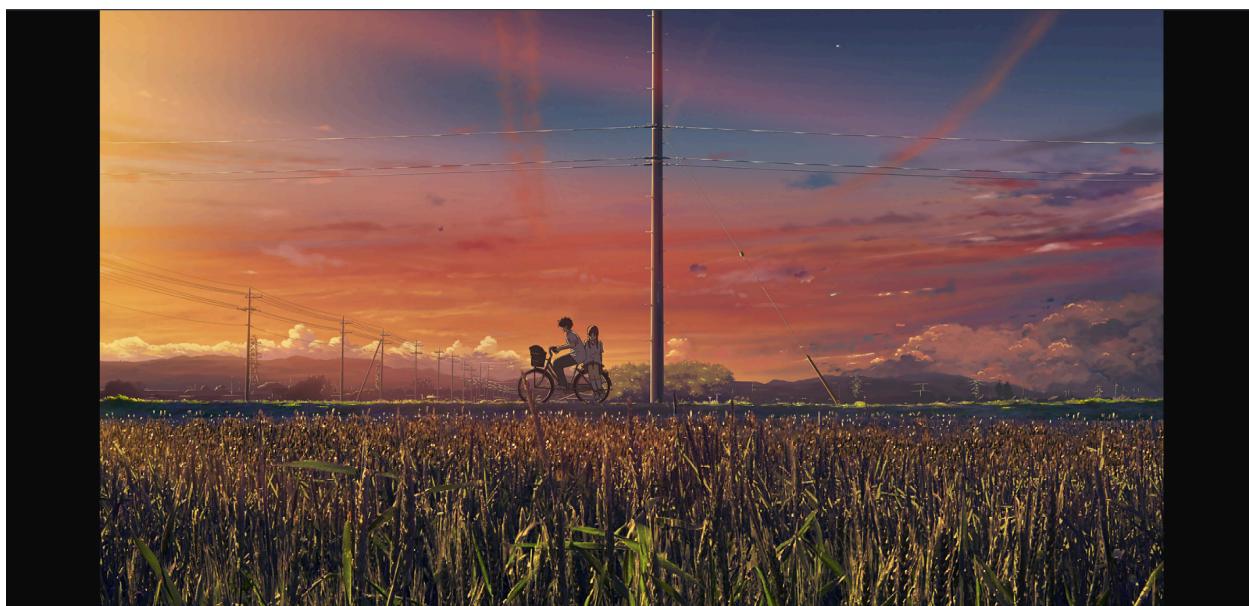
The screenshot shows the AWS Lambda Triggers configuration page. On the left, there's a sidebar with various options like General configuration, Triggers (selected), Permissions, Destinations, Function URL, Environment variables, Tags, VPC, RDS databases, Monitoring and operations tools, and Concurrency and recursion detection. The main panel displays a single trigger named "S3: tarun-original-image". The trigger is associated with the function "arnaws:s3:::tarun-original-image". It specifies the event type as "s3:ObjectCreated:*" and includes a detailed description of the notification settings.

7.) Final Test:-

1.) Upload an image again in the original image bucket and open it in the browser and see its dimensions. Here I have uploaded an 1gBDad9.png for this .

The screenshot shows the Amazon S3 Buckets page. The URL is "Amazon S3 > Buckets > tarun-original-image". The bucket name is "tarun-original-image". Below the bucket name, there are tabs for Objects (selected), Properties, Permissions, Metrics, Management, and Access Points. The "Objects" section shows two items:

Name	Type	Last modified	Size	Storage class
1gBDad9.png	png	October 23, 2024, 18:14:13 (UTC+05:30)	2.9 MB	Standard
3b7a782.png	png	October 23, 2024, 17:48:31 (UTC+05:30)	2.9 MB	Standard



2.) Go to your resized image bucket and open the image in the browser to see changed Dimensions



3.) Experiment successfully Done.

Conclusion:

By leveraging AWS Lambda and S3, an efficient and scalable solution for automatic image resizing is implemented. The Lambda function, developed in Node.js, ensures that each image uploaded to the source S3 bucket is resized and stored in the destination bucket without manual intervention. This approach enhances the image processing workflow, providing a cost-effective and automated system that can handle dynamic workloads.