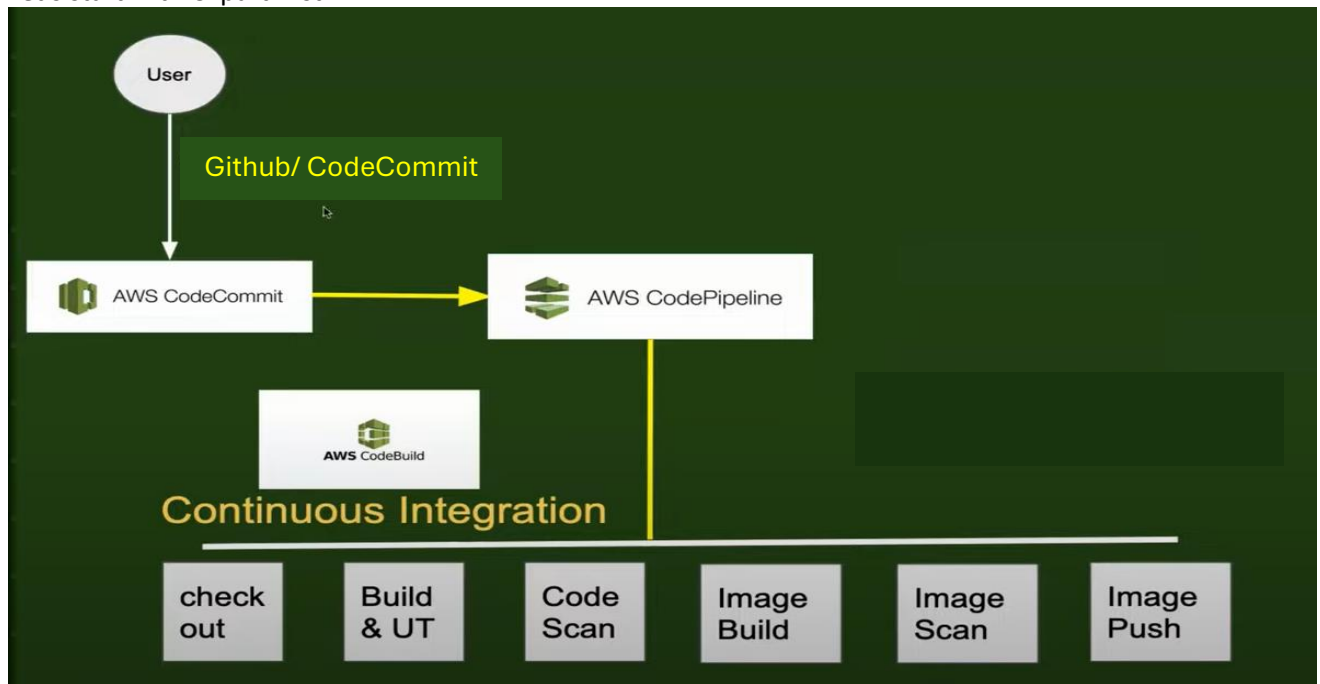


# End-to-End CI/CD Implementation for Python Flask Application on AWS

Let's start with CI part first.....



CI Diagram

1. Use some files present in our GitHub repo. like app.py, appspec.yml and Dockerfile etc.  
<https://github.com/Sona-Yadav/AWS-CICD-PROJECT>

2. Create a dockerfile:

```
# Base image
FROM python:3.8

# Set the working directory inside the container
WORKDIR /app

# Copy the requirements file
COPY requirements.txt .

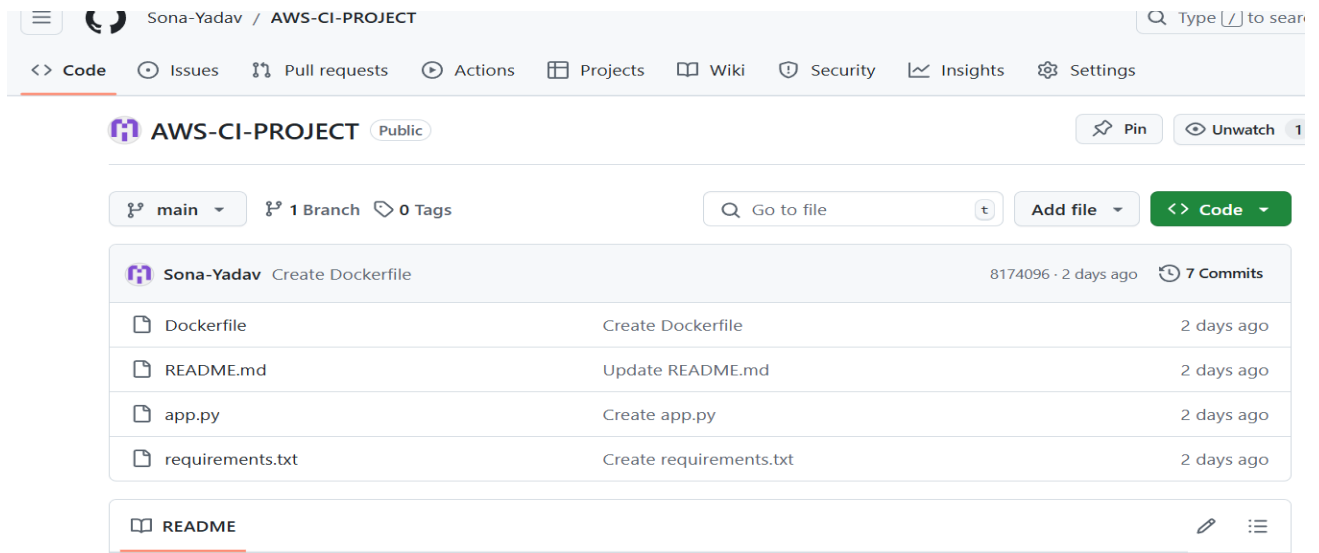
# Install the project dependencies
RUN pip install -r requirements.txt

# Copy the application code into the container
COPY . .

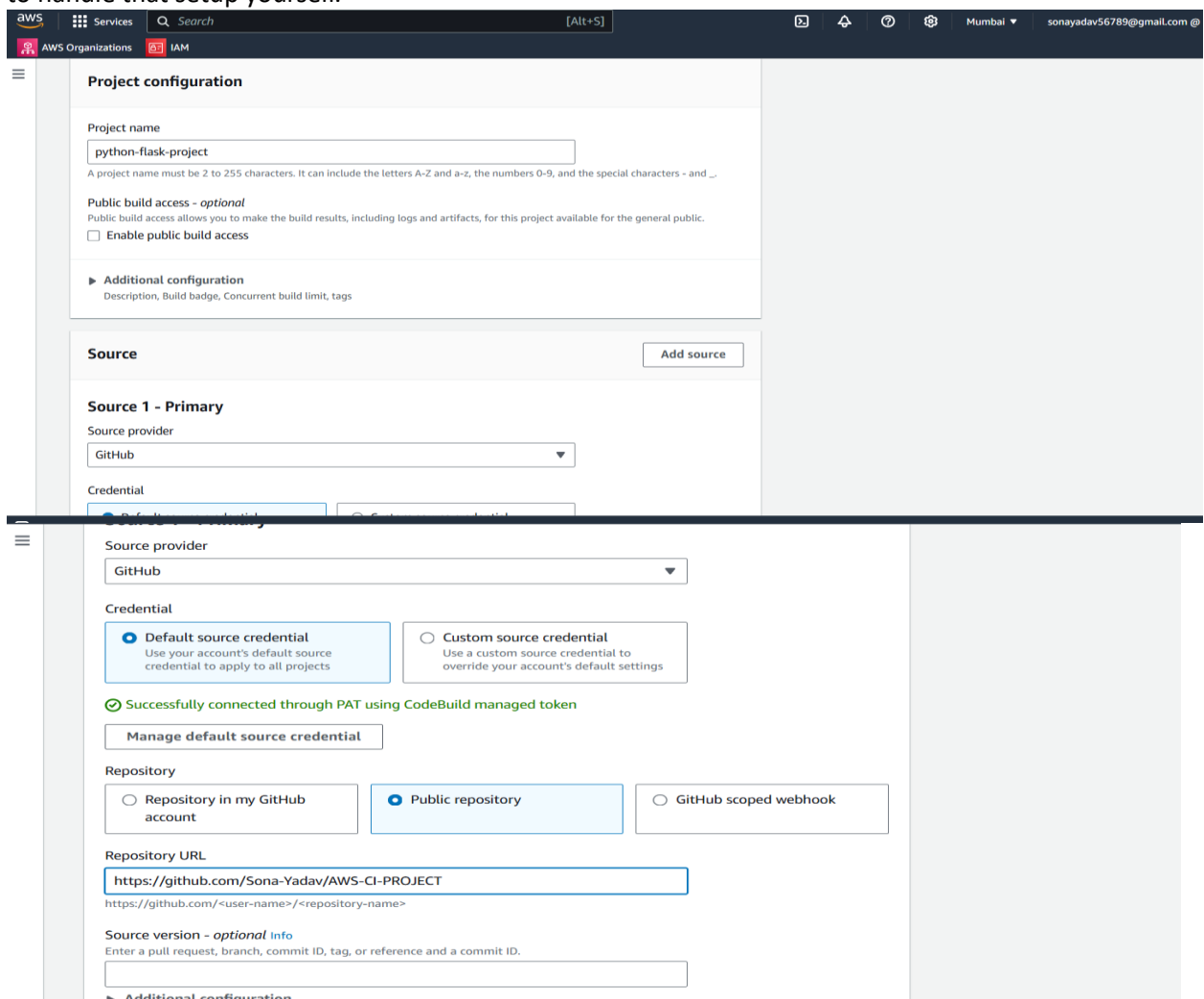
# Expose the port the Flask application will be listening on
EXPOSE 5000

# Set environment variables, if necessary
# ENV MY_ENV_VAR=value

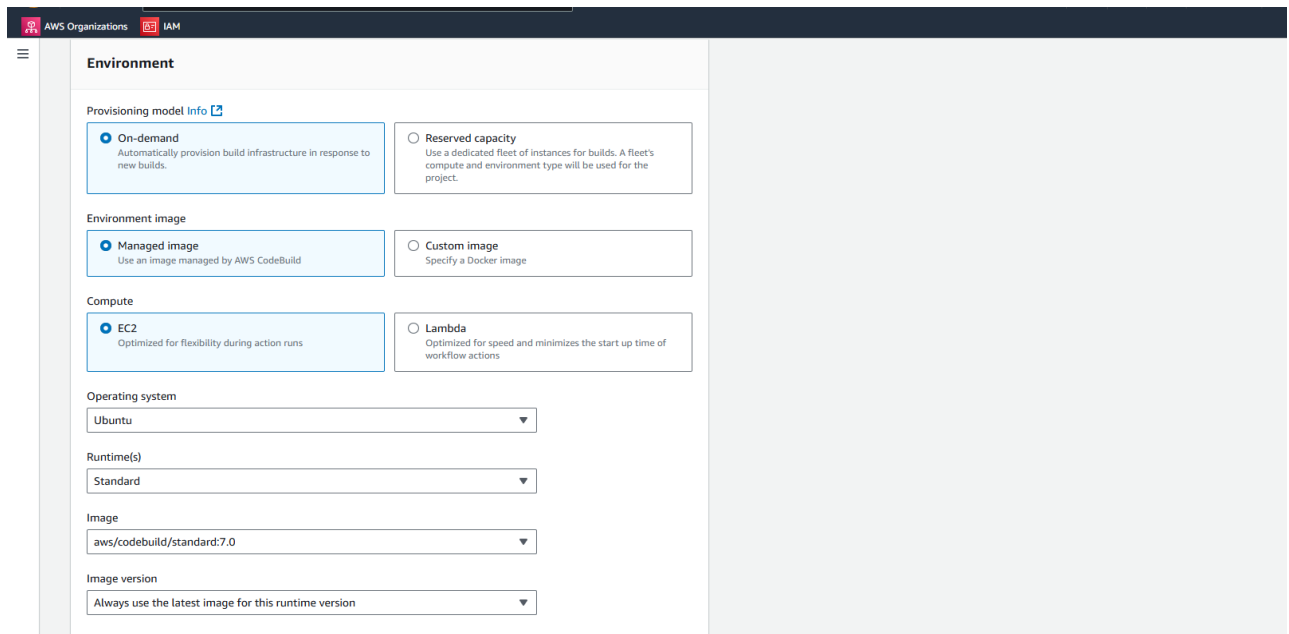
# Run the Flask application
CMD ["python", "app.py"]
```



3. (i) Go to AWS CodeBuild and click on "Create Project."
- (ii) Set the project name as python-flask-project.
- (iii) For now, do not modify the setting for restricting the number of concurrent builds. If multiple developers push commits to a GitHub or AWS CodeCommit repository, and 100 developers trigger code changes simultaneously, you can choose whether to run all 100 pipelines at once or limit the number of concurrent builds. We will leave this setting as-is for now.
- (iv) Set the source provider to GitHub.
- (v) For the environment, when using Jenkins, you would need to create worker nodes and install an operating system on top of those nodes. However, with CodeBuild, AWS provides managed images, so you don't need to handle that setup yourself.



(vi) Env.



**Environment**

Provisioning model [Info](#)

☒ **On-demand**  
Automatically provision build infrastructure in response to new builds.

☐ **Reserved capacity**  
Use a dedicated fleet of instances for builds. A fleet's compute and environment type will be used for the project.

Environment image

☒ **Managed image**  
Use an image managed by AWS CodeBuild

☐ **Custom image**  
Specify a Docker image

Compute

☒ **EC2**  
Optimized for flexibility during action runs

☐ **Lambda**  
Optimized for speed and minimizes the start up time of workflow actions

Operating system  
Ubuntu

Runtime(s)  
Standard

Image  
aws/codebuild/standard:7.0

Image version  
Always use the latest image for this runtime version

(vii) Created a new service role.

(viii) The **buildspec** file in AWS CodeBuild is similar to a Jenkinsfile in Jenkins. You can either use a buildspec file from your GitHub repository or create one manually by using the Insert build commands option provided in the CodeBuild interface.

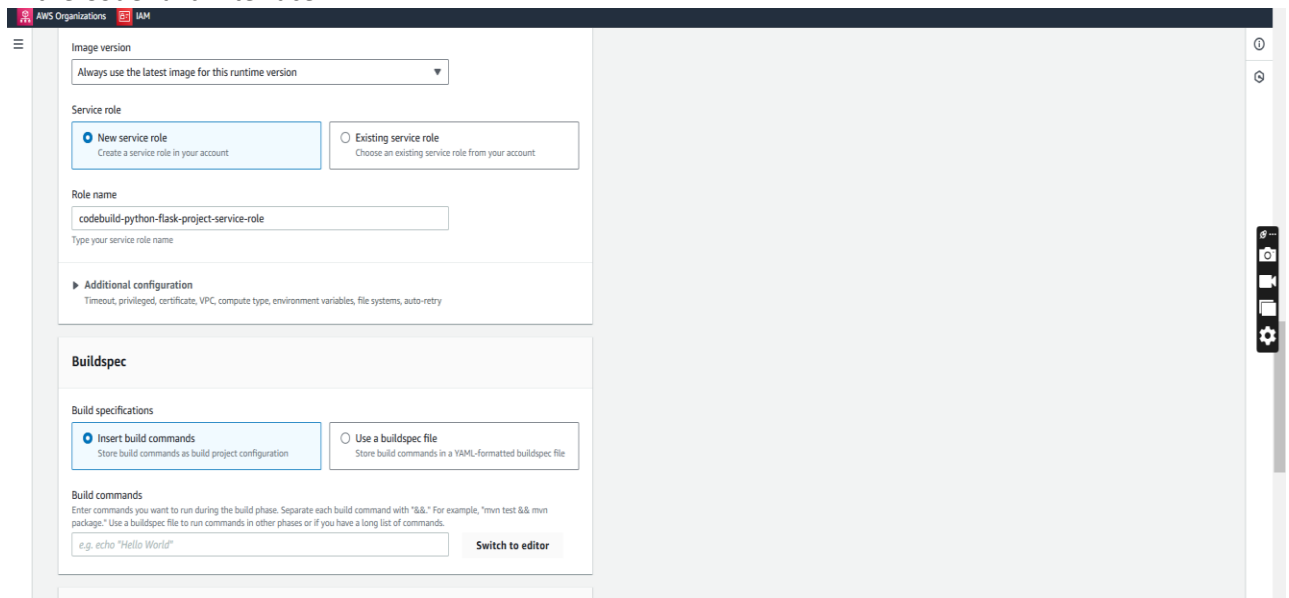


Image version  
Always use the latest image for this runtime version

Service role

☒ **New service role**  
Create a service role in your account

☐ **Existing service role**  
Choose an existing service role from your account

Role name  
codebuild-python-flask-project-service-role  
Type your service role name

► **Additional configuration**  
Timeout, privileged, certificate, VPC, compute type, environment variables, file systems, auto-retry

**Buildspec**

Build specifications

☒ **Insert build commands**  
Store build commands as build project configuration

☐ **Use a buildspec file**  
Store build commands in a YAML-formatted buildspec file

Build commands  
Enter commands you want to run during the build phase. Separate each build command with "&&". For example, "mvn test && mvn package." Use a buildspec file to run commands in other phases or if you have a long list of commands.  
e.g. echo "Hello World" [Switch to editor](#)

- Click on switch to editor (keep the image tag in Systems Manager to store credentials).
- Parameterstore use to provide the sensitive info like credentials in a secret location.

- CI code:

version: 0.2

phases:

install:

runtime-versions:

python: 3.11

pre\_build:

commands:

- pip install -r requirements.txt

build:

commands:

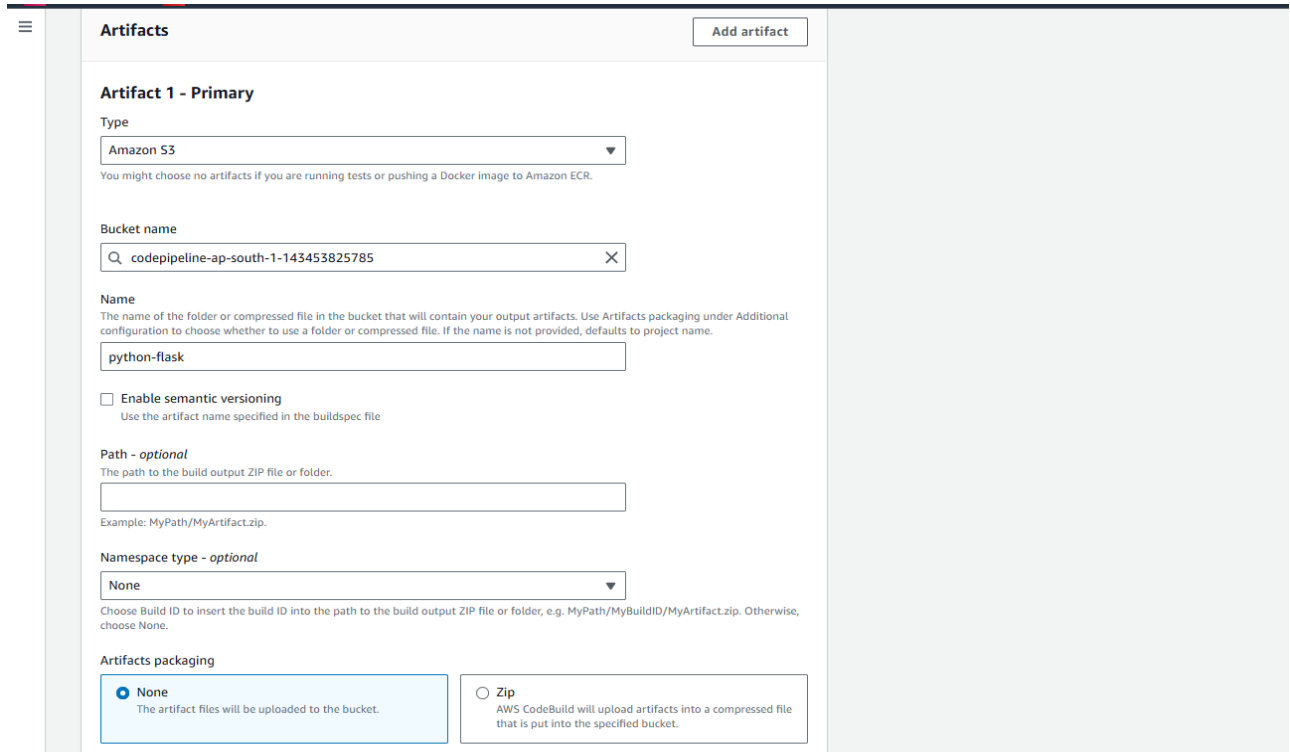
- echo "Building the Docker image"

- docker build -t "<>"

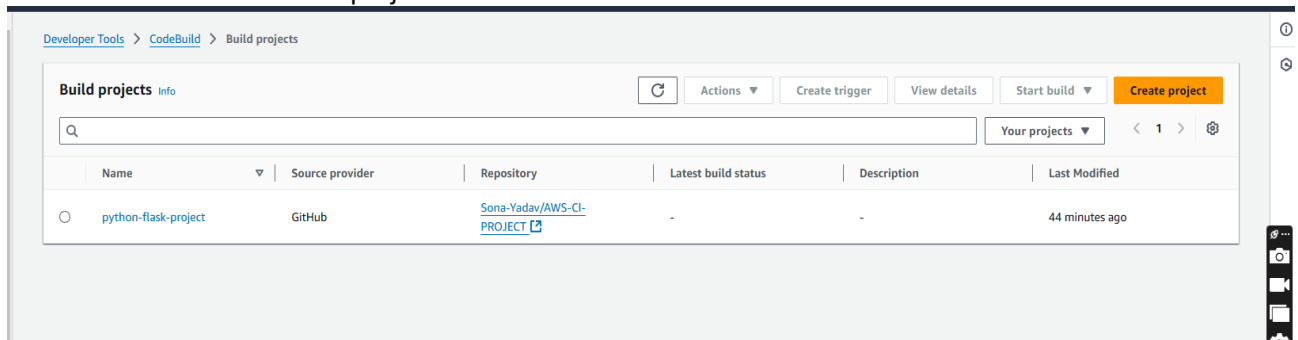
- docker push <>

post\_build:  
commands:  
- echo "Build is successful"

➔ Add S3 to the artifacts.

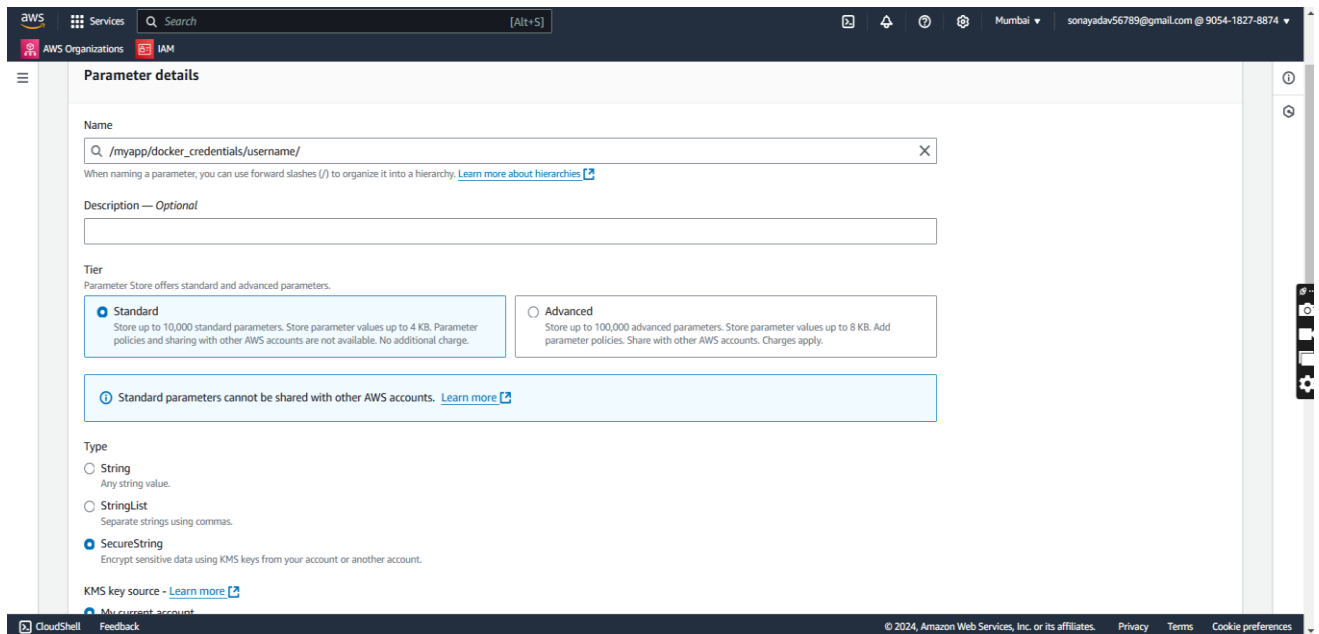


• Click on create build project.

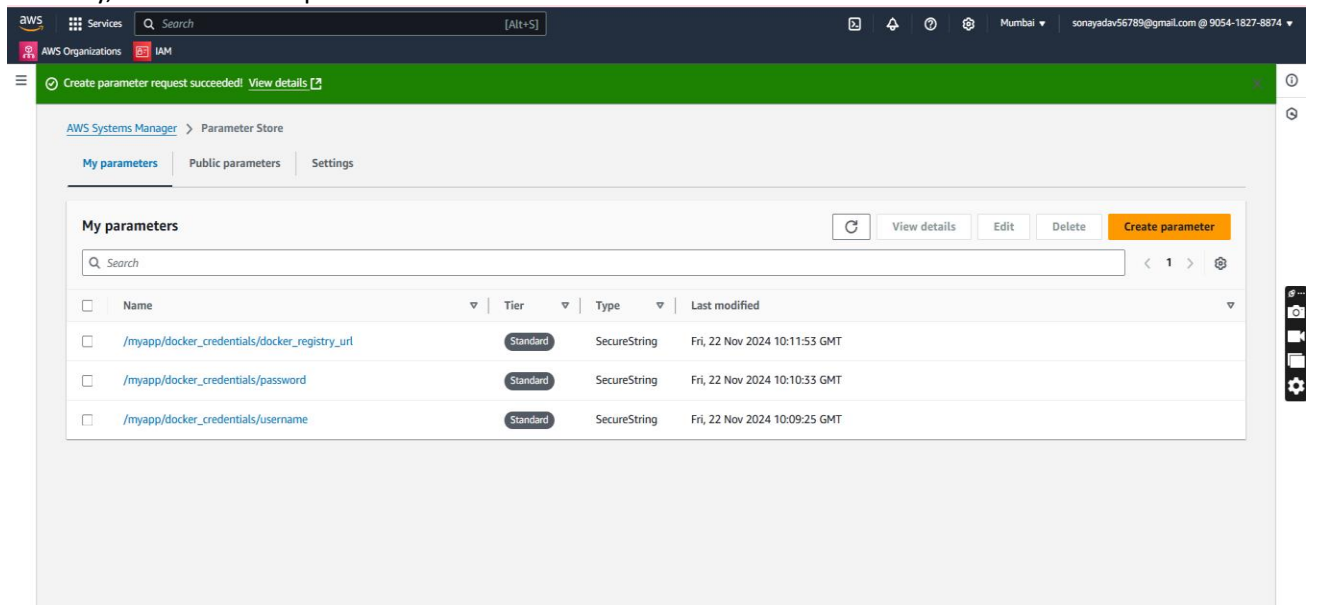


Name	Source provider	Repository	Latest build status	Description	Last Modified
python-flask-project	GitHub	<a href="#">Sona-Yadav/AWS-CL-PROJECT</a>	-	-	44 minutes ago

4. Store the sensitive information:  
Search for system manager ➔ Find the option called parameter store ➔ click on create parameter ➔ value = docker username ➔ click on create parameter.



Similarly, create another parameter store



##### 5. Search for CodeBuild:

Go to the edit build details/project details → edit buildspec file → update it version: 0.2

env:

parameter-store:

DOCKER\_REGISTRY\_USERNAME: /myapp/docker\_credentials/username

DOCKER\_REGISTRY\_PASSWORD: /myapp/docker\_credentials/password

DOCKER\_REGISTRY\_URL: /myapp/docker\_credentials/docker\_registry\_url

phases:

install:

runtime-versions:

python: 3.11

commands:

- echo "Installing dependencies..."

pre\_build:

commands:

- echo "Installing Python dependencies..."

```
- pip install -r requirements.txt
- echo "Logging in to Docker registry..."
- docker login -u "$DOCKER_REGISTRY_USERNAME" -p "$DOCKER_REGISTRY_PASSWORD"
"$DOCKER_REGISTRY_URL"
```

build:

commands:

```
- echo "Building the Docker image..."
- docker build -t "$DOCKER_REGISTRY_URL/$DOCKER_REGISTRY_USERNAME/python-flask-project:latest"
```

post\_build:

commands:

```
- echo "Pushing the Docker image to the registry..."
- docker push "$DOCKER_REGISTRY_URL/$DOCKER_REGISTRY_USERNAME/python-flask-project:latest"
- echo "Build and push completed successfully."
```

artifacts:

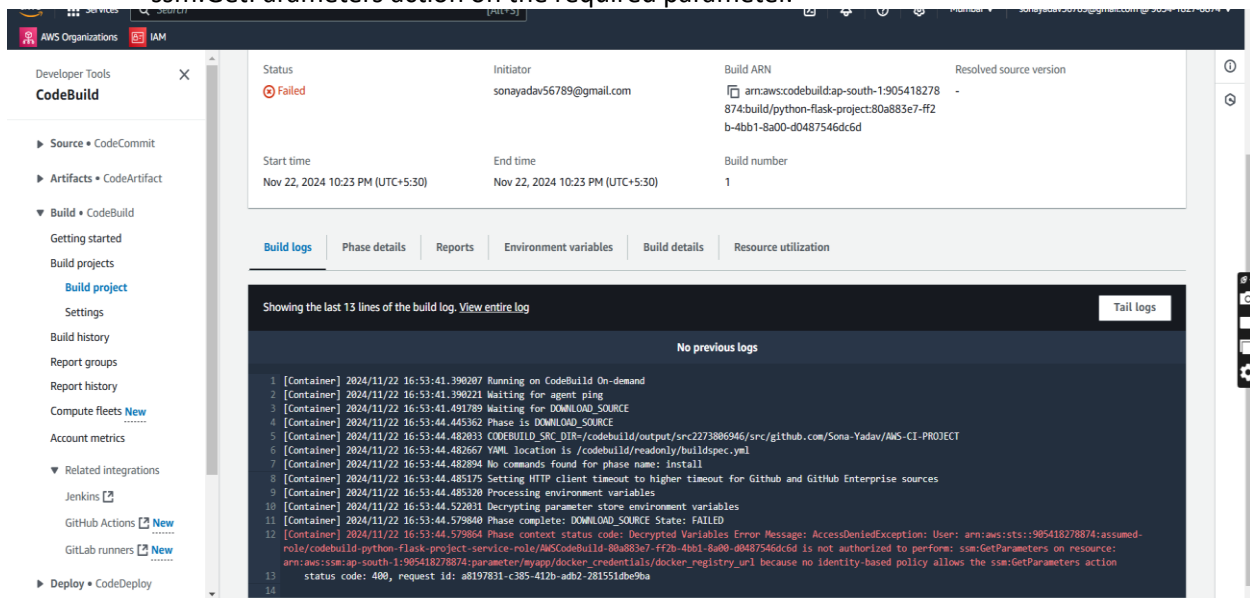
files:

```
- "**/*" # Upload all files in the project directory
- "!**/.git/*" # Exclude Git metadata
```

6. Click on start build.

Errors:

- (i) This occurs becoz codebuild doesn't have access to Systems Manager. The CodeBuild project needs access to the `docker_registry_url` parameter stored in the SSM Parameter Store to proceed with the build process. However, the IAM role assigned to CodeBuild (`codebuild-python-flask-project-service-role`) does not have a policy granting it permission to perform the `ssm:GetParameters` action on the required parameter.



**Solution:** Go to IAM → Roles (check the roles what was we created) → Add permission → Attach Policy → search for SSM → Grant SSM full access → save.

- (ii) Attach S3 full permission access to this service role.

7. Great!!! Build is successful.

Developer Tools > CodeBuild > Build projects > python-flask-project > python-flask-project:22896f4a-e1f0-473a-8c61-ac2754024b41

python-flask-project:22896f4a-e1f0-473a-8c61-ac2754024b41

Stop build Retry build

**Build status**

Status	Initiator	Build ARN	Resolved source version
Succeeded	sonayadav56789@gmail.com	arn:aws:codebuild:ap-south-1:905418278874:build/python-flask-project:22896f4a-e1f0-473a-8c61-ac2754024b41	b67beac34f1b4d22a24ec238ec6b107681ae0a8
Start time	End time	Build number	
Nov 22, 2024 11:09 PM (UTC+5:30)	Nov 22, 2024 11:10 PM (UTC+5:30)	6	

Build logs Phase details Reports Environment variables Build details Resource utilization

Name	Status	Context	Duration	Start time	End time
SUBMITTED	Succeeded	-	<1 sec	Nov 22, 2024 11:09 PM (UTC+5:30)	Nov 22, 2024 11:09 PM (UTC+5:30)
QUEUED	Succeeded	-	<1 sec	Nov 22, 2024 11:09 PM (UTC+5:30)	Nov 22, 2024 11:09 PM (UTC+5:30)
PROVISIONING	Succeeded	-	4 secs	Nov 22, 2024 11:09 PM (UTC+5:30)	Nov 22, 2024 11:09 PM (UTC+5:30)
DOWNLOAD_SOURCE	Succeeded	-	4 secs	Nov 22, 2024 11:09 PM (UTC+5:30)	Nov 22, 2024 11:09 PM (UTC+5:30)
INSTALL	Succeeded	-	<1 sec	Nov 22, 2024 11:09 PM (UTC+5:30)	Nov 22, 2024 11:09 PM (UTC+5:30)
PRE_BUILD	Succeeded	-	17 secs	Nov 22, 2024 11:09 PM (UTC+5:30)	Nov 22, 2024 11:10 PM (UTC+5:30)
BUILD	Succeeded	-	21 secs	Nov 22, 2024 11:10 PM (UTC+5:30)	Nov 22, 2024 11:10 PM (UTC+5:30)
POST_BUILD	Succeeded	-	16 secs	Nov 22, 2024 11:10 PM (UTC+5:30)	Nov 22, 2024 11:10 PM (UTC+5:30)

Go to resource CloudShell Feedback

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dockerhub Search Docker Hub ctrl+K

Explore / sonayadav978/python-flask-project / latest



sonayadav978/python-flask-project:latest

MANIFEST DIGEST sha256:7cba9a0204bd7130aa362a8b09a57bcf2a3011a47bfeddd423704885fa853798

OS/ARCH  
linux/amd64

COMPRESSED SIZE  
360.67 MB

LAST PUSHED  
11 minutes ago by sonayadav978

TYPE  
Image

MANIFEST DIGEST  
sha256:7cba9a02...

Image Layers

1 ADD file ... in /	47.26 MB
2 CMD ["bash"]	0 B
3 /bin/sh -c set -eux; apt-get	22.94 MB
4 /bin/sh -c set -eux; apt-get	61.41 MB
5 /bin/sh -c set -ex; apt-get	281.48 MB
6 ENV PATH=/usr/local/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/...	0 B

Command

ADD file:087f68d5558e06c7160c9322582925635e7539a7702413828357c28c77f6f345 1

8. Now, let's integrate it with pipeline to invoke automatically when a code change is made to Github repo.

Search for "CodePipeline" → Click on Create a pipeline

AWS Organizations IAM

Choose pipeline settings

Step 3 Add source stage

Step 4 Add build stage

Step 5 Add deploy stage

Step 6 Review

**Pipeline settings**

Pipeline name  
Enter the pipeline name. You cannot edit the pipeline name after it is created.  
python-flask-project  
No more than 100 characters

Pipeline type  
You can no longer create V1 pipelines through the console. We recommend you use the V2 pipeline type with improved release safety, pipeline triggers, parameterized pipelines, and a new billing model.

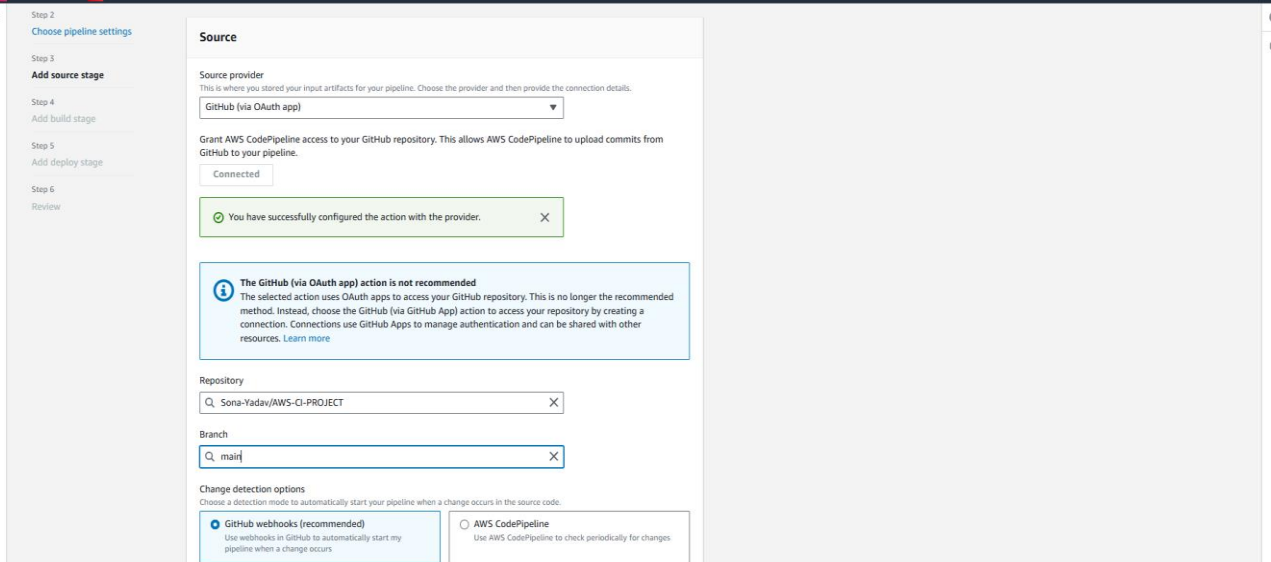
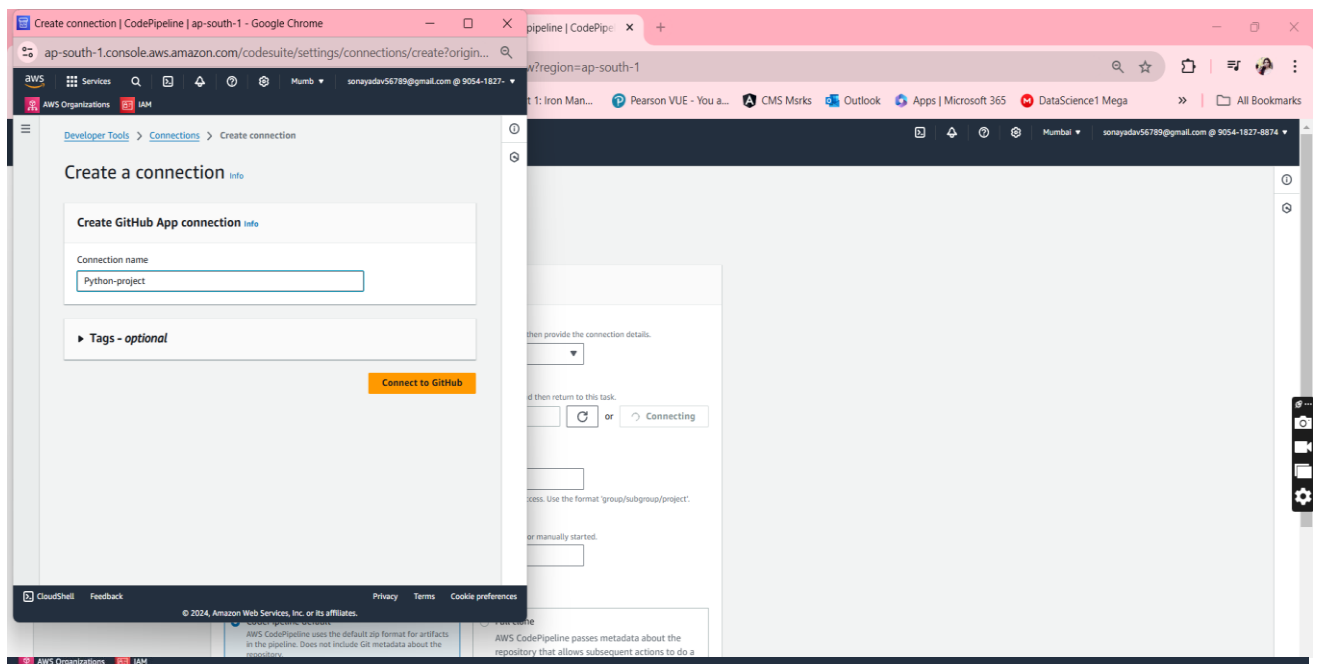
Execution mode  
Choose the execution mode for your pipeline. This determines how the pipeline is run.  
☐ Superseded  
A more recent execution can overtake an older one. This is the default.  
☒ Queued (Pipeline type V2 required)  
Executions are processed one by one in the order that they are queued.  
☐ Parallel (Pipeline type V2 required)  
Executions don't wait for other runs to complete before starting or finishing.

Service role  
☒ New service role  
Create a service role in your account.  
☐ Existing service role  
Choose an existing service role from your account.

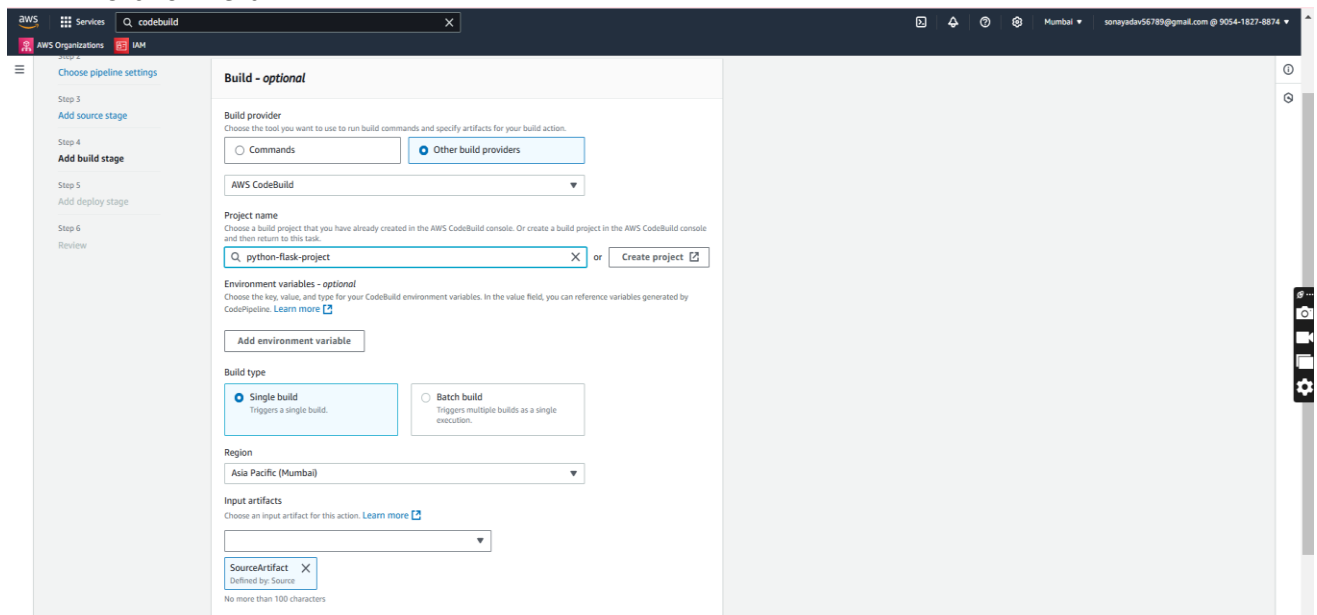
Role name  
AWSCodePipelineServiceRole-ap-south-1-python-flask-project  
Type your service role name:  
☒ Allow AWS CodePipeline to create a service role so it can be used with this new pipeline

→ Click on next.

→ Choose sources as github → click on connect to github



➔ Click on Next.



➔ Click on Next.

➔ For deployment provider, this comes in the CD part so skip this stage.

➔ Review and click on create pipeline.

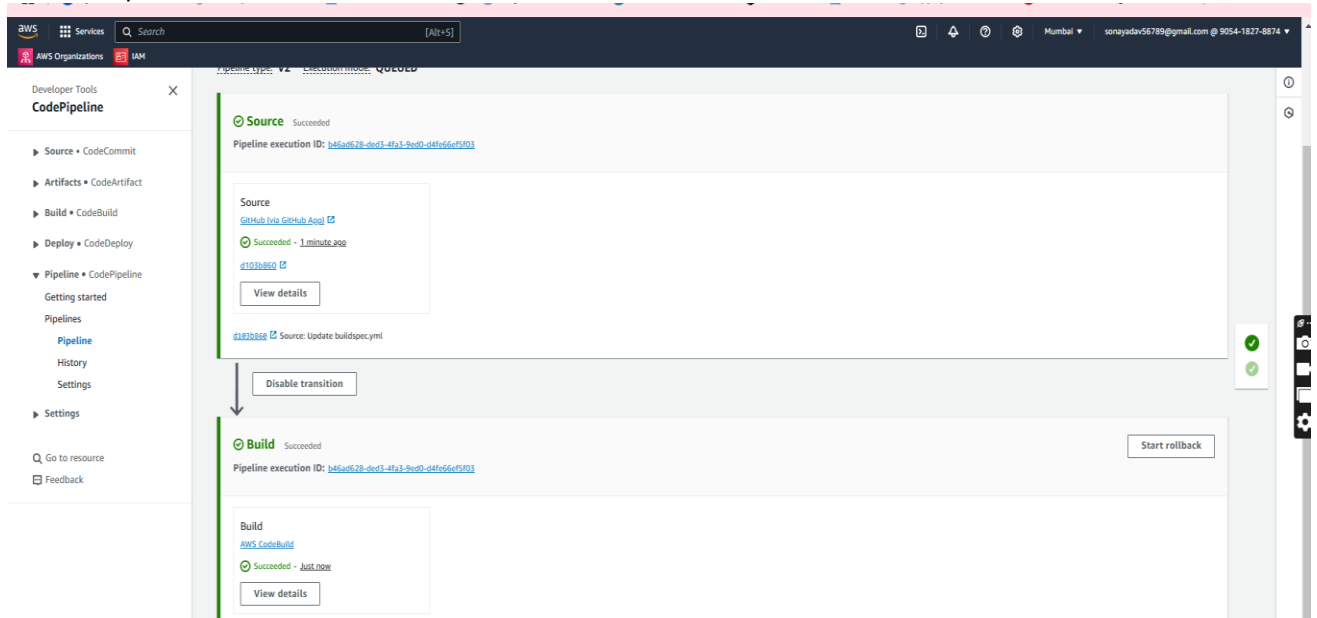


**Encounter issue:** Action execution failed Error message Error calling startBuild: Invalid characters in project name. Only alphanumeric characters, dash, and underscore are supported (Service: AWSCodeBuild; Status Code: 400; Error Code: InvalidInputException; Request ID: 9dd43b06-b469-4ba9-853b-cce1eb491f4d; Proxy: null)

**Solution:** Again, create a new CodeBuild and CodePipeline with different project name instead of using hyphen, I used underscore. Now it is working.

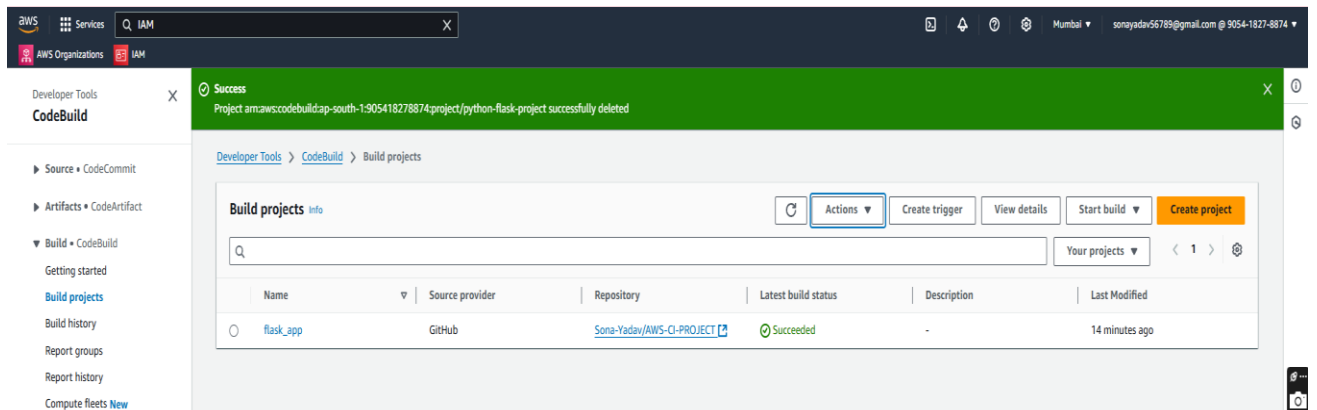
➔ Make any change in your code. It will trigger your pipeline automatically.

➔ Pipeline look like:

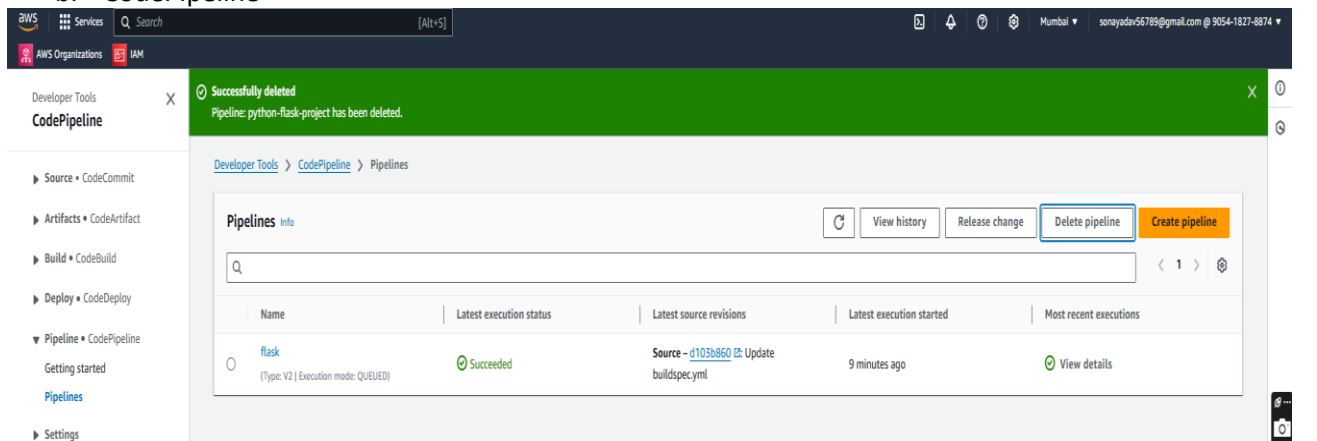


## 9 Result:

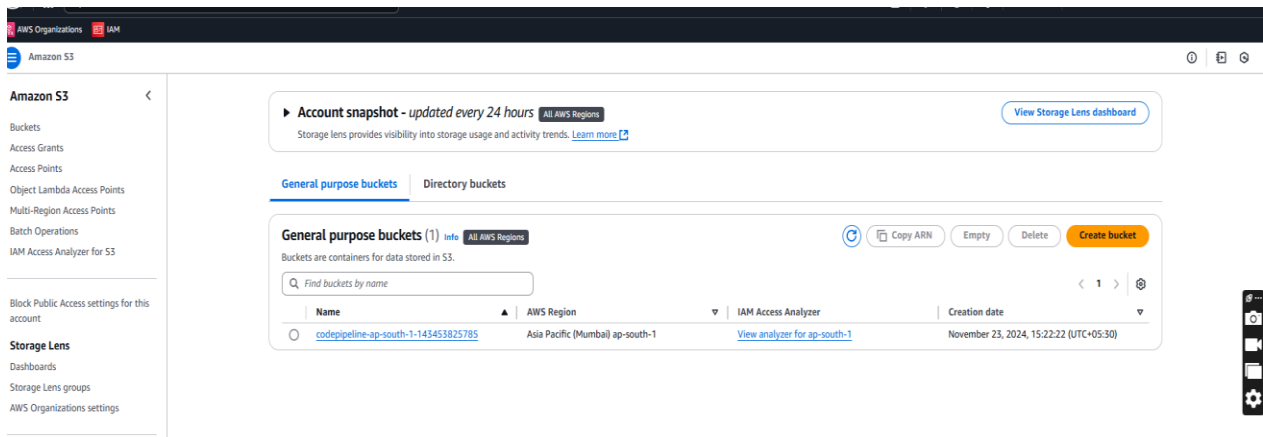
### a. CodeBuild



### b. CodePipeline



### c. S3 Bucket



CD

10

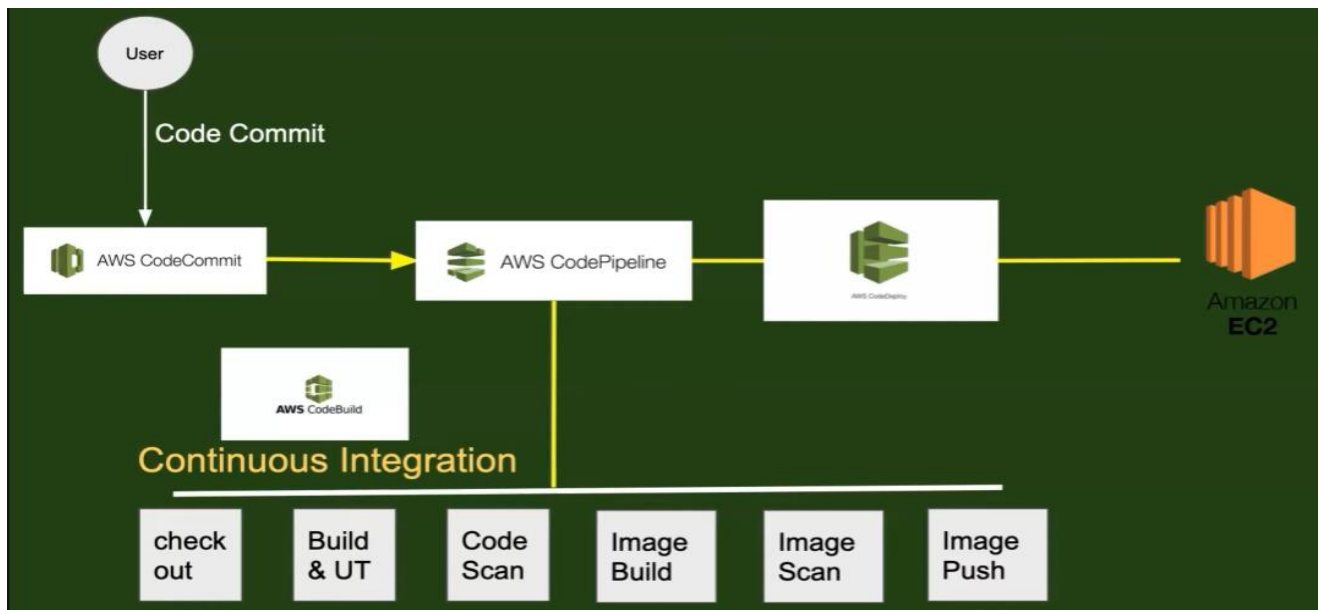
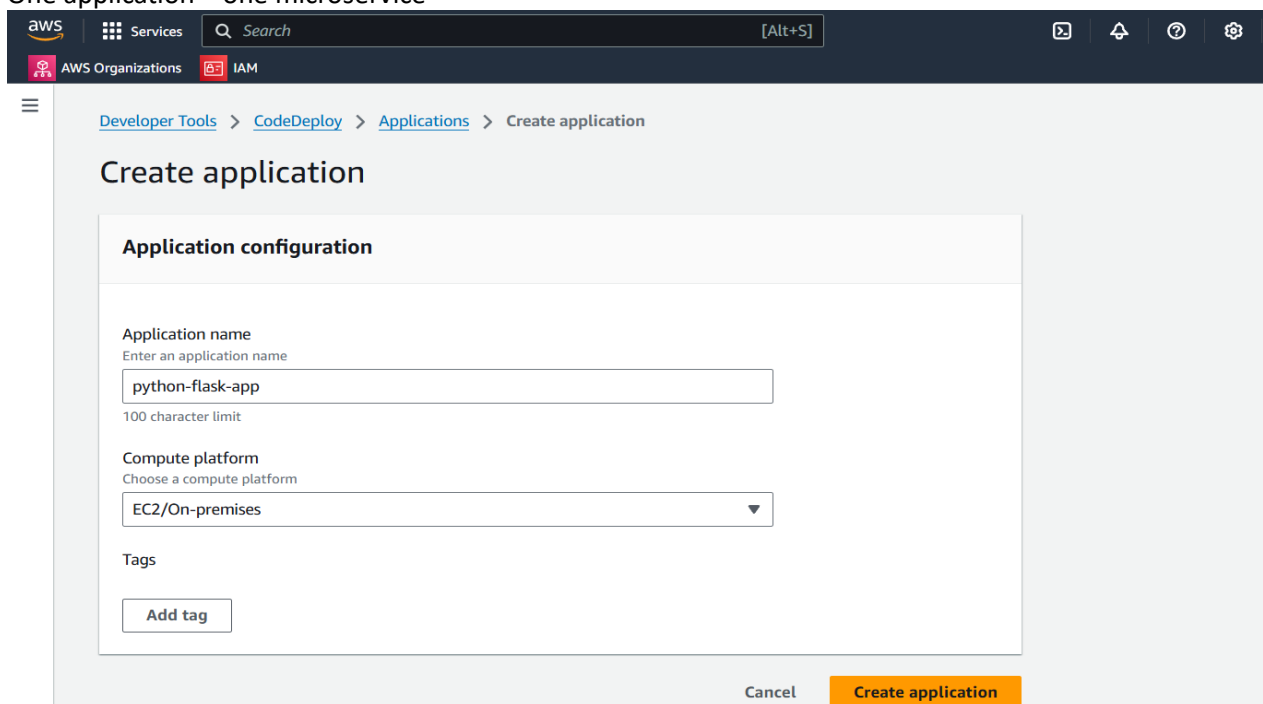


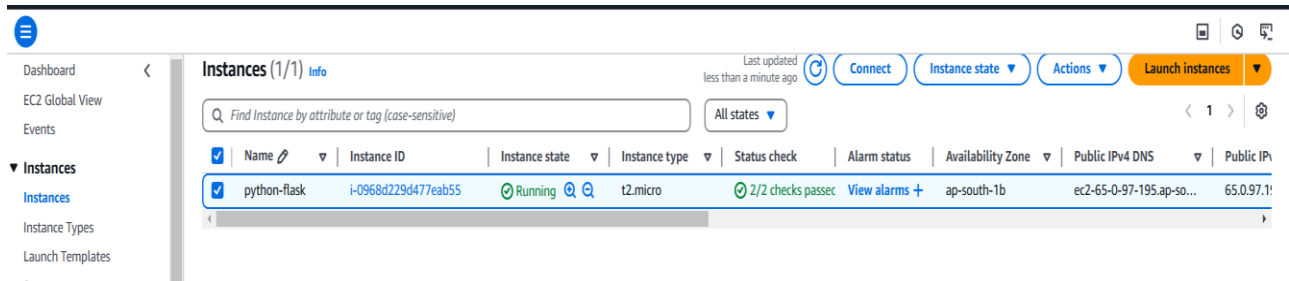
Diagram of CICD

11 Search for CodeDeploy→ click on getting started and create an application → Choose a compute platform as EC2 → click on create application.

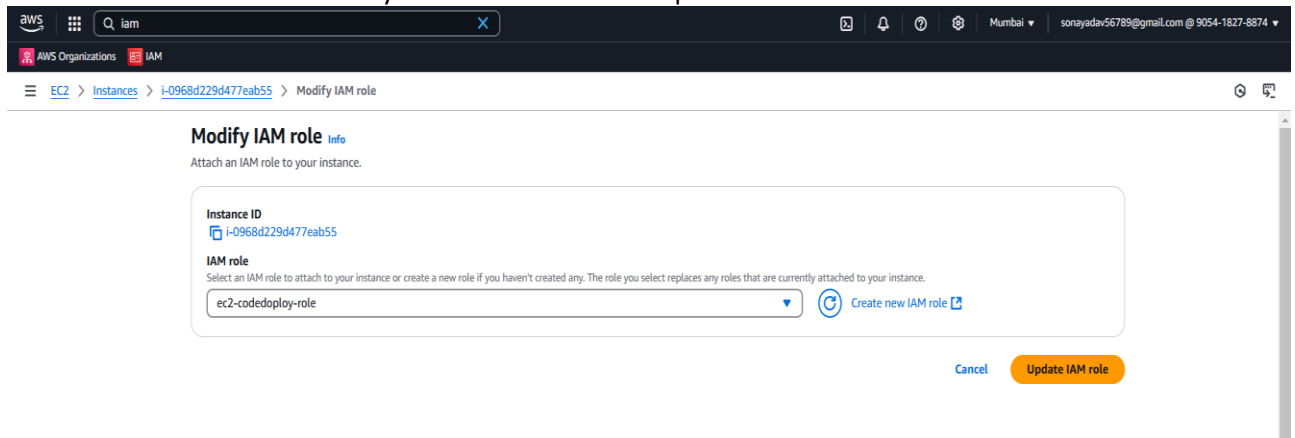
One application = one microservice



11 Go to the EC2 instance→ Launch an instance



- 12
  1. **CodeDeploy Deployment:**
    - CodeDeploy can be used to deploy applications on a single EC2 instance or multiple EC2 instances.
    - Tags in EC2 instances play a critical role in identifying and managing the deployment targets.
  2. **Installing the CodeDeploy Agent:**
    - Log in to the EC2 instance.
    - Run the script available in the GitHub repository to install the CodeDeploy agent: [Agent Installation Script](#).
    - Additionally, install Docker using the following command: `sudo apt install docker.io -y`
  3. **Assigning IAM Role to EC2:**
    - Search for IAM in the AWS Management Console.
    - Go to Roles and create a new role:
      - Trusted Entity Type: AWS Service
      - Use Case: EC2
      - Click Next.
      - Attach the AWSCodeDeployRole policy along with full EC2 and CodeDeploy access.
      - Click Next and then Create Role.
    - The role now has the necessary permissions for EC2 and CodeDeploy.
  4. **Assign Role to the EC2 Instance:**
    - Go to EC2 in the AWS Management Console.
    - Select the instance you want to assign the role to.
    - Click Actions → Security → Modify IAM Role.
    - Select the newly created IAM role and update it.



5. **Restart the CodeDeploy Agent:**
  - `sudo service codedeploy-agent restart`

- 13 **Configure the codedeploy:**

Go to CodeDeploy application section → click on create deployment group and provide the ec2 instance.



**Developer Tools** **CodeDeploy**

Source • CodeCommit

Artifacts • CodeArtifact

Build • CodeBuild

▼ **Deploy • CodeDeploy**

Getting started

Deployments

Applications

**Application**

Settings

Deployment configurations

On-premises instances

► Pipeline • CodePipeline

► Settings

Q Go to resource

Feedback

Make sure the AWS Systems Manager agents are installed on all instances and attach the required IAM policies to them. [Learn more](#)

Install AWS CodeDeploy Agent

☐ Never

☐ Only once

☒ Now and schedule updates

**Basic scheduler** Cron expression

14 Days

**Deployment settings**

**Deployment configuration**

Choose from a list of default and custom deployment configurations. A deployment configuration is a set of rules that determines how fast an application is deployed and the success or failure conditions for a deployment.

CodeDeployDefault.AllAtOnce or **Create deployment configuration**

**Load balancer**

Select a load balancer to manage incoming traffic during the deployment process. The load balancer blocks traffic from each instance while it's being deployed to and allows traffic to it again after the deployment succeeds.

☐ Enable load balancing

► Advanced - optional

Cancel **Create deployment group**

## 14 Deploy our application

**Developer Tools** **CodeDeploy**

Source • CodeCommit

Artifacts • CodeArtifact

Build • CodeBuild

▼ **Deploy • CodeDeploy**

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Deployments

Applications

**Application**

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On-premises instances

► Pipeline • CodePipeline

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Q Go to resource

Feedback

python-flask-app

Application details

Name: python-flask-app

Compute platform: EC2/On-premises

**Deployments** Deployment groups Revisions

**Application deployment history**

View details Actions Copy deployment Retry deployment **Create deployment**

Deployment Id	Status	Deployment type	Deployment group	Revision location	Initiating event	Start time	End time
No results							

There are no results to display.

**Developer Tools** **CodeDeploy**

Source • CodeCommit

Artifacts • CodeArtifact

Build • CodeBuild

▼ **Deploy • CodeDeploy**

Getting started

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Feedback

python-flask-app

**Create deployment**

**Deployment settings**

Application: python-flask-app

Deployment group: python-flask

Compute platform: EC2/On-premises

Deployment type: In-place

Managed hook execution role: The IAM role used by the CodeDeploy Managed Hook function to perform actions. [Edit Managed Hook execution role.](#)

Revision type

☐ My application is stored in Amazon S3

☒ My application is stored in GitHub

GitHub token name

Select the name of the token associated to an account you have already connected, or grant AWS CodeDeploy permission to access a different account. To connect to a GitHub account for the first time, type an alias for the account, and then choose Connect to GitHub

Connected

**Sona-Yadav/AWS-CICD-PROJECT**

Commit ID

**Deployment description**

Deployment description - optional  
Add a brief description about the deployment

**Additional deployment behavior settings**

**ApplicationStop lifecycle event failure - optional**  
Type a deployment group name  
☐ Don't fail the deployment to an instance if this lifecycle event on the instance fails

**Content options - optional**  
Choose what to do during a deployment when a file on a target instance has the same name as a file in the application revision  
An error is reported and the deployment status is changed to Failed.

☐ Fail the deployment

☐ Overwrite the content  
The file in the application revision is copied to the target location on the instance, replacing the previous file.

☐ Retain the content  
The file in the application revision is not copied to the instance. The existing file is kept at the target location and treated as part of the new deployment.

- Connect to Github
- Provide the last commit id.
- Click on create deployment.

15 Deployment is succeeded.

**Developer Tools** **CodeDeploy**

**d-5VPN7MUJ8**

**Deployment status**

Installing application on your instances  
1 of 1 instances updated: ✔ Succeeded 100%

**Deployment details**

Application	python-flask	Deployment ID	d-5VPN7MUJ8	Status	<span style="color: green;">✔ Succeeded</span>
Deployment configuration	CodeDeployDefault::AllAtOnce	Deployment group	python-flask	Initiated by	User action
Deployment description	-				

**Revision details**

Revision location	Revision created	Revision description
github://Sona-Yadav/AWS-CICD-PROJECT/fd8bba51f76d8bc04da5c7bc00c669f7d7b71148	1 minute ago	Application revision registered by Deployment ID: d-5VPN7MUJ8

**Developer Tools** **CodeDeploy**

**d-5VPN7MUJ8** **arn:aws:ec2:ap-south-1:905418278874:instance/i-0968d229d477eab55**

**Deployment details**

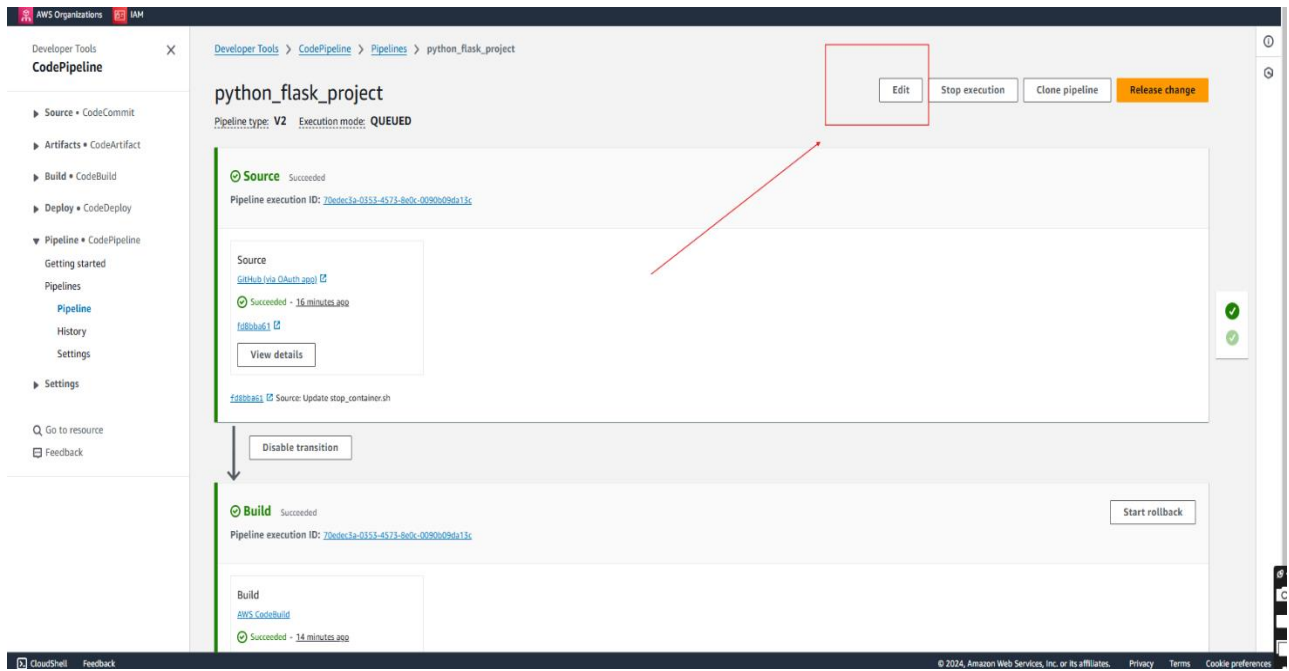
Application	python-flask	Deployment ID	d-5VPN7MUJ8	Status	<span style="color: green;">✔ Succeeded</span>
Deployment configuration	CodeDeployDefault::AllAtOnce	Deployment group	python-flask	Initiated by	User action
Deployment description	-				

**Revision details**

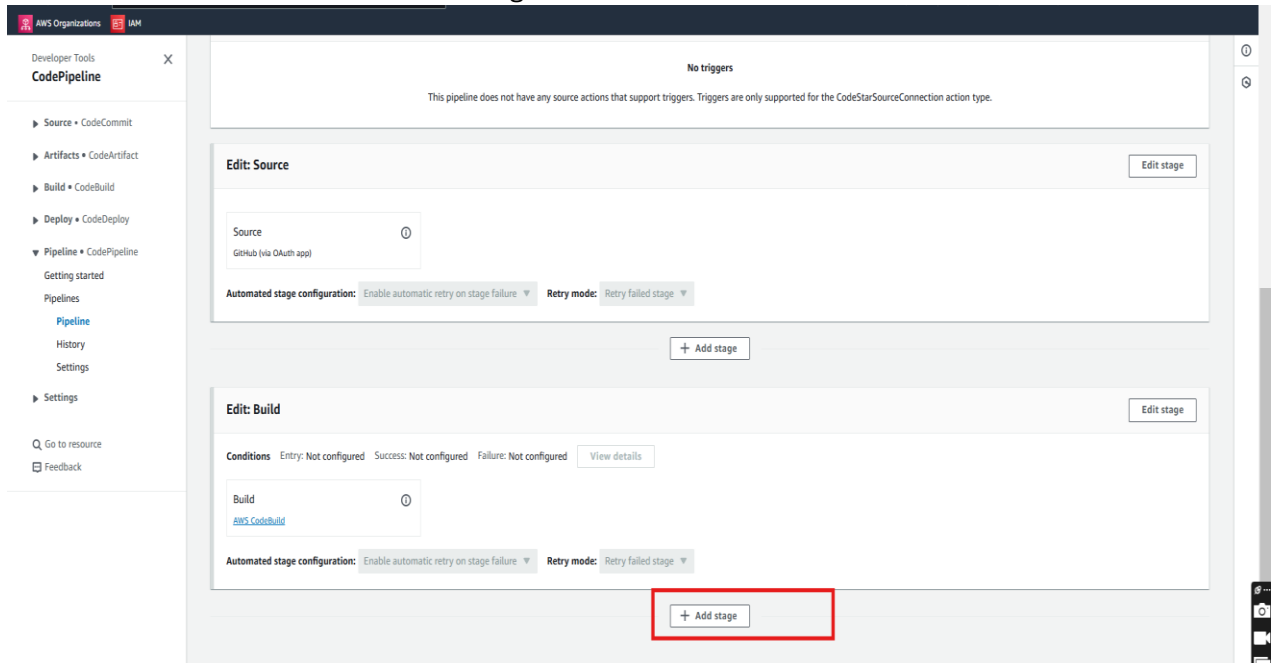
Revision location	Revision created	Revision description
github://Sona-Yadav/AWS-CICD-PROJECT/fd8bba51f76d8bc04da5c7bc00c669f7d7b71148	Just now	Application revision registered by Deployment ID: d-5VPN7MUJ8

Event	Duration	Status	Error code	Start time	End time
ApplicationStop	less than one second	<span style="color: green;">✔ Succeeded</span>	-	Nov 26, 2024 11:23 PM (UTC+5:30)	Nov 26, 2024 11:23 PM (UTC+5:30)
DownloadBundle	less than one second	<span style="color: green;">✔ Succeeded</span>	-	Nov 26, 2024 11:23 PM (UTC+5:30)	Nov 26, 2024 11:23 PM (UTC+5:30)
BeforeInstall	less than one second	<span style="color: green;">✔ Succeeded</span>	-	Nov 26, 2024 11:23 PM (UTC+5:30)	Nov 26, 2024 11:23 PM (UTC+5:30)
Install	less than one second	<span style="color: green;">✔ Succeeded</span>	-	Nov 26, 2024 11:24 PM (UTC+5:30)	Nov 26, 2024 11:24 PM (UTC+5:30)
AfterInstall	26 seconds	<span style="color: green;">✔ Succeeded</span>	-	Nov 26, 2024 11:24 PM (UTC+5:30)	Nov 26, 2024 11:24 PM (UTC+5:30)
ApplicationStart	less than one second	<span style="color: green;">✔ Succeeded</span>	-	Nov 26, 2024 11:24 PM (UTC+5:30)	Nov 26, 2024 11:24 PM (UTC+5:30)
ValidateService	less than one second	<span style="color: green;">✔ Succeeded</span>	-	Nov 26, 2024 11:24 PM (UTC+5:30)	Nov 26, 2024 11:24 PM (UTC+5:30)

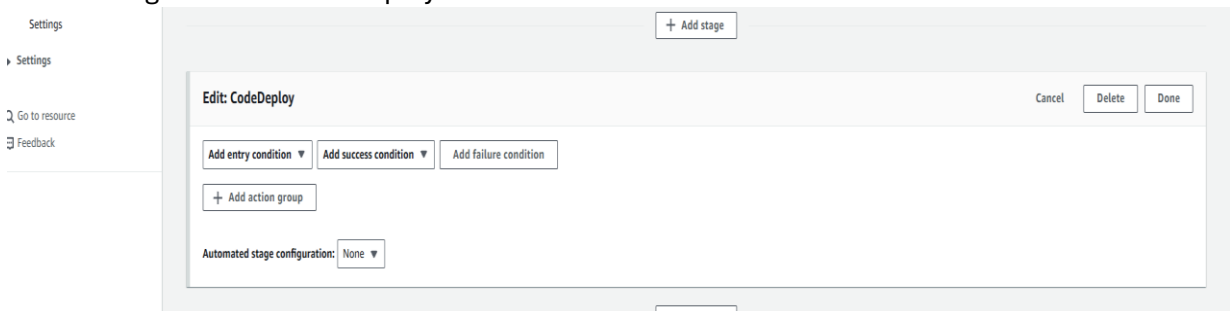
16 Go to the CodePipeline → add a new stage → Click on edit



- Scroll down and click on add stage



- Stage name = CodeDeploy



- Click on Add action group

Developer Tools

CodePipeline

Source • CodeCommit

Artifacts • CodeArtifact

Build • CodeBuild

Deploy • CodeDeploy

▼ Pipeline • CodePipeline

Getting started

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Pipeline

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Developer Tools

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Pipelines

python\_flask\_project

Edit python\_flask\_project

Delete

Cancel

Save

Editing: python\_flask\_project

Edit: Pipeline properties

Pipeline type

V2

Execution mode

QUEUED

Edit: Variables

Pipeline type V2 required

Edit variables

Action name

Choose a name for your action

codeDeploy

No more than 100 characters

Action provider

AWS CodeDeploy

Region

Asia Pacific (Mumbai)

Input artifacts

Choose an input artifact for this action. [Learn more](#)

BuildArtifact

Defined by: Build

No more than 100 characters

Application name

Choose an application that you have already created in the AWS CodeDeploy console. Or create an application in the AWS CodeDeploy console and then return to this task.

python-flask

Deployment group

Choose a deployment group that you have already created in the AWS CodeDeploy console. Or create a deployment group in the AWS CodeDeploy console and then return to this task.

python-flask

Variable namespace - optional

Choose a namespace for the output variables from this action. You must choose a namespace if you want to use the variables this action produces in your configuration. [Learn more](#)

Cancel

Done

- Click on done

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Artifacts • CodeArtifact

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python\_flask\_project

Edit python\_flask\_project

Delete

Cancel

Save

Editing: python\_flask\_project

Edit: Pipeline properties

Pipeline type

V2

Execution mode

QUEUED

Edit: Variables

Pipeline type V2 required

Edit variables

- Click on the save button
- Make any change on github.

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python\_flask\_project

Edit python\_flask\_project

Delete

Cancel

Save

Editing: python\_flask\_project

python\_flask\_project

Pipeline type: V2 Execution mode: QUEUED

Source

Succeeded

Pipeline execution ID: [6m5f244-h927-4375-8088-031e9f56a927](#)

Source

[github \[via Cloud9 app\]](#)

Succeeded - 1 minute ago

[900da47c](#)

View details

998da47c

Source: Update app.py

Disable transition

Build

Succeeded

Pipeline execution ID: [6m5f244-h927-4375-8088-031e9f56a927](#)

Build

[AWS CodeBuild](#)

Succeeded - Just now

[998da47c](#)

Source: Update app.py

Disable transition

CodeDeploy

Succeeded

Pipeline execution ID: [6m5f244-h927-4375-8088-031e9f56a927](#)

codeDeploy

[AWS CodeDeploy](#)

Succeeded - Just now

[998da47c](#)

View details

Hurray!!!!!! Completed.....