

# Configuration Manual

MSc Research Project  
MSc Cloud Computing

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**MSc Project Submission Sheet**  
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**Programme:** MSc in Cloud Computing

**Year:** 2024

**Module:** MSc Research Project

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**Submission Due**

**Date:** 12/08/2024

**Project Title:** Optimizing Movie Recommendations with MLOps in AWS

**Word Count:** .....1004..... **Page Count:** .....

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# Configuration Manual

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## 1. Introduction

This manual documents about all the used tools, technologies as well as some steps for building the framework. The manual is further divided into few parts such as environment setup, tools technology used and some screenshot's of code, implementation.

## 2. Project Requirements

This section has the essential requirements needed to successfully implement the Movie Recommendation System using MLOps tools on AWS. It covers hardware as well as the software specifications, along with the necessary cloud services and development tools:

### **a. Hardware requirements:**

Device: MacBook air m2 with 16GB and 512 gb SSD as a local device. However, the complete project was executed over AWS Public cloud using their hardware in background.

### **b. Software requirements:**

- **Operating System:** macOS Ventura./ Amazon Linux2
- **Programming Language:** Python 3.11
- **Framework:** Flask Framework
- **IDE:** AWS Cloud9

### **c. Cloud Services:**

- **AWS IAM User:** Essential as to develop and deploy a serverless function and manage the API gateways as well along with Lambda.
- **Sagemaker:** SageMaker is a fully managed machine learning (ML) as a service in AWS ("What is Amazon SageMaker? - Amazon SageMaker," n.d.). SageMaker simplifies the process of developing, training, and deploying machine learning models on a large scale.
- **AWS ECS (Elastic Container Service):** ECS is a container management service that is highly scalable and high-performance, it supports Docker containers and enables you to run applications on a managed cluster of servers.
- **AWS Lambda:** Lambda enables you to execute code without the need to allocate or oversee servers. It is utilized to carry out behind-the-scenes operations in reaction to AWS service events (such as modifications in an S3 bucket).

- **AWS CloudWatch:** CloudWatch keeps track of the AWS resources and the applications that run on AWS. It is utilized for gathering and monitoring metrics, logs, setting alarms, and automatically responding to changes in AWS resources, it is essential for managing and optimizing machine learning models.
- **AWS Elastic Container Registry (ECR):** ECR is a Private Docker container registry that makes it easy for developers to store, manage, and deploy Docker container images.
- **AWS Cloud9:** Cloud9 is an online integrated development environment (IDE) based on the AWS that allows to write, execute, and troubleshoot code in a web browser
- **Simple Storage Solution (S3):** S3 is a service for storing objects that provides scalability, data availability, security, and performance. It is utilized in this project for the storing and accessing of various data types, like training datasets, model artifacts, and output results.

#### **d. Development tools**

- **Github:** GitHub is a hosting service for Git repositories that also offers tools for version control and teamwork. Enables multiple developers to collaborate on projects remotely, a critical aspect of team-based software development.

### **3. Starting ML Pipeline**

1. Login to AWS Management Console.
2. Go to AWS Sagemaker.
3. Click on Domains.
4. Start a Domain.
5. Create an user.
6. Launch the studio.

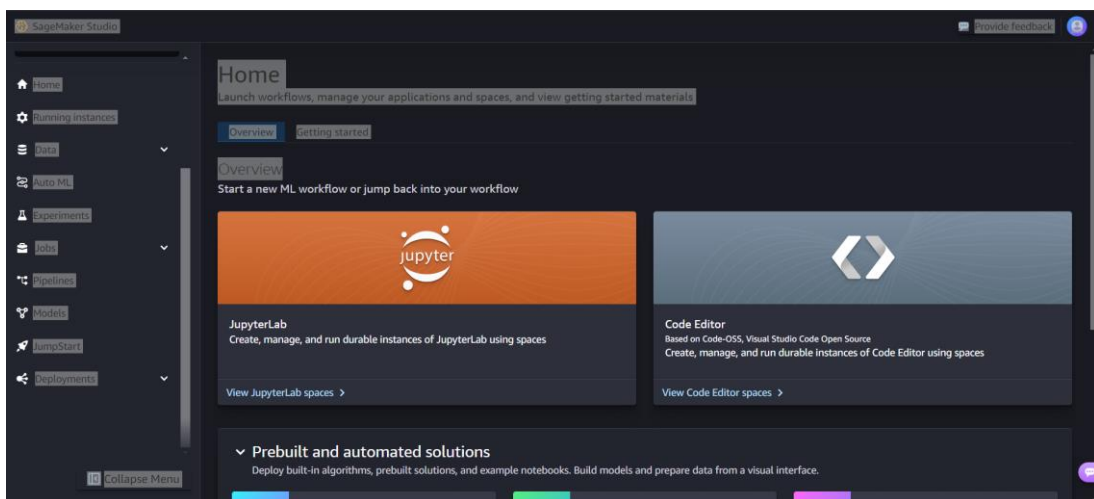


Fig 1: SageMaker Dashboard

7. Click on Jupyter Space.
8. Create a new space.
9. Copy my notebooks to the new space.
10. Run each cell.
11. Create a S3 bucket with names mentioned in my Notebook.

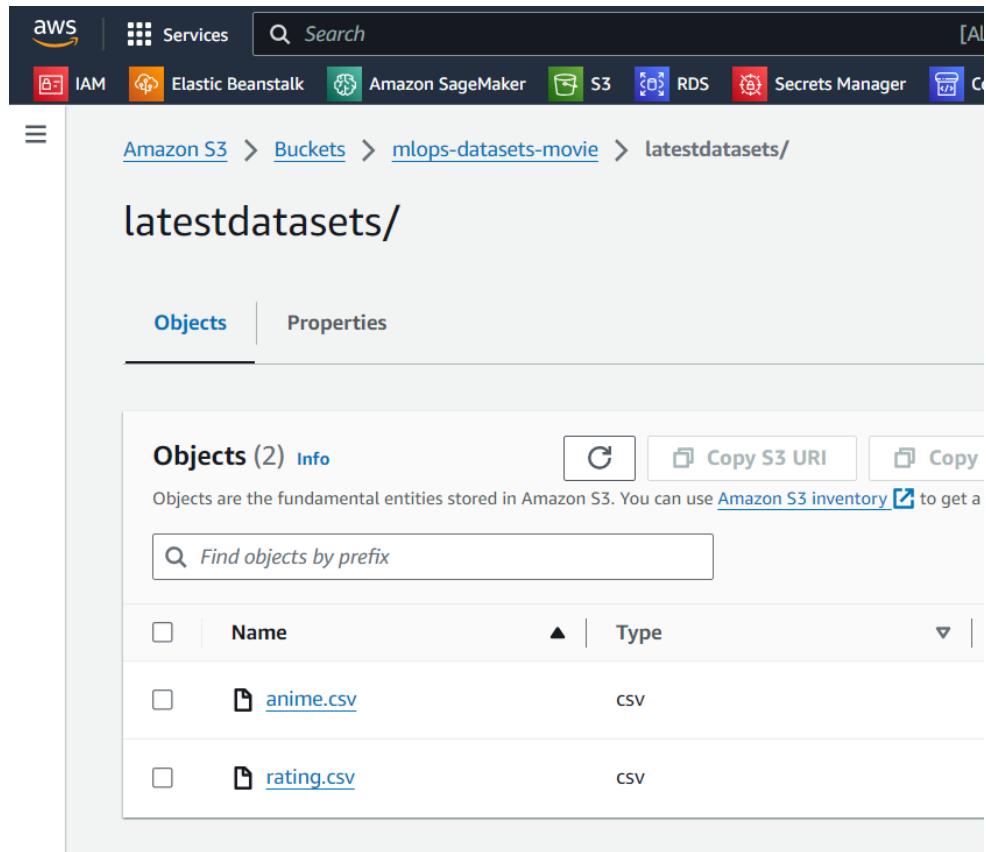


Fig 2: S3 Bucket

## 12. Create a Lambda function.

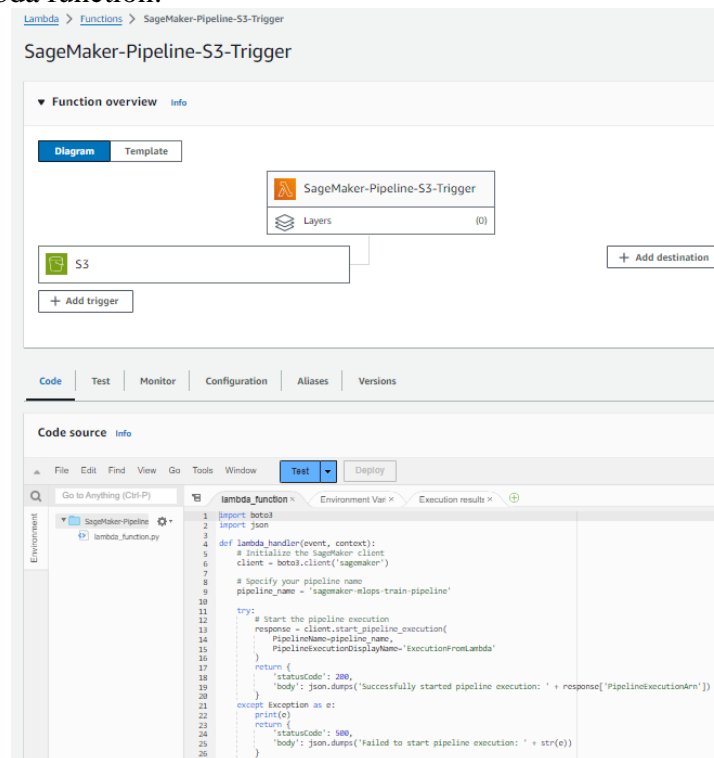
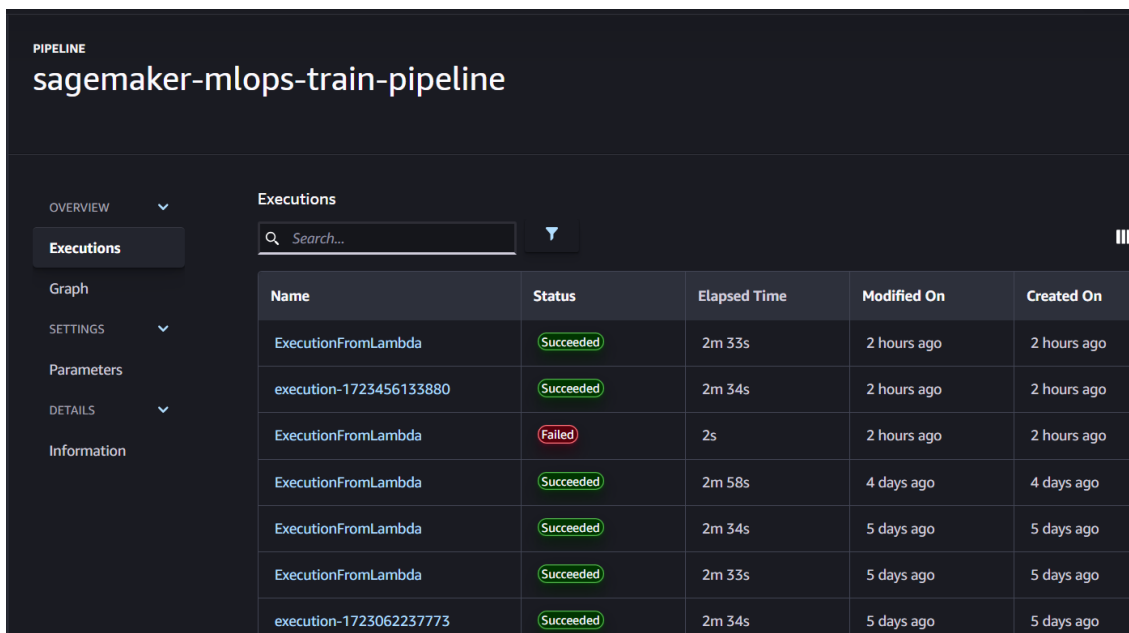


Fig 3: Lambda Function and Code

13. Add a trigger as S3 (PUT action only)
14. Insert dataset files into S3 bucket.
15. Re enter into Sagemaker and click on Pipelines from left panel.
16. There will be a pipeline executing due to new dataset uploaded in the S3 bucket.



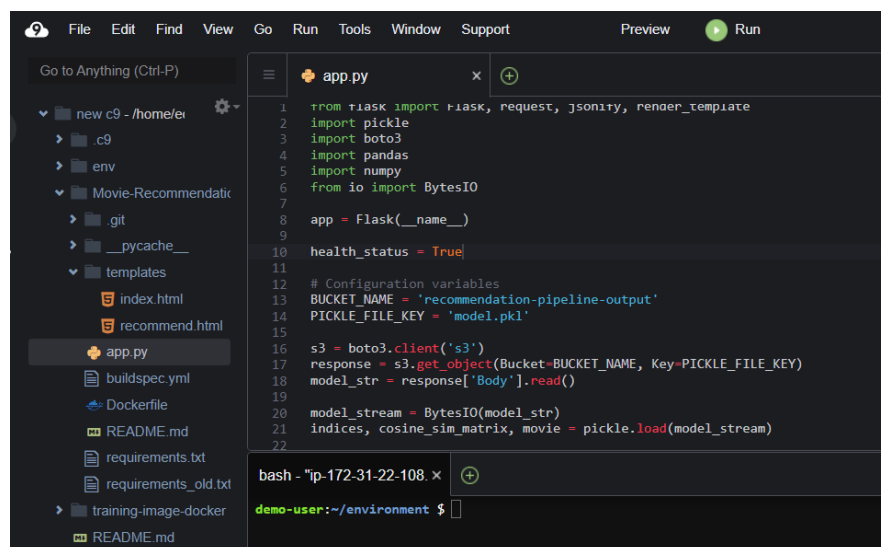
The screenshot shows the SageMaker Pipeline console for a pipeline named 'sagemaker-mlops-train-pipeline'. The left sidebar contains navigation options: OVERVIEW, Executions (selected), Graph, SETTINGS, Parameters, DETAILS, and Information. The main area displays a table of pipeline executions.

Name	Status	Elapsed Time	Modified On	Created On
ExecutionFromLambda	Succeeded	2m 33s	2 hours ago	2 hours ago
execution-1723456133880	Succeeded	2m 34s	2 hours ago	2 hours ago
ExecutionFromLambda	Failed	2s	2 hours ago	2 hours ago
ExecutionFromLambda	Succeeded	2m 58s	4 days ago	4 days ago
ExecutionFromLambda	Succeeded	2m 34s	5 days ago	5 days ago
ExecutionFromLambda	Succeeded	2m 33s	5 days ago	5 days ago
execution-1723062237773	Succeeded	2m 34s	5 days ago	5 days ago

Fig 4: SageMaker Pipeline

## 4. Starting CI/CD Pipeline

1. Start an Cloud9 instance.
2. Git clone: <https://github.com/priyalpatil98/Movie-Recommendation-System-MLOps.git>



The screenshot shows the Cloud9 IDE interface. The left sidebar displays the file explorer with a project structure including 'new c9 - /home/...', '.c9', 'env', 'Movie-Recommendation-System-MLOps', '.git', '\_\_pycache\_\_', 'templates', 'index.html', 'recommend.html', 'app.py' (selected), 'buildspec.yml', 'Dockerfile', 'README.md', 'requirements.txt', 'requirements\_old.txt', and 'training-image-docker'. The main editor area shows the code for 'app.py'.

```

1 from flask import Flask, request, jsonify, render_template
2 import pickle
3 import boto3
4 import pandas
5 import numpy
6 from io import BytesIO
7
8 app = Flask(__name__)
9
10 health_status = True
11
12 # Configuration variables
13 BUCKET_NAME = 'recommendation-pipeline-output'
14 PICKLE_FILE_KEY = 'model.pkl'
15
16 s3 = boto3.client('s3')
17 response = s3.get_object(Bucket=BUCKET_NAME, Key=PICKLE_FILE_KEY)
18 model_str = response['Body'].read()
19
20 model_stream = BytesIO(model_str)
21 indices, cosine_sim_matrix, movie = pickle.load(model_stream)
22

```

At the bottom, there is a terminal window with the prompt 'demo-user:~/environment \$'.

Fig 5: Cloud9 IDE

3. Create CodePipeline.

4. Add Source as Github.
5. Create CodeBuild project.
6. Use Buildspec.yml file to build project.
7. Create Deploy stage and add ECS.
8. Create a ECR and build an Image on Cloud9 using DockerFile and push to the ECR.

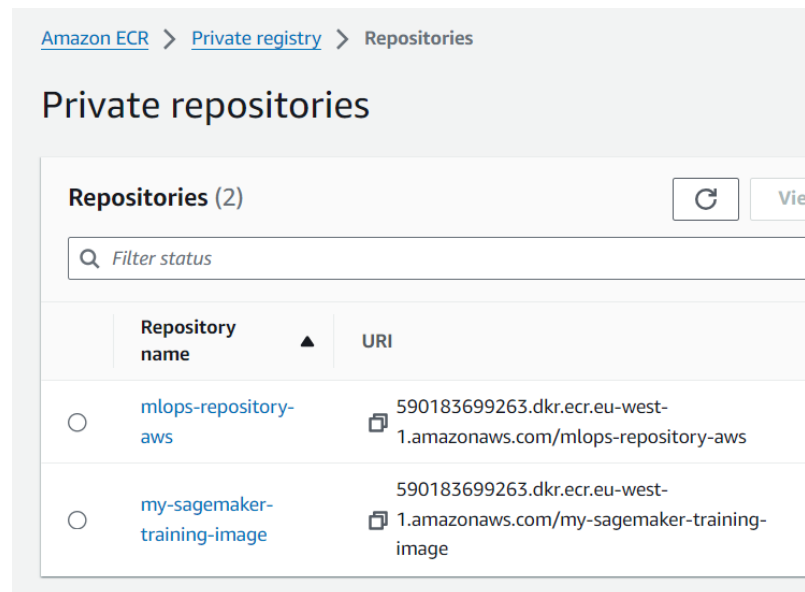


Fig 6: AWS ECR Repo

9. Trigger the pipeline by a git push to the main branch.
10. Wait until all three phases are implemented.

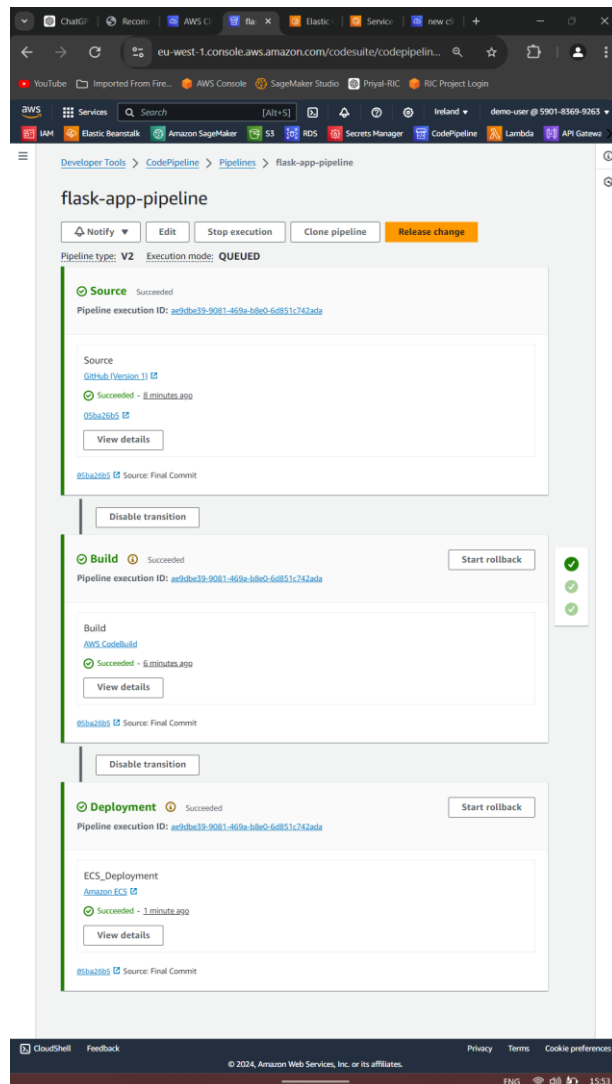


Fig 7: CI/CD CodePipeline

## References

**What is Amazon SageMaker?** - Amazon SageMaker [WWW Document], n.d. URL <https://docs.aws.amazon.com/sagemaker/latest/dg/whatis.html> (accessed 8.12.24).