National College of Ireland

Configuration Manual

MSc Research Project
Cloud Computing

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National College of Ireland

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National College of Ireland
Project Submission Sheet
School of Computing

Student Name:	Sameera Bano
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Configuration Manual

Sameera Bano
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Building a Flask Web Application with Machine Learning Models Using Docker

This guide details the steps to build and deploy a Flask web application that incorporates three machine learning models: Random Forest, Support Vector Machine (SVM), and Logistic Regression. The project is powered by Python and Docker for efficient development and deployment.

1 System Requirements

1.1 Hardware Requirements

- Operating System: Windows 10
- Processor: AMD Ryzen 3
- System Type: 64-bit Operating System
- RAM: 4 GB
- Storage:
  - SSD: 256 GB
  - HDD: 1 TB
- Display: HD with a refresh rate of 60 Hz

1.2 Software Requirements

- Python: Version 3.12
- VSCode: Version 1.95.3
- VSCode Extensions:
  - Pylance: Enabled
  - Docker Extension: Enabled
- Docker Desktop: Version 4.3.1

2. Installation Steps

1. Download the Flask Web App Code:
   Download the ZIP file containing the Flask application code and Docker configuration.

2. Extract the Files:
   Extract the ZIP file to a folder on your computer.

3. Open the Project in VSCode:
   Use VSCode to navigate to the extracted directory.

4. Run the Flask Application Locally:
   Start the application by running:
   ```bash
   python app.py
   ```

5. Install Dependencies:
   Install the required libraries, including Flask and machine learning packages, by running:
   ```bash
   pip install -r requirements.txt
   ```

3. Configuration

The application is designed to run in a containerized environment. The Dockerfile uses python:3.12-slim to minimize the container size while supporting all necessary libraries. Additionally, Docker Desktop was configured with WSL2 to ensure compatibility with Linux-based images.

4. Usage Instructions

4.1 Running the Flask Application

1. Start the Application:
   Run the app locally:
   ```bash
   python app.py
   ```
   The application will be available at http://localhost:5000.

2. Machine Learning Models Integration:
   The app includes the following models:
   - Random Forest: Predicts outcomes using an ensemble of decision trees.

- SVM: Performs classification tasks using hyperplanes.
- Logistic Regression: for checking if deployments were successful or not

3. Interact with the Application:
Use the web interface to input data and receive predictions from the models.

4.2 Deploying the Application with Docker

1. Create a Dockerfile:
```Dockerfile
# Use the official Python image
FROM python:3.12

# Set the working directory
WORKDIR /app

# Copy the dependencies file and install libraries
COPY requirements.txt /app/
RUN pip install --no-cache-dir -r requirements.txt

# Copy the Flask app and models
COPY . /app/

# Expose the port Flask will run on
EXPOSE 5000

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

2. Build the Docker Image:
```bash
docker build -t flask-ml-app .
```

3. Run the Docker Container:
```bash
docker run -p 5000:5000 flask-ml-app
```

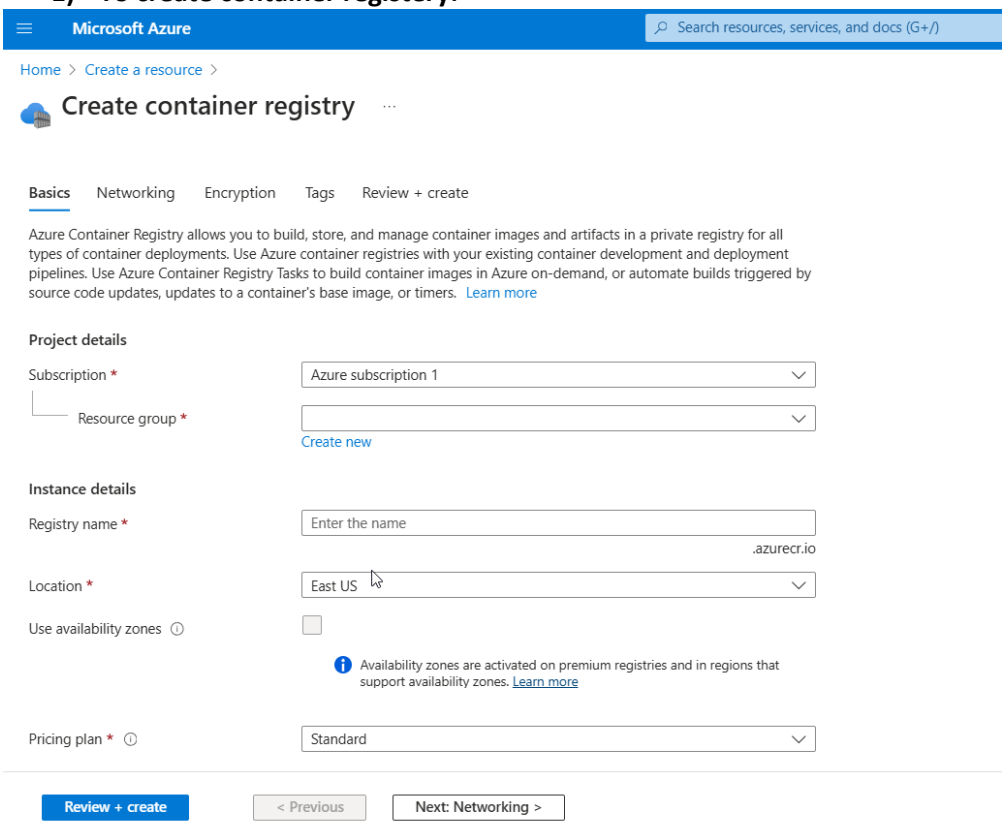
Key Features of the Application
- Random Forest: Predictive analytics using an ensemble learning method.
- SVM: Efficient classification of datasets with clear margins.

- Logistic Regression: for checked if deployments were successful or not.

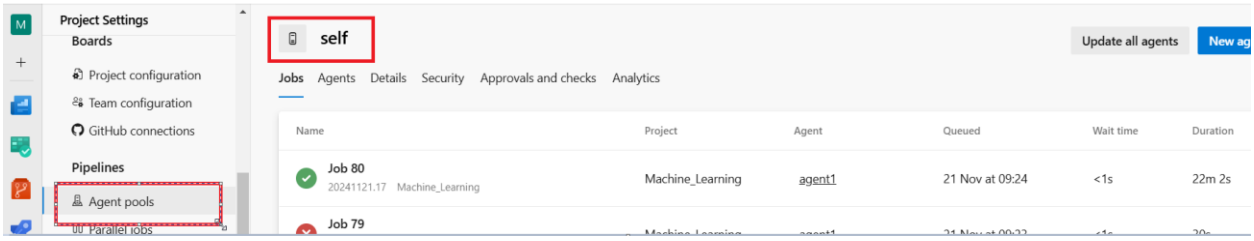
By combining these models, the application serves as a versatile tool for making predictions based on user inputs.

Screenshots:

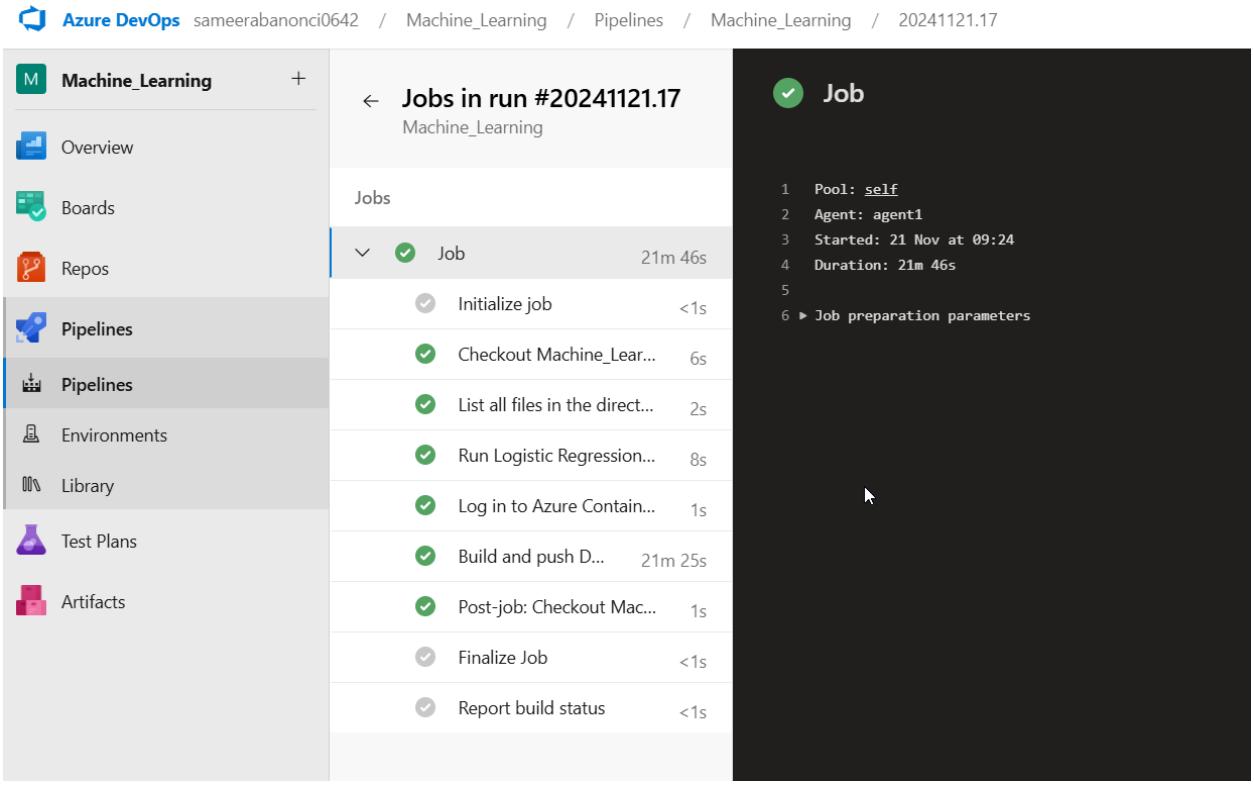
1) **To create container registery:**

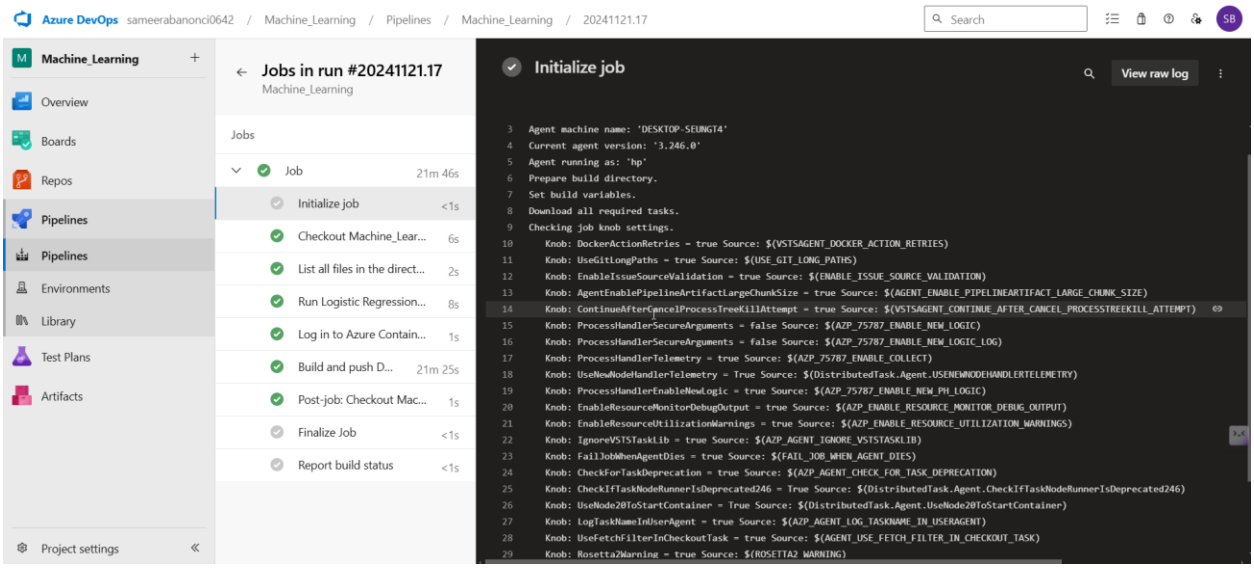


2) To run the pipeline I have used Agent pool with the name ‘self’



3) Jobs run in the pipeline :

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SB
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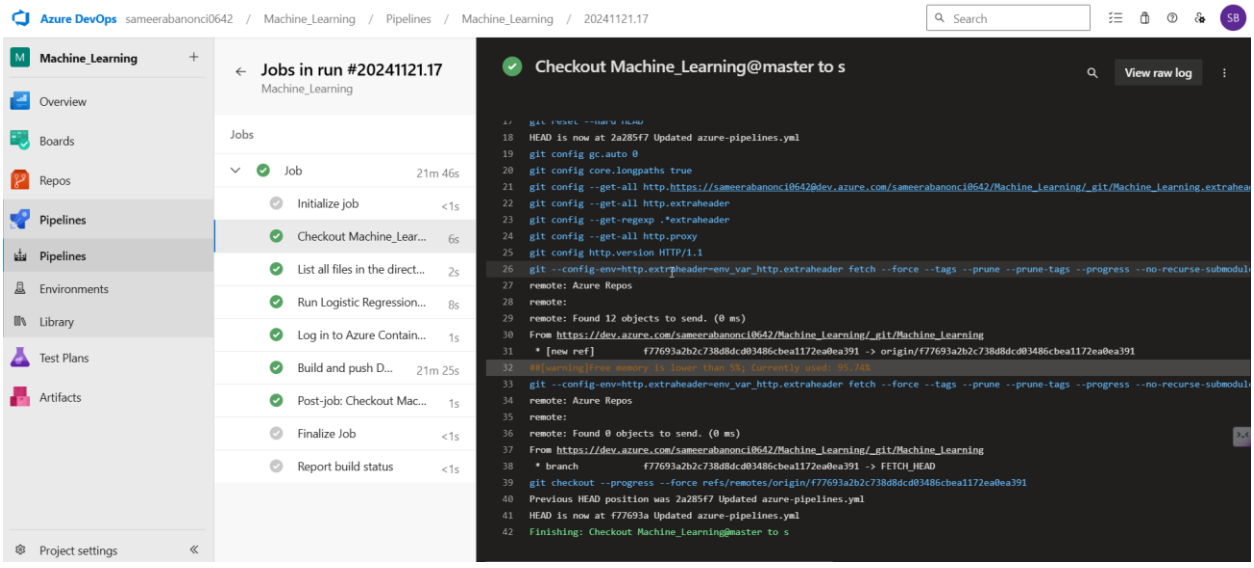
Overview
Boards
Repos
Pipelines
Pipelines
Environments
Library
Test Plans
Artifacts
Project settings
Jobs in run #20241121.17
Machine_Learning
Jobs
Job 21m 46s
Initialize job <1s
Checkout Machine_Lear... 6s
List all files in the direct... 2s
Run Logistic Regression... 8s
Log in to Azure Contain... 1s
Build and push D... 21m 25s
Post-job: Checkout Mac... 1s
Finalize Job <1s
Report build status <1s
Initialize job
View raw log
Agent machine name: 'DESKTOP-SEUNGT4'
Current agent version: '3.246.0'
Agent running as: 'hp'
Prepare build directory.
Set build variables.
Download all required tasks.
Checking job knob settings.
Knob: DockerActionRetries = true Source: $(VSTSAGENT_DOCKER_ACTION_RETRIES)
Knob: UseGitLongPaths = true Source: $(USE_GIT_LONG_PATHS)
Knob: EnableIssueSourceValidation = true Source: $(ENABLE_ISSUE_SOURCE_VALIDATION)
Knob: AgentEnablePipelineArtifactLargeChunkSize = true Source: $(AGENT_ENABLE_PIPELINEARTIFACT_LARGE_CHUNK_SIZE)
Knob: ContinueAfterCancelProcessTreeKillAttempt = true Source: $(VSTSAGENT_CONTINUE_AFTER_CANCEL_PROCESSTREEKILL_ATTEMPT)
Knob: ProcessHandlerSecureArguments = false Source: $(AZP_75787_ENABLE_NEW_LOGIC)
Knob: ProcessHandlerSecureArguments = false Source: $(AZP_75787_ENABLE_NEW_LOGIC_LOG)
Knob: ProcessHandlerTelemetry = true Source: $(AZP_75787_ENABLE_COLLECT)
Knob: UseNewNodeHandlerTelemetry = True Source: $(DistributedTask.Agent.USENEWNODEHANDLERTELEMETRY)
Knob: ProcessHandlerEnableNewLogic = true Source: $(AZP_75787_ENABLE_NEW_PH_LOGIC)
Knob: EnableResourceMonitorDebugOutput = true Source: $(AZP_ENABLE_RESOURCE_MONITOR_DEBUG_OUTPUT)
Knob: EnableResourceUtilizationWarnings = true Source: $(AZP_ENABLE_RESOURCE_UTILIZATION_WARNINGS)
Knob: IgnoreVSTSTaskLib = true Source: $(AZP_AGENT_IGNORE_VSTSTASKLIB)
Knob: FailJobWhenAgentDies = true Source: $(FAIL_JOB_WHEN_AGENT_DIES)
Knob: CheckForTaskDeprecation = true Source: $(AZP_AGENT_CHECK_FOR_TASK_DEPRECATION)
Knob: CheckIfTaskNodeRunnerIsDeprecated246 = True Source: $(DistributedTask.Agent.CheckIfTaskNodeRunnerIsDeprecated246)
Knob: UseNode20ToStartContainer = True Source: $(DistributedTask.Agent.UseNode20ToStartContainer)
Knob: LogTaskNameInUserAgent = true Source: $(AZP_AGENT_LOG_TASKNAME_IN_USERAGENT)
Knob: UseFetchFilterInCheckoutTask = true Source: $(AGENT_USE_FETCH_FILTER_IN_CHECKOUT_TASK)
Knob: Rosetta2Warning = true Source: $(ROSETTA2_WARNING)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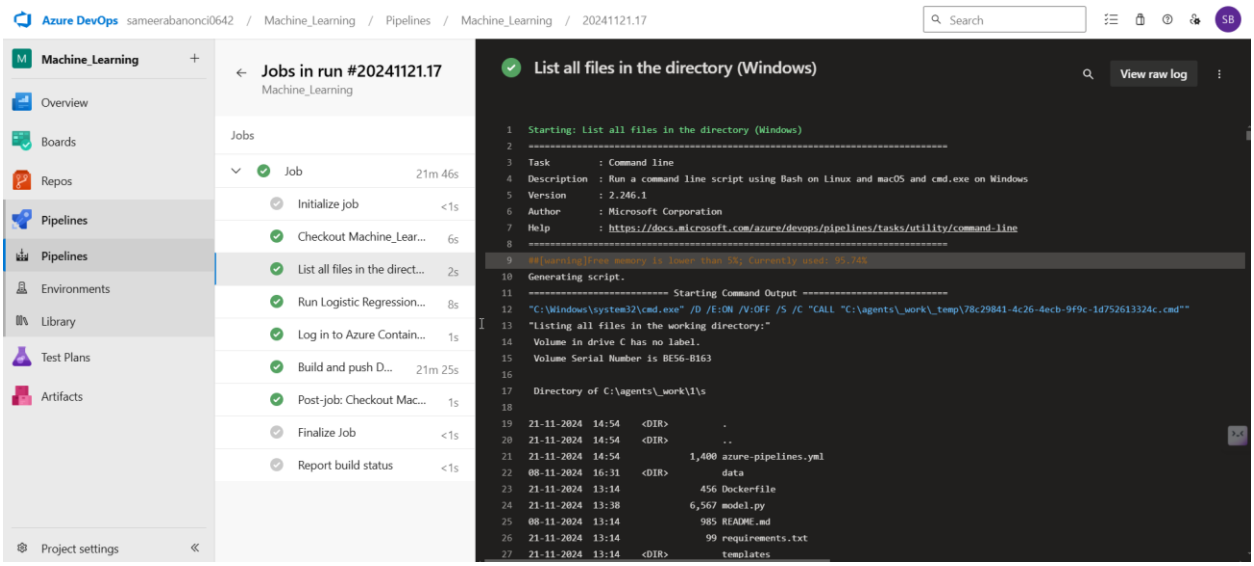
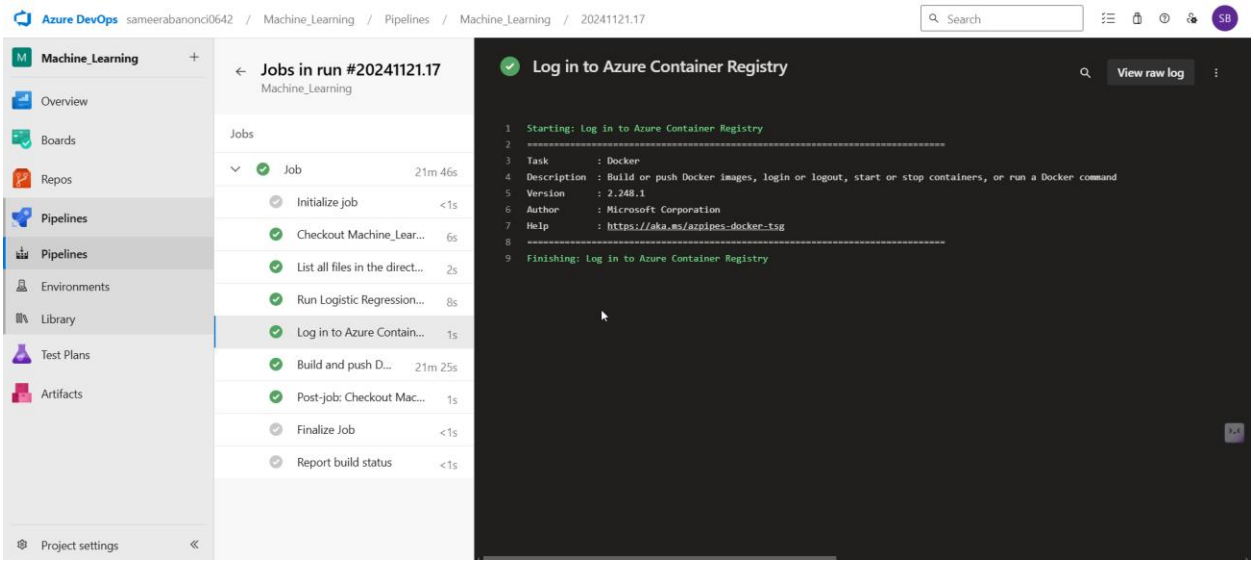
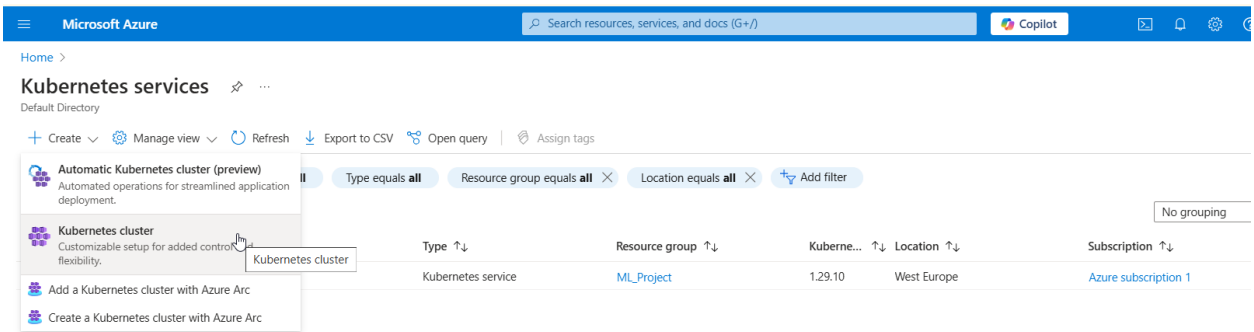
Jobs in run #20241121.17
Machine_Learning
Jobs
Job 21m 46s
Initialize job <1s
Checkout Machine_Lear... 6s
List all files in the direct... 2s
Run Logistic Regression... 8s
Log in to Azure Contain... 1s
Build and push D... 21m 25s
Post-job: Checkout Mac... 1s
Finalize Job <1s
Report build status <1s
Checkout Machine_Learning@master to s
View raw log
HEAD is now at 2a285f7 Updated azure-pipelines.yml
git config gc.auto 0
git config core.longpaths true
git config --get-all http.https://sameerabanonci0642@dev.azure.com/sameerabanonci0642/Machine_Learning/_git/Machine_Learning.extraheader
git config --get-all http.extraheader
git config --get-regexp .*extraheader
git config --get-all http.proxy
git config http.version HTTP/1.1
git --config-env=http.extraheader=env_var_http.extraheader fetch --force --tags --prune --prune-tags --progress --no-recurse-submodules
remote: Azure Repos
remote:
remote: Found 12 objects to send. (0 ms)
From https://dev.azure.com/sameerabanonci0642/Machine_Learning/_git/Machine_Learning
* [new ref] f77693a2b2c738d8dcd03486cbea1172ea0ea391 -> origin/f77693a2b2c738d8dcd03486cbea1172ea0ea391
##[warning]Free memory is lower than 5%, Currently used: 95.74%
git --config-env=http.extraheader=env_var_http.extraheader fetch --force --tags --prune --prune-tags --progress --no-recurse-submodules
remote: Azure Repos
remote:
remote: Found 0 objects to send. (0 ms)
From https://dev.azure.com/sameerabanonci0642/Machine_Learning/_git/Machine_Learning
* branch f77693a2b2c738d8dcd03486cbea1172ea0ea391 -> FETCH_HEAD
git checkout --progress --force refs/remotes/origin/f77693a2b2c738d8dcd03486cbea1172ea0ea391
Previous HEAD position was 2a285f7 Updated azure-pipelines.yml
HEAD is now at f77693a Updated azure-pipelines.yml
Finishing: Checkout Machine_Learning@master to s

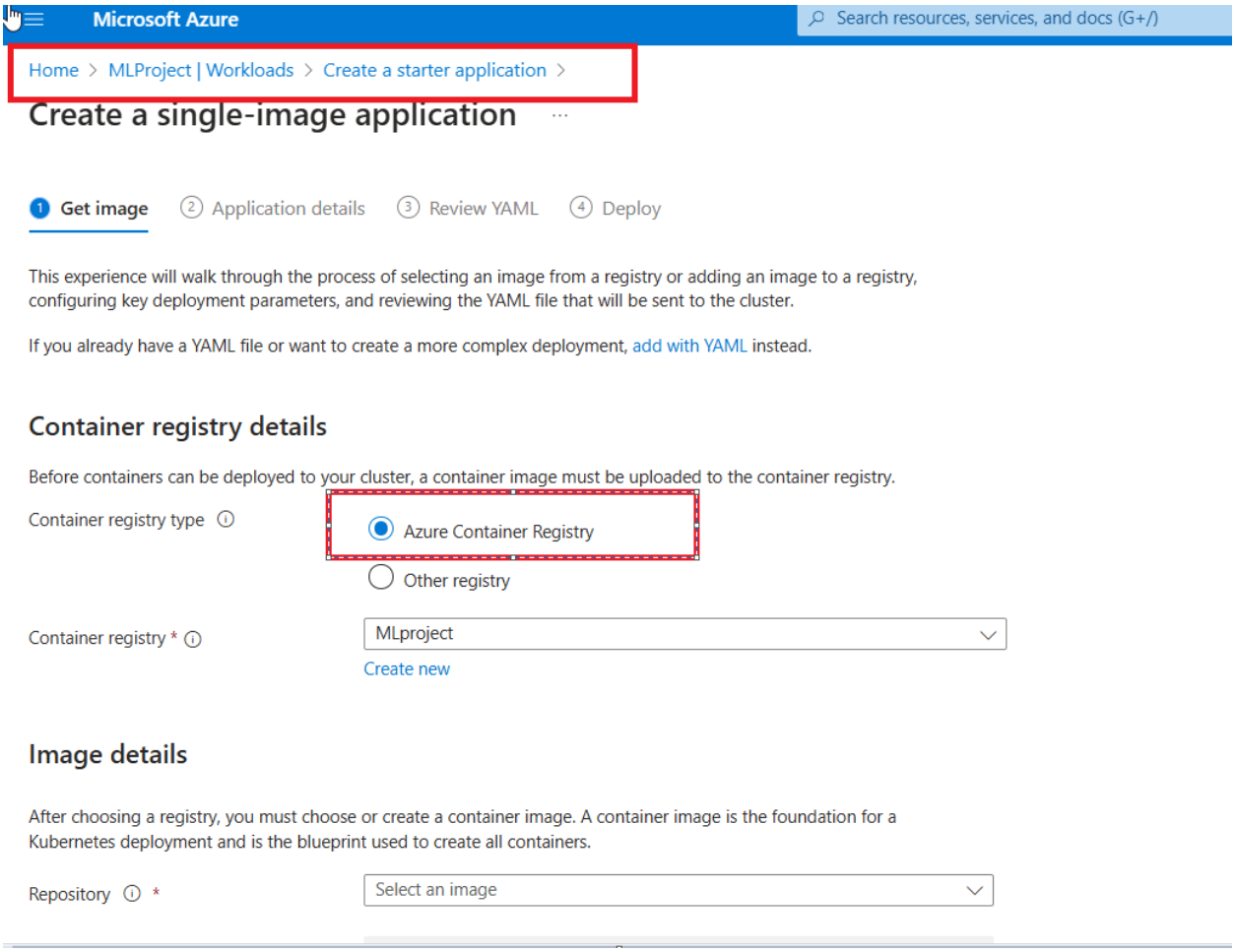




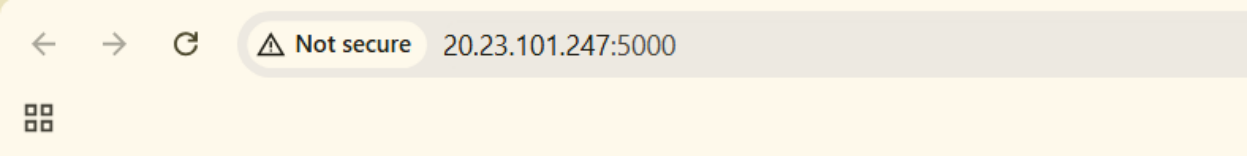
➢ To create the Kubernetes cluster:



➢ To create a starter application to be deployed :



- Public Address to check Machine Learning models evaluation in Azure- http://20.23.101.247:5000/



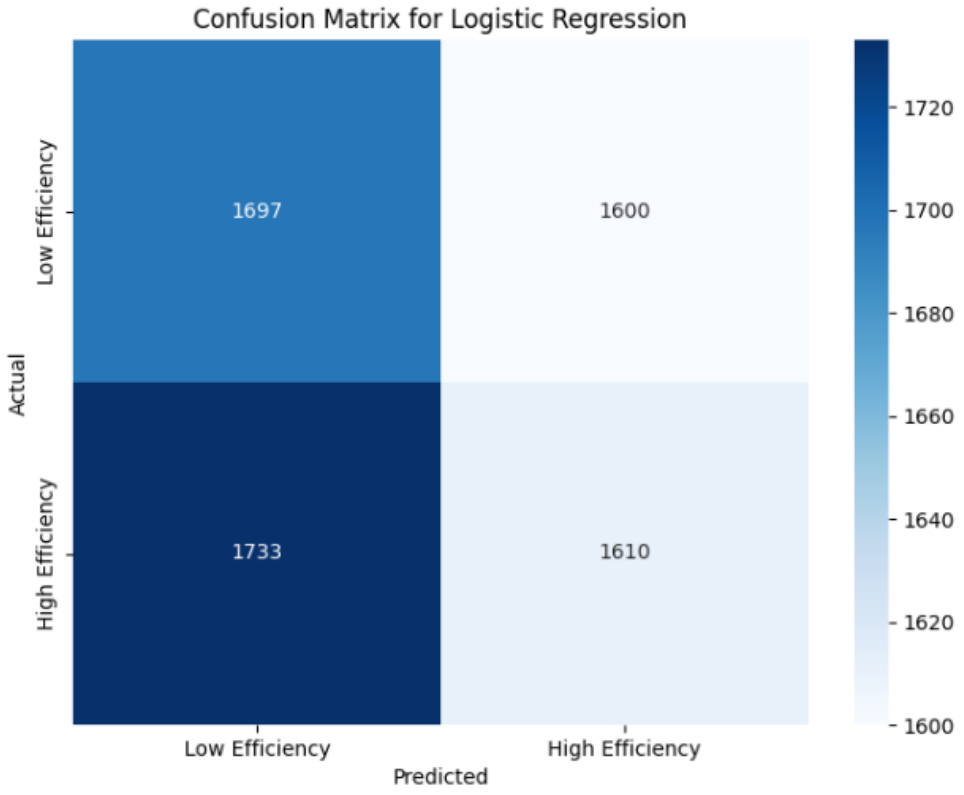
Model Evaluation Results

Logistic Regression

Accuracy: 0.4980421686746988

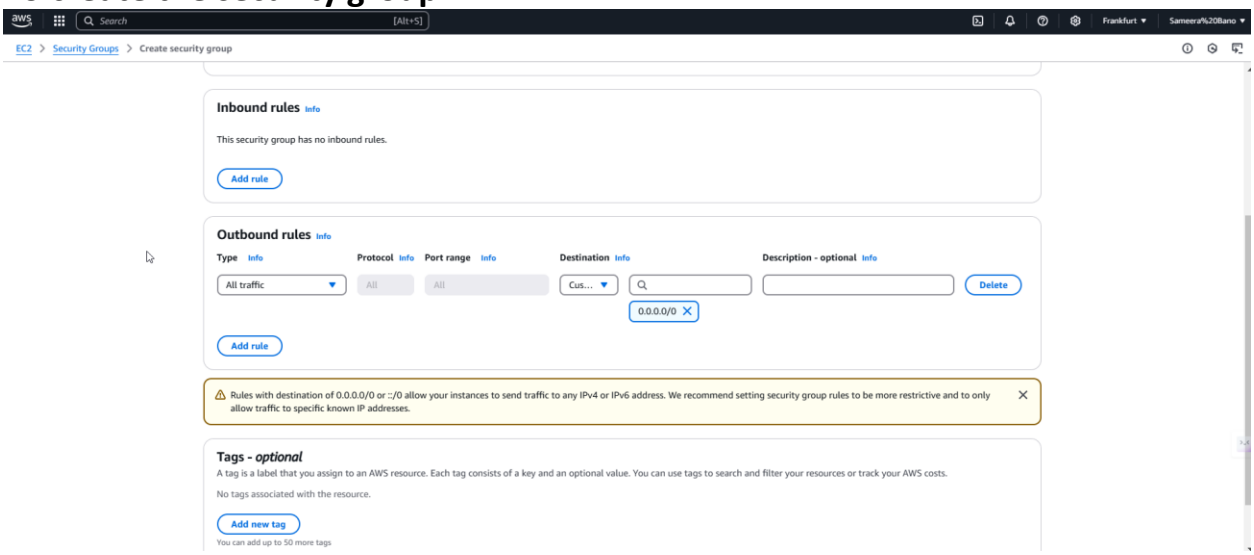
	precision	recall	f1-score	support
0	0.49	0.51	0.50	3297
1	0.50	0.48	0.49	3343
accuracy			0.50	6640
macro avg	0.50	0.50	0.50	6640
weighted avg	0.50	0.50	0.50	6640

Confusion Matrix:

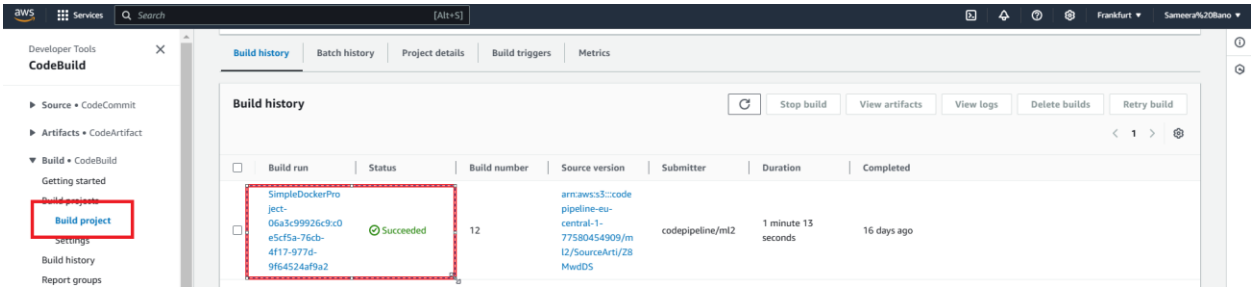


AWS:

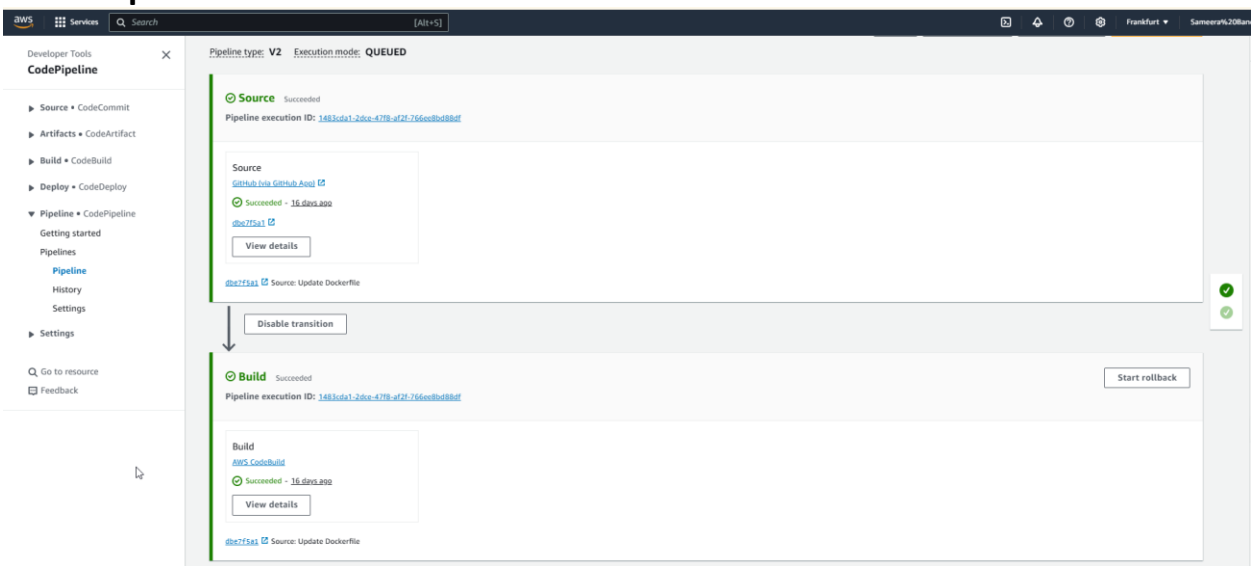
- **To create the security group:**



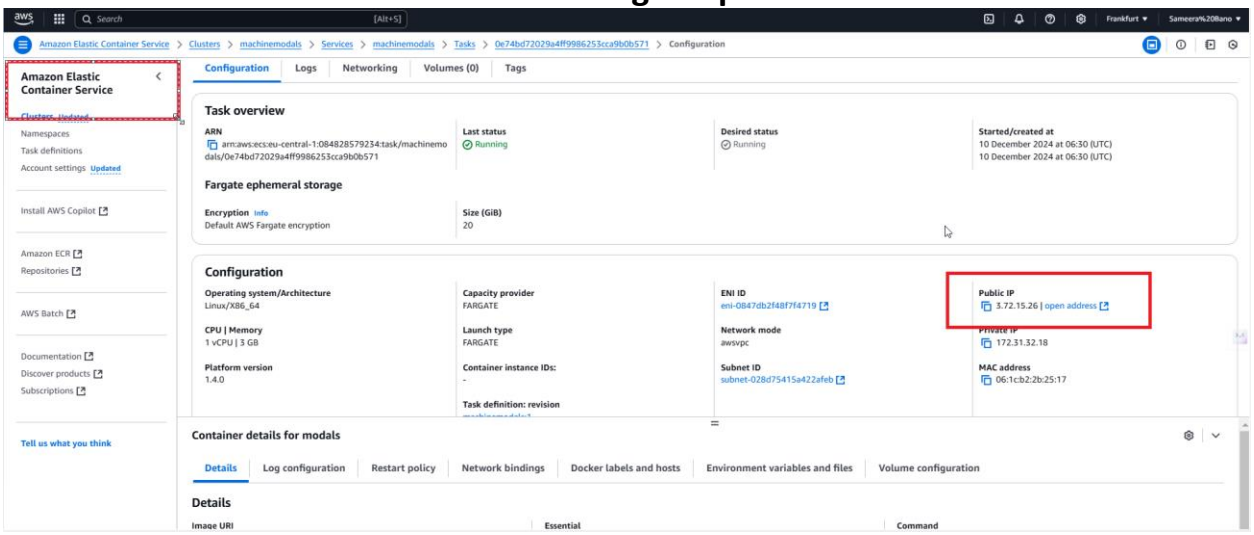
- **CodeBuild:**



➢ Pipeline:



➢ Elastic Container Service containing the public IP:



AWS public IP to analyse Machine learning models evaluation- http://3.72.15.26:5000/

Evaluation result:

Model Evaluation Results

Logistic Regression

Accuracy: 0.4935

	precision	recall	f1-score	support
0	0.51	0.38	0.43	5117
1	0.49	0.61	0.54	4883
accuracy			0.49	10000
macro avg	0.50	0.50	0.49	10000
weighted avg	0.50	0.49	0.49	10000

Confusion Matrix: