

Configuration Manual

MSc Research Project Cloud Computing

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MSc Project Submission Sheet

School of Computing

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| Student ID: | X23186607 |
| Programme: | MSc in Cloud Computing Year: 2024 |
| Module: | Research Project |
| Lecturer: Submission Due | Shivani Jaswal |
| Date: | 28.01.2025 |
| Project Title: | Improvement of Intelligent Task Prediction and Computation Offloading towards mobile-edge cloud computing. |
| Word Count: | 907 Page Count: 10 |

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.

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Signature: Pravin Ravindran Shanmugam

Date: 28.01.2025

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Configuration Manual

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AWS SageMaker Setup with S3

First, make sure your AWS account – be it your private account or college's one – is functional. If you do not have an account on AWS, then first, register for one. Configure the necessary IAM roles with the necessary permissions, such as:

AWS Generate Policy should be used when creating new ones. You can add new policies to build policies with an explicit ARN for any service and principle. Be certain to do this for all resources; if not, utilize the edit option in policy to change each certain policy as you deem fit.

| AWS Policy Generator | | | | |
|--|---|---|---|---------------------------------|
| | | ate policies that control access to Amazon Web s Management. Here are sample policies. | Services (AWS) products and resourc | es. For more information about |
| Step 1: Select Policy T | уре | | | |
| A Policy is a container for permiss Queue Policy. | ions. The different types (| of policies you can create are an IAM Policy, and | n S3 Bucket Policy, an SNS Topic Policy | , a VPC Endpoint Policy, and ar |
| Select Type of Po | S3 Bucket Policy | ~ | | |
| Step 2: Add Statemen | t(s) | | | |
| | | n. See a description of elements that you can i | use in statements. | |
| E | fect 💿 Allow i Den | у | | |
| Princ | ipal * | | | |
| | Use a comma to separa | ite multiple values. | | |
| AWS Ser | vice Amazon S3 | ~ | All Services ('*') | |
| | Use multiple statements | s to add permissions for more than one service. | | |
| Act | 2 Action(s) Selected | All Actions ('*' |) | |
| Amazon Resource Name (A | RN) arn:aws:s3:::x231866 | 507 | | |
| | ARN should follow the fi Use a comma to separa | ollowing format: arn:aws:s3:::\${BucketName}/\${KeyNa ite multiple values. | me}. | |
| | Add Conditions (Op | tional) | | |
| | Add Statement | | | |
| | | | | |
| | | | | |
| You added the following statemen | ts. Click the button below | / to Generate a policy. | | |
| Principal(s) E | ffect Action | Resource | | Conditions |
| • = A | | CreateBucket arn:aws:s3 DeleteBucket | ::::x23186607 | None |
| Step 3: Generate Polic | y | | | |
| A policy is a document (written in | the Access Policy Langua | ge) that acts as a container for one or more s | tatements. | |
| | | | | |
| | Generate Polic | y Start Over | | |

Fig. 1: Policy generation

This way you can paste it to include the specific services once the policy has been generated.

1. SageMaker Execution Role:

Wherever SageMaker will be utilised, this position should be able to communicate with the S3 buckets. Make careful to define execution roles for every S3 bucket if you are utilising more than one. The prototype for the authorization of the current S3 bucket included with a particular S3 bucket from the available permission option is shown in the image below.

| e bucket policy, written in JSON, provides access to the objects stored in the bucket. Bucket policies don't apply to objects owner ore [| l by other accounts. |
|--|----------------------|
| Public access is blocked because Block Public Access settings are turned on for this bucket To determine which settings are turned on, check your Block Public Access settings for this bucket. Learn more about using A <u>Access</u> | mazon S3 Block Pu |
| (| |
| "Version": "2012-10-17", | |
| "Statement": [| |
| t "Effect": "Allow", | |
| "Principal": { | |
| "AWS": "arn:aws:iam::816069168715:role/service-role/AmazonSageMaker-ExecutionRole-20241011T111399" | |
|), | |
| "Action": [| |
| "s3:GetObject", | |
| "S3:*" | |
| 1, | |
| "Resource": "arn:aws:s3:::x23186607/mobile_edge_dataset.csv" | |
| } | |
| 1 | |
| | |

| | nary | | | | | | Edit |
|---------------------|--|--|--|-----------|---|--------------------------|---|
| Creation October | | 024, 11:13 (UTC+01:00) | | | ARN | role/service.role/Amazor | SageMaker-ExecutionRole-20241011T111399 |
| Last acti | | , | | | Maximum session duration 1 hour | | |
| Permis | sions | Trust relationships Tags | Last Accessed Revoke | sessions | | | |
| Permi | issio | ns policies (6) Info | | | | C Simulate | Remove Add permissions |
| rou can | attach | up to 10 managed policies. | | - | - | Ŭ | |
| 0.0 | | | | Filter by | | | |
| Q Set | arch | | | All typ | Des | • | < 1 > |
| | | y name 🖸 🔹 🔺 | Туре | All ty | Attached entities | • | < 1 > |
| | | y name [7] AmazonSageMaker-ExecutionPolicy | Type Customer managed | | | • | |
| | Polic | _ | | | Attached entities | • | |
| | Polic | AmazonSageMaker-ExecutionPolicy | Customer managed | | Attached entities | • | |
| | Polic + | AmazonSageMaker-ExecutionPolicy | Customer managed AWS managed | | Attached entities | • | |
| | Polic e e | AmazonSageMaker-ExecutionPolicy AmazonSageMakerCanvasAlServi AmazonSageMakerCanvasDataPr | Customer managed AWS managed AWS managed | | Attached entities 1. 1. 1. | • | |
| | Polic (*) (*) (*) (*) (*) | AmazonSageMaker-ExecutionPolicy AmazonSageMakerCanvasAlServi AmazonSageMakerCanvasDataPr AmazonSageMakerCanvasFullAcc | Customer managed AWS managed AWS managed AWS managed | | Attached entities 1. 1. 1. 1. 1. | • | |
| | Polic e e e e | AmazonSageMaker-ExecutionPolicy AmazonSageMakerCanvasAlServi AmazonSageMakerCanvasAlServi AmazonSageMakerCanvasDataPr AmazonSageMakerCanvasDataPr AmazonSageMakerCanvasDataPr | Customer managed AWS managed AWS managed AWS managed AWS managed | | Attached entities 1. 1. 1. 1. 2. 2. 3. | • | |

Fig. 3: Execution Role Permission for SageMaker

Environmental Setup

Python: Make sure that the python has been installed in your computer. Depending upon whether Python is not installed in the computer, able to install and download Python available from the <u>official web site</u>. In the case of observation, follow the instructions based on your requirement. If you have already done that, please use the code below to check if the suitable version have been installed:

| C:\Users\pravi> | python | version |
|-----------------|--------|---------|
| Python 3.11.5 | | |

C:\Users\pravi>pip show scikit-learn Name: scikit-learn Version: 1.2.2

Fig. 6: Check Python and Scikit Version

Next check the scikit learn is install with 1.2.2 version since verify the deployed model's scikit learn version and machine's installed version are same.

Scikit Learn 1.2.2

Libraries: Please ensure to install all the necessary libraries for python as described in the fig. 7.

```
# Import necessary libraries
import sagemaker
import boto3
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import xgboost as xgb
import joblib
import os
```

all the second sec

Fig. 7: Import Python libraries

SageMaker:

1. Notebook Instance: The Jupyter instances Notebook configuration is basic to design, training and utilize model in SageMaker, as has been illustrated in fig. 8 first steps leading to the creation of a new notebook have to be undertaken.

| Create notebook instance | |
|---|-------------------|
| | |
| nazon SageMaker provides pre-built fully managed notebook instances that run Jupyter notebooks. The clude example code for common model training and hosting exercises. Learn more [2] | e notebook instar |
| Notebook instance settings | |
| Notebook instance name | |
| x23186607_Task_Offloading | |
| Maximum of 63 alphanumeric characters. Can include hyphens (-), but not spaces. Must be unique within your account i Notebook instance type | in an AWS Region. |
| ml.t3.medium | |
| Platform identifier Learn more [7] | |
| Amazon Linux 2, Jupyter Lab 3 | |
| Additional configuration Permissions and encryption | |
| IAM role Notebook instances require permissions to call other services including SageMaker and S3. Choose a role or let us create AmazonSageMakerFullAccess IAM policy attached. | e a role with the |
| AmazonSageMaker-ExecutionRole-20241011T111399 | |
| Create role using the role creation wizard 🖪 | |
| Root access - optional | |
| Enable - Give users root access to the notebook | |
| - | |

Fig. 8: Notebook Instance using SageMaker

For extended user interface, We can utilize the SageMaker Home console. In fact, once an instance has been created one can be able to see the status as Running. The specific reminder I have is always ensure you have stopped all the running services before turning it off.

| Noteb | ook instances | Git | repositories | | | | | |
|-------|----------------|-------------|--------------|------------------------|---|-------------|-----|------------------------------|
| Note | book insta | nces Infe |) | | (| C Actions | , | Create notebook instance |
| Q S | earch notebool | k instance: | 5 | | | | | < 1 > (§ |
| | Name | ∇ | Instance | Creation time | • | Status 🔻 | Act | ions |
| ~ | Task-Offload | P | ml.t3.medium | 11/12/2024, 8:14:48 PM | | ⊘ InService | 0 | en Jupyter Open JupyterLab |

Fig. 9: InService Notebook Instance

2. Loading of Dataset from S3: With generally setting region and the name of the bucket you can access to store the data and to read dataset from that storage cloud.

```
[5]: region = boto3.Session().region_name
sagemaker_session = sagemaker.Session()
role = sagemaker.get_execution_role()
[6]: print(f"AWS Region: {region}")
print(f"RoleArn: {role}")

AWS Region: us-east-1
RoleArn: arn:aws:1am::816069168715:role/AWS-Sagemaker-ExecutionRole-816069168715
```

2. Let's Look at the dataset Stored in S3 utilized by its name

- mobile_edge_dataset.csv is the dataset file taken from kaggle and used in this model, its a various task category details dataset
- The dataset management is managed by AWS S3 Bucket on cloud.

```
[7]: # Stored data Bucket name & file name
bucket_name = 'x23186607'
file_key = 'mobile_edge_dataset.csv'
[8]: #.Read_the_CSV_file_from_53
s3 = boto3.client('s3')
prefix = 'task-offloading' # Folder in 53
csv_obj = s3.get_object(Bucket=bucket_name, Key=file_key)
body = csv_obj['Body']
csv_string = body.read().decode('utf-8')
[9]: # Load the dataset into a pandas dataframe
data = pd.read_csv(StringIO(csv_string))
[10]: data
[10]: Device_ID CPU_Usage Memory_Usage Battery_Level (%) Server_ID CPU_Capacity Available_Memory Network_Latency Task_Type
```

| | De | vice_ID | (%) | (%) | (%) Ser | ver_ID | (%) | (%) | (ms) | таsк_туре |
|------|--------|----------|-----------|--------------|-----------|----------|-----|-----|------|-----------|
| | 0 | 1 | 61 | 83 | 49 | 2 | 64 | 85 | 20 | Sensor |
| Fig. | 10: Lo | oading o | of Datase | et from S3 t | so be use | d entire | ely | 50 | 25 | Image |

3. Model Training and Deployment of Endpoint: The following code snippet is responsible for the model training job as well as creation of the endpoint configuration. Use the code below.



Fig. 11: Job of Model Training

After the training of the task have been finished, the model is ready for deployment.



Fig. 12: Model deployed as endpoint for further usage.

Eclipse & iFogSim Setup:

1. Download Eclipse IDE in your System using specified link:

Link: https://www.eclipse.org/downloads/packages/

| | | Projects Working Group | s Members More - | | |
|--|--|--|---|--|--|
| Home / Downle | oads / Packages / Release / Eclipse IDE 2024-09 / R | | | | |
| Eclipse Install | er Eclipse Packages Eclipse Developer Builds • | | | | |
| The Eclips | e Installer 2024-09 R now includes a JRE for macOS, Window | s and Linux. | Sponsored Ad | | |
| | e Eclipse Installer 2024-09 R | Download macOS x86 64 AArch64 | RELATED LINKS | | |
| The easiest way to install and update your Eclipse Development Environment. | | Windows X88_64 Linux X86_64 AArch64 | Compare & Combine | | |
| | re 4 Installer Downloads Package Downloads and Updates | | Packages New and Noteworthy Install Guide Documentation Updating Eclipse | | |
| clipse ID | DE 2024-09 R Packages | | Forums Simultaneous Release | | |
| | Eclipse IDE for Enterprise Java and Web Developers | | MORE DOWNLOADS | | |
| | 530 MB 252,429 DOWNLOADS | | Other builds Eclipse 2024-06 (4.32) | | |
| | Tools for developers working with Java and Web applications, including a Java IDE, tools for JavaScript, TypeScript, JavaServer Pages and Faces, Yaml, Markdown, Web | | Eclipse 2024-00 (4.32) Eclipse 2024-03 (4.31) Eclipse 2023-12 (4.30) Eclipse 2023-09 (4.29) | | |

Fig. 13: Download Eclipse

For the purposes of this simulation, **Eclipse IDE for Java Developers** is the recommended option; select the appropriate version of Eclipse, Windows, MacOS or Linux compatible to your system.

1. With this download button, people can download the one that required.



Fig. 14: Install Eclipse

- 2. Install Eclipse:
- After running the installer select Eclipse IDE for Java Developers.
- Once that is done, launch the Eclipse tools.
- 3. Select and obtain a directory for your work that will act as the workspace.

2. Configure the environment for Java development

- 1. Verify that the Java Development Kit (JDK) have been installed on your computer: Available here : <u>Download JDK</u>.
- 2. Verify Java in Eclipse:
- Go to Window > Preferences > Java > Installed JREs.
- Add and select your installed JDK if it is not listed.

3. Download iFogSim from GitHub

- 1. Go to the iFogSim GitHub repository: <u>iFogSim GitHub</u>.
- 2. Click **Download ZIP** to download the repository.
- 3. Extract the ZIP file to a folder on your local machine.

| | | | | ⊙ Watch 16 | ♥ Fork 96 ♥ |
|-------------------------------|------------------------|-------------------------------|------------------|-------------|--|
| 🐉 main 👻 🤔 2 Branches 🛇 1 Tag | QG | o to file 🔹 | Add file 👻 | <> Code - | About |
| mgoudarzi90 Update README.md | | Local | Codes | paces | The iFogSimToolkit iFogSim2) for Mode |
| idea | All scripts are tested | ► Clone HTTPS SSH GitHub | cu | 3 | Resource Managem Internet of Things, E |
| dataset | All scripts are tested | | | | Computing Environ release Mobili Man |
| iars | jar files are updated | Clone using the web URL. | slab/iFogSim.git | Ģ | Management, and I mechanisms are ad |
| out/production/iFogSim2 | All scripts are tested | clone using the web okc. | | | D Readme |
| output | ECG to be fixed | Dpen with GitHub Desk | op | | - Activity |
| results | jar files, topologies, | Download ZIP | | | Custom propertie |
| src src | Microservice Mobilit | ty related bugfix. | | 3 years ago | ☆ 143 stars ⊙ 16 watching |
| topologies | jar files, topologies, | readme, are fixed and updated | | 3 years ago | 앟 96 forks |
| gitignore | jar files, topologies, | readme, are fixed and updated | | 3 years ago | Report repository |
| C README.md | Update README.mc | I | | 2 years ago | Releases 1 |
| iFogSim2.iml | All scripts are tested | and ready to work | | 3 years ago | v2.0.0 Latest on Apr 25, 2022 |
| D README | | | | ∅ :≡ | Packages |
| | | | | | No packages published |

Fig. 15: iFogSim Git Repo

4. Import iFogSim into Eclipse

- 1. Open Eclipse IDE.
- 2. Select File Import Existing Projects into Workspace.
- 3. On the import wizard:
 - Select the folder where you extracted the iFogSim repository.
 - Ensure the projects are listed and selected.
- 4. Click **Finish** to import iFogSim into your workspace.

5. Build and run iFogSim

- 1. Import the source project and the source plugins into Eclipse; Eclipse should build these two automatically.
- 2. Verify the build:
- 3. This is important to check that there are no mistakes on the Problems view.
- 4. Run an example simulation:
- 5. Visit a sample Java file for instance org.fog.test.perfeval.x23186607.java.
- 6. Form a right click on the file select run as > java application.



Figure 16: iFogSim Results

References

Gupta, H., Vahid Dastjerdi, A., Ghosh, S.K. and Buyya, R., 2017. iFogSim: A toolkit for modeling and simulation of resource management techniques in the Internet of Things, Edge and Fog computing environments. *Software: Practice and Experience*, *47*(9), pp.1275-1296.

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R. Daniels, "The Impacts on Management of Electromagnetic Compatibility," 1964 6th National Symposium Electromagnetic Compatibility, Los Angeles, CA, USA, 1964, pp. 1-2, doi: 10.1109/ISEMC.1964.7565199.