

Configuration Manual

MSc Research Project Cloud Computing

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Configuration Manual

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1 Introduction

In our initial setup in the development of this Thesis Project an Amazon SageMaker Notebook has been created to assist us with data preprocessing and preparation stages. In this notebook, various libraries were imported to support data analysis and manipulation. After that, Lambda function was developed to integrate it with the model endpoint that has been created. This Lambda function plays an important role in serving the model inference requests. Finally to allow external access to the model, an API Gateway was introduced, acting as an interface from the virtual network to trigger the lambda function.

2 Amazon SageMaker AI

2.1 NoteBook Creation

Below figure presents the successful creation of SageMaker Notebook with a sufficient computing resources.Figure 1.

aws Services Q Search	[Alt-S] 😡 🕹 🧿	🛞 🛛 N. Virginia 🔻	Abdo
Amazon SageMaker ×	Anszen SagetAler Al > Notebooks and Git Repos Notebooks and Git repos		
Getting started	♥ Try the new JupyterLab in SageMaker Studio		
Applications and IDEs Studio Cannos Ristudio Tensoribaard Profiler Notebooks Partner Al Apps Mtto	Ty the new Supported.ab in SageMaker Studio	Get Started	
 Admin configurations Domains 	Notebook instances Git repositories		
Role manager Images Lifecycle configurations	Notebook instances unio	tebook instance	
SageMaker Al dashboard Search	Name V Instance Creation time V Status V Actions O TestingHL mll3medium 11/20/2024, 95:45 AM ØitsGervice Open Juppler Open Jupp		

Figure 1: SageMaker NoteBook.

2.2 Data Collection

The dataset was collected from our Virtual Network and can be accessed through below GitHub link.

https://github.com/Abdu-AJ/ORAN.git

2.3 Data Exploration

All the Python libraries required to implement the entire project are listed in below figure Figure 2 and s3 bucket name.

Figure 2.



Figure 2: Required Libraries.

2.4 Data Preprocessing and Preparation for SageMaker

Below photos represent data preprocessing workflow. Where the dataset was splited into features and target labels, then divided into training and testing sets using an 80-20 split. After that to address class imbalance, SMOTE (Synthetic Minority Oversampling Technique) is applied to the training data. Finally resampled training and testing datasets are saved as CSV files and uploaded to Amazon S3, making them accessible for SageMaker trainingFigure 3Figure 4.



Figure 3: Data Preprocessing and Preparation.

2.5 Random Forest Model Training and Deployment Script

The script uses the provided data set to train a Random Forest Classifier using hyperparameters and save the trained model for deployment. The steps followed in this script were to preprocesses the data, train the model, evaluate its performance on test data,

<pre>X_train, X_test, y_train, y_test = train_test_split(x,y, test_size=0.2, ran</pre>	<pre>dom_state=0, shuffle=True)</pre>
<pre>smote = SMOTE(random_state=42) X train resampled, y train resampled = smote.fit resample(X train, y train)</pre>	<pre>trainx.to_csv("train-V-1.csv",index = False) testX.to_csv("test-V-1.csv", index = False)</pre>
<pre>trainX = pd.DataFrame(X_train_resampled, columns=features) trainX[label] = y_train_resampled</pre>	# send data to SJ. Sogetker will take training data from sJ sk prefix = "segenker/RD Power_classification/sklearncontainer" trainpath = ses.upload data(path="train.v-1.csv", bucket=bucket, key_prefix=sk_prefix
<pre>testX = pd.DataFrame(X_test, columns=features) testX[label] = y_test</pre>	<pre>testpath = sess.upload_data(path="test-V-1.csv", bucket=bucket, key_prefix=sk_prefix)</pre>

Figure 4: Data Preprocessing and Preparation.

and provide key metrics such as accuracy and classification report. These steps were implemented by the example provided in Spidy20 (2023)

Our Project Version can be found on—https://github.com/Abdu-AJ/ORAN.git

2.6 Configuring and Launching a SageMaker Training Job

Configuring and launching a SageMaker training job using the Scikit-learn framework by specifying the training script. Additionally, the job trains the model in the cloud using the provided training and testing data from S3 Figure 5.



Figure 5: SageMaker Training Job.

2.7 Model Retrieval, Deployment, and Endpoint Creation in SageMaker

Below final steps are used to handle the model being trained in SageMaker. Firstly, it retrieves the model, then creates a SageMaker model using this artifact. Finally, the model is deployed to a SageMaker endpoint to serve the model real-time predictions Figure 6.

In [32]:	<pre>sklearn_estimator.latest_training_job.wait(logs="None") artifact = sm_boto3.describe_training_job(Training_obName=sklearn_setimator.latest_training_job.name)["ModelArtifacts"]["S3ModelArtifacts"]</pre>
	<pre>print("Model artifact persisted at " + artifact)</pre>
	2024-11-28 12:36:47 Starting - Preparing the instances for training 2024-11-28 12:36:47 Downloading - bownloading the training image 2024-11-28 12:36:47 Training - Training image download completed. Training in progress. 2024-11-28 12:36:47 Omploading - bujoading generated training model 2024-11-28 12:36:47 Completed - Training joh completed Model artifact persisted at s3://sagemaker-us-east-1-423623834574/custom-sklearn-2024-11-28-12-34-20-279/output/model.tar.
In [33]:	<pre>model_name = "Custom-sklearn-model-" + strftime("%V-%m-%d-%H-%K-%S", gmtime()) model = SklearnModel(name = model_name, model_data-artifact, role-get_execution_role(), entry_point'script.pp", framework_version=FRAMEWORK_VERSION,)</pre>
In [34]:	<pre>endpoint_name = "Custom-sklearn-model-" + strftime("XY-Xm-Xd-XH-XS", gmtime()) print("EndpointName=()".forwat(endpoint_name)) predictor = model.deploy(intial_instance_count-1, instance_type="ml.nd.klarge", endpoint_name=endpoint_name,) }</pre>

Figure 6: Model retrieval, creation, and deployment.

3 Lambda

3.1 Lambda Function Creation

First chose the suitable Lambda Function name after that chose python 3.12 version as show in below Figure 7.

Lambda > Functions > Create function reate function Info loose one of the following options to create your function.		
Author from scratch Start with a simple Hello World example.	Use a blueprint Build a Lambda application from sample code and configuration presets for common use cases.	C Container image Select a container image to deploy for your function.
Basic information		
Function name Enter a name that describes the purpose of your function.		
RU_Power_lambd		
Function name must be 1 to 64 characters, must be unique to the Region, and can'	't include spaces. Valid characters are a-z, A-Z, O-9, hyphens (-), and underscore	s ().
Runtime Info Choose the language to use to write your function. Note that the console code edit	tor supports only Node.js, Python, and Ruby.	
Python 3.12	•	©
Architecture Info Choose the instruction set architecture you want for your function code.		
O x86_64		
🔾 arm64		
Permissions Info By default, Lambda will create an execution role with permissions to upload logs to	o Amazon CloudWatch Logs. You can customize this default role later when ad	kling triggers.
Change default execution role		
 Additional Configurations Use additional configurations to set up code signing, function URL, 	tags, and Amazon VPC access for your function.	
		Cancel Create function

Figure 7: Lambda Function Creation

3.2 Updating Lambda Function Role

First we have to find the Role that is being used by our lambda function as shown in Figure 8. Then under the IAM role section select the role and press the policy as shown below Figure 9. Finally, edit it Figure 10 as advised by Amazon's official website Amazon Web Services (2024) Figure 11.

Lambda > Functions > RU_Power_lambda	
RU_Power_lambda	Throttle Copy ARN Actions V
▼ Function overview Info	Export to Infrastructure Composer Download
Diagram Template Image: RU_Power_Lambda Image: RU_Power_Lambda Image: Layers (0) Image: API Gateway (+ Add destinution) (+ Add trigger) (1)	Description - Last modified 4 weeks age Function ABI 1 Transactambdaus-east-14/235/2384574/function/RU_Po wer_lambda Function URL Info
Code Test Monitor Configuration Aliases Versions General configuration Triggers Execution role Role name Bit Prover, lamidas role m2bdary (*) Aliases Versions	(C) (Edit) (View role document)

Figure 8: Lambda Role Update

IAM > Roles > RU_Power_Lar	ıbda-role-m2sdasyr	٥
dentity and Access 〈 fanagement (IAM)	RU_Power_lambda-role-m2sdasyr	Delete
Q. Search IAM	Summary	Edit
	Creation date November 27, 2024, 17:07 (UTC)	ARN
lashboard	Last activity	Maximum session duration
Access management	Ø 28 days ago	1 hour
ser groups		
Isers	Permissions Trust relationships Tags Last Accessed Revoke session	5
olicies		
lentity providers	Permissions policies (1) Info	C Simulate 🖸 Remove Add permissions 🔻
count settings	You can attach up to 10 managed policies.	
ot access management New	Filter b	у Туре
cess reports	Q. Search All ty	pes 🔹 < 1 > 🕲
cess Analyzer	Policy name	v Attached entities v
External access	AWSLambdaBasicExecutionRole-0a842258-b470-4ef. Customer managed	

Figure 9: IAM Role Update

Identity and Access 〈 Management (IAM)	AWSLambdaBasicExecut	Edit Deb			
Q Search IAM	Policy details				
	Type	Creation tim		Edited time	ARN
	Customer managed	November 2	7, 2024, 17:07 (UTC)	November 27, 2024, 19:14 (UTC)	amawsiam:423623834574:policy/service
Dashboard					role/AWSLambdaBasicExecutionRole- 0a842258-b470-4ef0-8004-b2ef9a7686c
Access management					
lser groups					
Isers	Permissions Entities attache	ed Tags Policy	versions Last Accessed		
toles					
olicies	(
dentity providers	Permissions defined in this				Edit Summary JSON
iccount settings	Permissions defined in this policy docu	ment specify which actions	are allowed or denied. To define pern	tissions for an IAM identity (user, user group,	or role), attach a policy to it
loot access management New	Q Search				
Access reports	Allow (2 of 438 services)				Show remaining 436 services
kccess Analyzer	Service	Access level	v Resource	Request condition	
External access	service	Access level	V Nesource	Request contraction	
External access					
Unused access	CloudWatch Logs	Limited: Write	Multiple	None	

Figure 10: IAM Role Update

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odify permissions in VSLambdaBasicExecutionRole- 842258-b470-4ef0-8004- ef9a7686c3	Modify permissions in AWSLambdaBasicExecutionRole-0a842258-b470-4ef0- Add permissions by selecting services, actions, resources, and conditions. Build permission statements using the JSON editor.	
o 2	Policy editor	Visual JSON Actions V
view and save	1 2	Edit statement
	5 "tffect": "Alles", 6 "%ctton": "leg:/orkstoig#vow", 7 "%couver": "wriaws10gs:us-est-1:42562804574:""	
	8 }, 9 • (Select a statement
	10 "Effect": "Allow", 11 * "Action": [12 "log::readedogtream",	Select an existing statement in the policy add a new statement.
	13 "log::PutiogDvents" 14], 15 W "Mesource": [+ Add new statement
	16 "arm:aws:logs:us-exst-1:421621834574:log-group:/aws/lambda/80_Power_lambda:*" 17]	
	18 }, 19 • {	
	<pre>'51d': "visualIditore", 21 '5'fest': "Allas", 22 'Arction': "agenake: invokeshippint",</pre>	
	23 "Tensores": "** 24) 25] 26]	

Figure 11: IAM Role Update

4 API Gateway

4.1 API Creation

REST API Creation Figure 12.

eate REST API		
API details		
New API Create a new REST API.	Cione existing API Create a copy of an API in this AWS account.	
Import API Import an API from an OpenAPI definition.	Example API Learn about API Gateway with an example API.	
API name		
RU_Power_API		
Description - optional		
API endpoint type https://www.endpoint.com/endpoint.co	rest CloudFort Point of Preserce. Private APts are only accessible from VPCs.	
Regional	•	

Figure 12: API Creation

4.2 Resource, Method and Deploying Creation

First we have to create a resource Figure 13 then a POST method under this resource. We dont have to forget to connect it to the lambda function as shown in Figure 14. Finally we have to deploy it so we would be able to trigger it Figure 15.

eate resource			
Resource details			
Proxy resource Info Proxy resources handle requests to all sub-resources. To create a proxy resource use a path parameter	ster that ends with a plus sion. for exam	sie (prover).	
		Resource name	
besource path			

Figure 13: Resource Creation

Method details Method details Method typ Software method for the second seco	way > <u>APIs</u> > <u>Resources - RU_Power_API (pdddm/lilk</u>) > Create method method	
Statest a method type • Integration type • Lendods relations Lendods rel	d details	
Mitgenetic type O MTP One of the calcular full of the calcula	уре	
Compared and the state of	method type	T
Image of press AN with a Landa function.	on type	
Integrate with an AWS Service.	grane yours APN which a Launchod Function.	
Lunda paray integration Send the request to your Lambda function as a structured event. Lambda function Lambda function Lambda function	d the request to your Lambda function as a structured event. function	
ve-ese-1 v Q anaxolambdase-esot-14236283650746mictionRU/Parer_lambd X Grant API Gateway permission to invole your Lambda function. To turn off, update the function's resource policy yourself, or provide an invole role that API Gateway uses to invole your function.		

Figure 14: Method Creation

Resources		API actions V Deploy API
Create resource	Resource details	Update documentation Enable CORS
/ /api-ml-model POST	Deploy API × Create or select a stage where your API will be deployed. You can use the deployment history to revert or change the active deployment for a stage. Learn more [2]	Resource ID qgwpgrgvy2
	Stage View stage*	Delete Create method ▼ Authorization ▼ API key ▼
	Stage name First Stage	ithods ds defined.
	① A new stage will be created with the default settings. Edit your stage settings on the Stage page.	
	Deployment description	
	Cancel Deploy	

Figure 15: Deployment

NPI Gateway <	Stages	Stage actions 🔻 Create sta
ustom domain names Updated Iomain name access associations New PC links	FirstStage / / / //pi-ml-model POST	Method overrides Create override By default, methods inherit stage-level settings. To contamice settings for a method, configure method overrides. © This method inherits its settings from the "FirstStage stage.
API: RU_Power_API resources tages withorizers		Threader UNR. The https://pidddwillk.netruite-apiuse-sast-1.amazonawas.com/PrintSlags/pipi-mi-model
ateway responses lodels		
source policy ocumentation		
ashboard Pl settings		

Figure 16: API GateWay URL

5 Virtual ORAN Network

The Virtual Open RAN network simulation code can be found at this link—https://github.com/Abdu-AJ/ORAN.git

References

- Amazon Web Services (2024). Amazon SageMaker Documentation: SageMaker Roles. URL: https://docs.aws.amazon.com/sagemaker/latest/dg/sagemaker-roles.html
- Spidy20 (2023). Sagemaker tutorials tutorial 1: Sagemaker sklearn custom script mode, https://github.com/Spidy20/Sagemaker-Tutorials/tree/master/ Tutorial%20-%201%20Sagemaker%20SKLearn%20Custom%20Script%20Mode.