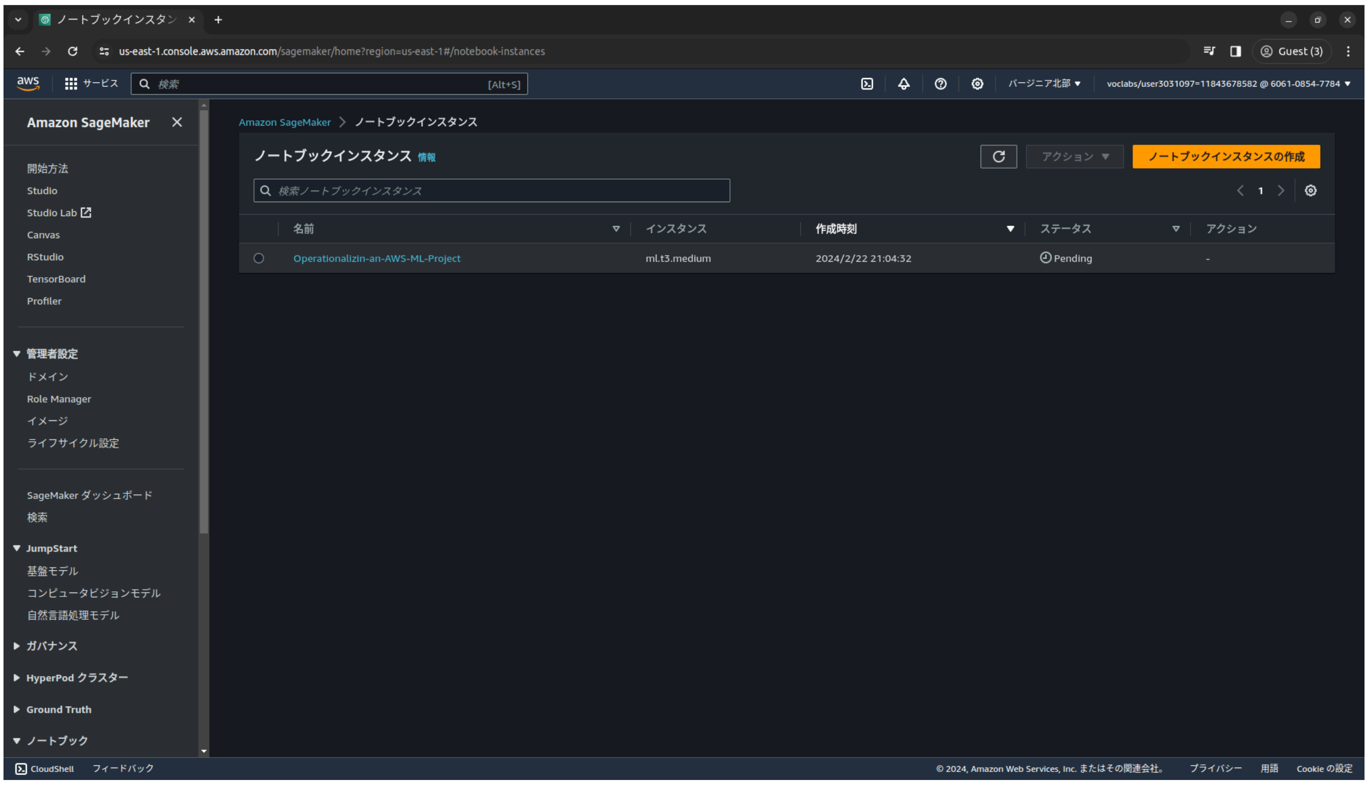
Project: Operationalizing an AWS ML Project

Training and deployment

Student sets up a Sagemaker instance:



us-east-1.console.aws.amazon.com/sagemaker/home?region=us-east-1#/notebook-instances

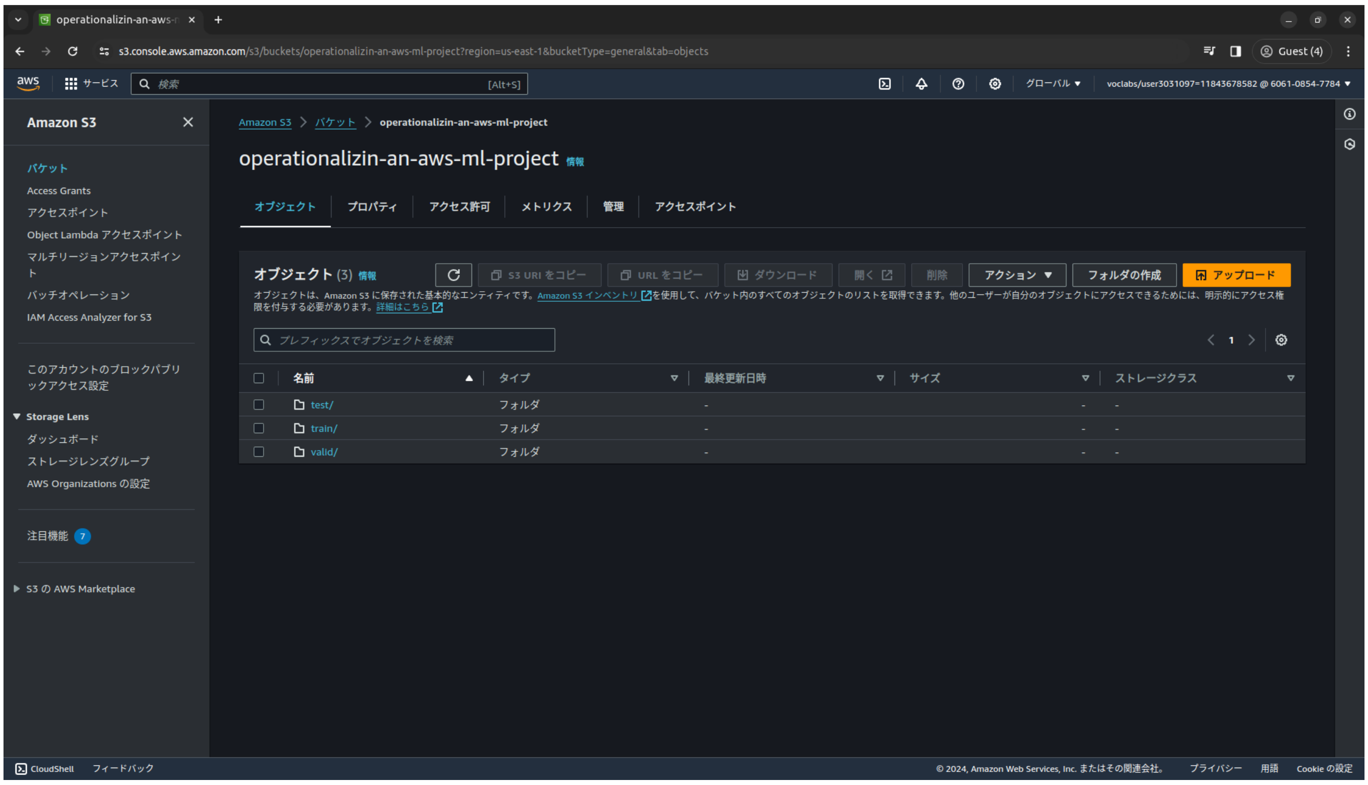
Amazon SageMaker > ノートブックインスタンス

ノートブックインスタンス

名前	インスタンス	作成時刻	ステータス	アクション
Operationalizin-an-AWS-ML-Project	ml.t3.medium	2024/2/22 21:04:32	Pending	-

Student justifies the type of Sagemaker instance they created: **ml.t3.medium** was created as it is sufficient to run my notebook.

Student creates an S3 bucket for data downloads:



s3.console.aws.amazon.com/s3/buckets/operationalizin-an-aws-ml-project?region=us-east-1&bucketType=general&tab=objects

Amazon S3 > バケット > operationalizin-an-aws-ml-project

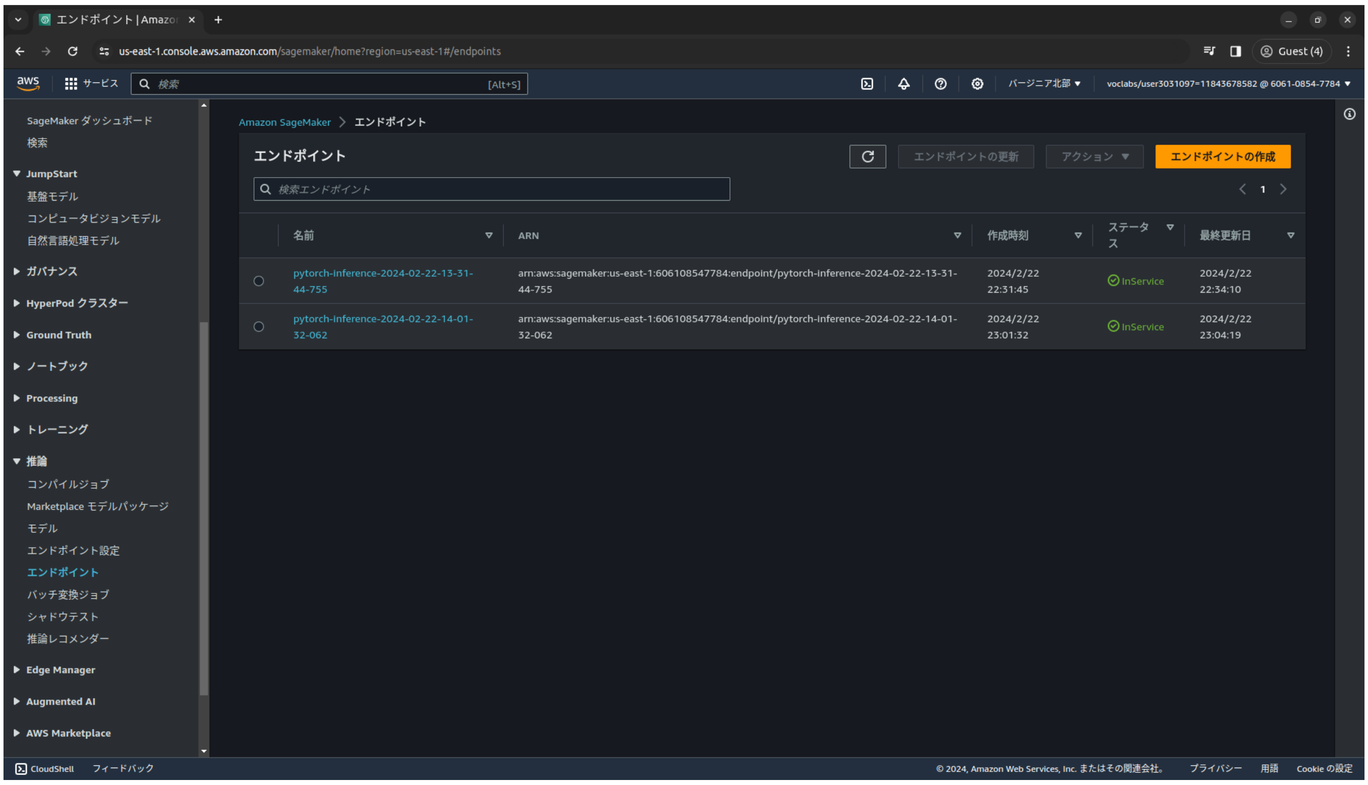
operationalizin-an-aws-ml-project

オブジェクト (3)

オブジェクトは、Amazon S3 に保存された基本的なエンティティです。Amazon S3 インベントリを使用して、バケット内のすべてのオブジェクトのリストを取得できます。他のユーザーが自分のオブジェクトにアクセスできるためには、明示的にアクセス権限を付与する必要があります。詳細はこちら

名前	タイプ	最終更新日時	サイズ	ストレージクラス
test/	フォルダ	-	-	-
train/	フォルダ	-	-	-
valid/	フォルダ	-	-	-

Student deploys an endpoint by running all starter notebooks:



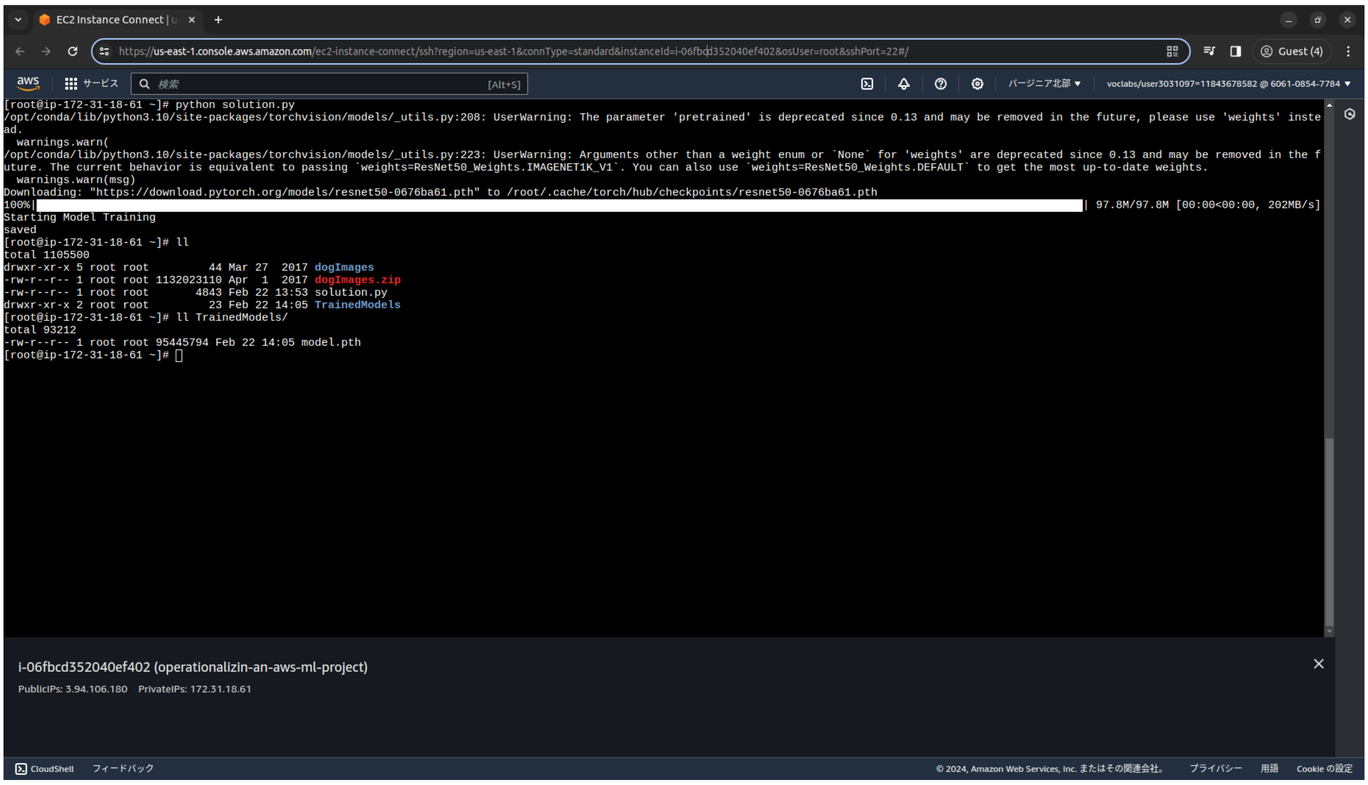
エンドポイント

	名前	ARN	作成時刻	ステータス	最終更新日
○	pytorch-inference-2024-02-22-13-31-44-755	arn:aws:sagemaker:us-east-1:606108547784:endpoint/pytorch-inference-2024-02-22-13-31-44-755	2024/2/22 22:31:45	InService	2024/2/22 22:34:10
○	pytorch-inference-2024-02-22-14-01-32-062	arn:aws:sagemaker:us-east-1:606108547784:endpoint/pytorch-inference-2024-02-22-14-01-32-062	2024/2/22 23:01:32	InService	2024/2/22 23:04:19

Student accomplishes multi-instance training: Jupyter-Notebook

EC2 Training

Create and open an EC2 instance: **m5.xlarge** with **Deep Learning AMI GPU PyTorch 2.1.0** was selected due to its low cost.



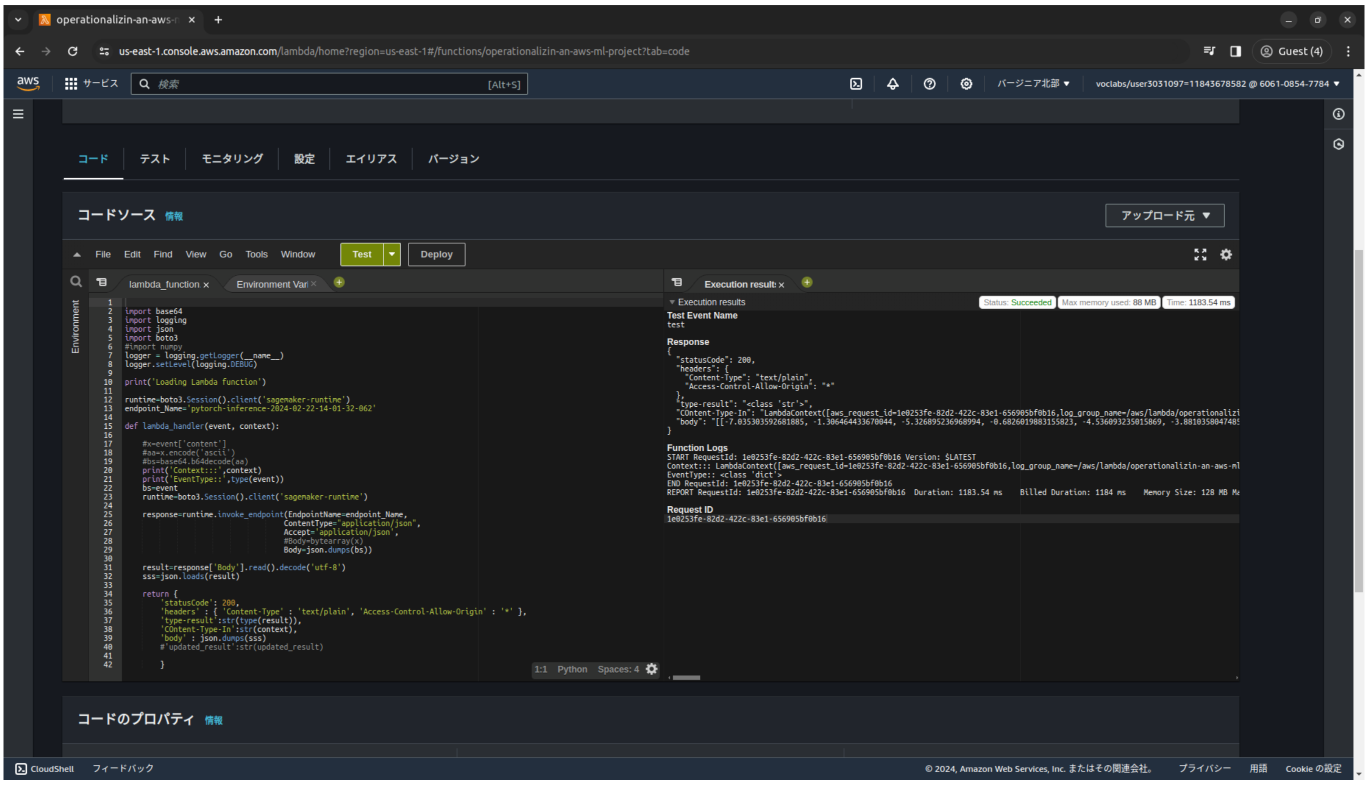
```
[root@ip-172-31-18-61 ~]# python solution.py
/opt/conda/lib/python3.10/site-packages/torchvision/models/_utils.py:208: UserWarning: The parameter 'pretrained' is deprecated since 0.13 and may be removed in the future, please use 'weights' inste
ad.
  warnings.warn(
/opt/conda/lib/python3.10/site-packages/torchvision/models/_utils.py:223: UserWarning: Arguments other than a weight enum or `None` for 'weights' are deprecated since 0.13 and may be removed in the f
uture. The current behavior is equivalent to passing `weights=ResNet50_Weights.IMAGENET1K_V1`. You can also use `weights=ResNet50_Weights.DEFAULT` to get the most up-to-date weights.
  warnings.warn(msg)
Downloading: "https://download.pytorch.org/models/resnet50-0676ba61.pth" to /root/.cache/torch/hub/checkpoints/resnet50-0676ba61.pth
100%|██████████████████████████████████████████████████| 97.8M/97.8M [00:00<00:00, 202MB/s]
Starting Model Training
saved
[root@ip-172-31-18-61 ~]# ll
total 1105500
drwxr-xr-x 5 root root         44 Mar 27  2017 dogImages
-rw-r--r-- 1 root root 1132023110 Apr  1  2017 dogImages.zip
-rw-r--r-- 1 root root       4843 Feb 22 13:53 solution.py
drwxr-xr-x 2 root root         23 Feb 22 14:05 TrainedModels
[root@ip-172-31-18-61 ~]# ll TrainedModels/
total 93212
-rw-r--r-- 1 root root 95445794 Feb 22 14:05 model.pth
[root@ip-172-31-18-61 ~]#
```

i-06fbcd352040ef402 (operationalizin-an-aws-ml-project)
PublicIPs: 3.94.106.180 PrivateIPs: 172.31.18.61

Train and save the classification model on EC2: Python Script

Lambda function setup

Lambda function invokes the student's deployed endpoint:



```python

import base64
import logging
import json
import boto3
#import numpy
logger = logging.getLogger(__name__)
logger.setLevel(logging.DEBUG)

print('Loading Lambda function')

runtime=boto3.Session().client('sagemaker-runtime')
endpoint_Name='pytorch-inference-2024-02-22-14-01-32-062'

def lambda_handler(event, context):

    #x=event['content']
    #aa=x.encode('ascii')
    #bs=base64.b64decode(aa)
    print('Context:::',context)
    print('EventType::',type(event))
    bs=event
    runtime=boto3.Session().client('sagemaker-runtime')

    response=runtime.invoke_endpoint(EndpointName=endpoint_Name,
                                    ContentType="application/json",
                                    Accept='application/json',
                                    #Body=bytearray(x)
                                    Body=json.dumps(bs))

    result=response['Body'].read().decode('utf-8')
    sss=json.loads(result)

    return {
        'statusCode': 200,
        'headers' : { 'Content-Type' : 'text/plain', 'Access-Control-Allow-Origin' : '*' },
        'type-result':str(type(result)),
        'COntent-Type-In':str(context),
        'body' : json.dumps(sss)
        #'updated_result':str(updated_result)

        }
```

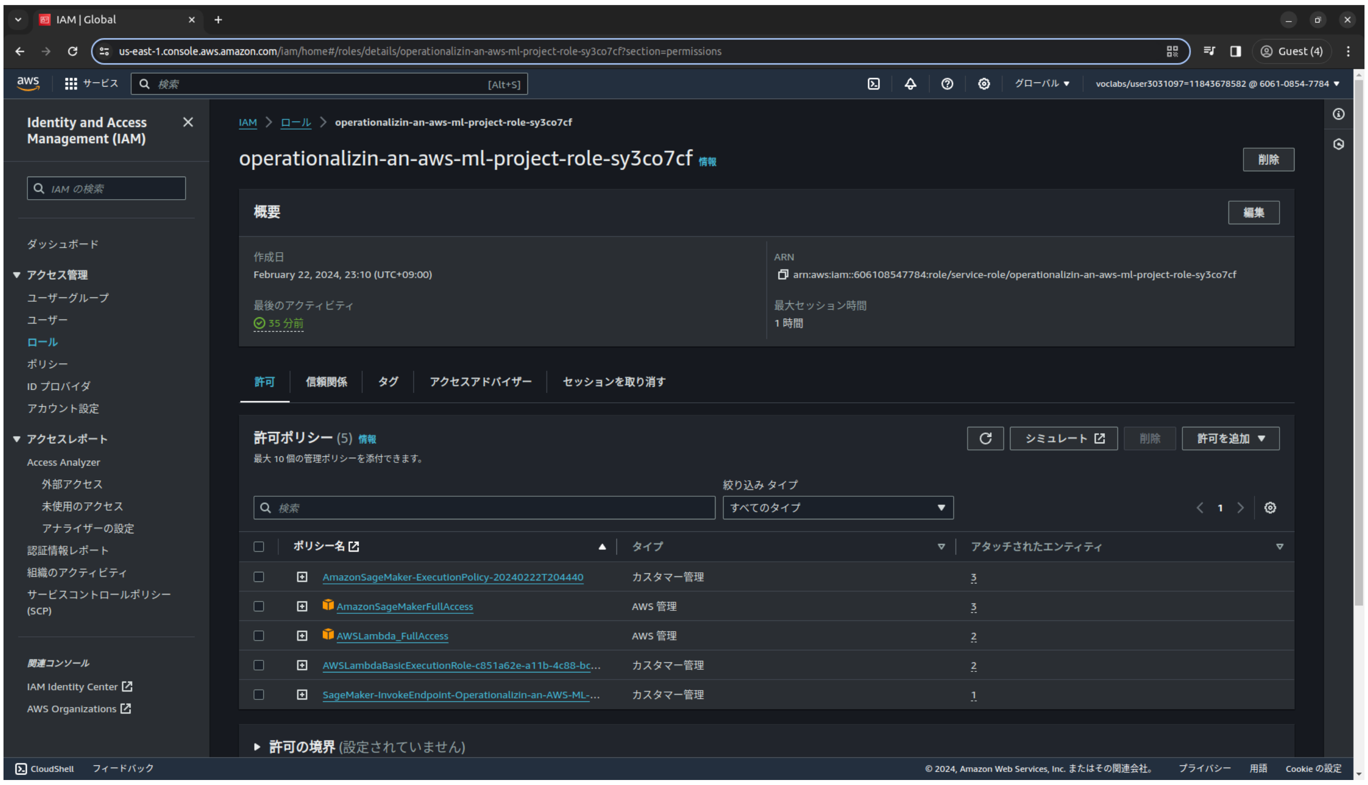
Execution results — Status: Succeeded | Max memory used: 88 MB | Time: 1183.54 ms

```
Test Event Name
test

Response
{
  "statusCode": 200,
  "headers": {
    "Content-Type": "text/plain",
    "Access-Control-Allow-Origin": "*"
  },
  "type-result": "<class 'str'>",
  "COntent-Type-In": "LambdaContext([aws_request_id=1e0253fe-82d2-422c-83e1-656905bf0b16,log_group_name=/aws/lambda/operationalizi
  "body": "[[-7.035303592681885, -1.306464433670044, -5.326895236968994, -0.6826019883155823, -4.536093235015869, -3.881035804748
}

Function Logs
START RequestId: 1e0253fe-82d2-422c-83e1-656905bf0b16 Version: $LATEST
Context::: LambdaContext([aws_request_id=1e0253fe-82d2-422c-83e1-656905bf0b16,log_group_name=/aws/lambda/operationalizin-an-aws-ml
EventType:: <class 'dict'>
END RequestId: 1e0253fe-82d2-422c-83e1-656905bf0b16
REPORT RequestId: 1e0253fe-82d2-422c-83e1-656905bf0b16  Duration: 1183.54 ms    Billed Duration: 1184 ms    Memory Size: 128 MB Ma

Request ID
1e0253fe-82d2-422c-83e1-656905bf0b16
```

Lambda function return statement follows best practices for API return statements

Security and testing

Attach a security policy to the role associated with the Lambda endpoint :



IAM > ロール > operationalizin-an-aws-ml-project-role-sy3co7cf

operationalizin-an-aws-ml-project-role-sy3co7cf

概要

作成日: February 22, 2024, 23:10 (UTC+09:00)

ARN: arn:aws:iam::606108547784:role/service-role/operationalizin-an-aws-ml-project-role-sy3co7cf

最後のアクティビティ: 35 分前

最大セッション時間: 1 時間

許可ポリシー (5)

最大 10 個の管理ポリシーを添付できます。

絞り込み タイプ: すべてのタイプ

ポリシー名	タイプ	アタッチされたエンティティ
AmazonSageMaker-ExecutionPolicy-20240222T204440	カスタマー管理	3
AmazonSageMakerFullAccess	AWS 管理	3
AWSLambda_FullAccess	AWS 管理	2
AWSLambdaBasicExecutionRole-c851a62e-a11b-4c88-bc...	カスタマー管理	2
SageMaker-InvokeEndpoint-Operationalizin-an-AWS-ML-...	カスタマー管理	1

許可の境界 (設定されていません)

Test the Lambda function by invoking the endpoint with the "lab.jpg" input :

```
{
  "statusCode": 200,
  "headers": {
    "Content-Type": "text/plain",
    "Access-Control-Allow-Origin": "*"
  },
  "type-result": "<class 'str'>",
  "COntent-Type-In": "LambdaContext([aws_request_id=8ce7215c-f463-4003-
a8e8-2eb52971c02e,log_group_name=/aws/lambda/project-
4,log_stream_name=2023/04/12/[$LATEST]779f63f6e8f74c13a51970470403d45d,func
tion_name=project-
4,memory_limit_in_mb=128,function_version=$LATEST,invoked_function_arn=arn:
aws:lambda:us-east-1:271564095025:function:project-
4,client_context=None,identity=CognitoIdentity([cognito_identity_id=None,co
gnito_identity_pool_id=None])])",
  "body": "[[-1.4969292879104614, -2.295322895050049, 1.7711918354034424,
1.7000603675842285, -2.9478816986083984, -2.8578217029571533,
-4.275012493133545, -0.1858823001384735, -7.876079559326172,
3.485708713531494, 1.0156581401824951, -5.376102924346924,
0.08712732791900635, 1.043073058128357, -6.567814350128174,
-4.29003381729126, -6.980752468109131, 0.8602855205535889,
-1.9477488994598389, 3.517031192779541, 1.1386747360229492,
2.9857466220855713, -7.429625034332275, -4.872533321380615,
-6.990846633911133, -6.551341533660889, -2.713444471359253,
-7.38569974899292, -4.197381973266602, 0.5921437740325928,
-0.23152270913124084, -1.7627674341201782, -4.5388617515563965,
0.545304000377655, -3.987135171890259, -3.03073787689209,
-3.0044939517974854, -0.24150973558425903, 1.3483713865280151,
-1.685007095336914, -1.484816312789917, 1.8437116146087646,
3.838435649871826, 0.6947075128555298, -0.1137256920337677,
-11.679482460021973, 1.3911057710647583, -1.805575966835022,
-2.34354567527771, 1.7085063457489014, -0.9614053964614868,
-8.280823707580566, -7.071294784545898, 0.16166920959949493,
-0.5199874639511108, -0.843184232711792, -6.246165752410889,
-2.350785732269287, -1.3200641870498657, -2.318167209625244,
-4.5581793785095215, -8.424875259399414, -7.389919281005859,
-8.225934028625488, -5.960506916046143, -6.004213333129883,
3.052112102508545, -0.9716691374778748, 0.1721428632736206,
1.1353175640106201, 5.675631046295166, -4.881450176239014,
-4.949894428253174, -4.2738471031188965, -1.0440956354141235,
0.615058183670044, -7.484931468963623, -3.1543450355529785,
-4.828455448150635, -7.795574188232422, 2.6574225425720215,
-8.622648239135742, 1.655287504196167, 1.2484384775161743,
-8.302145957946777, -3.6932826042175293, 2.7479288578033447,
-7.128697395324707, 1.1833446025848389, 2.0749804973602295,
-8.263742446899414, -2.6031601428985596, -2.9580190181732178,
-6.628727436065674, -2.2038745880126953, 0.8574008941650391,
0.36140191555023193, 1.240427851676941, -6.453752517700195,
-9.306218147277832, -5.975752353668213, -0.851379930973053,
-3.8800625801086426, -4.767630577087402, -2.8386266231536865,
-5.776670932769775, -1.417716383934021, 2.4901983737945557,
1.7963000535964966, 0.9240027666091919, 1.3527525663375854,
1.043146014213562, -5.193169116973877, -2.356482982635498,
-7.384207248687744, -0.1713782399892807, -4.5393853187561035,
-2.649200916290283, -4.741747856140137, 0.618251621723175,
0.2919156551361084, -3.7748732566833496, -3.141923666000366,
-1.8757330179214478, -6.020362377166748, -5.679347991943359,
-1.4780714511871338, 1.1916701793670654, -4.358892917633057,
-7.019332408905029, -5.486293792724609, 3.572416067123413,
-3.9262099266052246]]"
}
```

Student identified potential vulnerabilities in the project's IAM configuration :

Roles with "FullAccess" Policies: Roles that are granted "FullAccess" policies pose a significant security risk as they grant unrestricted access to resources and services within the system. These roles essentially provide overly broad permissions, which can lead to unauthorized access, data breaches, or even system compromise if exploited by malicious actors.

Concurrency and auto-scaling

Student clearly describes the configuration of concurrency (on the Lambda function) and auto-scaling (for the deployed endpoint)

In AWS, effective concurrency and auto-scaling configurations are vital for performance and cost efficiency. This overview delves into configuring both for Lambda functions and deployed endpoints, alongside traffic, cost, and efficiency considerations.

Concurrency (Lambda Function):

- Set maximum simultaneous executions.
- Use AWS Console or CLI.
- Consider reserved concurrency for precise control.

Auto-scaling (Deployed Endpoint):

- Utilize services like EC2 Auto Scaling or Elastic Beanstalk.
- Define scaling policies and integrate with CloudWatch.
- Considerations:

Traffic:

- Analyze patterns and adjust configurations accordingly.

Cost:

- Balance performance with cost by selecting appropriate instances and optimizing configurations.

Efficiency:

- Optimize resource usage through controls like serverless computing and load balancing.

Optimizing concurrency and auto-scaling in AWS enhances performance, saves costs, and maximizes resource utilization. Regular monitoring and adjustment ensure continued efficiency.