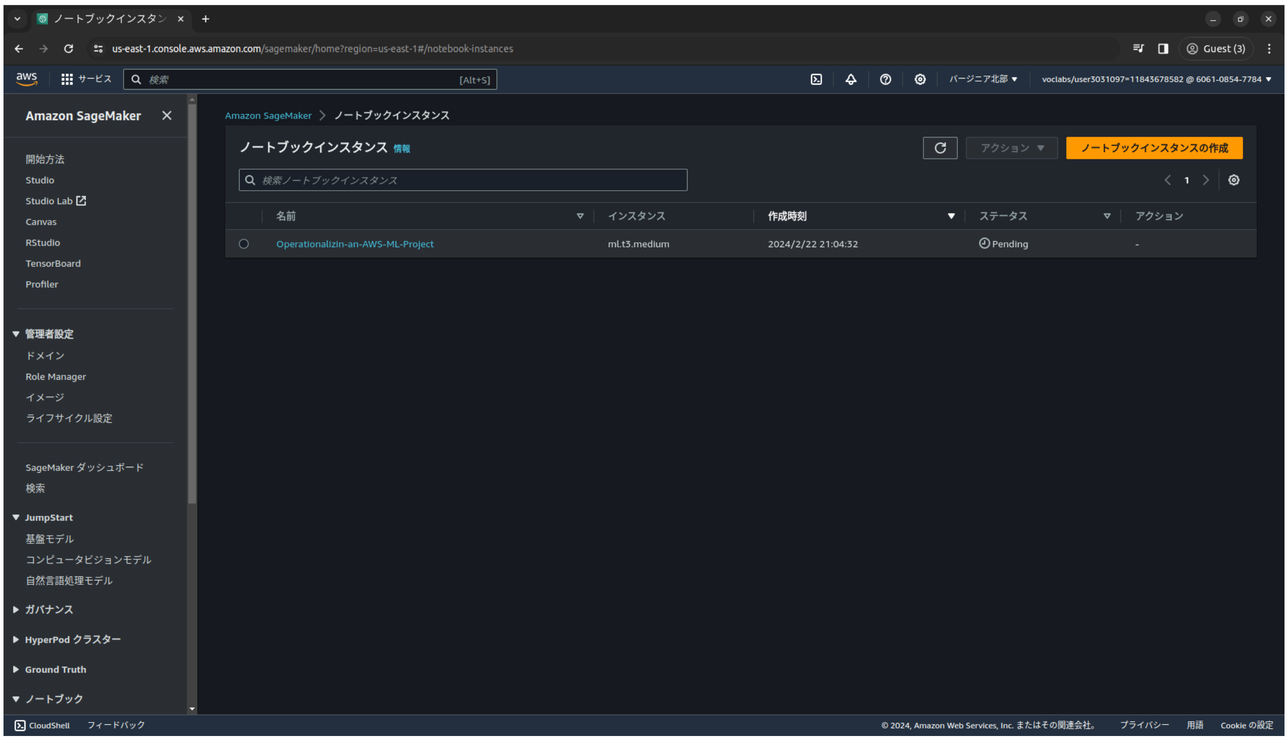
Project: Operationalizing an AWS ML Project

Training and deployment

- Student sets up a Sagemaker instance:



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.

  ### Reasons for Selecting Sagemaker Instance "ml.t3.medium"

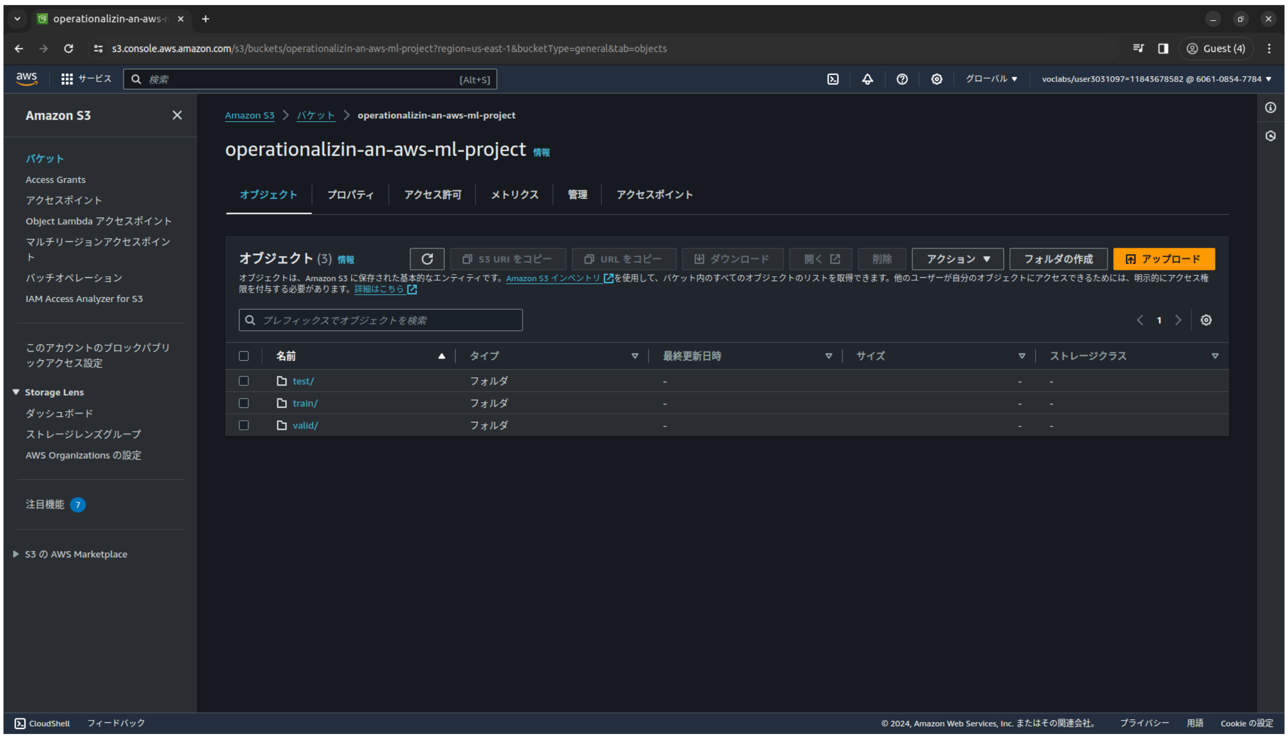
  When choosing the Sagemaker instance type "ml.t3.medium," several factors need to be considered, including power, speed, and cost efficiency.

  - **Power** : The "ml.t3.medium" instance offers sufficient computational power for many common machine learning tasks. While it may not be the most powerful option available, it provides adequate resources for training and deploying models on small to medium-sized datasets.
  - **Speed** : In terms of speed, the "ml.t3.medium" instance strikes a balance between performance and cost. It may not be the fastest instance type available, but it still offers reasonable processing speeds for training and inference tasks. For smaller datasets and less computationally intensive workloads, it can deliver satisfactory performance without incurring excessive costs.
  - **Cost Efficiency** : One of the primary reasons for choosing the "ml.t3.medium" instance is its cost efficiency. As a mid-tier instance type, it typically offers a lower hourly rate compared to higher-powered instances like "ml.m5.large" or "ml.c5.xlarge." This makes it an attractive option for users who prioritize cost savings without compromising too much on performance.

- **Flexibility** : The "ml.t3.medium" instance provides a good balance of CPU and memory resources, making it suitable for a wide range of machine learning tasks. Whether you're training supervised learning models, performing data preprocessing, or deploying inference endpoints, this instance type offers the flexibility to handle various workloads effectively.

In summary, selecting the "ml.t3.medium" instance type on Sagemaker can be justified by its adequate power, reasonable speed, cost efficiency, and flexibility, making it a suitable choice for many machine learning projects, especially those with budget constraints or moderate computational requirements.

- 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

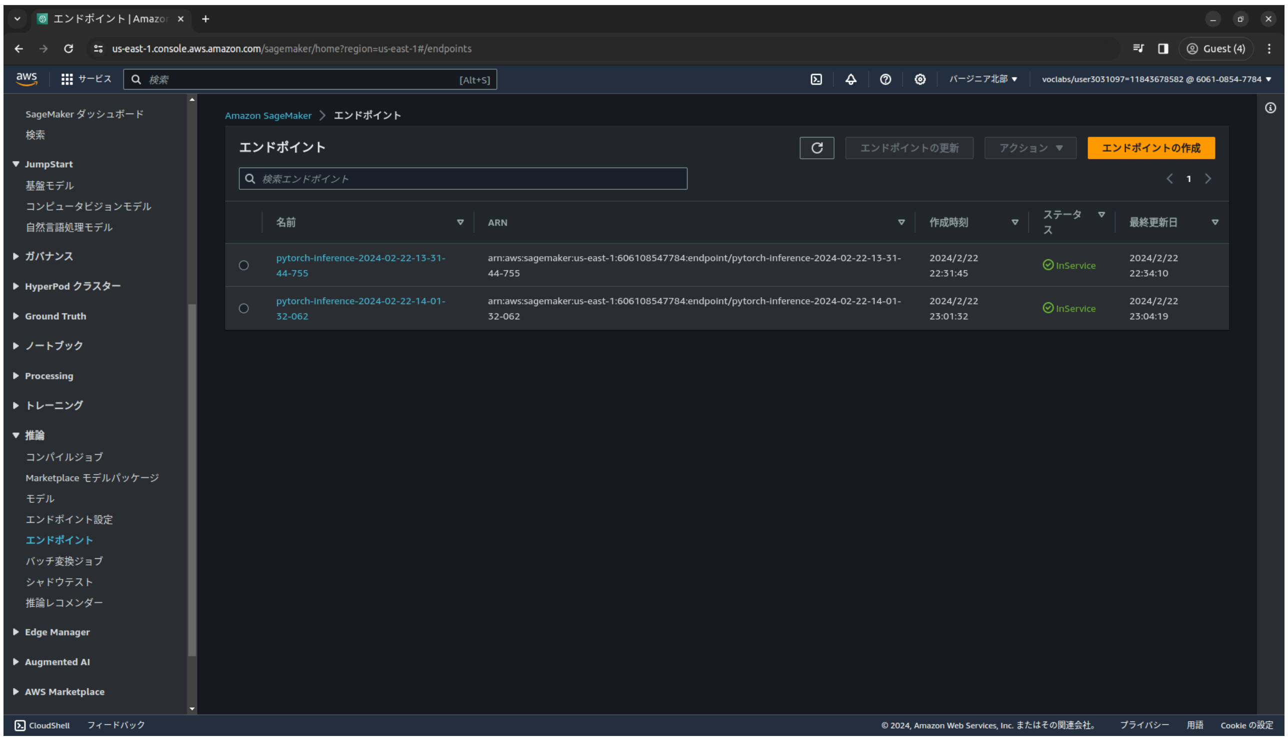
operationalizin-an-aws-ml-project

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:



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

Amazon SageMaker > エンドポイント

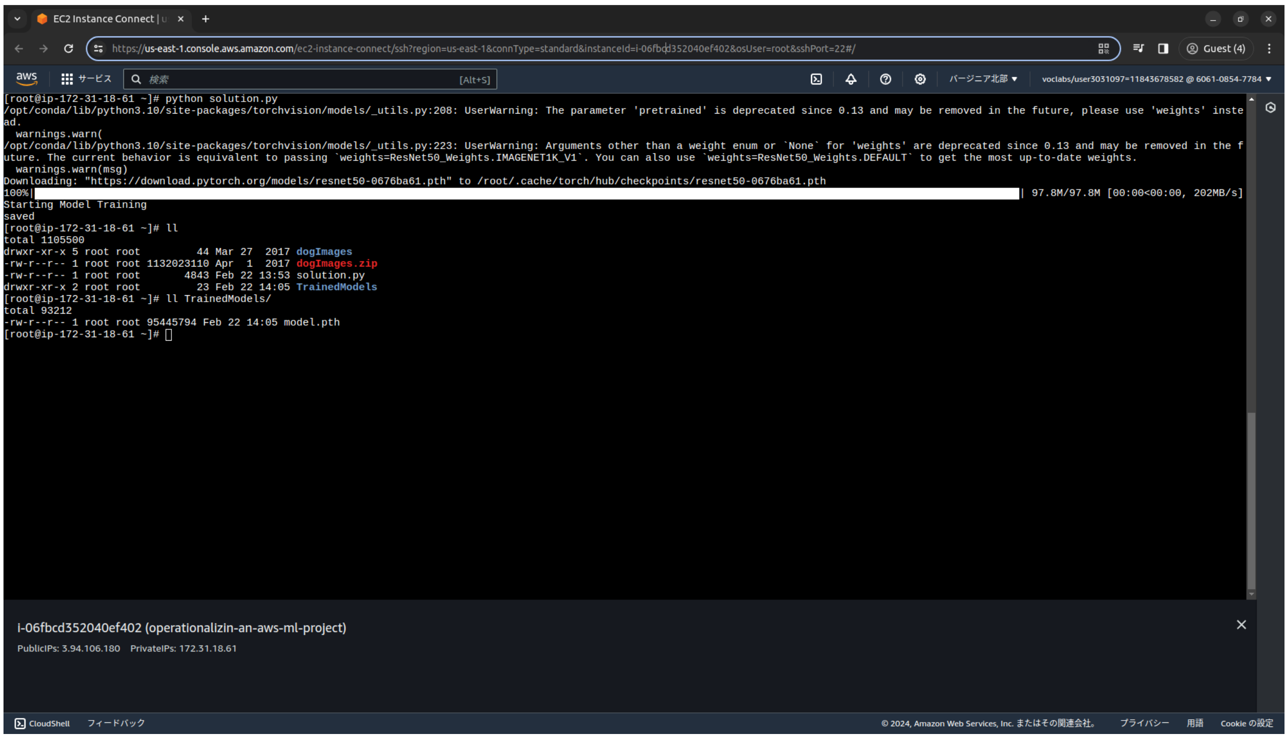
エンドポイント

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.


EC2 Instance Connect | u
https://us-east-1.console.aws.amazon.com/ec2-instance-connect/ssh?region=us-east-1&connType=standard&instanceId=i-06fbcd352040ef402&osUser=root&sshPort=22#/
Guest (4)
aws
サービス
検索
[Alt+S]
バージニア北部
voclabs/user3031097=11843678582 @ 6061-0854-7784
i-06fbcd352040ef402 (operationalizin-an-aws-ml-project)
PublicIPs: 3.94.106.180 PrivateIPs: 172.31.18.61
CloudShell
フィードバック
© 2024, Amazon Web Services, Inc. またはその関連会社。
プライバシー
用語
Cookie の設定

```
[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 ~]# 
```

Reasons for Selecting EC2 Instance "m5.xlarge"

When opting for the EC2 instance type "m5.xlarge," several factors come into play, including power, speed, and cost efficiency.

- **Power** : The "m5.xlarge" instance offers significant computational power suitable for a wide range of compute-intensive tasks. With its combination of vCPUs, memory, and network performance, it can handle demanding workloads such as data processing, machine learning training, and high-performance computing tasks effectively.
- **Speed** : In terms of speed, the "m5.xlarge" instance provides excellent performance for compute-bound applications. It features high-frequency Intel Xeon processors and enhanced networking capabilities, enabling faster data transfer and processing. This translates to reduced processing times and improved overall efficiency for time-sensitive tasks.
- **Cost Efficiency** : While the "m5.xlarge" instance may not be the most economical option available, it offers a good balance between performance and cost. Its hourly rate reflects the higher computational power and enhanced features compared to lower-tier instances. However, for workloads that demand superior performance, the increased cost may be justified by the time saved in completing tasks more quickly.
- **Resource Availability** : The "m5.xlarge" instance provides ample resources, including CPU cores, memory, and storage, making it suitable for a wide range of applications. Whether you're running data analytics, hosting web applications, or deploying machine learning models, this instance type offers the necessary resources to support your workload efficiently.

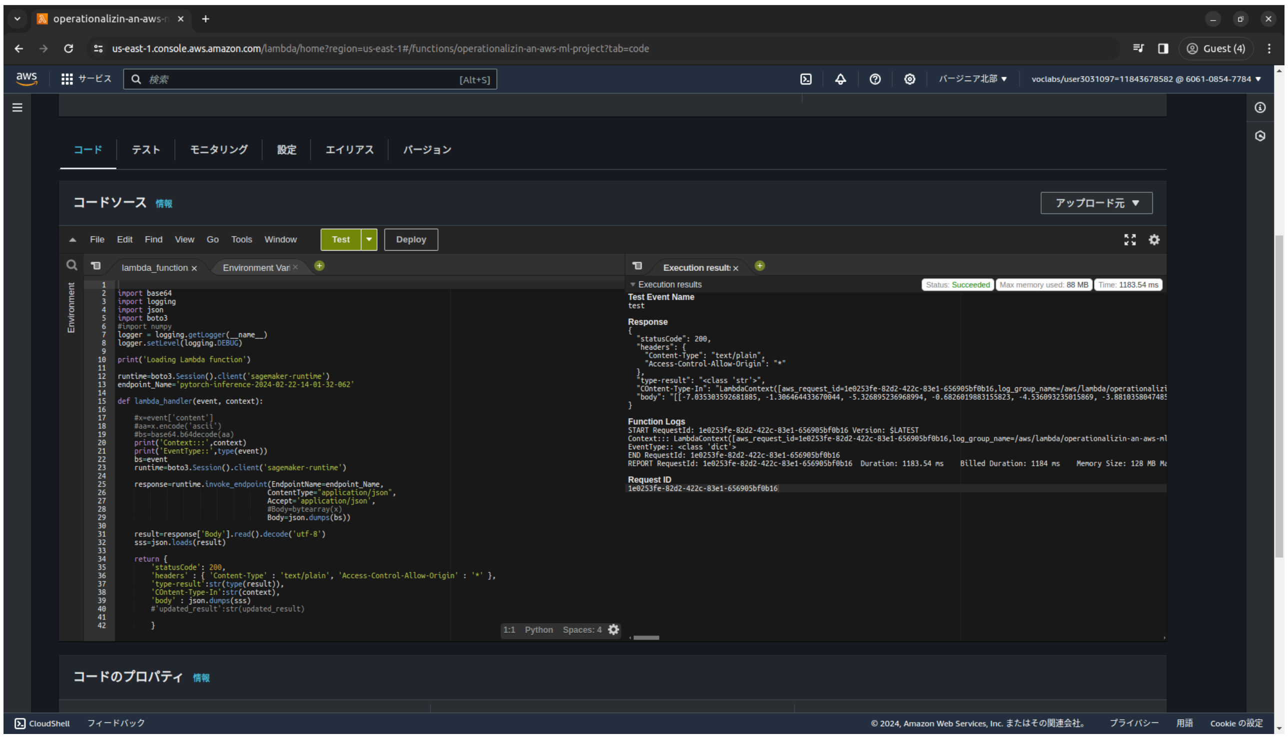
   - **Reliability and Availability** : Amazon EC2 instances are known for their reliability and availability, and the "m5.xlarge" instance is no exception. With access to AWS's robust infrastructure and global network, users can expect high uptime and minimal downtime, ensuring uninterrupted operation for critical workloads.

  In summary, selecting the "m5.xlarge" EC2 instance offers significant power, high-speed performance, reasonable cost efficiency, ample resource availability, and reliable operation, making it an excellent choice for compute-intensive applications where performance is paramount.

- Train and save the classification model on EC2: Python Script

Lambda function setup

- Lambda function invokes the student's deployed endpoint:



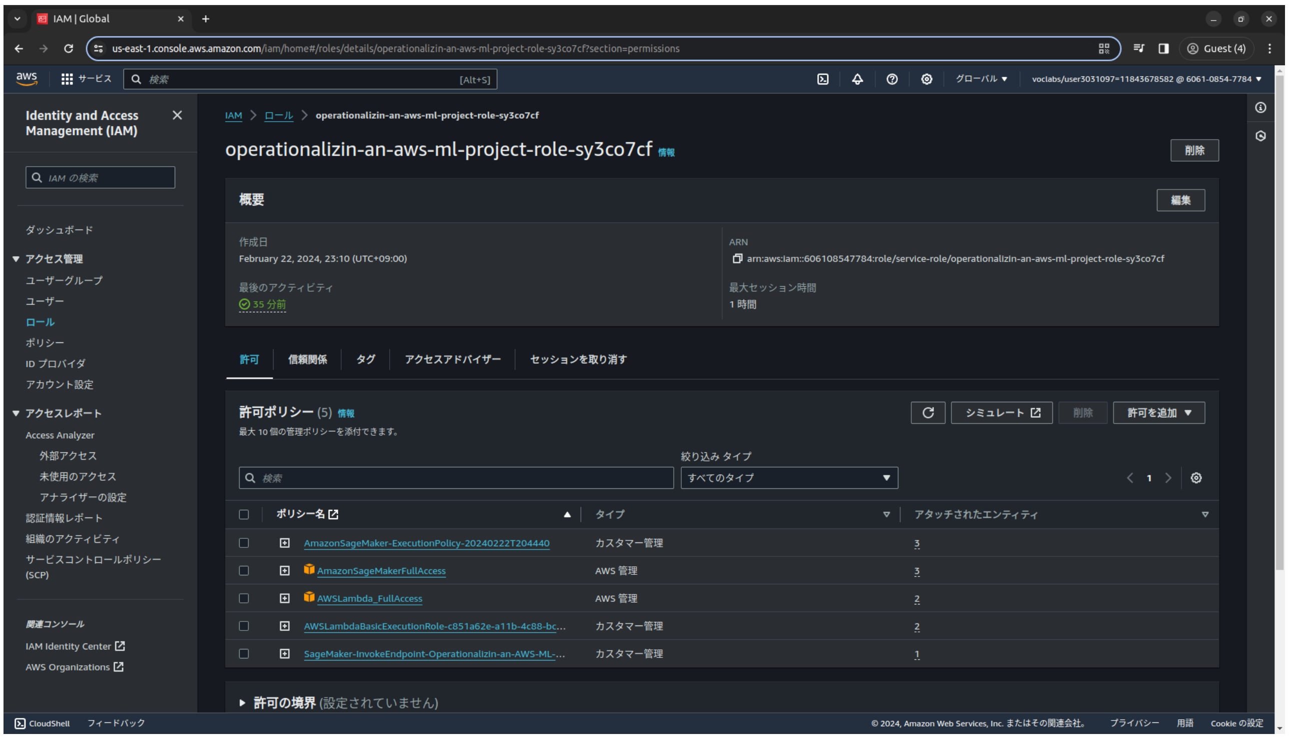
```python

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)

最後のアクティビティ
35 分前

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

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。

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/[$LATEST]779f63f6e8f74c13a51970470403d45d
,function_name=project-
4,memory_limit_in_mb=128,function_version=$LATEST,invoked_function_arn
=arn:aws:lambda:us-east-1:271564095025:function:project-
4,client_context=None,identity=CognitoIdentity([cognito_identity_id=No
ne,cognito_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.