udacity-aws-machine-learning-engineer-nanodegree-ch3-operationalizing-an-aws-ml-project

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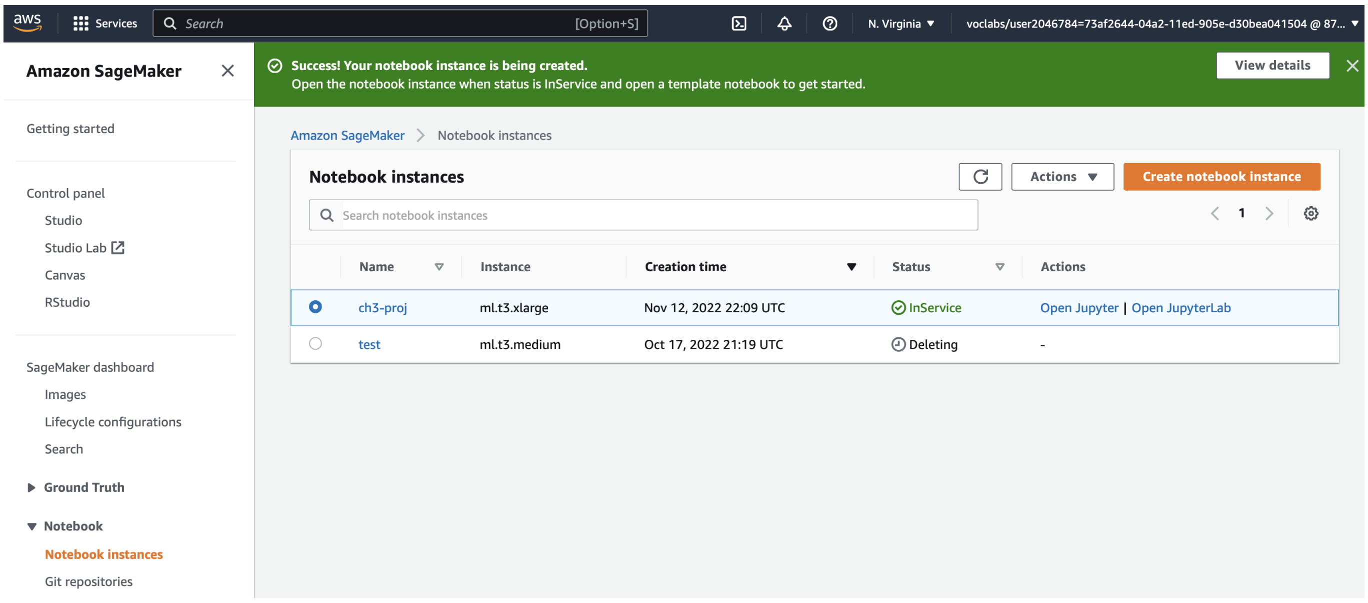
Initial setup, training and deployment

Initial Setup and Justification

I chose an ml.t3.xlarge, because I encountered a memory insufficiency error using ml.t3.medium (to save costs). Per docs https://docs.aws.amazon.com/sagemaker/latest/dg/howitworks-create-ws.html, if more memory is needed, recommend large or xlarge.



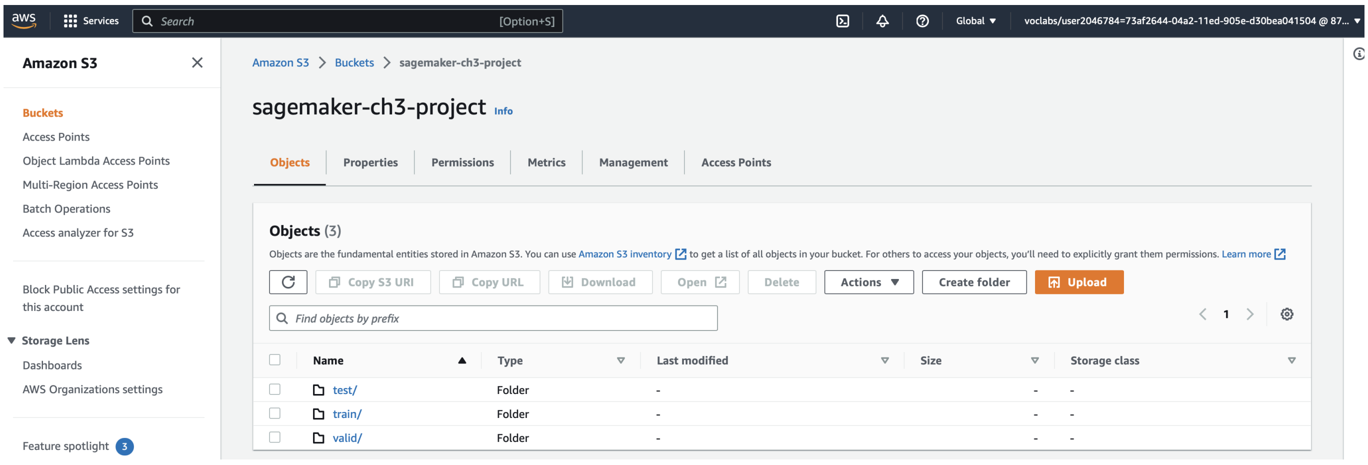
Success! Your notebook instance is being created.
Open the notebook instance when status is InService and open a template notebook to get started.

Notebook instances

Name	Instance	Creation time	Status	Actions
ch3-proj	ml.t3.xlarge	Nov 12, 2022 22:09 UTC	InService	Open Jupyter | Open JupyterLab
test	ml.t3.medium	Oct 17, 2022 21:19 UTC	Deleting	-

After you set up an S3 bucket, take a screenshot showing that you've set up an S3 bucket. Include this screenshot in your final submission.

Screenshot of S3 bucket



Amazon S3 > Buckets > sagemaker-ch3-project

sagemaker-ch3-project

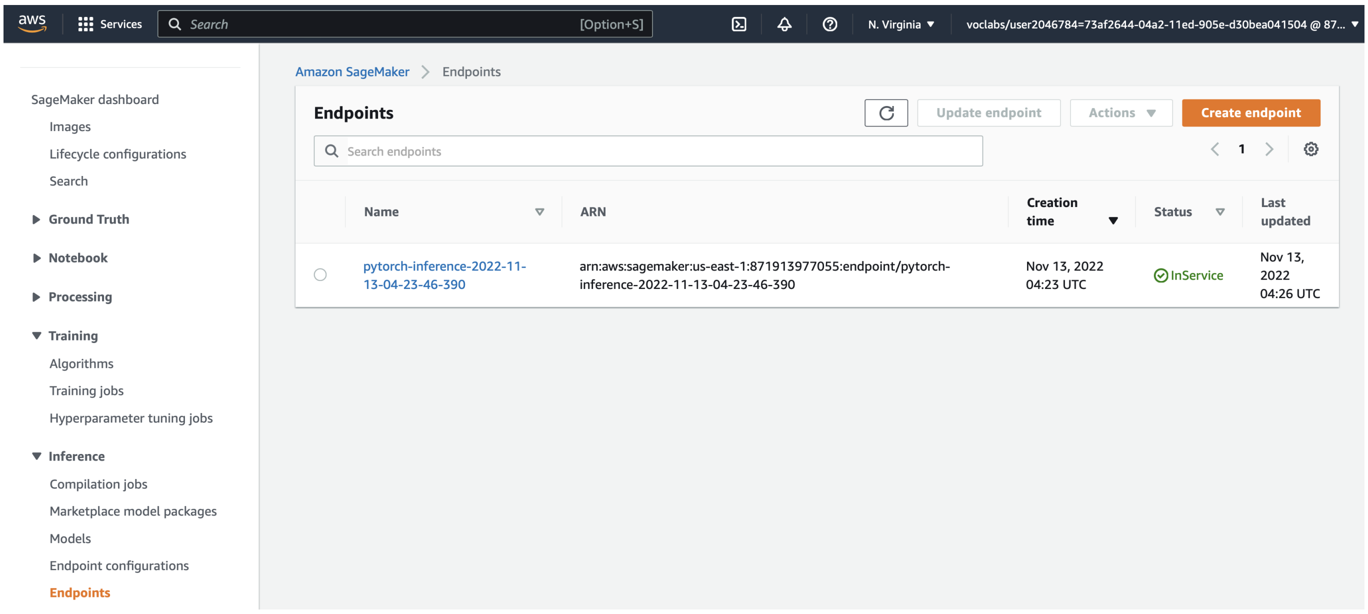
Objects (3)

Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more

Name	Type	Last modified	Size	Storage class
test/	Folder	-	-	-
train/	Folder	-	-	-
valid/	Folder	-	-	-

Training and Deployment

Screenshot of deployed endpoint in Inference > Endpoints



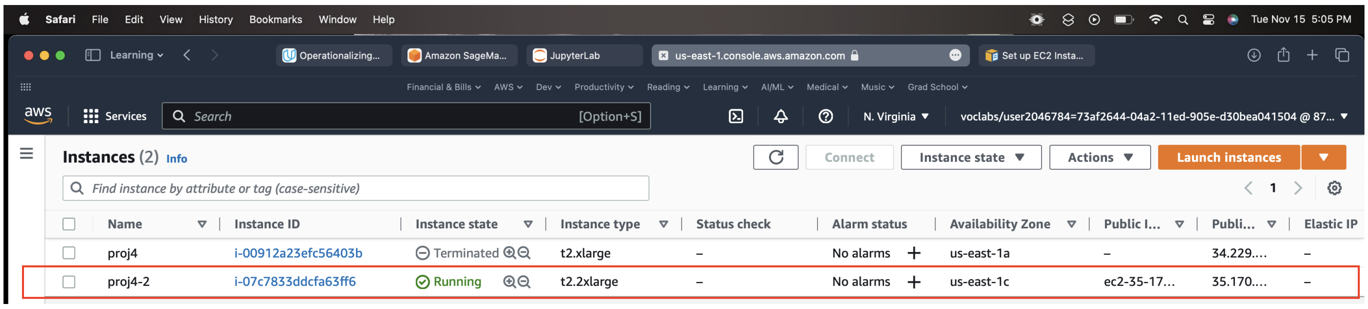
Endpoints

Name	ARN	Creation time	Status	Last updated
pytorch-inference-2022-11-13-04-23-46-390	arn:aws:sagemaker:us-east-1:871913977055:endpoint/pytorch-inference-2022-11-13-04-23-46-390	Nov 13, 2022 04:23 UTC	InService	Nov 13, 2022 04:26 UTC

EC2 Training

Justification for EC2 Instance

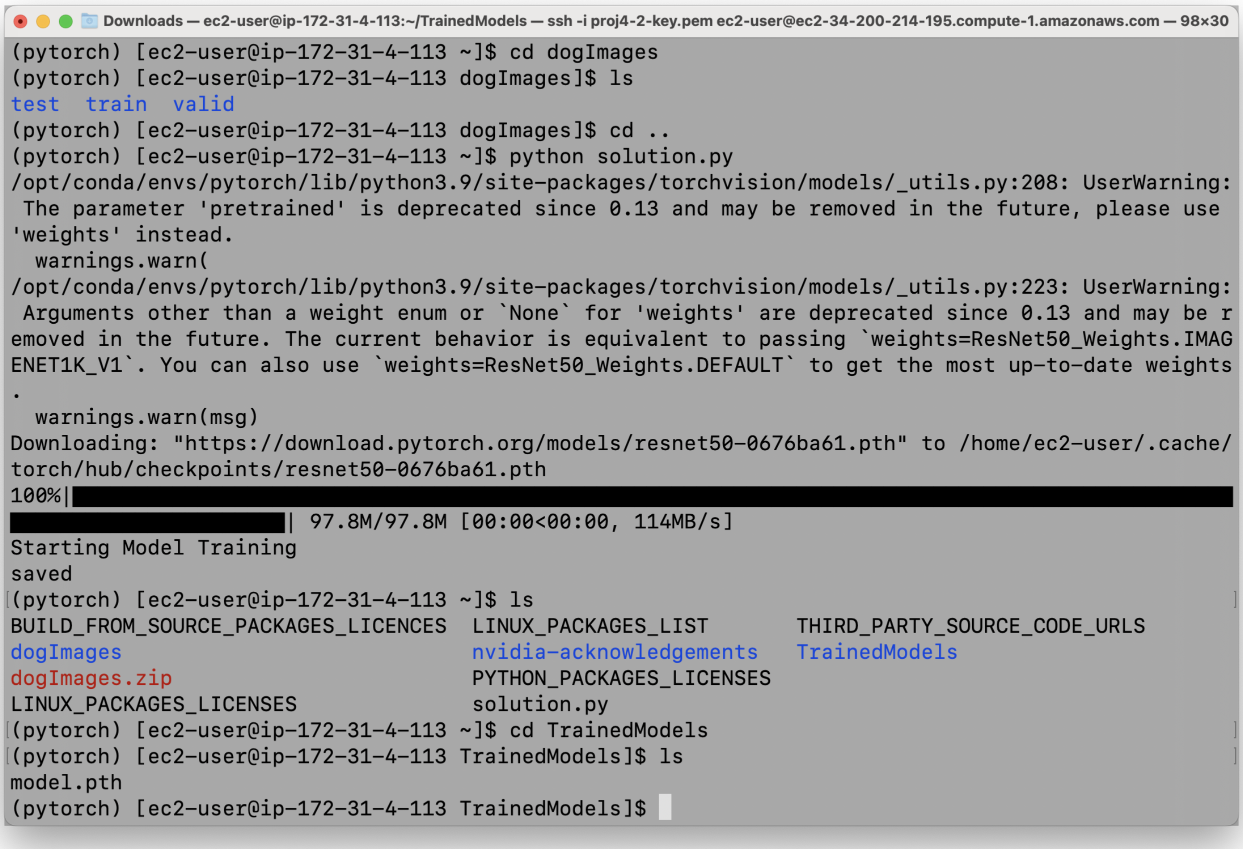
For EC2 Training I decided to choose something relatively low cost, but with more memory than the base tier - t2.xlarge (4 vCPUs and 16 Gib memory) This is to strike a balance between cost and performance.


Safari File Edit View History Bookmarks Window Help
Tue Nov 15 5:05 PM
Learning
Operationalizing...
Amazon SageMa...
JupyterLab
us-east-1.console.aws.amazon.com
Set up EC2 Insta...
Financial & Bills AWS Dev Productivity Reading Learning AI/ML Medical Music Grad School
aws
Services
Search [Option+S]
N. Virginia
voclabs/user2046784=73af2644-04a2-11ed-905e-d30bea041504 @ 87...
Info
Connect
Instance state
Actions
Launch instances
Find instance by attribute or tag (case-sensitive)

Instances (2)

Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public I...	Publi...	Elastic IP
proj4	i-00912a23efc56403b	Terminated	t2.xlarge	–	No alarms	us-east-1a	–	34.229....	–
proj4-2	i-07c7833ddcfa63ff6	Running	t2.2xlarge	–	No alarms	us-east-1c	ec2-35-17...	35.170....	–

Saved EC2 Model



Downloads — ec2-user@ip-172-31-4-113:~/TrainedModels — ssh -i proj4-2-key.pem ec2-user@ec2-34-200-214-195.compute-1.amazonaws.com — 98×30

```
(pytorch) [ec2-user@ip-172-31-4-113 ~]$ cd dogImages
(pytorch) [ec2-user@ip-172-31-4-113 dogImages]$ ls
test  train  valid
(pytorch) [ec2-user@ip-172-31-4-113 dogImages]$ cd ..
(pytorch) [ec2-user@ip-172-31-4-113 ~]$ python solution.py
/opt/conda/envs/pytorch/lib/python3.9/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' instead.
  warnings.warn(
/opt/conda/envs/pytorch/lib/python3.9/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 r
emoved in the future. The current behavior is equivalent to passing `weights=ResNet50_Weights.IMAG
ENET1K_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 /home/ec2-user/.cache/
torch/hub/checkpoints/resnet50-0676ba61.pth
100%|██████████████████████████████████████████████████████████████████████████████████████████████
██████████████████████| 97.8M/97.8M [00:00<00:00, 114MB/s]
Starting Model Training
saved
(pytorch) [ec2-user@ip-172-31-4-113 ~]$ ls
BUILD_FROM_SOURCE_PACKAGES_LICENCES  LINUX_PACKAGES_LIST       THIRD_PARTY_SOURCE_CODE_URLS
dogImages                            nvidia-acknowledgements   TrainedModels
dogImages.zip                        PYTHON_PACKAGES_LICENSES
LINUX_PACKAGES_LICENSES              solution.py
(pytorch) [ec2-user@ip-172-31-4-113 ~]$ cd TrainedModels
(pytorch) [ec2-user@ip-172-31-4-113 TrainedModels]$ ls
model.pth
(pytorch) [ec2-user@ip-172-31-4-113 TrainedModels]$ 
```

Differences between SageMaker code and EC2 training code

1. Reduced use of logger.

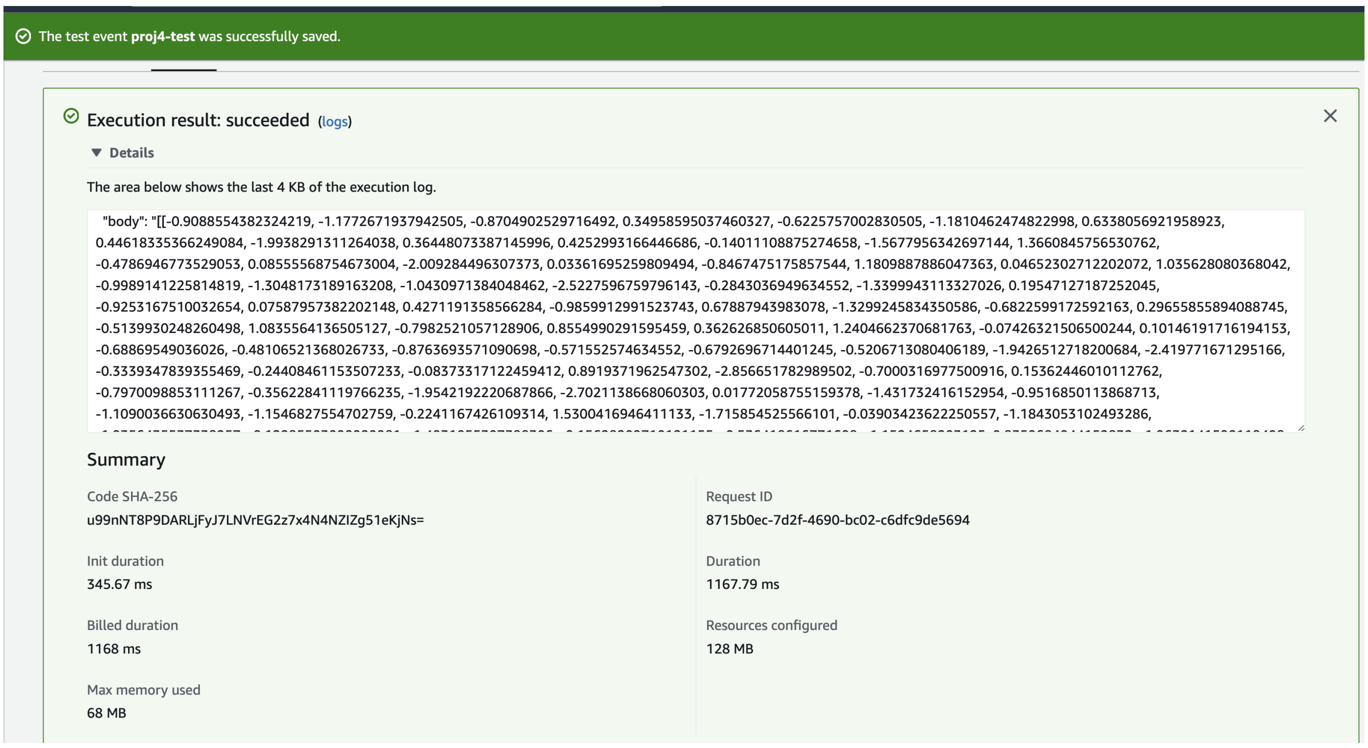
```
logger.setLevel(logging.DEBUG)
logger.addHandler(logging.StreamHandler(sys.stdout))```
```

2. No main function or arg parser

Lambda Function

I created a lambda function using the provided starter file. Within the function, I provided the endpoint name.

Test inference


The test event **proj4-test** was successfully saved.

Execution result: succeeded (logs)

Details

The area below shows the last 4 KB of the execution log.

```
  "body": "[[-0.9088554382324219, -1.1772671937942505, -0.8704902529716492, 0.34958595037460327, -0.6225757002830505, -1.1810462474822998, 0.6338056921958923,
0.44618335366249084, -1.9938291311264038, 0.36448073387145996, 0.4252993166446686, -0.14011108875274658, -1.5677956342697144, 1.3660845756530762,
-0.4786946773529053, 0.08555568754673004, -2.009284496307373, 0.03361695259809494, -0.8467475175857544, 1.1809887886047363, 0.04652302712202072, 1.035628080368042,
-0.9989141225814819, -1.3048173189163208, -1.0430971384048462, -2.5227596759796143, -0.2843036949634552, -1.3399943113327026, 0.19547127187252045,
-0.9253167510032654, 0.07587957382202148, 0.4271191358566284, -0.9859912991523743, 0.67887943983078, -1.3299245834350586, -0.6822599172592163, 0.29655855894088745,
-0.5139930248260498, 1.0835564136505127, -0.7982521057128906, 0.8554990291595459, 0.362626850605011, 1.2404662370681763, -0.07426321506500244, 0.10146191716194153,
-0.68869549036026, -0.48106521368026733, -0.8763693571090698, -0.571552574634552, -0.6792696714401245, -0.5206713080406189, -1.9426512718200684, -2.419771671295166,
-0.3339347839355469, -0.24408461153507233, -0.08373317122459412, 0.8919371962547302, -2.856651782989502, -0.7000316977500916, 0.15362446010112762,
-0.7970098853111267, -0.35622841119766235, -1.9542192220687866, -2.7021138668060303, 0.01772058755159378, -1.431732416152954, -0.9516850113868713,
-1.1090036630630493, -1.1546827554702759, -0.2241167426109314, 1.5300416946411133, -1.715854525566101, -0.03903423622250557, -1.1843053102493286,
```

Summary

Code SHA-256
u99nNT8P9DARLjFyJ7LNVrEG2z7x4N4NZIZg51eKjNs=

Request ID
8715b0ec-7d2f-4690-bc02-c6dfc9de5694

Init duration
345.67 ms

Duration
1167.79 ms

Billed duration
1168 ms

Resources configured
128 MB

Max memory used
68 MB

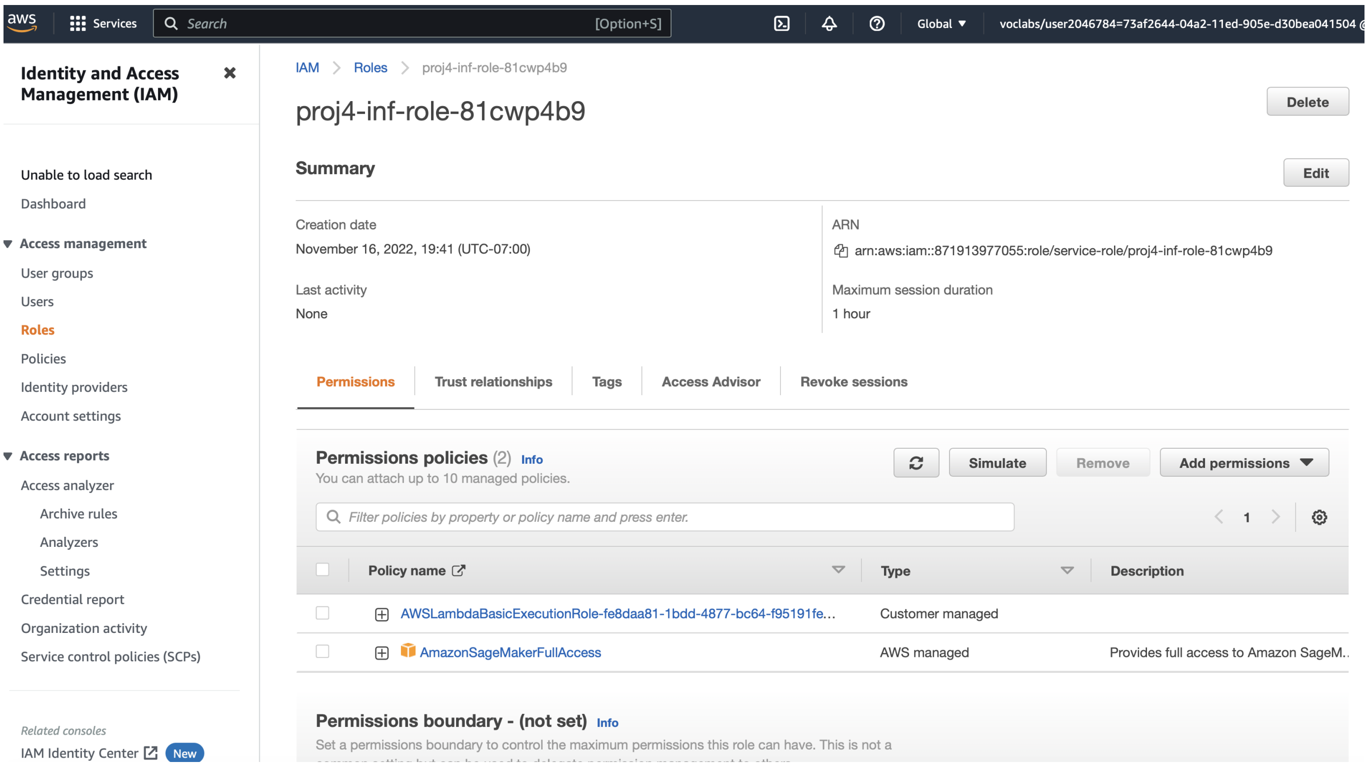
This is my test event:

```
{ "url": "https://s3.amazonaws.com/cdn-origin-etr.akc.org/wp-
content/uploads/2017/11/20113314/Carolina-Dog-standing-outdoors.jpg" }
```

Here are the results of the invocation:

```
{
  "statusCode": 200,
  "headers": {
    "Content-Type": "text/plain",
    "Access-Control-Allow-Origin": "*"
  },
  "type-result": "<class 'str'>",
  "COntent-Type-In": "LambdaContext([aws_request_id=8715b0ec-7d2f-4690-
bc02-c6dfc9de5694,log_group_name=/aws/lambda/proj4-
inf,log_stream_name=2022/11/17/[$LATEST]90a7ebba9fa04ee88968e73a63fd3710,f
unction_name=proj4-
inf,memory_limit_in_mb=128,function_version=$LATEST,invoked_function_arn=a
rn:aws:lambda:us-east-1:871913977055:function:proj4-
inf,client_context=None,identity=CognitoIdentity([cognito_identity_id=None
,cognito_identity_pool_id=None])])",
  "body": "[[-0.9088554382324219, -1.1772671937942505,
-0.8704902529716492, 0.34958595037460327, -0.6225757002830505,
-1.1810462474822998, 0.6338056921958923, 0.44618335366249084,
-1.9938291311264038, 0.36448073387145996, 0.4252993166446686,
-0.14011108875274658, -1.5677956342697144, 1.3660845756530762,
-0.4786946773529053, 0.08555568754673004, -2.009284496307373,
0.03361695259809494, -0.8467475175857544, 1.1809887886047363,
0.04652302712202072, 1.035628080368042, -0.9989141225814819,
-1.3048173189163208, -1.0430971384048462, -2.5227596759796143,
-0.2843036949634552, -1.3399943113327026, 0.19547127187252045,
-0.9253167510032654, 0.07587957382202148, 0.4271191358566284,
-0.9859912991523743, 0.67887943983078, -1.3299245834350586,
-0.6822599172592163, 0.29655855894088745, -0.5139930248260498,
1.0835564136505127, -0.7982521057128906, 0.8554990291595459,
0.362626850605011, 1.2404662370681763, -0.07426321506500244,
0.10146191716194153, -0.68869549036026, -0.48106521368026733,
-0.8763693571090698, -0.571552574634552, -0.6792696714401245,
-0.5206713080406189, -1.9426512718200684, -2.419771671295166,
-0.3339347839355469, -0.24408461153507233, -0.08373317122459412,
0.8919371962547302, -2.856651782989502, -0.7000316977500916,
0.15362446010112762, -0.7970098853111267, -0.35622841119766235,
-1.9542192220687866, -2.7021138668060303, 0.01772058755159378,
-1.431732416152954, -0.9516850113868713, -1.1090036630630493,
-1.1546827554702759, -0.2241167426109314, 1.5300416946411133,
-1.715854525566101, -0.03903423622250557, -1.1843053102493286,
-1.9356435537338257, -0.12285503000020981, -1.4931055307388306,
-0.15628209710121155, -0.536418616771698, -1.1524658203125,
0.8359684944152832, -1.9632141590118408, -0.04063112288713455,
0.36780649423599243, -1.129619836807251, -1.367497205734253,
-0.0011828616261482239, -0.6425749063491821, -0.7356793880462646,
1.0322339534759521, -0.8544481992721558, -1.4675880670547485,
-1.728093147277832, -1.2840062379837036, -0.4094080626964569,
-0.38233983516693115, -1.1601954698562622, 0.1524370163679123,
-1.3115702867507935, -1.653199315071106, -2.022322654724121,
-1.609832525253296, 0.21691259741783142, -2.072298526763916,
-1.5164365768432617, -1.1745740175247192, -0.8381267189979553,
-0.9472677707672119, -0.36459943652153015, -0.6767148971557617,
-0.06865213811397552, 0.7558403015136719, -1.1166062355041504,
-0.859592080116272, -1.0786547660827637, -0.19210000336170197,
-1.1853835582733154, 0.21012145280838013, -1.9923133850097656,
-0.22051474452018738, -1.0778053998947144, -1.6710342168807983,
-1.1564878225326538, -1.1558247804641724, -1.6072654724121094,
-1.6592135429382324, -1.4082069396972656, -1.3968602418899536,
-1.9419918060302734, -1.5573835372924805, -2.394296646118164,
-0.9858585596084595, -1.873814344406128]]"
}
```

lam role



IAM > Roles > proj4-inf-role-81cwp4b9

proj4-inf-role-81cwp4b9

Summary

Creation date
November 16, 2022, 19:41 (UTC-07:00)

ARN
arn:aws:iam::871913977055:role/service-role/proj4-inf-role-81cwp4b9

Last activity
None

Maximum session duration
1 hour

Permissions | Trust relationships | Tags | Access Advisor | Revoke sessions

Permissions policies (2) Info
You can attach up to 10 managed policies.

Policy name	Type	Description
AWSLambdaBasicExecutionRole-fe8daa81-1bdd-4877-bc64-f95191fe...	Customer managed	
AmazonSageMakerFullAccess	AWS managed	Provides full access to Amazon SageM..

Permissions boundary - (not set) Info
Set a permissions boundary to control the maximum permissions this role can have. This is not a

Potential security vulnerabilities

I think my workspace is secure, but in general note that: roles that have "FullAccess" policies attached may be too permissive and may lead to problems. Roles that are old or inactive may lead to vulnerabilities because they may belong to people who are no longer working on the project and who may not be careful about ensuring the project's success.

Concurrency

I set up provisioned concurrency of 2, so that my lambda can handle more requests concurrently.

Autoscaling

I configured my endpoint to have autoscaling. I chose to have a scale in and scale out cool down period of 30 seconds so that the endpoint will have less delay before spinning up additional instances, as well as less delay before shutting down any excess instance. I chose a value of 10 for SageMakerVariantInvocationsPerInstance, which is my chosen level of how many invocations my endpoint instance should be able to handle before I want to spin up an additional instance and as a target to decide when to shut down excess instances.