README.md

operationalizing-an-aws-ml-project

Dog Image Classification

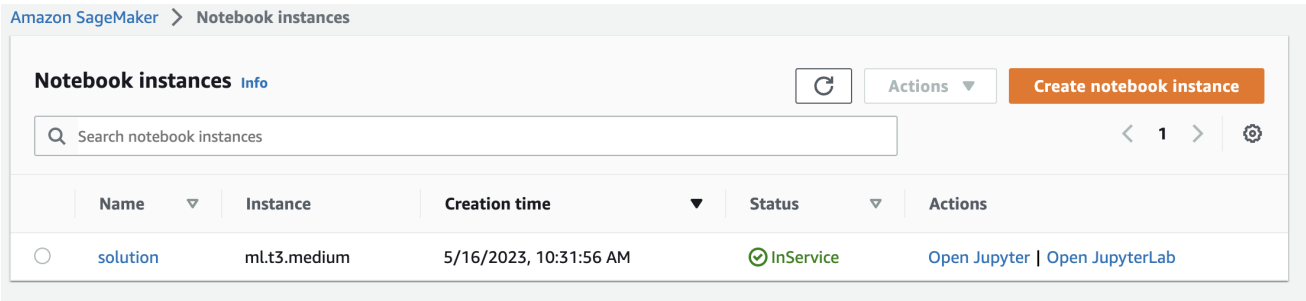
In this project, you will accomplish the following tasks:

1. Utilize SageMaker to train and deploy a model, selecting the most suitable instance types. Configure multi-instance training within your SageMaker notebook.
2. Modify your SageMaker notebooks to facilitate training and deployment on EC2 instances.
3. Establish a Lambda function associated with your deployed model. Configure auto-scaling for the deployed endpoint and manage concurrency for the Lambda function.
4. Implement proper security measures for your machine learning pipeline.

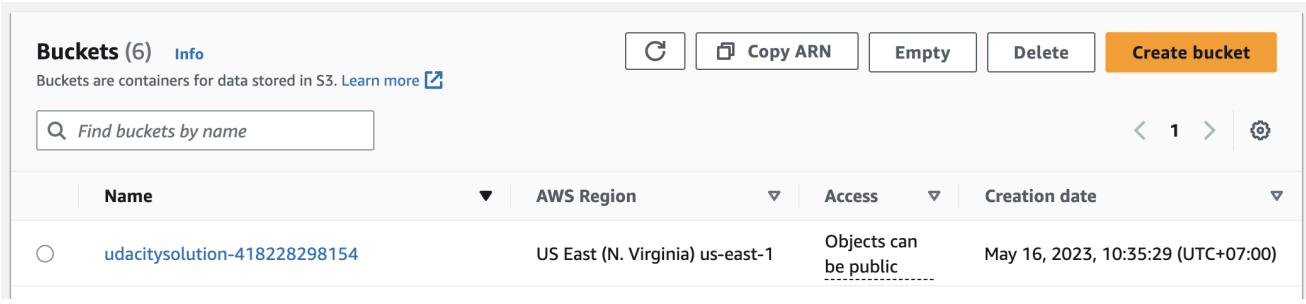
Project Steps:

Step 1: Training and deployment on Sagemaker

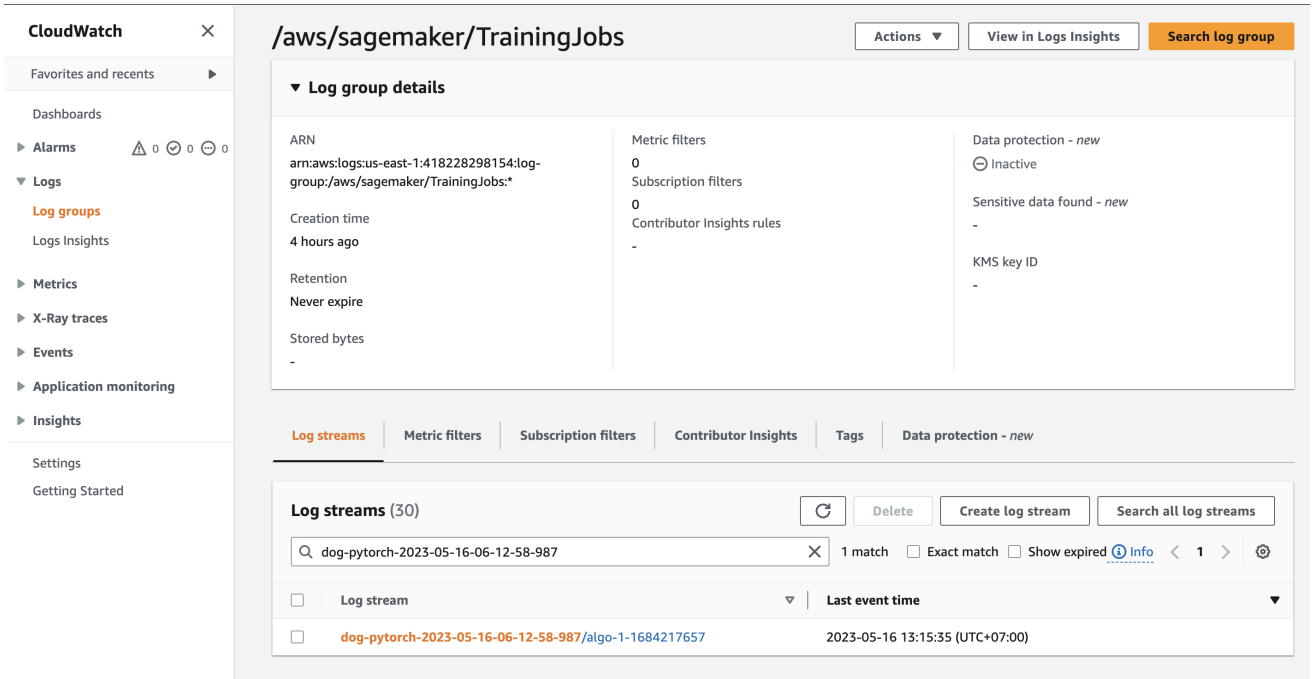
- Created sagemaker notebook instance I have used ml.t3.medium as this is suffiecint to run my notebook.



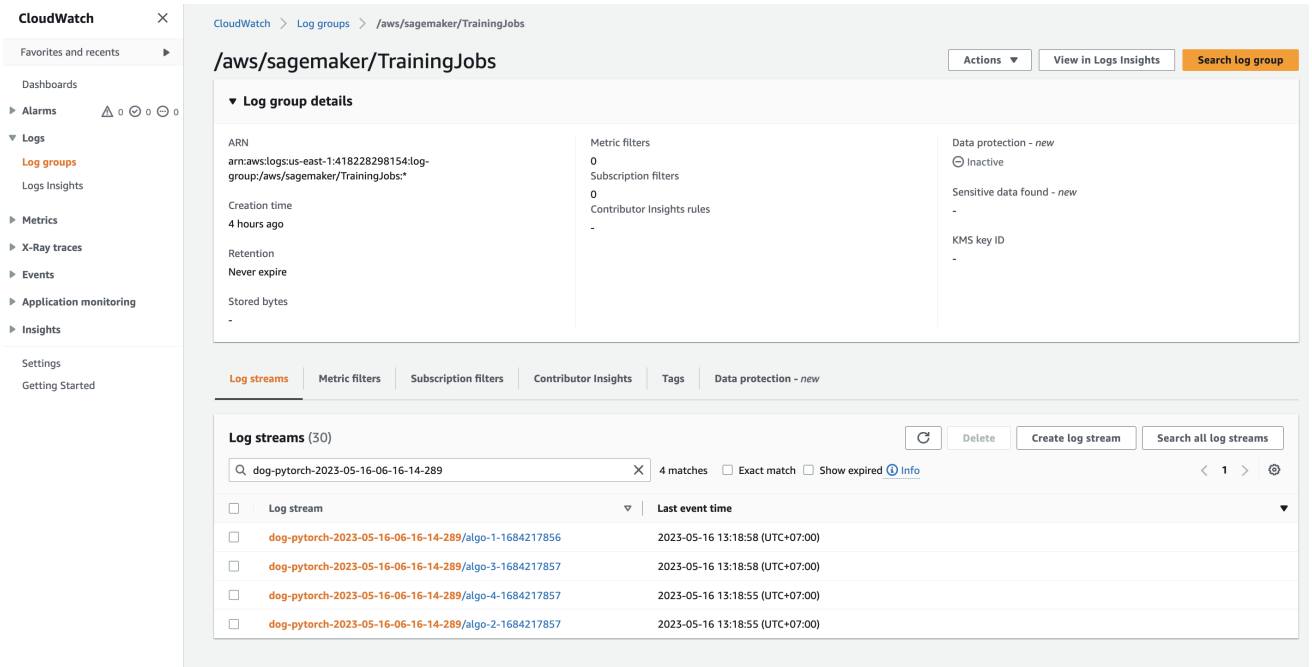
- Created S3 bucket for the job (udacitysolution-418228298154)



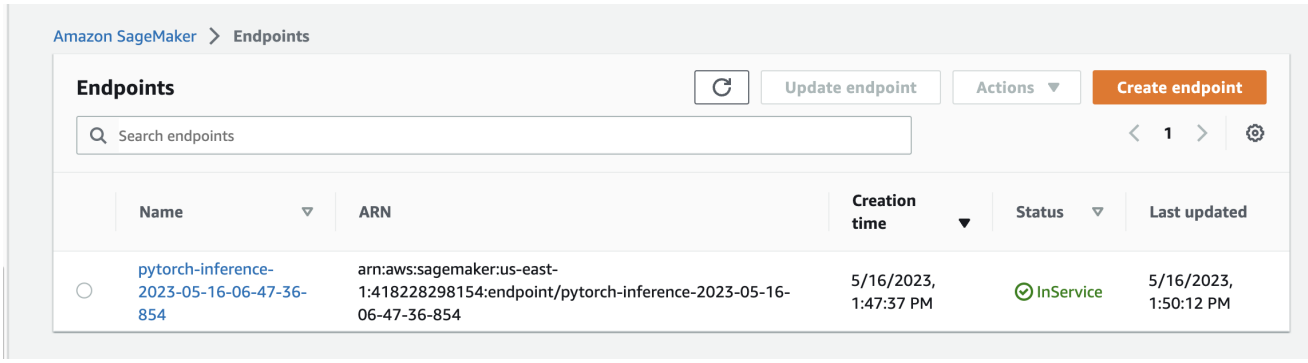
- Executed single instance training (1 epoch because of budget constraints)



- Executed multi-instance training (4 instances, 1 epoch because of budget constraints)

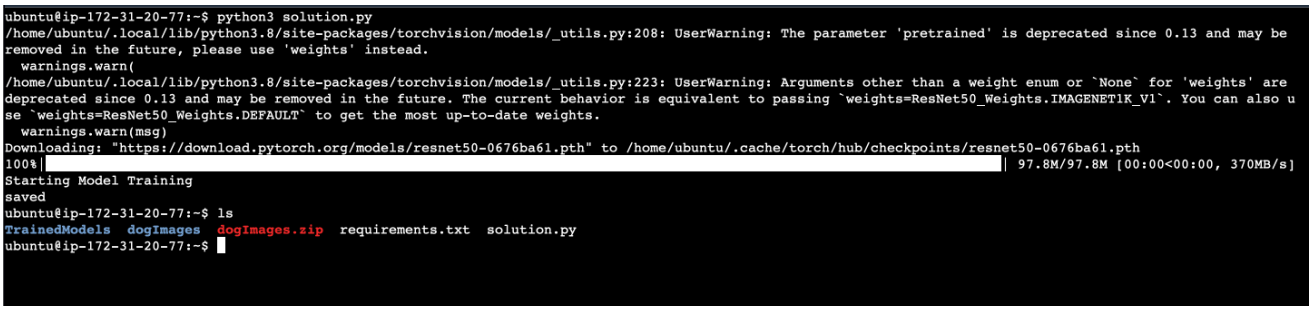


- Model deployment



Step 2: EC2 Training

- Model training can also be carried out on an EC2 instance. For this purpose, I opted for an Ubuntu 20.04 that already had the necessary libraries installed. I chose the `g4dn.xlarge` instance, as it comes equipped with the latest version of PyTorch.



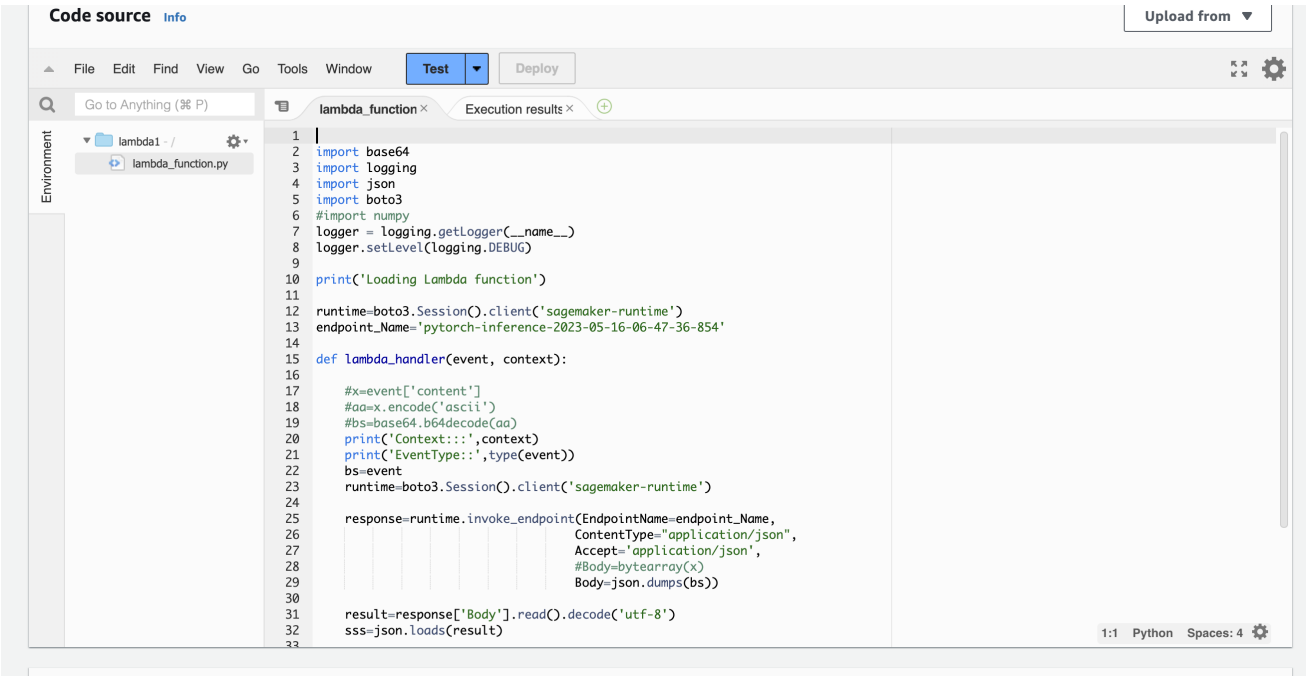
```
ubuntu@ip-172-31-20-77:~$ python3 solution.py
/home/ubuntu/.local/lib/python3.8/site-packages/torchvision/models/_utils.py:208: UserWarning: The parameter 'pretrained' is deprecated since 0.13 and may be
removed in the future, please use 'weights' instead.
  warnings.warn(
/home/ubuntu/.local/lib/python3.8/site-packages/torchvision/models/_utils.py:223: UserWarning: Arguments other than a weight enum or `None` for 'weights' are
deprecated since 0.13 and may be removed in the future. The current behavior is equivalent to passing `weights=ResNet50_Weights.IMAGENET1K_V1`. You can also u
se `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/ubuntu/.cache/torch/hub/checkpoints/resnet50-0676ba61.pth
100%|[------------------------------------------------------------------------------------------------------------------------]| 97.8M/97.8M [00:00<00:00, 370MB/s]
Starting Model Training
saved
ubuntu@ip-172-31-20-77:~$ ls
TrainedModels  dogImages  dogImages.zip  requirements.txt  solution.py
ubuntu@ip-172-31-20-77:~$
```

- The image above illustrates an EC2 instance executing the `ec2train1.py` script to train the model.

- The code modifications in `ec2train1.py` bear a significant resemblance to the code in `train_and_deploy-solution.ipynb`. However, there are a few distinctions due to some modules that are exclusive to SageMaker. A large portion of the EC2 training code has been modified from the functions outlined in the `hpo.py` starter script. While `ec2train.py` trains the model with specific arguments, `hpo.py` retrieves arguments for the model through command line parsing. This latter script is capable of training multiple models with varying hyperparameters.

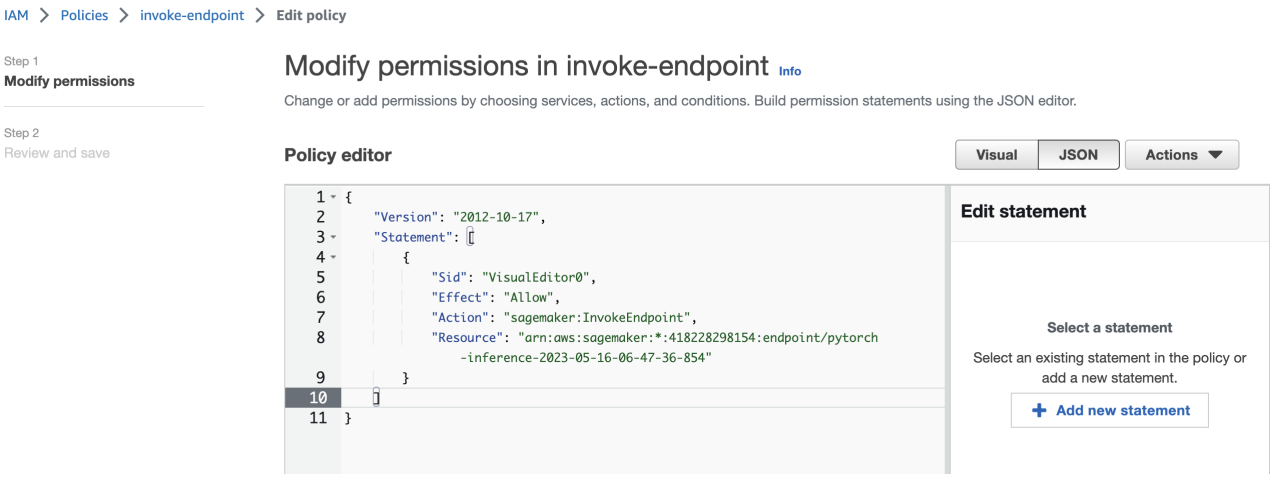
Step 3: Lambda function setup

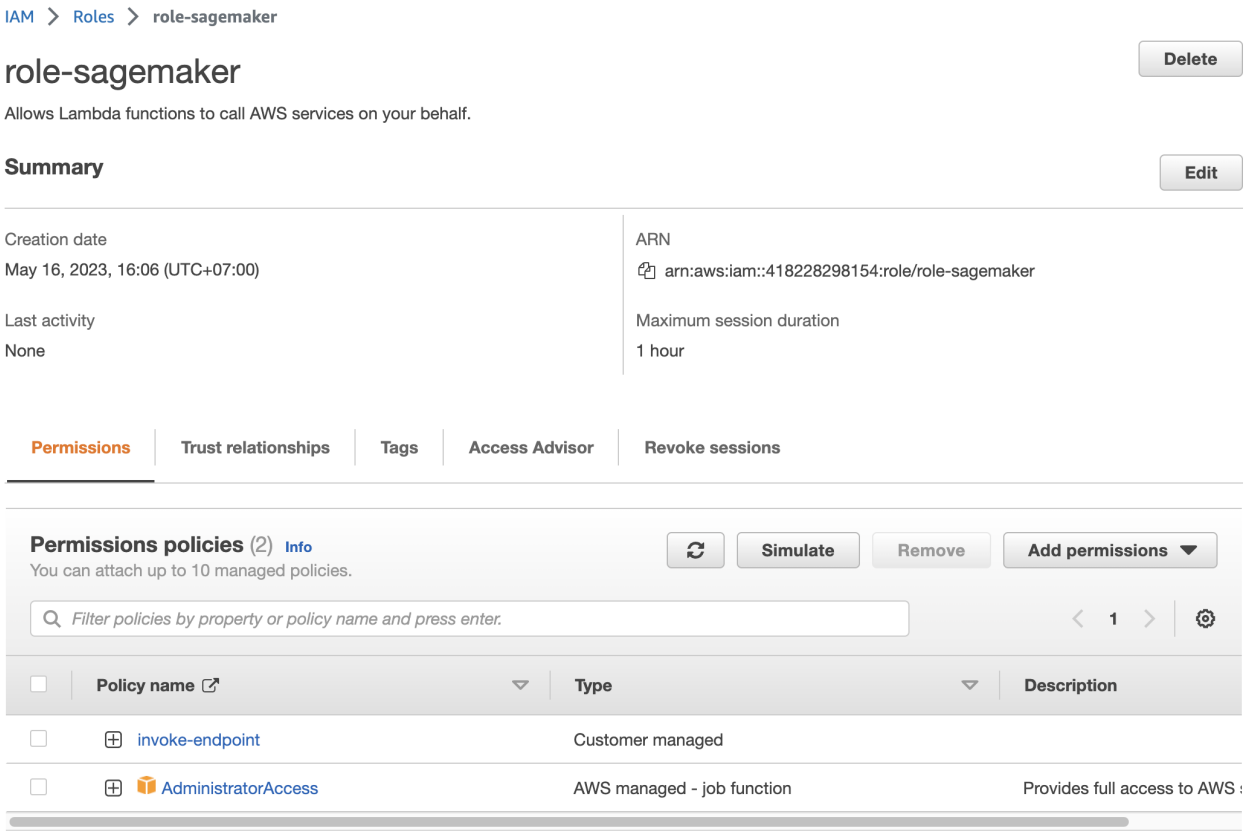
- Once your model has been trained and deployed, the subsequent crucial step is to establish a Lambda function. This function facilitates the access to your model and its predictions by APIs and other applications, thereby serving as a vital component of production deployment.



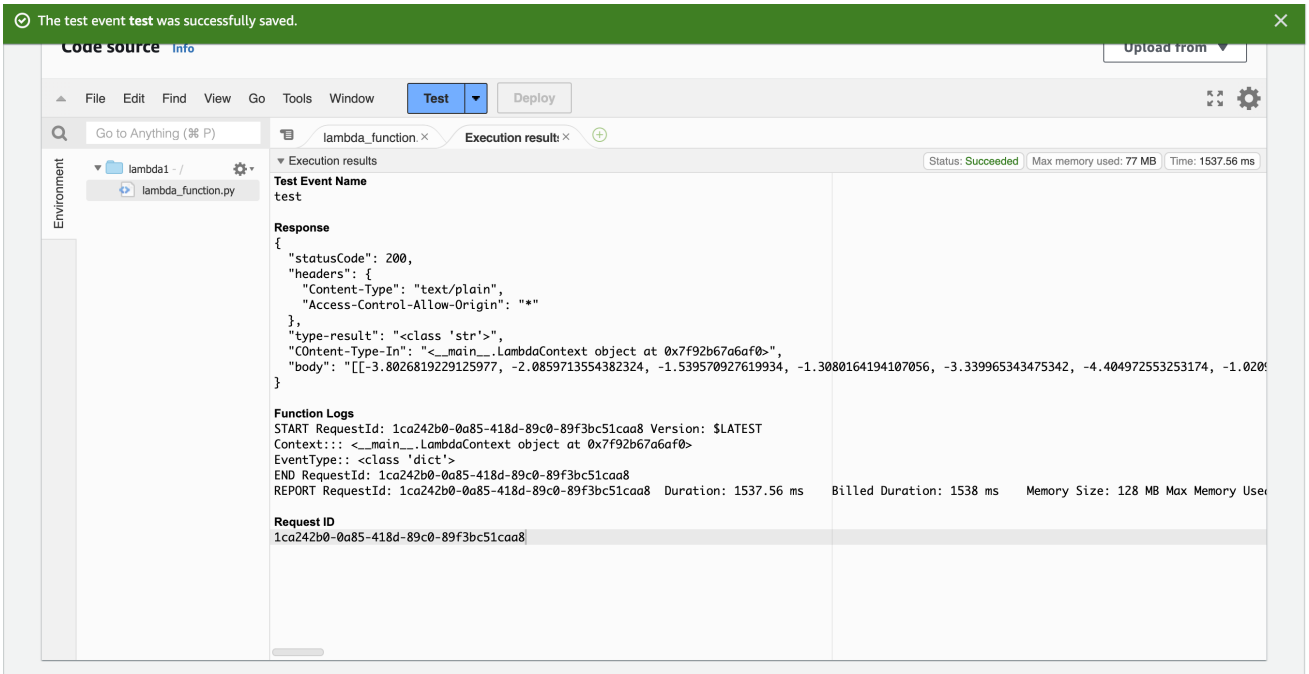
Step 4: Lambda policy and testing

- Creating policy with permission to only invoke specific endpoint.





- Testing lambda function



- Respone:

```
Response
{
  "statusCode": 200,
  "headers": {
    "Content-Type": "text/plain",
    "Access-Control-Allow-Origin": "*"
  },
```

```
  "type-result": "<class 'str'>",
  "COntent-Type-In": "<__main__.LambdaContext object at 0x7f92b67a6af0>",
  "body": "[[-3.8026819229125977, -2.0859713554382324, -1.539570927619934,
-1.3080164194107056, -3.339965343475342, -4.404972553253174,
-1.0209825038909912, -1.900415062904358, -2.956531286239624,
-0.31846800446510315, -1.2855305671691895, -4.488164901733398,
-1.0597424507141113, 1.0620988607406616, -3.998521566390991,
-3.0901365280151367, -4.347545623779297, -2.194549560546875,
-2.292271375656128, 1.4613531827926636, -2.8937950134277344,
-1.1955442428588867, -4.603621482849121, -2.92773699760437,
-2.6350646018981934, -3.281313180923462, -2.2812507152557373,
-3.261805534362793, -2.8130531311035156, -1.1878055334091187,
-0.9282594323158264, -3.1857945919036865, -4.730673789978027,
-1.5436851978302002, -4.537162780761719, -2.8843417167663574,
-3.3408946990966797, -2.4748477935791016, -1.0711184740066528,
-2.507316827774048, -2.1006064414978027, -2.077411413192749,
1.8813728094100952, -1.3100594282150269, -2.0014002323150635,
-5.724288463592529, -1.0919257402420044, -0.9209285378456116,
-1.01749849319458, -0.3974989354610443, -3.730351686477661,
-5.149448394775391, -4.111176490783691, -1.7322322130203247,
-3.022367238998413, -1.5153255462646484, -2.9911558628082275,
-3.6611413955688477, -1.9944188594818115, -2.1147618293762207,
-4.525941371917725, -2.997464895248413, -4.339841842651367,
-4.683041572570801, -2.261636734008789, -3.0569100379943848,
-0.9021389484405518, -4.452295303344727, -2.18411922454834,
-0.2539750933647156, 0.6183738112449646, -2.6141915321350098,
-3.3500468730926514, -3.0878090858459473, -3.2058985233306885,
-1.1343743801116943, -5.269481182098389, -1.3220785856246948,
-3.5936434268951416, -2.4593327045440674, -0.47329947352409363,
-3.876897096633911, 0.4124978184700012, -2.1235811710357666,
-5.330963611602783, -4.047287940979004, -1.3646618127822876,
-2.864323854446411, -1.7422258853912354, -1.4358495473861694,
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-3.5264501571655273, -2.2768118381500244, -0.4151455760002136,
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-2.759162425994873, -3.774449586868286, -1.6567118167877197,
-1.488266110420227, -3.67352294921875, -3.1619045734405518,
-3.5365829467773438, -2.6133177280426025, -1.365824580192566,
-3.008732795715332, -0.39713871479034424, -0.5222817063331604,
-0.2639937400817871, -4.13600492477417, -1.5596508979797363,
-3.58133864402771, -2.406162977218628, -6.019803524017334,
-0.6986405253410339, -3.070871591567993, -0.1717919111251831,
0.023802954703569412, -3.0725650787353516, -3.4439449310302734,
-2.497530221939087, -3.286989450454712, -2.190408229827881,
-1.2030950784683228, 0.4249667227268219, -3.0472755432128906,
-4.850414752960205, -1.4908115863800049, -1.322715163230896,
-2.5584988594055176]]"
}
```
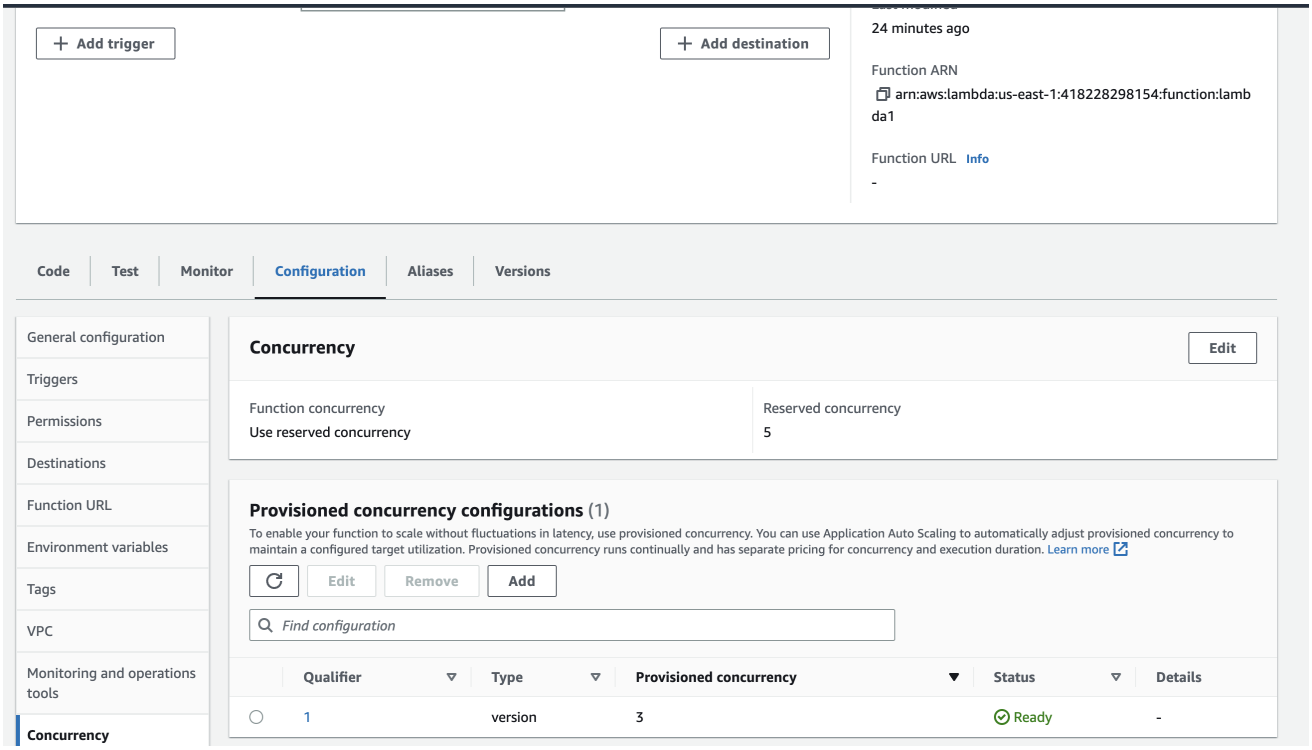


Step 5: Lambda concurrency setup and endpoint auto-scaling

- Concurrency

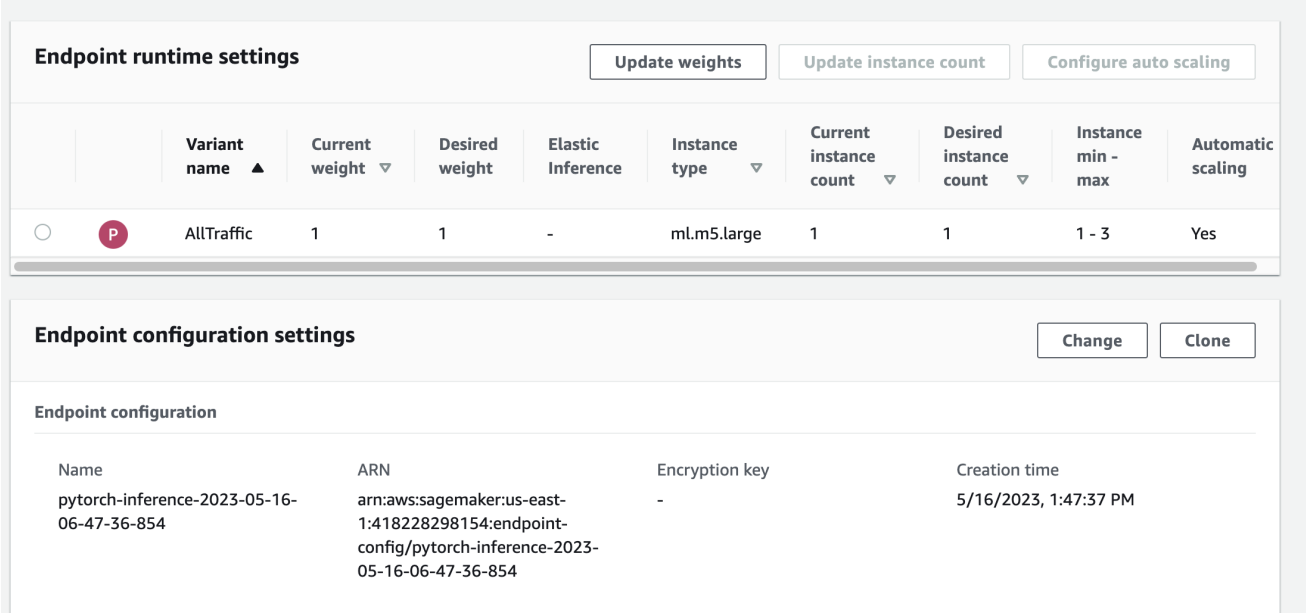
```
reserved instances: 5/1000
provisioned instances: 3/5
```



- Auto-scaling

Sagemaker endpoints require automatic scaling to respond to high traffic.

```
minimum instances: 1
maximum instances: 3
target value: 3    // number of simulataneous requests which will trigger
scaling
scale-in time: 300 s
scale-out time: 300 s
```



Endpoint runtime settings

Update weights | Update instance count | Configure auto scaling

		Variant name	Current weight	Desired weight	Elastic Inference	Instance type	Current instance count	Desired instance count	Instance min - max	Automatic scaling
○	P	AllTraffic	1	1	-	ml.m5.large	1	1	1 - 3	Yes

Endpoint configuration settings

Change | Clone

Endpoint configuration

Name	ARN	Encryption key	Creation time
pytorch-inference-2023-05-16-06-47-36-854	arn:aws:sagemaker:us-east-1:418228298154:endpoint-config/pytorch-inference-2023-05-16-06-47-36-854	-	5/16/2023, 1:47:37 PM