Title: Step by Step - How to Deploy a Model in Google Cloud Platform

— Master Thesis Support Document

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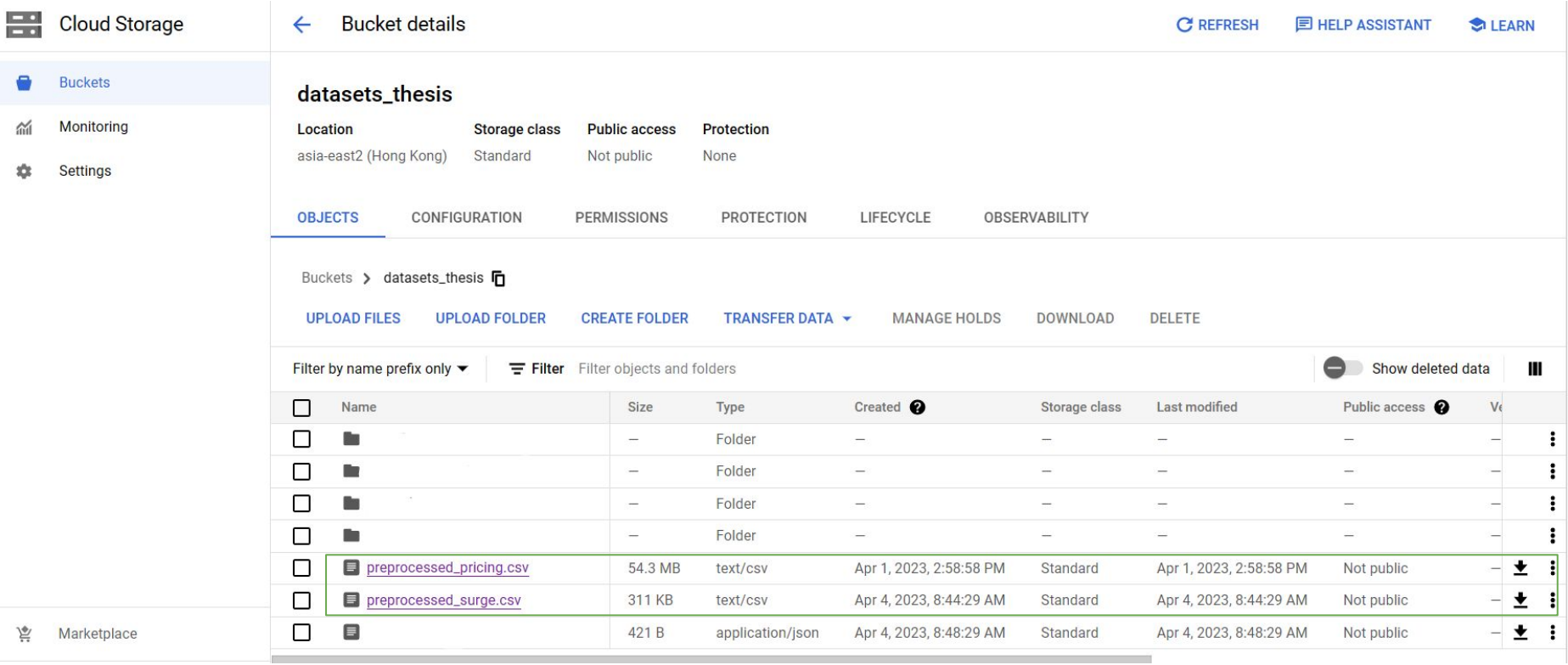
Master ADEO 2

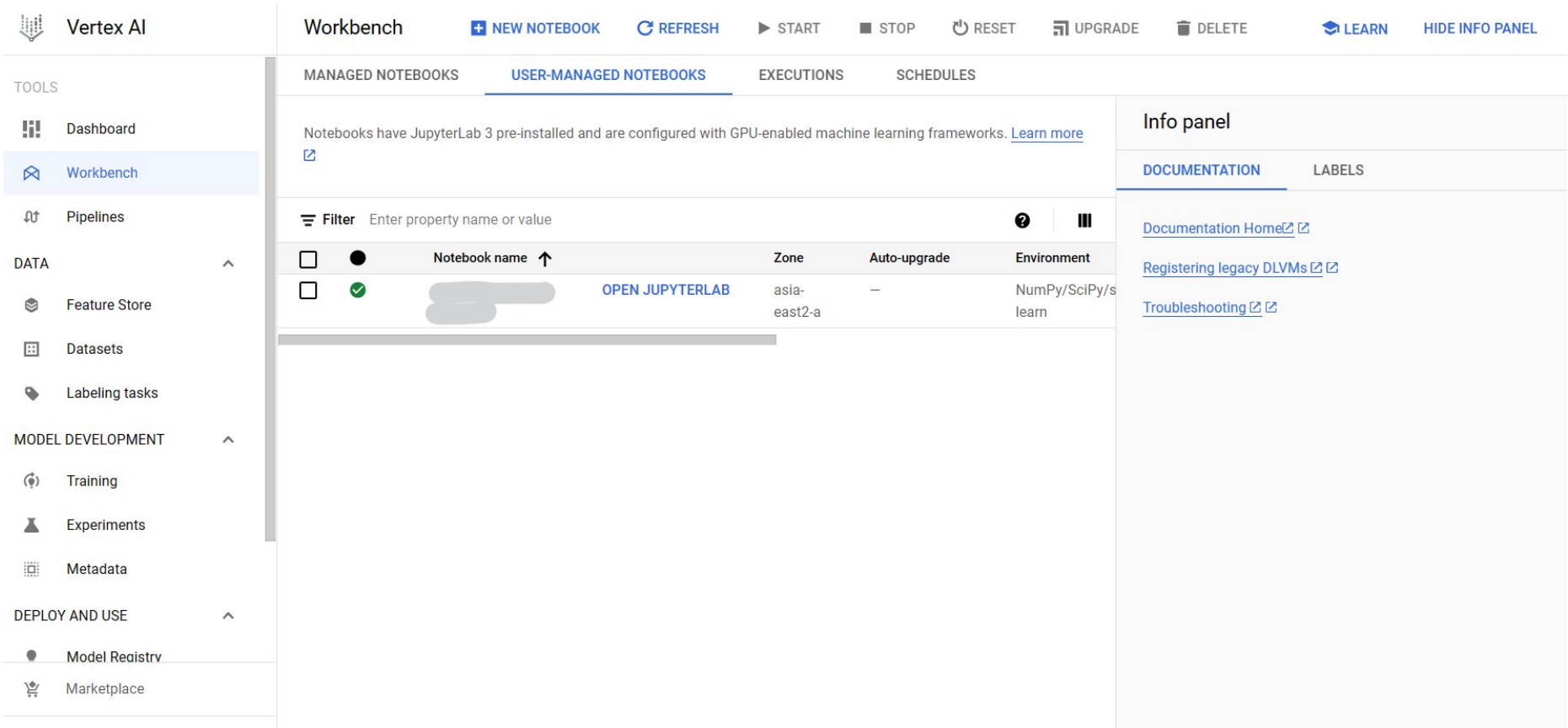
Project Setup

Storing Preprocessed Datasets : Google Storage - Buckets

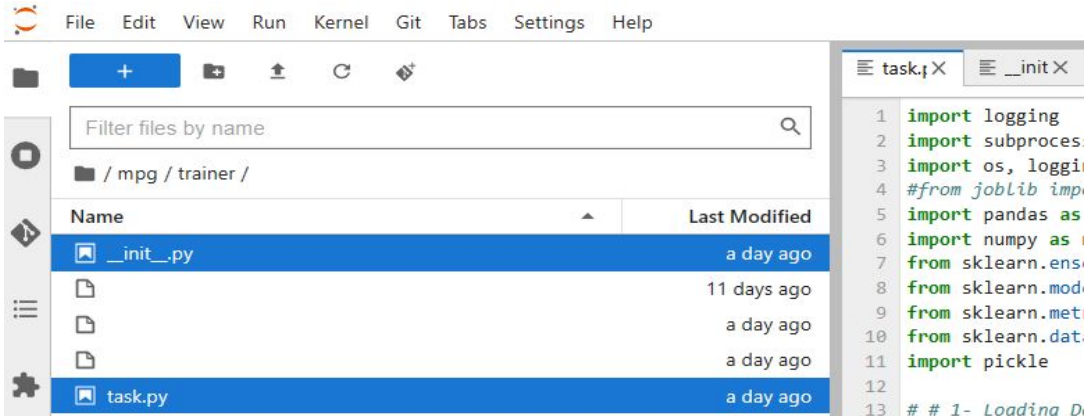
Important consideration for later stages: Make sure to unify the region (location) : Always use the same one and do not opt for multi-region when creating your bucket since it can be more costly and can be inconvenient later.



Creating a Workbench Managed Notebook : Workbench

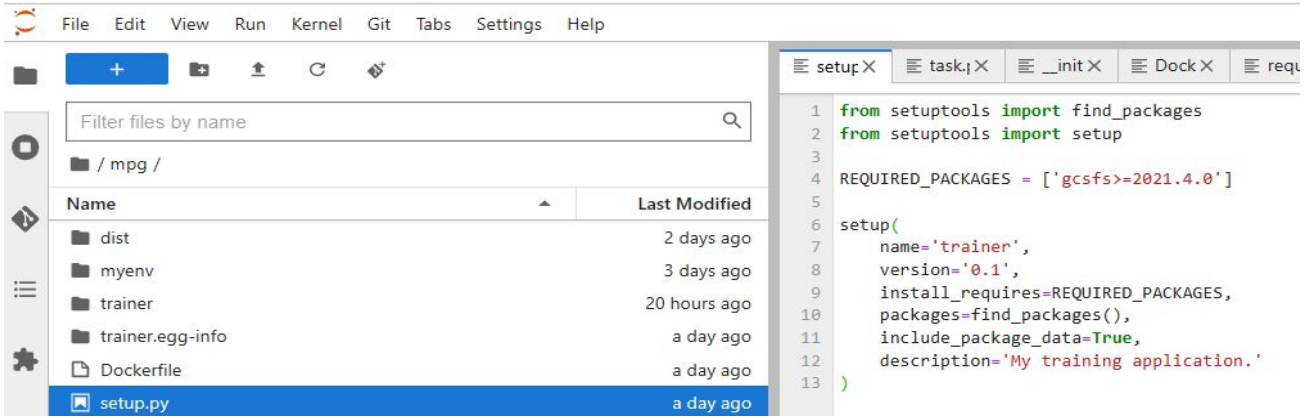


Upload .ipnb and create a .py version of it



Prebuilt Container Configuration

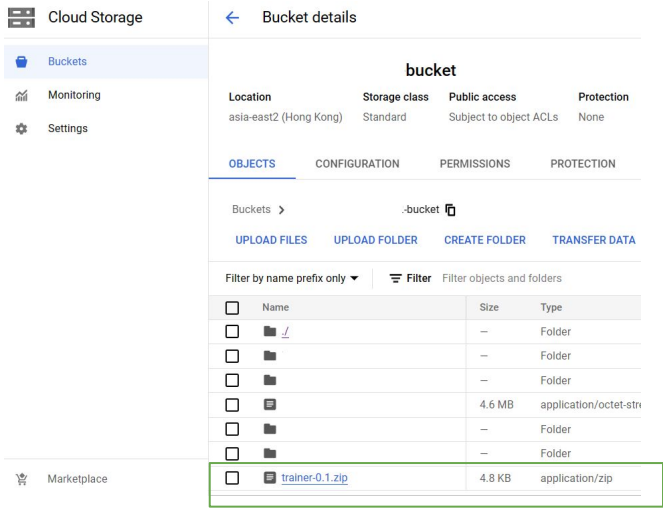
Prebuilt Container: Create setup.py



Prebuilt Container: Source distribution package (.zip)

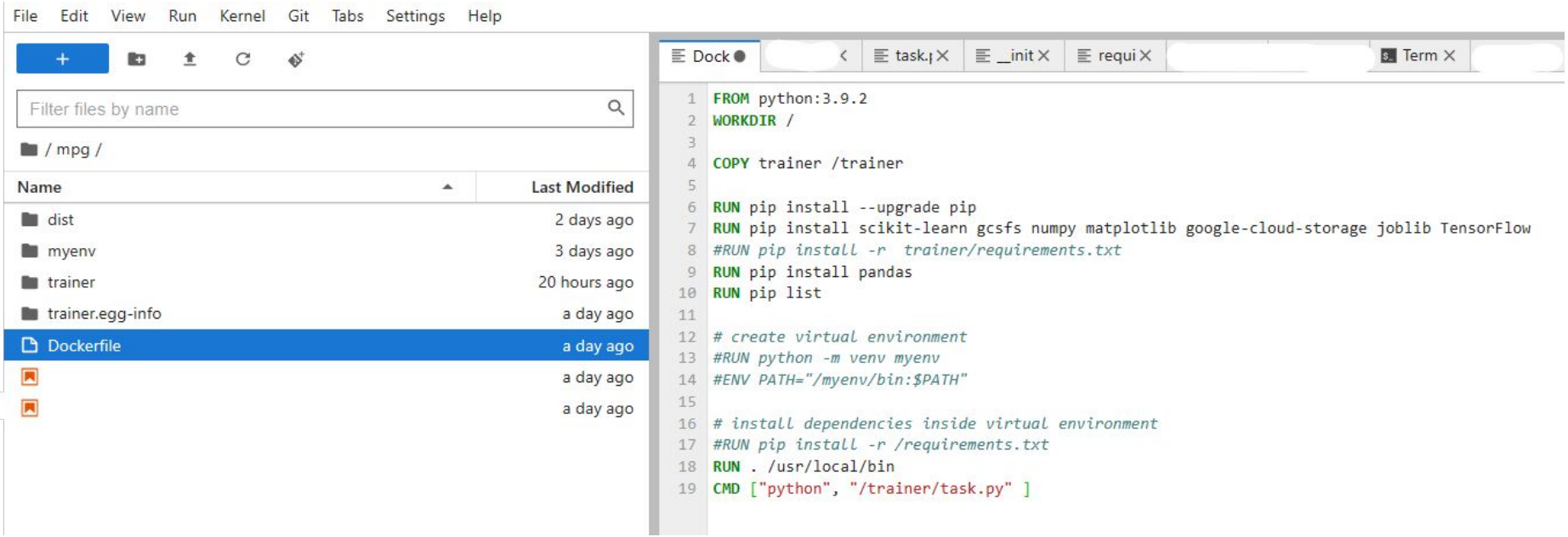
```
(jupyterlab) jupyter@python-20230401-144959:~/mpg$ gsutil cp dist/trainer-0.1.zip gs://boxwood-bliss-382412-bucket/              python setup.py sdist --formats
=zip
running sdist
running egg_info
writing trainer.egg-info/PKG-INFO
writing dependency_links to trainer.egg-info/dependency_links.txt
writing requirements to trainer.egg-info/requires.txt
writing top-level names to trainer.egg-info/top_level.txt
reading manifest file 'trainer.egg-info/SOURCES.txt'
writing manifest file 'trainer.egg-info/SOURCES.txt'
warning: sdist: standard file not found: should have one of README, README.rst, README.txt, README.md

running check
creating trainer-0.1
creating trainer-0.1/trainer
creating trainer-0.1/trainer.egg-info
copying files to trainer-0.1...
copying setup.py -> trainer-0.1
copying trainer/__init__.py -> trainer-0.1/trainer
copying trainer/task.py -> trainer-0.1/trainer
copying trainer/train.py -> trainer-0.1/trainer
copying trainer.egg-info/PKG-INFO -> trainer-0.1/trainer.egg-info
copying trainer.egg-info/SOURCES.txt -> trainer-0.1/trainer.egg-info
copying trainer.egg-info/dependency_links.txt -> trainer-0.1/trainer.egg-info
copying trainer.egg-info/requires.txt -> trainer-0.1/trainer.egg-info
copying trainer.egg-info/top_level.txt -> trainer-0.1/trainer.egg-info
Writing trainer-0.1/setup.cfg
creating 'dist/trainer-0.1.zip' and adding 'trainer-0.1' to it
adding 'trainer-0.1'
adding 'trainer-0.1/trainer'
adding 'trainer-0.1/trainer.egg-info'
adding 'trainer-0.1/setup.py'
adding 'trainer-0.1/PKG-INFO'
adding 'trainer-0.1/setup.cfg'
adding 'trainer-0.1/trainer/__init__.py'
adding 'trainer-0.1/trainer/task.py'
adding 'trainer-0.1/trainer/train.py'
adding 'trainer-0.1/trainer.egg-info/dependency_links.txt'
adding 'trainer-0.1/trainer.egg-info/PKG-INFO'
adding 'trainer-0.1/trainer.egg-info/top_level.txt'
adding 'trainer-0.1/trainer.egg-info/requires.txt'
adding 'trainer-0.1/trainer.egg-info/SOURCES.txt'
removing 'trainer-0.1' (and everything under it)
(jupyterlab) jupyter@python-20230401-144959:~/mpg$ python setup.py sdist --formagsutil cp dist/trainer-0.1.zip gs://boxwood-bliss-382412-bucket/
Copying file://dist/trainer-0.1.zip [Content-Type=application/zip]...
/ [1 files][  4.8 KiB/  4.8 KiB]
```



Customer Built Container Configuration

Custom Built Container: Create Dockerfile



Custom Built Container: Build, Run & Push Docker Image

```
(jupyterlab) jupyter@python-20230401-144959:~/mpg$ docker build -t asia-east2-docker.pkg.dev/boxwood-bliss-382412/mpg/dockerimage:V2 .
Sending build context to Docker daemon  442.7MB
Step 1/9 : FROM python:3.9.2
 ---> 587b1bc803b3
Step 2/9 : WORKDIR /
 ---> Using cache
 ---> c11eae721bdf
Step 3/9 : COPY trainer /trainer
 ---> 54d90cae06be
Step 4/9 : RUN pip install --upgrade pip
 ---> Running in 13abb34c4804
Requirement already satisfied: pip in /usr/local/lib/python3.9/site-packages (21.0.1)
Collecting pip
  Downloading pip-23.0.1-py3-none-any.whl (2.1 MB)
Installing collected packages: pip
  Attempting uninstall: pip
    Found existing installation: pip 21.0.1
    Uninstalling pip-21.0.1:
      Successfully uninstalled pip-21.0.1
Successfully installed pip-23.0.1
Removing intermediate container 13abb34c4804
 ---> 64820698e936
Step 5/9 : RUN pip install scikit-learn gcsfs numpy matplotlib google-cloud-storage joblib TensorFlow
 ---> Running in a27c4b86fa01
Collecting scikit-learn
  Downloading scikit_learn-1.2.2-cp39-cp39-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (9.6 MB)
     ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 9.6/9.6 MB 68.5 MB/s eta 0:00:00
```

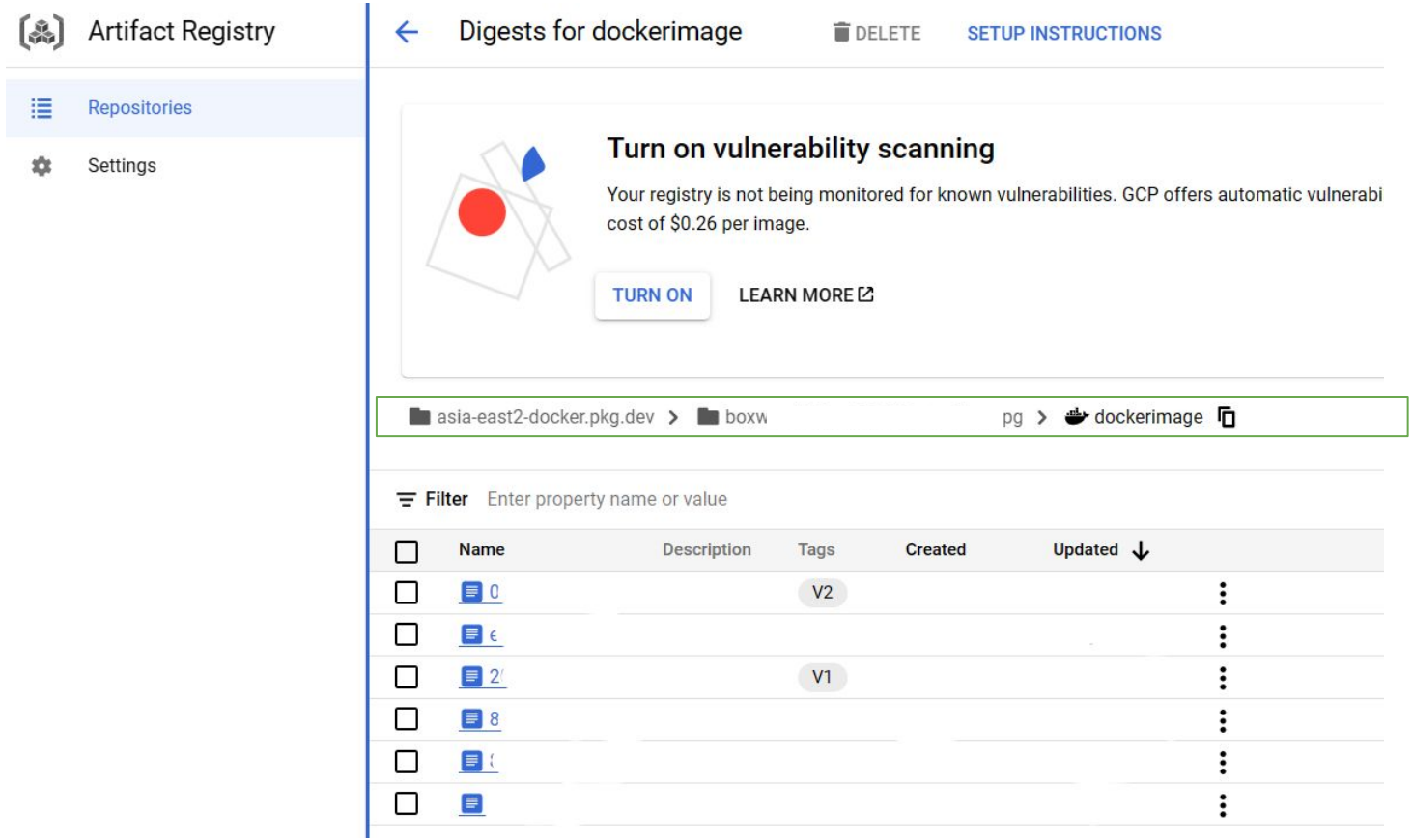
```
Removing intermediate container 061ba1bb79ae
 ---> 93c62b3696ca
Step 8/9 : RUN . /usr/local/bin
 ---> Running in 3144472f395d
Removing intermediate container 3144472f395d
 ---> d6ce02887662
Step 9/9 : CMD ["python", "/trainer/task.py" ]
 ---> Running in 6ab94f330432
Removing intermediate container 6ab94f330432
 ---> df974a45e6cf
Successfully built df974a45e6cf
Successfully tagged asia-east2-docker.pkg.dev/boxwood-bliss-382412/mpg/dockerimage:V2
```

```
(jupyterlab) jupyter@python-20230401-144959:~/mpg$ docker run --rm asia-east2-docker.pkg.dev/boxwood-bliss-382412/mpg/dockerimage:V2
Predicted values:
[1.5275 1.045  1.395  1.2525 1.715  1.025  1.25   1.1375 1.4025 1.92
 1.6125 1.32   1.0175 1.51   1.     1.025  1.2475 1.5625 1.7925 1.895
 1.     1.195  1.81   1.2475 1.7525 1.175  1.5175 1.045  1.4575 1.32
 1.235  1.5475 1.4975 1.7675 1.47   1.5625 1.4675 1.5875 1.8275 1.09
 1.995  1.6325 1.17   1.8    1.0175 1.     1.8825 1.0975 1.015  1.025
 1.035  1.005  1.005  1.315  1.25   1.0025 1.23   1.005  1.1175 1.12
 1.9775 1.7075 1.26   1.0125 1.155  1.0075 1.0475 1.8175 1.0025 1.06
 1.5125 1.0875 1.72   1.5175 1.885  1.86   1.66   1.575  1.5675 1.0275
 1.65   1.025  1.0175 1.4375 1.98   1.0825 1.4925 1.     1.245  1.1825
 1.3975 1.465  1.3125 1.585  1.395  1.84   1.9075 1.6775 1.8175 1.2575
 1.0675 1.2125 1.2575 1.34   1.005  1.04   1.4025 1.0125 1.5225 1.33
 1.2075 1.3425 1.02   1.84   1.5125 1.5225 1.955  1.1375 1.2325 1.
 1.1625 1.03   1.455  1.0475 1.0475 1.505  1.7625 1.2725 1.2975 1.14
 1.22   1.31   1.1025 1.9825 1.135  1.35   1.005  1.4575 1.46   1.
```

```
 1.2825 1.51   1.9525 1.99   1.2375 1.115  1.105  1.9875 1.6625 1.455
 1.4875 1.2475 1.5575 1.3125 1.5025 1.7325 1.4675 1.52   1.51   1.1875
 1.     1.3275 1.965  1.6175 1.04   1.01   1.1725 1.7775 1.3175 1.0975
 1.25   1.5025 1.0025]
INFO:root:Model exported to: gs://boxwood-bliss-382412-bucket/./model.pkl
```

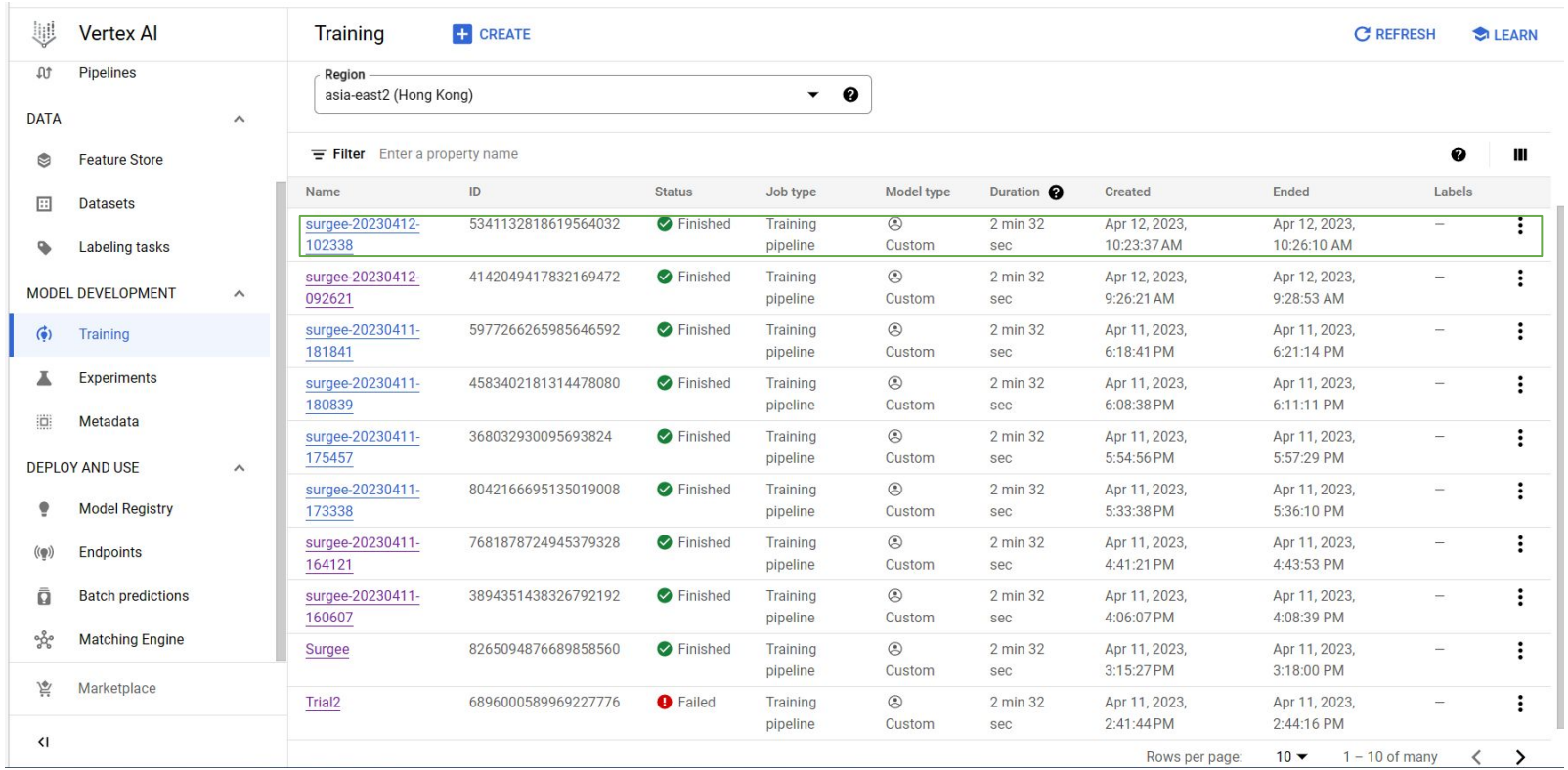
```
(jupyterlab) jupyter@python-20230401-144959:~/mpg$ docker push asia-east2-docker.pkg.dev/boxwood-bliss-382412/mpg/dockerimage:V2
The push refers to repository [asia-east2-docker.pkg.dev/boxwood-bliss-382412/mpg/dockerimage]
5b2ce1240cc3: Pushed
cd5cd3b3b064: Pushing [==========================>                        ]  1.314GB/2.687GB
d370c834963d: Pushed
16f6988ec7e8: Pushed
c249277a0e30: Layer already exists
e0b2f4d03f7b: Layer already exists
4cbe584e1645: Layer already exists
5ece9340957c: Layer already exists
093501b0a9e2: Layer already exists
b1169e57b139: Layer already exists
b3577d595e75: Layer already exists
3ee270f20d54: Layer already exists
4ef4adca5c3b: Layer already exists
```

Custom Built Container: Build, Run & Push Docker Image

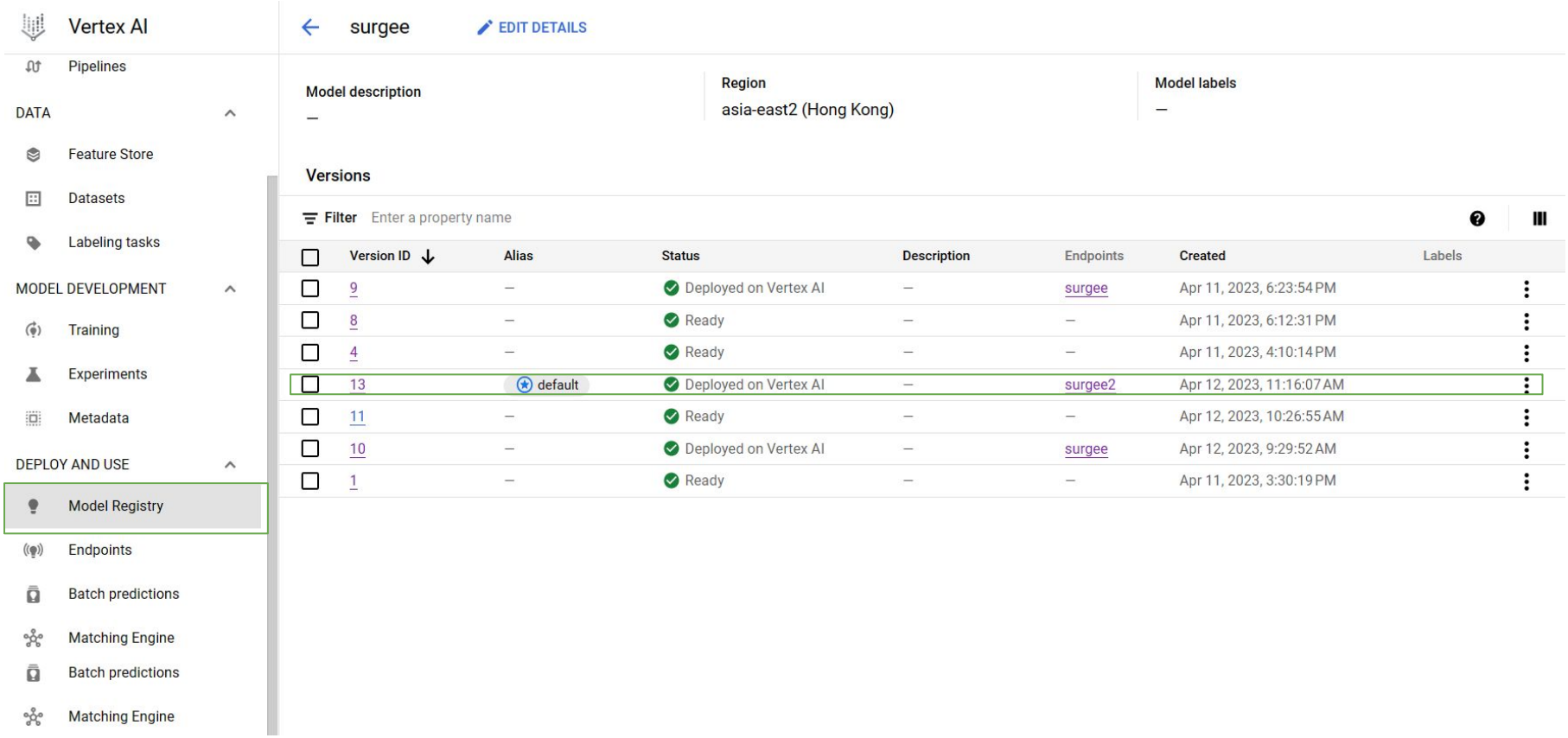


Model Training & Deployment

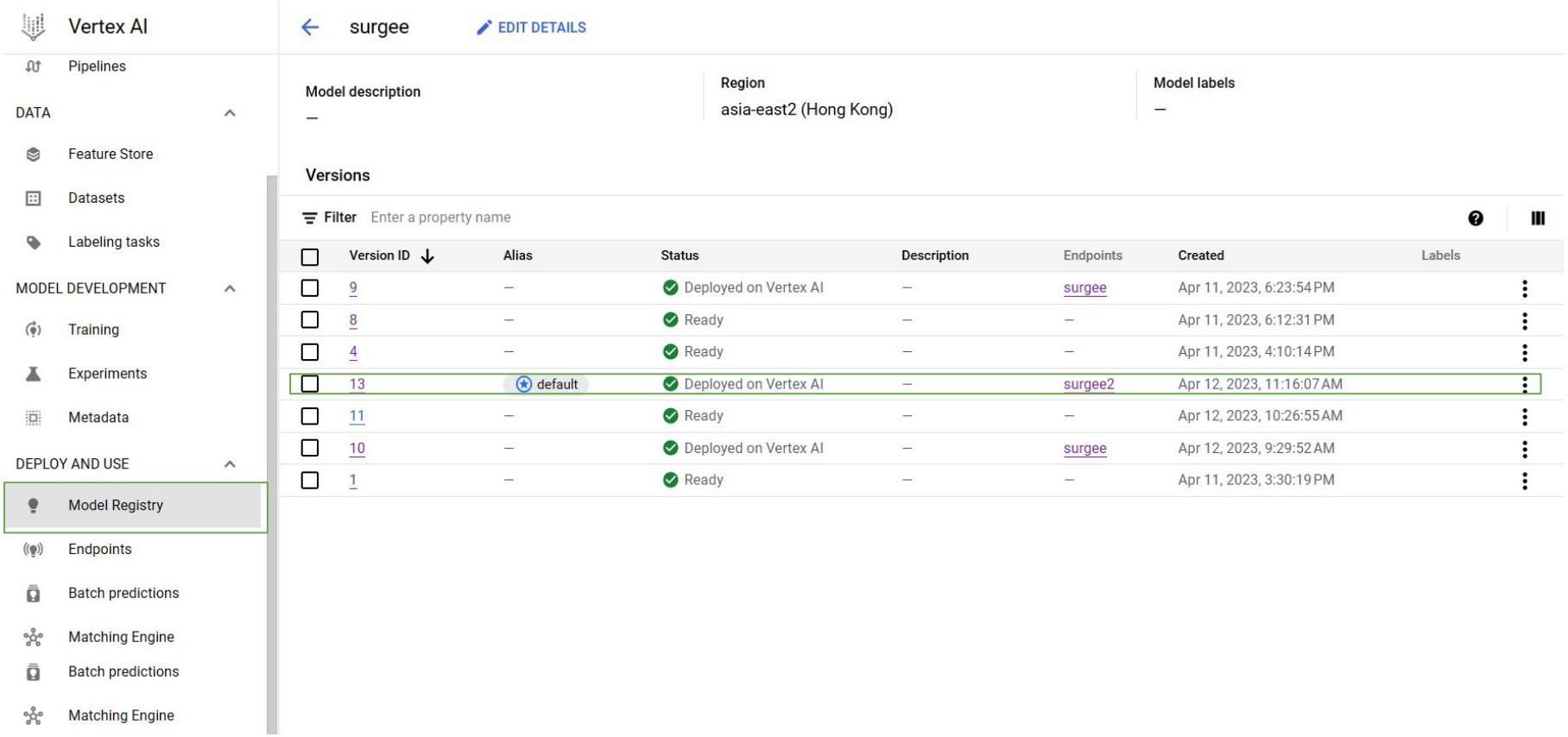
Model Training



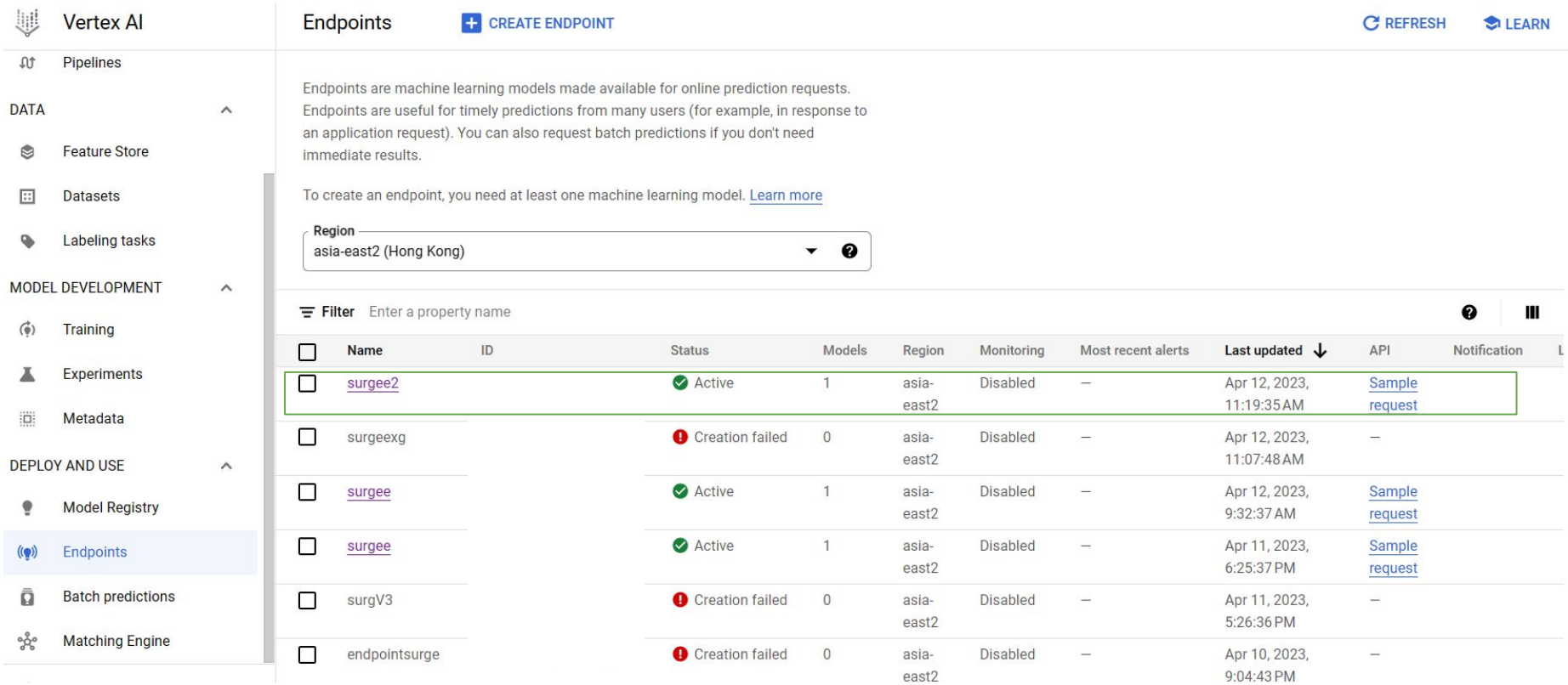
Model Registration & Version Control



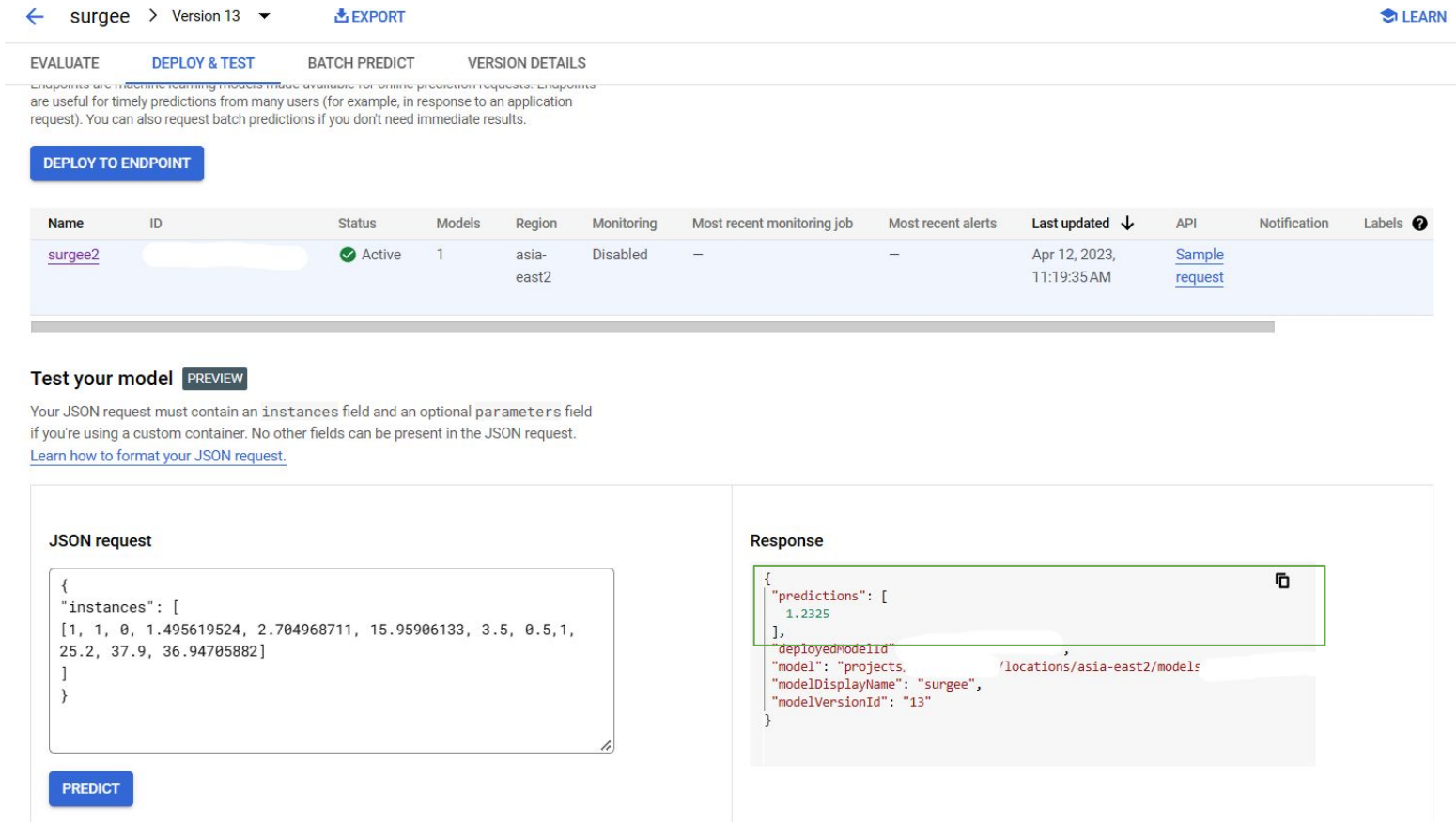
Deployment of Model in Endpoint



Deployment of Model in Endpoint



Testing Deployment



Invoking Model Endpoint

Testing Deployment

```
os.environ["GOOGLE_APPLICATION_CREDENTIALS"] = .json" # GCP key
```

```
def endpoint_predict_sample(
    project: str, location: str, instances: list, endpoint: str
):
    aiplatform.init(project=project, location=location)

    endpoint = aiplatform.Endpoint(endpoint)

    instances_list = [list(instance.values()) for instance in instances]
    prediction = endpoint.predict(instances=instances_list)
    print(prediction)
    return prediction
```

```
project = "
endpoint = "
location = "asia-east2"

instances = [
    {
        "Day": 1,
        "Month": 1,
        "Hour": 0,
        "passenger_count": 1,
        "trip_distance": 1.495619524,
        "total_amount": 2.704968711,
        "temp": 15.95906133,
        "feelslike": 3.5,
        "snow": 0.5,
        "windspeed": 25.2,
        "cloudcover": 37.9,
        "duration": 36.94705882
    }
    # Add more instances here if needed
]

endpoint_predict_sample(project, location, instances, endpoint)
```

```
PermissionDenied: 403 This API method requires billing to be enabled. Please enable billing on project #247345565503 by visiting
https://console.developers.google.com/billing/enable?project=247345565503 then retry. If you enabled billing for this project recently, wait a few minutes for the action
to propagate to our systems and retry. [links {
  description: "Google developers console billing"
  url: "https://console.developers.google.com/billing/enable?project=247345565503"
}
, reason: "BILLING_DISABLED"
domain: "googleapis.com"
metadata {
  key: "consumer"
  value: "projects                '
}
metadata {
  key: "service"
  value: "aiplatform.googleapis.com"
}
]
```

Important Note:
Due to some billing limitations, I was not able to invoke my endpoint in the frontend. However, if I would have upgraded my account, since the testing works, we would have gotten the results of the prediction

Thank you for your Attention

Feel free to ask any questions or give your feedback

By: Azza Kamoun