

## Screenshots for Assignment 7 : VERTEX AI

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### a) Intro to Vertex Pipelines

```
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ gcloud config set project deft-epoch-330820
Updated property [core/project].
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ gcloud services enable compute.googleapis.com containerregistry.googleapis.com aiplatform.googleapis.com cloudbuild.googleapis.c
on cloudfunctions.googleapis.com
Operation "operations/acf_p2-530904526604-49575aaf-c74a-4fce-92aa-d18c0b7e59af" finished successfully.
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ BUCKET_NAME=gs://$GOOGLE_CLOUD_PROJECT-bucket
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ gsutil mb -l us-central1 $BUCKET_NAME
Creating gs://deft-epoch-330820-bucket...
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ gcloud projects describe $GOOGLE_CLOUD_PROJECT > project-info.txt
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ PROJECT_NUM=$(cat project-info.txt | sed -nre 's::.*projectNumber: (.*)::p')
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ SVC_ACCOUNT="${PROJECT_NUM}/compute@developer.gserviceaccount.com"
```

```
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ SVC_ACCOUNT="compute@developer.gserviceaccount.com"
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ gcloud projects add-iam-policy-binding $GOOGLE_CLOUD_PROJECT --member serviceAccount:$SVC_ACCOUNT --role roles/storage.objectAdmin
in
Updated IAM policy for project [deft-epoch-330820].
bindings:
- members:
  - serviceAccount:deepmodel-training@deft-epoch-330820.iam.gserviceaccount.com
    role: roles/aiplatform.admin
- members:
  - serviceAccount:service-530904526604@gcp-sa-aiplatform-cc.iam.gserviceaccount.com
    role: roles/aiplatform.customCodeServiceAgent
- members:
  - serviceAccount:service-530904526604@gcp-sa-aiplatform.iam.gserviceaccount.com
    role: roles/aiplatform.serviceAgent
- members:
  - serviceAccount:service-530904526604@cloudbuild.gserviceaccount.com
    role: roles/cloudbuild.builds.builder
- members:
  - serviceAccount:service-530904526604@gcp-sa-cloudbuild.iam.gserviceaccount.com
    role: roles/cloudbuild.serviceAgent
- members:
  - serviceAccount:service-530904526604@gcf-admin-robot.iam.gserviceaccount.com
    role: roles/cloudfunctions.serviceAgent
- members:
  - serviceAccount:service-530904526604@compute-system.iam.gserviceaccount.com
    role: roles/compute.serviceAgent
- members:
  - serviceAccount:service-530904526604@containerregistry.iam.gserviceaccount.com
    role: roles/containerregistry.serviceAgent
- members:
  - serviceAccount:compute@developer.gserviceaccount.com
  - serviceAccount:530904526604@cloudservices.gserviceaccount.com
  - serviceAccount:deft-epoch-330820@appspot.gserviceaccount.com
    role: roles/editor
```

Datasets [CREATE](#) [REFRESH](#)

Managed datasets contain data used to train a machine learning model. [Learn more](#)

Region: us-central1 (Iowa) [?](#) [☰](#)

Filter: Enter a property name [?](#) [☰](#)

<input type="checkbox"/>	Name	ID	Status	Region	Type	Items	Last updated <a href="#">▼</a>	Labels <a href="#">?</a>
<input type="checkbox"/>	fraud_detection	6588687090005835776	<span>✓ Ready</span>	us-central1	<span>Tabular</span>	—	November 24, 2021	<a href="#">⋮</a>
<input type="checkbox"/>	automl-beans1637784971	6287157021204545536	<span>✓ Ready</span>	us-central1	<span>Tabular</span>	—	November 24, 2021	<a href="#">⋮</a>

**My First Project** ▾ **Search products and resources**

**hello-world-pi...** **CLOSE** **STOP** **DELETE**

**Runtime Graph** **0/3 steps completed** **Expand Artifacts** **100%** **Logs** **Logs** **Logs**

```

graph TD
    emoji[emoji python:3.7] --> buildSentence[build-sentence python:3.7]
    buildSentence --> artifact[ ]
  
```

**Pipeline run analysis**

**SUMMARY** **NODE INFO**

### Basic info

Duration	24 sec
Started	Nov 24, 2021, 12:14:03 PM
Completed	
Run name	hello-world-pipeline-20211124201345
Pipeline name	hello-world
Runtime environment	Serverless
Region	us-central1
Service account	530904526604-compute@developer.gserviceaccount.com

**Debugging info** [View pipeline proto](#)

### Run Parameters

Pipeline parameter values used for this run

Parameter	Type	Value
emoji_str	string	sparkles
text	string	Vertex Pipelines

**Google Cloud Platform** **My First Project** **Search products and resources**

**automl-tab-be...** **CLOSE** **STOP** **DELETE**

**Runtime Graph** **0/6 steps completed** **Expand Artifacts** **80%** **Logs** **Logs** **Logs**

```

graph TD
    tabulardataset[tabulardataset-create gcr.io/...line-components:0.2.0] --> automlJob[automatabulartrainingjob... gcr.io/...line-components:0.2.0]
    automlJob --> eval[classification-model-eval... gcr.io/.../h2-cpu:2.3:latest]
    eval --> condition[condition-deploy-decisio...]
    eval --> ml1[ML Component]
    eval --> ml2[ML Component]
  
```

**Pipeline run analysis**

**SUMMARY** **NODE INFO**

### Basic info

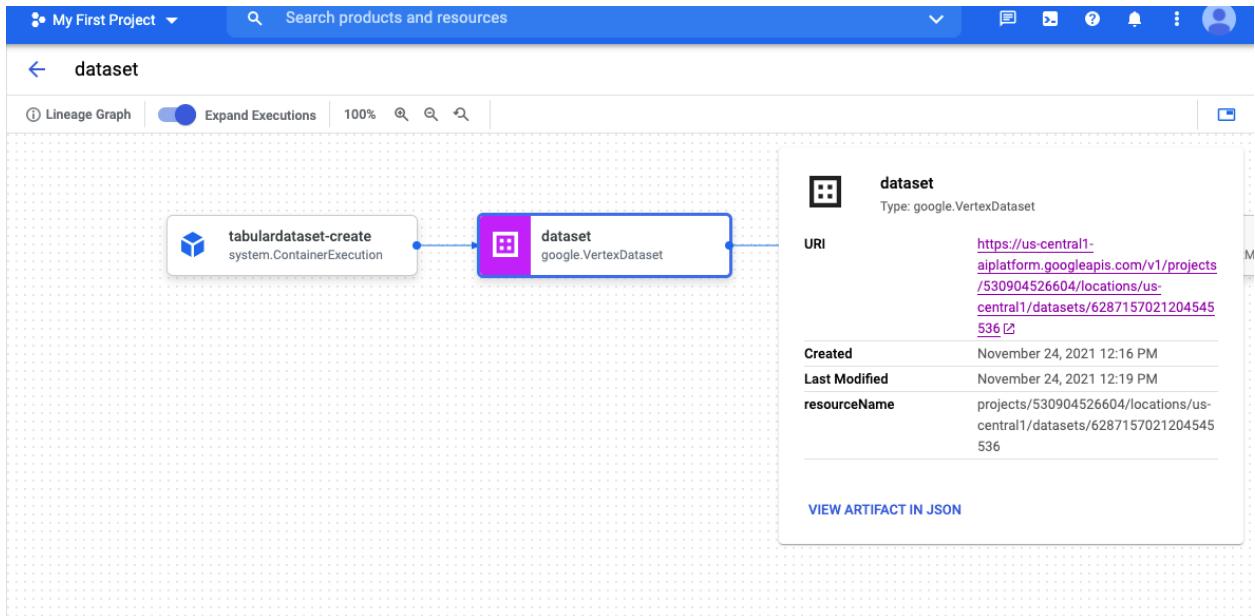
Duration	25 sec
Started	Nov 24, 2021, 12:16:42 PM
Completed	
Run name	automl-tab-beans-training-v2-20211124201635
Pipeline name	automl-tab-beans-training-v2
Runtime environment	Serverless
Region	us-central1
Service account	530904526604-compute@developer.gserviceaccount.com

**Debugging info** [View pipeline proto](#)

### Run Parameters

Pipeline parameter values used for this run

Parameter	Type	Value
display_name	string	automl-beans1637784971
bq_source	string	bq://aju-dev-demos.beans1
project	string	deft-epoch-330820
gcp_region	string	us-central1
thresholds_dict_str	string	{"auRoc": 0.95}
api_endpoint	string	us-central1-aiplatform.googleapis.com



```
] : pipeline_df = aiplatform.get_pipeline_df(pipeline="automl-tab-beans-training-v2")
small_pipeline_df = pipeline_df.head(2)
small_pipeline_df
```

	pipeline_name	run_name	param.input:thresholds_dict_str	param.input:bq_source	param.input:display_name	param.input:project	param.ir
0	automl-tab-beans-training-v2	automl-tab-beans-training-v2	{"auRoc": 0.95}	bq://aju-dev-demos.beans1	automl-beans1637784971	deft-epoch-330820	aiplatfo
		20211124201635					

## b ) Building a fraud detection model with AutoML

The screenshot shows the AutoML dataset analysis interface. At the top, there's a navigation bar with a back arrow and the word 'fraud\_detection'. The main area has tabs for 'SOURCE' and 'ANALYZE', with 'ANALYZE' being active.

**Dataset Info**

- Created: Nov 24, 2021 12:30 PM
- Dataset format: BigQuery
- Dataset location(s): [bq://bigquery-public-data.fraud\\_detection](bq://bigquery-public-data.fraud_detection)

**Summary**

- Total columns: 31
- Total rows: -

**Training jobs and models**

Use this dataset and annotation set to train a new machine learning model with AutoML or custom code.

**TRAIN NEW MODEL** button

**Statistics**

FLOAT: 30 (96.77%)  
INTEGER: 1 (3.23%)

**GENERATE STATISTICS** button

**Filter** input field: Enter property name or value

Column name ↑	BigQuery type	BigQuery mode	Missing % (count) ?	Distinct values ?
Amount	FLOAT	NULLABLE	-	-
Class	INTEGER	NULLABLE	-	-
Time	FLOAT	NULLABLE	-	-
V1	FLOAT	NULLABLE	-	-
V10	FLOAT	NULLABLE	-	-

Datasets [+ CREATE](#) [REFRESH](#)

Managed datasets contain data used to train a machine learning model. [Learn more](#)

Region: us-central1 (Iowa) [?](#)

Filter: Enter a property name [?](#) [☰](#)

<input type="checkbox"/>	Name	ID	Status	Region	Type	Items	Last updated	Labels <a href="#">?</a>
<input type="checkbox"/>	fraud_detection	6588687090005835776	<span>Ready</span>	us-central1	Tabular	—	November 24, 2021	<a href="#">⋮</a>
<input type="checkbox"/>	automl-beans1637784971	6287157021204545536	<span>Ready</span>	us-central1	Tabular	—	November 24, 2021	<a href="#">⋮</a>

[☰](#)

## Training jobs and models

 **fraud\_detection\_20211124203236**  
Training model...

[TRAIN NEW MODEL](#)

Training Pipelines

Name	ID	Status	Job type	Model type	Created	Elapsed time
fraud_detection_20211124203236	8214352415067996160	Training	Training pipeline	Tabular classification	Nov 24, 2021, 12:36:20 PM	3 min 15 sec
automl-beans1637784971	729792046843297792	Canceling	Training pipeline	Tabular classification	Nov 24, 2021, 12:22:57 PM	15 min 43 sec

### c) Vertex AI: Training and serving a custom model

```

deepmodel_training@tensorflow-2-3-20211124-122822:~$ mkdir mpg
deepmodel_training@tensorflow-2-3-20211124-122822:~$ cd mpg
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ touch Dockerfile
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ view Dockerfile
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ gcloud config list --format 'value(core.project)'
deft-epoch-330820
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ PROJECT_ID='deft-epoch-330820'
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ BUCKET_NAME="gs://${PROJECT_ID}-bucket"
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ gsutil mb -l us-central1 ${BUCKET_NAME}
Creating gs://deft-epoch-330820-bucket...
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ mkdir trainer
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ touch trainer/train.py
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ ls -lrt
total 8
-rw-r--r-- 1 deepmodel_training deepmodel_training 244 Nov 24 21:47 Dockerfile
drwxr-xr-x 2 deepmodel_training deepmodel_training 4096 Nov 24 21:48 trainer
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ cd trainer/
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg/trainer$ view train.py
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg/trainer$ echo ${BUCKET_NAME}
gs://deft-epoch-330820-bucket
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg/trainer$ view train.py
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg/trainer$ view train.py
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg/trainer$ IMAGE_URI="grc.io/${PROJECT_ID}/mpg:v1"
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg/trainer$ docker build ./ -t $IMAGE_URI
unable to prepare context: unable to evaluate symlinks in Dockerfile path: lstat /home/deepmodel_training/mpg/trainer/Dockerfile: no such file or directory
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg/trainer$ cd ..
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ ls -lrt
total 8
-rw-r--r-- 1 deepmodel_training deepmodel_training 244 Nov 24 21:47 Dockerfile
drwxr-xr-x 2 deepmodel_training deepmodel_training 4096 Nov 24 21:50 trainer
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ docker build ./ -t $IMAGE_URI

```

```
deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ docker build ./ -t $IMAGE_URI
Sending build context to Docker daemon 8.704kB
Step 1/5 : FROM gcr.io/deeplearning-platform-release/tf2-cpu.2-3
latest: Pulling from deeplearning-platform-release/tf2-cpu.2-3
7b1a6ab2e44d: Pull complete
6d576096c0bf: Pull complete
5a39c8988a9a: Pull complete
3bf0fd278fc1: Pull complete
4f4fb700ef54: Pull complete
a7b7cd42e273: Pull complete
5ed778ec318f: Pull complete
f99f0c7e1e5e: Pull complete
f330924abe9c: Pull complete
c0c380d7a40d: Pull complete
ea41e0ef378e: Pull complete
43854f3d04da: Pull complete
536331575f08: Pull complete
2c85fd51a83d: Pull complete
4d20bd165f23: Pull complete
1e0b4f132f82: Pull complete
f15ad2a24bla: Pull complete
3774007c1526: Pull complete
94bbf24e27a0: Pull complete
f5423bf6d752: Pull complete
Digest: sha256:d4ed0cd71aa0f635f9df9138f39fdf19fdd4dacdf1322b33a6582ac13f4aa9e6
Status: Downloaded newer image for gcr.io/deeplearning-platform-release/tf2-cpu.2-3:latest
--> 452a88fe95cc
Step 2/5 : WORKDIR /root
--> Running in 044c7dd85c13
Removing intermediate container 044c7dd85c13
--> 441f3b268d5a
Step 3/5 : WORKDIR /
--> Running in 591a1dd57478
Removing intermediate container 591a1dd57478
--> 34be254c281e
Step 4/5 : COPY trainer /trainer
--> bf0ef25e1ed5
Step 5/5 : ENTRYPOINT ["python", "-m", "trainer.train"]
--> Running in 8b6f7130746c
Removing intermediate container 8b6f7130746c
--> f56af88cf42
Successfully built f56af88cf42
Successfully tagged gcr.io/deft-epoch-330820/mpg:v1
```

```

0/8 [=====] - 0s 8ms/step - loss: 7.4553 - mae: 7.4553 - val_loss: 8.0851 - val_mae: 2.2780 - val_mse: 8.0851
Epoch 45/1000
8/8 [=====] - 0s 8ms/step - loss: 7.2635 - mae: 1.9211 - mse: 7.2635 - val_loss: 8.6270 - val_mae: 2.2257 - val_mse: 8.6270
Epoch 46/1000
8/8 [=====] - 0s 10ms/step - loss: 7.2699 - mae: 1.9168 - mse: 7.2699 - val_loss: 8.6871 - val_mae: 2.2349 - val_mse: 8.6871
Epoch 47/1000
8/8 [=====] - 0s 10ms/step - loss: 7.0323 - mae: 1.8982 - mse: 7.0323 - val_loss: 8.7908 - val_mae: 2.2880 - val_mse: 8.7908
Epoch 48/1000
8/8 [=====] - 0s 9ms/step - loss: 7.2702 - mae: 1.9264 - mse: 7.2702 - val_loss: 8.7143 - val_mae: 2.2703 - val_mse: 8.7143
Epoch 49/1000
8/8 [=====] - 0s 9ms/step - loss: 6.9780 - mae: 1.8823 - mse: 6.9780 - val_loss: 8.5080 - val_mae: 2.2730 - val_mse: 8.5080
Epoch 50/1000
8/8 [=====] - 0s 9ms/step - loss: 6.9307 - mae: 1.8765 - mse: 6.9307 - val_loss: 8.6132 - val_mae: 2.1977 - val_mse: 8.6132
Epoch 51/1000
8/8 [=====] - 0s 10ms/step - loss: 7.0746 - mae: 1.8855 - mse: 7.0746 - val_loss: 8.4805 - val_mae: 2.2228 - val_mse: 8.4805
Epoch 52/1000
8/8 [=====] - 0s 10ms/step - loss: 7.0373 - mae: 1.8792 - mse: 7.0373 - val_loss: 8.5634 - val_mae: 2.1901 - val_mse: 8.5634
Epoch 53/1000
8/8 [=====] - 0s 8ms/step - loss: 6.8444 - mae: 1.8459 - mse: 6.8444 - val_loss: 8.8236 - val_mae: 2.1918 - val_mse: 8.8236
Epoch 54/1000
8/8 [=====] - 0s 8ms/step - loss: 6.9272 - mae: 1.8725 - mse: 6.9272 - val_loss: 8.5710 - val_mae: 2.1774 - val_mse: 8.5710
Epoch 55/1000
8/8 [=====] - 0s 9ms/step - loss: 7.0761 - mae: 1.9197 - mse: 7.0761 - val_loss: 8.6296 - val_mae: 2.2565 - val_mse: 8.6296
Epoch 56/1000
8/8 [=====] - 0s 10ms/step - loss: 6.8069 - mae: 1.8404 - mse: 6.8069 - val_loss: 8.3702 - val_mae: 2.1969 - val_mse: 8.3702
Epoch 57/1000
8/8 [=====] - 0s 8ms/step - loss: 7.1312 - mae: 1.8903 - mse: 7.1312 - val_loss: 8.6685 - val_mae: 2.2911 - val_mse: 8.6685
Epoch 58/1000
8/8 [=====] - 0s 8ms/step - loss: 6.7585 - mae: 1.8469 - mse: 6.7585 - val_loss: 8.5020 - val_mae: 2.2251 - val_mse: 8.5020
Epoch 59/1000
8/8 [=====] - 0s 9ms/step - loss: 6.8096 - mae: 1.8633 - mse: 6.8096 - val_loss: 8.5269 - val_mae: 2.2201 - val_mse: 8.5269
Epoch 60/1000
8/8 [=====] - 0s 10ms/step - loss: 6.8193 - mae: 1.8623 - mse: 6.8193 - val_loss: 8.5045 - val_mae: 2.2288 - val_mse: 8.5045
Epoch 61/1000
8/8 [=====] - 0s 9ms/step - loss: 6.6153 - mae: 1.8130 - mse: 6.6153 - val_loss: 8.6994 - val_mae: 2.1908 - val_mse: 8.6994
Epoch 62/1000
8/8 [=====] - 0s 9ms/step - loss: 6.7078 - mae: 1.8390 - mse: 6.7078 - val_loss: 8.4316 - val_mae: 2.1959 - val_mse: 8.4316
Epoch 63/1000
8/8 [=====] - 0s 9ms/step - loss: 7.1229 - mae: 1.8809 - mse: 7.1229 - val_loss: 8.4813 - val_mae: 2.2071 - val_mse: 8.4813
Epoch 64/1000
8/8 [=====] - 0s 9ms/step - loss: 6.7089 - mae: 1.8202 - mse: 6.7089 - val_loss: 8.4912 - val_mae: 2.2198 - val_mse: 8.4912
Epoch 65/1000
8/8 [=====] - 0s 8ms/step - loss: 6.6144 - mae: 1.8273 - mse: 6.6144 - val_loss: 8.5736 - val_mae: 2.2236 - val_mse: 8.5736
Epoch 66/1000
8/8 [=====] - 0s 8ms/step - loss: 6.7712 - mae: 1.8611 - mse: 6.7712 - val_loss: 8.5251 - val_mae: 2.2297 - val_mse: 8.5251

```

My First Project ▾

vertex

**Training** + CREATE

REFRESH

TRAINING PIPELINES CUSTOM JOBS HYPERPARAMETER TUNING JOBS

Training pipelines are the primary model training workflow in Vertex AI. You can use training pipelines to create an AutoML-trained model or a custom-trained model. For custom-trained models, training pipelines orchestrate custom training jobs and hyperparameter tuning with additional steps like adding a dataset or uploading the model to Vertex AI for prediction serving. [Learn More](#)

Region: us-central1 (Iowa)

Name	ID	Status	Job type	Model type	Created	Elapsed time
mpg	6974032930192490496	Training	Training pipeline	Custom	Nov 24, 2021, 2:34:28 PM	31 sec
finetuned-question-answering-system-pytorch-pkg-ar-20211119070946	4783700214546432000	Failed	Training pipeline	Custom	Nov 18, 2021, 11:11:41 PM	12 min 4 sec

```

deepmodel_training@tensorflow-2-3-20211124-122822:~/mpg$ docker push $IMAGE_URI
The push refers to repository [gcr.io/deft-epoch-330820/mpg]
85fe27b5fb5c: Pushed
ddea097a06d2: Mounted from deeplearning-platform-release/tf2-cpu.2-3
3e0cd64f96da: Mounted from deeplearning-platform-release/tf2-cpu.2-3
a95a340ba3f8: Mounted from deeplearning-platform-release/tf2-cpu.2-3
fa199d73d202: Mounted from deeplearning-platform-release/tf2-cpu.2-3
7c190d09b449: Mounted from deeplearning-platform-release/tf2-cpu.2-3
482e160a6176: Mounted from deeplearning-platform-release/tf2-cpu.2-3
a0d8fa8c5974: Mounted from deeplearning-platform-release/tf2-cpu.2-3
3321d566dabc: Mounted from deeplearning-platform-release/tf2-cpu.2-3
7e7decd8b03b: Mounted from deeplearning-platform-release/tf2-cpu.2-3
5f68ac777a0a: Mounted from deeplearning-platform-release/tf2-cpu.2-3
94842575d7e1: Mounted from deeplearning-platform-release/tf2-cpu.2-3
acl1a4c7961f: Mounted from deeplearning-platform-release/tf2-cpu.2-3
65428201d795: Mounted from deeplearning-platform-release/tf2-cpu.2-3
3c8d72cb354a: Mounted from deeplearning-platform-release/tf2-cpu.2-3
944472f0b3bc: Mounted from deeplearning-platform-release/tf2-cpu.2-3
5f70bf18a086: Layer already exists
f41936d36931: Mounted from deeplearning-platform-release/tf2-cpu.2-3
89217499f23e: Mounted from deeplearning-platform-release/tf2-cpu.2-3
29f228689930: Mounted from deeplearning-platform-release/tf2-cpu.2-3
9f54eef41275: Layer already exists

```

#### d) Vertex AI Workbench: Train a TensorFlow model with data from BigQuery

The screenshot shows the Vertex AI Workbench interface. At the top, there are tabs for 'FEATURES & INFO', 'SHORTCUT', and 'DISABLE EDITOR TABS'. Below this is a search bar and a pinned project list for 'deft-epoch-330820'. The main area contains a code editor with a SQL query and a results table.

**Code Editor:**

```

1  end_station_name,
2  IF(start_station_name = end_station_name,
3      TRUE,
4      FALSE) same_station,
5  AVG(duration) AS avg_duration,
6  COUNT(*) AS total_rides
7  FROM
8      `bigquery-public-data.london_bicycles.cycle_hire`
9  GROUP BY
10     start_station_name,
11     end_station_name,
12     same_station
13 ORDER BY
14     total_rides DESC

```

**Results Table:**

Row	start_station_name	end_station_name	same_station	avg_duration	total_rides
1	Hyde Park Corner, Hyde Park	Hyde Park Corner, Hyde Park	true	3358.977834394902	58875
2	Black Lion Gate, Kensington Gardens	Black Lion Gate, Kensington Gardens	true	3240.6633838149246	32289
3	Albert Gate, Hyde Park	Albert Gate, Hyde Park	true	2870.757308467745	31744

The screenshot shows the Google Cloud Platform BigQuery interface. The top navigation bar includes 'Google Cloud Platform', 'My First Project', 'BigQuery', and various icons for search, refresh, and help. Below the navigation is a toolbar with 'FEATURES & INFO', 'SHORTCUT', 'DISABLE EDITOR TABS', and a 'COMPOSE NEW QUERY' button.

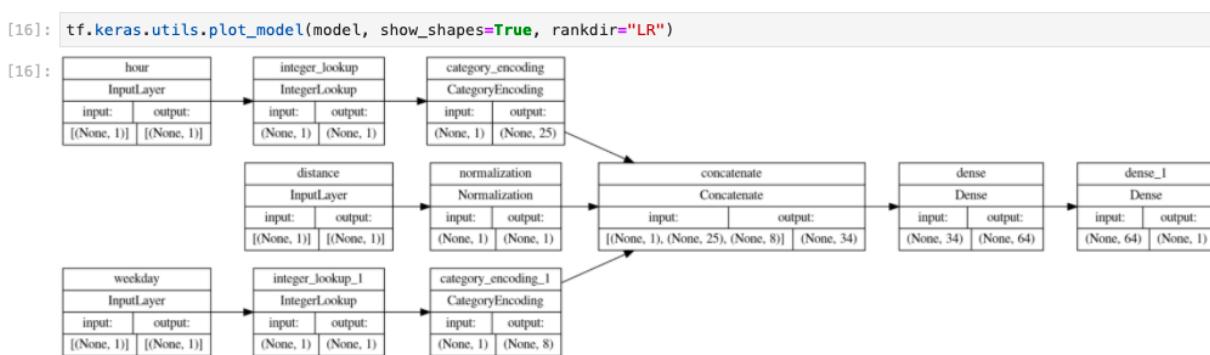
The main area is divided into sections: 'Explorer' on the left with a search bar and pinned projects list ('deft-epoch-330820'), and a central workspace for a query titled '\*UNSAVE...'. The workspace includes a toolbar with 'RUN', 'SAVE', 'SCHEDULE', and 'MORE' options, and a note indicating the query will process 1.3 GiB when run.

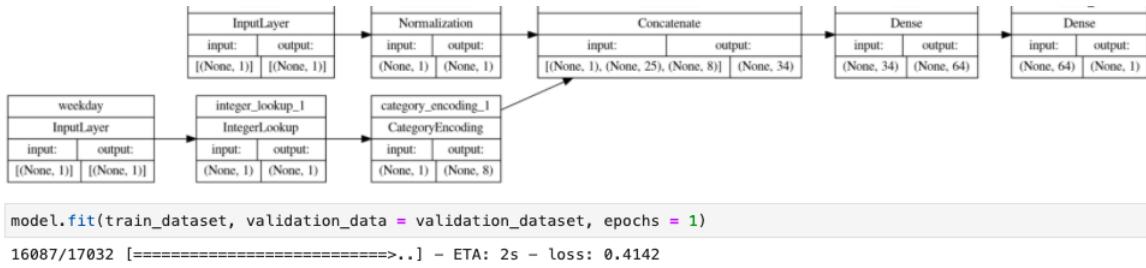
The query code is as follows:

```
21     |     ST_GEOPOINT(end_stn.longitude, end_stn.latitude)
22     |     ) AS distance, --meters
23     |     start_date,
24     |     end_date
25     |     ) AS bike
26     FROM `bigquery-public-data.london_bicycles.cycle_stations` AS start_stn
27     LEFT JOIN `bigquery-public-data.london_bicycles.cycle_hire` AS b
28     ON start_stn.id = b.start_station_id
29     LEFT JOIN `bigquery-public-data.london_bicycles.cycle_stations` AS end_stn
30     ON end_stn.id = b.end_station_id
31     LIMIT 700000
32
```

The processing location is set to EU. Below the query editor is a 'Query results' section with tabs for 'SAVE RESULTS' and 'EXPLORE DATA'. The results table shows the following data:

Row	starting.name	starting.POINT	starting.docks_count	starting.install_date	ending.name	ending.POINT
1	Macclesfield Rd, St Lukes	POINT(-0.097122 51.529423)	28	2010-10-11	Waterloo Station 2, Waterloo	POINT(-0.11342629 51.529423)
2	Macclesfield Rd, St Lukes	POINT(-0.097122 51.529423)	28	2010-10-11	Worship Street, Shoreditch	POINT(-0.079608554 51.529423)
3	Macclesfield Rd, St Lukes	POINT(-0.097122 51.529423)	28	2010-10-11	Royal College Street, Camden Town	POINT(-0.133952 51.529423)





### e) Custom training job and prediction using managed datasets

[← titanic](#)

SOURCE [ANALYZE](#)

**Dataset Info**

Created: Nov 24, 2021 3:09 PM  
Dataset format: BigQuery  
Dataset location(s): [bq://deft-epoch-33\\_titanic.survivors](bq://deft-epoch-33_titanic.survivors)

**Summary**

Total columns: 14  
Total rows: -

INTEGER 4 (28.57%)  
STRING 10 (71.43%)

[GENERATE STATISTICS](#)

**Filter** Enter property name or value

Column name	BigQuery type	BigQuery mode	Missing % (count)	Distinct values
age	STRING	NULLABLE	-	-
boat	STRING	NULLABLE	-	-
body	STRING	NULLABLE	-	-
cabin	STRING	NULLABLE	-	-
embarked	STRING	NULLABLE	-	-
fare	STRING	NULLABLE	-	-

**Training jobs and models**

Use this dataset and annotation set to train a new machine learning model with AutoML or custom code

[TRAIN NEW MODEL](#)

Google Cloud Platform vertex

Datasets [CREATE](#) [REFRESH](#)

Managed datasets contain data used to train a machine learning model. [Learn more](#)

Region us-central1 (Iowa)

**Filter** Enter a property name

<input type="checkbox"/>	Name	ID	Status	Region	Type	Items	Last updated	Labels
<input type="checkbox"/>	titanic	3368613356435931136	Ready	us-central1	Tabular	-	November 24, 2021	
<input type="checkbox"/>	fraud_detection	6588687090005835776	Ready	us-central1	Tabular	-	November 24, 2021	

Column name ↑	BigQuery type	BigQuery mode	Missing % (count) ⓘ	Distinct values ⓘ
age	STRING	NULLABLE	-	-
boat	STRING	NULLABLE	-	-
body	STRING	NULLABLE	-	-
cabin	STRING	NULLABLE	-	-
embarked	STRING	NULLABLE	-	-
fare	STRING	NULLABLE	-	-
home_dest	STRING	NULLABLE	-	-
name	STRING	NULLABLE	-	-
parch	INTEGER	NULLABLE	-	-
pclass	INTEGER	NULLABLE	-	-
sex	STRING	NULLABLE	-	-
sibsp	INTEGER	NULLABLE	-	-
survived	INTEGER	NULLABLE	-	-
ticket	STRING	NULLABLE	-	-

## f) Vertex AI:Hyperparameter Tuning

```
(base) jupyter@tensorflow-2-3-20211124-122822:~$ mkdir horses_or_humans
(base) jupyter@tensorflow-2-3-20211124-122822:~$ cd horses_or_humans
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ touch Dockerfile
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ view Dockerfile
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ mkdir trainer
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ touch trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ ls -lrt
total 8
-rw-r--r-- 1 jupyter jupyter 293 Nov 25 05:11 Dockerfile
drwxr-xr-x 2 jupyter jupyter 4096 Nov 25 05:11 trainer
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ ls -lrt trainer/
total 0
-rw-r--r-- 1 jupyter jupyter 0 Nov 25 05:11 task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ ls -lrt trainer/task.py
-rw-r--r-- 1 jupyter jupyter 0 Nov 25 05:11 trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ view trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ view trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ gcloud config list --format 'value(core.project)'
deft-epoch-330820
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ PROJECT_ID='deft-epoch-330820'
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ IMAGE_URI="gcr.io/$PROJECT_ID/horse-human:hypertune"
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ echo $IMAGE_URI
gcr.io/deft-epoch-330820/horse-human:hypertune
```

```
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ docker build . -t $IMAGE_URI
Sending build context to Docker daemon 6.144kB
Step 1/5 : FROM gcr.io/deeplearning-platform-release/tf2-gpu.2-5
latest: Pulling from deeplearning-platform-release/tf2-gpu.2-5
25fa05cd42bd: Pull complete
2d6e353a95ec: Pull complete
14d7996407de: Pull complete
0c9c6fc70f16: Pull complete
c3c76be11512: Pull complete
ab6e5a9c78ee: Downloading [=====] 895.1MB/1.188GB
7bc1690abd59: Download complete
f5b4dd7682bc: Downloading [=====] 786.4MB/1.026GB
d6897660f71d: Download complete
174d792fb622: Downloading [=====] 768.9MB/1.095GB
5f8143275aca: Waiting
56646f115483: Waiting
798922b52524: Waiting
e2699a9ff592b: Waiting
f43e7d1c07e4: Waiting
1e71d5e9923d: Waiting
bf6ae2a2e250: Waiting
e49679b748d5: Waiting
80208bd6f7fb: Waiting
b83c16bef138: Waiting
9d1427033824: Waiting
c0028679f003: Waiting
09c222e7ff04: Waiting
ae6048a3aec1: Waiting
1ced537de50b: Waiting
762ff1eb7f16: Waiting
f6f8f4265c8c: Waiting
595b1c49222a: Waiting
b6c7eb38f366: Waiting
520be5017b4d: Waiting
■
```

```
(base) jupyter@tensorflow-2-3-20211124-122822:~/horses_or_humans$ docker push $IMAGE_URI
The push refers to repository [gcr.io/deft-epoch-330820/horse-human]
6b363eab30b3: Pushed
4245d9928aac: Pushed
5bb1aa5df10d: Mounted from deeplearning-platform-release/tf2-gpu.2-5
f028010939aa: Mounted from deeplearning-platform-release/tf2-gpu.2-5
dc99c4ea3a81: Mounted from deeplearning-platform-release/tf2-gpu.2-5
37b508c5711b: Mounted from deeplearning-platform-release/tf2-gpu.2-5
756ab564e194: Mounted from deeplearning-platform-release/tf2-gpu.2-5
2ae86808a3d1: Mounted from deeplearning-platform-release/tf2-gpu.2-5
1dcccbdf9b557: Mounted from deeplearning-platform-release/tf2-gpu.2-5
cfccbdcb2b748: Mounted from deeplearning-platform-release/tf2-gpu.2-5
937ab8f29c2e: Mounted from deeplearning-platform-release/tf2-gpu.2-5
5d417b2f7486: Mounted from deeplearning-platform-release/tf2-gpu.2-5
d6a297a3e6e4: Mounted from deeplearning-platform-release/tf2-gpu.2-5
6474a5e8117f: Mounted from deeplearning-platform-release/tf2-gpu.2-5
fe498124ed57: Mounted from deeplearning-platform-release/tf2-gpu.2-5
d5454704bb3d: Mounted from deeplearning-platform-release/tf2-gpu.2-5
fb896ef24b4b: Mounted from deeplearning-platform-release/tf2-gpu.2-5
5087113f67c8: Mounted from deeplearning-platform-release/tf2-gpu.2-5
2a92857a1d48: Mounted from deeplearning-platform-release/tf2-gpu.2-5
0ded97864c52: Mounted from deeplearning-platform-release/tf2-gpu.2-5
b50bbaac3e32: Mounted from deeplearning-platform-release/tf2-gpu.2-5
262e1aaf4c10: Mounted from deeplearning-platform-release/tf2-gpu.2-5
b420a468ca49: Mounted from deeplearning-platform-release/tf2-gpu.2-5
608c205798d1: Mounted from deeplearning-platform-release/tf2-gpu.2-5
0760cd6d4269: Mounted from deeplearning-platform-release/tf2-gpu.2-5
fb4755c89c2a: Mounted from deeplearning-platform-release/tf2-gpu.2-5
22cfb9034da6: Mounted from deeplearning-platform-release/tf2-gpu.2-5
8bec4fbfce85: Mounted from deeplearning-platform-release/tf2-gpu.2-5
3b129ca3db46: Mounted from deeplearning-platform-release/tf2-gpu.2-5
64cb1a1930ab: Mounted from deeplearning-platform-release/tf2-gpu.2-5
600ef5a43f1f: Mounted from deeplearning-platform-release/tf2-gpu.2-5
8f8f0266f834: Layer already exists
hypertune: digest: sha256:aad10677e937dc1bb3236b353b7967ba295a9404e57bcc00ff9104a58456553b size: 7045
```

**i** Training began at Nov 24, 2021, 9:27:02 PM and is still in progress.

Status	Running
Hyperparameter tuning job ID	6016595796911194112
Created	Nov 24, 2021, 9:26:59 PM
Start time	Nov 24, 2021, 9:27:02 PM
Elapsed time	7 sec
Region	us-central1
Encryption type	Google-managed key
Dataset	No managed dataset
Study specs	<a href="#">VIEW JSON</a>
Trial job specs	<a href="#">VIEW JSON</a>
Algorithm	Custom training
Objective	Custom
Metric to optimize	accuracy
Goal	Maximize

#### Hyperparameter tuning trials

Filter <input type="text"/> Enter property name or value <a href="#">?</a>						
<input type="checkbox"/>	Trial ID	accuracy ↑	Training step	learning_rate	momentum	num_neurons
<input type="checkbox"/>	1	-		1.000000000000002e-1	5e-1	128
<input type="checkbox"/>	2	-		2.674237759548992e-1	2.8503949159094216e-1	64
<input type="checkbox"/>	3	-		9.272655106176761e-2	5.145078811686615e-1	128

[CPU](#) [GPU](#) [NETWORK](#)

```
{
  "studySpec": {
    "metrics": [
      {
        "metricId": "accuracy",
        "goal": "MAXIMIZE"
      }
    ],
    "parameters": [
      {
        "parameterId": "learning_rate",
        "doubleValueSpec": {
          "minValue": 0.01,
          "maxValue": 1
        },
        "scaleType": "UNIT_LOG_SCALE"
      },
      {
        "parameterId": "momentum",
        "doubleValueSpec": {
          "maxValue": 1
        },
        "scaleType": "UNIT_LINEAR_SCALE"
      },
      {
        "parameterId": "num_neurons",
        "discreteValueSpec": {
          "values": [
            64,
            128,
            512
          ]
        }
      }
    ]
  }
}.
```

## g) Using Vertex ML Metadata with Pipelines

```
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ project = deft-epoch-330820
-bash: project: command not found
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ gcloud config set project deft-epoch-330820
Updated property [core/project].
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ echo $GOOGLE_CLOUD_PROJECT
deft-epoch-330820
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ gcloud services enable compute.googleapis.com \
>           containerregistry.googleapis.com \
>           aiplatform.googleapis.com
Operation "operations/acf.p2-530904526604-94258f80-e303-486a-aa7b-789cbdd4d61d" finished successfully.
deepmodel_training@cloudshell:~ (deft-epoch-330820)$
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ BUCKET_NAME=gs://$GOOGLE_CLOUD_PROJECT-bucket
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ gsutil mb -l us-central1 $BUCKET_NAME
Creating gs://deft-epoch-330820-bucket...
ServiceException: 409 A Cloud Storage bucket named 'deft-epoch-330820-bucket' already exists. Try another name. Bucket names must be globally unique across all Google Cloud projects
, including those outside of your organization.
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ gcloud projects describe $GOOGLE_CLOUD_PROJECT > project-info.txt
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ PROJECT_NUM=$(cat project-info.txt | sed -nre 's:^(projectNumber: (.*)\:l:p')'
deepmodel_training@cloudshell:~ (deft-epoch-330820)$ SVC_ACCOUNT=$(PROJECT_NUM//`/`-compute@developer.gserviceaccount.com"
```

```

deepmodel_training@cloudshell:~ [deft-epoch-330820]$ gcloud projects add-iam-policy-binding $GOOGLE_CLOUD_PROJECT --member serviceAccount:$SVC_ACCOUNT --role roles/storage.objectAdmin
in
Updated IAM policy for project [deft-epoch-330820].
bindings:
- members:
  - serviceAccount:deepmodel-training@deft-epoch-330820.iam.gserviceaccount.com
    role: roles/aiplatform.admin
- members:
  - serviceAccount:service-530904526604@gcp-sa-aiplatform-cc.iam.gserviceaccount.com
    role: roles/aiplatform.customCodeServiceAgent
- members:
  - serviceAccount:service-530904526604@gcp-sa-aiplatform.iam.gserviceaccount.com
    role: roles/aiplatform.serviceAgent
- members:
  - serviceAccount:service-530904526604@cloudbuild.iam.gserviceaccount.com
    role: roles/cloudbuild.builds.builder
- members:
  - serviceAccount:service-530904526604@gcp-sa-cloudbuild.iam.gserviceaccount.com
    role: roles/cloudbuild.serviceAgent
- members:
  - serviceAccount:service-530904526604@gcf-admin-robot.iam.gserviceaccount.com
    role: roles/cloudfunctions.serviceAgent
- members:
  - serviceAccount:service-530904526604@compute-system.iam.gserviceaccount.com
    role: roles/compute.serviceAgent
- members:
  - serviceAccount:service-530904526604@containerregistry.iam.gserviceaccount.com
    role: roles/containerregistry.ServiceAgent
- members:
  - serviceAccount:530904526604@compute-developer.iam.gserviceaccount.com
  - serviceAccount:530904526604@cloudservices.iam.gserviceaccount.com
  - serviceAccount:deft-epoch-330820.appspot.iam.gserviceaccount.com
    role: roles/editor
- members:
  - serviceAccount:service-530904526604@gcp-sa-notebooks.iam.gserviceaccount.com
    role: roles/notebooks.serviceAgent
- members:
  - user:deepmodel.training@gmail.com
    role: roles/owner
- members:
  - serviceAccount:service-530904526604@gcp-sa-pubsub.iam.gserviceaccount.com
    role: roles/pubsub.serviceAgent
- members:
  - serviceAccount:530904526604@compute-developer.iam.gserviceaccount.com
  - serviceAccount:deepmodel-training@deft-epoch-330820.iam.gserviceaccount.com
    role: roles/storage.objectAdmin
etag: BwXRLnNqg9U=

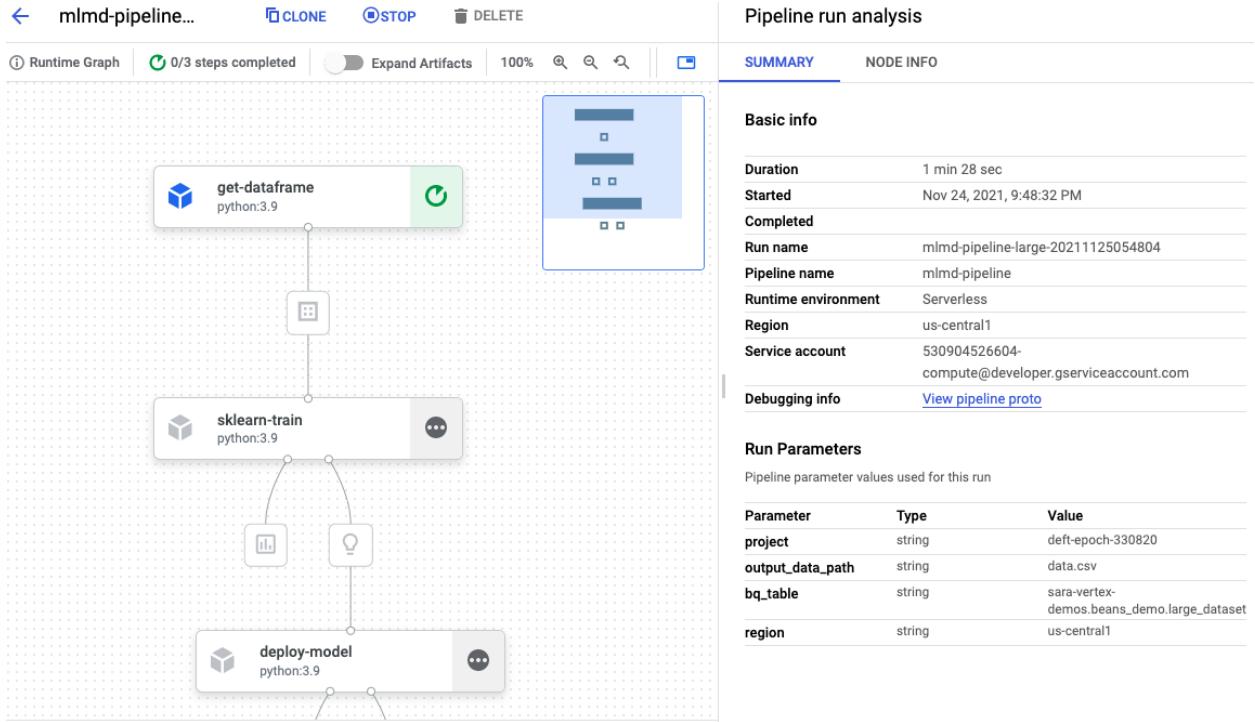
```

[← mlmd-pipeline...](#) [CLONE](#) [STOP](#) [DELETE](#)

[Runtime Graph](#) [0/3 steps completed](#) [Expand Artifacts](#) [100%](#) [🔍](#) [🔍](#) [☰](#)

The screenshot shows a pipeline named "mlmd-pipeline..." with three steps: "get-dataframe", "sklearn-train", and "deploy-model". The "get-dataframe" step is currently running, indicated by a green progress bar. The "sklearn-train" step has completed, indicated by a blue progress bar. The "deploy-model" step is pending, indicated by a grey progress bar. The "Pipeline run analysis" section on the right provides detailed information about the run, including basic info, run parameters, and debugging info.

SUMMARY	NODE INFO	
<b>Basic info</b>		
Duration	1 min 8 sec	
Started	Nov 24, 2021, 9:48:25 PM	
Completed		
Run name	mlmd-pipeline-small-20211125054804	
Pipeline name	mlmd-pipeline	
Runtime environment	Serverless	
Region	us-central1	
Service account	530904526604-compute@developer.gserviceaccount.com	
Debugging info	<a href="#">View pipeline proto</a>	
<b>Run Parameters</b>		
Pipeline parameter values used for this run		
Parameter	Type	Value
bq_table	string	sara-vertex-demos.beans_demo.small_dataset
project	string	deft-epoch-330820
region	string	us-central1
output_data_path	string	data.csv



[Pipelines](#) [CREATE RUN](#) [REFRESH](#) [CLONE](#) [COMPARE](#) [STOP](#) [DELETE](#)

Pipelines help you to automate, monitor, and govern your machine learning systems by orchestrating your workflow in a serverless manner. [Learn more](#)

Region — us-central1 (Iowa) [?](#)

[Filter](#) Filter runs [?](#) [☰](#)

Run	Status	Pipeline	Duration	Created	Ended
<a href="#">mlmd-pipeline-large-20211125054804</a>	<span style="color: green;">Running</span>	mlmd-pipeline	2 min 39 sec	Nov 24, 2021, 9:48:31 PM	
<a href="#">mlmd-pipeline-small-20211125054804</a>	<span style="color: green;">Running</span>	mlmd-pipeline	2 min 46 sec	Nov 24, 2021, 9:48:24 PM	
<a href="#">automl-tab-beans-training-v2-20211124201635</a>	<span style="color: red;">Failed</span>	automl-tab-beans-training-v2	26 min 57 sec	Nov 24, 2021, 12:16:42 PM	Nov 24, 2021, 12:43:40 PM
<a href="#">hello-world-pipeline-20211124201345</a>	<span style="color: green;">Succeeded</span>	hello-world	5 min 27 sec	Nov 24, 2021, 12:13:59 PM	Nov 24, 2021, 12:19:31 PM

## Compare Runs

### Parameters

Run	Input:bq_table	input:output_data_path	input:project	input:region
mlmd-pipeline-large-20211125054804	sara-vertex-demos.beans_demo.large_dataset	data.csv	deft-epoch-330820	us-central1
mlmd-pipeline-small-20211125054804	sara-vertex-demos.beans_demo.small_dataset	data.csv	deft-epoch-330820	us-central1

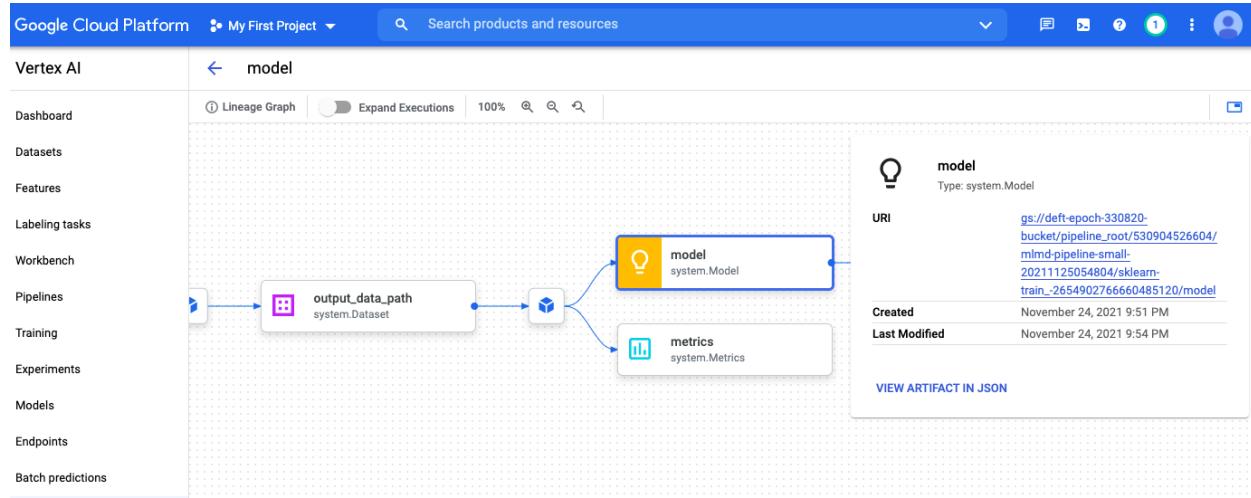
### Metrics

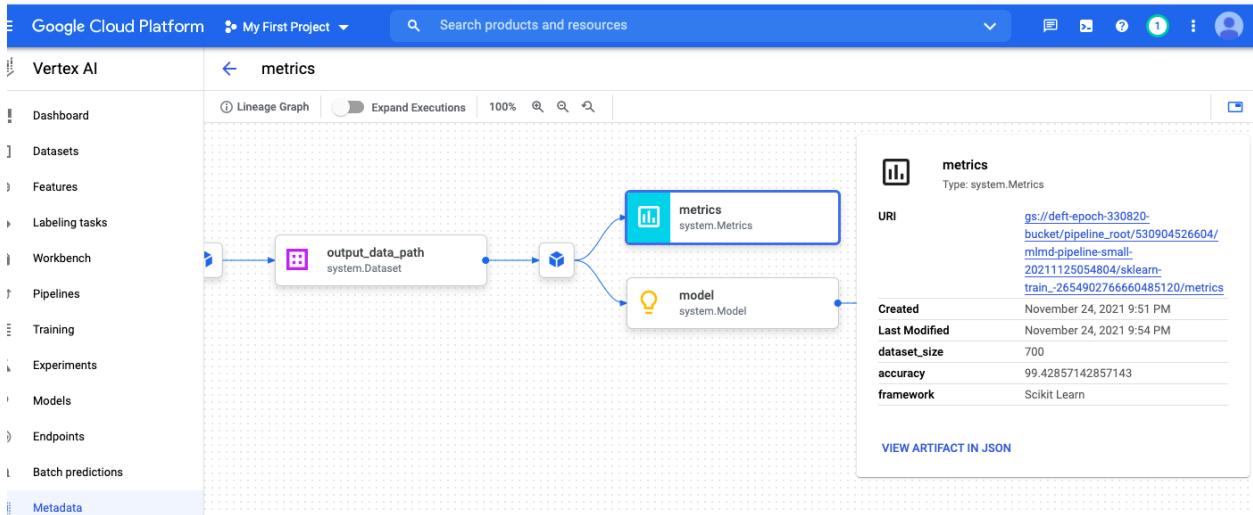
Info No scalar metrics found for the selected runs.

#### Run

mlmd-pipeline-large-20211125054804  
mlmd-pipeline-small-20211125054804

DONE





The screenshot shows the Google Cloud Platform Endpoints page. The top navigation bar includes 'My First Project' and a search bar. Below the header, a section titled 'Endpoints' features a 'CREATE ENDPOINT' button and a 'REFRESH' button. A descriptive text block explains that Endpoints are machine learning models made available for online prediction requests, useful for timely predictions from many users. It also mentions that batch predictions are available if immediate results are not needed. A note states that at least one machine learning model is required to create an endpoint, with a link to 'Learn more'. A 'Region' dropdown is set to 'us-central1 (Iowa)'. Below this, a table lists two endpoints:

	Name	ID	Status	Models	Region	Monitoring	Most recent alerts	Last updated	API	Notification	Labels
<input type="checkbox"/>	beans-model-pipeline_endpoint	2942407465137864704	Active	0	us-central1	Disabled	—	Nov 24, 2021, 9:56:51 PM	Sample request		
<input type="checkbox"/>	beans-model-pipeline_endpoint	598283859091521536	Active	0	us-central1	Disabled	—	Nov 24, 2021, 9:56:50 PM	Sample request		

h) Build an AutoML Forecasting Model with Vertex AI

Free trial status: \$169.48 credit and 68 days remaining - with a full account, you'll get unlimited access to all of Google Cloud Platform.

DISMISS ACTIVA

Google Cloud Platform • My First Project ▾ Search products and resources ⋮

Vertex AI ← Create dataset

Dashboard Dataset name \*  Can use up to 128 characters.

Datasets Select a data type and objective

Features

Labeling tasks

Workbench

Pipelines

Training

Experiments

Models

Endpoints

Batch predictions

Metadata

Marketplace

IMAGES TABULAR TEXT VIDEO

  Regression/classification Predict a target column's value. Supports tables with hundreds of columns and millions of rows.

  Forecasting PREVIEW Predict the likelihood of certain events or demand.

Region  ?

CREATE CANCEL

\$169.48 credit and 68 days remaining - with a full account, you'll get unlimited access to all of Google Cloud Platform.

DISMISS ACTIVA

Cloud Platform • My First Project ▾ Search products and resources ⋮

iowa\_daily CREATE LABELING TASK

SOURCE ANALYZE

Add data to your dataset

Before you begin, read the [data guide](#) to learn how to prepare your data. Then choose a data source.

Forecasting predicts future values based on historical values observed in a time series.

Select a data source

- CSV file: Can be uploaded from your computer or on Cloud Storage. [Learn more](#)
- BigQuery: Select a table or view from BigQuery. [Learn more](#)

Upload CSV files from your computer

Select CSV files from Cloud Storage

Select a table or view from BigQuery

Select CSV files from Cloud Storage

Enter the Cloud Storage path to one or more CSV files. Data from multiple files will be referenced as one dataset.

Import file path \*  BROWSE ?

ADD ANOTHER FILE

What happens next?

The selected CSV file will be associated with your dataset. Making changes to the referenced CSV file will affect the dataset.

CONTINUE

Free trial status: \$169.48 credit and 68 days remaining

Google Cloud Platform Vertex AI Models

**Train new model**

- 1 Training method
- 2 Model details
- 3 Training options
- 4 Compute and pricing

Dataset \*  ?

Please refer to the pricing guide for more details (and available deployment options) for each method.

Custom training with a managed dataset is not currently available. [Learn more about custom model training](#)

AutoML  
Train high-quality models with minimal effort and machine learning expertise. Just specify how long you want to train. [Learn more](#)

Custom training (advanced)  
Run your TensorFlow, scikit-learn, and XGBoost training applications in the cloud. Train with one of Google Cloud's pre-built containers or use your own. [Learn more](#)

**CONTINUE**

START TRAINING CANCEL

Free trial status: \$169.48 credit and 68 days remaining

Cloud Shell Training pipeline Cloud Shell Untitled.ipynb Models mlmd-pipeline metrics - View Metadata - View check-check Thangas - View +

console.cloud.google.com/vertex-ai/models/create?project=deft-epoch-330820

Train new model

- Training method
- 2 Model details
- 3 Training options
- 4 Compute and pricing

Model name \*  ?

Target column \*  ?

Series identifier column \*  ?

Timestamp column \*  ?

**Forecasting configuration**

Data granularity \*  ?

The granularity level of the timestamp column. Granularity must be the same for all rows. For example, if "days" is selected, timestamps must be within one day of each other. Data granularity also sets the time period granularity for the forecast horizon and context window.

Forecast horizon \*  ?

The number of time periods into the future for which forecasts will be created. Future periods start from the most recent timestamp in the dataset.

Context window \*  ?

Defines the input lags to the model for each time series. For most use cases, the context window is between 0-5 times the forecast horizon value. For a starting point, try setting the context window equal to the forecast horizon value. [Learn more](#)

Export test dataset to BigQuery

Export the test set into a new BigQuery table. The table ID cannot already exist. Use the following format: "ProjectId.DatasetId.tableId".

BROWSE

START TRAINING CANCEL



Free trial status: \$169.48 credit and 68 days remaining - with a full account, you'll get unlimited access to all of Google Cloud Platform.

☰ Google Cloud Platform • My First Project ▾

🔍 Search products and resources

Vertex AI ← iowa\_daily\_202111256440 ⏪ VIEW TRAINING DATASET

Dashboard	<p>ⓘ Training began at Nov 24, 2021, 10:07:01 PM and is still in progress.</p>																																
Datasets																																	
Features																																	
Labeling tasks																																	
Workbench																																	
Pipelines																																	
<b>Training</b>	<table border="1"><tbody><tr><td>Status</td><td>Training</td></tr><tr><td>Training pipeline ID</td><td>5204681226589306880</td></tr><tr><td>Created</td><td>Nov 24, 2021, 10:07:01 PM</td></tr><tr><td>Start time</td><td>Nov 24, 2021, 10:07:01 PM</td></tr><tr><td>Elapsed time</td><td>9 sec</td></tr><tr><td>Region</td><td>us-central1</td></tr><tr><td>Encryption type</td><td>Google-managed key</td></tr><tr><td>Dataset</td><td>iowa_daily</td></tr><tr><td>Target column</td><td>y</td></tr><tr><td>Series identifier column</td><td>id</td></tr><tr><td>Timestamp column</td><td>ds</td></tr><tr><td>Data split</td><td>Chronologically assigned</td></tr><tr><td>Column metadata</td><td><a href="#">VIEW DETAILS</a></td></tr><tr><td>Algorithm</td><td>AutoML</td></tr><tr><td>Objective</td><td>Forecasting</td></tr><tr><td>Optimized for</td><td>MAE</td></tr></tbody></table>	Status	Training	Training pipeline ID	5204681226589306880	Created	Nov 24, 2021, 10:07:01 PM	Start time	Nov 24, 2021, 10:07:01 PM	Elapsed time	9 sec	Region	us-central1	Encryption type	Google-managed key	Dataset	iowa_daily	Target column	y	Series identifier column	id	Timestamp column	ds	Data split	Chronologically assigned	Column metadata	<a href="#">VIEW DETAILS</a>	Algorithm	AutoML	Objective	Forecasting	Optimized for	MAE
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Objective	Forecasting																																
Optimized for	MAE																																
Experiments																																	
Models																																	
Endpoints																																	
Batch predictions																																	
Metadata																																	

### i) Multi-Worker Training and Transfer Learning with TensorFlow

```

(base) jupyter@tensorflow-2-3-20211124-122822:~$ mkdir cassava
(base) jupyter@tensorflow-2-3-20211124-122822:~$ cd cassava
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ touch Dockerfile
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ view Dockerfile
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ PROJECT_ID='deft-epoch-330820'
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ BUCKET="gs://${PROJECT_ID}-bucket"
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ gsutil mb -l us-central1 $BUCKET
Creating gs://deft-epoch-330820-bucket...
ServiceException: 409 A Cloud Storage bucket named 'deft-epoch-330820-bucket' already exists. Try another name. Bucket names must be globally unique across all Google Cloud projects, including those outside of your organization.
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ mkdir trainer
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ touch trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ view trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ view trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ view trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ echo $BUCKET
gs://deft-epoch-330820-bucket
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ view trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ deft-epoch-330820-bucket
bash: deft-epoch-330820-bucket: command not found
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ view trainer/task.py
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ IMAGE_URI="gcr.io/${PROJECT_ID}/multiworker:cassava"
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ echo $IMAGE_URI
gcr.io/deft-epoch-330820/multiworker:cassava
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ docker build ./ -t $IMAGE_URI

Sending build context to Docker daemon 6.656kB
Step 1/4 : FROM gcr.io/deeplearning-platform-release/tf2-gpu.2-5
--> 307b41blaec7
Step 2/4 : WORKDIR /
--> Using cache
--> bd8058cbf75d
Step 3/4 : COPY trainer /trainer
--> dd21ced5f5ef
Step 4/4 : ENTRYPOINT ["python", "-m", "trainer.task"]
--> Running in d0ddd8d6a23
Removing intermediate container d0ddd8d6a23
--> 2064cb552382
Successfully built 2064cb552382
Successfully tagged gcr.io/deft-epoch-330820/multiworker:cassava
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$
```

The push refers to repository [gcr.io/deft-epoch-330820/multiworker]

```

fbccdcbe3016: Pushed
5bb1aa5df10d: Layer already exists
f028010939aa: Layer already exists
dc99c4ea3a81: Layer already exists
37b508c5711b: Layer already exists
756ab564e194: Layer already exists
2ae86808a3d1: Layer already exists
1dccbd9b557: Layer already exists
cfcbdbc2b748: Layer already exists
937ab8f29c2e: Layer already exists
5d417b2f7486: Layer already exists
d6a297a3e6e4: Layer already exists
6474a5e8117f: Layer already exists
fe498124ed57: Layer already exists
d5454704bb3d: Layer already exists
fb896ef24b4b: Layer already exists
5087113f67c8: Layer already exists
2a92857a1d48: Layer already exists
0ded97864c52: Layer already exists
b50bbaac3e32: Layer already exists
262ealaf4c10: Layer already exists
b420a468ca49: Layer already exists
608c205798d1: Layer already exists
0760cd6d4269: Layer already exists
fb4755c89c2a: Layer already exists
22cfb9034da6: Layer already exists
8bec4fbfce85: Layer already exists
3b129ca3db46: Layer already exists
64cb1a1930ab: Layer already exists
600ef5a43f1f: Layer already exists
8ff8f0266f834: Layer already exists
cassava: digest: sha256:2a56c8bd859b20b2756012590a5eabdf14a952471f4e105906731199e43d40fa size: 6836

```

**Train new model**

- 1 Training method**
- 2 Model details**
- 3 Training container**
- 4 Hyperparameters (optional)**
- 5 Compute and pricing**
- 6 Prediction container (optional)**

Dataset \*  ?

Annotation set  ?

Objective  ?

Please refer to the pricing guide for more details (and available deployment options) for each method.

**AutoML options are only available when you train with a managed dataset.**

- AutoML  
Train high-quality models with minimal effort and machine learning expertise. Just specify how long you want to train. [Learn more](#)
- AutoML Edge  
Train a model that can be exported for on-prem/on-device use. Typically has lower accuracy. [Learn more](#)
- Custom training (advanced)  
Run your TensorFlow, scikit-learn, and XGBoost training applications in the cloud. Train with one of Google Cloud's pre-built containers or use your own. [Learn more](#)

**CONTINUE**

Cloud Shell | Select servi... | Cloud Shell | 2 - Jupyter... | Training pip... | mlmd-pipe... | metrics - v... | Metadata - | check-che... | Paiya -

console.cloud.google.com/vertex-ai/models/create?project=deft-epoch-330820

Free trial status: \$170.42 credit and 68 days remaining

**Train new model**

- Training method**
- 2 Model details**
- 3 Training container**
- 4 Hyperparameters (optional)**
- 5 Compute and pricing**
- 6 Prediction container (optional)**

Model name \*  ?

**ADVANCED OPTIONS**

**CONTINUE**

The screenshot shows the 'Train new model' interface in the Google Cloud Platform Vertex AI section. The left sidebar lists various AI services like Cloud Shell, Select service, Cloud Shell, Jupyter, Training pipeline, mlmd-pipeline, metrics, Metadata, check-check, and Palya. The 'Models' section is selected.

The main area is titled 'Train new model' and shows a step-by-step process:

- Training method
- Model details
- Training container
- Hyperparameters (optional)
- Compute and pricing (selected)
- Prediction container (optional)

Below the steps are two 'Worker pool' sections:

**Worker pool 0**

- Machine type \*: n1-standard-8, 8 vCPUs, 30 GiB memory
- Accelerator type: (dropdown menu)
- Worker count: 1
- Disk type: SSD
- Disk size (GB): 100

**Worker pool 1**

Select the type of virtual machine to use for your training job's second worker pool nodes, as well as the number of worker replicas to use.

- Machine type: n1-standard-8, 8 vCPUs, 30 GiB memory
- Accelerator type: (dropdown menu)
- Worker count: 1
- Disk type: SSD

At the bottom are 'START TRAINING' and 'CANCEL' buttons.

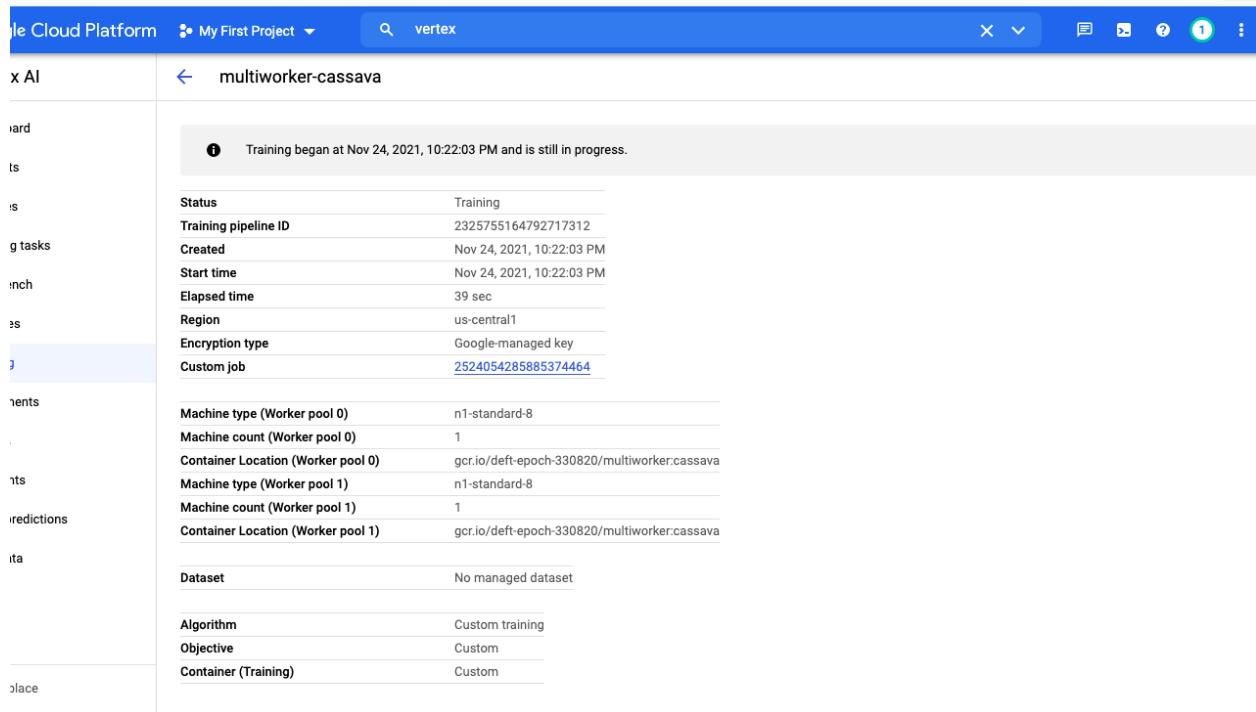
Free trial status: \$170.42 credit and 68 days remaining - with a full account, you'll get unlimited access to all of Google Cloud Platform.

**DISMISS** **ACTIVATE**

Google Cloud Platform • My First Project ▾ vertex X V 1

**Vertex AI** Training **+ CREATE** REFRESH

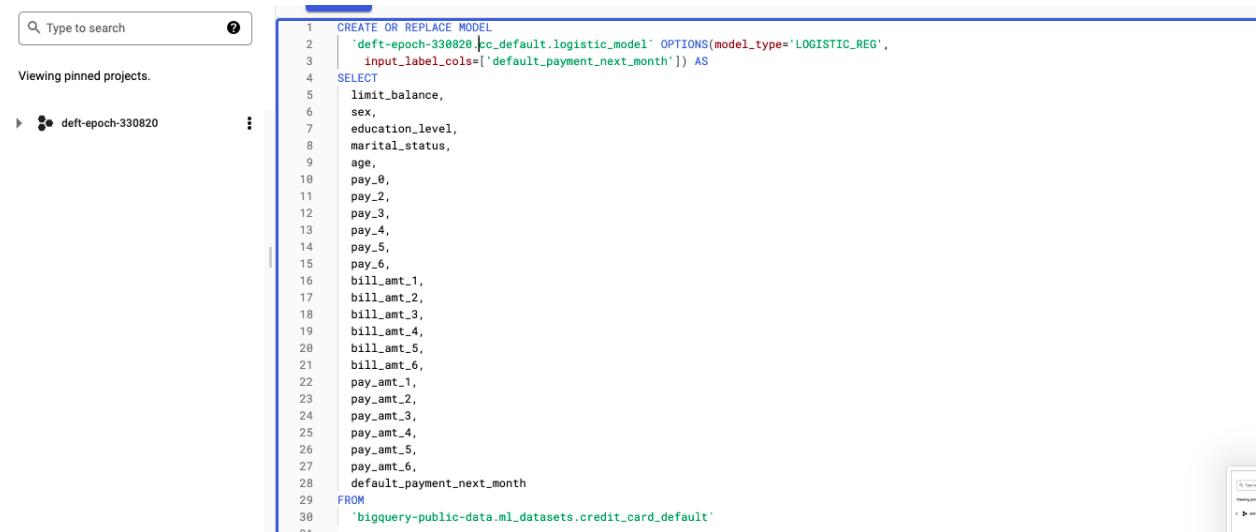
	TRAINING PIPELINES	CUSTOM JOBS	HYPERPARAMETER TUNING JOBS				
Dashboard							
Datasets	Training pipelines are the primary model training workflow in Vertex AI. You can use training pipelines to create an AutoML-trained model or a custom-trained model. For custom-trained models, training pipelines orchestrate custom training jobs and hyperparameter tuning with additional steps like adding a dataset or uploading the model to Vertex AI for prediction serving. <a href="#">Learn More</a>						
Features							
Labeling tasks							
Workbench	Region us-central1 (Iowa)						
Pipelines							
Training	<input type="text" value="Enter a property name"/>						
Experiments	Name	ID	Status	Job type	Model type	Created	Elapsed time
Models	multiworker-cassava	2325755164792717312	Training	Training pipeline	Custom	Nov 24, 2021, 10:22:03 PM	
Endpoints	iowa_daily_202111256440	5204681226589306880	Training	Training pipeline	Tabular forecasting	Nov 24, 2021, 10:07:01 PM	15 min 1 sec
Batch predictions	horses-humans-hypertune	1136241913213485056	Stopped	Training pipeline	Custom	Nov 24, 2021, 0:26:50 PM	10 min 19 sec



The screenshot shows the Google Cloud Platform AI Platform interface. The top navigation bar includes 'My First Project' and a search bar with 'vertex'. The main view displays a 'multiworker-cassava' training job. A message indicates 'Training began at Nov 24, 2021, 10:22:03 PM and is still in progress.' Below this, detailed configuration parameters are listed:

Status	Training
Training pipeline ID	2325755164792717312
Created	Nov 24, 2021, 10:22:03 PM
Start time	Nov 24, 2021, 10:22:03 PM
Elapsed time	39 sec
Region	us-central1
Encryption type	Google-managed key
Custom job	<a href="#">2524054285885374464</a>
Machine type (Worker pool 0)	n1-standard-8
Machine count (Worker pool 0)	1
Container Location (Worker pool 0)	gcr.io/deft-epoch-330820/multiworker:cassava
Machine type (Worker pool 1)	n1-standard-8
Machine count (Worker pool 1)	1
Container Location (Worker pool 1)	gcr.io/deft-epoch-330820/multiworker:cassava
Dataset	No managed dataset
Algorithm	Custom training
Objective	Custom
Container (Training)	Custom

### j) Export and deploy a BigQuery Machine Learning Model for Prediction



The screenshot shows the BigQuery ML interface. A search bar at the top contains 'Type to search'. Below it, a sidebar lists 'Viewing pinned projects' with one pinned project: 'deft-epoch-330820'. The main area displays a code editor with a SQL query:

```

1 CREATE OR REPLACE MODEL
2   `deft-epoch-330820.ml_default.logistic_model` OPTIONS(model_type='LOGISTIC_REG',
3     input_label_cols=['default_payment_next_month']) AS
4   SELECT
5     limit_balance,
6     sex,
7     education_level,
8     marital_status,
9     age,
10    pay_0,
11    pay_2,
12    pay_3,
13    pay_4,
14    pay_5,
15    pay_6,
16    bill_amt_1,
17    bill_amt_2,
18    bill_amt_3,
19    bill_amt_4,
20    bill_amt_5,
21    bill_amt_6,
22    pay_amt_1,
23    pay_amt_2,
24    pay_amt_3,
25    pay_amt_4,
26    pay_amt_5,
27    pay_amt_6,
28    default_payment_next_month
29   FROM
30   `bigquery-public-data.ml_datasets.credit_card_default`

```

The screenshot shows the Google Cloud Platform Big Query interface. The top navigation bar includes 'Google Cloud Platform', 'My First Project', a search bar ('big query'), and various icons. Below the navigation is a sidebar with icons for file operations like upload, download, and delete. The main area is titled 'cc\_default' and has tabs for 'SOURCE' and 'ANALYZE'. The 'ANALYZE' tab is selected, showing a table of column statistics. The columns listed are: age, bill\_amt\_1, bill\_amt\_2, bill\_amt\_3, bill\_amt\_4, bill\_amt\_5, bill\_amt\_6, default\_payment\_next\_month, education\_level, id, limit\_balance, marital\_status, pay\_0, pay\_2, pay\_3, pay\_4, pay\_5, and pay\_6. Each row includes 'BigQuery type', 'BigQuery mode', 'Missing % (count)', and 'Distinct values'. A 'GENERATE STATISTICS' button is at the top right of the table. To the right of the table, there's a section titled 'Training jobs and models' with a 'TRAIN NEW MODEL' button.

Column name ↑	BigQuery type	BigQuery mode	Missing % (count)	Distinct values
age	FLOAT	NULLABLE	-	-
bill_amt_1	FLOAT	NULLABLE	-	-
bill_amt_2	FLOAT	NULLABLE	-	-
bill_amt_3	FLOAT	NULLABLE	-	-
bill_amt_4	FLOAT	NULLABLE	-	-
bill_amt_5	FLOAT	NULLABLE	-	-
bill_amt_6	FLOAT	NULLABLE	-	-
default_payment_next_month	STRING	NULLABLE	-	-
education_level	STRING	NULLABLE	-	-
id	FLOAT	NULLABLE	-	-
limit_balance	FLOAT	NULLABLE	-	-
marital_status	STRING	NULLABLE	-	-
pay_0	FLOAT	NULLABLE	-	-
pay_2	FLOAT	NULLABLE	-	-
pay_3	FLOAT	NULLABLE	-	-
pay_4	FLOAT	NULLABLE	-	-
pay_5	STRING	NULLABLE	-	-
pay_6	STRING	NULLABLE	-	-

#### k) Building a financial ML model with the What-If Tool and Vertex AI

```
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$ pip3 install xgboost==1.2
Collecting xgboost==1.2
  Downloading xgboost-1.2.0-py3-none-manylinux2010_x86_64.whl (148.9 MB)
    |██████████| 148.9 MB 29 kB/s
Requirement already satisfied: numpy in /opt/conda/lib/python3.7/site-packages (from xgboost==1.2) (1.19.5)
Requirement already satisfied: scipy in /opt/conda/lib/python3.7/site-packages (from xgboost==1.2) (1.7.2)
Installing collected packages: xgboost
Successfully installed xgboost-1.2.0
(base) jupyter@tensorflow-2-3-20211124-122822:~/cassava$
```

Last Modified

- 7 hours ago
- an hour ago
- an hour ago
- an hour ago
- an hour ago
- 2 minutes ago
- 7 hours ago
- seconds ago**

		as_of_year	agency_code	loan_type	property_type	loan_purpose	occupancy	loan_amt_thousands	preapproval	county_code	applicant
310650	2016	Consumer Financial Protection Bureau (CFPB)	Conventional (any loan other than FHA, VA, FSA...)	One to four-family (other than manufactured ho...)	Refinancing	1	110.0	Not applicable	119.0		
630129	2016	Department of Housing and Urban Development (HUD)	Conventional (any loan other than FHA, VA, FSA...)	One to four-family (other than manufactured ho...)	Home purchase	1	480.0	Not applicable	33.0		
715484	2016	Federal Deposit Insurance Corporation (FDIC)	Conventional (any loan other than FHA, VA, FSA...)	One to four-family (other than manufactured ho...)	Refinancing	2	240.0	Not applicable	59.0		
887708	2016	Office of the Comptroller of the Currency (OCC)	Conventional (any loan other than FHA, VA, FSA...)	One to four-family (other than manufactured ho...)	Refinancing	1	76.0	Not applicable	65.0		
719598	2016	National Credit Union Administration (NCUA)	Conventional (any loan other than FHA, VA, FSA...)	One to four-family (other than manufactured ho...)	Refinancing	1	100.0	Not applicable	127.0		

```
[20]: print(data['approved'].value_counts())
labels = data['approved'].values
data = data.drop(columns=['approved'])

1    665389
0    334610
Name: approved, dtype: int64
```

```
[21]: dummy_columns = list(data.dtypes[data.dtypes == 'category'].index)
data = pd.get_dummies(data, columns=dummy_columns)

data.head()
```

```
[21]:
as_of_year occupancy loan_amt_thousands county_code applicant_income_thousands population ffiec_median_fam_income tract_to_n

310650    2016      1        110.0       119.0          55.0     5930.0      64100.0
630129    2016      1        480.0       33.0          270.0     4791.0      90300.0
715484    2016      2        240.0       59.0          96.0     3439.0      105700.0
887708    2016      1        76.0        65.0          85.0     3952.0      61300.0
719598    2016      1        100.0       127.0          70.0     2422.0      46400.0
```

5 rows × 44 columns

```

[22]: x,y = data.values,labels
x_train,x_test,y_train,y_test = train_test_split(x,y)

[23]: model = xgb.XGBClassifier(
    objective='reg:logistic'
)

[24]: model.fit(x_train, y_train)

[24]: XGBClassifier(base_score=0.5, booster='gbtree', colsample_bylevel=1,
                   colsample_bynode=1, colsample_bytree=1, gamma=0, gpu_id=-1,
                   importance_type='gain', interaction_constraints='',
                   learning_rate=0.300000012, max_delta_step=0, max_depth=6,
                   min_child_weight=1, missing=nan, monotone_constraints='()',
                   n_estimators=100, n_jobs=0, num_parallel_tree=1,
                   objective='reg:logistic', random_state=0, reg_alpha=0,
                   reg_lambda=1, scale_pos_weight=1, subsample=1,
                   tree_method='exact', validate_parameters=1, verbosity=None)

[25]: y_pred = model.predict(x_test)
acc = accuracy_score(y_test, y_pred.round())
print(acc, '\n')

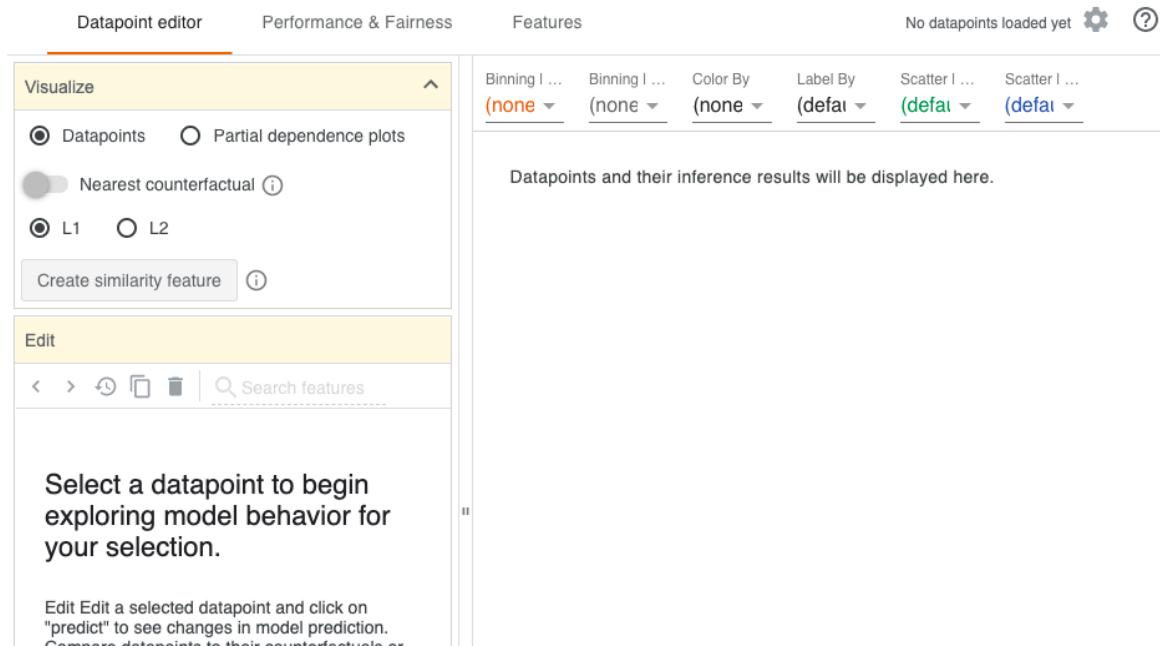
```

0.872816

```

28]: config_builder = (WitConfigBuilder(test_examples.tolist(), data.columns.tolist() + ['mortgage_status'])
    .set_custom_predict_fn(model.predict_proba)
    .set_target_feature('mortgage_status')
    .set_label_vocab(['denied', 'approved']))
WitWidget(config_builder, height=800)

```

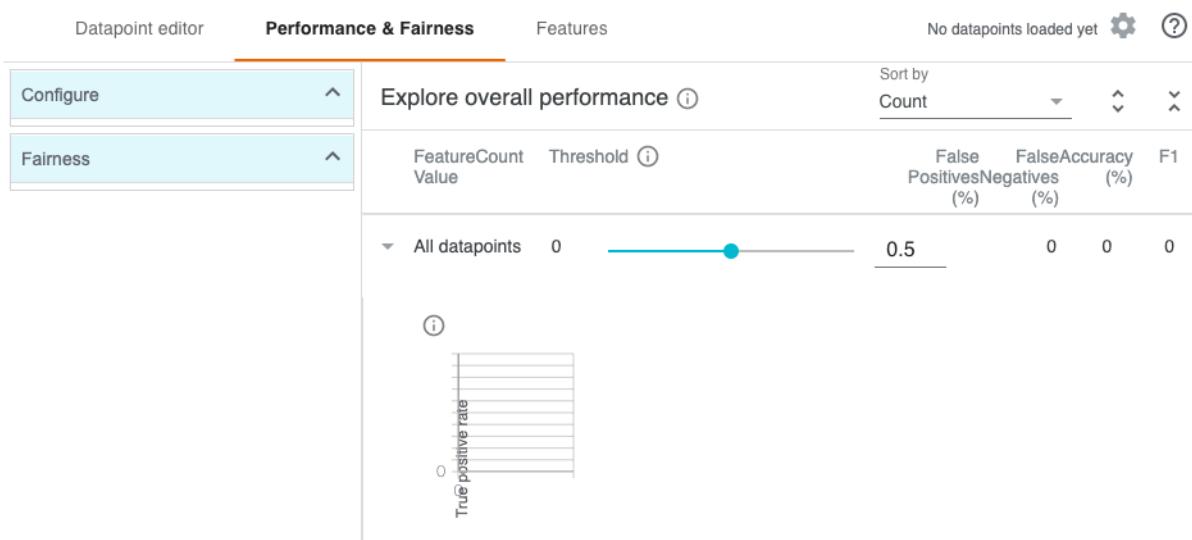


- I) Build an image classification model with transfer learning and the notebook executor

```

: config_builder = (WitConfigBuilder(test_examples.tolist(), data.columns.tolist() + ['mortgage_status'])
    .set_custom_predict_fn(model.predict_proba)
    .set_target_feature('mortgage_status')
    .set_label_vocab(['denied', 'approved']))
WitWidget(config_builder, height=800)

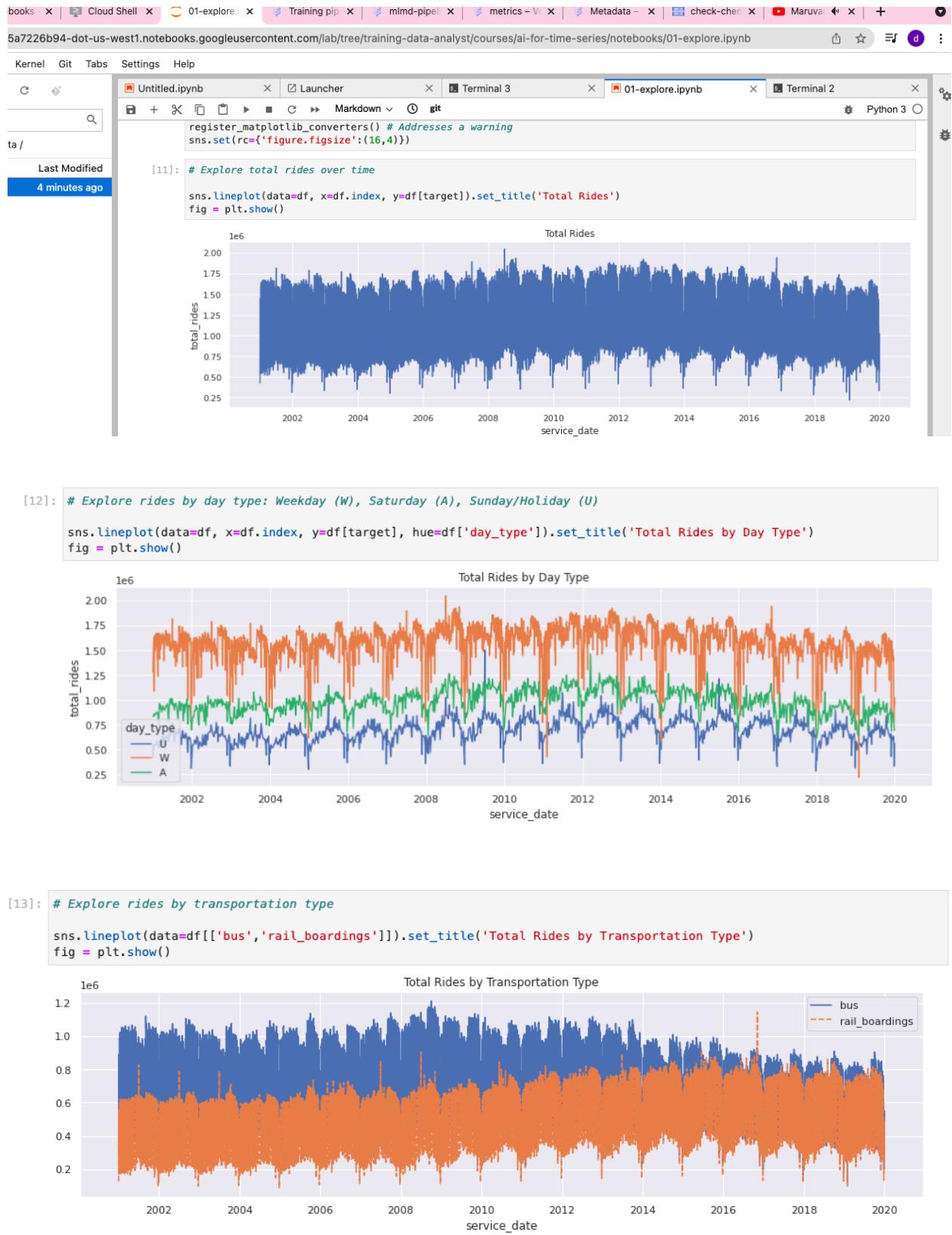
```



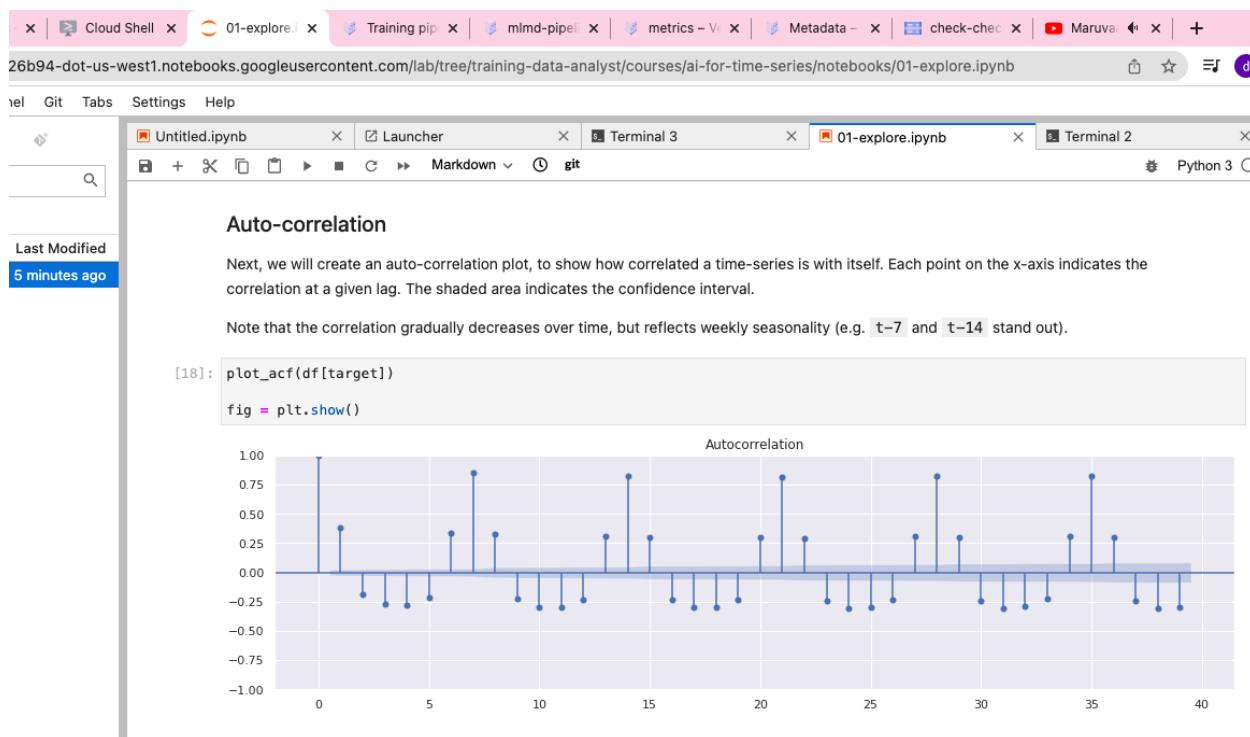
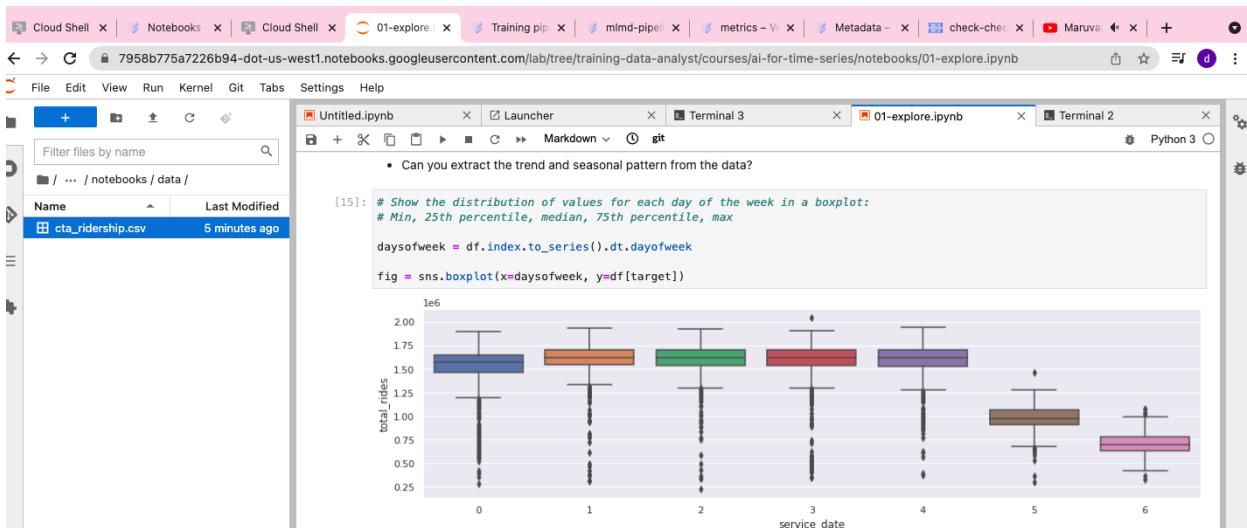
```

(base) jupyter@tensorflow-2-3-20211124-122822:~$ git clone https://github.com/GoogleCloudPlatform/training-data-analyst
Cloning into 'training-data-analyst'...
remote: Enumerating objects: 54124, done.
remote: Counting objects: 100% (23/23), done.
remote: Compressing objects: 100% (23/23), done.
remote: Total 54124 (delta 8), reused 1 (delta 0), pack-reused 54101
Receiving objects: 100% (54124/54124), 618.59 MiB | 31.61 MiB/s, done.
Resolving deltas: 100% (34356/34356), done.
Checking out files: 100% (10931/10931), done.
(base) jupyter@tensorflow-2-3-20211124-122822:~$ █

```



## m) Time Series Forecasting with Vertex AI and BigQuery ML



The screenshot shows the Google Cloud Platform Big Query interface. The top navigation bar includes 'Google Cloud Platform' and 'My First Project'. The search bar contains 'big query'. The main area displays a query for creating an ARIMA model:

```
1 CREATE OR REPLACE MODEL
2   `demo.cta_ridership_model` OPTIONS(MODEL_TYPE='ARIMA',
3     TIME_SERIES_TIMESTAMP_COL='service_date',
4     TIME_SERIES_DATA_COL='total_rides',
5     HOLIDAY_REGION='us') AS
6   SELECT
7     service_date, total_rides
8   FROM
9     `demo.cta_ridership`
```

Below the query, there are buttons for 'RUN', 'SAVE', 'SCHEDULE', and 'MORE'. A note indicates 'This query will process 4.4 MiB (ML) when run.' The sidebar on the left shows pinned projects: 'deft-epoch-330820' and 'demo', which contains 'cta\_ridership'. There are also 'MORE RESULTS' links.

The screenshot shows the Google Cloud Platform BigQuery interface. The top navigation bar includes 'Google Cloud Platform', 'My First Project', a search bar with 'big query', and various icons for account and settings.

The left sidebar displays pinned projects: 'deft-epoch-330820' (selected), 'demo', and 'Models (1)'. Under 'Models (1)', there is a single entry: 'cta\_ridership\_model'. There are also 'MORE RESULTS' buttons.

The main workspace contains two tabs: '\*UNSAVE... 5' and '\*UNSAVE... 6'. The second tab is active, showing a query editor with the following code:

```
1 SELECT
2   *
3   FROM
4   ML.EVALUATE(MODEL `demo.cta_ridership_model`)
```

Below the query editor are 'RUN', 'SAVE', 'SCHEDULE', and 'MORE' buttons. A red notification on the right says 'Not found: Model deft-epoch-330820:demo.cta\_ridership\_model'.

The results section shows a table with the following data:

Row	non_seasonal_p	non_seasonal_d	non_seasonal_q	has_drift	log_likelihood	AIC	variance	seasonal_periods
1	0	1	5	true	-84291.96365702226	168597.92731404453	2.0899385335999274E9	WEEKLY YEARLY
2	0	1	5	false	-84293.2544933968	168598.5089867936	2.090729530268954E9	WEEKLY YEARLY
3	1	1	4	true	-84295.84360207952	168605.68720415904	2.0922881217453368E9	WEEKLY YEARLY

Google Cloud Platform My First Project big query

FEATURES & INFO SHORTCUT DISABLE EDITOR TABS

**Explorer** + ADD DATA

Type to search

Viewing pinned projects.

- deft-epoch-330820
  - demo
    - Models (1)
      - cta\_ridership\_model
    - cta\_ridership

MORE RESULTS MORE RESULTS

**Query results** SAVE RESULTS EXPLORE DATA

Query complete (0.3 sec elapsed, 23.4 KB processed)

Row	forecast_timestamp	forecast_value	standard_error	confidence_level	prediction_interval_lower_bound	prediction_interval_upper_bound	confidence_inter
1	2020-01-01 00:00:00 UTC	672673.4067125214	45715.84554178048	0.95	583232.2707817592	762114.5426432837	5832:
2	2020-01-02 00:00:00 UTC	1028503.0865139209	45806.99994822557	0.95	938883.6108070718	1118122.56222077	93881:
3	2020-01-03 00:00:00 UTC	1177797.9717879058	46287.610736162766	0.95	1087238.2012160213	1268357.7423597903	10872:
4	2020-01-04 00:00:00 UTC	638818.6543572493	47234.50401336978	0.95	546406.3267711629	731230.9819433356	54641:
5	2020-01-05 00:00:00 UTC	473730.2287011511	48149.235480549505	0.95	379528.2673343356	567932.1900679666	3795:
6	2020-01-06 00:00:00 UTC	1163952.3480790951	48179.67357435147	0.95	1069690.8358573639	1258213.8603008264	106961:

This query will process 23.4 kB when run.

7958b775a7226b94-dot-us-west1.notebooks.googleusercontent.com/lab/tree/training-data-analyst/courses/ai-for-time-series/notebooks/02-model.ipynb

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Untitled.ipynb

```
early_stopping = EarlyStopping(monitor='val_loss', patience=patience)
_ = model.fit(x=X_train, y=y_train, validation_data=(X_test, y_test), epochs=epochs, callbacks=[early_stopping])

2021-11-25 07:02:15.964363: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcuda.so.1'; dlsym or dlsym_r error: libcuda.so.1: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /local/cuda/lib64:/usr/local/nccl2/lib:/usr/local/cuda/extras/CUPTI/lib64
2021-11-25 07:02:15.964363: W tensorflow/stream_executor/cuda/cuda_driver.cc:269] failed call to cuInit: UNKNOWN ERROR(0)
2021-11-25 07:02:15.964397: I tensorflow/stream_executor/cuda/cuda_diagnostics.cc:156] kernel driver does not appear to be running on this host (tensorflow-2-3-20211124-122822): /proc/driver/nvidia/version does not exist
2021-11-25 07:02:15.965052: I tensorflow/core/platform/cpu_feature_guard.cc:151] This TensorFlow binary is optimized for oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructions in performance-critical operations: X2 FMA
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
Epoch 1/1000
173/173 [=====] - 6s 21ms/step - loss: 0.6506 - val_loss: 0.4304
Epoch 2/1000
173/173 [=====] - 3s 18ms/step - loss: 0.3172 - val_loss: 0.2564
Epoch 3/1000
173/173 [=====] - 3s 17ms/step - loss: 0.2361 - val_loss: 0.2446
Epoch 4/1000
173/173 [=====] - 3s 17ms/step - loss: 0.2260 - val_loss: 0.2337
Epoch 5/1000
173/173 [=====] - 3s 17ms/step - loss: 0.2209 - val_loss: 0.2272
Epoch 6/1000
173/173 [=====] - 3s 18ms/step - loss: 0.2190 - val_loss: 0.2306
Epoch 7/1000
173/173 [=====] - 3s 18ms/step - loss: 0.2136 - val_loss: 0.2192
Epoch 8/1000
173/173 [=====] - 3s 18ms/step - loss: 0.2083 - val_loss: 0.2160
Epoch 9/1000
173/173 [=====] - 3s 18ms/step - loss: 0.2048 - val_loss: 0.2203
Epoch 10/1000
173/173 [=====] - 3s 18ms/step - loss: 0.2022 - val_loss: 0.2164
Epoch 11/1000
173/173 [=====] - 3s 18ms/step - loss: 0.2005 - val_loss: 0.2147
```

