

a) Vertex AI Workbench:

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

Objective:

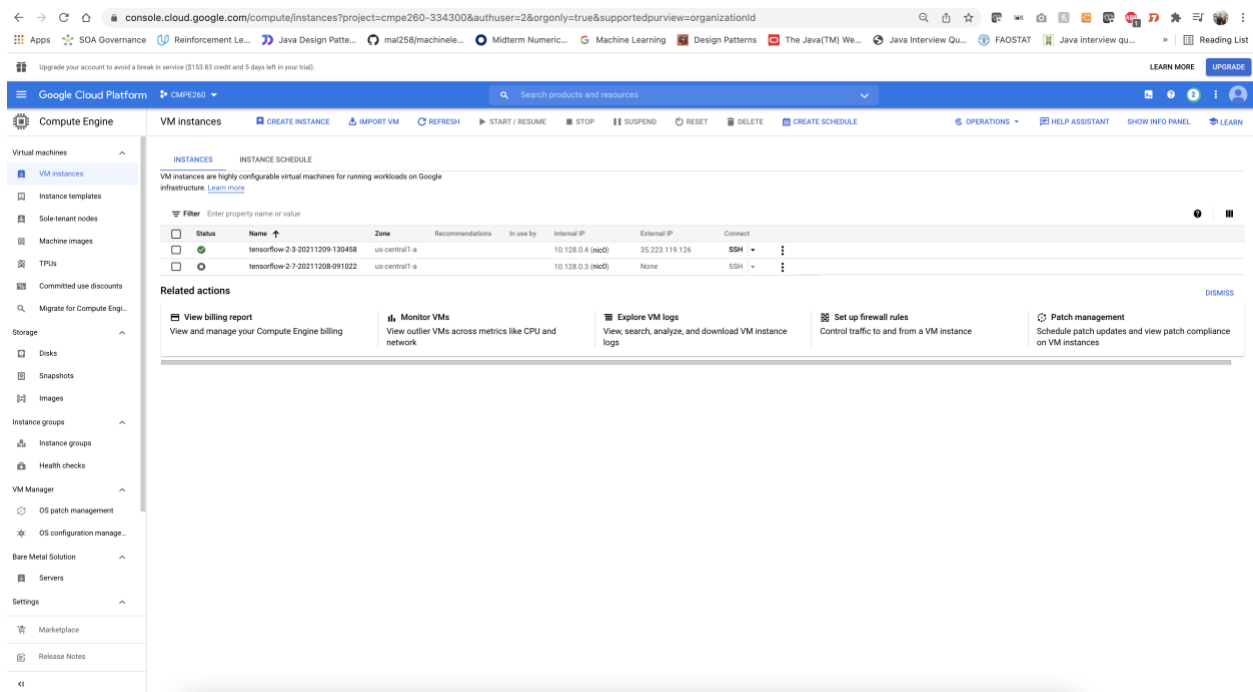
How to configure and launch notebook executions with Vertex AI Workbench.

- Use parameters in a notebook
- Configure and launch notebook executions from the Vertex AI Workbench UI

In this lab, you'll use transfer learning to train an image classification model on the DeepWeeds dataset from TensorFlow Datasets. You'll use TensorFlow Hub to experiment with feature vectors extracted from different model architectures, such as ResNet50, Inception, and MobileNet, all pre-trained on the ImageNet benchmark dataset. By leveraging the notebook executor via the Vertex AI Workbench UI, you'll launch jobs on Vertex AI Training that use these pre-trained models and retrain the last layer to recognize the classes from the DeepWeeds dataset.

Set up Cloud environment

Step 1: Enable the Compute Engine API



Step 2: Enable the Vertex AI API

Get started with Vertex AI

Vertex AI empowers machine learning developers, data scientists, and data engineers to take their projects from ideation to deployment, quickly and cost-effectively. [Learn more](#)

Try an interactive tutorial to learn how to train, evaluate, and deploy a Vertex AI AutoML or custom-trained model. [View Tutorials](#)

Region: us-central1 (Iowa)

Recent datasets

- iowa_daily (23 minutes ago) [+ CREATE DATASET](#)

Recent models

- beans_model_pipeline (1 hour ago) [+ TRAIN NEW MODEL](#)
- beans_model_pipeline (1 hour ago)

Get predictions

After you train a model, you can use it to get predictions, either online as an endpoint or through batch requests. [+ CREATE BATCH PREDICTION](#)

Recent notebook instances

- tensorflow-2-9-20211209-130458 (58 minutes ago)
- tensorflow-2-7-20211208-091022 (3 hours ago) [+ CREATE NOTEBOOK INSTANCE](#)

Recent endpoints

Endpoint	Online Traffic	Requests	Error Rate
	1.0%		
	0.0%		
	0.0%		

No data is available for the selected time range.

Step 3: Create a Vertex AI Workbench instance

Notebooks [NEW NOTEBOOK](#) [REFRESH](#) [START](#) [STOP](#) [RESET](#) [DELETE](#) [SHOW INFO PANEL](#)

MANAGED NOTEBOOKS [PREVIEW](#) [USER-MANAGED NOTEBOOKS](#) [EXECUTIONS](#) [PREVIEW](#) [SCHEDULES](#) [PREVIEW](#)

Filter Enter property name or value

	Notebook name	Zone	Auto-upgrade	Environment	Machine type	GPUs	Permission	Last modified
<input type="checkbox"/>	tensorflow-2-9-20211209-130458	OPEN.JUPYTERLAB	us-central1-a	TensorFlow 2.3	4 vCPUs, 15 GB RAM	None	Service account	Dec 9, 2021, 2:34:45 PM
<input type="checkbox"/>	tensorflow-2-7-20211208-091022	OPEN.JUPYTERLAB	us-central1-a	TensorFlow 2.7	4 vCPUs, 15 GB RAM	None	Service account	Dec 9, 2021, 11:57:12 AM

Create Managed Notebook:

console.cloud.google.com/vertex-ai/workbench/create-managed?authuser=2&orgonly=true&project=cme260-334300&supportedpurview=organizationid

Google Cloud Platform CMPE260 Vertex AI

Create a managed notebook

None

Based on the zone, environment, and machine type selected above, the available GPU types and the minimum number of GPUs that can be selected may vary. [Learn more](#)

Data disk type: Standard Persistent Disk Data disk size in GB: 100

Disk encryption

☒ Google-managed encryption key
No configuration required

☐ Customer-managed encryption key (CMEK)
Manage via Google Cloud Key Management Service

Idle shutdown

☒ Enable Idle Shutdown

Time of inactivity before shutdown (Minutes): 60
Must be integer 1-600

Networking

The network must have outbound connection to the internet. [Learn more](#) about the networking options below.

☒ Google-managed networks
No configuration required

☐ Networks in this project
Private service access required

☐ Networks shared with me
Private service access required

Security

☒ Enable rbconvert

☒ Enable file downloading from Notebook UI

Permission

Managed notebooks currently only support single user only mode. Single user only mode restricts access to the user specified below.

Owner: musketterspsu@gmail.com

CREATE CANCEL

console.cloud.google.com/vertex-ai/workbench/list/managed?authuser=5&orgonly=true&project=legalpa-sandbox-4c9d&supportedpurview=organizationid

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Managed notebooks

NEW NOTEBOOK REFRESH START STOP RESET DELETE

MANAGED NOTEBOOKS **PREVIEW** USER-MANAGED NOTEBOOKS EXECUTIONS **PREVIEW** SCHEDULES **PREVIEW**

Managed notebooks provide JupyterLab services and flexible computing resources integrated with Google Cloud services. [Learn more](#)

Region: us-central1 (Iowa)

Filter: Enter property name or value

	Notebook name	Location	Owner	Last modified
<input type="checkbox"/>	london-bikes-codelab	us-central1-b	ragun@cisico.com	Nov 30, 2021, 12:01:14 AM
<input type="checkbox"/>	managed-notebook-1639094160	us-central1-b	ragun@cisico.com	Dec 9, 2021, 3:57:35 PM

Write training code

Step 1: Download and preprocess dataset

```
Import the necessary libraries

[1]: import tensorflow as tf
import tensorflow_datasets as tfds
import tensorflow_hub as hub

Download the data from TensorFlow Datasets and extract the number of classes and dataset size.

[2]: data, info = tfds.load(name='deep_weeds', as_supervised=True, with_info=True)
NUM_CLASSES = info.features['label'].num_classes
DATASET_SIZE = info.splits['train'].num_examples

Downloading and preparing dataset 469.32 MiB (download: 469.32 MiB, generated: 469.99 MiB, total: 939.31 MiB) to /home/jupyter/tensorflow_datasets/deep_weeds/3.0.0...
DI Completed... 100% [2/2 [00:16<00:00, 4.83s/ url]
DI Size... 100% [468/468 [00:16<00:00, 57.06 MiB/s]
Extraction completed... 100% [1/1 [00:16<00:00, 16.13s/ file]

Dataset deep_weeds downloaded and prepared to /home/jupyter/tensorflow_datasets/deep_weeds/3.0.0. Subsequent calls will reuse this data.
2021-12-10 00:37:00.333589: W tensorflow/stream_executor/platform/default/dso_loader.cc:64] Could not load dynamic library 'libcuda.so.1'; dLError: libcuda.so.1: cannot open shared object file: No such file or directory; LD_LIBRARY_PATH: /usr/local/cuda/lib64:/usr/local/cuda/lib:/usr/local/lib/x86_64-linux-gnu:/usr/local/nvidia/lib:/usr/local/nvidia/lib64:/usr/local/nvidia/lib:/usr/local/nvidia/lib64
2021-12-10 00:37:00.333702: W tensorflow/stream_executor/cuda/cuda_driver.cc:269] failed call to cuInit: UNKNOWN ERROR (383)
2021-12-10 00:37:00.357850: I tensorflow/core/platform/cpu_feature_guard.cc:156] kernel driver does not appear to be running on this host (vm-eb37d7a1-6ab0-4ed6-89bb-0e098395f920): /proc/driver/nvidia/version does not exist
2021-12-10 00:37:00.357850: I tensorflow/core/platform/cpu_feature_guard.cc:151] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructions in performance-critical operations: AVX2 FMA
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
```

Step 2: Create model

```
[3]: def preprocess_data(image, label):
    image = tf.image.resize(image, (300,300))
    return tf.cast(image, tf.float32) / 255., label

[4]: # Create train/validation splits

# Shuffle dataset
dataset = data['train'].shuffle(10000)

train_split = 0.8
val_split = 0.2
train_size = int(train_split * DATASET_SIZE)
val_size = int(val_split * DATASET_SIZE)

train_data = dataset.take(train_size)
train_data = train_data.map(preprocess_data)
train_data = train_data.batch(64)

validation_data = dataset.skip(train_size)
validation_data = validation_data.map(preprocess_data)
validation_data = validation_data.batch(64)

[5]: feature_extractor_model = "inception_v3"
```

Model Compile and Fit

```
val_split = 0.2
train_size = int(train_split * DATASET_SIZE)
val_size = int(val_split * DATASET_SIZE)

train_data = dataset.take(train_size)
train_data = train_data.map(preprocess_data)
train_data = train_data.batch(64)

validation_data = dataset.skip(train_size)
validation_data = validation_data.map(preprocess_data)
validation_data = validation_data.batch(64)

[5]: feature_extractor_model = "inception_v3"

[7]: tf_hub_uri = f"https://tfhub.dev/google/imagenet/{feature_extractor_model}/feature_vector/5"

[8]: feature_extractor_layer = hub.KerasLayer(
    tf_hub_uri,
    trainable=False)

[10]: model = tf.keras.Sequential([
    feature_extractor_layer,
    tf.keras.layers.Dense(units=NUM_CLASSES)
])

[4]: model.compile(
    optimizer=tf.keras.optimizers.Adam(),
    loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
    metrics=['acc'])

model.fit(train_data, validation_data=validation_data, epochs=20)

Epoch 1/20
114/219 [=====>.....] - ETA: 10:53 - loss: 1.2528 - acc: 0.5873
```

Execute notebook

Submit notebooks to Executor

Create a one-time or recurring notebook execution using Vertex AI Training. Results are stored in a shareable Cloud Storage bucket. Charges apply for training and storage. [Learn more](#)

Notebook: Untitled.ipynb

Execution name
image_example__1639097809753
Up to 128 lowercase letters, numbers, or underscores.

Cloud Storage bucket
ltg_model_test
Where results are stored. Select an existing bucket or create a new one.

Machine type
4 CPUs, 15 GB RAM

Accelerator type
NVIDIA Tesla P4

Accelerator count
1

Environment
TensorFlow Enterprise 2.6 (GPU)

Type
One-time execution

Execution will start immediately after being submitted

Input parameters (optional)
feature_extractor_model=resnet_v2_50

Each parameter needs to be separated by commas (Example: a=x,b=y)

SUBMIT CANCEL

console.cloud.google.com/vertex-ai/workbench/list/executions?authuser=5&orgonly=true&project=legalpa-sandbox-4o9d&supportedpurview=organizationid

Google Cloud Platform LegalPA

Notebooks REFRESH DELETE

MANAGED NOTEBOOKS PREVIEW USER-MANAGED NOTEBOOKS EXECUTIONS PREVIEW SCHEDULES PREVIEW

This page shows your notebook executions created through Notebook Executor. You can share execution results with others by clicking the icon in the table below.

Region: us-central1 (Iowa)

<input type="checkbox"/>	Execution name	VIEW RESULT	Source Notebook	Execution time	Schedule	
<input type="checkbox"/>	image_example__1639097809753		untitled_at_2021_12_09_17_10_17.ipynb	Dec 9, 2021, 5:10:17 PM	None	

console.cloud.google.com/vertex-ai/locations/us-central1/training/3860377628540141568?authuser=5&orgonly=true&project=legalpa-sandbox-4o9d&supportedpurview=organizationid

Google Cloud Platform LegalPA

image_example__1639097809753

Training began at Dec 9, 2021, 5:10:18 PM and is still in progress.

Status	Pending
Custom job ID	3860377628540141568
Created	Dec 9, 2021, 5:10:18 PM
Start time	Dec 9, 2021, 5:10:18 PM
Elapsed time	1 min 39 sec
Region	us-central1
Encryption type	Google-managed key
Machine type (Worker pool 0)	n1-standard-4
Machine count (Worker pool 0)	1
Accelerator (Worker pool 0)	NVIDIA_TESLA_P4
Accelerator count (Worker pool 0)	1
Container Location (Worker pool 0)	gcr.io/deeplearning-platform-release/tf2-gpu-2.6-latest
Arguments (Worker pool 0)	nbexecutor:--input-notebook:gs://big_model_test/nbexecutor_files/image_example__1639097809753/untitled.ipynb;--output-notebook:gs://big_model_test/nbexecutor_files/image_example__1639097809753/untitled_at_2021_12_09_17_10_17.ipynb;--parameters:feature_extractor_model=reset_v2_50;--kernel-name:pytorch3
Dataset	No managed dataset
Algorithm	Custom training
Objective	Custom
Container (Training)	Custom
Logs	View logs

[VIEW CUSTOM JOB INPUTS IN JSON](#)

console.cloud.google.com/vertex-ai/locations/us-central1/training/3860377628540141568/cpu?authuser=5&orgonly=true&project=legalpa-sandbox-4o9d&supportedpurview=organizationid

Google Cloud Platform LegalPA

image_example__1639097809753

Custom job was completed on Dec 9, 2021, 5:58:46 PM.

Status	Finished
Custom job ID	3860377628540141568
Created	Dec 9, 2021, 5:10:18 PM
Start time	Dec 9, 2021, 5:20:31 PM
Elapsed time	38 min 15 sec
Region	us-central1
Encryption type	Google-managed key
Machine type (Worker pool 0)	n1-standard-4
Machine count (Worker pool 0)	1
Accelerator (Worker pool 0)	NVIDIA_TESLA_P4
Accelerator count (Worker pool 0)	1
Container Location (Worker pool 0)	gcr.io/deeplearning-platform-release/tf2-gpu-2.6-latest
Arguments (Worker pool 0)	nbexecutor:--input-notebook:gs://big_model_test/nbexecutor_files/image_example__1639097809753/untitled.ipynb;--output-notebook:gs://big_model_test/nbexecutor_files/image_example__1639097809753/untitled_at_2021_12_09_17_10_17.ipynb;--parameters:feature_extractor_model=reset_v2_50;--kernel-name:pytorch3
Dataset	No managed dataset
Algorithm	Custom training
Objective	Custom
Container (Training)	Custom
Logs	View logs

[VIEW CUSTOM JOB INPUTS IN JSON](#)

CPU GPU NETWORK

CPU utilization

Percent

This page shows your notebook executions created through Notebook Executor. You can share execution results with others by clicking the icon in the table below.

Region: us-central1 (Iowa)

<input type="checkbox"/>	Execution name	Source Notebook	Execution time	Schedule	
<input type="checkbox"/>	image_example_1639097809753	untitled_at_2021_12_09_17_10_17.ipynb	Dec 9, 2021, 5:10:17 PM	None	

Clean Up

Delete the Execution and notebook

This page shows your notebook executions created through Notebook Executor. You can share execution results with others by clicking the icon in the table below.

Region: us-central1 (Iowa)

<input type="checkbox"/>	Execution name	Source Notebook	Execution time	Schedule
No executions to display				

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Region: us-central1 (Iowa)

Filter: Enter property name or value

<input type="checkbox"/>	Notebook name	Location	Owner	Last modified
<input type="checkbox"/>	london-bikes-codelab	us-central1-b	ragurs@cisco.com	Nov 30, 2021, 12:01:14 AM
<input checked="" type="checkbox"/>	managed-notebook-1639094160	us-central1-b	ragurs@cisco.com	Dec 9, 2021, 6:34:12 PM

Delete notebook

Are you sure you want to delete notebook "managed-notebook-1639094160"? (This will also delete boot disk "managed-notebook-1639094160")

CANCEL DELETE