

1. Create a variable for projectID:

```
export PROJECT_ID=bert-289322
```

2. Configure `gcloud` to use the project where you want to create Cloud TPU.

```
gcloud config set project ${PROJECT_ID}
```

3. Create a Service Account for the Cloud TPU project.

```
gcloud beta services identity create --service tpu.googleapis.com --project $PROJECT_ID
```

4. Create a Cloud Storage bucket:

```
gsutil mb -p ${PROJECT_ID} -c standard -l europe-west4 -b on gs://bert_gt
```

The screenshot shows the Google Cloud Platform (GCP) dashboard for a project named 'BERT' with ID 'bert-289322'. The dashboard includes sections for Project info, API APIs, and Google Cloud Platform status. Below the dashboard is a Cloud Shell terminal window showing the execution of the commands from the previous steps. The terminal output confirms that the project is set to 'bert-289322', the service account is created, and the Cloud Storage bucket 'bert_gt' is successfully created.

```
Welcome to Cloud Shell! Type "help" to get started.
Your Cloud Platform project in this session is set to bert-289322.
Use "gcloud config set project [PROJECT_ID]" to change to a different project.
gtimokhina@cloudshell:~ (bert-289322)$ export PROJECT_ID=bert-289322
gtimokhina@cloudshell:~ (bert-289322)$ gcloud config set project ${PROJECT_ID}
Updated property [core/project].
gtimokhina@cloudshell:~ (bert-289322)$ gcloud beta services identity create --service tpu.googleapis.com --project $PROJECT_ID
Service identity created: service-774557860120@cloud-tpu.iam.gserviceaccount.com
gtimokhina@cloudshell:~ (bert-289322)$ gsutil mb -p ${PROJECT_ID} -c standard -l europe-west4 -b on gs://bert
Creating gs://bert/...
ServiceException: 409 Bucket bert already exists
```

5. Launch the Compute Engine VM resource using the `ctpu up` command.

```
ctpu up --tpu-size=v3-8 \
  --name=bert-tutorial \
  --machine-type=n1-standard-8 \
  --zone=europe-west4-a \
  --tf-version=2.3
```

```
CLOUD SHELL
Terminal (bert-289322) x + ▾ Open Editor

Creating gs://bert/...
ServiceException: 409 Bucket bert already exists.
gtimokhina@cloudshell:~ (bert-289322)$ gsutil mb -p ${PROJECT_ID} -c standard -l europe-west4 -b on gs://bert_gt
Creating gs://bert_gt/...
gtimokhina@cloudshell:~ (bert-289322)$ ctpu up --tpu-size=v3-32 \
> --name=bert-tutorial \
> --machine-type=n1-standard-8 \
> --zone=europe-west4-a \
> --tf-version=2.3

Welcome to ctpu!

After confirming the configuration looks correct, ctpu will enable the
necessary service APIs, start a Cloud TPU with the latest released TensorFlow
version, and start a Compute Engine VM with a compatible version of TensorFlow
pre-installed. When everything is ready, ctpu will automatically open an ssh
connection to your new VM and port-forward commonly used ports. For more
details, see the documentation at:
https://github.com/tensorflow/tpu/tree/master/tools/ctpu

ctpu will use the following configuration:

Name: bert-tutorial
Zone: europe-west4-a
GCP Project: bert-289322
TensorFlow Version: 2.3
```

6. Set TPU name variables:

```
export TPU_NAME=bert-tutorial
```

7. Install extra package.

```
sudo pip3 install -r /usr/share/models/official/requirements.txt
```

8. Define additional variables:

```
export STORAGE_BUCKET=gs://bert_gt
export PYTHONPATH="${PYTHONPATH}:/usr/share/models"
export BERT_BASE_DIR=gs://cloud-tpu-checkpoints/bert/keras_bert/uncased_L-24_H-1024_A-16
export MODEL_DIR=${STORAGE_BUCKET}/bert-output
export GLUE_DIR=gs://cloud-tpu-checkpoints/bert/classification
export TASK=mnli
```

```
Successfully installed pycocotools
WARNING: You are using pip version 20.2; however, version 20.2.3 is available.
You should consider upgrading via the '/usr/bin/python3 -m pip install --upgrade pip' command.
gtimokhina@bert-tutorial:~$ export STORAGE_BUCKET=gs://bert_gt
gtimokhina@bert-tutorial:~$ export PYTHONPATH="${PYTHONPATH}:/usr/share/models"
gtimokhina@bert-tutorial:~$ export BERT_BASE_DIR=gs://cloud-tpu-checkpoints/bert/keras_bert/uncased_L-24_H-1024_A-16
gtimokhina@bert-tutorial:~$ export MODEL_DIR=${STORAGE_BUCKET}/bert-output
gtimokhina@bert-tutorial:~$ export GLUE_DIR=gs://cloud-tpu-checkpoints/bert/classification
gtimokhina@bert-tutorial:~$ export TASK=mnli
gtimokhina@bert-tutorial:~$ python3 /usr/share/models/official/nlp/bert/run_classifier.py \
> --mode='train_and_eval' \
> --input_meta_data_path=${GLUE_DIR}/${TASK}_meta_data \
> --train_data_path=${GLUE_DIR}/${TASK}_train.tf_record \
> --eval_data_path=${GLUE_DIR}/${TASK}_eval.tf_record \
> --bert_config_file=${BERT_BASE_DIR}/bert_config.json \
> --init_checkpoint=${BERT_BASE_DIR}/bert_model.ckpt \
> --train_batch_size=32 \
> --eval_batch_size=32 \
> --learning_rate=2e-5 \
> --num_train_epochs=1 \
> --model_dir=${MODEL_DIR} \
> --distribution_strategy=tpu \
> --tpu=${TPU_NAME} \
> --steps_per_loop=1000
/usr/local/lib/python3.7/dist-packages/tensorflow_addons/utils/ensure_tf_install.py:68: UserWarning: Tensorflow Addons supports using Python ops for all Te
nsorflow versions above or equal to 2.2.0 and strictly below 2.3.0 (nightly versions are not supported).
```

```

INFO:tensorflow:Found TPU system:
I0912 22:52:17.194361 139676113041216 tpu_system_metadata.py:159] Found TPU system:
INFO:tensorflow:*** Num TPU Cores: 8
I0912 22:52:17.194587 139676113041216 tpu_system_metadata.py:160] *** Num TPU Cores: 8
INFO:tensorflow:*** Num TPU Workers: 1
I0912 22:52:17.194823 139676113041216 tpu_system_metadata.py:161] *** Num TPU Workers: 1
INFO:tensorflow:*** Num TPU Cores Per Worker: 8
I0912 22:52:17.194924 139676113041216 tpu_system_metadata.py:163] *** Num TPU Cores Per Worker: 8
INFO:tensorflow:*** Available Device: _DeviceAttributes(/job:localhost/replica:0/task:0/device:CPU:0, CPU, 0, 0)
I0912 22:52:17.195084 139676113041216 tpu_system_metadata.py:165] *** Available Device: _DeviceAttributes(/job:localhost/replica:0/task:0/device:CPU:0, CPU, 0, 0)
INFO:tensorflow:*** Available Device: _DeviceAttributes(/job:localhost/replica:0/task:0/device:XLA_CPU:0, XLA_CPU, 0, 0)
I0912 22:52:17.195272 139676113041216 tpu_system_metadata.py:165] *** Available Device: _DeviceAttributes(/job:localhost/replica:0/task:0/device:XLA_CPU:0, XLA_CPU, 0, 0)
INFO:tensorflow:*** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:CPU:0, CPU, 0, 0)
I0912 22:52:17.195361 139676113041216 tpu_system_metadata.py:165] *** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:CPU:0, CPU, 0, 0)
INFO:tensorflow:*** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:TPU:0, TPU, 0, 0)
I0912 22:52:17.195478 139676113041216 tpu_system_metadata.py:165] *** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:TPU:0, TPU, 0, 0)
INFO:tensorflow:*** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:TPU:1, TPU, 0, 0)
I0912 22:52:17.195535 139676113041216 tpu_system_metadata.py:165] *** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:TPU:1, TPU, 0, 0)
INFO:tensorflow:*** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:TPU:2, TPU, 0, 0)
I0912 22:52:17.195587 139676113041216 tpu_system_metadata.py:165] *** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:TPU:2, TPU, 0, 0)

```

9. Run the training script for 3 epoch:

```

python3 /usr/share/models/official/nlp/bert/run_classifier.py \
--mode='train_and_eval' \
--input_meta_data_path=${GLUE_DIR}/${TASK}_meta_data \
--train_data_path=${GLUE_DIR}/${TASK}_train.tf_record \
--eval_data_path=${GLUE_DIR}/${TASK}_eval.tf_record \
--bert_config_file=${BERT_BASE_DIR}/bert_config.json \
--init_checkpoint=${BERT_BASE_DIR}/bert_model.ckpt \
--train_batch_size=32 \
--eval_batch_size=32 \
--learning_rate=2e-5 \
--num_train_epochs=1 \
--model_dir=${MODEL_DIR} \
--distribution_strategy=tpu \
--tpu=${TPU_NAME} \
--steps_per_loop=1000

```

```

INFO:tensorflow:Initializing the TPU system: bert-tutorial
I0912 23:22:26.878622 139893938259776 tpu_strategy_util.py:73] Initializing the TPU system: bert-tutorial
INFO:tensorflow:Clearing out eager caches
I0912 23:22:32.124595 139893938259776 tpu_strategy_util.py:108] Clearing out eager caches
INFO:tensorflow:Finished initializing TPU system.
I0912 23:22:32.130125 139893938259776 tpu_strategy_util.py:131] Finished initializing TPU system.
W0912 23:22:32.132838 139893938259776 tpu_strategy.py:320] 'tf.distribute.experimental.TPUStrategy' is deprecated, please use the non experimental symbol
'tf.distribute.TPUStrategy' instead.
I0912 23:22:32.175255 139893938259776 transport.py:157] Attempting refresh to obtain initial access_token
I0912 23:22:32.287615 139893938259776 transport.py:157] Attempting refresh to obtain initial access_token
INFO:tensorflow:Found TPU system:
I0912 23:22:32.360162 139893938259776 tpu_system_metadata.py:159] Found TPU system:
INFO:tensorflow:*** Num TPU Cores: 8
I0912 23:22:32.360378 139893938259776 tpu_system_metadata.py:160] *** Num TPU Cores: 8
INFO:tensorflow:*** Num TPU Workers: 1
I0912 23:22:32.360579 139893938259776 tpu_system_metadata.py:161] *** Num TPU Workers: 1
INFO:tensorflow:*** Num TPU Cores Per Worker: 8
I0912 23:22:32.360660 139893938259776 tpu_system_metadata.py:163] *** Num TPU Cores Per Worker: 8
INFO:tensorflow:*** Available Device: _DeviceAttributes(/job:localhost/replica:0/task:0/device:CPU:0, CPU, 0, 0)
I0912 23:22:32.360713 139893938259776 tpu_system_metadata.py:165] *** Available Device: _DeviceAttributes(/job:localhost/replica:0/task:0/device:CPU:0, CPU, 0, 0)
INFO:tensorflow:*** Available Device: _DeviceAttributes(/job:localhost/replica:0/task:0/device:XLA_CPU:0, XLA_CPU, 0, 0)
I0912 23:22:32.360910 139893938259776 tpu_system_metadata.py:165] *** Available Device: _DeviceAttributes(/job:localhost/replica:0/task:0/device:XLA_CPU:0, XLA_CPU, 0, 0)
INFO:tensorflow:*** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:CPU:0, CPU, 0, 0)
I0912 23:22:32.360959 139893938259776 tpu_system_metadata.py:165] *** Available Device: _DeviceAttributes(/job:worker/replica:0/task:0/device:CPU:0, CPU, 0, 0)

```

```

Epoch 3/3
I0912 23:53:50.503880 139893938259776 keras_utils.py:133] TimeHistory: 56.84 seconds, 563.01 examples/second between steps 24542 and 25542
1000/12271 [====>.....] - ETA: 1s - loss: 0.2293 - accuracy: 0.9181I0912 23:54:47.445458 139893938259776 keras_utils.py:133] TimeHisto
ry: 56.83 seconds, 563.04 examples/second between steps 25542 and 26542
2000/12271 [====>.....] - ETA: 4:52 - loss: 0.2206 - accuracy: 0.9215I0912 23:55:44.385960 139893938259776 keras_utils.py:133] TimeHis
tory: 56.84 seconds, 562.98 examples/second between steps 26542 and 27542
3000/12271 [====>.....] - ETA: 5:52 - loss: 0.2110 - accuracy: 0.9251I0912 23:56:41.332104 139893938259776 keras_utils.py:133] TimeHis
tory: 56.84 seconds, 563.02 examples/second between steps 27542 and 28542
4000/12271 [====>.....] - ETA: 5:53 - loss: 0.1976 - accuracy: 0.9308I0912 23:57:38.306904 139893938259776 keras_utils.py:133] TimeHis
tory: 56.83 seconds, 563.07 examples/second between steps 28542 and 29542
5000/12271 [====>.....] - ETA: 5:31 - loss: 0.1922 - accuracy: 0.9332I0912 23:58:35.258976 139893938259776 keras_utils.py:133] TimeHis
tory: 56.83 seconds, 563.04 examples/second between steps 29542 and 30542
6000/12271 [====>.....] - ETA: 4:57 - loss: 0.1896 - accuracy: 0.9342I0912 23:59:32.183815 139893938259776 keras_utils.py:133] TimeHis
tory: 56.83 seconds, 563.09 examples/second between steps 30542 and 31542
7000/12271 [====>.....] - ETA: 4:17 - loss: 0.1875 - accuracy: 0.9352I0913 00:00:29.125554 139893938259776 keras_utils.py:133] TimeHis
tory: 56.84 seconds, 562.97 examples/second between steps 31542 and 32542
8000/12271 [====>.....] - ETA: 3:32 - loss: 0.1822 - accuracy: 0.9372I0913 00:01:26.046521 139893938259776 keras_utils.py:133] TimeHis
tory: 56.81 seconds, 563.28 examples/second between steps 32542 and 33542
9000/12271 [====>.....] - ETA: 2:45 - loss: 0.1776 - accuracy: 0.9388I0913 00:02:22.981111 139893938259776 keras_utils.py:133] TimeHis
tory: 56.82 seconds, 563.15 examples/second between steps 33542 and 34542
10000/12271 [====>.....] - ETA: 1:56 - loss: 0.1743 - accuracy: 0.9400I0913 00:03:19.931766 139893938259776 keras_utils.py:133] TimeHis
tory: 56.83 seconds, 563.03 examples/second between steps 34542 and 35542
11000/12271 [====>.....] - ETA: 1:05 - loss: 0.1716 - accuracy: 0.9411I0913 00:04:16.913704 139893938259776 keras_utils.py:133] TimeHis
tory: 56.85 seconds, 562.93 examples/second between steps 35542 and 36542
12000/12271 [====>.....] - ETA: 14s - loss: 0.1696 - accuracy: 0.9419 I0913 00:04:32.871608 139893938259776 keras_utils.py:133] TimeHis
tory: 15.85 seconds, 547.04 examples/second between steps 36542 and 36813

```

```

12000/12271 [====>.....] - ETA: 14s - loss: 0.1696 - accuracy: 0.9419 I0913 00:04:32.871608 139893938259776 keras_utils.py:133] TimeHis
tory: 15.85 seconds, 547.04 examples/second between steps 36542 and 36813
12271/12271 [=====] - 688s 56ms/step - loss: 0.1690 - accuracy: 0.9422 - val_loss: 0.4925 - val_accuracy: 0.8588
gtimokhina@bert-tutorial:~$

```

10. Clean Up

```

exit
ctpu delete --name=bert-tutorial \
  --zone=europe-west4-a
gsutil rm -r gs://bert_gt

```