```python
#PROJECT VARIABLES TO COPY TO DRIVE: DO NOT MODIFY!

#DATASET GLOBAL PATH CONFIGURATION:
PROJECT_ROOT_DIR = '/content/drive/MyDrive/testProj/'
DATASETS_ROOT_DIR = PROJECT_ROOT_DIR + 'datasets/'
TAMIL_DATASET_HOME = DATASETS_ROOT_DIR + 'ta/'
SPEECH_CORPORA_ZIPS_DIR = DATASETS_ROOT_DIR + 'zips/speech_corpora/'
LM_CORPORA_ZIPS_DIR = DATASETS_ROOT_DIR + 'zips/lm_corpora/'
CV_DATASET_DIR = TAMIL_DATASET_HOME + 'commonvoice/'
OPENSLR_DATASET_DIR = TAMIL_DATASET_HOME + 'openslr/'
ULCA_DATASET_DIR = TAMIL_DATASET_HOME + 'ulca_corpus/'
  #UTILS VARS:
UTILS_HOME = PROJECT_ROOT_DIR+'utils/'
DEEPSPEECH_HOME = UTILS_HOME + 'deepspeech/'
KENLM_HOME=UTILS_HOME + 'kenlm/'

  #MODEL VARS:
LM_PATH = PROJECT_ROOT_DIR + 'lm/'
MODEL_HOME = '/content/' + 'model_0_new/'
FEATURE_CACHE_PATH = MODEL_HOME + 'feature_cache/'
CHECKPOINTS_DIR = MODEL_HOME + 'checkpoints/'
EXPORTS_DIR = MODEL_HOME + 'exports/'
SUMMARY_DIR = MODEL_HOME + 'summary/'
TEST_OUTPUT_JSON_PATH = MODEL_HOME + 'output.json'


drive.flush_and_unmount()


#Mounting Drive:
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```python
!ls $TAMIL_DATASET_HOME"csv/complete_datasets/"
```

```
complete_dataset_remapped.csv   msr_open_dataset.csv   ulca_dataset.csv
iitm_asr_challenge_corpus.csv   openslr+cv.csv
```

```python
!ls $TAMIL_DATASET_HOME"split_dataset/part56/"
```

```
b   part56.csv   part56_missing.csv
```

```python
import pandas as pd
import os

#df = pd.read_csv(TAMIL_DATASET_HOME + 'csv/complete_datasets/complete_dataset_remapped.cs
doneCount = 0
for i in range(1, 162):
    ct = 0
    for j in range(0, 5):
```

```
        ch = chr(ord('a') + j)
        ct1 = !ls $TAMIL_DATASET_HOME"split_dataset/part"$i"/"$ch | wc -l
        ct += int(ct1[0])
    doneCount += ct
    print('Part', i, ', Found:', ct)
print('Found', doneCount, 'files in total.')# CSV Length:', len(df.index))
```

```
!sudo apt-get install sox libsox-fmt-all
```

```
    Processing triggers for man-db (2.8.3-2ubuntu0.1) ...
    Processing triggers for mime-support (3.60ubuntu1) ...
```

```
!pip install commonvoice-utils
```

```
    Collecting commonvoice-utils
      Downloading commonvoice_utils-0.2.16-py3-none-any.whl (180 kB)
         |████████████████████████████████| 180 kB 8.1 MB/s
    Installing collected packages: commonvoice-utils
    Successfully installed commonvoice-utils-0.2.16
```

```
!pip install indic-nlp-library
```

```
!pip install torch==1.3.1+cpu -f https://download.pytorch.org/whl/torch_stable.html
!pip install inltk
from inltk.inltk import setup
setup('ta')
#Add more lib install work as needed here...
```

```
!rm -rf /content/drive/MyDrive/testProj/utils/deepspeech/onnx-tensorflow
```

```
%cd $DEEPSPEECH_HOME
```

```
!apt-get install python3-dev
!pip install --upgrade pip==20.2.2 wheel==0.34.2 setuptools==49.6.0
!pip install --upgrade -e .
```

```
#!python util/taskcluster.py --arch gpu --target tc/ --branch v0.9.3
!pip uninstall -y tensorflow
!pip uninstall -y tensorflow-gpu
%tensorflow_version 1.x
!pip install 'tensorflow-gpu==1.15.4'
!pip install 'deepspeech-gpu==0.9.3'
```

‣ Datasets

[ ] ↳ *114 cells hidden*

▾ DeepSpeech Model

‣ Preflight steps

[ ] ↳ *10 cells hidden*

▾ Model Training

```
!rm -rf $MODEL_HOME
```

```
#Create dirs (needed one time only!!)
!mkdir -p $MODEL_HOME
!mkdir -p $LM_PATH
!mkdir -p $FEATURE_CACHE_PATH
!mkdir -p $CHECKPOINTS_DIR
!mkdir -p $EXPORTS_DIR
!mkdir -p $SUMMARY_DIR
```

```
!cp -av /content/model_0_new/ /content/drive/MyDrive/testProj/
```

```
!cp -av /content/drive/MyDrive/testProj/model_0_new/  /content/
```

▾ Model Training (epoch-wise)

```
 #Train + Dev
import os
os.environ['TF_FORCE_GPU_ALLOW_GROWTH'] = 'false'
%cd $DEEPSPEECH_HOME

import glob

!python -u DeepSpeech.py --train_files $TAMIL_DATASET_HOME"train-model0.csv" \
--dev_files $TAMIL_DATASET_HOME"dev-model0.csv" \
--scorer $LM_PATH"kenlm-tamil.scorer" \
--feature_cache $FEATURE_CACHE_PATH \
--learning_rate 0.0001 \
--train_batch_size 64 \
--dev_batch_size 128 \
--checkpoint_secs 1200 \
--checkpoint_dir $CHECKPOINTS_DIR \
--export_dir $EXPORTS_DIR \
--summary_dir $SUMMARY_DIR \
--n_hidden 2048 \
--train_cudnn True \
--dropout_rate 0.4 \
--audio_sample_rate 48000 \
--epochs 5 \
--cache_for_epochs 5 \
```

```
--log_level 0 \
--max_to_keep 2 \
--augment reverb[p=0.2,delay=50.0~30.0,decay=10.0:2.0~1.0] \
--augment volume[p=0.2,dbfs=-10:-40] \
--augment pitch[p=0.2,pitch=1~0.2] \
--augment tempo[p=0.2,factor=1~0.5] \
--noearly_stop
```

Testing with custom WAV files

```
# With ULCA audio
%cd $DEEPSPEECH_HOME
!python -u DeepSpeech.py --test_files $TAMIL_DATASET_HOME"test-sample.csv" \
--scorer $LM_PATH"kenlm-tamil.scorer" \
--test_batch_size 64 \
--checkpoint_dir $CHECKPOINTS_DIR \
--audio_sample_rate 48000 \
--test_output_file  $TEST_OUTPUT_JSON_PATH \
--log_level 0 \
--augment reverb[p=0.2,delay=50.0~30.0,decay=10.0:2.0~1.0] \
--augment volume[p=0.2,dbfs=-10:-40] \
--augment pitch[p=0.2,pitch=1~0.2] \
--augment tempo[p=0.2,factor=1~0.5]
```

```
    /content/drive/MyDrive/testProj/utils/deepspeech
    2022-01-06 07:11:47.253299: I tensorflow/core/platform/cpu_feature_guard.cc:142] Y
    2022-01-06 07:11:47.258309: I tensorflow/core/platform/profile_utils/cpu_utils.cc:9
    2022-01-06 07:11:47.258600: I tensorflow/compiler/xla/service/service.cc:168] XLA
    2022-01-06 07:11:47.258638: I tensorflow/compiler/xla/service/service.cc:176]    St
    2022-01-06 07:11:47.260451: I tensorflow/stream_executor/platform/default/dso_load
    2022-01-06 07:11:47.519167: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc
    2022-01-06 07:11:47.520203: I tensorflow/compiler/xla/service/service.cc:168] XLA
    2022-01-06 07:11:47.520238: I tensorflow/compiler/xla/service/service.cc:176]    St
    2022-01-06 07:11:47.520435: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc
    2022-01-06 07:11:47.521099: I tensorflow/core/common_runtime/gpu/gpu_device.cc:163!
    name: Tesla P100-PCIE-16GB major: 6 minor: 0 memoryClockRate(GHz): 1.3285
    pciBusID: 0000:00:04.0
    2022-01-06 07:11:47.521427: I tensorflow/stream_executor/platform/default/dso_load
    2022-01-06 07:11:47.522670: I tensorflow/stream_executor/platform/default/dso_load
    2022-01-06 07:11:47.523745: I tensorflow/stream_executor/platform/default/dso_load
    2022-01-06 07:11:47.524090: I tensorflow/stream_executor/platform/default/dso_load
    2022-01-06 07:11:47.525501: I tensorflow/stream_executor/platform/default/dso_load
    2022-01-06 07:11:47.526590: I tensorflow/stream_executor/platform/default/dso_load
    2022-01-06 07:11:47.530194: I tensorflow/stream_executor/platform/default/dso_load
    2022-01-06 07:11:47.530290: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc
    2022-01-06 07:11:47.530838: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc
    2022-01-06 07:11:47.531373: I tensorflow/core/common_runtime/gpu/gpu_device.cc:176?
    2022-01-06 07:11:47.531421: I tensorflow/stream_executor/platform/default/dso_load
    2022-01-06 07:11:47.532457: I tensorflow/core/common_runtime/gpu/gpu_device.cc:118(
    2022-01-06 07:11:47.532483: I tensorflow/core/common_runtime/gpu/gpu_device.cc:118
    2022-01-06 07:11:47.532490: I tensorflow/core/common_runtime/gpu/gpu_device.cc:119!
    2022-01-06 07:11:47.532592: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc
    2022-01-06 07:11:47.533144: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc
    2022-01-06 07:11:47.533640: W tensorflow/core/common_runtime/gpu/gpu_bfc_allocator
```

```
2022-01-06 07:11:47.533671: I tensorflow/core/common_runtime/gpu/gpu_device.cc:132
I0106 07:11:48.228958 139636725057408 utils.py:157] NumExpr defaulting to 4 thread
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow_core/pyt
Instructions for updating:
Use `tf.compat.v1.data.get_output_types(iterator)`.
W0106 07:11:49.098606 139636725057408 deprecation.py:323] From /usr/local/lib/pythe
Instructions for updating:
Use `tf.compat.v1.data.get_output_types(iterator)`.
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow_core/pyt
Instructions for updating:
Use `tf.compat.v1.data.get_output_shapes(iterator)`.
W0106 07:11:49.098844 139636725057408 deprecation.py:323] From /usr/local/lib/pythe
Instructions for updating:
Use `tf.compat.v1.data.get_output_shapes(iterator)`.
WARNING:tensorflow:From /usr/local/lib/python3.7/dist-packages/tensorflow_core/pyt
Instructions for updating:
Use `tf.compat.v1.data.get_output_classes(iterator)`.
W0106 07:11:49.098948 139636725057408 deprecation.py:323] From /usr/local/lib/pythe
Instructions for updating:
Use `tf.compat.v1.data.get_output_classes(iterator)`.
WARNING:tensorflow:
The TensorFlow contrib module will not be included in TensorFlow 2.0.
For more information, please see:
  * https://github.com/tensorflow/community/blob/master/rfcs/20180907-contrib-sunse
  * https://github.com/tensorflow/addons
  * https://github.com/tensorflow/io (for I/O related ops)
If you depend on functionality not listed there, please file an issue
```

```
!sox $PROJECT_ROOT_DIR"test_audio.mp3" -r 48000 $PROJECT_ROOT_DIR"output.wav"
!sox $PROJECT_ROOT_DIR"output.wav" $PROJECT_ROOT_DIR"output_mono.wav" remix 1,2
!sox $PROJECT_ROOT_DIR"output_mono.wav" -b 16 -c 1 $PROJECT_ROOT_DIR"output_mono_48k.wav"
```

```
!soxi $PROJECT_ROOT_DIR"output_mono_16k.wav"
```

```
Input File      : '/content/drive/MyDrive/FYP2022-SpeechProcessing/output_mono_16k.wav
Channels        : 1
Sample Rate     : 16000
Precision       : 16-bit
Duration        : 00:00:19.59 = 313496 samples ~ 1469.51 CDDA sectors
File Size       : 627k
Bit Rate        : 256k
Sample Encoding: 16-bit Signed Integer PCM
```

```
!deepspeech --model $MODEL_HOME"exports/output_graph.pb" --scorer $LM_PATH"kenlm-tamil.sco
```

```
2021-12-10 04:28:12.069711: I tensorflow/stream_executor/platform/default/dso_loader
Loading model from file /content/drive/MyDrive/FYP2022-SpeechProcessing/model/exports
TensorFlow: v2.3.0-6-g23ad988
DeepSpeech: v0.9.3-0-gf2e9c85
2021-12-10 04:28:12.224913: I tensorflow/core/platform/cpu_feature_guard.cc:142] This
To enable them in other operations, rebuild TensorFlow with the appropriate compiler
2021-12-10 04:28:12.226113: I tensorflow/stream_executor/platform/default/dso_loader
2021-12-10 04:28:12.247174: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:98
2021-12-10 04:28:12.248066: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1716]
```

```
        pciBusID: 0000:00:04.0 name: Tesla K80 computeCapability: 3.7
        coreClock: 0.8235GHz coreCount: 13 deviceMemorySize: 11.17GiB deviceMemoryBandwidth:
        2021-12-10 04:28:12.248102: I tensorflow/stream_executor/platform/default/dso_loader
        2021-12-10 04:28:12.250224: I tensorflow/stream_executor/platform/default/dso_loader
        2021-12-10 04:28:12.251384: I tensorflow/stream_executor/platform/default/dso_loader
        2021-12-10 04:28:12.251672: I tensorflow/stream_executor/platform/default/dso_loader
        2021-12-10 04:28:12.253750: I tensorflow/stream_executor/platform/default/dso_loader
        2021-12-10 04:28:12.254774: I tensorflow/stream_executor/platform/default/dso_loader
        2021-12-10 04:28:12.259073: I tensorflow/stream_executor/platform/default/dso_loader
        2021-12-10 04:28:12.259182: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:98
        2021-12-10 04:28:12.260045: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:98
        2021-12-10 04:28:12.260753: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1858]
        2021-12-10 04:28:12.493819: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1257]
        2021-12-10 04:28:12.493886: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1263]
        2021-12-10 04:28:12.493908: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1276]
        2021-12-10 04:28:12.494122: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:98
        2021-12-10 04:28:12.494922: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:98
        2021-12-10 04:28:12.495743: I tensorflow/stream_executor/cuda/cuda_gpu_executor.cc:98
        2021-12-10 04:28:12.496472: W tensorflow/core/common_runtime/gpu/gpu_bfc_allocator.cc
        2021-12-10 04:28:12.496523: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1402]
        Loaded model in 0.288s.
        Loading scorer from files /content/drive/MyDrive/FYP2022-SpeechProcessing/lm/kenlm-ta
        Loaded scorer in 0.00731s.
        Running inference.
        2021-12-10 04:28:12.560510: I tensorflow/stream_executor/platform/default/dso_loader
        புலவன் கும் வாழும் மனு க பக்தர்கள் களி வகுக்கும் எம் உழு கலங்க வணக்கங்கள
        Inference took 4.719s for 19.593s audio file.
```

```
!pip install torch==1.3.1+cpu torchvision==0.4.2+cpu -f https://download.pytorch.org/whl/t
!pip install git+https://github.com/onnx/onnx-tensorflow.git@v1.6.0-tf-1.15
!pip install onnx
```

```
        Looking in links: https://download.pytorch.org/whl/torch_stable.html
        Collecting torch==1.3.1+cpu
          Downloading https://download.pytorch.org/whl/cpu/torch-1.3.1%2Bcpu-cp37-cp37m-linux
             |████████████████████████████████| 111.8 MB 134 kB/s
        Collecting torchvision==0.4.2+cpu
          Downloading https://download.pytorch.org/whl/cpu/torchvision-0.4.2%2Bcpu-cp37-cp37m
             |████████████████████████████████| 13.5 MB 399 bytes/s
        Requirement already satisfied: numpy in /usr/local/lib/python3.7/dist-packages (from
        Requirement already satisfied: pillow>=4.1.1 in /usr/local/lib/python3.7/dist-package
        Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from to
        Installing collected packages: torch, torchvision
          Attempting uninstall: torch
            Found existing installation: torch 1.10.0+cu111
            Uninstalling torch-1.10.0+cu111:
              Successfully uninstalled torch-1.10.0+cu111
          Attempting uninstall: torchvision
            Found existing installation: torchvision 0.11.1+cu111
            Uninstalling torchvision-0.11.1+cu111:
              Successfully uninstalled torchvision-0.11.1+cu111
        ERROR: pip's dependency resolver does not currently take into account all the package
        torchtext 0.11.0 requires torch==1.10.0, but you have torch 1.3.1+cpu which is incomp
        torchaudio 0.10.0+cu111 requires torch==1.10.0, but you have torch 1.3.1+cpu which is
        Successfully installed torch-1.3.1+cpu torchvision-0.4.2+cpu
        Collecting git+https://github.com/onnx/onnx-tensorflow.git@v1.6.0-tf-1.15
          Cloning https://github.com/onnx/onnx-tensorflow.git (to revision v1.6.0-tf-1.15) to
            Running command git clone -q https://github.com/onnx/onnx-tensorflow.git /tmp/pip-
```

```
    Running command git checkout -q 6b9e76d6fca74d5ddbf47049b9670120abaaf70f
Collecting onnx>=1.6.0
  Downloading onnx-1.10.2-cp37-cp37m-manylinux_2_12_x86_64.manylinux2010_x86_64.whl (
    |████████████████████████████████| 12.7 MB 14.0 MB/s
Requirement already satisfied: PyYAML in /usr/local/lib/python3.7/dist-packages (from
Requirement already satisfied: numpy>=1.16.6 in /usr/local/lib/python3.7/dist-package
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from on
Requirement already satisfied: typing-extensions>=3.6.2.1 in /usr/local/lib/python3.7
Requirement already satisfied: protobuf in /usr/local/lib/python3.7/dist-packages (fr
Building wheels for collected packages: onnx-tf
  Building wheel for onnx-tf (setup.py) ... done
  Created wheel for onnx-tf: filename=onnx_tf-1.6.0-py3-none-any.whl size=181668 sha2
  Stored in directory: /tmp/pip-ephem-wheel-cache-4jmho_2j/wheels/af/e5/e9/78a20b9317
Successfully built onnx-tf
Installing collected packages: onnx, onnx-tf
Successfully installed onnx-1.10.2 onnx-tf-1.6.0
Requirement already satisfied: onnx in /usr/local/lib/python3.7/dist-packages (1.10.2
Requirement already satisfied: typing-extensions>=3.6.2.1 in /usr/local/lib/python3.7
Requirement already satisfied: numpy>=1.16.6 in /usr/local/lib/python3.7/dist-package
Requirement already satisfied: six in /usr/local/lib/python3.7/dist-packages (from on
Requirement already satisfied: protobuf in /usr/local/lib/python3.7/dist-packages (fr
```

```
%tensorflow_version 1.x
```

```
TensorFlow 1.x selected.
```

```
!wget -O model.pt "https://storage.googleapis.com/vakyansh-open-models/models/tamil/ta-IN/
```

```
--2022-01-18 13:34:56--  https://storage.googleapis.com/vakyansh-open-models/models/1
Resolving storage.googleapis.com (storage.googleapis.com)... 74.125.143.128, 173.194
Connecting to storage.googleapis.com (storage.googleapis.com)|74.125.143.128|:443...
HTTP request sent, awaiting response... 200 OK
Length: 1133060160 (1.1G) [application/octet-stream]
Saving to: 'model.pt'

model.pt            100%[===================>]   1.05G  95.7MB/s    in 11s

2022-01-18 13:35:07 (98.1 MB/s) - 'model.pt' saved [1133060160/1133060160]
```