

assignment-11-1

November 13, 2023

```
[ ]: !pip install -q -U "tensorflow-text==2.8.*"
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4.9/4.9 MB
36.7 MB/s eta 0:00:00
498.1/498.1
MB 3.3 MB/s eta 0:00:00
42.6/42.6 kB
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1.1/1.1 MB
67.6 MB/s eta 0:00:00
5.8/5.8 MB
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462.3/462.3
kB 36.3 MB/s eta 0:00:00
1.4/1.4 MB
75.5 MB/s eta 0:00:00
4.9/4.9 MB
93.3 MB/s eta 0:00:00
781.3/781.3
kB 49.9 MB/s eta 0:00:00
ERROR: pip's dependency resolver does not currently take into account
all the packages that are installed. This behaviour is the source of the
following dependency conflicts.
tensorflow-datasets 4.9.3 requires protobuf>=3.20, but you have protobuf 3.19.6
which is incompatible.
tensorflow-metadata 1.14.0 requires protobuf<4.21,>=3.20.3, but you have
protobuf 3.19.6 which is incompatible.
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[ ]: !pip install -q tf-models-official==2.7.0
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1.8/1.8 MB
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119.7/119.7
kB 13.4 MB/s eta 0:00:00
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43.6/43.6 kB
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Preparing metadata (setup.py) ... done
612.3/612.3
kB 42.4 MB/s eta 0:00:00
241.2/241.2
kB 19.0 MB/s eta 0:00:00
5.4/5.4 MB
82.2 MB/s eta 0:00:00
5.4/5.4 MB
73.1 MB/s eta 0:00:00
5.4/5.4 MB
60.2 MB/s eta 0:00:00
53.3/53.3 kB
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Building wheel for sequeval (setup.py) ... done

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[ ]: !pip install numpy==1.21
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Collecting numpy==1.21
  Downloading numpy-1.21.0.zip (10.3 MB)
10.3/10.3 MB
40.6 MB/s eta 0:00:00
Installing build dependencies ... done
Getting requirements to build wheel ... done
Preparing metadata (pyproject.toml) ... done
Building wheels for collected packages: numpy
  Building wheel for numpy (pyproject.toml) ... canceledERROR:
Operation cancelled by user

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[ ]: !pip install tensorflow_text
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Collecting tensorflow_text
  Downloading tensorflow_text-2.14.0-cp310-cp310-manylinux_2_17_x86_64.manylinux
2014_x86_64.whl (6.5 MB)
6.5/6.5 MB
26.9 MB/s eta 0:00:00
Requirement already satisfied: tensorflow-hub>=0.13.0 in
/usr/local/lib/python3.10/dist-packages (from tensorflow_text) (0.15.0)
Requirement already satisfied: tensorflow<2.15,>=2.14.0 in

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/usr/local/lib/python3.10/dist-packages (from tensorflow_text) (2.14.0)
 Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (1.4.0)
 Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (1.6.3)
 Requirement already satisfied: flatbuffers>=23.5.26 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (23.5.26)
 Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (0.5.4)
 Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (0.2.0)
 Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (3.9.0)
 Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (16.0.6)
 Requirement already satisfied: ml-dtypes==0.2.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (0.2.0)
 Requirement already satisfied: numpy>=1.23.5 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (1.23.5)
 Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (3.3.0)
 Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (23.2)
 Requirement already satisfied: protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<5.0.0dev,>=3.20.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (3.20.3)
 Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (67.7.2)
 Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (1.16.0)
 Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (2.3.0)
 Requirement already satisfied: typing-extensions>=3.6.6 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (4.5.0)
 Requirement already satisfied: wrapt<1.15,>=1.11.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (1.14.1)
 Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in

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/usr/local/lib/python3.10/dist-packages (from
tensorflow<2.15,>=2.14.0->tensorflow_text) (0.34.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in
/usr/local/lib/python3.10/dist-packages (from
tensorflow<2.15,>=2.14.0->tensorflow_text) (1.59.2)
Requirement already satisfied: tensorboard<2.15,>=2.14 in
/usr/local/lib/python3.10/dist-packages (from
tensorflow<2.15,>=2.14.0->tensorflow_text) (2.14.1)
Requirement already satisfied: tensorflow-estimator<2.15,>=2.14.0 in
/usr/local/lib/python3.10/dist-packages (from
tensorflow<2.15,>=2.14.0->tensorflow_text) (2.14.0)
Requirement already satisfied: keras<2.15,>=2.14.0 in
/usr/local/lib/python3.10/dist-packages (from
tensorflow<2.15,>=2.14.0->tensorflow_text) (2.14.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in
/usr/local/lib/python3.10/dist-packages (from
astunparse>=1.6.0->tensorflow<2.15,>=2.14.0->tensorflow_text) (0.41.3)
Requirement already satisfied: google-auth<3,>=1.6.3 in
/usr/local/lib/python3.10/dist-packages (from
tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2.17.3)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in
/usr/local/lib/python3.10/dist-packages (from
tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (1.0.0)
Requirement already satisfied: markdown>=2.6.8 in
/usr/local/lib/python3.10/dist-packages (from
tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (3.5.1)
Requirement already satisfied: requests<3,>=2.21.0 in
/usr/local/lib/python3.10/dist-packages (from
tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2.31.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in
/usr/local/lib/python3.10/dist-packages (from
tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from
tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (3.0.1)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard
<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (5.3.2)
Requirement already satisfied: pyasn1-modules>=0.2.1 in
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard
<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (0.3.0)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.10/dist-
packages (from google-auth<3,>=1.6.3->tensorboard<2.15,>=2.14->tensorflow<2.15,>
=2.14.0->tensorflow_text) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in
/usr/local/lib/python3.10/dist-packages (from google-auth-oauthlib<1.1,>=0.5->te
nsorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in

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/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2
.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-
packages (from requests<3,>=2.21.0->tensorboard<2.15,>=2.14->tensorflow<2.15,>=2
.14.0->tensorflow_text) (3.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2
.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2
.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2023.7.22)
Requirement already satisfied: MarkupSafe>=2.1.1 in
/usr/local/lib/python3.10/dist-packages (from werkzeug>=1.0.1->tensorboard<2.15,
>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2.1.3)
Requirement already satisfied: pyasn1<0.6.0,>=0.4.6 in
/usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1->google-auth
<3,>=1.6.3->tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text)
(0.5.0)
Requirement already satisfied: oauthlib>=3.0.0 in
/usr/local/lib/python3.10/dist-packages (from requests-oauthlib>=0.7.0->google-
auth-oauthlib<1.1,>=0.5->tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tens
orflow_text) (3.2.2)
Installing collected packages: tensorflow_text
Successfully installed tensorflow_text-2.14.0

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```
[ ]: !pip install tf-models-official
```

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Collecting tf-models-official
  Downloading tf_models_official-2.14.2-py2.py3-none-any.whl (2.7 MB)
                                2.7/2.7 MB
16.2 MB/s eta 0:00:00
Requirement already satisfied: Cython in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (3.0.5)
Requirement already satisfied: Pillow in /usr/local/lib/python3.10/dist-packages
(from tf-models-official) (9.4.0)
Requirement already satisfied: gin-config in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (0.5.0)
Requirement already satisfied: google-api-python-client>=1.6.7 in
/usr/local/lib/python3.10/dist-packages (from tf-models-official) (2.84.0)
Collecting immutabledict (from tf-models-official)
  Downloading immutabledict-3.0.0-py3-none-any.whl (4.0 kB)
Requirement already satisfied: kaggle>=1.3.9 in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (1.5.16)
Requirement already satisfied: matplotlib in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (3.7.1)
Requirement already satisfied: numpy>=1.20 in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (1.23.5)
Requirement already satisfied: oauth2client in /usr/local/lib/python3.10/dist-

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packages (from tf-models-official) (4.1.3)
Requirement already satisfied: opencv-python-headless in
/usr/local/lib/python3.10/dist-packages (from tf-models-official) (4.8.1.78)
Requirement already satisfied: pandas>=0.22.0 in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (1.5.3)
Requirement already satisfied: psutil>=5.4.3 in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (5.9.5)
Requirement already satisfied: py-cpuinfo>=3.3.0 in
/usr/local/lib/python3.10/dist-packages (from tf-models-official) (9.0.0)
Requirement already satisfied: pycocotools in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (2.0.7)
Requirement already satisfied: pyyaml>=6.0.0 in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (6.0.1)
Collecting sacrebleu (from tf-models-official)
  Downloading sacrebleu-2.3.2-py3-none-any.whl (119 kB)
      119.7/119.7

kB 18.0 MB/s eta 0:00:00
Requirement already satisfied: scipy>=0.19.1 in
/usr/local/lib/python3.10/dist-packages (from tf-models-official) (1.11.3)
Collecting sentencepiece (from tf-models-official)
  Downloading
sentencepiece-0.1.99-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl
(1.3 MB)
      1.3/1.3 MB

34.9 MB/s eta 0:00:00
Collecting seqeval (from tf-models-official)
  Downloading seqeval-1.2.2.tar.gz (43 kB)
      43.6/43.6 kB

6.0 MB/s eta 0:00:00
  Preparing metadata (setup.py) ... done
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages
(from tf-models-official) (1.16.0)
Requirement already satisfied: tensorflow-datasets in
/usr/local/lib/python3.10/dist-packages (from tf-models-official) (4.9.3)
Requirement already satisfied: tensorflow-hub>=0.6.0 in
/usr/local/lib/python3.10/dist-packages (from tf-models-official) (0.15.0)
Collecting tensorflow-model-optimization>=0.4.1 (from tf-models-official)
  Downloading tensorflow_model_optimization-0.7.5-py2.py3-none-any.whl (241 kB)
      241.2/241.2

kB 22.8 MB/s eta 0:00:00
Requirement already satisfied: tensorflow-text~=2.14.0 in
/usr/local/lib/python3.10/dist-packages (from tf-models-official) (2.14.0)
Requirement already satisfied: tensorflow~=2.14.0 in
/usr/local/lib/python3.10/dist-packages (from tf-models-official) (2.14.0)
Requirement already satisfied: tf-slim>=1.1.0 in /usr/local/lib/python3.10/dist-
packages (from tf-models-official) (1.1.0)

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Requirement already satisfied: httplib2<1dev,>=0.15.0 in /usr/local/lib/python3.10/dist-packages (from google-api-python-client>=1.6.7->tf-models-official) (0.22.0)

Requirement already satisfied: google-auth<3.0.0dev,>=1.19.0 in /usr/local/lib/python3.10/dist-packages (from google-api-python-client>=1.6.7->tf-models-official) (2.17.3)

Requirement already satisfied: google-auth-httplib2>=0.1.0 in /usr/local/lib/python3.10/dist-packages (from google-api-python-client>=1.6.7->tf-models-official) (0.1.1)

Requirement already satisfied: google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5 in /usr/local/lib/python3.10/dist-packages (from google-api-python-client>=1.6.7->tf-models-official) (2.11.1)

Requirement already satisfied: uritemplate<5,>=3.0.1 in /usr/local/lib/python3.10/dist-packages (from google-api-python-client>=1.6.7->tf-models-official) (4.1.1)

Requirement already satisfied: certifi in /usr/local/lib/python3.10/dist-packages (from kaggle>=1.3.9->tf-models-official) (2023.7.22)

Requirement already satisfied: python-dateutil in /usr/local/lib/python3.10/dist-packages (from kaggle>=1.3.9->tf-models-official) (2.8.2)

Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-packages (from kaggle>=1.3.9->tf-models-official) (2.31.0)

Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages (from kaggle>=1.3.9->tf-models-official) (4.66.1)

Requirement already satisfied: python-slugify in /usr/local/lib/python3.10/dist-packages (from kaggle>=1.3.9->tf-models-official) (8.0.1)

Requirement already satisfied: urllib3 in /usr/local/lib/python3.10/dist-packages (from kaggle>=1.3.9->tf-models-official) (2.0.7)

Requirement already satisfied: bleach in /usr/local/lib/python3.10/dist-packages (from kaggle>=1.3.9->tf-models-official) (6.1.0)

Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas>=0.22.0->tf-models-official) (2023.3.post1)

Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (1.4.0)

Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (1.6.3)

Requirement already satisfied: flatbuffers>=23.5.26 in /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (23.5.26)

Requirement already satisfied: gast!=0.5.0,!=0.5.1,!=0.5.2,>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (0.5.4)

Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (0.2.0)

Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.10/dist-

packages (from tensorflow~=2.14.0->tf-models-official) (3.9.0)
 Requirement already satisfied: libclang>=13.0.0 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (16.0.6)
 Requirement already satisfied: ml-dtypes==0.2.0 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (0.2.0)
 Requirement already satisfied: opt-einsum>=2.3.2 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (3.3.0)
 Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (23.2)
 Requirement already satisfied:
 protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<5.0.0dev,>=3.20.3
 in /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (3.20.3)
 Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (67.7.2)
 Requirement already satisfied: termcolor>=1.1.0 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (2.3.0)
 Requirement already satisfied: typing-extensions>=3.6.6 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (4.5.0)
 Requirement already satisfied: wrapt<1.15,>=1.11.0 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (1.14.1)
 Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (0.34.0)
 Requirement already satisfied: grpcio<2.0,>=1.24.3 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (1.59.2)
 Requirement already satisfied: tensorboard<2.15,>=2.14 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (2.14.1)
 Requirement already satisfied: tensorflow-estimator<2.15,>=2.14.0 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (2.14.0)
 Requirement already satisfied: keras<2.15,>=2.14.0 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow~=2.14.0->tf-models-official) (2.14.0)
 Requirement already satisfied: dm-tree~=0.1.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow-model-optimization>=0.4.1->tf-models-official) (0.1.8)
 Requirement already satisfied: contourpy>=1.0.1 in
 /usr/local/lib/python3.10/dist-packages (from matplotlib->tf-models-official) (1.2.0)
 Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-

packages (from matplotlib->tf-models-official) (0.12.1)
 Requirement already satisfied: fonttools>=4.22.0 in
 /usr/local/lib/python3.10/dist-packages (from matplotlib->tf-models-official)
 (4.44.0)
 Requirement already satisfied: kiwisolver>=1.0.1 in
 /usr/local/lib/python3.10/dist-packages (from matplotlib->tf-models-official)
 (1.4.5)
 Requirement already satisfied: pyparsing>=2.3.1 in
 /usr/local/lib/python3.10/dist-packages (from matplotlib->tf-models-official)
 (3.1.1)
 Requirement already satisfied: pyasn1>=0.1.7 in /usr/local/lib/python3.10/dist-
 packages (from oauth2client->tf-models-official) (0.5.0)
 Requirement already satisfied: pyasn1-modules>=0.0.5 in
 /usr/local/lib/python3.10/dist-packages (from oauth2client->tf-models-official)
 (0.3.0)
 Requirement already satisfied: rsa>=3.1.4 in /usr/local/lib/python3.10/dist-
 packages (from oauth2client->tf-models-official) (4.9)
 Collecting portalocker (from sacrebleu->tf-models-official)
 Downloading portalocker-2.8.2-py3-none-any.whl (17 kB)
 Requirement already satisfied: regex in /usr/local/lib/python3.10/dist-packages
 (from sacrebleu->tf-models-official) (2023.6.3)
 Requirement already satisfied: tabulate>=0.8.9 in
 /usr/local/lib/python3.10/dist-packages (from sacrebleu->tf-models-official)
 (0.9.0)
 Collecting colorama (from sacrebleu->tf-models-official)
 Downloading colorama-0.4.6-py2.py3-none-any.whl (25 kB)
 Requirement already satisfied: lxml in /usr/local/lib/python3.10/dist-packages
 (from sacrebleu->tf-models-official) (4.9.3)
 Requirement already satisfied: scikit-learn>=0.21.3 in
 /usr/local/lib/python3.10/dist-packages (from sequeval->tf-models-official)
 (1.2.2)
 Requirement already satisfied: array-record in /usr/local/lib/python3.10/dist-
 packages (from tensorflow-datasets->tf-models-official) (0.5.0)
 Requirement already satisfied: click in /usr/local/lib/python3.10/dist-packages
 (from tensorflow-datasets->tf-models-official) (8.1.7)
 Requirement already satisfied: etils[enp,epath,etree]>=0.9.0 in
 /usr/local/lib/python3.10/dist-packages (from tensorflow-datasets->tf-models-
 official) (1.5.2)
 Requirement already satisfied: promise in /usr/local/lib/python3.10/dist-
 packages (from tensorflow-datasets->tf-models-official) (2.3)
 Requirement already satisfied: tensorflow-metadata in
 /usr/local/lib/python3.10/dist-packages (from tensorflow-datasets->tf-models-
 official) (1.14.0)
 Requirement already satisfied: toml in /usr/local/lib/python3.10/dist-packages
 (from tensorflow-datasets->tf-models-official) (0.10.2)
 Requirement already satisfied: wheel<1.0,>=0.23.0 in
 /usr/local/lib/python3.10/dist-packages (from
 astunparse>=1.6.0->tensorflow~=2.14.0->tf-models-official) (0.41.3)

Requirement already satisfied: fsspec in /usr/local/lib/python3.10/dist-packages (from etils[enp,epath,etree]>=0.9.0->tensorflow-datasets->tf-models-official) (2023.6.0)

Requirement already satisfied: importlib_resources in /usr/local/lib/python3.10/dist-packages (from etils[enp,epath,etree]>=0.9.0->tensorflow-datasets->tf-models-official) (6.1.1)

Requirement already satisfied: zipp in /usr/local/lib/python3.10/dist-packages (from etils[enp,epath,etree]>=0.9.0->tensorflow-datasets->tf-models-official) (3.17.0)

Requirement already satisfied: googleapis-common-protos<2.0.dev0,>=1.56.2 in /usr/local/lib/python3.10/dist-packages (from google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-python-client>=1.6.7->tf-models-official) (1.61.0)

Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from google-auth<3.0.0dev,>=1.19.0->google-api-python-client>=1.6.7->tf-models-official) (5.3.2)

Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle>=1.3.9->tf-models-official) (3.3.2)

Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests->kaggle>=1.3.9->tf-models-official) (3.4)

Requirement already satisfied: joblib>=1.1.1 in /usr/local/lib/python3.10/dist-packages (from scikit-learn>=0.21.3->sequeval->tf-models-official) (1.3.2)

Requirement already satisfied: threadpoolctl>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from scikit-learn>=0.21.3->sequeval->tf-models-official) (3.2.0)

Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow~=2.14.0->tf-models-official) (1.0.0)

Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow~=2.14.0->tf-models-official) (3.5.1)

Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow~=2.14.0->tf-models-official) (0.7.2)

Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.15,>=2.14->tensorflow~=2.14.0->tf-models-official) (3.0.1)

Requirement already satisfied: webencodings in /usr/local/lib/python3.10/dist-packages (from bleach->kaggle>=1.3.9->tf-models-official) (0.5.1)

Requirement already satisfied: text-unidecode>=1.3 in /usr/local/lib/python3.10/dist-packages (from python-slugify->kaggle>=1.3.9->tf-models-official) (1.3)

Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from google-auth-oauthlib<1.1,>=0.5->tensorboard<2.15,>=2.14->tensorflow~=2.14.0->tf-models-official) (1.3.1)

Requirement already satisfied: MarkupSafe>=2.1.1 in
 /usr/local/lib/python3.10/dist-packages (from
 werkzeug>=1.0.1->tensorboard<2.15,>=2.14->tensorflow~=2.14.0->tf-models-
 official) (2.1.3)

Requirement already satisfied: oauthlib>=3.0.0 in
 /usr/local/lib/python3.10/dist-packages (from requests-oauthlib>=0.7.0->google-
 auth-oauthlib<1.1,>=0.5->tensorboard<2.15,>=2.14->tensorflow~=2.14.0->tf-models-
 official) (3.2.2)

Building wheels for collected packages: sequeval
 Building wheel for sequeval (setup.py) ... done
 Created wheel for sequeval: filename=sequeval-1.2.2-py3-none-any.whl size=16161
 sha256=22340384ed3709f8c7d0e194ba3654b7dae2150ff8297f52b3b099223e3b11aa
 Stored in directory: /root/.cache/pip/wheels/1a/67/4a/ad4082dd7dfc30f2abfe4d80
 a2ed5926a506eb8a972b4767fa
 Successfully built sequeval

Installing collected packages: sentencepiece, tensorflow-model-optimization,
 portalocker, immutabledict, colorama, sacrebleu, sequeval, tf-models-official
 Successfully installed colorama-0.4.6 immutabledict-3.0.0 portalocker-2.8.2
 sacrebleu-2.3.2 sentencepiece-0.1.99 sequeval-1.2.2 tensorflow-model-
 optimization-0.7.5 tf-models-official-2.14.2

```
[ ]: import os
import shutil

import tensorflow as tf
import tensorflow_hub as hub
import tensorflow_text as text
from official.nlp import optimization # to create AdamW optimizer

import matplotlib.pyplot as plt

tf.get_logger().setLevel('ERROR')
```

```
[ ]: from google.colab import drive
drive.mount('/content/drive')
```

Drive already mounted at /content/drive; to attempt to forcibly remount, call
 drive.mount("/content/drive", force_remount=True).

```
[ ]: file_path = '/content/sample_data/california_housing_train.csv'
```

```
[ ]: import pandas as pd
df = pd.read_csv(file_path)
```

```
[ ]: import pandas as pd
import tensorflow as tf
```

```

# Read the CSV file
file_path = '/content/sample_data/california_housing_train.csv'
df = pd.read_csv(file_path)

# Assuming you want to predict a column, for example 'median_house_value'
target = df.pop('median_house_value')

# Create a TensorFlow Dataset
dataset = tf.data.Dataset.from_tensor_slices((df.values, target.values))

# Batch the dataset
batch_size = 32
dataset = dataset.batch(batch_size)

# Explore the dataset
for batch in dataset.take(1):
    features, labels = batch
    print(features, labels)

```

```

tf.Tensor(
[[-1.1431e+02  3.4190e+01  1.5000e+01  5.6120e+03  1.2830e+03  1.0150e+03
   4.7200e+02  1.4936e+00]
 [-1.1447e+02  3.4400e+01  1.9000e+01  7.6500e+03  1.9010e+03  1.1290e+03
   4.6300e+02  1.8200e+00]
 [-1.1456e+02  3.3690e+01  1.7000e+01  7.2000e+02  1.7400e+02  3.3300e+02
   1.1700e+02  1.6509e+00]
 [-1.1457e+02  3.3640e+01  1.4000e+01  1.5010e+03  3.3700e+02  5.1500e+02
   2.2600e+02  3.1917e+00]
 [-1.1457e+02  3.3570e+01  2.0000e+01  1.4540e+03  3.2600e+02  6.2400e+02
   2.6200e+02  1.9250e+00]
 [-1.1458e+02  3.3630e+01  2.9000e+01  1.3870e+03  2.3600e+02  6.7100e+02
   2.3900e+02  3.3438e+00]
 [-1.1458e+02  3.3610e+01  2.5000e+01  2.9070e+03  6.8000e+02  1.8410e+03
   6.3300e+02  2.6768e+00]
 [-1.1459e+02  3.4830e+01  4.1000e+01  8.1200e+02  1.6800e+02  3.7500e+02
   1.5800e+02  1.7083e+00]
 [-1.1459e+02  3.3610e+01  3.4000e+01  4.7890e+03  1.1750e+03  3.1340e+03
   1.0560e+03  2.1782e+00]
 [-1.1460e+02  3.4830e+01  4.6000e+01  1.4970e+03  3.0900e+02  7.8700e+02
   2.7100e+02  2.1908e+00]
 [-1.1460e+02  3.3620e+01  1.6000e+01  3.7410e+03  8.0100e+02  2.4340e+03
   8.2400e+02  2.6797e+00]
 [-1.1460e+02  3.3600e+01  2.1000e+01  1.9880e+03  4.8300e+02  1.1820e+03
   4.3700e+02  1.6250e+00]
 [-1.1461e+02  3.4840e+01  4.8000e+01  1.2910e+03  2.4800e+02  5.8000e+02
   2.1100e+02  2.1571e+00]
 [-1.1461e+02  3.4830e+01  3.1000e+01  2.4780e+03  4.6400e+02  1.3460e+03

```

```

4.7900e+02 3.2120e+00]
[-1.1463e+02 3.2760e+01 1.5000e+01 1.4480e+03 3.7800e+02 9.4900e+02
3.0000e+02 8.5850e-01]
[-1.1465e+02 3.4890e+01 1.7000e+01 2.5560e+03 5.8700e+02 1.0050e+03
4.0100e+02 1.6991e+00]
[-1.1465e+02 3.3600e+01 2.8000e+01 1.6780e+03 3.2200e+02 6.6600e+02
2.5600e+02 2.9653e+00]
[-1.1465e+02 3.2790e+01 2.1000e+01 4.4000e+01 3.3000e+01 6.4000e+01
2.7000e+01 8.5710e-01]
[-1.1466e+02 3.2740e+01 1.7000e+01 1.3880e+03 3.8600e+02 7.7500e+02
3.2000e+02 1.2049e+00]
[-1.1467e+02 3.3920e+01 1.7000e+01 9.7000e+01 2.4000e+01 2.9000e+01
1.5000e+01 1.2656e+00]
[-1.1468e+02 3.3490e+01 2.0000e+01 1.4910e+03 3.6000e+02 1.1350e+03
3.0300e+02 1.6395e+00]
[-1.1473e+02 3.3430e+01 2.4000e+01 7.9600e+02 2.4300e+02 2.2700e+02
1.3900e+02 8.9640e-01]
[-1.1494e+02 3.4550e+01 2.0000e+01 3.5000e+02 9.5000e+01 1.1900e+02
5.8000e+01 1.6250e+00]
[-1.1498e+02 3.3820e+01 1.5000e+01 6.4400e+02 1.2900e+02 1.3700e+02
5.2000e+01 3.2097e+00]
[-1.1522e+02 3.3540e+01 1.8000e+01 1.7060e+03 3.9700e+02 3.4240e+03
2.8300e+02 1.6250e+00]
[-1.1532e+02 3.2820e+01 3.4000e+01 5.9100e+02 1.3900e+02 3.2700e+02
8.9000e+01 3.6528e+00]
[-1.1537e+02 3.2820e+01 3.0000e+01 1.6020e+03 3.2200e+02 1.1300e+03
3.3500e+02 3.5735e+00]
[-1.1537e+02 3.2820e+01 1.4000e+01 1.2760e+03 2.7000e+02 8.6700e+02
2.6100e+02 1.9375e+00]
[-1.1537e+02 3.2810e+01 3.2000e+01 7.4100e+02 1.9100e+02 6.2300e+02
1.6900e+02 1.7604e+00]
[-1.1537e+02 3.2810e+01 2.3000e+01 1.4580e+03 2.9400e+02 8.6600e+02
2.7500e+02 2.3594e+00]
[-1.1538e+02 3.2820e+01 3.8000e+01 1.8920e+03 3.9400e+02 1.1750e+03
3.7400e+02 1.9939e+00]
[-1.1538e+02 3.2810e+01 3.5000e+01 1.2630e+03 2.6200e+02 9.5000e+02
2.4100e+02 1.8958e+00]], shape=(32, 8), dtype=float64) tf.Tensor(
[ 66900.  80100.  85700.  73400.  65500.  74000.  82400.  48500.  58400.
  48100.  86500.  62000.  48600.  70400.  45000.  69100.  94900.  25000.
  44000.  27500.  44400.  59200.  50000.  71300.  53500. 100000.  71100.
  80900.  68600.  74300.  65800.  67500.], shape=(32,), dtype=float64)

```

```

[ ]: from sklearn.model_selection import train_test_split

seed = 42
train_df, val_df = train_test_split(df, test_size=0.2, random_state=seed)

```

```
[ ]: import pandas as pd
from sklearn.model_selection import train_test_split
import tensorflow as tf

# Load your dataset
file_path = '/content/sample_data/california_housing_train.csv' # Update this
    ↳ to your dataset path
df = pd.read_csv(file_path)

# Split the dataset into training and validation sets
train_df, val_df = train_test_split(df, test_size=0.2, random_state=42) # You
    ↳ can adjust the test_size and random_state

# Rest of your code for creating TensorFlow datasets
AUTOTUNE = tf.data.AUTOTUNE

def df_to_dataset(dataframe, shuffle=True, batch_size=32):
    dataframe = dataframe.copy()
    labels = dataframe.pop('latitude') # Replace 'latitude' with your target
    ↳ column
    ds = tf.data.Dataset.from_tensor_slices((dict(dataframe), labels))
    if shuffle:
        ds = ds.shuffle(buffer_size=len(dataframe))
    ds = ds.batch(batch_size)
    ds = ds.prefetch(buffer_size=AUTOTUNE)
    return ds

train_ds = df_to_dataset(train_df)
val_ds = df_to_dataset(val_df, shuffle=False)

# Continue with your code...
```

```
[ ]: import pandas as pd
import tensorflow as tf
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler

# Load dataset
file_path = '/content/sample_data/california_housing_train.csv'
df = pd.read_csv(file_path)

# Optional: Preprocess the DataFrame (handle missing values, encode categorical
    ↳ variables, etc.)

# Split into features and target
target_column = 'median_house_value' # Change this to your target column
X = df.drop(target_column, axis=1)
```

```

y = df[target_column]

# Normalize or standardize X if needed
scaler = StandardScaler()
X = scaler.fit_transform(X)

```

```

[ ]: # Split the dataset
seed = 40
X_train, X_temp, y_train, y_temp = train_test_split(X, y, test_size=0.4,
↳random_state=seed)
X_val, X_test, y_val, y_test = train_test_split(X_temp, y_temp, test_size=0.5,
↳random_state=seed)

```

```

[ ]: AUTOTUNE = tf.data.AUTOTUNE
batch_size = 32

# Function to create a TensorFlow dataset
def create_tf_dataset(X, y, shuffle=True, batch_size=32):
    ds = tf.data.Dataset.from_tensor_slices((X, y))
    if shuffle:
        ds = ds.shuffle(buffer_size=len(X))
    ds = ds.batch(batch_size)
    ds = ds.prefetch(buffer_size=AUTOTUNE)
    return ds

# Create TensorFlow datasets
train_ds = create_tf_dataset(X_train, y_train)
val_ds = create_tf_dataset(X_val, y_val, shuffle=False)
test_ds = create_tf_dataset(X_test, y_test, shuffle=False)

```

```

[ ]: def print_dataset_samples(dataset, num_samples=3):
    for feature_batch, label_batch in dataset.take(1):
        for i in range(num_samples):
            print(f'Features: {feature_batch[i].numpy()}')
            print(f'Label: {label_batch[i].numpy()}\n')

print("Training Dataset Samples:")
print_dataset_samples(train_ds)

print("Validation Dataset Samples:")
print_dataset_samples(val_ds)

print("Test Dataset Samples:")
print_dataset_samples(test_ds)

```

Training Dataset Samples:
Features: [-0.23833724 -0.42354114 -1.23857071 0.59559876 0.1081627

0.09794753
0.03583281 1.42645634]
Label: 500001.0

Features: [0.67931933 -0.76509725 0.50932452 -0.43060312 -0.03893553
0.71651185
0.0176278 -0.80786006]
Label: 154200.0

Features: [-0.12363017 0.55433869 0.35042495 0.60936097 0.12951567
-0.09197785
0.15546574 0.82161395]
Label: 143300.0

Validation Dataset Samples:
Features: [-0.44780232 -0.45161424 -1.87416897 0.11942641 0.38575129
-0.11114463
0.30370654 -0.45882182]
Label: 135200.0

Features: [-1.33054804 1.00818722 1.22437257 -0.13930308 0.6775752
1.20526478
0.64960174 -1.19630922]
Label: 118100.0

Features: [-1.39538247 0.91928906 -0.68242223 -0.00259849 0.74637921
-0.06758376
0.56377812 -0.19447514]
Label: 350600.0

Test Dataset Samples:
Features: [-0.86174523 1.171947 0.19152539 -0.75034506 -0.77679924
-0.85080816
-0.79639623 -0.78186562]
Label: 113500.0

Features: [0.6144849 -0.741703 1.85997083 -0.04526133 -0.32838689
-0.3707674
-0.33606954 -0.12906978]
Label: 420000.0

Features: [0.56461226 -0.56390666 -1.23857071 0.4387096 0.09629994
0.32185039
0.19447648 1.26488203]
Label: 218300.0


```
[3]: !pip install tensorflow_text
```

```
Collecting tensorflow_text
```

```
  Downloading tensorflow_text-2.14.0-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (6.5 MB)
```

```
6.5/6.5 MB
```

```
44.8 MB/s eta 0:00:00
```

```
Requirement already satisfied: tensorflow-hub>=0.13.0 in
```

```
/usr/local/lib/python3.10/dist-packages (from tensorflow_text) (0.15.0)
```

```
Requirement already satisfied: tensorflow<2.15,>=2.14.0 in
```

```
/usr/local/lib/python3.10/dist-packages (from tensorflow_text) (2.14.0)
```

```
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (1.4.0)
```

```
Requirement already satisfied: astunparse>=1.6.0 in
```

```
/usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (1.6.3)
```

```
Requirement already satisfied: flatbuffers>=23.5.26 in
```

```
/usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (23.5.26)
```

```
Requirement already satisfied: gast!=0.5.0,!0.5.1,!0.5.2,>=0.2.1 in
```

```
/usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (0.5.4)
```

```
Requirement already satisfied: google-pasta>=0.1.1 in
```

```
/usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (0.2.0)
```

```
Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (3.9.0)
```

```
Requirement already satisfied: libclang>=13.0.0 in
```

```
/usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (16.0.6)
```

```
Requirement already satisfied: ml-dtypes==0.2.0 in
```

```
/usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (0.2.0)
```

```
Requirement already satisfied: numpy>=1.23.5 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (1.23.5)
```

```
Requirement already satisfied: opt-einsum>=2.3.2 in
```

```
/usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (3.3.0)
```

```
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (23.2)
```

```
Requirement already satisfied:
```

```
protobuf!=4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<5.0.0dev,>=3.20.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (3.20.3)
```

```
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (67.7.2)
```

```
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-
```

packages (from tensorflow<2.15,>=2.14.0->tensorflow_text) (1.16.0)
 Requirement already satisfied: termcolor>=1.1.0 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorflow<2.15,>=2.14.0->tensorflow_text) (2.3.0)
 Requirement already satisfied: typing-extensions>=3.6.6 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorflow<2.15,>=2.14.0->tensorflow_text) (4.5.0)
 Requirement already satisfied: wrapt<1.15,>=1.11.0 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorflow<2.15,>=2.14.0->tensorflow_text) (1.14.1)
 Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorflow<2.15,>=2.14.0->tensorflow_text) (0.34.0)
 Requirement already satisfied: grpcio<2.0,>=1.24.3 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorflow<2.15,>=2.14.0->tensorflow_text) (1.59.2)
 Requirement already satisfied: tensorboard<2.15,>=2.14 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorflow<2.15,>=2.14.0->tensorflow_text) (2.14.1)
 Requirement already satisfied: tensorflow-estimator<2.15,>=2.14.0 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorflow<2.15,>=2.14.0->tensorflow_text) (2.14.0)
 Requirement already satisfied: keras<2.15,>=2.14.0 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorflow<2.15,>=2.14.0->tensorflow_text) (2.14.0)
 Requirement already satisfied: wheel<1.0,>=0.23.0 in
 /usr/local/lib/python3.10/dist-packages (from
 astunparse>=1.6.0->tensorflow<2.15,>=2.14.0->tensorflow_text) (0.41.3)
 Requirement already satisfied: google-auth<3,>=1.6.3 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2.17.3)
 Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (1.0.0)
 Requirement already satisfied: markdown>=2.6.8 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (3.5.1)
 Requirement already satisfied: requests<3,>=2.21.0 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2.31.0)
 Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (0.7.2)
 Requirement already satisfied: werkzeug>=1.0.1 in
 /usr/local/lib/python3.10/dist-packages (from
 tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (3.0.1)
 Requirement already satisfied: cachetools<6.0,>=2.0.0 in
 /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard

```

<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (5.3.2)
Requirement already satisfied: pyasn1-modules>=0.2.1 in
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard
<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (0.3.0)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.10/dist-
packages (from google-auth<3,>=1.6.3->tensorboard<2.15,>=2.14->tensorflow<2.15,>
=2.14.0->tensorflow_text) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in
/usr/local/lib/python3.10/dist-packages (from google-auth-oauthlib<1.1,>=0.5->te
nsorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2
.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-
packages (from requests<3,>=2.21.0->tensorboard<2.15,>=2.14->tensorflow<2.15,>=2
.14.0->tensorflow_text) (3.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2
.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard<2
.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2023.7.22)
Requirement already satisfied: MarkupSafe>=2.1.1 in
/usr/local/lib/python3.10/dist-packages (from werkzeug>=1.0.1->tensorboard<2.15,
>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text) (2.1.3)
Requirement already satisfied: pyasn1<0.6.0,>=0.4.6 in
/usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1->google-auth
<3,>=1.6.3->tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tensorflow_text)
(0.5.0)
Requirement already satisfied: oauthlib>=3.0.0 in
/usr/local/lib/python3.10/dist-packages (from requests-oauthlib>=0.7.0->google-
auth-oauthlib<1.1,>=0.5->tensorboard<2.15,>=2.14->tensorflow<2.15,>=2.14.0->tens
orflow_text) (3.2.2)
Installing collected packages: tensorflow_text
Successfully installed tensorflow_text-2.14.0

```

```

[4]: import tensorflow as tf
import tensorflow_hub as hub
import tensorflow_text

tfhub_handle_encoder = 'https://tfhub.dev/tensorflow/small_bert/
↳bert_en_uncased_L-12_H-768_A-12/2'
tfhub_handle_preprocess = 'https://tfhub.dev/tensorflow/
↳bert_en_uncased_preprocess/3'

bert_preprocess_model = hub.KerasLayer(tfhub_handle_preprocess)
bert_model = hub.KerasLayer(tfhub_handle_encoder)

```

```
[5]: def build_classifier_model():
    text_input = tf.keras.layers.Input(shape=(), dtype=tf.string, name='text')
    preprocessing_layer = hub.KerasLayer(tfhub_handle_preprocess,
    ↪name='preprocessing')
    encoder_inputs = preprocessing_layer(text_input)
    encoder = hub.KerasLayer(tfhub_handle_encoder, trainable=True,
    ↪name='BERT_encoder')
    outputs = encoder(encoder_inputs)
    net = outputs['pooled_output']
    net = tf.keras.layers.Dropout(0.1)(net)
    net = tf.keras.layers.Dense(1, activation='sigmoid', name='classifier')(net)
    return tf.keras.Model(text_input, net)

model = build_classifier_model()
```

```
[6]: model.compile(optimizer='adam',
    loss='binary_crossentropy',
    metrics=['accuracy'])
```

```
[8]: test_text = ['sure is a great movie. i like it']
print(test_text)

text_preprocessed = bert_preprocess_model(test_text)

print(f'Keys      : {list(text_preprocessed.keys())}')
print(f'Shape      : {text_preprocessed["input_word_ids"].shape}')
print(f'Word Ids     : {text_preprocessed["input_word_ids"][0, :12]}')
print(f'Input Mask    : {text_preprocessed["input_mask"][0, :12]}')
print(f'Type Ids     : {text_preprocessed["input_type_ids"][0, :12]}')

['sure is a great movie. i like it']
Keys      : ['input_word_ids', 'input_type_ids', 'input_mask']
Shape      : (1, 128)
Word Ids   : [ 101 2469 2003 1037 2307 3185 1012 1045 2066 2009 102    0]
Input Mask : [1 1 1 1 1 1 1 1 1 1 1 0]
Type Ids   : [0 0 0 0 0 0 0 0 0 0 0 0]
```

```
[9]: bert_model = hub.KerasLayer(tfhub_handle_encoder)
```

```
[10]: bert_results = bert_model(text_preprocessed)

print(f'Loaded BERT: {tfhub_handle_encoder}')
print(f'Pooled Outputs Shape:{bert_results["pooled_output"].shape}')
print(f'Pooled Outputs Values:{bert_results["pooled_output"][0, :12]}')
print(f'Sequence Outputs Shape:{bert_results["sequence_output"].shape}')
print(f'Sequence Outputs Values:{bert_results["sequence_output"][0, :12]}')
```

Loaded BERT:

https://tfhub.dev/tensorflow/small_bert/bert_en_uncased_L-12_H-768_A-12/2

Pooled Outputs Shape:(1, 768)

Pooled Outputs Values:[0.27562302 0.0220592 0.61316353 -0.38410702
-0.24262239 -1.

0.01575971 -0.01057402 -0.11686126 -0.12149739 0.3210509 0.31505176]

Sequence Outputs Shape:(1, 128, 768)

Sequence Outputs Values:[[-0.38209137 0.26192373 -0.03789858 ... -0.2340353
0.10006617

-0.68768]

[0.21871108 0.29800376 -0.05649345 ... -0.10530257 -0.18246414
-0.21424693]

[0.06475549 0.14396279 0.73149806 ... 0.3738087 0.36286542
-0.9408501]

...

[0.06710664 -0.19816272 0.36512032 ... -0.49234077 0.05057085
0.09882294]

[-0.3989354 0.13868438 0.77379584 ... -0.789147 0.5287743
-0.58697253]

[0.09365423 0.6435768 0.39770842 ... -0.61784273 0.00768723
0.11496]]

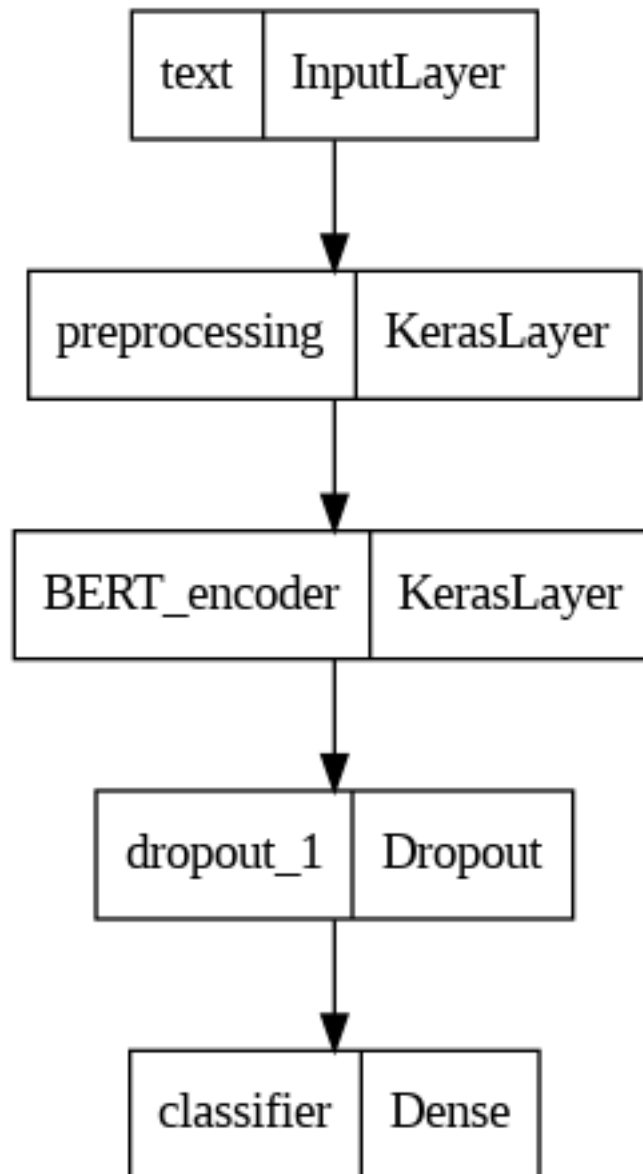
```
[11]: def build_classifier_model():  
    text_input = tf.keras.layers.Input(shape=(), dtype=tf.string, name='text')  
    preprocessing_layer = hub.KerasLayer(tfhub_handle_preprocess,   
    ↪name='preprocessing')  
    encoder_inputs = preprocessing_layer(text_input)  
    encoder = hub.KerasLayer(tfhub_handle_encoder, trainable=True,   
    ↪name='BERT_encoder')  
    outputs = encoder(encoder_inputs)  
    net = outputs['pooled_output']  
    net = tf.keras.layers.Dropout(0.1)(net)  
    net = tf.keras.layers.Dense(1, activation=None, name='classifier')(net)  
    return tf.keras.Model(text_input, net)
```

```
[12]: classifier_model = build_classifier_model()  
bert_raw_result = classifier_model(tf.constant(test_text))  
print(tf.sigmoid(bert_raw_result))
```

tf.Tensor([[0.5032732]], shape=(1, 1), dtype=float32)

```
[13]: tf.keras.utils.plot_model(classifier_model)
```

```
[13]:
```



```
[14]: loss = tf.keras.losses.BinaryCrossentropy(from_logits=True)

metrics = tf.metrics.BinaryAccuracy()
```

```
[ ]: # Importance of Cleaning Data: You learned how to clean textual data, which is
      ↪crucial for any NLP task. This includes removing punctuation, which can be
      ↪non-informative for many NLP models, and stop words, which are common words
      ↪that typically don't contribute much to the meaning of a sentence.
```

Stemming and Lemmatizing: These techniques reduce words to their base or root form, helping in standardizing words for model processing. Understanding the difference between stemming (which often results in a form that is not a valid word) and lemmatizing (which tries to bring words back to their dictionary form) is crucial.

Python Libraries Utilization: Skills in utilizing NLP libraries like NLTK or spaCy for these preprocessing steps.

BERT Model Architecture: You learned about BERT (Bidirectional Encoder Representations from Transformers) and its effectiveness in understanding the context of words in sentences.

Combining BERT with a Classifier: Skills in integrating BERT with a custom neural network layer for binary classification. This typically involved using a dense layer with a sigmoid activation function for the binary classification output.

Model Customization and Integration: Understanding how to customize a model to suit specific requirements, like binary classification, by adding layers on top of the BERT model.