Importing Librtaries

```
import tensorflow as tf

from imblearn.under_sampling import RandomUnderSampler
from sklearn.model_selection import train_test_split

import matplotlib.pyplot as plt
import numpy as np
import pandas as pd

import os
import json
import gzip
from urllib.request import urlopen

from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
```

Download and Import the Amazon Review Data (2018) Dataset

Dataset Link - https://nijianmo.github.io/amazon/index.html

```
# download data zip file
# matadata
# !wget http://deepyeti.ucsd.edu/jianmo/amazon/sample/meta_Computers.json.gz

# review data
!wget http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Cell_Phones_and_Accessories_5
!wget http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Arts_Crafts_and_Sewing_5.json
!wget http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Clothing_Shoes_and_Jewelry_5.
!wget http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Books_5.json.gz
!wget http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Electronics_5.json.gz
!wget http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Home_and_Kitchen_5.json.gz
!wget http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Kindle_Store_5.json.gz
!wget http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Sports_and_Outdoors_5.json.gz
!wget http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Toys_and_Games_5.json.gz
```

```
--2021-11-23 06:33:42--  http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Ce
Resolving deepyeti.ucsd.edu (deepyeti.ucsd.edu)... 169.228.63.50
Connecting to deepyeti.ucsd.edu (deepyeti.ucsd.edu)|169.228.63.50|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 169071325 (161M) [application/octet-stream]
```

```
Saving to: ‘Cell_Phones_and_Accessories_5.json.gz’

Cell_Phones_and_Acc 100%[===================>] 161.24M  50.3MB/s    in 3.4s

2021-11-23 06:33:46 (48.1 MB/s) - ‘Cell_Phones_and_Accessories_5.json.gz’ saved [1690

--2021-11-23 06:33:46--  http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Ar
Resolving deepyeti.ucsd.edu (deepyeti.ucsd.edu)... 169.228.63.50
Connecting to deepyeti.ucsd.edu (deepyeti.ucsd.edu)|169.228.63.50|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 53965563 (51M) [application/octet-stream]
Saving to: ‘Arts_Crafts_and_Sewing_5.json.gz’

Arts_Crafts_and_Sew 100%[===================>]  51.46M  39.6MB/s    in 1.3s

2021-11-23 06:33:47 (39.6 MB/s) - ‘Arts_Crafts_and_Sewing_5.json.gz’ saved [53965563/

--2021-11-23 06:33:47--  http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Cl
Resolving deepyeti.ucsd.edu (deepyeti.ucsd.edu)... 169.228.63.50
Connecting to deepyeti.ucsd.edu (deepyeti.ucsd.edu)|169.228.63.50|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 1262892731 (1.2G) [application/octet-stream]
Saving to: ‘Clothing_Shoes_and_Jewelry_5.json.gz’

Clothing_Shoes_and_ 100%[===================>]   1.18G  53.5MB/s    in 23s

2021-11-23 06:34:11 (52.4 MB/s) - ‘Clothing_Shoes_and_Jewelry_5.json.gz’ saved [12628

--2021-11-23 06:34:11--  http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Bo
Resolving deepyeti.ucsd.edu (deepyeti.ucsd.edu)... 169.228.63.50
Connecting to deepyeti.ucsd.edu (deepyeti.ucsd.edu)|169.228.63.50|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 7096438325 (6.6G) [application/octet-stream]
Saving to: ‘Books_5.json.gz’

Books_5.json.gz     100%[===================>]   6.61G  34.1MB/s    in 2m 17s

2021-11-23 06:36:28 (49.3 MB/s) - ‘Books_5.json.gz’ saved [7096438325/7096438325]

--2021-11-23 06:36:31--  http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/El
Resolving deepyeti.ucsd.edu (deepyeti.ucsd.edu)... 169.228.63.50
Connecting to deepyeti.ucsd.edu (deepyeti.ucsd.edu)|169.228.63.50|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 1251876861 (1.2G) [application/octet-stream]
Saving to: ‘Electronics_5.json.gz’

Electronics_5.json. 100%[===================>]   1.17G  28.2MB/s    in 24s

2021-11-23 06:36:56 (48.8 MB/s) - ‘Electronics_5.json.gz’ saved [1251876861/125187686

--2021-11-23 06:36:56--  http://deepyeti.ucsd.edu/jianmo/amazon/categoryFilesSmall/Ho
Resolving deepyeti.ucsd.edu (deepyeti.ucsd.edu)... 169.228.63.50
```

```
data_set_name = {
    1 : 'Cell_Phones_and_Accessories',
```

```
    2 : 'Arts_Crafts_and_Sewing',
    3 : 'Clothing_Shoes_and_Jewelry',
    4 : 'Books',
    5 : 'Electronics',
    6 : 'Kindle_Store',
    7 : 'Sports_and_Outdoors',
    8 : 'Toys_and_Games'
}


def extract_data(data_name):
  ### load the meta data
  data = []
  path = '/content/'+ data_name + '_5.json.gz'
  count = 1
  with gzip.open(path) as f:
    for l in f:
      data.append(json.loads(l.strip()))
      if count >= 100000:
        break
      count += 1

  # total length of list, this number equals total number of products
  print(len(data), ':', data_name)

  # first row of the list
  # print(data[0])

  return data


data = {}
for data_name in data_set_name.values():
  data[data_name] = extract_data(data_name)

    100000 : Cell_Phones_and_Accessories
    100000 : Arts_Crafts_and_Sewing
    100000 : Clothing_Shoes_and_Jewelry
    100000 : Books
    100000 : Electronics
    100000 : Kindle_Store
    100000 : Sports_and_Outdoors
    100000 : Toys_and_Games
```

Data Analysis and Preprocessing

```
def process_data(data_array, data_name):
  # convert list into pandas dataframe
  print('######[ Processing', data_name, 'Data ]######')
```

```
    df = pd.DataFrame.from_dict(data_array)
    df = df[['overall', 'reviewText']]

    print("Unique Rating : ", df['overall'].unique())

    df = df[df['reviewText'].notna()]

    # convert target type from float to int
    df = df.astype({'overall': 'int32'})

    # df['overall'].plot(kind='hist', title='Rating Distribution of {}'.format(data_name))
    # plt.show()

    # handle class imbalance problem
    rus  = RandomUnderSampler(random_state=42)
    df, _ = rus.fit_resample(df, df['overall'])
    df = pd.DataFrame(df, columns=['overall','reviewText'])
    print('Final size of data :', len(df), '\n')

    # convert target type from float to int
    df = df.astype({'overall': 'int32'})

    # df['overall'].plot(kind='hist', title='Target Distribution after undersampling of {}'.for
    # plt.show()

    return df


processed_data = {}
for data_name, data_array in data.items():
  processed_data[data_name] = process_data(data_array, data_name)
```

```
    ######[ Processing Cell_Phones_and_Accessories Data ]######
    Unique Rating :  [5. 3. 2. 4. 1.]
    Final size of data : 30380

    ######[ Processing Arts_Crafts_and_Sewing Data ]######
    Unique Rating :  [4. 5. 2. 3. 1.]
    Final size of data : 12955

    ######[ Processing Clothing_Shoes_and_Jewelry Data ]######
    Unique Rating :  [5. 4. 2. 3. 1.]
    Final size of data : 22750

    ######[ Processing Books Data ]######
    Unique Rating :  [5. 3. 2. 4. 1.]
    Final size of data : 17420

    ######[ Processing Electronics Data ]######
    Unique Rating :  [5. 3. 4. 2. 1.]
    Final size of data : 17525
```

```
######[ Processing Kindle_Store Data ]######
Unique Rating :  [4. 5. 3. 2. 1.]
Final size of data : 18655

######[ Processing Sports_and_Outdoors Data ]######
Unique Rating :  [5. 1. 4. 3. 2.]
Final size of data : 16610

######[ Processing Toys_and_Games Data ]######
Unique Rating :  [5. 4. 2. 1. 3.]
Final size of data : 16630
```

```
# Marge the data of all catagories to a single dataframe
final_data = pd.concat(processed_data.values())
final_data.shape
```

```
(152925, 2)
```

```
# converting rationg to binary labels (1 = Good, 0 = Bad)
y = final_data.iloc[:, 0].values > 2
y = np.array([int(i) for i in y])
```

```
# split data into training and validation set in ratio of 9:1
X_train, X_test, Y_train, Y_test = train_test_split(final_data['reviewText'], y, random_state

print('No. of samples Training data :', X_train.shape[0])
print('No. of samples Validation data :', X_test.shape[0])
```

```
No. of samples Training data : 137632
No. of samples Validation data : 15293
```

```
# Get one hot encoding of Y_train
# Y_train = pd.get_dummies(Y_train)
# Y_test = pd.get_dummies(Y_test)

# Y_train.head()
```

Tensorflow Word Preprocessing

```
vocab_size = 10000
embedding_dim = 16
max_length = 120
trunc_type='post'
oov_tok = "<OOV>"
```

```
tokenizer = Tokenizer(num_words = vocab_size, oov_token=oov_tok)
```

```
tokenizer = Tokenizer(num_words = vocab_size, oov_token=oov_tok)
tokenizer.fit_on_texts(X_train)
word_index = tokenizer.word_index

sequences = tokenizer.texts_to_sequences(X_train)
padded = pad_sequences(sequences, maxlen=max_length, truncating=trunc_type)

testing_sequences = tokenizer.texts_to_sequences(X_test)
testing_padded = pad_sequences(testing_sequences, maxlen=max_length)


reverse_word_index = dict([(value, key) for (key, value) in word_index.items()])

def decode_review(text):
    return ' '.join([reverse_word_index.get(i, '?') for i in text])

print(decode_review(padded[1]))
print(X_train[1])
```

```
? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
1    Characters you don't care about, exposition in...
1    This is a rugged case, but you will not be abl...
1                        pile of garbage, don't buy it
1    but definitly NOT...  tiny book..  make robot ...
1    From buying this totally waste of technology. ...
1    I am so frustrated with Anita Shreve.  I canno...
1    The only thing nice I can say is it is made of...
1                                          Toxic??!!!
Name: reviewText, dtype: object
```

```
padded.shape
```

```
(137632, 120)
```

TF Model Training

```
# Model Definition with Conv1D
model = tf.keras.Sequential([
    tf.keras.layers.Embedding(vocab_size, embedding_dim, input_length=max_length),
    tf.keras.layers.Conv1D(120, 5, activation='relu'),
    tf.keras.layers.GlobalAveragePooling1D(),
    tf.keras.layers.Dense(32, activation='relu'),
    tf.keras.layers.Dense(1, activation='sigmoid')
])
opt = tf.keras.optimizers.Adam(learning_rate=0.0001)
model.compile(loss='binary_crossentropy', optimizer=opt, metrics=['accuracy'])
model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding (Embedding)       (None, 120, 16)           160000

 conv1d (Conv1D)             (None, 116, 120)          9720

 global_average_pooling1d (G  (None, 120)              0
 lobalAveragePooling1D)

 dense (Dense)               (None, 32)                3872

 dense_1 (Dense)             (None, 1)                 33

=================================================================
Total params: 173,625
Trainable params: 173,625
Non-trainable params: 0
_________________________________________________________________
```

```
num_epochs = 10
history = model.fit(padded, Y_train, epochs=num_epochs, validation_data=(testing_padded, Y_te
```

```
Epoch 1/10
4301/4301 [==============================] - 39s 7ms/step - loss: 0.5674 - accuracy: 0.7
Epoch 2/10
4301/4301 [==============================] - 28s 7ms/step - loss: 0.4481 - accuracy: 0.7
Epoch 3/10
4301/4301 [==============================] - 28s 7ms/step - loss: 0.4218 - accuracy: 0.8
Epoch 4/10
4301/4301 [==============================] - 30s 7ms/step - loss: 0.4076 - accuracy: 0.8
Epoch 5/10
4301/4301 [==============================] - 30s 7ms/step - loss: 0.3979 - accuracy: 0.8
Epoch 6/10
4301/4301 [==============================] - 30s 7ms/step - loss: 0.3907 - accuracy: 0.8
Epoch 7/10
4301/4301 [==============================] - 30s 7ms/step - loss: 0.3847 - accuracy: 0.8
Epoch 8/10
4301/4301 [==============================] - 28s 7ms/step - loss: 0.3797 - accuracy: 0.8
Epoch 9/10
4301/4301 [==============================] - 28s 7ms/step - loss: 0.3750 - accuracy: 0.8
Epoch 10/10
4301/4301 [==============================] - 29s 7ms/step - loss: 0.3710 - accuracy: 0.8
```

```
num_epochs = 10
history = model.fit(padded, Y_train, epochs=num_epochs, validation_data=(testing_padded, Y_te
```

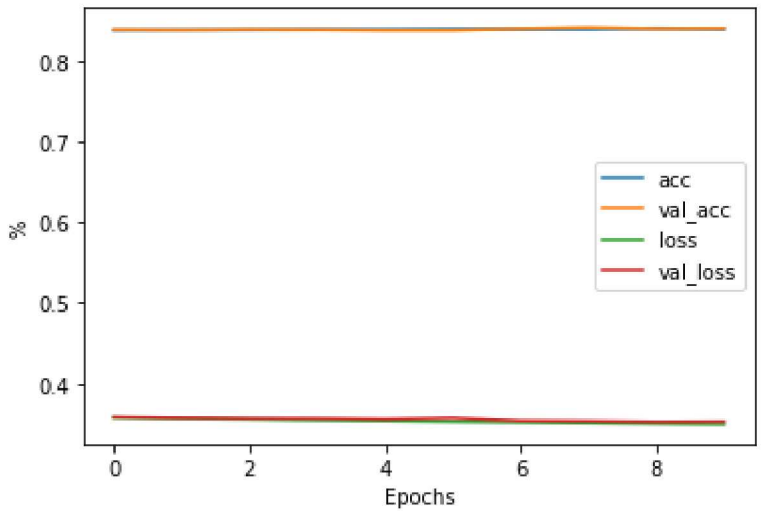
```
Epoch 1/10
4301/4301 [==============================] - 78s 18ms/step - loss: 0.3577 - accuracy: 0
Epoch 2/10
4301/4301 [==============================] - 74s 17ms/step - loss: 0.3567 - accuracy: 0
Epoch 3/10
```

```
4301/4301 [==============================] - 77s 18ms/step - loss: 0.3558 - accuracy: 0
Epoch 4/10
4301/4301 [==============================] - 76s 18ms/step - loss: 0.3545 - accuracy: 0
Epoch 5/10
4301/4301 [==============================] - 83s 19ms/step - loss: 0.3538 - accuracy: 0
Epoch 6/10
4301/4301 [==============================] - 75s 18ms/step - loss: 0.3528 - accuracy: 0
Epoch 7/10
4301/4301 [==============================] - 83s 19ms/step - loss: 0.3520 - accuracy: 0
Epoch 8/10
4301/4301 [==============================] - 82s 19ms/step - loss: 0.3512 - accuracy: 0
Epoch 9/10
4301/4301 [==============================] - 85s 20ms/step - loss: 0.3504 - accuracy: 0
Epoch 10/10
4301/4301 [==============================] - 71s 17ms/step - loss: 0.3497 - accuracy: 0
```

```
model.save('/content/drive/MyDrive/Colab Notebooks/Amazon Review/model.h5')
```

Evaluate Model Performance

```
plt.plot(history.history['accuracy'])
plt.plot(history.history['val_accuracy'])
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.xlabel("Epochs")
plt.ylabel('%')
plt.legend(['acc', 'val_acc', 'loss', 'val_loss'])
plt.show()
```




```
from sklearn.metrics import confusion_matrix, classification_report
```

```
y_pred = model.predict(testing_padded).arg

print(confusion_matrix(Y_test, y_pred))
print(classification_report(Y_test, y_pred))
```

Test With Custom Input

```
your_review = "it is not good but cover is not good"


your_padded_review = pad_sequences(tokenizer.texts_to_sequences([your_review]), maxlen=max_le
prediction = model.predict(your_padded_review)[0][0]

if prediction > 0.5:
  print('good')
else:
  print('not good')

prediction
```

```
not good
0.48141798
```

✓ 0s completed at 12:33 PM