Downloading the dataset from Kaggle

```
! pip install -q kaggle

from google.colab import files

files.upload()
```

```
! mkdir ~/.kaggle

!cp kaggle.json ~/.kaggle/

! chmod 600 ~/.kaggle/kaggle.json

! kaggle datasets list
```

```
! kaggle datasets download -d jp797498e/twitter-entity-sentiment-analysis
```

```
! mkdir input

! unzip twitter-entity-sentiment-analysis.zip -d input
```

Importing dependencies

```
import numpy as np
import pandas as pd

import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.model_selection import train_test_split

import tensorflow as tf
tf.random.set_seed(26)
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences

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

```
import itertools
```

```
train_df = pd.read_csv('./input/twitter_training.csv')
train_df.iloc[:, -1] = train_df.iloc[:, -1].astype(str)
```

```
train_df.tail()
```

	2401	Borderlands	Positive	im getting on borderlands and i will murder you all ,
74676	9200	Nvidia	Positive	Just realized that the Windows partition of my...
74677	9200	Nvidia	Positive	Just realized that my Mac window partition is ...
74678	9200	Nvidia	Positive	Just realized the windows partition of my Mac ...
74679	9200	Nvidia	Positive	Just realized between the windows partition of...
74680	9200	Nvidia	Positive	Just like the windows partition of my Mac is l...

```
train_df['Positive'].unique()
```

```
array(['Positive', 'Neutral', 'Negative', 'Irrelevant'], dtype=object)
```

```
train_df = train_df[train_df['Positive'] != 'Irrelevant']
```

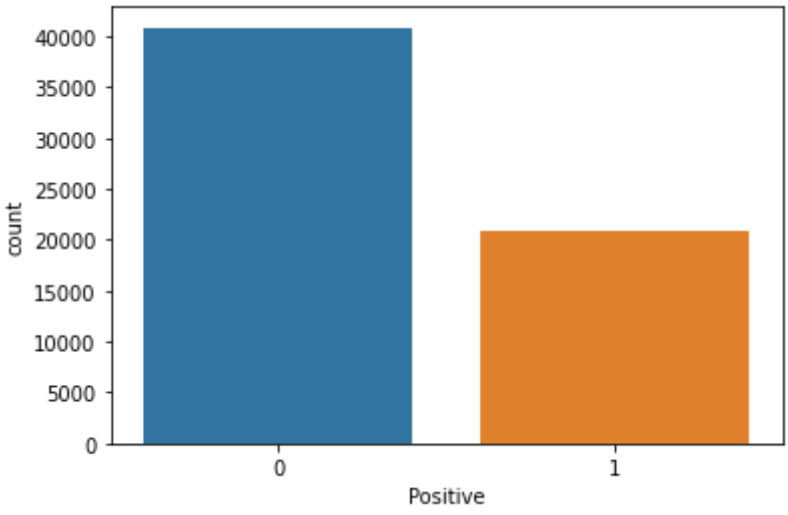
Label Encoding

```
to_replace = {'Positive' : {'Negative' : 0, 'Neutral' : 0, 'Positive' : 1}}
train_df.replace(to_replace, inplace = True)
train_df['Positive'].unique()
```

```
array([1, 0])
```

```
sns.countplot(train_df['Positive'])
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/_decorators.py:43: FutureWarning: P
  FutureWarning
<matplotlib.axes._subplots.AxesSubplot at 0x7f813aa18850>
```



There are alot more zeroes in the dataset after replacement, because positive sentiments should be focused on more.

```
sentences = train_df.iloc[:, -1]
labels = train_df['Positive']
```

Separate features from labels

Split train and test

```
X_train, X_test, y_train, y_test = train_test_split(sentences, labels, test_size = 0.30, r
```

Fitting the Tokenizer

```
num_words = 10000
oov_token = '<OOV>'
tokenizer = Tokenizer(num_words = num_words, oov_token = oov_token)

tokenizer.fit_on_texts(X_train)
```

Creating padded sequences using the fitted tokenizer

```
training_sequences = tokenizer.texts_to_sequences(X_train)
training_padded = np.array(pad_sequences(training_sequences, maxlen = 100, padding = 'post

testing_sequences = tokenizer.texts_to_sequences(X_test)
testing_padded = np.array(pad_sequences(testing_sequences, maxlen = 100, padding = 'post',
```

Creating the model (sequentially)

```
model = tf.keras.Sequential([
    tf.keras.layers.Embedding(num_words, 16, input_length = 100),
    tf.keras.layers.GlobalAveragePooling1D(),
    tf.keras.layers.Dense(24, activation = 'relu'),
    tf.keras.layers.Dense(1, activation = 'sigmoid')
])
```

Model compilation

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

```
model.summary()
```

```
Model: "sequential_3"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 embedding_3 (Embedding)     (None, 100, 16)           160000

 global_average_pooling1d_3   (None, 16)               0
 (GlobalAveragePooling1D)

 dense_6 (Dense)             (None, 24)                408

 dense_7 (Dense)             (None, 1)                 25

=================================================================
Total params: 160,433
Trainable params: 160,433
Non-trainable params: 0
_________________________________________________________________
```

Creating the callback

```
acc_threshold = 0.94

class CustomCallback(tf.keras.callbacks.Callback):
  def on_epoch_end(self, epoch, logs = None):
    if (logs['accuracy'] is not None and logs['accuracy'] >= acc_threshold):
      print('\nREACHED ACCURACY THRESHOLD, TRAINING WILL BE STOPPED...')
      self.model.stop_training = True

callbacks = CustomCallback()
```

Model training

```
history = model.fit(training_padded, y_train, epochs = 30, validation_data = (testing_padc
```

```
Epoch 1/30
1350/1350 [==============================] - 8s 5ms/step - loss: 0.5602 - accuracy:
Epoch 2/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.3748 - accuracy:
Epoch 3/30
1350/1350 [==============================] - 6s 4ms/step - loss: 0.3055 - accuracy:
Epoch 4/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.2651 - accuracy:
Epoch 5/30
```

```
1350/1350 [==============================] - 7s 5ms/step - loss: 0.2370 - accuracy:
Epoch 6/30
1350/1350 [==============================] - 6s 5ms/step - loss: 0.2185 - accuracy:
Epoch 7/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.2053 - accuracy:
Epoch 8/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1958 - accuracy:
Epoch 9/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1862 - accuracy:
Epoch 10/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1793 - accuracy:
Epoch 11/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1747 - accuracy:
Epoch 12/30
1350/1350 [==============================] - 6s 5ms/step - loss: 0.1700 - accuracy:
Epoch 13/30
1350/1350 [==============================] - 6s 5ms/step - loss: 0.1651 - accuracy:
Epoch 14/30
1350/1350 [==============================] - 6s 4ms/step - loss: 0.1620 - accuracy:
Epoch 15/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1586 - accuracy:
Epoch 16/30
1350/1350 [==============================] - 6s 4ms/step - loss: 0.1553 - accuracy:
Epoch 17/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1522 - accuracy:
Epoch 18/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1515 - accuracy:
Epoch 19/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1480 - accuracy:
Epoch 20/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1453 - accuracy:
Epoch 21/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1445 - accuracy:
Epoch 22/30
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1430 - accuracy:
Epoch 23/30
1346/1350 [============================>.] - ETA: 0s - loss: 0.1402 - accuracy: 0.94
REACHED ACCURACY THRESHOLD, TRAINING WILL BE STOPPED...
1350/1350 [==============================] - 7s 5ms/step - loss: 0.1403 - accuracy:
```

Model evaluation on validation set

```
test_df = pd.read_csv('./input/twitter_validation.csv')
test_df.iloc[:, -1] = test_df.iloc[:, -1].astype(str)

test_df = test_df[test_df['Irrelevant'] != 'Irrelevant']
test_to_replace = {'Irrelevant' : {'Negative' : 0, 'Neutral' : 0, 'Positive' : 1}}
test_df.replace(test_to_replace, inplace = True)

test_sentences = test_df.iloc[:, -1].tolist()

test_labels = np.array(test_df['Irrelevant'].tolist(), dtype = np.float32)
```

```
test_sequences = tokenizer.texts_to_sequences(test_sentences)
test_padded = pad_sequences(test_sequences, maxlen = 100, padding = 'post', truncating = '
test_pred = model.predict(test_padded)

results = model.evaluate(test_padded, test_labels, batch_size = 128)
```

```
7/7 [==============================] - 0s 4ms/step - loss: 0.1522 - accuracy: 0.9626
```

```
print(f'ACCURACY ON TEST DATASET: {int(results[1] * 100)}%')
```

```
ACCURACY ON TEST DATASET: 96%
```

Playground

```
def test_sentiment(sentence):
  z = []

  z.append(sentence)
  sentence = z
  func_seq = tokenizer.texts_to_sequences(sentence)
  func_padded = pad_sequences(func_seq, maxlen = 100, padding = 'post', truncating = 'post
  print(model.predict(func_padded))

sent_input = input('Enter sentence for sentiment analysis: ')
test_sentiment(sent_input)
```

```
Enter sentence for sentiment analysis: i love you
[[0.9610832]]
```

```
sent_input = input('Enter sentence for sentiment analysis: ')
test_sentiment(sent_input)
```

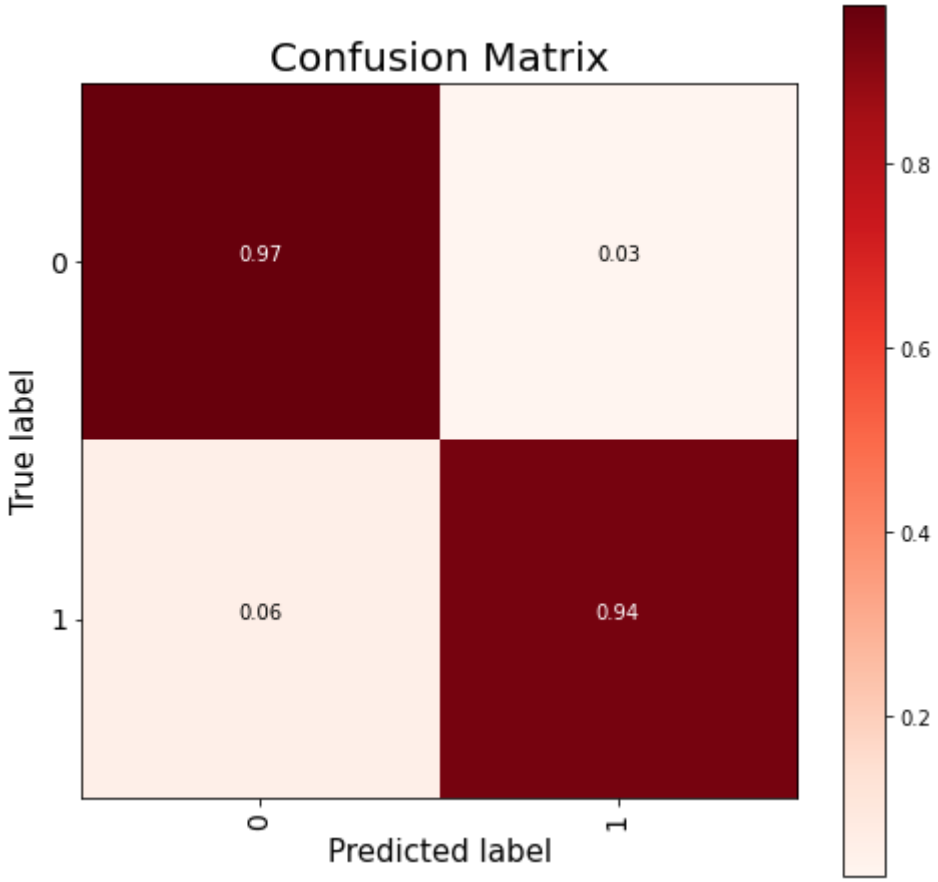
```
Enter sentence for sentiment analysis: i hate you
[[0.02350268]]
```

Visualizing model evaluation

```
def plot_confusion_matrix(cm, classes,
                          title='Confusion matrix',
                          cmap=plt.cm.Reds):

    cm = cm / cm.sum(axis=1)[:, np.newaxis]

    plt.imshow(cm, interpolation='nearest', cmap=cmap)
    plt.title(title, fontsize=20)
    plt.colorbar()
    tick_marks = np.arange(len(classes))
```

```
    plt.xticks(tick_marks, classes, rotation=90, fontsize=14)
    plt.yticks(tick_marks, classes, fontsize=14)

    fmt = '.2f'
    thresh = cm.max() / 2.
    for i, j in itertools.product(range(cm.shape[0]), range(cm.shape[1])):
        plt.text(j, i, format(cm[i, j], fmt),
                 horizontalalignment="center",
                 color="white" if cm[i, j] > thresh else "black")

    plt.ylabel('True label', fontsize=15)
    plt.xlabel('Predicted label', fontsize=15)
```

```
conf_y_true = test_labels
conf_y_pred = test_pred.round()

cmf_matrix = confusion_matrix(conf_y_true, conf_y_pred)

plt.figure(figsize = (8, 8))
plot_confusion_matrix(cmf_matrix, classes = y_train.unique(), title = "Confusion Matrix")
```




```
print(classification_report(conf_y_true, conf_y_pred))
```

```
                  precision    recall  f1-score   support

             0.0       0.97      0.97      0.97       551
             1.0       0.95      0.94      0.94       277
```

```
          accuracy                           0.96       828
         macro avg       0.96      0.96      0.96       828
      weighted avg       0.96      0.96      0.96       828
```

```
accuracy_score(conf_y_true, conf_y_pred)
```

```
0.9625603864734299
```

Saving the model

```
model.save('model.h5')
```