1. Importing Libraries

In [1]:
```
import pandas as pd
import numpy as np
import string
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
import matplotlib.pyplot as plt
import seaborn as sns
from nltk.corpus import stopwords
import nltk
import re
import multiprocessing
import tensorflow as tf
from sklearn.model_selection import train_test_split
nltk.download("stopwords")

import warnings
warnings.filterwarnings("ignore")
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\rosin\AppData\Roaming\nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

2. Loading the Data

In [3]:
```
# setting the names of the columns into col_names

col_names = ["target", "ids", "date", "flag", "user", "text"]
# reading the data from the path and using ISO-8859-1 encoding to decode it.

df = pd.read_csv(r'C:\Users\rosin\OneDrive\Desktop\New folder (4)\data.csv',
            encoding = "ISO-8859-1",
            names=col_names)
```

In [4]:
```
df = df.sample(160000) # taking 160k rows from the data
df.head()
```

Out[4]:

	target	ids	date	flag	user	text
1065590	4	1964969545	Fri May 29 15:06:37 PDT 2009	NO_QUERY	i_like_limes	@juliesauce why thank you
395240	0	2055902835	Sat Jun 06 10:09:52 PDT 2009	NO_QUERY	Gabuki	ow ow ow. my stomach's hurting
435575	0	2065458470	Sun Jun 07 08:38:16 PDT 2009	NO_QUERY	adrigirl	Enjoying my Sunday morning, although its almos...
271834	0	1990089175	Mon Jun 01 03:50:39 PDT 2009	NO_QUERY	pascal1982	where is that plane of air france???
858041	4	1574064694	Tue Apr 21 04:06:09 PDT 2009	NO_QUERY	elainebenter	oh, i got followers! awesome

3. Let's Explore the Data

In [5]:
```
df.info() # shows the columns, and their types.
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 160000 entries, 1065590 to 1526827
Data columns (total 6 columns):
 #   Column  Non-Null Count   Dtype
---  ------  --------------   -----
 0   target  160000 non-null  int64
 1   ids     160000 non-null  int64
 2   date    160000 non-null  object
 3   flag    160000 non-null  object
 4   user    160000 non-null  object
 5   text    160000 non-null  object
dtypes: int64(2), object(4)
memory usage: 8.5+ MB
```

In [6]:
```
df.shape
```

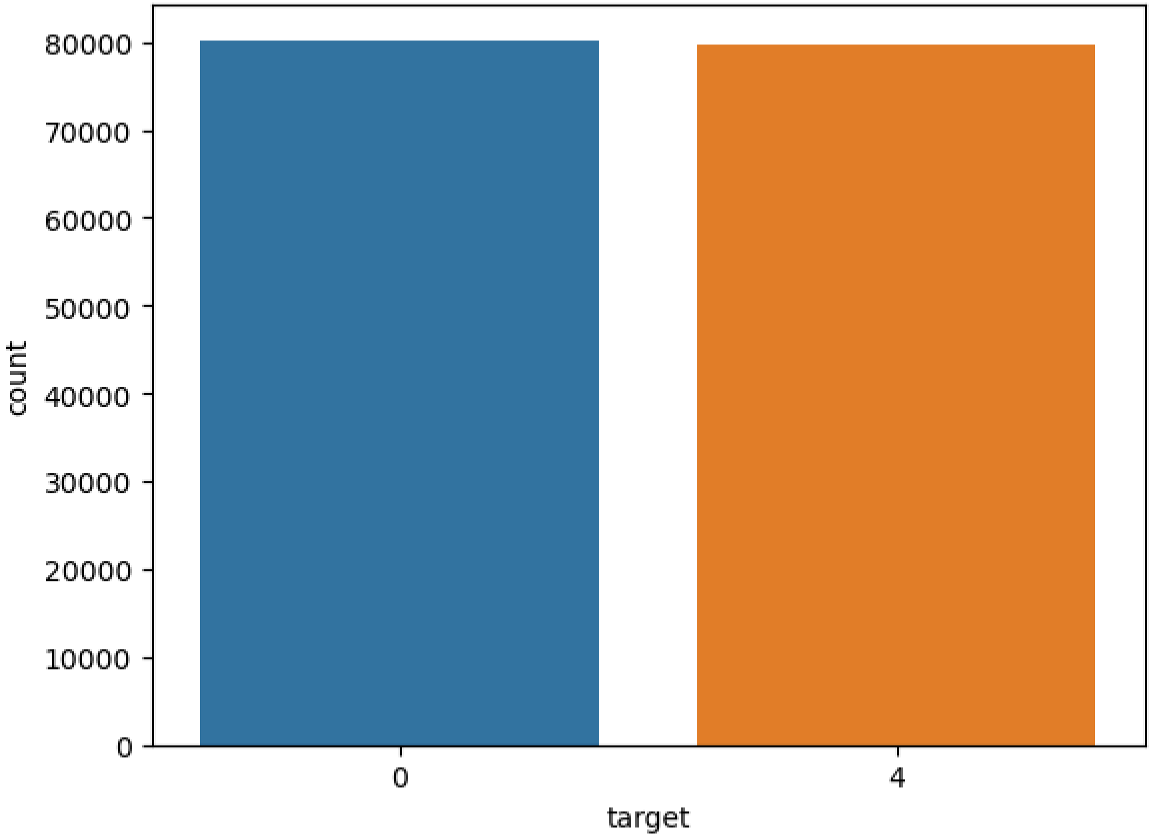
Out[6]:
```
(160000, 6)
```

In [7]:
```
df.describe(include='all') # To statistical measures of the columns
```

Out[7]:

	target	ids	date	flag	user	text
count	160000.000000	1.600000e+05	160000	160000	160000	160000
unique	NaN	NaN	143706	1	123555	159380
top	NaN	NaN	Tue Jun 02 13:46:43 PDT 2009	NO_QUERY	lost_dog	isPlayer Has Died! Sorry
freq	NaN	NaN	6	160000	52	25
mean	1.994300	1.999127e+09	NaN	NaN	NaN	NaN
std	1.999998	1.933825e+08	NaN	NaN	NaN	NaN
min	0.000000	1.467812e+09	NaN	NaN	NaN	NaN
25%	0.000000	1.957033e+09	NaN	NaN	NaN	NaN
50%	0.000000	2.002255e+09	NaN	NaN	NaN	NaN
75%	4.000000	2.177081e+09	NaN	NaN	NaN	NaN
max	4.000000	2.329205e+09	NaN	NaN	NaN	NaN

In [8]:
```
sns.countplot(x=df['target']); # shows a count plot refering to the number of 0 and 4 in the
```



In [9]:
```
df = df.drop(['ids', 'date', 'flag','user'], axis = 1) # dropping unnecessary columns
```

In [10]:
```
df.head()
```

Out[10]:

	target	text
1065590	4	@juliesauce why thank you
395240	0	ow ow ow. my stomach's hurting
435575	0	Enjoying my Sunday morning, although its almos...
271834	0	where is that plane of air france???
858041	4	oh, i got followers! awesome

4. Preprocessing

Here 0 represents as negative and 4 as positive so lets change 4 to 1.

In [11]:
```
df['target']=df['target'].replace(4,1)
```

In [12]:
```
data = df['text']
labels = np.array(df['target'])
```

In [13]:
```
data.iloc[1] # displaying a row of the data
```

Out[13]:
```
"ow ow ow. my stomach's hurting "
```

4.B. Stopwords removal

In [14]:
```
# this function is copied from another kernel. Don't know who is the original author of it.
stop = set(stopwords.words('english'))
punctuation = list(string.punctuation)
```

```
stop.update(punctuation)

#Removing the stopwords from text
def split_into_words(text):
    # split into words by white space
    words = text.split()
    return words

def to_lower_case(words):
    # convert to lower case
    words = [word.lower() for word in words]
    return words

def remove_punctuation(words):
    # prepare regex for char filtering
    re_punc = re.compile('[%s]' % re.escape(string.punctuation))
    # remove punctuation from each word
    stripped = [re_punc.sub('', w) for w in words]
    return stripped

def keep_alphabetic(words):
    # remove remaining tokens that are not alphabetic
    words = [word for word in words if word.isalpha()]
    return words

def remove_stopwords(words):
    # filter out stop words
    stop_words = set(stopwords.words('english'))
    words = [w for w in words if not w in stop_words]
    return words

def to_sentence(words):
    # join words to a sentence
    return ' '.join(words)
def tweet(words):
    tweet_tokenizer = nltk.tokenize.TweetTokenizer(strip_handles=True,reduce_len=True)
    tweet = tweet_tokenizer.tokenize(words)
    return tweet


#Removing the noisy text
def denoise_text(text):
    words = split_into_words(text)
    words = to_lower_case(words)
    words = remove_punctuation(words)
    words = keep_alphabetic(words)
    words = remove_stopwords(words)
    return to_sentence(words)
```

In [17]:

```
data = data.apply(denoise_text)
```

To see the difference in before and after applying stopwords function.

In [18]:

```
print('Before: {}'. format(list(df['text'][:2])))
print('---')
print('After: {}'. format(list(data[:2])))
```

```
Before: ['@juliesauce why thank you ', "ow ow ow. my stomach's hurting "]
---
After: ['juliesauce thank', 'ow ow ow stomachs hurting']
```

In [19]:

```
print(f"dataset contains {len(data)} examples\n")

print(f"Text of second example should look like this:  {data.iloc[1]}\n")
print(f"Text of fourth example should look like this:  {data.iloc[3]}")

print(f"\nLabels of last 5 examples should look like this:\n{labels[-5:]}")
```

```
dataset contains 160000 examples

Text of second example should look like this:  ow ow ow stomachs hurting

Text of fourth example should look like this:  plane air france

Labels of last 5 examples should look like this:
[1 1 0 0 1]
```

4.C. Splitting the Data

In [20]:
```
# Split in training validation and test sets
X_train, X_test, y_train, y_test = test = train_test_split(data, labels,test_size=0.20,
                                                           random_state=1,
                                                           stratify = labels)
```

5. TOKENIZER

In [21]:
```
# lets take 10k words in num_words
tokenizer = Tokenizer(num_words=10000, oov_token = '<OOV>')
tokenizer.fit_on_texts(X_train)
word_index = tokenizer.word_index
VOCAB_SIZE = len(word_index)+1
VOCAB_SIZE
```

Out[21]:
```
116346
```

In [22]:
```
maxlen = max([len(x) for x in X_train]) # return 175 which is too big for tweets data.
maxlen = 50
```

5.B. Sequencing and Padding

In [23]:
```
train_sequences = tokenizer.texts_to_sequences(X_train)
train_padded_sequences = pad_sequences(train_sequences,maxlen=maxlen,padding='post',truncatin
test_sequences = tokenizer.texts_to_sequences(X_test)
test_padded_sequences = pad_sequences(test_sequences,maxlen=maxlen,padding='post',truncating=
```

In [24]:
```
len(train_padded_sequences[0])
```

Out[24]:
```
50
```

5. Data Modeling

In [28]:
```
embedding_dim = 32
```

In [34]:
```
model = tf.keras.Sequential([
        tf.keras.layers.Embedding(VOCAB_SIZE+1, embedding_dim, input_length=maxlen),
        tf.keras.layers.Bidirectional(tf.keras.layers.LSTM(16)),
        tf.keras.layers.Flatten(),
        tf.keras.layers.BatchNormalization(),
        tf.keras.layers.Dropout(0.30),
        tf.keras.layers.Dense(embedding_dim,activation='relu'),
        tf.keras.layers.BatchNormalization(),
        tf.keras.layers.Dropout(0.30),
        tf.keras.layers.Dense(8,activation='relu'),
        tf.keras.layers.Dense(1,activation='sigmoid'),
```

```
    ])

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

In [33]:

```
#summary of the model.
model.summary()
```

Model: "sequential_1"

Layer (type)	Output Shape	Param #
embedding_1 (Embedding)	(32, 50, 32)	3,723,104
bidirectional_1 (Bidirectional)	(32, 32)	6,272
flatten_1 (Flatten)	(32, 32)	0
batch_normalization_2 (BatchNormalization)	(32, 32)	128
dropout_2 (Dropout)	(32, 32)	0
dense_3 (Dense)	(32, 32)	1,056
batch_normalization_3 (BatchNormalization)	(32, 32)	128
dropout_3 (Dropout)	(32, 32)	0
dense_4 (Dense)	(32, 8)	264
dense_5 (Dense)	(32, 1)	9

Total params: 11,192,629 (42.70 MB)

Trainable params: 3,730,833 (14.23 MB)

Non-trainable params: 128 (512.00 B)

Optimizer params: 7,461,668 (28.46 MB)

In [31]:

```
# Training the model we created above.
history =    model.fit(train_padded_sequences,
                              y_train,
                              validation_data = (test_padded_sequences, y_te
                              epochs = 3)
```

```
Epoch 1/3
4000/4000 ━━━━━━━━━━━━━━━━━━━━ 120s 29ms/step - accuracy: 0.6840 - loss: 0.5890 - val_accurac
y: 0.5875 - val_loss: 0.6772
Epoch 2/3
4000/4000 ━━━━━━━━━━━━━━━━━━━━ 115s 29ms/step - accuracy: 0.7745 - loss: 0.4779 - val_accurac
y: 0.7686 - val_loss: 0.4796
Epoch 3/3
4000/4000 ━━━━━━━━━━━━━━━━━━━━ 116s 29ms/step - accuracy: 0.7938 - loss: 0.4450 - val_accurac
y: 0.7630 - val_loss: 0.4858
```

In [35]:

```
print(X_test.iloc[99],'label: ;',y_test[99])
```

```
sitting sister enjoying guiness label: ; 1
```

In [36]:

```
tokenizer.sequences_to_texts(test_padded_sequences)[99]
```

Out[36]:
```
'sitting sister enjoying <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <O
OV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV>
<OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OOV> <OO
V> <OOV> <OOV> <OOV> <OOV>'
```

In [37]:
```python
model.predict(test_padded_sequences)[99]
```

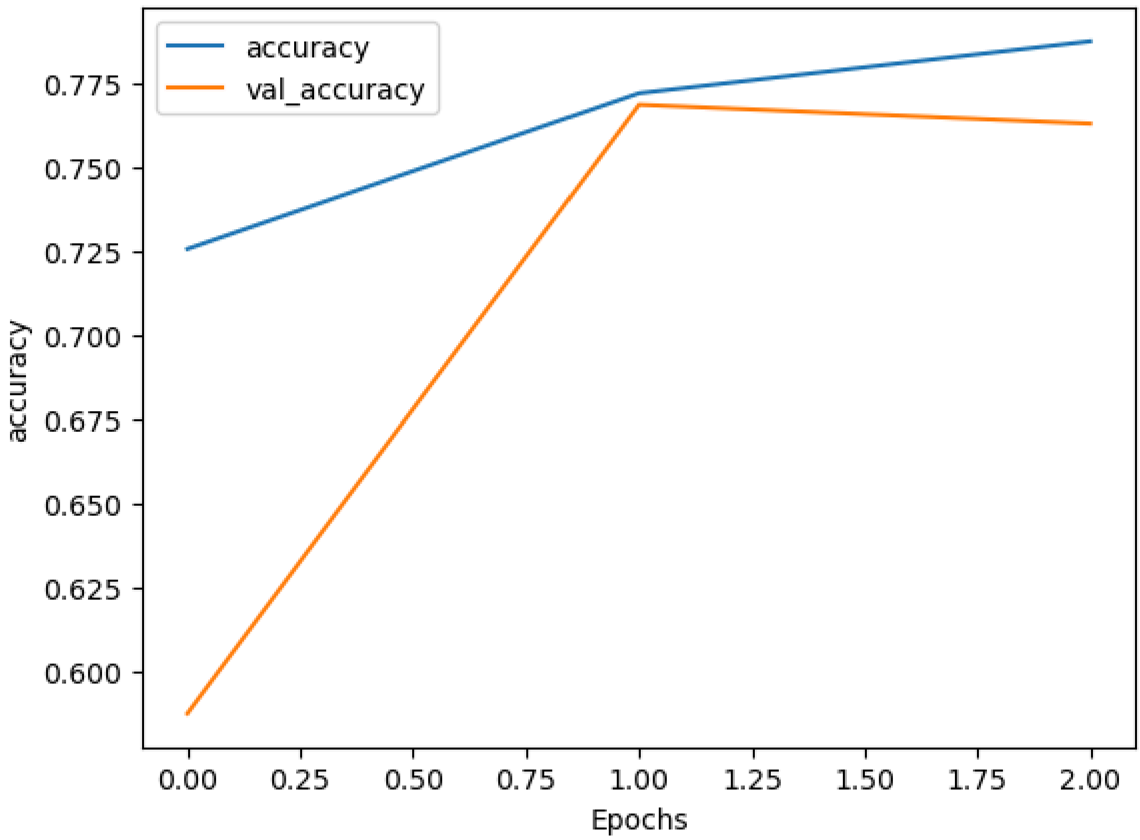
```
1000/1000 ━━━━━━━━━━━━━━━━━━━━ 4s 3ms/step
```

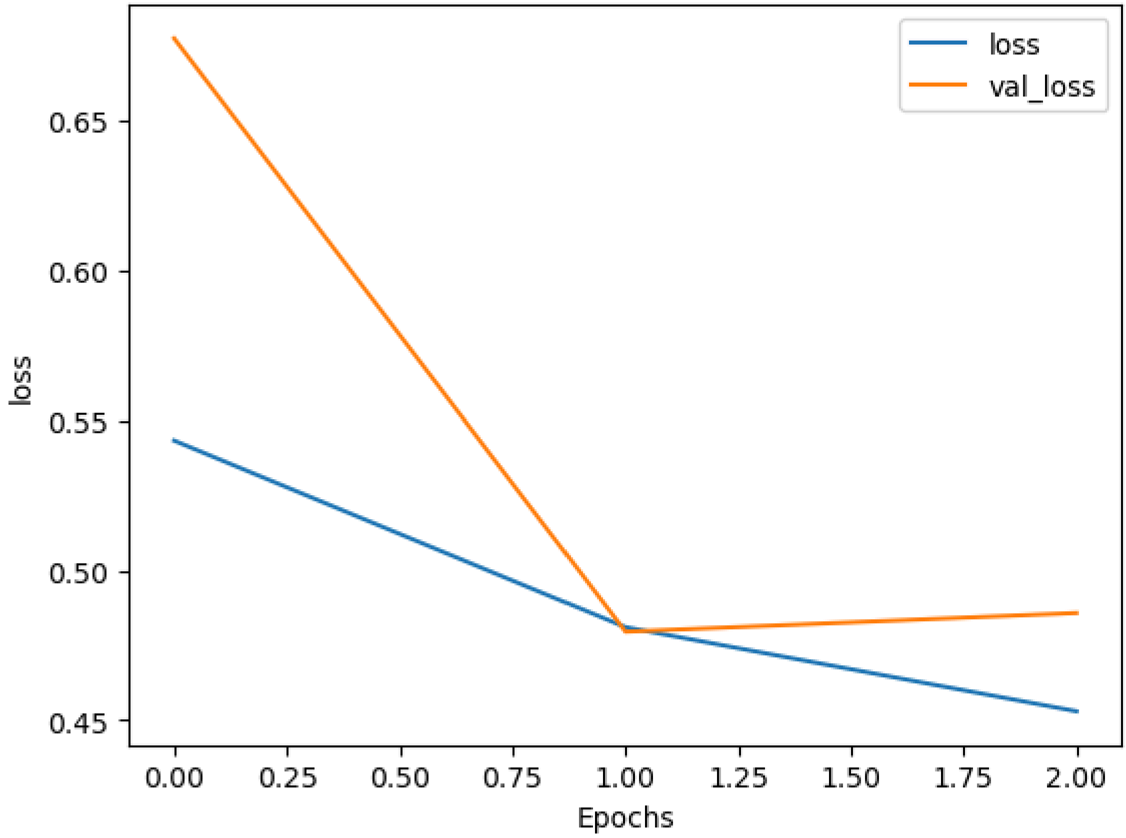
Out[37]:
```
array([0.49627855], dtype=float32)
```

In [38]:
```python
import matplotlib.pyplot as plt

# Plot utility
def plot_graphs(model, string):
  plt.plot(model.history[string])
  plt.plot(model.history['val_'+string])
  plt.xlabel("Epochs")
  plt.ylabel(string)
  plt.legend([string, 'val_'+string])
  plt.show()

# Plot the accuracy and loss
plot_graphs(history, "accuracy")
plot_graphs(history, "loss")
```





In [39]:

```
train_accuracy = history.history['accuracy'][-1]
val_accuracy = history.history['val_accuracy'][-1]
print(f"Final Training Accuracy: {train_accuracy:.4f}")
print(f"Final Validation Accuracy: {val_accuracy:.4f}")
```

```
Final Training Accuracy: 0.7875
Final Validation Accuracy: 0.7630
```