Google Colab Implementation

A. Getting Data from Kaggle onto Google Colab

In [ ]:
```
!pip install kaggle
```

```
Requirement already satisfied: kaggle in /usr/local/lib/python3.6/dist-packages
(1.5.9)
Requirement already satisfied: python-dateutil in /usr/local/lib/python3.6/dist-pa
ckages (from kaggle) (2.8.1)
Requirement already satisfied: requests in /usr/local/lib/python3.6/dist-packages
(from kaggle) (2.23.0)
Requirement already satisfied: six>=1.10 in /usr/local/lib/python3.6/dist-packages
(from kaggle) (1.15.0)
Requirement already satisfied: urllib3 in /usr/local/lib/python3.6/dist-packages
(from kaggle) (1.24.3)
Requirement already satisfied: python-slugify in /usr/local/lib/python3.6/dist-pac
kages (from kaggle) (4.0.1)
Requirement already satisfied: certifi in /usr/local/lib/python3.6/dist-packages
(from kaggle) (2020.6.20)
Requirement already satisfied: slugify in /usr/local/lib/python3.6/dist-packages
(from kaggle) (0.0.1)
Requirement already satisfied: tqdm in /usr/local/lib/python3.6/dist-packages (fro
m kaggle) (4.41.1)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.6/dist-packa
ges (from requests->kaggle) (2.10)
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.6/dist-
packages (from requests->kaggle) (3.0.4)
Requirement already satisfied: text-unidecode>=1.3 in /usr/local/lib/python3.6/dis
t-packages (from python-slugify->kaggle) (1.3)
```

- First, grab your token from Kaggle account page.
- Then scroll down to API and hit “Create New API Token.”
- That’s going to download a file called kaggle.json. Make sure you know where this file is! Maybe put it somewhere you can find it.
- Upload it on the colab by clicking upload link.
- Copy its path and use below:

In [ ]:
```
!mkdir ~/.kaggle  ## Making a folder on root directory. This is the way of making r
oot directory
```

```
mkdir: cannot create directory ‘/root/.kaggle’: File exists
```

In [ ]:
```
!cp /content/kaggle.json  ~/.kaggle/kaggle.json

# !cp  /colab path of kaggle.jon file copied   ~/root path
# Copying this kaggle.json file from current directory to root directory ~/.kaggle
# kaggle search for authentication and require this file to be in root directory li
ke this.
```

```
In [ ]: !ls ~/.kaggle ## Checking content of root directory ,  list working directory conte
        nts
```

```
kaggle.json
```

```
In [ ]: !pwd # print working directory
```

```
/content
```

```
In [ ]: # To delete a folder which has multiple folders, use:
        # %rm -rf ~/.kaggle

        # Not requird here, If you run this you have to again run above two cell.
```

Setting kaggle download path:

- Provide the path where you want to save the downloaded file from kaggle

```
In [ ]: !mkdir kaggle  # Making directory  You will see a directory with this name
        # In this directory we want to save our data
```

```
mkdir: cannot create directory ‘kaggle’: File exists
```

```
In [ ]: !ls   #  check you can see a new folder kaggle added in the list
```

```
drive  kaggle  kaggle.json  sample_data
```

```
In [ ]: !kaggle config set -n path -v /content/kaggle
```

```
- path is now set to: /content/kaggle
```

```
In [ ]: !chmod 600 /root/.kaggle/kaggle.json
In [ ]: # To access a list of Kaggle datasets.
        !kaggle datasets list
```

```
Warning: Looks like you're using an outdated API Version, please consider updating
(server 1.5.9 / client 1.5.4)
ref                                                         title
size  lastUpdated          downloadCount
--------------------------------------------------------  ------------------------
-------------------  -----  -------------------  -------------
unanimad/us-election-2020                                   US Election 2020
416KB  2020-11-08 00:14:42            613
manchunhui/us-election-2020-tweets                          US Election 2020 Tweets
276MB  2020-11-07 12:06:54            708
headsortails/us-election-2020-presidential-debates          US Election 2020 - Presi
dential Debates      199MB  2020-10-23 16:56:10            231
radustoicescu/2020-united-states-presidential-election      2020 United States presi
dential election      11MB  2019-07-04 15:00:45            560
etsc9287/2020-general-election-polls                        2020 General Election Po
lls                  109KB  2020-02-09 08:20:59            349
shivamb/netflix-shows                                       Netflix Movies and TV Sh
ows                  971KB  2020-01-20 07:33:56          55222
terenceshin/covid19s-impact-on-airport-traffic              COVID-19's Impact on Air
port Traffic         106KB  2020-10-19 12:40:17           2907
sootersaalu/amazon-top-50-bestselling-books-2009-2019       Amazon Top 50 Bestsellin
g Books 2009 - 2019   15KB  2020-10-13 09:39:21           2830
nehaprabhavalkar/indian-food-101                            Indian Food 101
7KB  2020-09-30 06:23:43            6434
omarhanyy/500-greatest-songs-of-all-time                    500 Greatest Songs of Al
l Time                33KB  2020-10-26 13:36:09            882
heeraldedhia/groceries-dataset                              Groceries dataset
257KB  2020-09-17 04:36:08           6820
andrewmvd/trip-advisor-hotel-reviews                        Trip Advisor Hotel Revie
ws                     5MB  2020-09-30 08:31:20           4588
karangadiya/fifa19                                          FIFA 19 complete player
dataset                2MB  2018-12-21 03:52:59         102638
docstein/brics-world-bank-indicators                        BRICS World Bank Indicat
ors                    4MB  2020-10-22 12:18:40            726
thomaskonstantin/highly-rated-children-books-and-stories    Highly Rated Children Bo
oks And Stories      106KB  2020-10-24 12:09:59            528
christianlillelund/donald-trumps-rallies                    Donald Trump's Rallies
720KB  2020-09-26 10:25:08           1569
datasnaek/youtube-new                                       Trending YouTube Video S
tatistics            201MB  2019-06-03 00:56:47         113830
google/tinyquickdraw                                        QuickDraw Sketches
11GB  2018-04-18 19:38:04            2425
anikannal/solar-power-generation-data                       Solar Power Generation D
ata                    2MB  2020-08-18 15:52:03           9113
zynicide/wine-reviews                                       Wine Reviews
51MB  2017-11-27 17:08:04          117952
```

In [ ]:
```
## If you’re looking for a specific dataset, you can run syntax below
!kaggle datasets list -s sentiment
```

```
Warning: Looks like you're using an outdated API Version, please consider updating
(server 1.5.9 / client 1.5.4)
ref                                                          title
size  lastUpdated          downloadCount
-------------------------------------------------------  -------------------------
----------------------  -----  -------------------  -------------
crowdflower/twitter-airline-sentiment                        Twitter US Airline Sentim
ent                        3MB  2019-10-16 00:04:05         46065
harriken/emoji-sentiment                                     Emoji sentiment
12MB  2017-10-01 09:56:54           2577
kazanova/sentiment140                                        Sentiment140 dataset with
1.6 million tweets      81MB  2017-09-13 22:43:19          41482
yash612/stockmarket-sentiment-dataset                        Stock-Market Sentiment Da
taset                     201KB  2020-06-05 19:16:19          1555
bittlingmayer/amazonreviews                                  Amazon Reviews for Sentim
ent Analysis              493MB  2019-11-18 02:50:34          29949
arkhoshghalb/twitter-sentiment-analysis-hatred-speech        Twitter Sentiment Analysi
s                          2MB  2019-01-06 05:00:19          5882
ankurzing/sentiment-analysis-for-financial-news              Sentiment Analysis for Fi
nancial News              903KB  2020-05-27 18:38:15          2087
crowdflower/first-gop-debate-twitter-sentiment               First GOP Debate Twitter
Sentiment                  2MB  2019-11-17 21:18:37         17912
welkin10/airline-sentiment                                   Airline sentiment
1MB  2018-05-27 07:23:18            988
marklvl/sentiment-labelled-sentences-data-set                Sentiment Labelled Senten
ces Data Set              326KB  2018-04-24 21:20:20          6896
mksaad/arabic-sentiment-twitter-corpus                       Arabic Sentiment Twitter
Corpus                    17MB  2020-07-27 20:57:37          1569
cjroth/chronist                                              Emotion, Aging, and Senti
ment Over Time            13MB  2017-02-12 22:44:03          1427
akash14/product-sentiment-classification                     Product Sentiment Classif
ication                   397KB  2020-09-27 20:11:54            37
columbine/imdb-dataset-sentiment-analysis-in-csv-format      IMDB dataset (Sentiment a
nalysis) in CSV format    26MB  2019-11-28 15:44:05          2660
sonaam1234/sentimentdata                                     Sentiment Analysis Datase
t                         947KB  2019-11-18 02:41:47          2703
atulanandjha/stanford-sentiment-treebank-v2-sst2             Stanford Sentiment Treeba
nk v2 (SST2)              19MB  2020-03-14 20:27:18           698
lakshmi25npathi/imdb-dataset-of-50k-movie-reviews            IMDB Dataset of 50K Movie
Reviews                   26MB  2019-03-09 06:32:21          26533
rtatman/sentiment-lexicons-for-81-languages                  Sentiment Lexicons for 81
Languages                  2MB  2017-09-13 19:59:05          8434
taniaj/australian-election-2019-tweets                       Australian Election 2019
Tweets                    29MB  2019-05-21 09:41:38          4122
rahulin05/sentiment-labelled-sentences-data-set              Sentiment Labelled Senten
ces Data Set              80KB  2017-08-31 14:07:09          1476
```

Go to Kaggle, find the dataset you want, and on that page, click the API button (it will copy the code automatically).

In [ ]:
```
!kaggle datasets download -d kazanova/sentiment140
```

```
sentiment140.zip: Skipping, found more recently modified local copy (use --force t
o force download)
```

B. Downloading Glove for Embedding Matrix

In [ ]:
```
!kaggle datasets download -d danielwillgeorge/glove6b100dtxt
```

```
glove6b100dtxt.zip: Skipping, found more recently modified local copy (use --force
to force download)
```

Unzipping the file

In [ ]:
```
import zipfile
```

In [ ]:
```
## Unzipping data
local_zip = '/content/kaggle/datasets/kazanova/sentiment140/sentiment140.zip'
zip_ref = zipfile.ZipFile(local_zip, 'r')
zip_ref.extractall('/content/kaggle/datasets/kazanova/sentiment140')
zip_ref.close()
```

In [ ]:
```
## Unzipping Glove
local_zip='/content/kaggle/datasets/danielwillgeorge/glove6b100dtxt/glove6b100dtxt.
zip'
zip_ref = zipfile.ZipFile(local_zip, 'r')
zip_ref.extractall('/content/kaggle/datasets/danielwillgeorge/glove6b100dtxt')
zip_ref.close()
```

C. Data Prepocessing & Cleaning

- Reading the unzipped file and working on it.
- Importing all necessary library required

In [ ]:
```
import pandas as pd
import nltk
```

In [ ]:
```
df=pd.read_csv('/content/kaggle/datasets/kazanova/sentiment140/training.1600000.processed.noemoticon.csv',encoding='latin-1',header=None)
df.head()
```

Out[ ]:

	0	1	2	3	4	5
0	0	1467810369	Mon Apr 06 22:19:45 PDT 2009	NO_QUERY	_TheSpecialOne_	@switchfoot http://twitpic.com/2y1zl - Awww, t...
1	0	1467810672	Mon Apr 06 22:19:49 PDT 2009	NO_QUERY	scotthamilton	is upset that he can't update his Facebook by ...
2	0	1467810917	Mon Apr 06 22:19:53 PDT 2009	NO_QUERY	mattycus	@Kenichan I dived many times for the ball. Man...
3	0	1467811184	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	ElleCTF	my whole body feels itchy and like its on fire
4	0	1467811193	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	Karoli	@nationwideclass no, it's not behaving at all....

In [ ]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1600000 entries, 0 to 1599999
Data columns (total 6 columns):
 #   Column  Non-Null Count    Dtype 
---  ------  --------------    ----- 
 0   0       1600000 non-null  int64 
 1   1       1600000 non-null  int64 
 2   2       1600000 non-null  object
 3   3       1600000 non-null  object
 4   4       1600000 non-null  object
 5   5       1600000 non-null  object
dtypes: int64(2), object(4)
memory usage: 73.2+ MB
```

In [ ]:
```
df[0].value_counts()
```

Out[ ]:
```
4    800000
0    800000
Name: 0, dtype: int64
```

In [ ]:
```
df.drop([1,2,3,4],axis=1,inplace=True)
```

In [ ]:
```
df.rename({0:'Labels',5:'Tweets'},axis=1,inplace=True)
```

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

```
In [ ]: df.tail()
```

Out[ ]:

	Labels	Tweets
1599995	1	Just woke up. Having no school is the best fee...
1599996	1	TheWDB.com - Very cool to hear old Walt interv...
1599997	1	Are you ready for your MoJo Makeover? Ask me f...
1599998	1	Happy 38th Birthday to my boo of alll time!!! ...
1599999	1	happy #charitytuesday @theNSPCC @SparksCharity...

Preprocessing

- Working with dataframe is a slow process converting data into numpy array and working with it.

```
In [ ]: import numpy as np
```

```
In [ ]: x=df.Tweets.values
        y=df.Labels.values
        # we have to preprocess the feature i.e. tweets
```

```
In [ ]: x[:5] # Checking first 5 entries
```

```
Out[ ]: array(["@switchfoot http://twitpic.com/2y1zl - Awww, that's a bummer.  You shoulda
        got David Carr of Third Day to do it. ;D",
               "is upset that he can't update his Facebook by texting it... and might cry
        as a result  School today also. Blah!",
               '@Kenichan I dived many times for the ball. Managed to save 50%  The rest g
        o out of bounds',
               'my whole body feels itchy and like its on fire ',
               "@nationwideclass no, it's not behaving at all. i'm mad. why am i here? bec
        ause I can't see you all over there. "],
              dtype=object)
```

1.Replacing emoticons with equivalent text

```
In [ ]: ## Replacing emoticons with words
        !pip install emot
        #Importing libraries
        import re
        from emot.emo_unicode import UNICODE_EMO, EMOTICONS

        Requirement already satisfied: emot in /usr/local/lib/python3.6/dist-packages (2.
        1)
```

```
In [ ]: # Function for converting emoticons into word
        def convert_emoticons(text):
            for emot in EMOTICONS:
                text = re.sub(u'('+emot+')', " ", text)
            return text
```

```
In [ ]: # Example
        convert_emoticons("Finally I finished my work :)")

Out[ ]: 'Finally I finished my work  '
```

2. Removing tags

- Not required in this data set

```
In [ ]: def remove_tag(text):
          return re.sub('<[^<]+?>','', text)
```

```
In [ ]: remove_tag("""<head><body> hello world! </body></head>""")

Out[ ]: ' hello world! '
```

3. Removing URLS

```
In [ ]: def remove_urls(text):
          rgx=re.compile(r"((http://)[^ ]*|(http)[^ ]*|(https://)[^ ]*|( www\.)[^ ]*)")
          text=rgx.sub(' ',text)
          return text
```

```
In [ ]: remove_urls('visit www.yahoo.com http:// http')

Out[ ]: 'visit     '
```

4. Removing single alphabet,double alphabet and alphanumeric character.

```
In [ ]: def remove_apha_numeric(text):
          rgx= re.compile(r'\d+\w+|\w+\d+|\d+|\s\w\w\s|\s\w\s')
          text=rgx.sub(' ',text)
          return text
```

```
In [ ]: remove_apha_numeric("@switchfoot http://twitpic.com/2y1zl - Awww, 10 that's a bumme
        r. a You shoulda got 10m David Carr of df4 Third Day to do it. ;D")

Out[ ]: "@switchfoot http://twitpic.com/  - Awww, that's bummer. You shoulda got   David C
        arr   Third Day do it. ;D"
```

5. Removing user names

```
In [ ]: def remove_user_name(text):
          rgx=re.compile(r'[@]\w+')
          text=rgx.sub(' ',text)
          return text
```

```
In [ ]: remove_user_name('@Jaggan who are you')
```

```
Out[ ]: '  who are you'
```

6. Removing Multiple repetetions and keeping only two for alphabets

- Removing Consecutive letters: 3 or more consecutive letters are replaced by 2 letters. (eg: "Heyyyy" to "Heyy")

```
In [ ]: def repeat2only(text):
          rgx_pattern = r"(.)\1\1+"
          rgx_replace = r"\1\1"
          text=re.sub(rgx_pattern,rgx_replace,text)
          return text
```

```
In [ ]: repeat2only('Hellooooo')
```

```
Out[ ]: 'Helloo'
```

7. Removing Punctuations

```
In [ ]: from string import punctuation
        def strip_punctuation(text):
          text=[char for char in text if char not in punctuation]
          return ''.join(text)
```

```
In [ ]: text = "Hello!? how are you doing?"
        strip_punctuation(text)
```

```
Out[ ]: 'Hello how are you doing'
```

8. Lemmatize

Lemmatization does morphological analysis of the words.Lemmatize the text so as to get its root form eg: functions,funtionality as function.

```
In [ ]: nltk.download('wordnet')
```

```
        [nltk_data] Downloading package wordnet to /root/nltk_data...
        [nltk_data]   Package wordnet is already up-to-date!
```

```
Out[ ]: True
```

```
In [ ]: from nltk.stem import WordNetLemmatizer #is based on The Porter Stemming Algorithm
```

```
In [ ]: def lemmatizer(text):
          wordnet_lemmatizer = WordNetLemmatizer()
          word_list = text.split()
          lemmatized_list = [wordnet_lemmatizer.lemmatize(word) for word in word_list]
          return ' '.join (lemmatized_list)
```

```
In [ ]: lemmatizer('i watches of this fan is great')
```

```
Out[ ]: 'i watch of this fan is great'
```

9. Spell Correction

- Not implemented here, Too slow, Takes too much time

```
In [ ]: !pip install autocorrect
```

```
Requirement already satisfied: autocorrect in /usr/local/lib/python3.6/dist-packag
es (2.2.2)
```

```
In [ ]: from autocorrect import Speller
        def spell_correct(text):
          spell = Speller(lang='en')
          return spell(text)
```

```
In [ ]: text = "I'm not sleapy and tehre is no place I'm giong to."
        spell_correct(text)
```

```
Out[ ]: "I'm not sleepy and there is no place I'm going to."
```

Trying othter one

```
In [ ]: !pip install pyspellchecker
```

```
Requirement already satisfied: pyspellchecker in /usr/local/lib/python3.6/dist-pac
kages (0.5.5)
```

```
In [ ]: from spellchecker import SpellChecker
        text = "I havv goood speling !"
        spell = SpellChecker()
        ([spell.correction(word) for word in text.split()])
```

```
Out[ ]: ['I', 'have', 'good', 'spelling', '!']
```

```
In [ ]: ## Making function for spelling correction
        def spell_correct(text_array):
          sen_list=[]
          for sen in text_array:
            text=sen.split()
            text = [spell.correction(word) for word  in text ]
            sen_list.append(' '.join(text))
          return np.array(sen_list)
```

10. Removing stopwords

```
In [ ]: nltk.download('stopwords')
        from nltk.corpus import stopwords
        stopwords=stopwords.words('english')
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

```
In [ ]: stopwords[:6] ## Displayiing first few storpwords
```

```
Out[ ]: ['i', 'me', 'my', 'myself', 'we', 'our']
```

```
In [ ]: ## Making function for removing stopwords
        def remove_stop_words(text_array):
          sen_list=[]
          for sen in text_array:
            text=sen.split()
            text = [i for i in text if not i in stopwords]
            sen_list.append(' '.join(text))
          return np.array(sen_list)
```

Making a combined function for all above

```
In [ ]: def preprocess(x):
          value=x.copy()
          value = [tweet.lower() for tweet in value] # Conveting into lower case.
          value = [convert_emoticons(i) for  i in (value)]   # Tried but not useful for imp
        roving the accuray takes 9 minutes to complete
          value = [remove_urls(i) for  i in (value)]
          value = [remove_user_name(i) for  i in (value)]
          value = [strip_punctuation(i) for  i in (value)]
          value = [remove_tag(i) for  i in (value)]
          value = [repeat2only(i) for  i in (value)]
          value = [ lemmatizer(i) for  i in (value)]  #1 minutes
          value = remove_stop_words(value)
          value = [remove_apha_numeric(i) for  i in (value)]
          return value
```

```
In [ ]: import time
        t = time.time()
        x_clean= preprocess(x) # It may take time
        print(f'Text Preprocessing complete.')
        print(f'Time Taken: {round((time.time()-t)/60,2)}, Minutes')
```

```
Text Preprocessing complete.
Time Taken: 7.07, Minutes
```

```
In [ ]: x_clean[:10]
```

```
Out[ ]: [' zl aww thats bummer shoulda got david carr third day',
         'upset cant update facebook texting might cry result school today also blah',
         'dived many time ball managed save rest bound',
         'whole body feel itchy like fire',
         'behaving mad cant see',
         'whole crew',
         'need hug',
         'hey long time see yes rain bit bit lol fine thanks hows',
         'nope didnt',
         'que muera']
```

```
In [ ]: x[:10] ## Comapre with initial daa
```

```
Out[ ]: array(["@switchfoot http://twitpic.com/2y1zl - Awww, that's a bummer.  You shoulda
        got David Carr of Third Day to do it. ;D",
               "is upset that he can't update his Facebook by texting it... and might cry
        as a result  School today also. Blah!",
               '@Kenichan I dived many times for the ball. Managed to save 50%  The rest g
        o out of bounds',
               'my whole body feels itchy and like its on fire ',
               "@nationwideclass no, it's not behaving at all. i'm mad. why am i here? bec
        ause I can't see you all over there. ",
               '@Kwesidei not the whole crew ', 'Need a hug ',
               "@LOLTrish hey  long time no see! Yes.. Rains a bit ,only a bit  LOL , I'm
        fine thanks , how's you ?",
               "@Tatiana_K nope they didn't have it ",
               '@twittera que me muera ? '], dtype=object)
```

D. A little bit of data exploration

```
In [ ]: import matplotlib.pyplot as plt
        import seaborn as sns
```

```
In [ ]: from collections import Counter
```

```
In [ ]: word_list= [sen.split() for sen in x_clean]
```

```
In [ ]: ## Counting total unique words in the vocabulary
        word_list_with_repetation=Counter([word  for list1 in word_list for word in list1])
        unique_word_count=len(list(word_list_with_repetation.keys()))
        unique_word_count
```

```
Out[ ]: 417082
```

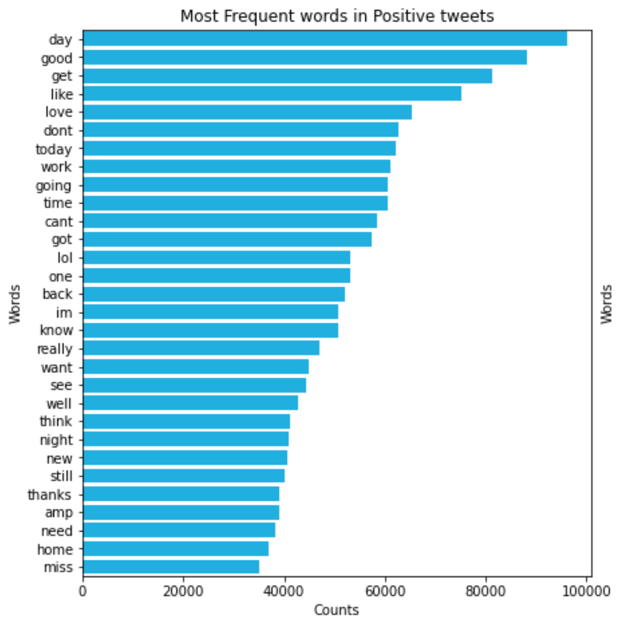
```
In [ ]: len(set(word_list_with_repetation.keys()))
```

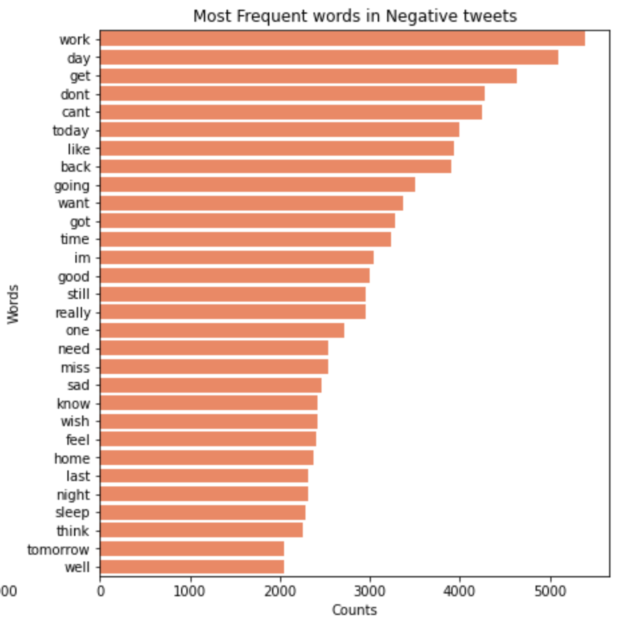
```
Out[ ]: 417082
```

```
In [ ]: positive_list=word_list[80000:]
        negative_list=word_list[:80000]
```

In [ ]:
```
top_pos=Counter([word  for list1 in positive_list for word in list1])
top_pos_df=pd.DataFrame(top_pos.most_common(100),columns=['Words','Counts'])

top_neg=Counter([word  for list1 in negative_list for word in list1])
top_neg_df=pd.DataFrame(top_neg.most_common(100),columns=['Words','Counts'])
```

In [ ]:
```
fig,ax=plt.subplots(nrows=1,ncols=2,figsize=(15,7.5))
sns.barplot(y='Words',x='Counts',data=top_pos_df[:30],color='deepskyblue',ax=ax[0])
sns.barplot(y='Words',x='Counts',data=top_neg_df[:30],color='coral',ax=ax[1])
ax[0].set_title("Most Frequent words in Positive tweets")
ax[1].set_title("Most Frequent words in Negative tweets")
plt.show()
```





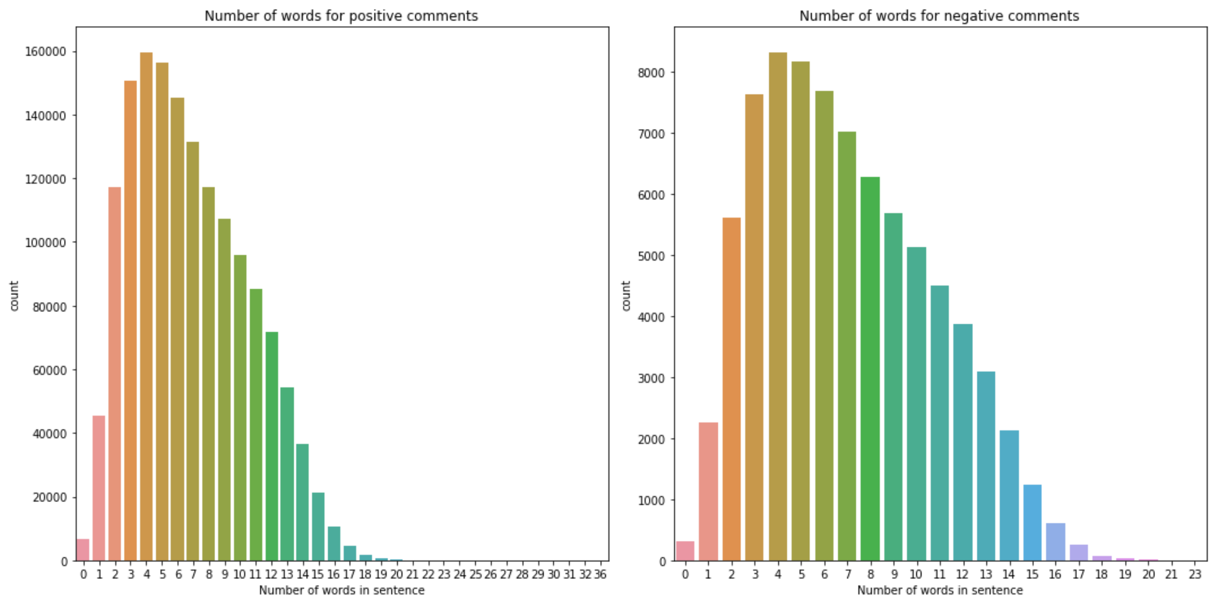
In [ ]:

Sentences having different number of word in each positive and negative group

In [ ]:
```
positive_list=word_list[80000:]
negative_list=word_list[:80000]
```

In [ ]:
```
word_count_positive=[len(list) for list in positive_list]
word_count_negative=[len(list) for list in negative_list]
```

In [ ]:
```
fig,ax =plt.subplots(nrows=1,ncols=2,figsize=(15,7.5))

sns.countplot(x=word_count_positive,ax=ax[0])
sns.countplot(x=word_count_negative,ax=ax[1])
ax[0].set_title('Number of words for positive comments')
ax[0].set_xlabel('Number of words in sentence')
ax[1].set_title('Number of words for negative comments')
ax[1].set_xlabel('Number of words in sentence')
plt.tight_layout()
plt.show()
```

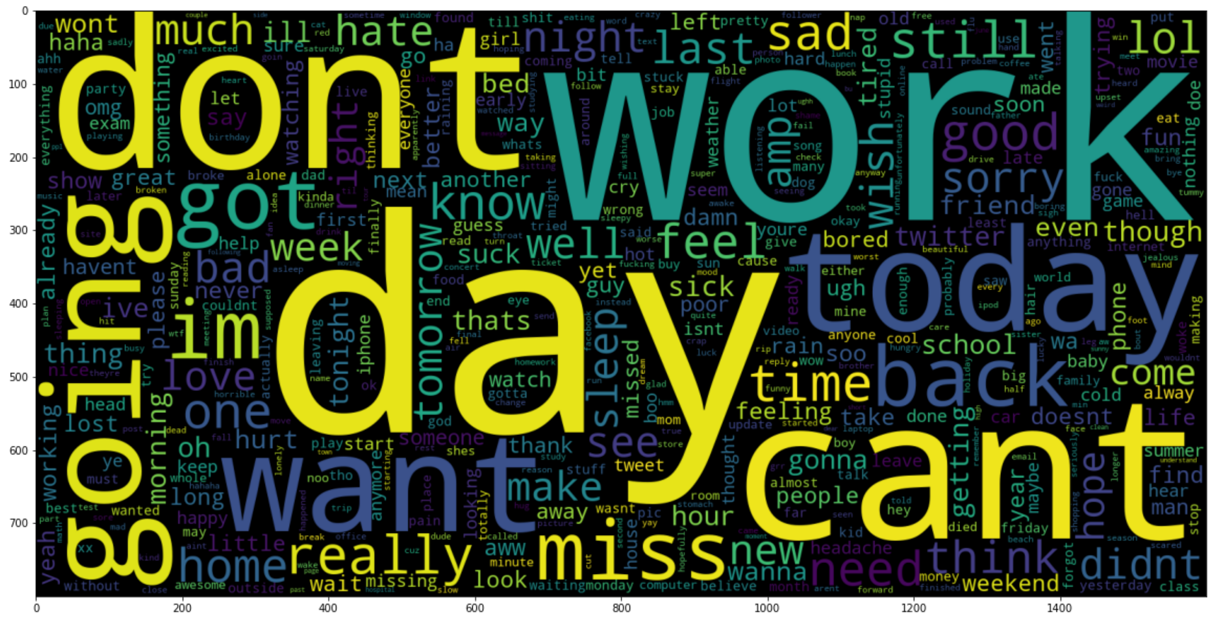


Word-Cloud for Negative tweets

In [ ]:
```
from wordcloud import WordCloud
```

In [ ]:
```
data_neg = x_clean[:800000]
plt.figure(figsize = (20,20))
wc = WordCloud(max_words = 500 , width = 1600 , height = 800,
               collocations=False).generate(" ".join(data_neg))
plt.imshow(wc)
```

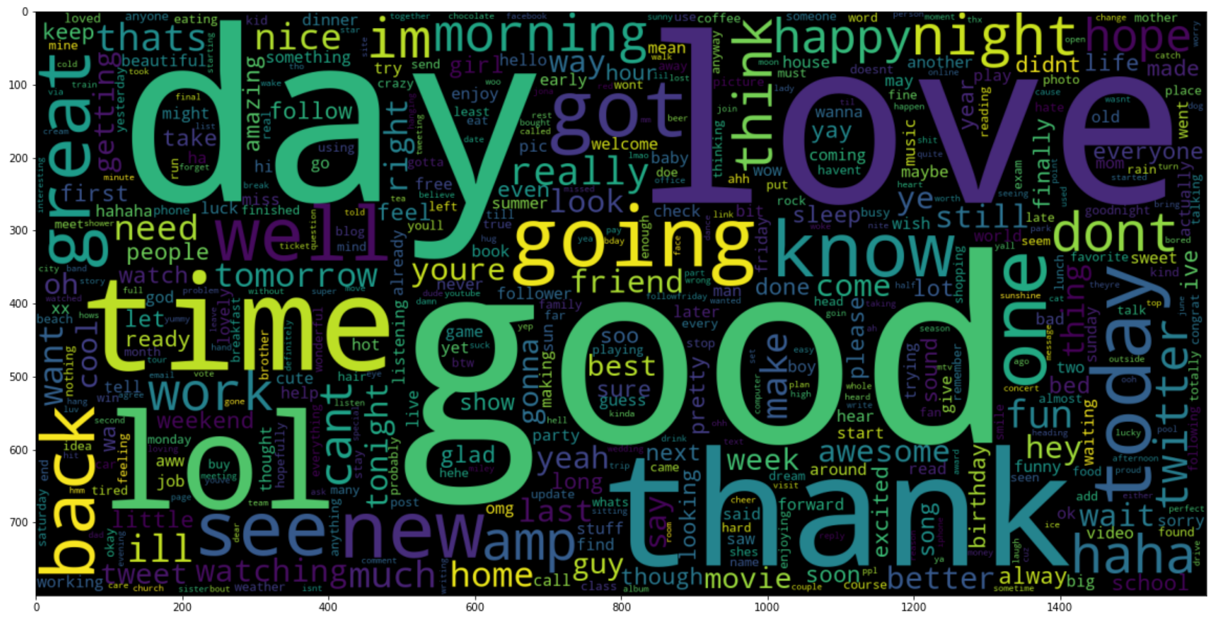
Out[ ]:
```
<matplotlib.image.AxesImage at 0x7f790db547f0>
```



Word-Cloud for Positiveve tweets

In [ ]:
```
data_neg = x_clean[800000:]
plt.figure(figsize = (20,20))
wc = WordCloud(max_words = 500 , width = 1600 , height = 800,
               collocations=False).generate(" ".join(data_neg))
plt.imshow(wc)
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x7f790db65240>
```



E. Modelling Using DNN Tensorflow

Note: tokenizer in tensorflow, by default carry out lower case operation and removal of punctuation as well.

```
In [ ]: len(x_clean)
```

```
Out[ ]: 1600000
```

```
In [ ]: x_clean[:5]
```

```
Out[ ]: [' zl aww thats bummer shoulda got david carr third day',
         'upset cant update facebook texting might cry result school today also blah',
         'dived many time ball managed save rest bound',
         'whole body feel itchy like fire',
         'behaving mad cant see']
```

Modelling

```
In [ ]: import tensorflow as tf
        import random
        from tensorflow.keras.preprocessing.text import Tokenizer
        from tensorflow.keras.preprocessing.sequence import pad_sequences
        from tensorflow.keras.utils import to_categorical
        from tensorflow.keras import regularizers
```

```
In [ ]: embedding_dim = 100
        max_length = 16
        training_size=160000
        trunc_type='post'
        padding_type='post'
        oov_tok = "<OOV>"
        test_portion=.1
```

Tokenization, Padding & Train_Test_Split

```
In [ ]: corpus1=(np.vstack([np.array(x_clean),y]).T)
```

```
In [ ]: corpus=corpus1.tolist()
In [ ]: random.shuffle(corpus)
        sentences=[]
        labels=[]
        random.shuffle(corpus)
        for x in range(training_size):
            sentences.append(corpus[x][0])
            labels.append(int(corpus[x][1]))
        tokenizer = Tokenizer()
        tokenizer.fit_on_texts(sentences)

        word_index = tokenizer.word_index
        vocab_size=len(word_index)
        print('Size of Vocabulary :', vocab_size)
        sequences = tokenizer.texts_to_sequences(sentences)
        padded = pad_sequences(sequences, maxlen=max_length, padding=padding_type, truncati
        ng=trunc_type)

        split = int(test_portion * training_size)

        x_test_pad =np.array(padded[0:split])
        y_test = np.array(labels[0:split])
        x_train_pad = np.array(padded[split:training_size])
        y_train = np.array(labels[split:training_size])
```

```
Size of Vocabulary : 83303
```

```
In [ ]: print(len(x_train_pad))
        print(len(y_train))
        print(len(x_test_pad))
        print(len(y_test))
```

```
144000
144000
16000
16000
```

```
In [ ]: x_train_pad.shape

Out[ ]: (144000, 16)
```

```
In [ ]: y_train.shape
```

Making Embedding Matrix from Downloaded Glove

In [ ]:
```
embeddings_index = {};
with open('/content/kaggle/datasets/danielwillgeorge/glove6b100dtxt/glove.6B.100d.t
xt') as f:
    for line in f:
        values = line.split();
        word = values[0];
        coefs = np.asarray(values[1:], dtype='float32');
        embeddings_index[word] = coefs;

embeddings_matrix = np.zeros((vocab_size+1, embedding_dim));
for word, i in word_index.items():
    embedding_vector = embeddings_index.get(word);
    if embedding_vector is not None:
        embeddings_matrix[i] = embedding_vector;
```

In [ ]:
```
print(len(embeddings_matrix))
```

```
83304
```

```
In [ ]: model = tf.keras.Sequential([
            tf.keras.layers.Embedding(vocab_size+1, embedding_dim, input_length=max_length,
        weights=[embeddings_matrix], trainable=False),
            tf.keras.layers.Dropout(0.2),
            tf.keras.layers.Conv1D(64, 5, activation='relu'),
            tf.keras.layers.MaxPooling1D(pool_size=4),
            tf.keras.layers.LSTM(64),
            tf.keras.layers.Dense(1, activation='sigmoid')
        ])
        model.compile(loss='binary_crossentropy',optimizer='adam',metrics=['accuracy'])
        model.summary()

        num_epochs = 50

        history = model.fit(x_train_pad,y_train, epochs=num_epochs,validation_data=(x_test_
        pad,y_test), verbose=2)

        print("Training Complete")
```

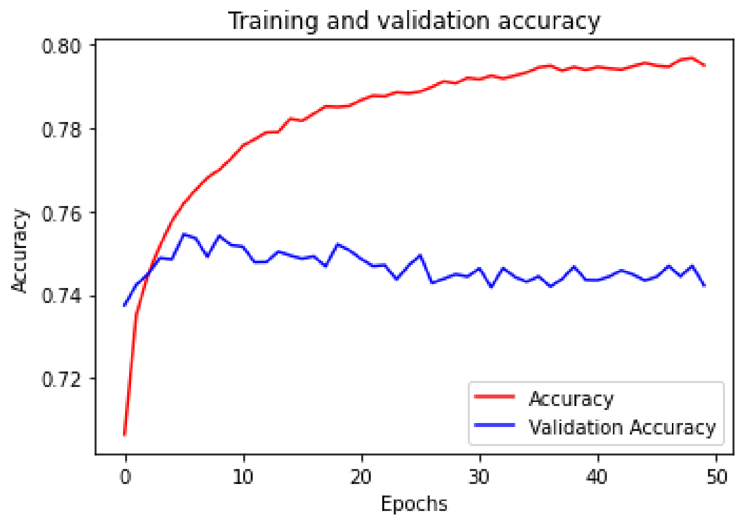
```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
embedding (Embedding)        (None, 16, 100)           8330400
_________________________________________________________________
dropout (Dropout)            (None, 16, 100)           0
_________________________________________________________________
conv1d (Conv1D)              (None, 12, 64)            32064
_________________________________________________________________
max_pooling1d (MaxPooling1D) (None, 3, 64)             0
_________________________________________________________________
lstm (LSTM)                  (None, 64)                33024
_________________________________________________________________
dense (Dense)                (None, 1)                 65
=================================================================
Total params: 8,395,553
Trainable params: 65,153
Non-trainable params: 8,330,400
_________________________________________________________________
Epoch 1/50
4500/4500 - 17s - loss: 0.5621 - accuracy: 0.7065 - val_loss: 0.5256 - val_accurac
y: 0.7375
Epoch 2/50
4500/4500 - 16s - loss: 0.5275 - accuracy: 0.7353 - val_loss: 0.5157 - val_accurac
y: 0.7424
Epoch 3/50
4500/4500 - 16s - loss: 0.5127 - accuracy: 0.7450 - val_loss: 0.5106 - val_accurac
y: 0.7450
Epoch 4/50
4500/4500 - 16s - loss: 0.5034 - accuracy: 0.7519 - val_loss: 0.5065 - val_accurac
y: 0.7489
Epoch 5/50
4500/4500 - 16s - loss: 0.4940 - accuracy: 0.7577 - val_loss: 0.5071 - val_accurac
y: 0.7485
Epoch 6/50
4500/4500 - 16s - loss: 0.4878 - accuracy: 0.7619 - val_loss: 0.5024 - val_accurac
y: 0.7545
Epoch 7/50
4500/4500 - 16s - loss: 0.4820 - accuracy: 0.7652 - val_loss: 0.5044 - val_accurac
y: 0.7536
Epoch 8/50
4500/4500 - 18s - loss: 0.4770 - accuracy: 0.7681 - val_loss: 0.5050 - val_accurac
y: 0.7491
Epoch 9/50
4500/4500 - 16s - loss: 0.4740 - accuracy: 0.7700 - val_loss: 0.5004 - val_accurac
y: 0.7542
Epoch 10/50
4500/4500 - 16s - loss: 0.4700 - accuracy: 0.7727 - val_loss: 0.5075 - val_accurac
y: 0.7519
Epoch 11/50
4500/4500 - 16s - loss: 0.4670 - accuracy: 0.7758 - val_loss: 0.5087 - val_accurac
y: 0.7516
Epoch 12/50
4500/4500 - 17s - loss: 0.4632 - accuracy: 0.7774 - val_loss: 0.5112 - val_accurac
y: 0.7478
Epoch 13/50
4500/4500 - 16s - loss: 0.4607 - accuracy: 0.7790 - val_loss: 0.5034 - val_accurac
y: 0.7479
Epoch 14/50
```

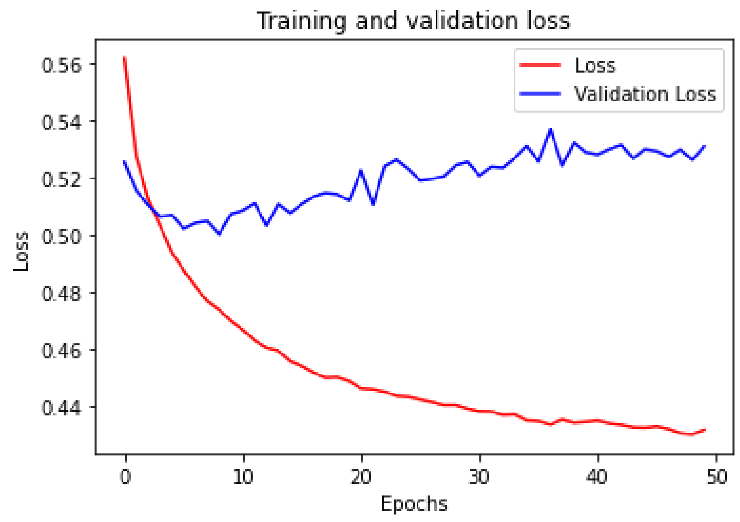
```
4500/4500 - 16s - loss: 0.4597 - accuracy: 0.7791 - val_loss: 0.5110 - val_accurac
y: 0.7504
Epoch 15/50
4500/4500 - 16s - loss: 0.4560 - accuracy: 0.7823 - val_loss: 0.5078 - val_accurac
y: 0.7494
Epoch 16/50
4500/4500 - 17s - loss: 0.4543 - accuracy: 0.7818 - val_loss: 0.5109 - val_accurac
y: 0.7487
Epoch 17/50
Epoch 18/50
4500/4500 - 16s - loss: 0.4502 - accuracy: 0.7853 - val_loss: 0.5148 - val_accurac
y: 0.7468
Epoch 19/50
4500/4500 - 16s - loss: 0.4504 - accuracy: 0.7851 - val_loss: 0.5144 - val_accurac
y: 0.7521
Epoch 20/50
4500/4500 - 16s - loss: 0.4490 - accuracy: 0.7853 - val_loss: 0.5122 - val_accurac
y: 0.7507
Epoch 21/50
4500/4500 - 16s - loss: 0.4465 - accuracy: 0.7868 - val_loss: 0.5228 - val_accurac
y: 0.7486
Epoch 22/50
4500/4500 - 16s - loss: 0.4462 - accuracy: 0.7878 - val_loss: 0.5107 - val_accurac
y: 0.7469
Epoch 23/50
4500/4500 - 16s - loss: 0.4453 - accuracy: 0.7877 - val_loss: 0.5242 - val_accurac
y: 0.7471
Epoch 24/50
4500/4500 - 16s - loss: 0.4438 - accuracy: 0.7886 - val_loss: 0.5265 - val_accurac
y: 0.7437
Epoch 25/50
4500/4500 - 16s - loss: 0.4435 - accuracy: 0.7884 - val_loss: 0.5232 - val_accurac
y: 0.7470
Epoch 26/50
4500/4500 - 16s - loss: 0.4426 - accuracy: 0.7888 - val_loss: 0.5192 - val_accurac
y: 0.7495
Epoch 27/50
4500/4500 - 18s - loss: 0.4417 - accuracy: 0.7899 - val_loss: 0.5198 - val_accurac
y: 0.7428
Epoch 28/50
4500/4500 - 16s - loss: 0.4407 - accuracy: 0.7913 - val_loss: 0.5206 - val_accurac
y: 0.7439
Epoch 29/50
4500/4500 - 16s - loss: 0.4407 - accuracy: 0.7907 - val_loss: 0.5245 - val_accurac
y: 0.7449
Epoch 30/50
4500/4500 - 16s - loss: 0.4394 - accuracy: 0.7921 - val_loss: 0.5257 - val_accurac
y: 0.7444
Epoch 31/50
4500/4500 - 16s - loss: 0.4384 - accuracy: 0.7917 - val_loss: 0.5209 - val_accurac
y: 0.7464
Epoch 32/50
4500/4500 - 16s - loss: 0.4383 - accuracy: 0.7926 - val_loss: 0.5240 - val_accurac
y: 0.7418
Epoch 33/50
4500/4500 - 16s - loss: 0.4372 - accuracy: 0.7919 - val_loss: 0.5236 - val_accurac
y: 0.7464
Epoch 34/50
4500/4500 - 16s - loss: 0.4374 - accuracy: 0.7926 - val_loss: 0.5271 - val_accurac
y: 0.7443
```

```
Epoch 35/50
4500/4500 - 16s - loss: 0.4353 - accuracy: 0.7934 - val_loss: 0.5312 - val_accurac
y: 0.7431
Epoch 36/50
4500/4500 - 16s - loss: 0.4351 - accuracy: 0.7946 - val_loss: 0.5257 - val_accurac
y: 0.7444
Epoch 37/50
4500/4500 - 15s - loss: 0.4339 - accuracy: 0.7950 - val_loss: 0.5371 - val_accurac
y: 0.7420
Epoch 38/50
4500/4500 - 16s - loss: 0.4356 - accuracy: 0.7938 - val_loss: 0.5244 - val_accurac
y: 0.7438
Epoch 39/50
4500/4500 - 16s - loss: 0.4345 - accuracy: 0.7947 - val_loss: 0.5324 - val_accurac
y: 0.7468
Epoch 40/50
4500/4500 - 16s - loss: 0.4348 - accuracy: 0.7940 - val_loss: 0.5290 - val_accurac
y: 0.7436
Epoch 41/50
4500/4500 - 16s - loss: 0.4353 - accuracy: 0.7947 - val_loss: 0.5282 - val_accurac
y: 0.7435
Epoch 42/50
4500/4500 - 16s - loss: 0.4343 - accuracy: 0.7944 - val_loss: 0.5301 - val_accurac
y: 0.7444
Epoch 43/50
4500/4500 - 16s - loss: 0.4337 - accuracy: 0.7941 - val_loss: 0.5316 - val_accurac
y: 0.7459
Epoch 44/50
4500/4500 - 16s - loss: 0.4329 - accuracy: 0.7949 - val_loss: 0.5269 - val_accurac
y: 0.7449
Epoch 45/50
4500/4500 - 16s - loss: 0.4327 - accuracy: 0.7957 - val_loss: 0.5301 - val_accurac
y: 0.7434
Epoch 46/50
4500/4500 - 16s - loss: 0.4332 - accuracy: 0.7950 - val_loss: 0.5294 - val_accurac
y: 0.7444
Epoch 47/50
4500/4500 - 16s - loss: 0.4322 - accuracy: 0.7948 - val_loss: 0.5275 - val_accurac
y: 0.7469
Epoch 48/50
4500/4500 - 16s - loss: 0.4308 - accuracy: 0.7965 - val_loss: 0.5299 - val_accurac
y: 0.7444
Epoch 49/50
4500/4500 - 16s - loss: 0.4304 - accuracy: 0.7969 - val_loss: 0.5263 - val_accurac
y: 0.7470
Epoch 50/50
4500/4500 - 16s - loss: 0.4320 - accuracy: 0.7951 - val_loss: 0.5310 - val_accurac
y: 0.7423
Training Complete
```

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

#-----------------------------------------------------------
# Retrieve a list of list results on training and test data
# sets for each training epoch
#-----------------------------------------------------------
acc=history.history['accuracy']
val_acc=history.history['val_accuracy']
loss=history.history['loss']
val_loss=history.history['val_loss']

epochs=range(len(acc)) # Get number of epochs

#------------------------------------------------
# Plot training and validation accuracy per epoch
#------------------------------------------------
plt.plot(epochs, acc, 'r')
plt.plot(epochs, val_acc, 'b')
plt.title('Training and validation accuracy')
plt.xlabel("Epochs")
plt.ylabel("Accuracy")
plt.legend(["Accuracy", "Validation Accuracy"])

plt.figure()

#------------------------------------------------
# Plot training and validation loss per epoch
#------------------------------------------------
plt.plot(epochs, loss, 'r')
plt.plot(epochs, val_loss, 'b')
plt.title('Training and validation loss')
plt.xlabel("Epochs")
plt.ylabel("Loss")
plt.legend(["Loss", "Validation Loss"])

plt.figure()


# Expected Output
# A chart where the validation loss does not increase sharply!
```

```
Out[ ]: <Figure size 432x288 with 0 Axes>
```





```
<Figure size 432x288 with 0 Axes>
```

Prediction Part

```
In [ ]: def sentiment_pred(text):
          sequences = tokenizer.texts_to_sequences(np.array([x_test]))
          x_test_pad = pad_sequences(sequences, maxlen=max_length, padding=padding_type, tr
        uncating=trunc_type)
          score = model.predict([x_test_pad])[0,0]
          if score>=0.7:
            print('Positive')
          else:
            print('Negative')
```

```
In [ ]: x_test=" what shit this was a bad movie"
        sentiment_pred(x_test)

        Negative
```