In [1]:
```
# Importing the required libraries

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

from sklearn.model_selection import train_test_split, GridSearchCV, RandomizedSearchCV, KFold
from sklearn.metrics import accuracy_score, roc_auc_score, confusion_matrix, recall_score, precision_
from sklearn.preprocessing import MinMaxScaler
from sklearn.feature_selection import RFE
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier, GradientBoostingClassifier
from sklearn.svm import SVC
from sklearn.naive_bayes import MultinomialNB
from sklearn import svm
from sklearn.svm import LinearSVC
from sklearn.naive_bayes import BernoulliNB
from sklearn.preprocessing import StandardScaler, MinMaxScaler
from sklearn.model_selection import cross_val_score
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfTransformer, TfidfVectorizer
from sklearn.pipeline import Pipeline
from sklearn.utils import shuffle

import xgboost as xgb
# from xgboost import XGBClassifier

from scipy.stats import boxcox

import nltk
from nltk.corpus import stopwords
from nltk import tokenize
from nltk.tokenize import word_tokenize
from nltk.stem.porter import PorterStemmer
from nltk.stem import WordNetLemmatizer
from nltk import pos_tag
from nltk.corpus import wordnet

from wordcloud import WordCloud

from joblib import dump, load
import pickle

import string
import re
import time

# pip install pandas_profiling
# from pandas_profiling import ProfileReport

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

In [2]:
```
# Importing dataset

data = pd.read_csv("training.1600000.processed.noemoticon.csv", encoding = "ISO-8859-1")
data.head()
```

Out[2]:

	0	1467810369	Mon Apr 06 22:19:45 PDT 2009	NO_QUERY	_TheSpecialOne_	@switchfoot http://twitpic.com/2y1zl - Awww, that's a bummer. You shoulda got David Carr of Third Day to do it. ;D
0	0	1467810672	Mon Apr 06 22:19:49 PDT 2009	NO_QUERY	scotthamilton	is upset that he can't update his Facebook by ...
1	0	1467810917	Mon Apr 06 22:19:53 PDT 2009	NO_QUERY	mattycus	@Kenichan I dived many times for the ball. Man...
2	0	1467811184	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	ElleCTF	my whole body feels itchy and like its on fire
3	0	1467811193	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	Karoli	@nationwideclass no, it's not behaving at all....
4	0	1467811372	Mon Apr 06 22:20:00 PDT 2009	NO_QUERY	joy_wolf	@Kwesidei not the whole crew

In [3]:
```
# column names

data.columns = ["sentiment", "time", "date", "query", "username", "text"]
data.head()
```

Out[3]:

	sentiment	time	date	query	username	text
0	0	1467810672	Mon Apr 06 22:19:49 PDT 2009	NO_QUERY	scotthamilton	is upset that he can't update his Facebook by ...
1	0	1467810917	Mon Apr 06 22:19:53 PDT 2009	NO_QUERY	mattycus	@Kenichan I dived many times for the ball. Man...
2	0	1467811184	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	ElleCTF	my whole body feels itchy and like its on fire
3	0	1467811193	Mon Apr 06 22:19:57 PDT 2009	NO_QUERY	Karoli	@nationwideclass no, it's not behaving at all....
4	0	1467811372	Mon Apr 06 22:20:00 PDT 2009	NO_QUERY	joy_wolf	@Kwesidei not the whole crew

In [4]:
```
data.shape
```

Out[4]:
```
(1599999, 6)
```

In [5]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1599999 entries, 0 to 1599998
Data columns (total 6 columns):
 #   Column     Non-Null Count    Dtype 
---  ------     --------------    ----- 
 0   sentiment  1599999 non-null  int64 
 1   time       1599999 non-null  int64 
 2   date       1599999 non-null  object
 3   query      1599999 non-null  object
 4   username   1599999 non-null  object
 5   text       1599999 non-null  object
dtypes: int64(2), object(4)
memory usage: 73.2+ MB
```

In [6]:
```
data.isnull().sum()
```

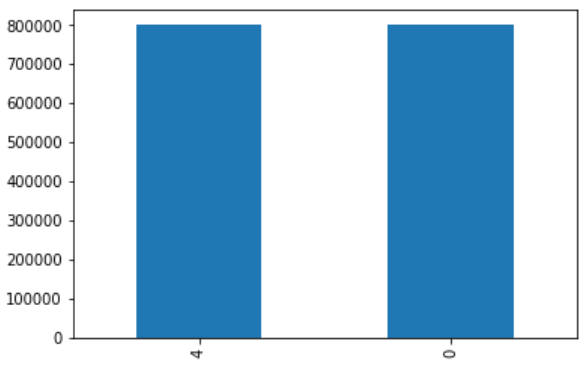
Out[6]:
```
sentiment    0
time         0
date         0
query        0
username     0
text         0
dtype: int64
```

In [7]:
```
data['sentiment'].value_counts()
```

Out[7]:
```
4    800000
0    799999
Name: sentiment, dtype: int64
```

In [8]:
```
data['sentiment'].value_counts().plot.bar()
```

Out[8]:
```
<AxesSubplot:>
```



In [9]:
```
data = data[['text', 'sentiment']]
data.head()
```

Out[9]:

	text	sentiment
0	is upset that he can't update his Facebook by ...	0
1	@Kenichan I dived many times for the ball. Man...	0
2	my whole body feels itchy and like its on fire	0
3	@nationwideclass no, it's not behaving at all....	0
4	@Kwesidei not the whole crew	0

In [10]:
```
# convert positive 1 and negative 0
data['sentiment'] = data['sentiment'].apply(lambda x : 1 if x == 4 else x)
```

In [11]:
```
data['sentiment'].value_counts()
```

Out[11]:
```
1    800000
0    799999
Name: sentiment, dtype: int64
```

In [12]:
```
data.head()
```

Out[12]:

	text	sentiment
0	is upset that he can't update his Facebook by ...	0
1	@Kenichan I dived many times for the ball. Man...	0
2	my whole body feels itchy and like its on fire	0
3	@nationwideclass no, it's not behaving at all....	0
4	@Kwesidei not the whole crew	0

In [13]:
```
text, sentiment = list(data['text']), list(data['sentiment'])
```

In [14]:
```
print(text[:5])
```

```
["is upset that he can't update his Facebook by texting it... and might cry as a result  School tod
ay also. Blah!", '@Kenichan I dived many times for the ball. Managed to save 50%  The rest go out o
f bounds', 'my whole body feels itchy and like its on fire ', "@nationwideclass no, it's not behavi
ng at all. i'm mad. why am i here? because I can't see you all over there. ", '@Kwesidei not the wh
ole crew ']
```

In [21]:
```
#check if all values are str
all(isinstance(x, str) for x in text)
```

Out[21]:
```
True
```

In [16]:
```
#data preprocessing

#stop = stopwords.words('english')
```

In [116]:
```
#defined method with preprocessing functions

def preprocess(textdata):

    #defining dictionary containing all emojis with their meanings
    emojis = {':)': 'smile', ':-)': 'smile', ';d': 'wink', ':-E': 'vampire', ':(': 'sad',
              ':-(': 'sad', ':-<': 'sad', ':P': 'raspberry', ':O': 'surprised',
              ':-@': 'shocked', ':@': 'shocked',':-$': 'confused', ':\\\\': 'annoyed',
              ':#': 'mute', ':X': 'mute', ':^)': 'smile', ':-&': 'confused', '$_$': 'greedy',
              '@@': 'eyeroll', ':-!': 'confused', ':-D': 'smile', ':-0': 'yell', 'O.o': 'confused',
              '<(-_-)>': 'robot', 'd[-_-]b': 'dj', ":'-)": 'sadsmile', ';)': 'wink',
              ';-)': 'wink', 'O:-)': 'angel','O*-)': 'angel','(:-D': 'gossip', '=^.^=': 'cat'}

    stopwordlist = ['a', 'about', 'above', 'after', 'again', 'ain', 'all', 'am', 'an',
                    'and','any','are', 'as', 'at', 'be', 'because', 'been', 'before',
                    'being', 'below', 'between','both', 'by', 'can', 'd', 'did', 'do',
                    'does', 'doing', 'down', 'during', 'each','few', 'for', 'from',
                    'further', 'had', 'has', 'have', 'having', 'he', 'her', 'here',
                    'hers', 'herself', 'him', 'himself', 'his', 'how', 'i', 'if', 'in',
                    'into','is', 'it', 'its', 'itself', 'just', 'll', 'm', 'ma',
                    'me', 'more', 'most','my', 'myself', 'now', 'o', 'of', 'on', 'once',
                    'only', 'or', 'other', 'our', 'ours','ourselves', 'out', 'own', 're',
                    's', 'same', 'she', "shes", 'should', "shouldve",'so', 'some', 'such',
                    't', 'than', 'that', "thatll", 'the', 'their', 'theirs', 'them',
                    'themselves', 'then', 'there', 'these', 'they', 'this', 'those',
                    'through', 'to', 'too','under', 'until', 'up', 've', 'very', 'was',
                    'we', 'were', 'what', 'when', 'where','which','while', 'who', 'whom',
                    'why', 'will', 'with', 'won', 'y', 'you', "youd","youll", "youre",
                    "youve", 'your', 'yours', 'yourself', 'yourselves']

    processedText = []


    # Defining regex patterns.\n",
    urlPattern = r"((http://)[^ ]*|(https://)[^ ]*|( www\.)[^ ]*)"

    userPattern = '@[^\\s]+'

    #alphaPattern      = "[^a-zA-Z]
    alphaPattern      = "[^a-zA-Z]"
    sequencePattern   = r"(.)\1\1+"
    seqReplacePattern = r"\1\1"

    for tweet in textdata:
        tweet = tweet.lower()

        #replace all URLs with 'URL'
        tweet = re.sub(urlPattern, ' URL', tweet)

        #Replace all emojis
        for emoji in emojis.keys():
            tweet = tweet.replace(emoji, "EMOJI" + emojis[emoji])

        #Replace @username to USER:
        tweet = re.sub(userPattern, ' USER', tweet)

        # Replace all non alphabets
        tweet = re.sub(alphaPattern, " ", tweet)

        # Replace 3 or more consecutive letters by 2 Letter
        tweet = re.sub(sequencePattern, seqReplacePattern, tweet)

        # Removing punctuations
        all_char_list = []
        all_char_list = [char for char in tweet if char not in string.punctuation]
        tweet = ''.join(all_char_list)

        #removing stopwords
        tweetwords = ''
        for word in tweet.split():
            if word not in (stopwordlist):
                if len(word)>1:
                    tweetwords += (word+ ' ')

        processedText.append(tweetwords)

    return processedText
```

In [117]:
```
#calc time taken

t = time.time()
preprocessedtext = preprocess(text)
print('Text processing complete')
print(f'Time Taken: {round(time.time()-t)} seconds')
```

```
Text processing complete
Time Taken: 90 seconds
```

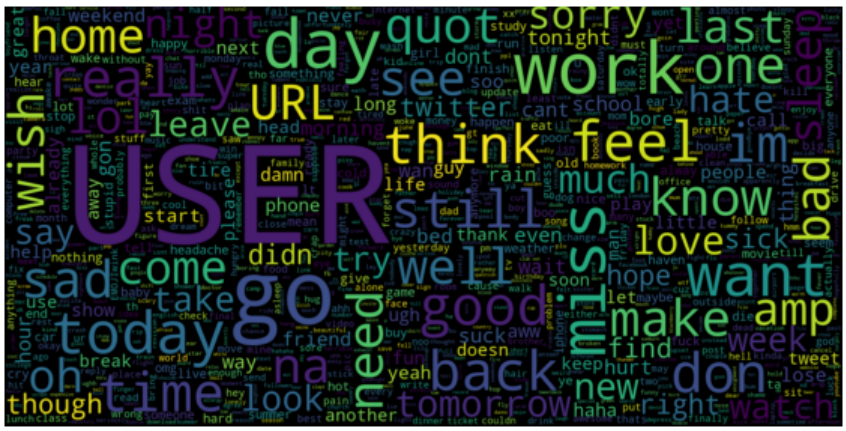
In [118]:
```
# defining method to return 2nd parameter for lemmatization that is POS tag

def get_wordnet_pos_tag(tag):
    if tag.startswith("J"):
        return wordnet.ADJ
    if tag.startswith("V"):
        return wordnet.VERB
    if tag.startswith("N"):
        return wordnet.NOUN
    if tag.startswith("R"):
        return wordnet.ADV
    else:
        return wordnet.NOUN
```

In [119]:
```
# create a method to perform lemmatization with POS tags identified via a pos_tag method

def lemmatize_process(preprocessedtext):
    lemma = WordNetLemmatizer()

    finalprocessedtext = []
    for tweet in preprocessedtext:
        text_pos = pos_tag(word_tokenize(tweet))
        words = [x[0] for x in text_pos]
        pos = [x[1] for x in text_pos]
        tweet_lemma = " ".join([lemma.lemmatize(a,get_wordnet_pos_tag(b)) for a,b in zip(words,pos)])
        finalprocessedtext.append(tweet_lemma)
    return finalprocessedtext
```

In [121]:
```
# applying entire text stored in list "text" for preprocessing and calc time taken to perform operati

t = time.time()
processedtext = lemmatize_process(preprocessedtext)
print('Text Lemmatization complete')
print(f'Time Taken: {round(time.time()-t)} seconds')
```

```
Text Lemmatization complete
Time Taken: 1333 seconds
```

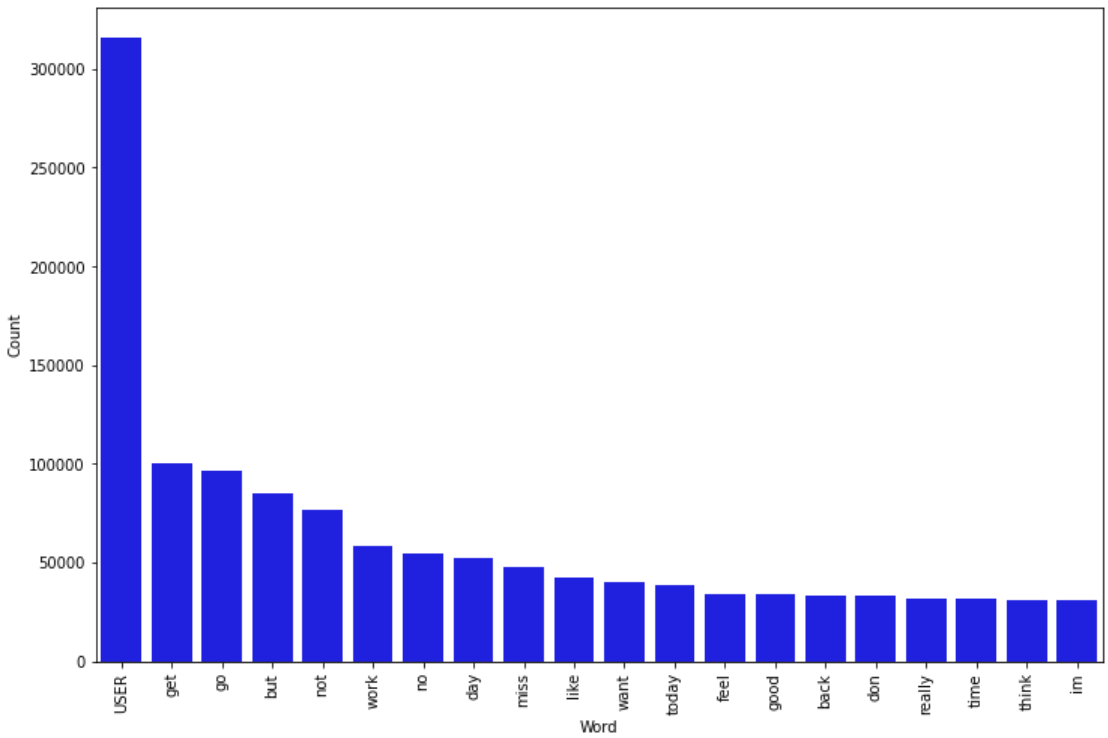
In [122]:
```
#Data Analysis

data_neg = processedtext[:800000]
all_negwords = ' '.join(data_neg)
wordcloud = WordCloud(max_words = 1000, width = 1600, height = 800,
                      collocations = False).generate(all_negwords)

plt.figure(figsize=(10,7))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.show()
```



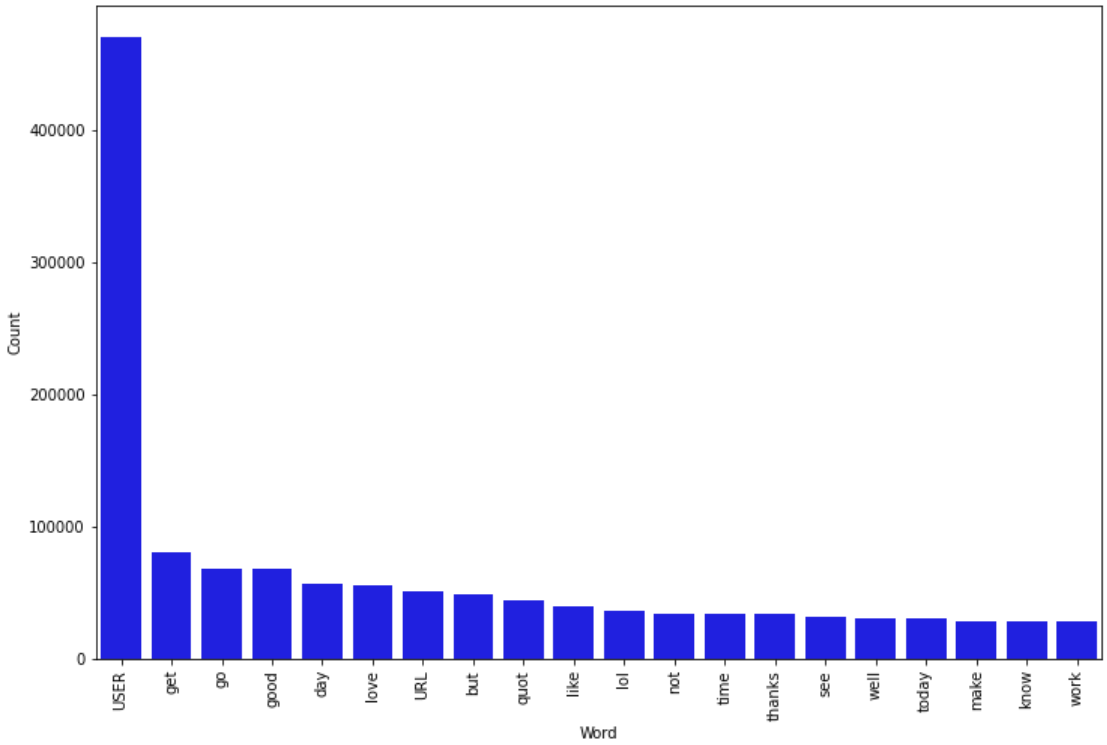
In [123]:
```
#Data Analysis

data_pos = processedtext[800000:]
all_poswords = ' '.join(data_pos)
wordcloud = WordCloud(max_words = 1000, width = 1600, height = 800,
                      collocations = False).generate(all_negwords)

plt.figure(figsize=(10,7))
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis("off")
plt.show()
```

In [124]:
```
token_wspace = tokenize.WhitespaceTokenizer()

def mostFrequentWords(tweets, quantity):
    all_words = ' '.join(tweets)
    all_tokens = token_wspace.tokenize(all_words)
    freq_dist = nltk.FreqDist(all_tokens)
    df_frequency = pd.DataFrame({"Word":list(freq_dist.keys()), "Frequency":list(freq_dist.values())})
    df_frequency = df_frequency.nlargest(columns="Frequency", n=quantity)
    plt.figure(figsize=(12,8))
    ax = sns.barplot(data = df_frequency, x = "Word", y = "Frequency", color = "blue")
    ax.set(ylabel = "Count")
    plt.xticks(rotation = 'vertical')
    plt.show()
```

In [125]:
```
# negative

mostFrequentWords(processedtext[:800000], 20)
```



In [126]:
```
# positive

mostFrequentWords(processedtext[800000:], 20)
```



In [128]:
```
# train test split

X_train, X_test, y_train, y_test = train_test_split(processedtext, sentiment, test_size = 0.05, rando

print('Data split done...')
```

```
Data split done...
```

In [129]:
```
# TF-IDF Vectorizer
# Fitting TFIDF vectorizer on the train dataset

vectoriser = TfidfVectorizer(ngram_range=(1,2), max_features=500000)
vectoriser.fit(X_train)
print('Vectoriser fitted')
print('No. of feature_words: ', len(vectoriser.get_feature_names()))
```

```
Vectoriser fitted
No. of feature_words:  500000
```

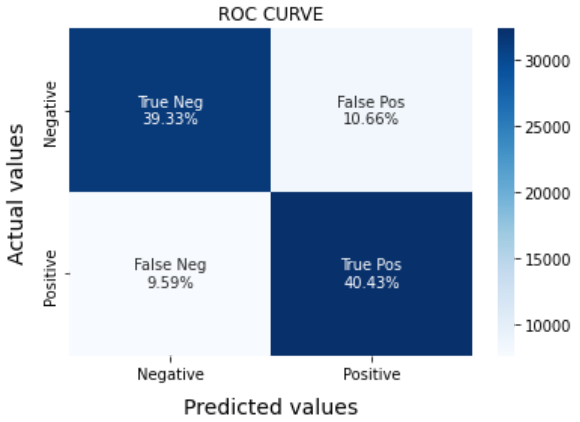
In [130]:
```
# transforming the dataset
X_train = vectoriser.transform(X_train)
X_test = vectoriser.transform(X_test)
print('Data Transformed')
```

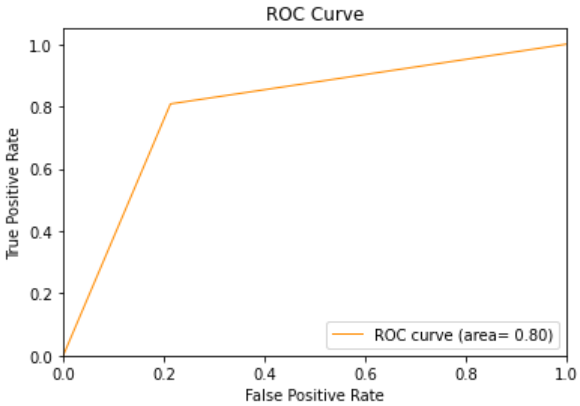
```
Data Transformed
```

In [135]:
```
# model evaluation method

def model_Evaluate(model):

    #Predict values for test dataset
    y_pred = model.predict(X_test)
    #print evaluation metric
    print(classification_report(y_test, y_pred))

    #compute and plot confusion matrix
    cf_matrix = confusion_matrix(y_test, y_pred)

    categories = ['Negative', 'Positive']
    group_names = ['True Neg', 'False Pos', 'False Neg', 'True Pos']
    group_percentages = ['{0:.2%}'.format(value) for value in cf_matrix.flatten() / np.sum(cf_matrix)]

    labels = [f'{v1}\n{v2}' for v1, v2 in zip(group_names, group_percentages)]
    labels = np.asarray(labels).reshape(2,2)

    sns.heatmap(cf_matrix, annot = labels, cmap = 'Blues', fmt = '',
                xticklabels = categories, yticklabels = categories)

    plt.xlabel("Predicted values", fontdict = {'size':14}, labelpad = 10)
    plt.ylabel("Actual values", fontdict = {'size':14}, labelpad = 10)
    plt.title("Confusion Matrix", fontdict = {'size':18}, pad = 20)

    plt.title("ROC CURVE")
    #Area under the curve
    fpr, tpr, thresholds = roc_curve(y_test, y_pred)
    roc_auc = auc(fpr, tpr)
    plt.figure()
    plt.plot(fpr, tpr, color='darkorange', lw=1, label='ROC curve (area= %0.2f)' % roc_auc)
    plt.xlim([0.0, 1.0])
    plt.ylim([0.0, 1.05])
    plt.xlabel('False Positive Rate')
    plt.ylabel('True Positive Rate')
    plt.title('ROC Curve')
    plt.legend(loc="lower right")
    plt.show()

    return y_pred
```

In [136]:
```
# create a linear svc model

SVCmodel = LinearSVC()
SVCmodel.fit(X_train, y_train)
model_Evaluate(SVCmodel)
```

```
              precision    recall  f1-score   support

           0       0.80      0.79      0.80     39986
           1       0.79      0.81      0.80     40014

    accuracy                           0.80     80000
   macro avg       0.80      0.80      0.80     80000
weighted avg       0.80      0.80      0.80     80000
```

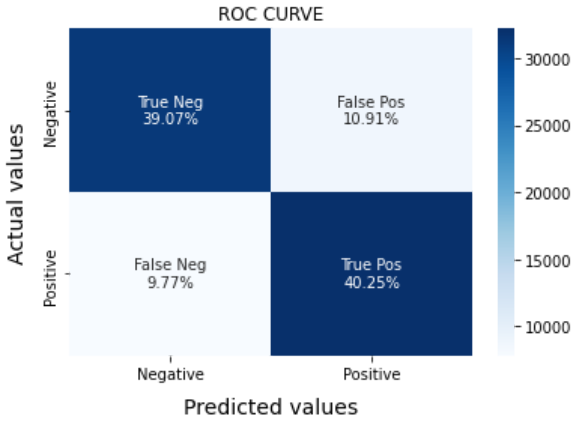


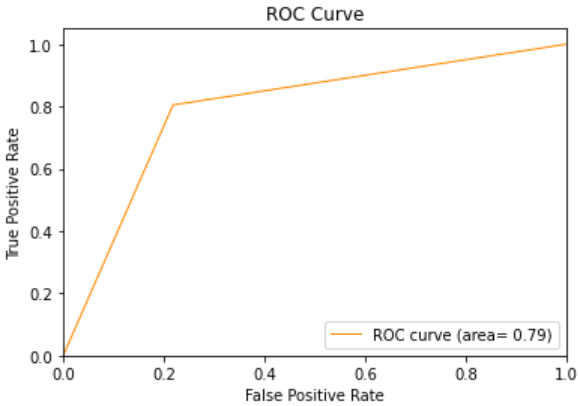


Out[136]:
```
array([1, 1, 0, ..., 1, 1, 1])
```

In [137]:
```
# create bernoulli naive bayes model

BNBmodel = BernoulliNB(alpha=2)
BNBmodel.fit(X_train, y_train)
model_Evaluate(BNBmodel)
```

```
              precision    recall  f1-score   support

           0       0.80      0.78      0.79     39986
           1       0.79      0.80      0.80     40014

    accuracy                           0.79     80000
   macro avg       0.79      0.79      0.79     80000
weighted avg       0.79      0.79      0.79     80000
```

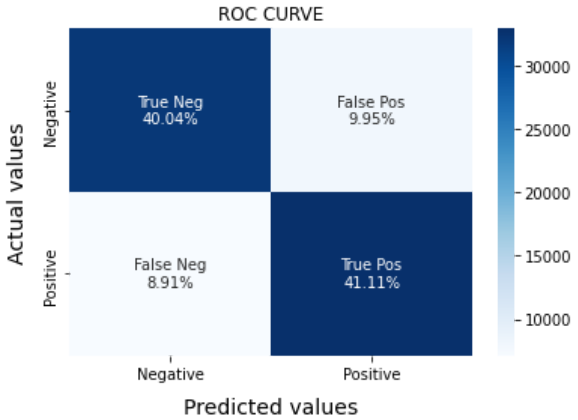


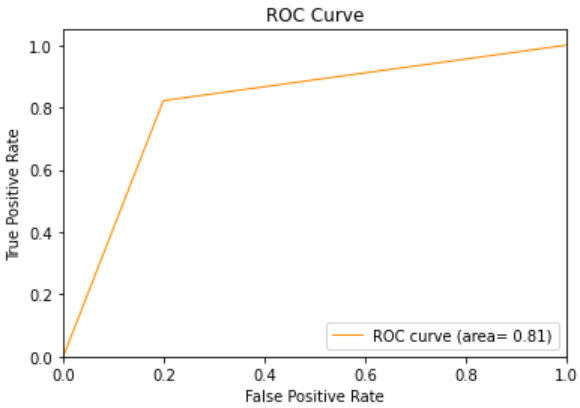


Out[137]:
```
array([1, 1, 0, ..., 1, 1, 0])
```

In [138]:
```
# logistic regression model
LRmodel = LogisticRegression(C = 1, max_iter = 1000, n_jobs = -1)
LRmodel.fit(X_train, y_train)
y_test_pred = model_Evaluate(LRmodel)
```

```
              precision    recall  f1-score   support

           0       0.82      0.80      0.81     39986
           1       0.81      0.82      0.81     40014

    accuracy                           0.81     80000
   macro avg       0.81      0.81      0.81     80000
weighted avg       0.81      0.81      0.81     80000
```





In [139]:
```
# print pos and neg sentiment on test data based on logisitc regression model

print("Positive Sentiment Percentage : {}%".format(round(np.count_nonzero(y_test_pred == 1)/len(y_tes

print("Negative Sentiment Percentage : {}%".format(round(np.count_nonzero(y_test_pred == 0)/len(y_tes
```

```
Positive Sentiment Percentage : 51.05%
Negative Sentiment Percentage : 48.95%
```

In [143]:
```
# SAVE MODEL

file = open('/Users/hlabs/Desktop/hoop/chatdash/models/vectoriser.pickle', 'wb')
pickle.dump(vectoriser, file)
file.close()

file = open('/Users/hlabs/Desktop/hoop/chatdash/models/Sentiment-LR.pickle', 'wb')
pickle.dump(LRmodel, file)
file.close()
```

In [144]:
```
#using the model
def load_models():

    #Load the vectoriser
    file = open('/Users/hlabs/Desktop/hoop/chatdash/models/vectoriser.pickle', 'rb')
    vectoriser = pickle.load(file)
    file.close()

    #Load the LR Model
    file = open('/Users/hlabs/Desktop/hoop/chatdash/models/Sentiment-LR.pickle', 'rb')
    LRmodel = pickle.load(file)
    file.close()

    return vectoriser, LRmodel

def predict(vectoriser, model, text):
    finaldata = []

    textdata = vectoriser.transform(lemmatize_process(preprocess(text)))
    sentiment = model.predict(textdata)

    #print(model.classes_)
    sentiment_prob = model.predict_proba(textdata)

    for index,tweet in enumerate(text):
        if sentiment[index] == 1:
            sentiment_probFinal = sentiment_prob[index][1]
        else:
            sentiment_probFinal = sentiment_prob[index][0]

        sentiment_probFinal2 = "{}%".format(round(sentiment_probFinal*100, 2))
        finaldata.append((tweet, sentiment[index], sentiment_probFinal2))

    df = pd.DataFrame(finaldata, columns = ['tweet', 'sentiment', 'Probability(Confidence Level)'])
    df = df.replace([0,1], ["Negative", "Positive"])
    return df
```

In [145]:
```
# text to classify
text = ["I hate twitter",
        "I do not like the movie",
        "Mr. Stark, I don't feel so good",
        "May the force be with you.",
        "I read the book, the content is not good",
        "This is a new beginning for us"]
```

In [146]:
```
vectoriser, LRmodel = load_models()
df = predict(vectoriser, LRmodel, text)
df
```

Out[146]:

	tweet	sentiment	Probability(Confidence Level)
0	I hate twitter	Negative	93.21%
1	I do not like the movie	Negative	80.73%
2	Mr. Stark, I don't feel so good	Negative	68.76%
3	May the force be with you.	Positive	66.8%
4	I read the book, the content is not good	Negative	67.31%
5	This is a new beginning for us	Positive	79.58%

In [147]:
```
# excel upload

data = pd.read_csv("/Users/hlabs/Desktop/hoop/chatdash/testdata.csv", encoding = "ISO-8859-1")
data.head()
```

Out[147]:

	url	date	text
0	https://twitter.com/EcoLisa_/status/9022754290...	Mon Aug 28 21:03:20 2017	Here's how you can help victims of #HurricaneH...
1	https://twitter.com/RedefiningDecor/status/903...	Thu Aug 31 15:43:15 2017	RT @tripgabriel: This is a very gripping graph...
2	https://twitter.com/BestofY00/status/903281998...	Thu Aug 31 15:43:05 2017	RT @tripgabriel: This is a very gripping graph...
3	https://twitter.com/Deborah9111966/status/9032...	Thu Aug 31 15:43:01 2017	RT @tripgabriel: This is a very gripping graph...
4	https://twitter.com/kirkbocchi/status/90328194...	Thu Aug 31 15:42:53 2017	RT @tripgabriel: This is a very gripping graph...

In [148]:
```
data.shape
```

Out[148]:
```
(15428, 3)
```

In [149]:
```
text = list(data['text'])
```

In [150]:
```
def predict_Excel(vectoriser, model, text):
    finaldata = []

    textdata = vectoriser.transform(lemmatize_process(preprocess(text)))
    sentiment = model.predict(textdata)

    # print(model.classes_)
    sentiment_prob = model.predict_proba(textdata)

    for index, tweet in enumerate(text):
        sentiment_probFinal = sentiment_prob[index][0]

        sentiment_probFinal2 = "{}%".format(round(sentiment_probFinal*100,2))
        finaldata.append((tweet, sentiment[index], sentiment_probFinal2))

    #Convert the list into a pandas df

    df = pd.DataFrame(finaldata, columns = ['tweet', 'sentiment', 'Severity'])
    df = df.replace([0,1], ["Negative", "Positive"])
    return df
```

In [151]:
```
vectoriser, LRmodel = load_models()
df = predict_Excel(vectoriser, LRmodel, text)
```

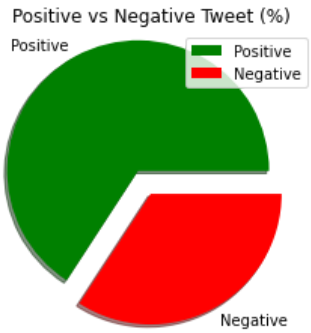
In [152]:
```
df.sort_values(by=['Severity'], ascending=False, inplace=True)
df
```

Out[152]:

	tweet	sentiment	Severity
6888	When the storm comes it affects us all...no ex...	Negative	99.6%
2009	This breaks my heart. I wish I could do more t...	Negative	99.53%
18	This is so sad. Thousands Cried for Help as Ho...	Negative	99.3%
9121	It's Sad That Some Hispanics In Houston Have T...	Negative	99.18%
9794	Sad and scary situation in Houston https://t.c...	Negative	99.12%
...	...	...	...
9538	RT @PRyan: Thank you @JJWatt. You make Wiscons...	Positive	0.98%
9558	RT @PRyan: Thank you @JJWatt. You make Wiscons...	Positive	0.98%
9533	RT @PRyan: Thank you @JJWatt. You make Wiscons...	Positive	0.98%
1477	Good morning #SPNFamily I'm so proud of us Ke...	Positive	0.91%
9680	Thank you @JJWatt. You make Wisconsin proud. h...	Positive	0.66%

15428 rows × 3 columns

In [154]:
```
positive = round(np.count_nonzero(df['sentiment'] == "Positive")/len(df['sentiment'])*100,2)
negative = round(np.count_nonzero(df['sentiment'] == "Negative")/len(df['sentiment'])*100,2)

labels = ['Positive', 'Negative']
values = np.array([positive,negative])
myexplode = [0.2,0]
mycolours = ["green", "red"]

fig,ax = plt.subplots()
ax.pie(values, labels = labels, explode = myexplode, shadow = True, colors = mycolours)
ax.legend()
ax.set_title("Positive vs Negative Tweet (%)")
fig.show()
```



In [155]:
```
filename = 'Final.csv'
df.to_csv(filename, index=False)
print('Saved file: ' + filename)
```

```
Saved file: Final.csv
```

In [ ]: