Naive_Bayes_on_Amazon_Reviews

June 8, 2018

In [1]:
```
import sqlite3
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import plotly.plotly as py
import plotly.graph_objs as go
from sklearn.cross_validation import train_test_split
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score
from sklearn.cross_validation import cross_val_score
from collections import Counter
from sklearn.metrics import accuracy_score
from sklearn import cross_validation
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import roc_curve, auc
from nltk.stem.porter import PorterStemmer
from sklearn.decomposition import TruncatedSVD
```

```
/usr/local/lib/python3.6/dist-packages/sklearn/cross_validation.py:41: DeprecationWarning:

This module was deprecated in version 0.18 in favor of the model_selection module into which al
```

1 Loading the Data and Sorting(Time-wise)

In [4]:
```
final_data = pd.read_csv("final.csv")

final_data = final_data.drop(["Text"], axis = 1)
final_data = final_data.drop(final_data.columns[0], axis = 1)
labels = final_data.Score
final_data = final_data.sort_values("Time")
final_data.shape
```

Out[4]: (364171, 10)

2 Train/Test Split(70-30)

In [0]:
```
n = final_data.shape[0]
train_size = 0.7

train_set = final_data.iloc[:int(n*train_size)]
test_set =final_data.iloc[int(n*train_size):]

X_train = train_set.CleanedText
y_train = train_set.Score

X_test = test_set.CleanedText
y_test= test_set.Score
```

In [0]:
```
# Feature Importance(WordCloud Visualization)
```

In [0]:
```
import matplotlib as mpl
from wordcloud import WordCloud, STOPWORDS
stopwords = set(STOPWORDS)

#mpl.rcParams['figure.figsize']=(8.0,6.0)    #(6.0,4.0)
mpl.rcParams['font.size']=12                #10
mpl.rcParams['savefig.dpi']=100             #72
mpl.rcParams['figure.subplot.bottom']=.1


def show_wordcloud(data, title = None):
    wordcloud = WordCloud(
        background_color='white',
        stopwords=stopwords,
        max_words=200,
        max_font_size=40,
        scale=3,
        random_state=1 # chosen at random by flipping a coin; it was heads
    ).generate(str(data))

    fig = plt.figure(1, figsize=(8, 8))
    plt.axis('off')
    if title:
        fig.suptitle(title, fontsize=20)
        fig.subplots_adjust(top=2.3)

    plt.imshow(wordcloud)
    plt.show()

show_wordcloud(final_data["CleanedText"])
```

In [0]: show_wordcloud(final_data[final_data.Score == "negative"]["CleanedText"], title = "Nega

Negative words

In [0]: show_wordcloud(final_data[final_data.Score == "positive"]["CleanedText"], title = "Posi

Positive words

3 Bag of words Vectorization

```
In [0]: count_vect = CountVectorizer() #in scikit-learn
        X_train1 = count_vect.fit_transform(X_train)
        X_test1 = count_vect.transform(X_test)
```

```
In [7]: #Standardization
        from sklearn.preprocessing import StandardScaler
        sc= StandardScaler(with_mean=False)
        X_train1 = sc.fit_transform(X_train1)
        X_test1 = sc.transform(X_test1)
```

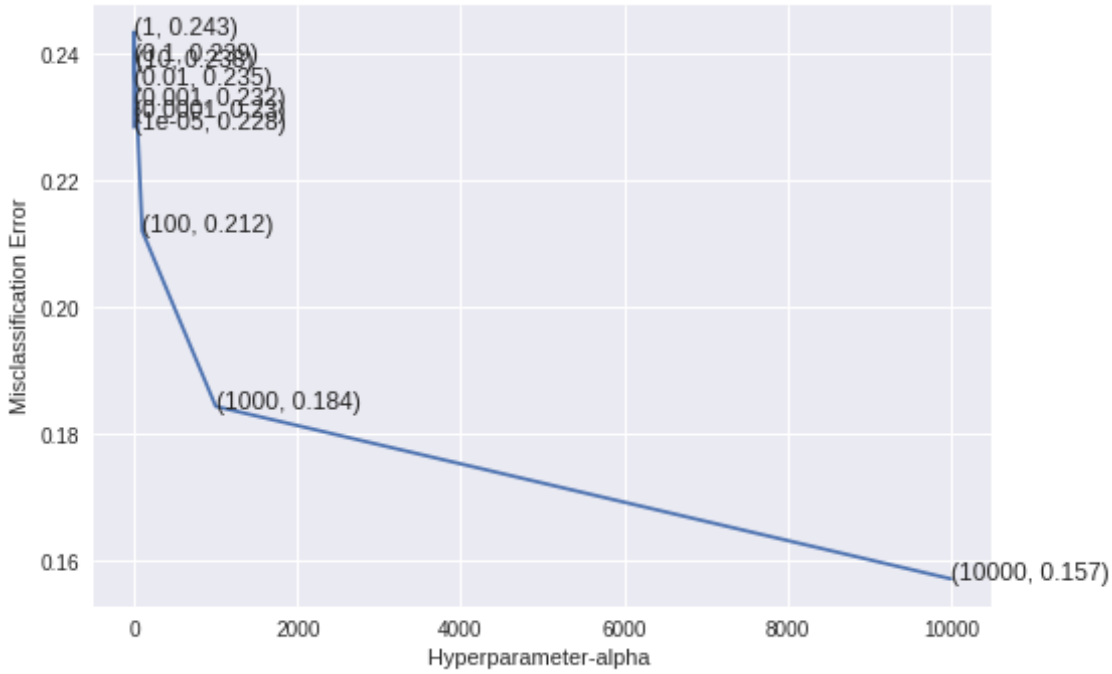
```
/usr/local/lib/python3.6/dist-packages/sklearn/utils/validation.py:475: DataConversionWarning:

Data with input dtype int64 was converted to float64 by StandardScaler.
```

4 Applying Naive Bayes

```
In [9]: from sklearn.naive_bayes import MultinomialNB
        from sklearn.model_selection import TimeSeriesSplit
        import pylab as pl

        al = [0.00001,0.0001,0.001,0.01,0.1,1,10,100,1000,10000]
```

```
        # empty list that will hold cv scores
        cv_scores = []
        my_cv = [(train,test) for train, test in TimeSeriesSplit(n_splits=10).split(X_train1)]
        # perform 10-fold cross validation
        for a in al:
            knn = MultinomialNB(alpha=a)
            scores = cross_val_score(knn, X_train1, y_train, cv = my_cv, scoring='accuracy')
            cv_scores.append(scores.mean())


        # changing to misclassification error
        MSE = [1 - x for x in cv_scores]

        # determining best alpha
        optimal_a = MSE.index(min(MSE))
        n = al[optimal_a]
        print('\nThe optimal hyperparameter alpha is %f.' % n)

        # plot misclassification error vs alpha
        plt.plot(al, MSE)

        for xy in zip(al, np.round(MSE,3)):
            plt.annotate('(%s, %s)' % xy, xy=xy, textcoords='data')

        plt.xlabel('Hyperparameter-alpha ')
        plt.ylabel('Misclassification Error')
        plt.show()

        print("the misclassification error for each alpha value is : ", (np.round(MSE,3)))
```

```
The optimal hyperparameter alpha is 10000.000000.
```




```
the misclassification error for each alpha value is :  [0.228 0.23  0.232 0.235 0.239 0.243 0.1
```

```
In [0]: nb = MultinomialNB(alpha = 10000)
        nb.fit(X_train1,y_train)
        pred = nb.predict(X_test1)
```

5 Generating Confusion matrix and Classification report

```
In [11]: import itertools
         from sklearn.metrics import classification_report
         from sklearn.metrics import confusion_matrix
         acc = accuracy_score(y_test, pred, normalize=True) * float(100)
         x = nb.predict(X_train1)
         tr_acc = accuracy_score(y_train, x, normalize=True) * float(100)
         print('\n****Train accuracy is {:.2f}'.format(tr_acc))
         print('\n****Test accuracy is {:.2f}'.format(acc))
         print(confusion_matrix(y_test, pred))

         print("")
         target_names = ["positive", "negative"]
         print(classification_report(y_test, pred, target_names=target_names))
```

```
****Train accuracy is 85.46
```

```
****Test accuracy is 82.46
[[  249 18832]
 [  326 89845]]

             precision    recall  f1-score   support

   positive       0.43      0.01      0.03     19081
   negative       0.83      1.00      0.90     90171

avg / total       0.76      0.82      0.75    109252
```

```
In [0]: # Tf-idf Vectorization
```

```
In [0]: #TF-IDF
        tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
        X_train2 = tf_idf_vect.fit_transform(X_train)
        X_test2 = tf_idf_vect.transform(X_test)
```

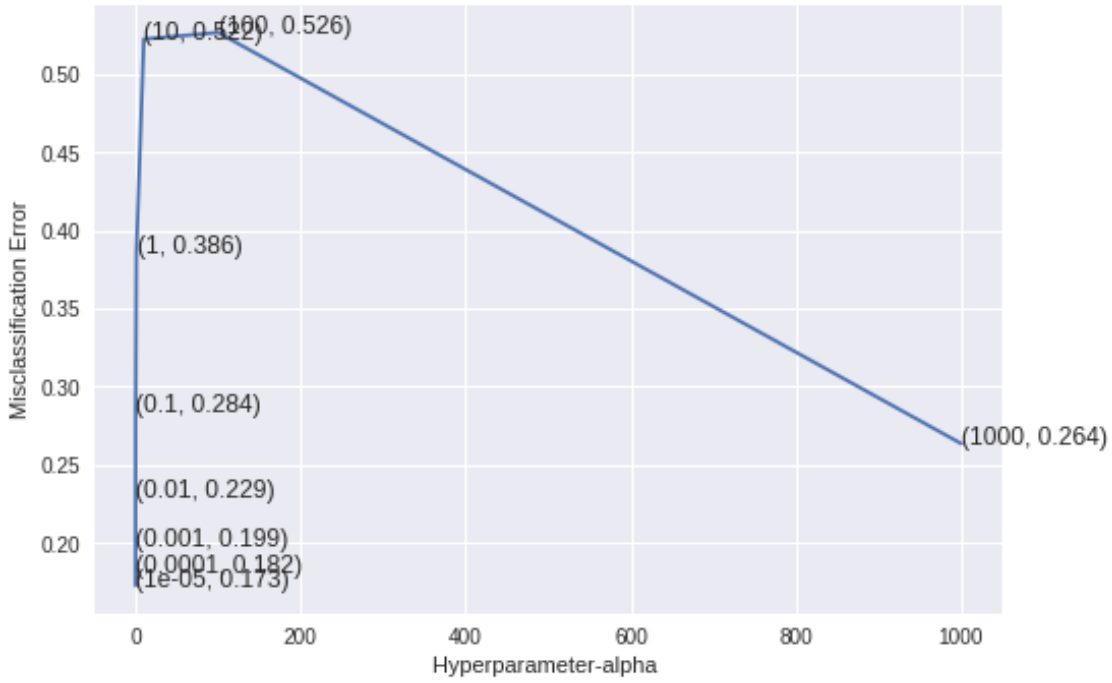
```
In [0]: #Standardization
        from sklearn.preprocessing import StandardScaler
        sc= StandardScaler(with_mean=False)
        X_train2 = sc.fit_transform(X_train2)
        X_test2 = sc.transform(X_test2)
```

6 Applying Naive Bayes

```
In [0]: from sklearn.naive_bayes import MultinomialNB
        from sklearn.model_selection import TimeSeriesSplit
        import pylab as pl

        al = [0.00001,0.0001,0.001,0.01,0.1,1,10,100,1000]

        # empty list that will hold cv scores
        cv_scores = []
        my_cv = [(train,test) for train, test in TimeSeriesSplit(n_splits=10).split(X_train2)]
        # perform 10-fold cross validation
        for a in al:
            knn = MultinomialNB(alpha=a)
            scores = cross_val_score(knn, X_train2, y_train, cv = my_cv, scoring='accuracy')
            cv_scores.append(scores.mean())


        # changing to misclassification error
        MSE = [1 - x for x in cv_scores]
```

```
        # determining best alpha
        optimal_a = MSE.index(min(MSE))
        n = al[optimal_a]
        print('\nThe optimal hyperparameter alpha is %f.' % n)

        # plot misclassification error vs alpha
        plt.plot(al, MSE)

        for xy in zip(al, np.round(MSE,3)):
            plt.annotate('(%s, %s)' % xy, xy=xy, textcoords='data')

        plt.xlabel('Hyperparameter-alpha ')
        plt.ylabel('Misclassification Error')
        plt.show()

        print("the misclassification error for each alpha value is : ", (np.round(MSE,3)))
```

```
The optimal hyperparameter alpha is 0.000010.
```




```
the misclassification error for each alpha value is :  [0.173 0.182 0.199 0.229 0.284 0.386 0.5
```

```
In [0]: nb = MultinomialNB(alpha = 0.00001)
        nb.fit(X_train2,y_train)
        pred = nb.predict(X_test2)
```

7 Generating Confusion matrix and Classification report

```
In [0]: import itertools
        from sklearn.metrics import classification_report
        from sklearn.metrics import confusion_matrix
        acc = accuracy_score(y_test, pred, normalize=True) * float(100)
        x = nb.predict(X_train2)
        tr_acc = accuracy_score(y_train, x, normalize=True) * float(100)
        print('\n****Train accuracy is {:.2f}'.format(tr_acc))
        print('\n****Test accuracy is {:.2f}'.format(acc))
        print(confusion_matrix(y_test, pred))

        print("")
        target_names = ["positive", "negative"]
        print(classification_report(y_test, pred, target_names=target_names))
```

```
****Train accuracy is 99.79

****Test accuracy is 82.22
[[ 4264 14817]
 [ 4605 85566]]

             precision    recall  f1-score   support

   positive       0.48      0.22      0.31     19081
   negative       0.85      0.95      0.90     90171

avg / total       0.79      0.82      0.79    109252
```

8 Conclusion

For 'Bag of Words'

- Train accuracy is 85.46%
- Test accuracy is 82.46%

	Precision	recall	f1-score	support
positive	0.43	0.01	0.03	19081
negative	0.83	1.00	0.90	90171
avg/total	0.76	0.82	0.75	109252

8.1 Confusion Matrix:

```
[[  249 18832]
[  326 89845]]
```

For 'Tf-idf'

- Train accuracy is 99.79%
- Test accuracy is 82.22%

8.2 Confusion Matrix:

```
[[ 4264 14817]
[ 4605 85566]]
```

	Precision	recall	f1-score	support
positive	0.48	0.22	0.31	19081
negative	0.85	0.95	0.90	90171
avg/total	0.79	0.82	0.79	109252

8.3 Important Words

8.3.1 Positive :

- 'product', 'use', 'great', 'movie'

8.3.2 Negative :

- 'product', disappoint', 'good', 'taste'