Knn on amazon reviews

June 6, 2018

```
In [0]: 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
```

```
In [0]: final = pd.read_csv("final.csv")
```

1 Sampling the data

```
In [0]: positive_reviews = final.loc[final["Score"] == "positive"]
        negative_reviews = final.loc[final["Score"] == "negative"]

        positive_reviews = positive_reviews.sample(n = 5000)
        negative_reviews = negative_reviews.sample(n = 5000)

        f1 = [positive_reviews, negative_reviews]
        final_data = pd.concat(f1)

        final_data = final_data.drop(["Text"], axis = 1)
        final_data = final_data.drop(final_data.columns[0], axis = 1)
```

2 Sorting the dataset based on ’time’

```
In [0]: labels = final_data.Score
```

```
In [0]: final_data = final_data.sort_values("Time")
```

```
In [49]: final_data.shape
```

```
Out[49]: (10000, 10)
```

2.1 Splitting the dataset into train and test data

```
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 [11]: import re
         # Tutorial about Python regular expressions: https://pymotw.com/2/re/
         import string
         from nltk.corpus import stopwords
         from nltk.stem import PorterStemmer
         from nltk.stem.wordnet import WordNetLemmatizer

         stop = set(stopwords.words('english')) #set of stopwords
         sno = nltk.stem.SnowballStemmer('english') #initialising the snowball stemmer

         def cleanhtml(sentence): #function to clean the word of any html-tags
             cleanr = re.compile('<.*?>')
             cleantext = re.sub(cleanr, ' ', sentence)
             return cleantext
         def cleanpunc(sentence): #function to clean the word of any punctuation or special ch
             cleaned = re.sub(r'[?|!|\'|"|#]',r'',sentence)
             cleaned = re.sub(r'[.|,|)|(|\|/]',r' ',cleaned)
             return  cleaned
         print(stop)
         print('************************************')
         print(sno.stem('tasty'))
```

```
{"don't", 'this', 'me', 'if', 'hers', 'at', 'should', 'from', 'now', 'myself', 'or', 'do', 'abo
************************************
tasti
```

3 K-NN using 'Bag of Words'

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

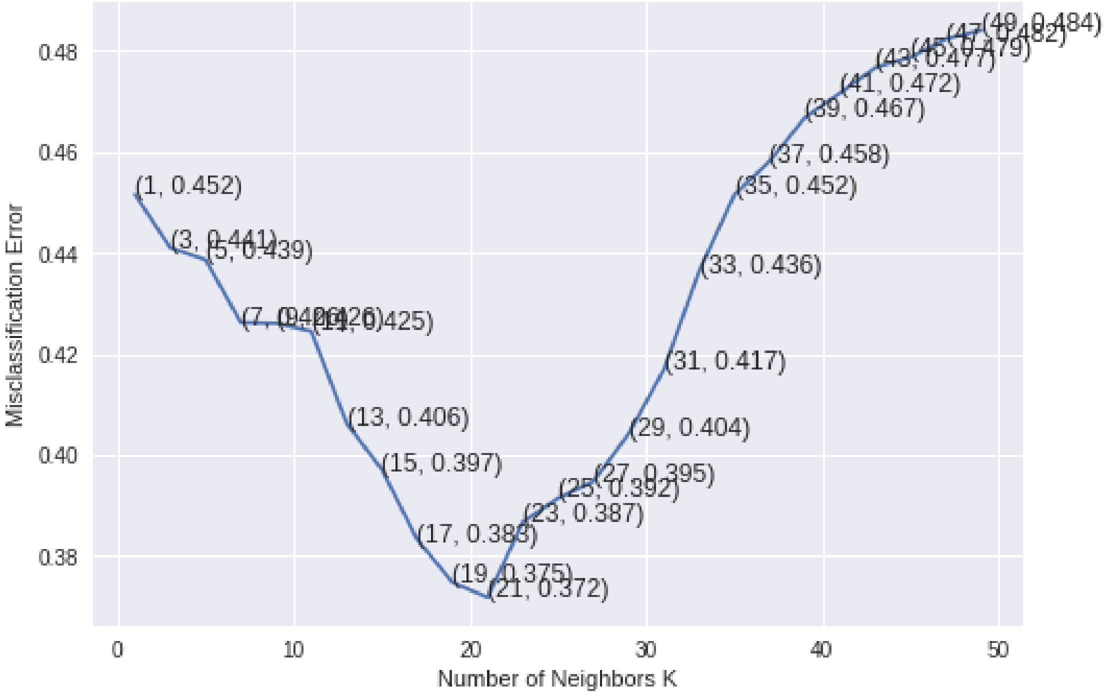
```
In [13]: #Standardization
         from sklearn.preprocessing import StandardScaler
         sc= StandardScaler(with_mean=False)
         X_train1 = sc.fit_transform(X_train1)
         X_test1 = sc.transform(X_test1)
```

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

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

```
In [14]: from sklearn.model_selection import TimeSeriesSplit
         # creating odd list of K for KNN
         myList = list(range(0,50))
         neighbors = list(filter(lambda x: x % 2 != 0, myList))

         # 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 k in neighbors:
             knn = KNeighborsClassifier(n_neighbors=k)
             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 k
         optimal_k = neighbors[MSE.index(min(MSE))]
         print('\nThe optimal number of neighbors is %d.' % optimal_k)

         # plot misclassification error vs k
         plt.plot(neighbors, MSE)

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

         plt.xlabel('Number of Neighbors K')
         plt.ylabel('Misclassification Error')
         plt.show()
```

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

```
The optimal number of neighbors is 21.
```



```
the misclassification error for each k value is :  [0.452 0.441 0.439 0.426 0.426 0.425 0.406
 0.392 0.395 0.404 0.417 0.436 0.452 0.458 0.467 0.472 0.477 0.479 0.482
 0.484]
```

3.0.1 Best 'k' = 21

```
In [0]: k = 21
        knn = KNeighborsClassifier(n_neighbors = k)
        knn.fit(X_train1,y_train)
        pred = knn.predict(X_test1)
```

3.1 Generate the confusion matrix

```
In [22]: import itertools
         from sklearn.metrics import confusion_matrix
         acc = accuracy_score(y_test, pred, normalize=True) * float(100)
         x = knn.predict(X_train1)
```

```
    tr_acc = accuracy_score(y_train, x, normalize=True) * float(100)
    print('\n****Train accuracy for k = {} is {:.2f}'.format(k,tr_acc))
    print('\n****Test accuracy for k = {} is {:.2f}'.format(k,acc))
    print(confusion_matrix(y_test, pred))
```

```
****Train accuracy for k = 21 is 77.46

****Test accuracy for k = 21 is 64.67
[[991 622]
 [438 949]]
```

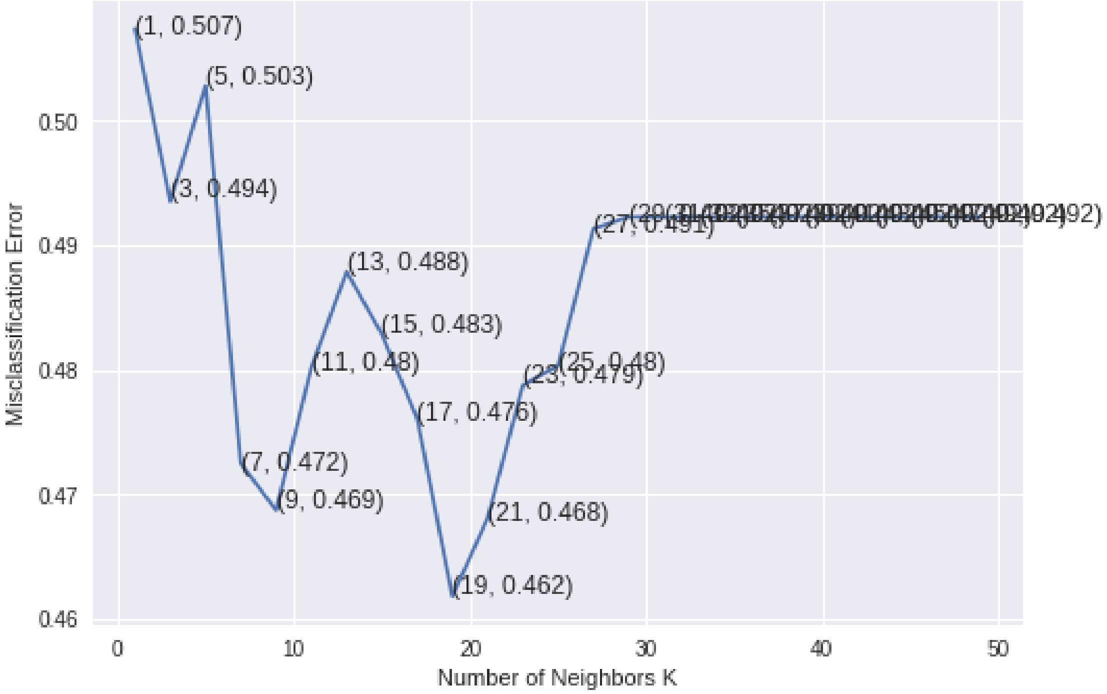
4 K-NN using Tf-idf

```
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)
```

```
In [84]: # creating odd list of K for KNN
         myList = list(range(0,50))
         neighbors = list(filter(lambda x: x % 2 != 0, myList))

         # 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 k in neighbors:
             knn = KNeighborsClassifier(n_neighbors=k)
             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 k
         optimal_k = neighbors[MSE.index(min(MSE))]
         print('\nThe optimal number of neighbors is %d.' % optimal_k)

         # plot misclassification error vs k
         plt.plot(neighbors, MSE)

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

         plt.xlabel('Number of Neighbors K')
         plt.ylabel('Misclassification Error')
         plt.show()

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

```
The optimal number of neighbors is 19.
```



```
the misclassification error for each k value is :  [0.507 0.494 0.503 0.472 0.469 0.48  0.488
 0.48  0.491 0.492 0.492 0.492 0.492 0.492 0.492 0.492 0.492 0.492 0.492
 0.492]
```

4.0.1 Best 'k' = 19

```
In [85]: k = 19
         knn = KNeighborsClassifier(n_neighbors = k)
         knn.fit(X_train2,y_train)
```

```
    pred = knn.predict(X_test2)
    acc = accuracy_score(y_test, pred, normalize=True) * float(100)
    x = knn.predict(X_train2)
    tr_acc = accuracy_score(y_train, x, normalize=True) * float(100)
    print('\n****Train accuracy for k = {} is {:.2f}'.format(k,tr_acc))
    print('\n****Test accuracy for k = {} is {:.2f}'.format(k,acc))
```

```
****Train accuracy for k = 19 is 48.40

****Test accuracy for k = 19 is 53.97
```

4.1 Generate the confusion matrix

```
In [0]: print(confusion_matrix(y_test, pred))
```

```
[[   0 1608]
 [   0 1392]]
```

5 Preparing Data using Word2Vec for K-NN

```
In [0]: # Train your own Word2Vec model using your own text corpus
        import gensim
        i=0
        train_sent=[]
        for sent in X_train:
            filtered_sentence=[]
            sent=cleanhtml(sent)
            for w in sent.split():
                for cleaned_words in cleanpunc(w).split():
                    if(cleaned_words.isalpha()):
                        filtered_sentence.append(cleaned_words.lower())
                    else:
                        continue
            train_sent.append(filtered_sentence)
```

```
In [0]: i=0
        test_sent=[]
        for sent in X_test:
            filtered_sentence=[]
            sent=cleanhtml(sent)
            for w in sent.split():
                for cleaned_words in cleanpunc(w).split():
                    if(cleaned_words.isalpha()):
                        filtered_sentence.append(cleaned_words.lower())
                    else:
                        continue
            test_sent.append(filtered_sentence)
```

```
In [0]: from gensim.models import Word2Vec
        from gensim.models import KeyedVectors

        w2v_model1=gensim.models.Word2Vec(train_sent,min_count=5,size=50, workers=4)
        w2v_model2=gensim.models.Word2Vec(test_sent,min_count=5,size=50, workers=4)
```

5.1 K-NN using Average Word2Vec

```
In [54]: #AVG-W2V
         sent_vectors = []; # the avg-w2v for each sentence/review is stored in this list
         for sent in train_sent: # for each review/sentence
             sent_vec = np.zeros(50) # as word vectors are of zero length
             cnt_words =0; # num of words with a valid vector in the sentence/review
             for word in sent: # for each word in a review/sentence
                 try:
                     vec = w2v_model1.wv[word]
                     sent_vec += vec
                     cnt_words += 1
                 except:
                     pass
             sent_vec /= cnt_words
             sent_vectors.append(sent_vec)
         print(len(sent_vectors))
         print(len(sent_vectors[0]))
```

```
7000
50
```

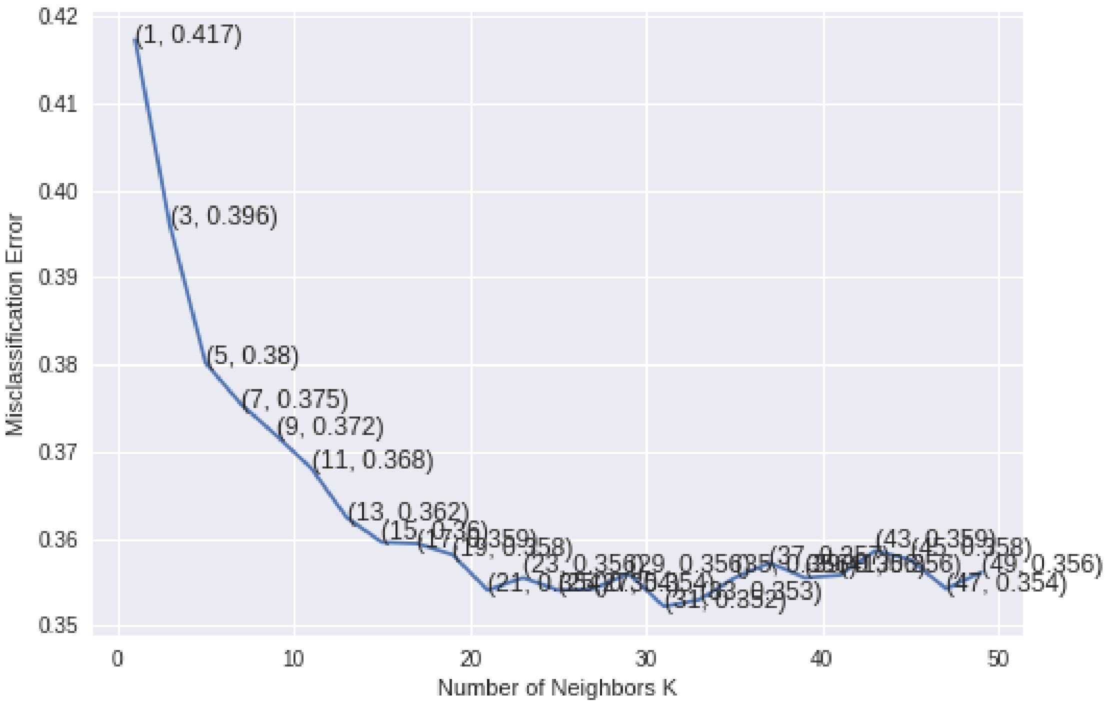
```
In [55]: #AVG-W2V
         sent_vectors2 = []; # the avg-w2v for each sentence/review is stored in this list
         for sent in test_sent: # for each review/sentence
             sent_vec = np.zeros(50) # as word vectors are of zero length
             cnt_words =0; # num of words with a valid vector in the sentence/review
             for word in sent: # for each word in a review/sentence
                 try:
                     vec = w2v_model2.wv[word]
                     sent_vec += vec
                     cnt_words += 1
                 except:
                     pass
             sent_vec /= cnt_words
             sent_vectors2.append(sent_vec)
         print(len(sent_vectors2))
         print(len(sent_vectors2[0]))
```

```
3000
50
```

```
In [0]: #Standardization
        from sklearn.preprocessing import StandardScaler
        sc= StandardScaler(with_mean=False)
        X_train3 = sc.fit_transform(sent_vectors)
        X_test3 = sc.transform(sent_vectors2)
```

```
In [57]: # creating odd list of K for KNN
         myList = list(range(0,50))
         neighbors = list(filter(lambda x: x % 2 != 0, myList))

         # empty list that will hold cv scores
         cv_scores = []
         my_cv = [(train,test) for train, test in TimeSeriesSplit(n_splits=10).split(X_train3)]
         # perform 10-fold cross validation
         for k in neighbors:
             knn = KNeighborsClassifier(n_neighbors=k)
             scores = cross_val_score(knn, X_train3, 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 k
         optimal_k = neighbors[MSE.index(min(MSE))]
         print('\nThe optimal number of neighbors is %d.' % optimal_k)

         # plot misclassification error vs k
         plt.plot(neighbors, MSE)

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

         plt.xlabel('Number of Neighbors K')
         plt.ylabel('Misclassification Error')
         plt.show()

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

```
The optimal number of neighbors is 31.
```



```
the misclassification error for each k value is :  [0.417 0.396 0.38  0.375 0.372 0.368 0.362
 0.354 0.354 0.356 0.352 0.353 0.356 0.357 0.356 0.356 0.359 0.358 0.354
 0.356]
```

5.1.1 Best 'k' = 31

```
In [58]: k = 31
         knn = KNeighborsClassifier(n_neighbors = k)
         knn.fit(X_train3,y_train)
         pred = knn.predict(X_test3)
         acc = accuracy_score(y_test, pred, normalize=True) * float(100)
         x = knn.predict(X_train3)
         tr_acc = accuracy_score(y_train, x, normalize=True) * float(100)
         print('\n****Train accuracy for k = {} is {:.2f}'.format(k,tr_acc))
         print('\n****Test accuracy for k = {} is {:.2f}'.format(k,acc))
```

```
****Train accuracy for k = 31 is 68.73

****Test accuracy for k = 31 is 51.50
```

5.2 Generate the confusion matrix

```
In [59]: print(confusion_matrix(y_test, pred))
```

```
[[1428  133]
 [1322  117]]
```

6 K-NN using Word2Vec-Tfidf

```
In [0]: #TF-IDF


        tf_idf_vect = TfidfVectorizer()
        final_tf_idf = tf_idf_vect.fit_transform(X_train)
        tfidf_feat = tf_idf_vect.get_feature_names()
         # tfidf words/col-names
        # final_tf_idf is the sparse matrix with row= sentence, col=word and cell_val = tfidf

        train_vectors = []; # the tfidf-w2v for each sentence/review is stored in this list
        row=0;
        for sent in train_sent: # for each review/sentence
            sent_vec = np.zeros(50) # as word vectors are of zero length
            weight_sum = 0; # num of words with a valid vector in the sentence/review
            for word in sent: # for each word in a review/sentence
                try:
                    vec = w2v_model1.wv[word]
                    # obtain the tf_idf of a word in a sentence/review
                    tfidf = final_tf_idf[row, tfidf_feat.index(word)]
                    sent_vec += (vec * tfidf)
                    weight_sum += tfidf


                except:
                    pass

            sent_vec /= weight_sum
            #print(np.isnan(np.sum(sent_vec)))

            train_vectors.append(sent_vec)
            row += 1
```

```
In [0]: #TF-IDF


        tf_idf_vect = TfidfVectorizer()
        final_tf_idf = tf_idf_vect.fit_transform(X_test)
        tfidf_feat = tf_idf_vect.get_feature_names()
         # tfidf words/col-names
        # final_tf_idf is the sparse matrix with row= sentence, col=word and cell_val = tfidf

        test_vectors = []; # the tfidf-w2v for each sentence/review is stored in this list
        row=0;
```

```
for sent in test_sent: # for each review/sentence
    sent_vec = np.zeros(50) # as word vectors are of zero length
    weight_sum = 0; # num of words with a valid vector in the sentence/review
    for word in sent: # for each word in a review/sentence
        try:
            vec = w2v_model2.wv[word]
            # obtain the tf_idf of a word in a sentence/review
            tfidf = final_tf_idf[row, tfidf_feat.index(word)]
            sent_vec += (vec * tfidf)
            weight_sum += tfidf


        except:
            pass

    sent_vec /= weight_sum
    #print(np.isnan(np.sum(sent_vec)))

    test_vectors.append(sent_vec)
    row += 1
```

In [0]:

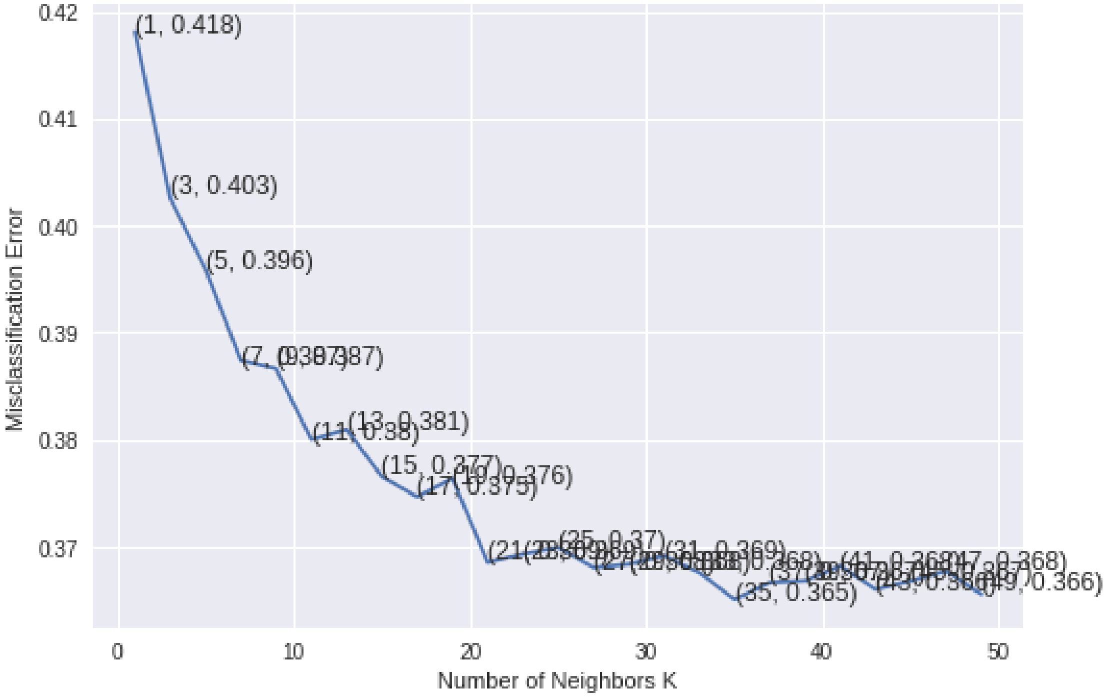
```
#Standardization
from sklearn.preprocessing import StandardScaler
sc= StandardScaler(with_mean=False)
X_train4 = sc.fit_transform(train_vectors)
X_test4 = sc.transform(test_vectors)
```

In [0]:

```
# creating odd list of K for KNN
myList = list(range(0,50))
neighbors = list(filter(lambda x: x % 2 != 0, myList))

# empty list that will hold cv scores
cv_scores = []
my_cv = [(train,test) for train, test in TimeSeriesSplit(n_splits=10).split(X_train4)]
# perform 10-fold cross validation
for k in neighbors:
    knn = KNeighborsClassifier(n_neighbors=k)
    scores = cross_val_score(knn, X_train4, 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 k
optimal_k = neighbors[MSE.index(min(MSE))]
print('\nThe optimal number of neighbors is %d.' % optimal_k)
```

```
        # plot misclassification error vs k
        plt.plot(neighbors, MSE)

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

        plt.xlabel('Number of Neighbors K')
        plt.ylabel('Misclassification Error')
        plt.show()

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

```
The optimal number of neighbors is 35.
```



```
the misclassification error for each k value is :  [0.418 0.403 0.396 0.387 0.387 0.38  0.381
 0.37  0.368 0.368 0.369 0.368 0.365 0.367 0.367 0.368 0.366 0.367 0.368
 0.366]
```

6.0.1 Best 'k' = 35

```
In [76]: k = 35
         knn = KNeighborsClassifier(n_neighbors = k)
```

```
knn.fit(X_train4,y_train)
pred = knn.predict(X_test4)
acc = accuracy_score(y_test, pred, normalize=True) * float(100)
x = knn.predict(X_train4)
tr_acc = accuracy_score(y_train, x, normalize=True) * float(100)
print('\n****Train accuracy for k = {} is {:.2f}'.format(k,tr_acc))
print('\n****Test accuracy for k = {} is {:.2f}'.format(k,acc))
```

```
****Train accuracy for k = 35 is 71.41

****Test accuracy for k = 35 is 47.37
```

6.1 Generate the confusion matrix

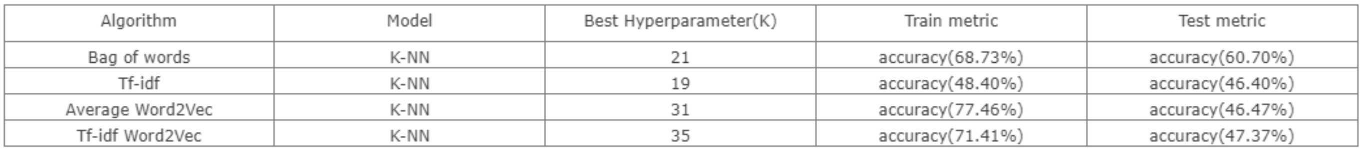
```
In [0]: print(confusion_matrix(y_test, pred))
```

```
[[ 105 1503]
 [  76 1316]]
```

```
In [0]: import plotly.tools as tls
        tls.set_credentials_file(username='kv007', api_key='MSfBc0Jqh4Vq99anlb0p')
```

7 Conclusion

```
In [ ]: trace = go.Table(
            header=dict(values=['Algorithm', 'Model', 'Best Hyperparameter(K)','Train metric',
            cells=dict(values=[['Bag of words', 'Tf-idf', 'Average Word2Vec', 'Tf-idf Word2Vec
                               ['K-NN', 'K-NN', 'K-NN', 'K-NN'],
                               [21,19,31,35],
                               ['accuracy(68.73%)','accuracy(48.40%)','accuracy(77.46%)','accu
                              ['accuracy(60.70%)','accuracy(46.40%)','accuracy(46.47%)','accura

        data = [trace]
        py.iplot(data, filename = 'Conclusion')
```



Algorithm	Model	Best Hyperparameter(K)	Train metric	Test metric
Bag of words	K-NN	21	accuracy(68.73%)	accuracy(60.70%)
Tf-idf	K-NN	19	accuracy(48.40%)	accuracy(46.40%)
Average Word2Vec	K-NN	31	accuracy(77.46%)	accuracy(46.47%)
Tf-idf Word2Vec	K-NN	35	accuracy(71.41%)	accuracy(47.37%)