In [74]:

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import numpy as np
import nltk
%matplotlib inline


from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score
from sklearn.model_selection import cross_val_score
from sklearn.metrics import confusion_matrix
from gensim.models import Word2Vec
from sklearn.feature_extraction.text import TfidfVectorizer

from prettytable import PrettyTable
```

In [52]:

```
def knn_kfold_validation(neighbours, X_train, y_train, algo='auto'):
    cv_scores=[]
    for k in neighbours:
        knn = KNeighborsClassifier(n_neighbors=k,algorithm='brute')
        scores = cross_val_score(knn, X_train, y_train, scoring='accuracy', cv=10)
        cv_scores.append(scores.mean())
        print("K : %d , Score : %f" % (k,scores.mean()))
    return cv_scores

def optimal_k_plot(neighbours, cv_scores):
    optimal_k = neighbours[cv_scores.index(max(cv_scores))]
    plt.plot(neighbours, cv_scores)
    for xy in zip(neighbours,np.round(cv_scores,2)):
        plt.annotate("('%s',%s)"% xy, xy=xy, textcoords='data')
    plt.xlabel('Number of Neighbors K')
    plt.ylabel('CV_Scores')
    print("CV_SCORES: ",cv_scores)
    return optimal_k

def optimal_knn(optimal_k, X_train, X_test, y_train, y_test, algo='auto'):
    # ============================== KNN with k = optimal_k
==============================================
    # instantiate learning model k = optimal_k
    knn_optimal = KNeighborsClassifier(n_neighbors=optimal_k, algorithm = algo)

    # fitting the model
    knn_optimal.fit(X_train, y_train)

    # predict the response
    pred = knn_optimal.predict(X_test)

    # evaluate accuracy
    acc = accuracy_score(y_test, pred) * 100
    print('\nThe accuracy of the knn classifier for k = %d is %f%%' % (optimal_k, acc))

    return pred

def gen_confusion(c_matrix):
    print(sns.heatmap(c_matrix,cmap="viridis",fmt='g', annot=True))

def gen_tfidf_w2v(model,list_of_sent,w2v_model,dictionary):
    tfidf_feat = model.get_feature_names() # tfidf words/col-names
    # final_tf_idf is the sparse matrix with row= sentence, col=word and cell_val = tfidf

    tfidf_sent_vectors = []; # the tfidf-w2v for each sentence/review is stored in this list
    row=0;
    for sent in tqdm(list_of_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
            if word in w2v_words:
                vec = w2v_model.wv[word]
    #             tf_idf = tf_idf_matrix[row, tfidf_feat.index(word)]
                # to reduce the computation we are
                # dictionary[word] = idf value of word in whole courpus
                # sent.count(word) = tf valeus of word in this review
                tf_idf = dictionary[word]*(sent.count(word)/len(sent))
                sent_vec += (vec * tf_idf)
                weight_sum += tf_idf
        if weight_sum != 0:
            sent_vec /= weight_sum
        tfidf_sent_vectors.append(sent_vec)
        row += 1
    return tfidf_sent_vectors
```

In [4]:

```
# Reading processed dataset
data = pd.read_csv('final_data.csv')
data.dropna(inplace=True)
```

In [6]:

```
data.shape
```

Out[6]:

```
(364156, 11)
```

In [7]:

```
data.head()
```

Out[7]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenominator	Score	Time	Summa
0	150524	0006641040	ACITT7DI6IDDL	shari zychinski	0	0	positive	939340800	EVE bool educatio
1	150506	0006641040	A2IW4PEEKO2R0U	Tracy	1	1	positive	1194739200	Love book, m the h co vers
2	150507	0006641040	A1S4A3IQ2MU7V4	sally sue "sally sue"	1	1	positive	1191456000	chick soup w r mon
3	150508	0006641040	AZGXZ2UUK6X	Catherine Hallberg " (Kate)"	1	1	positive	1076025600	a go swir rhythm read alo
4	150509	0006641040	A3CMRKGE0P909G	Teresa	3	4	positive	1018396800	A gr way learn mon

In [5]:

```
data.sort_values(by='Time',ascending=True, inplace=True)
```

In [6]:

```
data.reset_index(drop=True, inplace=True)
```

In [10]:

```
sampled_data = data.loc[:99999]
```

In [11]:

```
sampled_data.shape
```

Out[11]:

```
(100000, 11)
```

In [12]:

```
sampled_data['Score'].replace('positive','1',inplace=True)
sampled_data['Score'].replace('negative','0', inplace=True)
```

```
C:\Users\prabh\Anaconda3\lib\site-packages\pandas\core\generic.py:5890: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-
docs/stable/indexing.html#indexing-view-versus-copy
  self._update_inplace(new_data)
```

In [13]:

```
sampled_data['Score'].value_counts()
```

Out[13]:

```
1    87730
0    12270
Name: Score, dtype: int64
```

In [ ]:

In [ ]:

In [14]:

```
X = sampled_data['CleanedText']
y = sampled_data['Score']
```

In [15]:

```
X_train = X[:67000]
y_train = y[:67000]
X_test = X[67000:]
y_test = y[67000:]
```

In [ ]:

In [ ]:

```
```

In [ ]:

```
```

In [ ]:

```
```

In [ ]:

```
```

In [ ]:

```
```

In [75]:

```
table = PrettyTable()
```

BOW

In [14]:

```
count_vect = CountVectorizer()
```

In [15]:

```
count_vect.fit(X_train.values)
```

Out[15]:

```
CountVectorizer(analyzer='word', binary=False, decode_error='strict',
        dtype=<class 'numpy.int64'>, encoding='utf-8', input='content',
        lowercase=True, max_df=1.0, max_features=None, min_df=1,
        ngram_range=(1, 1), preprocessor=None, stop_words=None,
        strip_accents=None, token_pattern='(?u)\\b\\w\\w+\\b',
        tokenizer=None, vocabulary=None)
```

In [16]:

```
train_counts = count_vect.transform(X_train.values)
```

In [17]:

```
print(type(train_counts))
print(train_counts.shape)
```

```
<class 'scipy.sparse.csr.csr_matrix'>
(67000, 30764)
```

In [18]:

```
test_counts = count_vect.transform(X_test.values)
```

In [19]:

```
knn= KNeighborsClassifier(n_neighbors=5)
```

```
knn= KNeighborsClassifier(n_neighbors=5)
knn.fit(train_counts,y_train)
```

Out[19]:

```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='minkowski',
           metric_params=None, n_jobs=1, n_neighbors=5, p=2,
           weights='uniform')
```

In [58]:

```
```

In [59]:

```
pred = knn.predict(test_counts)
```

In [60]:

```
accuracy_score(y_test,pred)
```

Out[60]:

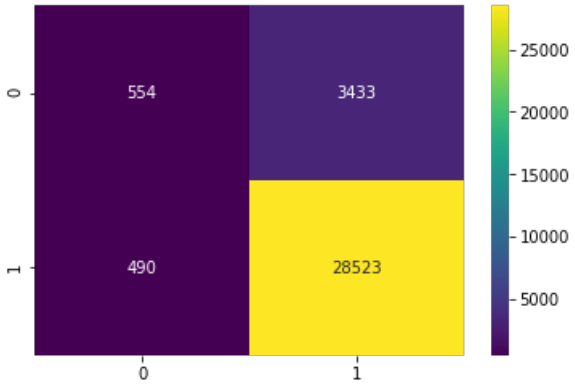
```
0.8811212121212121
```

In [28]:

```
```

In [68]:

```
gen_confusion(confusion_matrix(y_test,pred))
```



In [66]:

```
```

In [20]:

```
```

In [39]:

```
neighbours = list(range(3,41,2))
```

In [21]:

```
cv_scores = knn_kfold_validation(neighbours, X_train=train_counts,y_train=y_train)
```

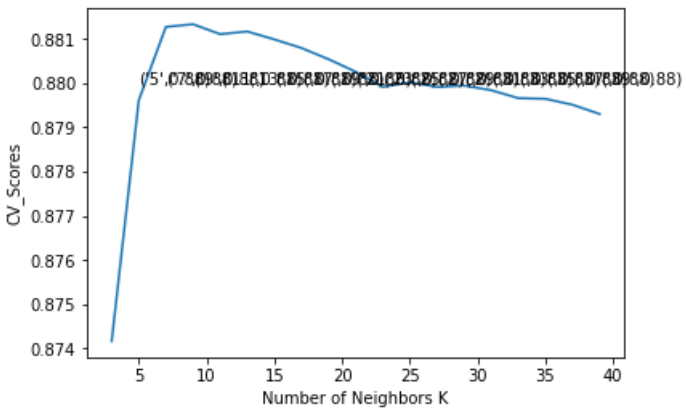
```
K : 3 , Score : 0.874164
K : 5 , Score : 0.879612
K : 7 , Score : 0.881269
```

```
K : 9 , Score : 0.881328
K : 11 , Score : 0.881104
K : 13 , Score : 0.881164
K : 15 , Score : 0.880985
K : 17 , Score : 0.880791
K : 19 , Score : 0.880537
K : 21 , Score : 0.880254
K : 23 , Score : 0.879910
K : 25 , Score : 0.880015
K : 27 , Score : 0.879910
K : 29 , Score : 0.879940
K : 31 , Score : 0.879836
K : 33 , Score : 0.879657
K : 35 , Score : 0.879642
K : 37 , Score : 0.879507
K : 39 , Score : 0.879298
```

In [23]:

```
op_k = optimal_k_plot(neighbours, cv_scores)
```

```
CV_SCORES:  [0.8741639992053504, 0.8796119208639357, 0.8812685994364321, 0.8813283454789982,
0.881104464881983, 0.8811641530098445, 0.880985028479566, 0.8807910186728416, 0.8805372895555632,
0.8802536918713397, 0.8799104506086188, 0.8800149438158954, 0.8799104350146127,
0.8799403058088929, 0.8798358036922755, 0.879656703669999, 0.8796417649268686, 0.8795074343413247,
0.8792984857967896]
```



In [27]:

```
pred = optimal_knn(op_k, train_counts, test_counts, y_train, y_test)
```

```
The accuracy of the knn classifier for k = 9 is 88.384848%
```

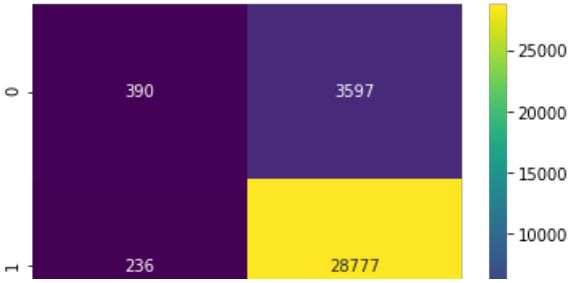
In [29]:

```
conf_matrix = confusion_matrix(y_test,pred)
```

In [30]:

```
from prettytable
```

```
AxesSubplot(0.125,0.125;0.62x0.755)
```



In [ ]:

```
# Model (Algorithm) HyperParameter(k) TrainError TestError
```

In [81]:

```
table = PrettyTable()
table.field_names = ["Model(Algorithm)", "Technique", "HyperParameter(k)", "TrainAccuracy", "TestAccuracy"]
table.add_row(['KNN(Brute Force)', 'Bag Of Words','k = 9', "88.13%", "88.34%"])
print(table)
```

```
+------------------+--------------+--------------------+----------------+--------------+
| Model(Algorithm) |  Technique   | HyperParameter(k) | TrainAccuracy | TestAccuracy |
+------------------+--------------+--------------------+----------------+--------------+
| KNN(Brute Force) | Bag Of Words |       k = 9        |     88.13%     |    88.34%    |
+------------------+--------------+--------------------+----------------+--------------+
```

In [ ]:

```

```

Tfidf

In [15]:

```

```

In [16]:

```
tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
```

In [17]:

```
tf_idf_vect.fit(X_train.values)
```

Out[17]:

```
TfidfVectorizer(analyzer='word', binary=False, decode_error='strict',
        dtype=<class 'numpy.int64'>, encoding='utf-8', input='content',
        lowercase=True, max_df=1.0, max_features=None, min_df=1,
        ngram_range=(1, 2), norm='l2', preprocessor=None, smooth_idf=True,
        stop_words=None, strip_accents=None, sublinear_tf=False,
        token_pattern='(?u)\\b\\w\\w+\\b', tokenizer=None, use_idf=True,
        vocabulary=None)
```

In [27]:

```
train_counts = tf_idf_vect.transform(X_train.values)
```

In [28]:

```
test_counts = tf_idf_vect.transform(X_test.values)
```

In [29]:

```
cv_scores = knn_kfold_validation(neighbours, X_train=train_counts,y_train=y_train)
```

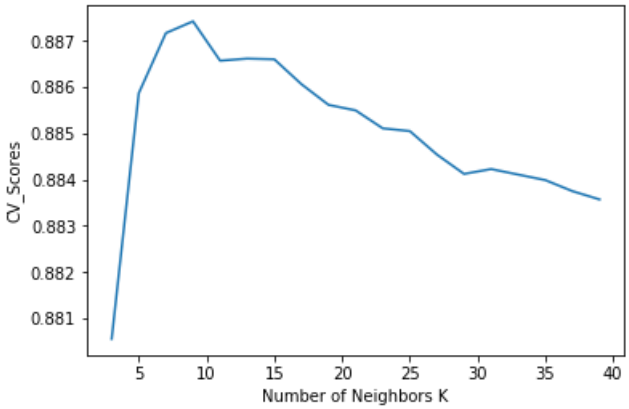
```
K : 3 , Score : 0.880552
K : 5 , Score : 0.885866
K : 7 , Score : 0.887164
```

```
K : 7 , Score : 0.887164
K : 9 , Score : 0.887418
K : 11 , Score : 0.886567
K : 13 , Score : 0.886612
K : 15 , Score : 0.886597
K : 17 , Score : 0.886060
K : 19 , Score : 0.885612
K : 21 , Score : 0.885493
K : 23 , Score : 0.885105
K : 25 , Score : 0.885045
K : 27 , Score : 0.884537
K : 29 , Score : 0.884119
K : 31 , Score : 0.884224
K : 33 , Score : 0.884105
K : 35 , Score : 0.883985
K : 37 , Score : 0.883746
K : 39 , Score : 0.883567
```

In [30]:

```
op_k = optimal_k_plot(neighbours, cv_scores)
```

```
CV_SCORES:  [0.8805522862167232, 0.8858657124483406, 0.8871642444243489, 0.8874179624089411,
0.8865672094522941, 0.8866119788850366, 0.8865970535125672, 0.8860597400717518,
0.8856119833270724, 0.8854925892493437, 0.8851045406831972, 0.8850448547800113,
0.8845373987687999, 0.8841194749523726, 0.8842239614756486, 0.8841045495792385,
0.8839851465941637, 0.8837463383940195, 0.8835672227757417]
```



In [32]:

```
pred = optimal_knn(op_k, train_counts, test_counts, y_train, y_test,algo='brute')
```

```
The accuracy of the knn classifier for k = 9 is 89.054545%
```

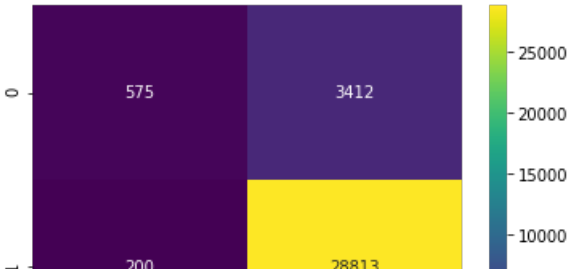
In [36]:

```
conf_matrix = confusion_matrix(y_test, pred)
```

In [37]:

```
gen_confusion(conf_matrix)
```

```
AxesSubplot(0.125,0.125;0.62x0.755)
```



In [ ]:

In [82]:

```
table = PrettyTable()
table.field_names = ["Model(Algorithm)", "Technique", "HyperParameter(k)", "TrainAccuracy", "TestAccuracy"]
table.add_row(['KNN(Brute Force)', 'Tfidf','k = 9', "88.7%", "89%"])
print(table)
```

```
+------------------+-----------+--------------------+---------------+--------------+
| Model(Algorithm) | Technique | HyperParameter(k) | TrainAccuracy | TestAccuracy |
+------------------+-----------+--------------------+---------------+--------------+
| KNN(Brute Force) |   Tfidf   |       k = 9        |     88.7%     |     89%      |
+------------------+-----------+--------------------+---------------+--------------+
```

In [ ]:

In [ ]:

In [ ]:

In [53]:

Average Word2Vec

In [23]:

```
list_of_sent = []
for sentence in X_train:
  try:
    list_of_sent.append(sentence.split())
  except:
    print(sentence)
len(list_of_sent)
```

Out[23]:

67000

In [24]:

```
w2v_model=Word2Vec(list_of_sent,min_count=5,size=50, workers=4)
```

In [25]:

```
w2v_words = list(w2v_model.wv.vocab)
```

In [ ]:

In [26]:

```
len(w2v_words)
```

Out[26]:

```
10452
```

In [64]:

```
# average Word2Vec
# compute average word2vec for each review.
sent_vectors = []; # the avg-w2v for each sentence/review is stored in this list
for sent in list_of_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
        if word in w2v_words:
            vec = w2v_model.wv[word]
            sent_vec += vec
            cnt_words += 1
    if cnt_words != 0:
        sent_vec /= cnt_words
    sent_vectors.append(sent_vec)
print(len(sent_vectors))
print(len(sent_vectors[0]))
```

```
67000
50
```

In [68]:

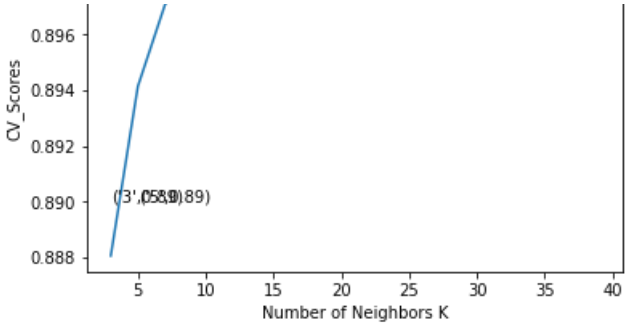
```
cv_scores = knn_kfold_validation(neighbours, sent_vectors, y_train)
```

```
K : 3 , Score : 0.888059
K : 5 , Score : 0.894134
K : 7 , Score : 0.897060
K : 9 , Score : 0.898463
K : 11 , Score : 0.899134
K : 13 , Score : 0.899433
K : 15 , Score : 0.899283
K : 17 , Score : 0.899448
K : 19 , Score : 0.899045
K : 21 , Score : 0.899343
K : 23 , Score : 0.899134
K : 25 , Score : 0.898851
K : 27 , Score : 0.898851
K : 29 , Score : 0.898463
K : 31 , Score : 0.898089
K : 33 , Score : 0.897851
K : 35 , Score : 0.897985
K : 37 , Score : 0.897880
K : 39 , Score : 0.897895
```

In [69]:

```
op_k = optimal_k_plot(neighbours, cv_scores)
```

```
CV_SCORES:  [0.8880594928229157, 0.8941341576317529, 0.8970595263453245, 0.8984625092152253,
0.8991342200729454, 0.8994327409062928, 0.8992834247969295, 0.899447588308731, 0.8990445586774255,
0.8993430906487789, 0.8991341666109159, 0.8988506045633905, 0.8988506045613958,
0.8984625359452425, 0.8980893793342227, 0.8978505778207388, 0.8979849039516126,
0.8978804486150193, 0.8978953294374599]
```



In [70]:

```
op_k
```

Out[70]:

17

In [84]:

```
test_list_of_sent = []
for sentence in X_test:
  try:
    test_list_of_sent.append(sentence.split())
  except:
    print(sentence)
print(len(test_list_of_sent))
# average Word2Vec
# compute average word2vec for each review.
test_sent_vectors = []; # the avg-w2v for each sentence/review is stored in this list
for sent in test_list_of_sent: # for each review/sentence
    test_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
        if word in w2v_words:
            vec = w2v_model.wv[word]
            test_sent_vec += vec
            cnt_words += 1
    if cnt_words != 0:
        test_sent_vec /= cnt_words
    test_sent_vectors.append(test_sent_vec)
print(len(test_sent_vectors))
print(len(test_sent_vectors[0]))
```

```
33000
33000
50
```

In [ ]:

```
```

In [85]:

```
pred = optimal_knn(17, sent_vectors, test_sent_vectors, y_train, y_test,algo='brute')
```

```
The accuracy of the knn classifier for k = 17 is 88.563636%
```

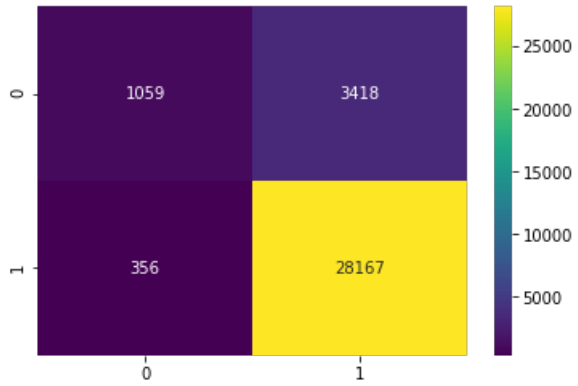
In [86]:

```
conf_matrix = confusion_matrix(y_test, pred)
```

In [87]:

```
gen_confusion(conf_matrix)
```

```
AxesSubplot(0.125,0.125;0.62x0.755)
```



In [83]:

```
table = PrettyTable()
table.field_names = ["Model(Algorithm)", "Technique", "HyperParameter(k)", "TrainAccuracy", "TestAccuracy"]
table.add_row(['KNN(Brute Force)', 'Avg Word2Vec','k = 17', "89.9%", "88.56%"])
print(table)
```

```
+------------------+--------------+-------------------+---------------+--------------+
| Model(Algorithm) |  Technique   | HyperParameter(k) | TrainAccuracy | TestAccuracy |
+------------------+--------------+-------------------+---------------+--------------+
| KNN(Brute Force) | Avg Word2Vec |       k = 17      |     89.9%     |    88.56%    |
+------------------+--------------+-------------------+---------------+--------------+
```

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [16]:

```
list_of_sent = []
for sentence in X_train:
  try:
    list_of_sent.append(sentence.split())
  except:
    print(sentence)
len(list_of_sent)
```

Out[16]:

67000

In [20]:

```
tf_idf_vect = TfidfVectorizer()
```

In [21]:

```
tf_idf_vect.fit(X_train.values)
```

Out[21]:

```
TfidfVectorizer(analyzer='word', binary=False, decode_error='strict',
        dtype=<class 'numpy.int64'>, encoding='utf-8', input='content',
        lowercase=True, max_df=1.0, max_features=None, min_df=1,
        ngram_range=(1, 1), norm='l2', preprocessor=None, smooth_idf=True,
        stop_words=None, strip_accents=None, sublinear_tf=False,
        token_pattern='(?u)\\b\\w\\w+\\b', tokenizer=None, use_idf=True,
        vocabulary=None)
```

In [22]:

```
dictionary = dict(zip(tf_idf_vect.get_feature_names(), list(tf_idf_vect.idf_)))
```

In [26]:

```
from tqdm import tqdm
```

In [27]:

```
w2v_model=Word2Vec(list_of_sent,min_count=5,size=50, workers=4)
```

In [28]:

```
w2v_words = list(w2v_model.wv.vocab)
```

In [30]:

```

```

In [47]:

```
X_train = gen_tfidf_w2v(tf_idf_vect,list_of_sent,w2v_model,dictionary)
```

```
100%|██████████████████████████████████████████████████████████████████████████| 67000/67000 [01:17<00:00, 865.91it/s]
```

In [40]:

```
cv_scores = knn_kfold_validation(neighbours, X_train,y_train=y_train)
```

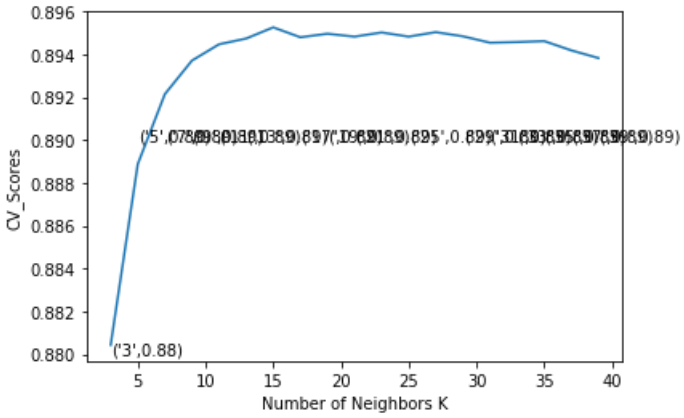
```
K : 3 , Score : 0.880433
K : 5 , Score : 0.888880
K : 7 , Score : 0.892149
K : 9 , Score : 0.893716
K : 11 , Score : 0.894478
K : 13 , Score : 0.894746
K : 15 , Score : 0.895269
K : 17 , Score : 0.894806
K : 19 , Score : 0.894970
K : 21 , Score : 0.894836
K : 23 , Score : 0.895030
K : 25 , Score : 0.894836
K : 27 , Score : 0.895045
K : 29 , Score : 0.894851
K : 31 , Score : 0.894552
K : 33 , Score : 0.894582
K : 35 , Score : 0.894627
K : 37 , Score : 0.894194
K : 39 , Score : 0.893836
```

In [41]:

```
op_k = optimal_k_plot(neighbours, cv_scores)
```

```
CV_SCORES:  [0.8804326070015209, 0.8888804529420142, 0.8921491765383358, 0.8937163184647025,
```

```
0.8944775280965394, 0.8947461335822527, 0.8952685105112630, 0.8948057927467767, 0.8949699963572613,
0.8948356657677273, 0.8950296956231284, 0.8948356613177116, 0.8950446455022696,
0.8948505978275222, 0.8945521015001816, 0.8945819166031024, 0.8946266927231703,
0.8941938658082907, 0.8938356568510718]
```



In [42]:

```
op_k
```

Out[42]:

```
15
```

In [43]:

```
test_list_of_sent = []
for sentence in X_test:
  try:
    test_list_of_sent.append(sentence.split())
  except:
    print(sentence)
```

In [ ]:

```

```

In [49]:

```
X_test = gen_tfidf_w2v(tf_idf_vect,test_list_of_sent,w2v_model,dictionary)
```

```
100%|████████████████████████████████████████████████████████████████████████████| 33000/33000 [00:
42<00:00, 776.38it/s]
```

In [50]:

```
pred = optimal_knn(15,X_train,X_test,y_train,y_test,algo='brute')
```

```
The accuracy of the knn classifier for k = 15 is 87.939394%
```

In [ ]:

```

```

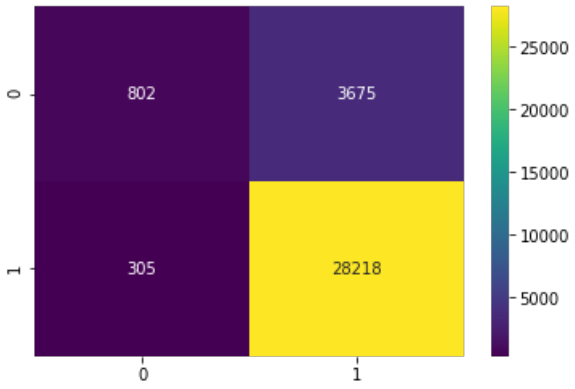
In [51]:

```
conf_matrix = confusion_matrix(y_test, pred)
```

In [52]:

```
gen_confusion(conf_matrix)
```

```
AxesSubplot(0.125,0.125;0.62x0.755)
```



In [84]:

```
table = PrettyTable()
table.field_names = ["Model(Algorithm)", "Technique", "HyperParameter(k)", "TrainAccuracy", "TestAccuracy"]
table.add_row(['KNN(Brute Force)', 'Avg Word2Vec','k = 15', "89.5%", "87.9%"])
print(table)
```

```
+------------------+--------------+-------------------+---------------+--------------+
| Model(Algorithm) |  Technique   | HyperParameter(k) | TrainAccuracy | TestAccuracy |
+------------------+--------------+-------------------+---------------+--------------+
| KNN(Brute Force) | Avg Word2Vec |       k = 15      |     89.5%     |    87.9%     |
+------------------+--------------+-------------------+---------------+--------------+
```

In [ ]:

In [ ]:

In [ ]:

In [53]:

```
# kd-tree
```

In [7]:

```
data.sort_values(by='Time',ascending=True, inplace=True)
data.reset_index(drop=True, inplace=True)
```

In [8]:

```
sampled_data = data.loc[:9999]
```

In [9]:

```
sampled_data.shape
```

Out[9]:

```
(10000, 11)
```

In [10]:

```
sampled_data['Score'].replace('positive','1',inplace=True)
sampled_data['Score'].replace('negative','0', inplace=True)
```

```
C:\Users\prabh\Anaconda3\lib\site-packages\pandas\core\generic.py:5890: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-
docs/stable/indexing.html#indexing-view-versus-copy
  self._update_inplace(new_data)
```

In [11]:

```
X = sampled_data['CleanedText']
y = sampled_data['Score']
```

In [12]:

```
X_train = X[:6700]
y_train = y[:6700]
X_test = X[6700:]
y_test = y[6700:]
```

In [ ]:

```

```

In [ ]:

```

```

In [20]:

```
#BOW
```

In [13]:

```
count_vect = CountVectorizer()
```

In [14]:

```
count_vect.fit(X_train)
```

Out[14]:

```
CountVectorizer(analyzer='word', binary=False, decode_error='strict',
        dtype=<class 'numpy.int64'>, encoding='utf-8', input='content',
        lowercase=True, max_df=1.0, max_features=None, min_df=1,
        ngram_range=(1, 1), preprocessor=None, stop_words=None,
        strip_accents=None, token_pattern='(?u)\\b\\w\\w+\\b',
        tokenizer=None, vocabulary=None)
```

In [15]:

```
bow_X_train = count_vect.transform(X_train)
```

In [16]:

```
bow_X_test = count_vect.transform(X_test)
```

In [17]:

```
neighbours = list(range(3,41,2))
```

In [19]:

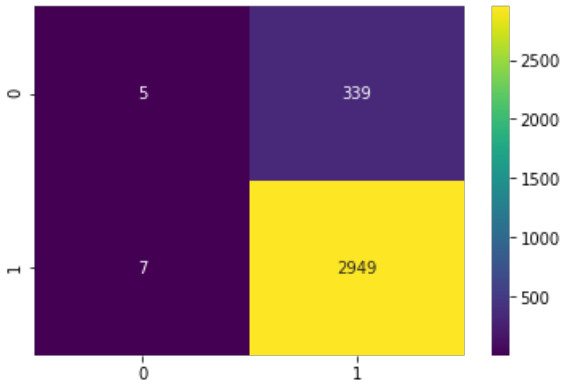
```
pred = optimal_knn(9, bow_X_train.toarray(),bow_X_test.toarray(),y_train, y_test, algo='kd_tree')
```

```
The accuracy of the knn classifier for k = 9 is 89.515152%
```

In [23]:

```
conf_matrix = confusion_matrix(y_test, pred)
gen_confusion(conf_matrix)
```

```
AxesSubplot(0.125,0.125;0.62x0.755)
```



In [85]:

```
table = PrettyTable()
table.field_names = ["Model(Algorithm)", "Technique", "HyperParameter(k)", "TrainAccuracy", "TestAccuracy"]
table.add_row(['KNN(Kd_tree)', 'Bag Of Words','k = 9', "88.1%", "88.51%"])
print(table)
```

```
+------------------+--------------+--------------------+----------------+--------------+
| Model(Algorithm) |  Technique   | HyperParameter(k) | TrainAccuracy | TestAccuracy |
+------------------+--------------+--------------------+----------------+--------------+
|   KNN(Kd_tree)   | Bag Of Words |       k = 9        |     88.1%      |    88.51%    |
+------------------+--------------+--------------------+----------------+--------------+
```

In [ ]:

```

```

In [ ]:

```

```

Tf_idf Kd_tree

In [24]:

```
tf_idf_vect = TfidfVectorizer(ngram_range=(1,2))
```

In [25]:

```
tf_idf_vect.fit(X_train)
```

Out[25]:

```
TfidfVectorizer(analyzer='word', binary=False, decode_error='strict',
        dtype=<class 'numpy.float64'>, encoding='utf-8', input='content',
        lowercase=True, max_df=1.0, max_features=None, min_df=1,
        ngram_range=(1, 2), norm='l2', preprocessor=None, smooth_idf=True,
        stop_words=None, strip_accents=None, sublinear_tf=False,
        token_pattern='(?u)\\b\\w\\w+\\b', tokenizer=None, use_idf=True,
        vocabulary=None)
```

vocabulary=None)

In [28]:

```
tf_idf_train = tf_idf_vect.transform(X_train)
```

In [29]:

```
tf_idf_test = tf_idf_vect.transform(X_test)
```

In [32]:

```
pred = optimal_knn(9, tf_idf_train.toarray(), tf_idf_test.toarray(), y_train, y_test,algo='kd_tree'
)
```

```
The accuracy of the knn classifier for k = 9 is 90.666667%
```

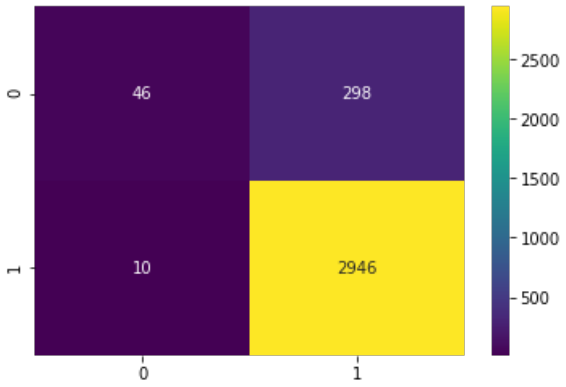
In [33]:

```
conf_matrix = confusion_matrix(y_test, pred)
```

In [35]:

```
gen_confusion(conf_matrix)
```

```
AxesSubplot(0.125,0.125;0.62x0.755)
```



In [ ]:

```

```

In [ ]:

```

```

Kd_tree Average W2V

In [ ]:

```
#Average W2V
```

In [36]:

```
list_of_sent = []
for sentence in X_train:
  try:
    list_of_sent.append(sentence.split())
  except:
    print(sentence)
len(list_of_sent)
```

Out[36]:

```
6700
```

In [38]:

```
test_list_of_sent = []
for sentence in X_test:
  try:
    test_list_of_sent.append(sentence.split())
  except:
    print(sentence)
print(len(test_list_of_sent))
```

```
3300
```

In [39]:

```
w2v_model=Word2Vec(list_of_sent,min_count=5,size=50, workers=4)
```

In [41]:

```
w2v_words = list(w2v_model.wv.vocab)
```

In [42]:

```
# average Word2Vec
# compute average word2vec for each review.
sent_vectors = []; # the avg-w2v for each sentence/review is stored in this list
for sent in list_of_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
        if word in w2v_words:
            vec = w2v_model.wv[word]
            sent_vec += vec
            cnt_words += 1
    if cnt_words != 0:
        sent_vec /= cnt_words
    sent_vectors.append(sent_vec)
print(len(sent_vectors))
print(len(sent_vectors[0]))
```

```
6700
50
```

In [43]:

```
# average Word2Vec
# compute average word2vec for each review.
test_sent_vectors = []; # the avg-w2v for each sentence/review is stored in this list
for sent in test_list_of_sent: # for each review/sentence
    test_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
        if word in w2v_words:
            vec = w2v_model.wv[word]
            test_sent_vec += vec
            cnt_words += 1
    if cnt_words != 0:
        test_sent_vec /= cnt_words
    test_sent_vectors.append(test_sent_vec)
print(len(test_sent_vectors))
print(len(test_sent_vectors[0]))
```

```
3300
50
```

In [45]:

```
pred = optimal_knn(17, sent_vectors, test_sent_vectors, y_train, y_test,algo='kd_tree')
```

```
The accuracy of the knn classifier for k = 17 is 89.515152%
```

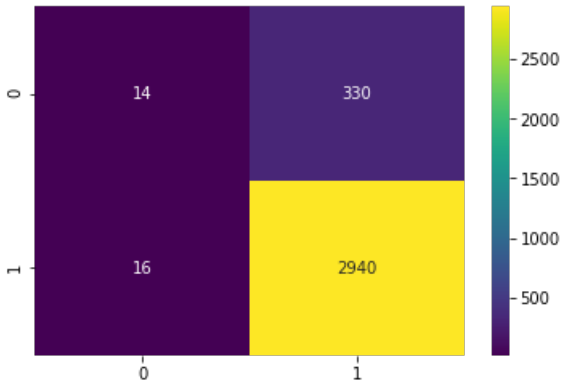
In [48]:

```
conf_mat = confusion_matrix(y_test,pred)
```

In [49]:

```
gen_confusion(conf_mat)
```

```
AxesSubplot(0.125,0.125;0.62x0.755)
```



In [ ]:

```

```

In [ ]:

```

```

In [ ]:

```

```

Kd_tree Tfidf W2V

In [50]:

```
dictionary = dict(zip(tf_idf_vect.get_feature_names(), list(tf_idf_vect.idf_)))
```

In [55]:

```
X_train = gen_tfidf_w2v(tf_idf_vect,list_of_sent,w2v_model,dictionary)
```

```
100%|████████████████████████████████████████████████████████████████████████| 6700/6700
[00:13<00:00, 494.58it/s]
```

In [56]:

```
X_test = gen_tfidf_w2v(tf_idf_vect,test_list_of_sent,w2v_model,dictionary)
```

```
100%|████████████████████████████████████████████████████████████████████████| 3300/3300
[00:04<00:00, 715.28it/s]
```

In [57]:

```
pred = optimal_knn(15,X_train,X_test,y_train,y_test,algo='kd_tree')
```

```
The accuracy of the knn classifier for k = 15 is 89.515152%
```

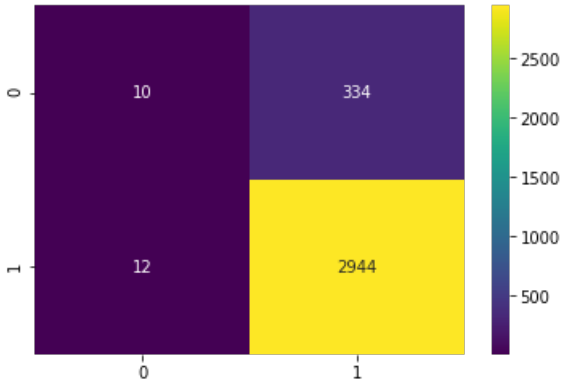
In [58]:

```
conf_mat = confusion_matrix(y_test,pred)
```

In [59]:

```
gen_confusion(conf_mat)
```

```
AxesSubplot(0.125,0.125;0.62x0.755)
```



In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

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In [ ]:

In [ ]:

In [ ]: