# 28.15.Amazon_food_review_SVM

June 9, 2018

## 1 Amazon food review dataset apply SVM

Data set from https://www.kaggle.com/snap/amazon-fine-food-reviews

## 2 Objective

Try predicting review using SVM random and grid search and different value of lambda and C

## 3 Import data and libraries

In [1]:
```
from sklearn.manifold import TSNE
import sqlite3
import pandas as pd
import numpy as np
import nltk
import string
import matplotlib.pyplot as plt
import seaborn as sns
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.cross_validation import train_test_split,KFold
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.grid_search import GridSearchCV
from sklearn.linear_model import LogisticRegression

con = sqlite3.connect('database.sqlite')
```

```
        #get only +ve and -ve review
        raw_data = pd.read_sql_query("""SELECT * FROM Reviews WHERE Score != 3""", con)
```

```
C:\Users\suman\Anaconda3\lib\site-packages\sklearn\cross_validation.py:41: DeprecationWarning:
  "This module will be removed in 0.20.", DeprecationWarning)
C:\Users\suman\Anaconda3\lib\site-packages\sklearn\grid_search.py:42: DeprecationWarning: This
  DeprecationWarning)
```

## 4 Data preprocessing

```
In [2]: filtered_data=raw_data
        # Score>3 a positive rating, and score<3 a negative rating.
        def partition(x):
            if x < 3:
                return 'negative'
            return 'positive'

        #changing reviews with score less than 3 to be positive and vice-versa
        actualScore = filtered_data['Score']
        positiveNegative = actualScore.map(partition)
        filtered_data['Score'] = positiveNegative

        filtered_data.sample(5)
        filtered_data['Score'].value_counts()

        #Sorting data according to ProductId in ascending order
        sorted_data=filtered_data.sort_values('ProductId', axis=0, ascending=True, inplace=Fals

        #Deduplication of entries for same profilename,userid, time, text and take first eleme
        sorted_data=sorted_data.drop_duplicates(subset={"UserId","ProfileName","Time","Text"},
```

```
In [41]: #take only 5000
         #clean_data=sorted_data.sample(frac=1).groupby('Score').head(400)
         _ , clean_data = train_test_split(sorted_data, test_size = 5000, stratify = sorted_dat
         clean_data['Score'].value_counts()
         #print(clean_data.shape)
```

```
Out[41]: positive    4216
         negative     784
         Name: Score, dtype: int64
```

```
In [42]: # Clean html tag and punctuation

         import 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

#substitute html tag and punctuation
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(sno.stem('tasty'))
```

In [43]:
```
i=0
str1=' '
mystop={'of','four','one','would'}
final_string=[]
all_positive_words=[] # store words from +ve reviews here
all_negative_words=[] # store words from -ve reviews here.
s=''
#Create new catagory as Cleanedtext after removing htmltag and punctuation and upperc
for sent in clean_data['Text'].values:
    #change later
    #sent=sent[:20]
    filtered_sentence=[]
    #print(sent);
    sent=cleanhtml(sent) # remove HTMl tags
    for w in sent.split():
        for cleaned_words in cleanpunc(w).split():
            if((cleaned_words.isalpha()) & (len(cleaned_words)>2)):
                if((cleaned_words.lower() not in stop) & (cleaned_words.lower() not i
                    s=(sno.stem(cleaned_words.lower())).encode('utf8')
                    filtered_sentence.append(s)
                    if (clean_data['Score'].values)[i] == 'positive':
                        all_positive_words.append(s) #list of all words used to descr
                    if(clean_data['Score'].values)[i] == 'negative':
                        all_negative_words.append(s) #list of all words used to descr
                else:
                    continue
            else:
                continue
    str1 = b" ".join(filtered_sentence) #final string of cleaned words

    final_string.append(str1)
```

```
            i+=1
```

In [44]:
```
clean_data['CleanedText']=final_string
#store for future use
#conn = sqlite3.connect('clean_data.sqlite')
#c=conn.cursor()
#conn.text_factory = str
#clean_data.to_sql('Reviews1', conn, flavor=None, schema=None, if_exists='replace', i
#con = sqlite3.connect('clean_data.sqlite')
#clean_data = pd.read_sql_query("""SELECT * FROM Reviews1 WHERE Score != 3""", con)
#clean_data['CleanedText'].sample(15)
print(clean_data.shape)
#Sort data on timestamp
clean_data=clean_data.sort_values(by=['Time'],ascending=False)
#clean_data
clean_data['CleanedText'].sample(2)
```

```
(5000, 11)
```

Out[44]:
```
37868     b'regular groceri store honey dark deep molass...
162011    b'drank back year ago could find pleasent surp...
Name: CleanedText, dtype: object
```

## 5 Create BOW and try linear kernel SVM

In [45]:
```
#now convert CleanedText to TDM
count_vect = CountVectorizer() #in scikit-learn
final_counts = count_vect.fit_transform(clean_data['CleanedText'].values)
print(final_counts.get_shape())
print(type(final_counts))
#print(final_counts[[1]])
print("new")
#print(final_counts[0,:])# this is stored like dict format only non zero values. spar
#x = pd.DataFrame(final_counts.toarray())#this is stored like dataframe format all 0
# sparse matrix in csr format works faster compare to dense format
#print(x.shape,x.loc[0])
```

```
(5000, 9911)
<class 'scipy.sparse.csr.csr_matrix'>
new
```

In [46]:
```
from sklearn.preprocessing import StandardScaler
x=final_counts
y =clean_data['Score']
```

```
        #Standarize the features
        #below not working
        #sc = StandardScaler(with_mean=False)
        # this is sparse matrix so standarization is required differently
        from sklearn.preprocessing import normalize
        x = normalize(x, norm='l1', axis=0)


        print(x.get_shape())
        print(type(x))

        n=x.shape[0]
        n1=int(n*.3)
        #X_test = x[0:n1]
        #X_train= x[n1:n+1]

        #y should be changed to binary

        from sklearn.preprocessing import label_binarize
        encoded_column_vector = label_binarize(y, classes=['negative','positive']) # negative
        encoded_labels = np.ravel(encoded_column_vector) # Reshape array
        y=encoded_labels

        y_test=y[0:n1]
        y_train=y[n1:n+1]


        X_test = x[0:n1,:]
        X_train= x[n1:n+1,:]
        y_test=y[0:n1]
        y_train=y[n1:n+1]
        print('size of X_train, X_test, y_train , y_test ',X_train.shape, X_test.shape,y_trai
        #print("positive and negative review in train and test\n",y_train.value_counts(),"\n"
```

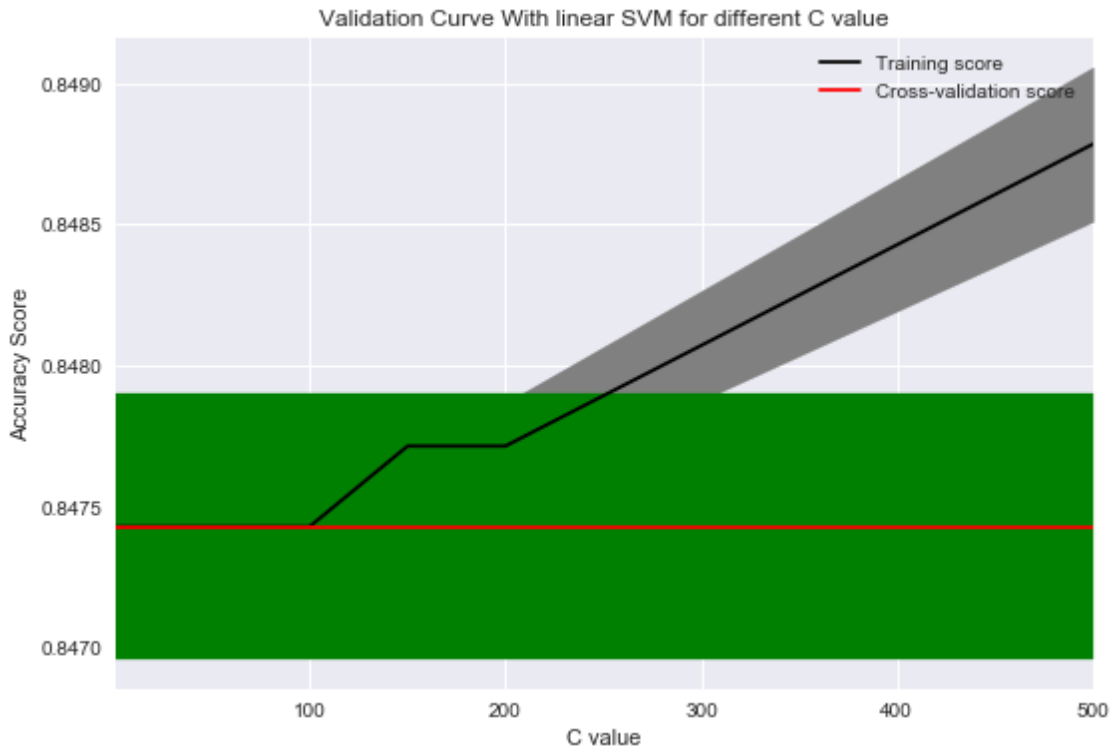
```
(5000, 9911)
<class 'scipy.sparse.csc.csc_matrix'>
size of X_train, X_test, y_train , y_test  (3500, 9911) (1500, 9911) (3500,) (1500,)
```

In [47]:
```
        # Build model with linear kernel with random and grid search
        import warnings
        warnings.filterwarnings('ignore')
        from sklearn import svm
        from sklearn.model_selection import validation_curve


        # Use grid search for L2
```

```
C=[.1,1,10,100]
kernel=['linear']
gamma=['auto']

tuned_parameters=dict(C=C, kernel=kernel,gamma=gamma)

#Using GridSearchCV
model = GridSearchCV(svm.SVC(), tuned_parameters, scoring = 'f1', cv=5)
model.fit(X_train, y_train)


print('Best parameters with linear karnel and grid search\n',model.best_estimator_)
#print('Model test score', model.score(X_test, y_test))

optimumc=model.best_estimator_.C
#optimumkernel=model.best_estimator_.kernel
optimumgamma=model.best_estimator_.gamma

#print(type(X_train),type(y_train))

#build model with best parameter
model = svm.SVC(C=optimumc,gamma=optimumgamma)
model.fit(X_train, y_train)

pred=model.predict(X_test)
mat=pd.crosstab(y_test, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tru
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0] ;fp=mat.iloc[0,1];fn=mat.iloc[1,0];precision=tp/(tp
recall=tp/(tp+fn)
fscoretest=2*precision*recall/(precision+recall)

pred=model.predict(X_train)
mat=pd.crosstab(y_train, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tr
print(mat);tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;prec
recall=tp/(tp+fn)
fscoretrain=2*precision*recall/(precision+recall)


aa=pd.DataFrame({'type':['Grid search BOW'],'kernel':['linear'],'accuracy_train':[mode
                 'fscore_train':[fscoretrain],'accuracy_test':[model.score(X_test,y_te
                 'C':[model.C],'gamma':[model.gamma]})


# Check test accuracy
print("Test accuracy using linear kernel",model.score(X_test, y_test))
# Print coefficients
# check no of parameter
#w = model.coef_
#print('Count of non zero element in coefficient',np.count_nonzero(w))
```

```
        #print('Model test score',model.score(X_test,y_test))
        print(aa)
        #Plot accuracy with C
        #create plot for training and test validation
        # Calculate accuracy on training and test set using range of parameter values
        C=[1,10,50,100,150,200,500]
        param_range=[1,10,50,100,150,200,500]
        train_scores, test_scores = validation_curve(svm.SVC(), X_train, y_train, param_name='
        train_scores_mean = np.mean(train_scores, axis=1)
        train_scores_std = np.std(train_scores, axis=1)
        test_scores_mean = np.mean(test_scores, axis=1)
        test_scores_std = np.std(test_scores, axis=1)
        plt.plot(param_range, train_scores_mean, label="Training score", color="black")
        plt.plot(param_range, test_scores_mean, label="Cross-validation score", color="red")
        plt.fill_between(param_range, train_scores_mean - train_scores_std, train_scores_mean
        plt.fill_between(param_range, test_scores_mean - test_scores_std, test_scores_mean + t
        plt.title("Validation Curve With linear SVM for different C value")
        plt.xlabel("C value")
        plt.ylabel("Accuracy Score")
        plt.xlim(1,500)
        plt.tight_layout()
        plt.legend(loc="best")
        plt.show()
```

```
Best parameters with linear karnel and grid search
 SVC(C=1, cache_size=200, class_weight=None, coef0=0.0,
  decision_function_shape='ovr', degree=3, gamma='auto', kernel='linear',
  max_iter=-1, probability=False, random_state=None, shrinking=True,
  tol=0.001, verbose=False)
Predicted     1   All
Actual
0           534   534
1          2966  2966
All        3500  3500
Test accuracy using linear kernel 0.833333333333
   C  accuracy_test  accuracy_train  fscore_test  fscore_train gamma  kernel  \
0  1       0.833333        0.847429        0.625      0.628923  auto  linear

              type
0  Grid search BOW
```




In [48]:
```
# Try random search
from sklearn.model_selection import RandomizedSearchCV

C=[.1,.5,.8,1,2]
kernel=['linear']
gamma=['auto']

tuned_parameters=dict(C=C, kernel=kernel,gamma=gamma)

#Using random search
model = RandomizedSearchCV(svm.SVC(), tuned_parameters, random_state=1, scoring = 'f1

#print(model)

print('Best parameters using linear kernel and random search \n',model.estimator)
#build model with best parameter
optimumc=model.estimator.C
#optimumkernel=model.best_estimator_.kernel
optimumgamma=model.estimator.gamma


model = svm.SVC(C=optimumc,gamma=optimumgamma)
model.fit(X_train, y_train)
```

```
        pred=model.predict(X_test)
        mat=pd.crosstab(y_test, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tru
        tp=mat.iloc[1,1] ;tn=mat.iloc[0,0] ;fp=mat.iloc[0,1];fn=mat.iloc[1,0];precision=tp/(tp
        recall=tp/(tp+fn)
        fscoretest=2*precision*recall/(precision+recall)

        pred=model.predict(X_train)
        mat=pd.crosstab(y_train, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tr
        print(mat);tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;prec
        recall=tp/(tp+fn)
        fscoretrain=2*precision*recall/(precision+recall)

        bb=pd.DataFrame({'type':['Random Search BOW'],'kernel':['linear'],'accuracy_train':[mo
                         'fscore_train':[fscoretrain],'accuracy_test':[model.score(X_test,y_te
                         'C':[model.C],'gamma':[model.gamma]})
        aa=aa.append(bb)

        print(aa)
        # Check test accuracy
        print("Test accuracy",model.score(X_test, y_test))
```

```
Best parameters using linear kernel and random search
 SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
  decision_function_shape='ovr', degree=3, gamma='auto', kernel='rbf',
  max_iter=-1, probability=False, random_state=None, shrinking=True,
  tol=0.001, verbose=False)
Predicted     1   All
Actual
0           534   534
1          2966  2966
All        3500  3500
     C  accuracy_test  accuracy_train  fscore_test  fscore_train gamma  \
0  1.0       0.833333        0.847429        0.625      0.628923  auto
0  1.0       0.833333        0.847429        0.625      0.628923  auto

   kernel               type
0  linear    Grid search BOW
0  linear  Random Search BOW
Test accuracy 0.833333333333
```

## 6 Apply RBF kernel

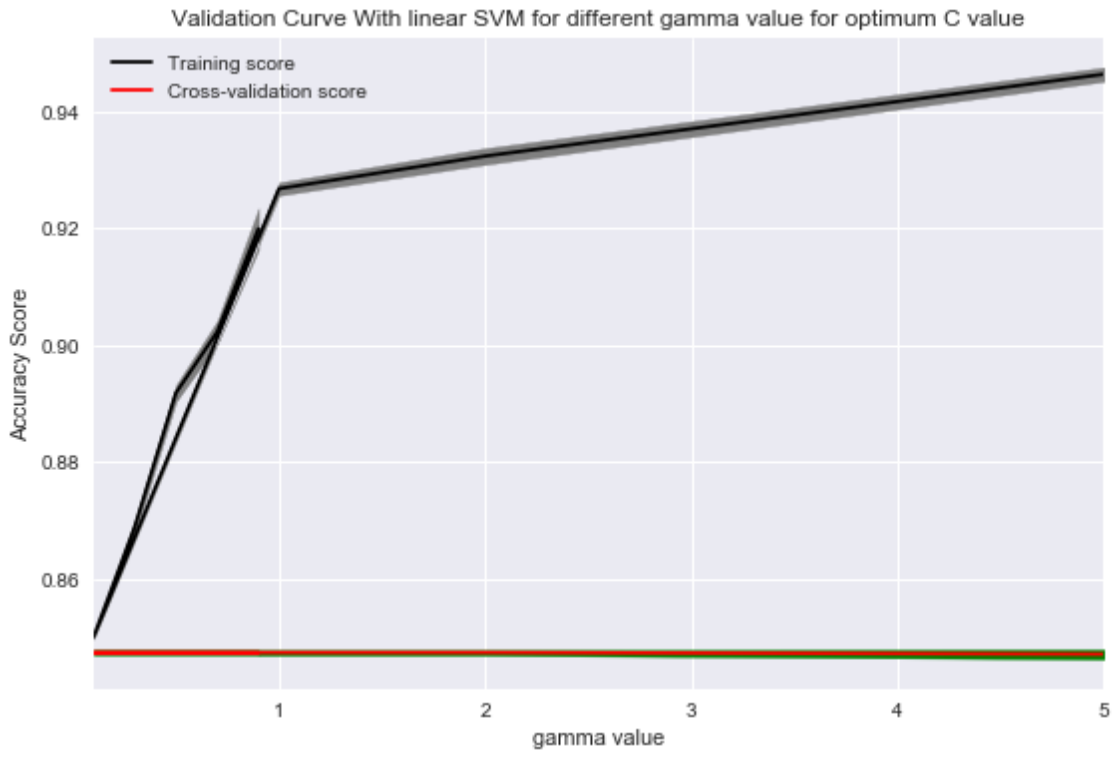
In [49]:
```
        # Build model with linear kernel with random and grid search

        import warnings
```

```
warnings.filterwarnings('ignore')
from sklearn import svm


# Use grid search for L2
C=[.1,1,10,100]
kernel=['rbf']
gamma=[.01,.1,1,10]

tuned_parameters=dict(C=C, kernel=kernel,gamma=gamma)

#Using GridSearchCV
model = GridSearchCV(svm.SVC(), tuned_parameters, scoring = 'f1', cv=5)
model.fit(X_train, y_train)


print('Best parameters with rbf karnel and grid search\n',model.best_estimator_)
#print('Model test score', model.score(X_test, y_test))

optimumc=model.best_estimator_.C
#optimumkernel=model.best_estimator_.kernel
optimumgamma=model.best_estimator_.gamma

#print(type(X_train),type(y_train))

#build model with best parameter
model = svm.SVC(C=optimumc,gamma=optimumgamma)
model.fit(X_train, y_train)

pred=model.predict(X_test)
mat=pd.crosstab(y_test, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tru
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0] ;fp=mat.iloc[0,1];fn=mat.iloc[1,0];precision=tp/(tp
recall=tp/(tp+fn)
fscoretest=2*precision*recall/(precision+recall)

pred=model.predict(X_train)
mat=pd.crosstab(y_train, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tr
print(mat);tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;prec
recall=tp/(tp+fn)
fscoretrain=2*precision*recall/(precision+recall)


bb=pd.DataFrame({'type':['Grid search BOW'],'kernel':['rbf'],'accuracy_train':[model.s
                 'fscore_train':[fscoretrain],'accuracy_test':[model.score(X_test,y_te
                 'C':[model.C],'gamma':[model.gamma]})
aa=aa.append(bb)
```

```
# Check test accuracy
print("Test accuracy using linear kernel",model.score(X_test, y_test))
# Print coefficients
# check no of parameter
#w = model.coef_
#print('Count of non zero element in coefficient',np.count_nonzero(w))
#print('Model test score',model.score(X_test,y_test))


C=[.1,.5,.8,1,2,5]
kernel=['rbf']
gamma=[.01,.1,1,10]

tuned_parameters=dict(C=C, kernel=kernel,gamma=gamma)

#Using random search
model = RandomizedSearchCV(svm.SVC(), tuned_parameters, random_state=1, scoring = 'f1

#print(model)

print('Best parameters using rbf kernel and random search \n',model.estimator)
#build model with best parameter
optimumc=model.estimator.C
#optimumkernel=model.best_estimator_.kernel
optimumgamma=model.estimator.gamma


model = svm.SVC(C=optimumc,gamma=optimumgamma)
model.fit(X_train, y_train)

# Check test accuracy
print("Test accuracy",model.score(X_test, y_test))

# plot accuracy with gamma with optimum c
gamma=[.9,.7,.5,.3,.1,1,2,5]
param_range=[.9,.7,.5,.3,.1,1,2,5]
train_scores, test_scores = validation_curve(svm.SVC(kernel='rbf',C=optimumc), X_trai
                                             param_range=gamma,cv=5)
train_scores_mean = np.mean(train_scores, axis=1)
train_scores_std = np.std(train_scores, axis=1)
test_scores_mean = np.mean(test_scores, axis=1)
test_scores_std = np.std(test_scores, axis=1)
plt.plot(param_range, train_scores_mean, label="Training score", color="black")
plt.plot(param_range, test_scores_mean, label="Cross-validation score", color="red")
plt.fill_between(param_range, train_scores_mean - train_scores_std, train_scores_mean
plt.fill_between(param_range, test_scores_mean - test_scores_std, test_scores_mean + t
plt.title("Validation Curve With linear SVM for different gamma value for optimum C va
plt.xlabel("gamma value")
```

```
        plt.ylabel("Accuracy Score")
        plt.xlim(.1,5)
        plt.tight_layout()
        plt.legend(loc="best")
        plt.show()
```

```
Best parameters with rbf karnel and grid search
 SVC(C=0.1, cache_size=200, class_weight=None, coef0=0.0,
  decision_function_shape='ovr', degree=3, gamma=0.01, kernel='rbf',
  max_iter=-1, probability=False, random_state=None, shrinking=True,
  tol=0.001, verbose=False)
Predicted     1   All
Actual
0           534   534
1          2966  2966
All        3500  3500
Test accuracy using linear kernel 0.833333333333
Best parameters using rbf kernel and random search
 SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
  decision_function_shape='ovr', degree=3, gamma='auto', kernel='rbf',
  max_iter=-1, probability=False, random_state=None, shrinking=True,
  tol=0.001, verbose=False)
Test accuracy 0.833333333333
```



## 7 Try with TFIDF

In [50]:
```
tf_idf_vect = TfidfVectorizer()
final_counts = tf_idf_vect.fit_transform(clean_data['CleanedText'].values)

x=final_counts
y =clean_data['Score']

x = normalize(x, norm='l1', axis=0)

n=x.shape[0]
n1=int(n*.3)
#y should be changed to binary

encoded_column_vector = label_binarize(y, classes=['negative','positive']) # negative
encoded_labels = np.ravel(encoded_column_vector) # Reshape array
y=encoded_labels

y_test=y[0:n1]
y_train=y[n1:n+1]


X_test = x[0:n1,:]
X_train= x[n1:n+1,:]
y_test=y[0:n1]
y_train=y[n1:n+1]
print('size of X_train, X_test, y_train , y_test ',X_train.shape, X_test.shape,y_trai

# Build model with linear kernel with random and grid search
import warnings
warnings.filterwarnings('ignore')
from sklearn import svm


# Use grid search for L2
C=[.1,1,10,100]
kernel=['rbf']
gamma=[.01,.1,1,10]

tuned_parameters=dict(C=C, kernel=kernel,gamma=gamma)

#Using GridSearchCV
model = GridSearchCV(svm.SVC(), tuned_parameters, scoring = 'f1', cv=5)
model.fit(X_train, y_train)


print('Best parameters with rbf karnel and grid search using TFIDF\n',model.best_esti
#print('Model test score', model.score(X_test, y_test))
```

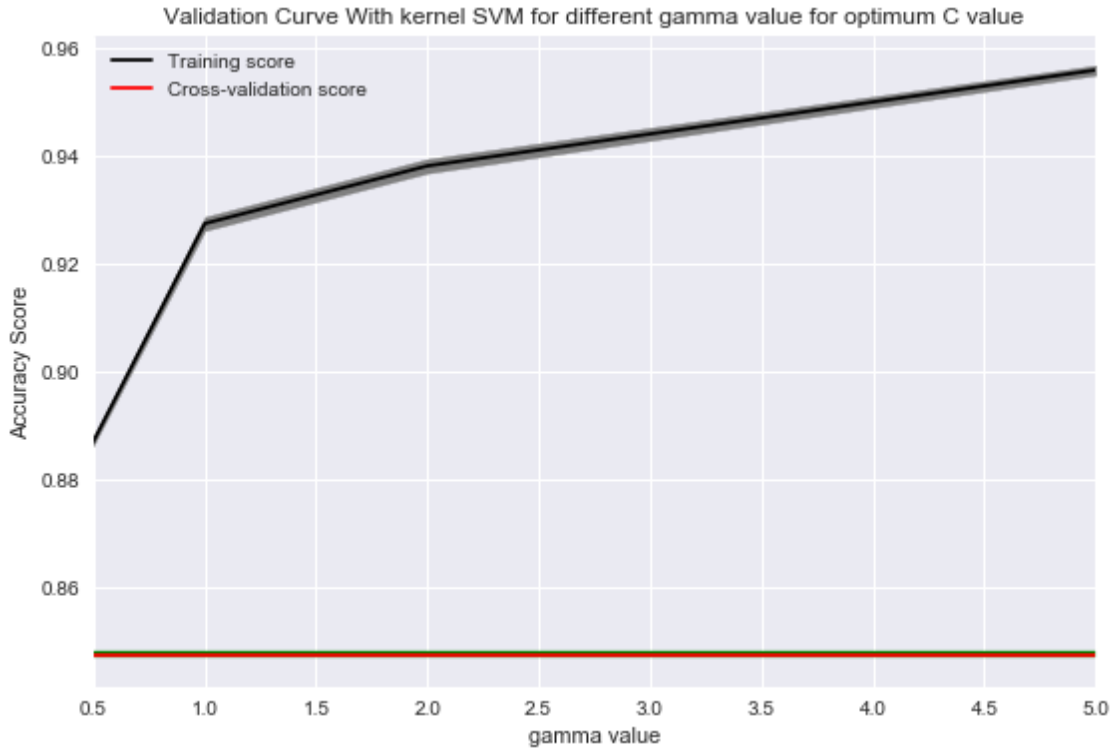
```
optimumc=model.best_estimator_.C
#optimumkernel=model.best_estimator_.kernel
optimumgamma=model.best_estimator_.gamma

#print(type(X_train),type(y_train))

#build model with best parameter
model = svm.SVC(C=optimumc,gamma=optimumgamma)
model.fit(X_train, y_train)

pred=model.predict(X_test)
mat=pd.crosstab(y_test, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tru
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0] ;fp=mat.iloc[0,1];fn=mat.iloc[1,0];precision=tp/(tp
recall=tp/(tp+fn)
fscoretest=2*precision*recall/(precision+recall)

pred=model.predict(X_train)
mat=pd.crosstab(y_train, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tr
print(mat);tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;prec
recall=tp/(tp+fn)
fscoretrain=2*precision*recall/(precision+recall)


bb=pd.DataFrame({'type':['Grid search TFIDF'],'kernel':['rbf'],'accuracy_train':[model
                 'fscore_train':[fscoretrain],'accuracy_test':[model.score(X_test,y_te
                 'C':[model.C],'gamma':[model.gamma]})
aa=aa.append(bb)

# Check test accuracy
print("Test accuracy using linear kernel TFIDF",model.score(X_test, y_test))
# Print coefficients
# check no of parameter
#w = model.coef_
#print('Count of non zero element in coefficient',np.count_nonzero(w))
#print('Model test score',model.score(X_test,y_test))


C=[.1,.5,.8,1,2,5,10,100]
kernel=['rbf']
gamma=[.01,.1,1,10]

tuned_parameters=dict(C=C, kernel=kernel,gamma=gamma)

#Using random search
model = RandomizedSearchCV(svm.SVC(), tuned_parameters, random_state=1, scoring = 'f1

#print(model)
```

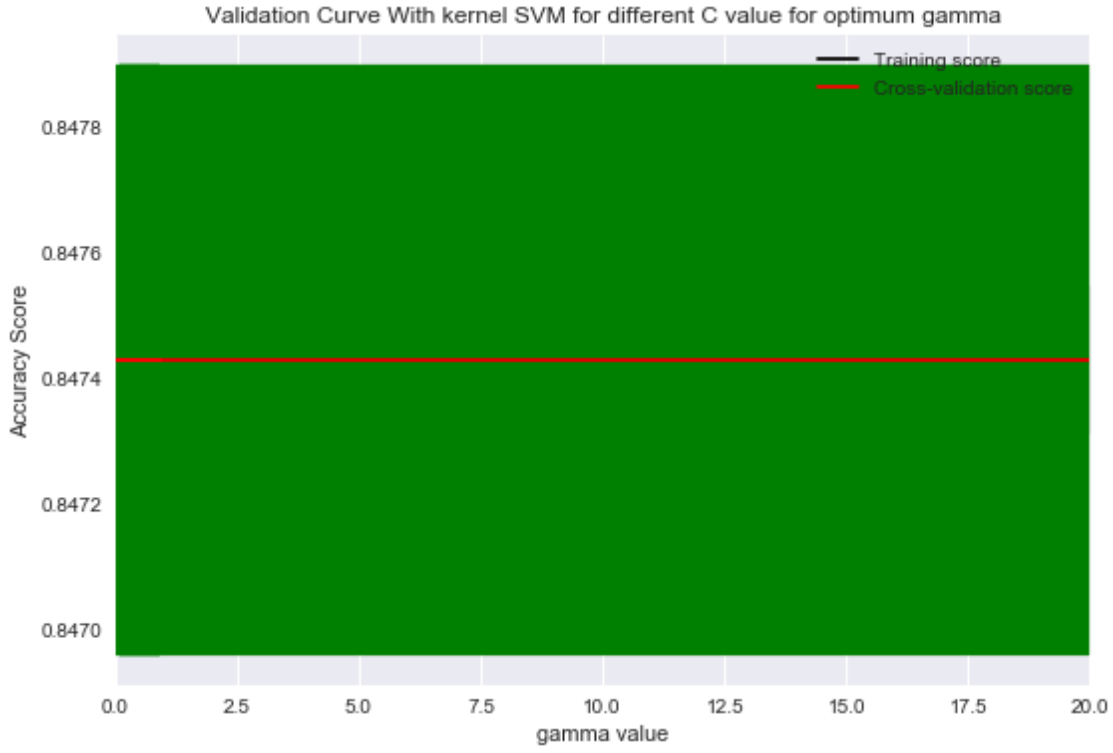
```
        print('Best parameters using rbf kernel and random search TFIDF\n',model.estimator)
        #build model with best parameter
        optimumc=model.estimator.C
        #optimumkernel=model.best_estimator_.kernel
        optimumgamma=model.estimator.gamma


        model = svm.SVC(C=optimumc,gamma=optimumgamma)
        model.fit(X_train, y_train)

        # Check test accuracy
        print("Test accuracy",model.score(X_test, y_test))
```

```
size of X_train, X_test, y_train , y_test  (3500, 9911) (1500, 9911) (3500,) (1500,)
Best parameters with rbf karnel and grid search using TFIDF
 SVC(C=0.1, cache_size=200, class_weight=None, coef0=0.0,
  decision_function_shape='ovr', degree=3, gamma=0.01, kernel='rbf',
  max_iter=-1, probability=False, random_state=None, shrinking=True,
  tol=0.001, verbose=False)
Predicted     1   All
Actual
0           534   534
1          2966  2966
All        3500  3500
Test accuracy using linear kernel TFIDF 0.833333333333
Best parameters using rbf kernel and random search TFIDF
 SVC(C=1.0, cache_size=200, class_weight=None, coef0=0.0,
  decision_function_shape='ovr', degree=3, gamma='auto', kernel='rbf',
  max_iter=-1, probability=False, random_state=None, shrinking=True,
  tol=0.001, verbose=False)
Test accuracy 0.833333333333
```

In [51]:
```
        # Plot
        # plot accuracy with gamma with optimum c
        gamma=[.05,.03,.02,.01,1,2,5]
        param_range=[.05,.03,.02,.01,1,2,5]
        train_scores, test_scores = validation_curve(svm.SVC(kernel='rbf',C=optimumc), X_trai
                                                     param_range=gamma,cv=5)
        train_scores_mean = np.mean(train_scores, axis=1)
        train_scores_std = np.std(train_scores, axis=1)
        test_scores_mean = np.mean(test_scores, axis=1)
        test_scores_std = np.std(test_scores, axis=1)
        plt.plot(param_range, train_scores_mean, label="Training score", color="black")
        plt.plot(param_range, test_scores_mean, label="Cross-validation score", color="red")
        plt.fill_between(param_range, train_scores_mean - train_scores_std, train_scores_mean
        plt.fill_between(param_range, test_scores_mean - test_scores_std, test_scores_mean + t
```

```
plt.title("Validation Curve With kernel SVM for different gamma value for optimum C va
plt.xlabel("gamma value")
plt.ylabel("Accuracy Score")
plt.xlim(.5,5)
plt.tight_layout()
plt.legend(loc="best")
plt.show()

# plot accuracy with C with optimum gamma
C=[.01,.9,.7,.5,.3,.1,1,2,5,10,20]
param_range=[.01,.9,.7,.5,.3,.1,1,2,5,10,20]
train_scores, test_scores = validation_curve(svm.SVC(kernel='rbf',gamma=optimumgamma)
                                             param_range=C,cv=5)
train_scores_mean = np.mean(train_scores, axis=1)
train_scores_std = np.std(train_scores, axis=1)
test_scores_mean = np.mean(test_scores, axis=1)
test_scores_std = np.std(test_scores, axis=1)
plt.plot(param_range, train_scores_mean, label="Training score", color="black")
plt.plot(param_range, test_scores_mean, label="Cross-validation score", color="red")
plt.fill_between(param_range, train_scores_mean - train_scores_std, train_scores_mean
plt.fill_between(param_range, test_scores_mean - test_scores_std, test_scores_mean + t
plt.title("Validation Curve With kernel SVM for different C value for optimum gamma")
plt.xlabel("gamma value")
plt.ylabel("Accuracy Score")
plt.xlim(.01,20)
plt.tight_layout()
plt.legend(loc="best")
plt.show()
```


Validation Curve With kernel SVM for different gamma value for optimum C value
Training score
Cross-validation score
Accuracy Score
0.96
0.94
0.92
0.90
0.88
0.86
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
gamma value


Validation Curve With kernel SVM for different C value for optimum gamma
Training score
Cross-validation score
Accuracy Score
0.8478
0.8476
0.8474
0.8472
0.8470
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
gamma value

```
In [52]: aa
```

```
Out[52]:      C  accuracy_test  accuracy_train  fscore_test  fscore_train gamma  \
         0  1.0       0.833333        0.847429        0.625      0.628923  auto
         0  1.0       0.833333        0.847429        0.625      0.628923  auto
         0  0.1       0.833333        0.847429        0.625      0.628923  0.01
         0  0.1       0.833333        0.847429        0.625      0.628923  0.01

            kernel              type
         0  linear   Grid search BOW
         0  linear  Random Search BOW
         0     rbf   Grid search BOW
         0     rbf  Grid search TFIDF
```

## 8 Conclusion

The scores are below

```
In [53]: aa
```

```
Out[53]:      C  accuracy_test  accuracy_train  fscore_test  fscore_train gamma  \
         0  1.0       0.833333        0.847429        0.625      0.628923  auto
         0  1.0       0.833333        0.847429        0.625      0.628923  auto
         0  0.1       0.833333        0.847429        0.625      0.628923  0.01
         0  0.1       0.833333        0.847429        0.625      0.628923  0.01

            kernel              type
         0  linear   Grid search BOW
         0  linear  Random Search BOW
         0     rbf   Grid search BOW
         0     rbf  Grid search TFIDF
```

```
In [ ]:
```