28.15.Amazon_food_review_SVM_v1.0

July 21, 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 [3]:
```
#take only 10000
#clean_data=sorted_data.sample(frac=1).groupby('Score').head(400)
_ , clean_data = train_test_split(sorted_data, test_size = 10000, random_state=0,strati
clean_data['Score'].value_counts()
#print(clean_data.shape)
```

Out[3]:
```
positive    8432
negative    1568
Name: Score, dtype: int64
```

In [4]:
```
# 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 cha
    cleaned = re.sub(r'[?|!|\'|"|#]',r'',sentence)
    cleaned = re.sub(r'[.|,|)|(|\|/]',r' ',cleaned)
    return  cleaned
#print(sno.stem('tasty'))

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 upperca
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 in
                    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 descri
                    if(clean_data['Score'].values)[i] == 'negative':
                        all_negative_words.append(s) #list of all words used to descri
                else:
                    continue
            else:
                continue
    str1 = b" ".join(filtered_sentence) #final string of cleaned words

    final_string.append(str1)
```

```
            i+=1

        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', in
        #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)
```

```
(10000, 11)
```

```
C:\Users\suman\Anaconda3\lib\site-packages\ipykernel_launcher.py:56: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/indexing.html
```

```
Out[4]: 401762    b'pleas product cornstarch wondra thicken left...
        507762    b'stuff absolut amaz like everyth els ive tri ...
        Name: CleanedText, dtype: object
```

5 Split train and test

```
In [5]: x=clean_data['CleanedText'].values
        y = clean_data['Score']
        n=x.shape[0]
        n1=int(n*.3)
        X_test_raw = x[0:n1]
        X_train_raw= 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_raw.shape, X_test_raw.shape
        print("positive and negative review in train and test\n",y_train.value_counts(),"\n",y
```

```
size of X_train, X_test, y_train , y_test  (7000,) (3000,) (7000,) (3000,)
positive and negative review in train and test
 positive    5939
negative    1061
```

```
Name: Score, dtype: int64
 positive    2493
negative     507
Name: Score, dtype: int64
```

6 Create BOW and try linear kernel SVM

```
In [6]: #now convert CleanedText to TDM
        count_vect = CountVectorizer() #in scikit-learn
        X_train = count_vect.fit_transform(X_train_raw)

        #use the same vectors to convert test data
        X_test=count_vect.transform(X_test_raw)
        print(X_train.get_shape(),X_test.get_shape())

        #print(final_counts[0,:])# this is stored like dict format only non zero values. spars
        #x = pd.DataFrame(final_counts.toarray())#this is stored like dataframe format all 0 a
        # sparse matrix in csr format works faster compare to dense format
        #print(x.shape,x.loc[0])
```

```
(7000, 11132) (3000, 11132)
```

```
In [7]: from sklearn.preprocessing import StandardScaler

        #Use scale of train and apply to test
        from sklearn.preprocessing import StandardScaler
        scaler = StandardScaler(with_mean=False).fit(X_train)
        X_train = scaler.transform(X_train)
        X_test  = scaler.transform(X_test)

        from sklearn.preprocessing import label_binarize

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

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


        print('size of X_train, X_test, y_train , y_test ',X_train.shape, X_test.shape,y_train
        #print("positive and negative review in train and test\n",y_train.value_counts(),"\n",
```

```
size of X_train, X_test, y_train , y_test  (7000, 11132) (3000, 11132) (7000,) (3000,)
```

```
C:\Users\suman\Anaconda3\lib\site-packages\sklearn\utils\validation.py:475: DataConversionWarni
  warnings.warn(msg, DataConversionWarning)
C:\Users\suman\Anaconda3\lib\site-packages\sklearn\utils\validation.py:475: DataConversionWarni
  warnings.warn(msg, DataConversionWarning)
C:\Users\suman\Anaconda3\lib\site-packages\sklearn\utils\validation.py:475: DataConversionWarni
  warnings.warn(msg, DataConversionWarning)
```

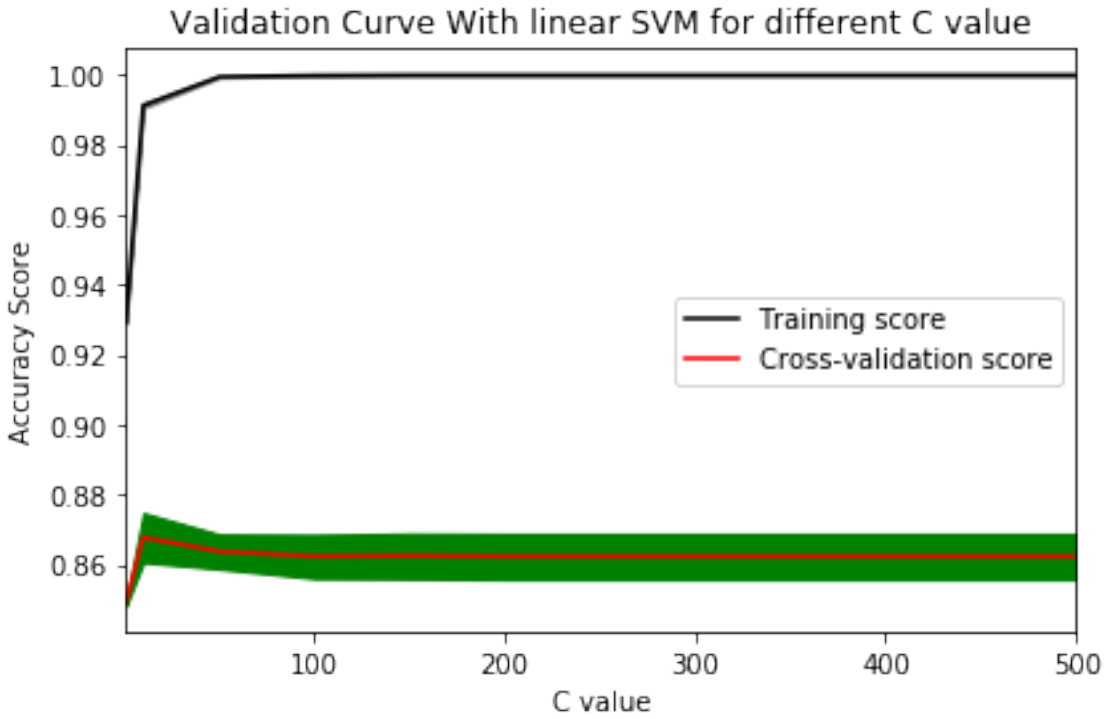
In [11]:
```
# Build model with linear kernel with random and grid search
import warnings
warnings.filterwarnings('ignore')
from sklearn import svm
from sklearn.model_selection import validation_curve

# Use grid search for L2
C=[.1,1,10,100]
#alpha=[.001,.01,.1,1,10,100]
kernel=['linear']
gamma=['auto']

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

from sklearn.linear_model import SGDClassifier

#Using GridSearchCV
#model = GridSearchCV(svm.SVC(), tuned_parameters, scoring = 'f1', cv=5)
#using hinge loss with SGD classifier is more performant
import time
start_time=time.clock()
model = GridSearchCV(svm.SVC(), tuned_parameters, scoring = 'f1', cv=5)
print('Time took for preprocessing the text :',time.clock() - start_time, "seconds")
#SGDClassifier( class_weight='balanced', alpha=i, penalty='l2', loss='hinge', random_

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
start_time=time.clock()
```

```
model = svm.SVC(C=optimumc,gamma=optimumgamma)
model.fit(X_train, y_train)
print('Time took for preprocessing the text :',time.clock() - start_time, "seconds")


pred=model.predict(X_test)
mat=pd.crosstab(y_test, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tru
print('confusion matrix\n',mat)
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
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
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
start_time=time.clock()

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()

print('Time took for preprocessing the text :',time.clock() - start_time, "seconds")


#****************************************
#TRY SGD classifier for better performance
alpha=[.001,.01,.1,1,10,100]
tuned_parameters=dict(alpha=alpha)

from sklearn.linear_model import SGDClassifier
start_time=time.clock()
model = GridSearchCV(SGDClassifier(penalty='l2',loss='hinge'),tuned_parameters, scorin
print('Time took for preprocessing the text SGDclassifier grid search:',time.clock() -

model.fit(X_train, y_train)
optimumalpha=model.best_estimator_.alpha
#build model with best parameter
model = SGDClassifier(penalty='l2',loss='hinge',alpha=optimumalpha)
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
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
recall=tp/(tp+fn)
fscoretrain=2*precision*recall/(precision+recall)
bb=pd.DataFrame({'type':['SGD BOW'],'kernel':['linear'],'accuracy_train':[model.score
                 'fscore_train':[fscoretrain],'accuracy_test':[model.score(X_test,y_te
                 'C':[model.C],'gamma':['na']})
aa=aa.append(bb)
```

```
Time took for preprocessing the text : 0.00018088997876475332 seconds
Best parameters with linear karnel and grid search
 SVC(C=0.1, 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)
```

```
Time took for preprocessing the text : 19.59668334161529 seconds
confusion matrix
 Predicted     1   All
Actual
0            507   507
1           2493  2493
All         3000  3000
Test accuracy using linear kernel 0.831
     C  accuracy_test  accuracy_train  fscore_test  fscore_train gamma  \
0  0.1           0.831        0.848429     0.624343      0.629198  auto

   kernel             type
0  linear  Grid search BOW
```




```
Time took for preprocessing the text : 822.9294024472749 seconds
Time took for preprocessing the text SGDclassifier grid search: 0.0005332619466571487 seconds
```

```
In [12]: # 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
        print('confusion matrix \n',mat)
        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
        tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
        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)
confusion matrix
 Predicted  0     1   All
```

```
Actual
0          7   500   507
1          0  2493  2493
All        7  2993  3000
     C  accuracy_test  accuracy_train  fscore_test  fscore_train gamma  \
0  0.1       0.831000        0.848429     0.624343      0.629198  auto
0  1.0       0.872000        0.965429     0.926913      0.980003    na
0  1.0       0.833333        0.932143     0.908859      0.961548  auto

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

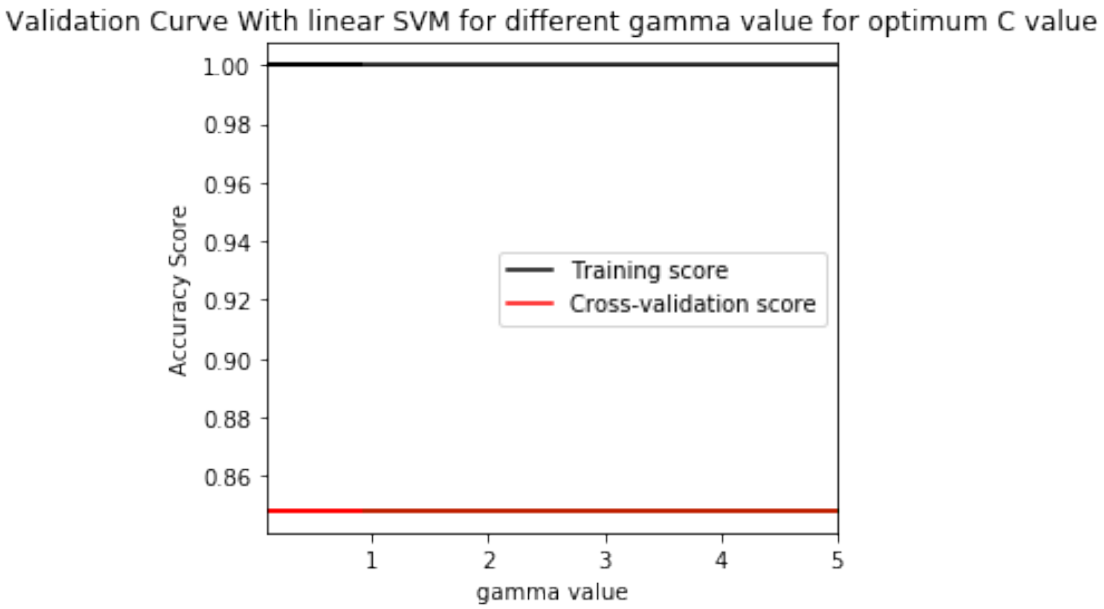
7 Apply RBF kernel

In [13]:
```
# 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
print('confusion matrix',mat)
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
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
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)
confusion matrix Predicted     1   All
Actual
0           507   507
1          2493  2493
All        3000  3000
Test accuracy using linear kernel 0.831
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
```



8 Try with TFIDF

```
In [14]: tf_idf_vect = TfidfVectorizer()
         final_counts = tf_idf_vect.fit_transform(X_train_raw)
         #use the same vectors to convert test data
         X_test=count_vect.transform(X_test_raw)
         print(X_train.get_shape(),X_test.get_shape())
         #Use scale of train and apply to test
         from sklearn.preprocessing import StandardScaler
         scaler = StandardScaler(with_mean=False).fit(X_train)
         X_train = scaler.transform(X_train)
         X_test  = scaler.transform(X_test)
         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_estim
#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
print('confusion matrix\n',mat)
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
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
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]
```

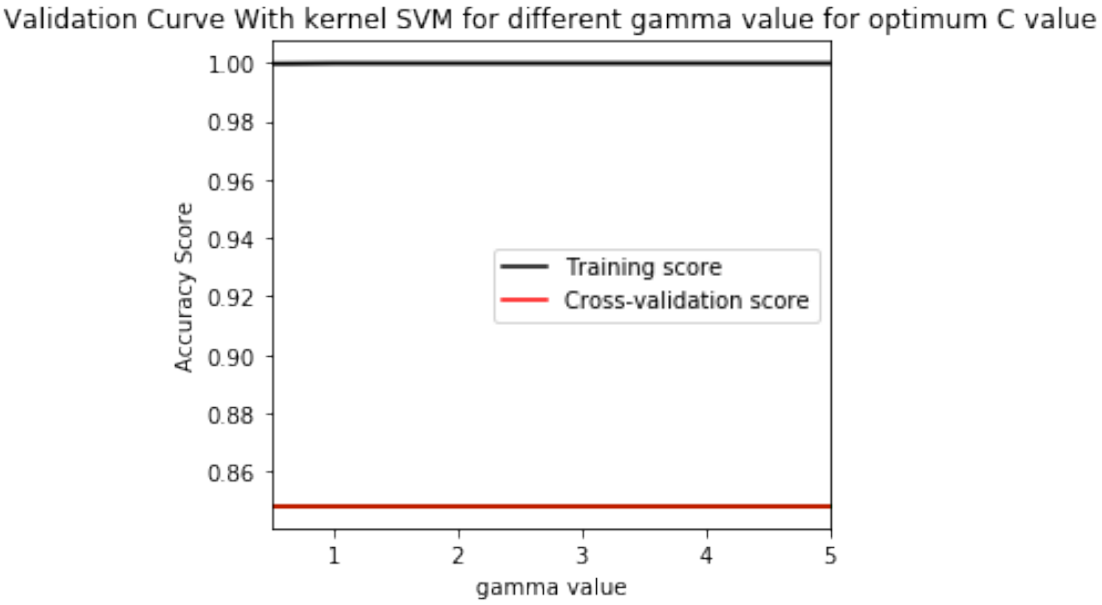
```
kernel=['rbf']
gamma=[.01,.1,1,10]

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)

pred=model.predict(X_test)
mat=pd.crosstab(y_test, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tru
print('confusion matrix test\n',mat)
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
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
recall=tp/(tp+fn)
fscoretrain=2*precision*recall/(precision+recall)

bb=pd.DataFrame({'type':['Random search TFIDF'],'kernel':['rbf'],'accuracy_train':[moc
                 '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",model.score(X_test, y_test))

#*****************************
#TRY SGD classifier for better performance
alpha=[.001,.01,.1,1,10,100]
tuned_parameters=dict(alpha=alpha)

from sklearn.linear_model import SGDClassifier
start_time=time.clock()
```

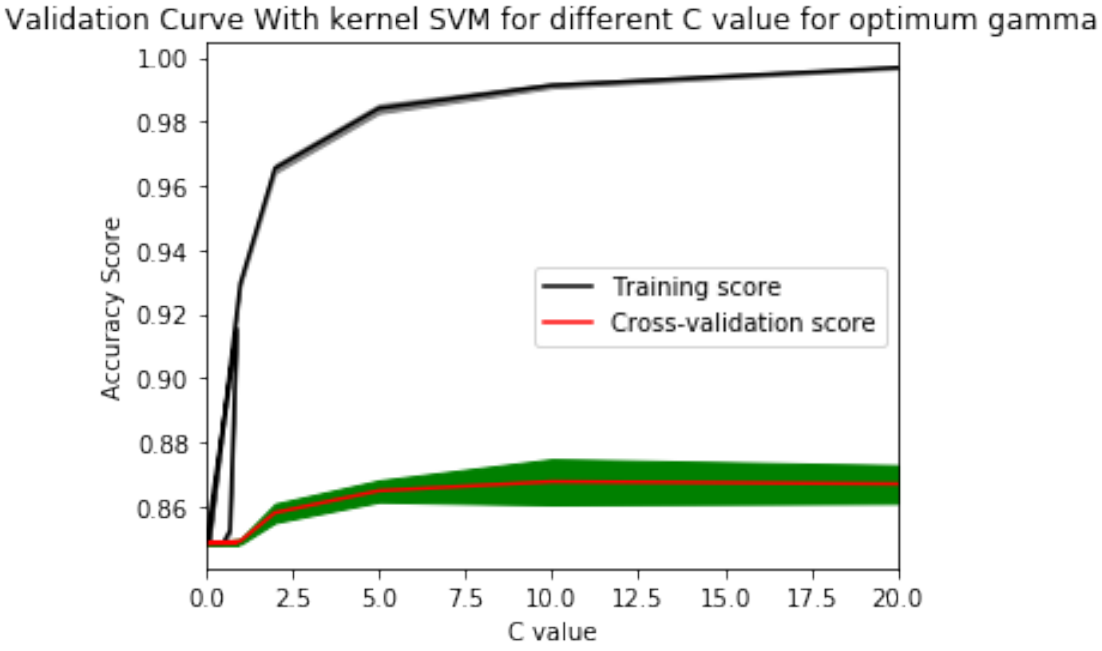
```
        model = GridSearchCV(SGDClassifier(penalty='l2',loss='hinge'),tuned_parameters, scorin
        print('Time took for preprocessing the text SGDclassifier grid search:',time.clock() -

        model.fit(X_train, y_train)
        optimumalpha=model.best_estimator_.alpha
        #build model with best parameter
        model = SGDClassifier(penalty='l2',loss='hinge',alpha=optimumalpha)
        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
        tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
        recall=tp/(tp+fn)
        fscoretrain=2*precision*recall/(precision+recall)
        bb=pd.DataFrame({'type':['SGD TFIDF'],'kernel':['linear'],'accuracy_train':[model.scor
                         'fscore_train':[fscoretrain],'accuracy_test':[model.score(X_test,y_te
                         'C':[model.C],'gamma':['na']})
        aa=aa.append(bb)
```

```
(7000, 11132) (3000, 11132)
size of X_train, X_test, y_train , y_test  (7000, 11132) (3000, 11132) (7000,) (3000,)
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)
confusion matrix
 Predicted     1   All
Actual
0           507   507
1          2493  2493
All        3000  3000
Test accuracy using linear kernel TFIDF 0.831
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)
confusion matrix test
 Predicted     1   All
Actual
0           507   507
1          2493  2493
All        3000  3000
```

```
Test accuracy 0.831
Time took for preprocessing the text SGDclassifier grid search: 0.0004391820530145196 seconds
```

```
In [15]: # 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("C value")
         plt.ylabel("Accuracy Score")
         plt.xlim(.01,20)
         plt.tight_layout()
         plt.legend(loc="best")
         plt.show()
```






```
In [16]: aa
```

```
Out[16]:      C  accuracy_test  accuracy_train  fscore_test  fscore_train gamma  \
         0  0.1       0.831000        0.848429     0.624343      0.629198  auto
         0  1.0       0.872000        0.965429     0.926913      0.980003    na
```

```
0  1.0       0.833333        0.932143     0.908859      0.961548  auto
0  0.1       0.831000        0.848429     0.624343      0.629198  0.01
0  0.1       0.831000        0.848429     0.624343      0.629198  0.01
0  1.0       0.831000        0.932143     0.624343      0.961548  auto
0  1.0       0.834333        0.966000     0.909323      0.980327    na
```

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

9 AVG W2V

In [17]:
```
#ignore warning
import warnings
warnings.filterwarnings('ignore')


from gensim.models import Word2Vec
from gensim.models import KeyedVectors
import pickle
model = KeyedVectors.load_word2vec_format('GoogleNews-vectors-negative300.bin.gz', bi
import gensim
#convert W2V train data
i=0
#create a list of list to be used in W2V
list_of_sent_train=[]
for sent in X_train_raw:  #clean_data['CleanedText'].values:
    filtered_sentence=[]
    #sent=cleanhtml(sent)
    for w in sent.split():
        #for cleaned_words in cleanpunc(w).split():
         for cleaned_words in w.split():
            if(cleaned_words.isalpha()):
                filtered_sentence.append(cleaned_words.lower().decode('utf8'))
            else:
                continue
    list_of_sent_train.append(filtered_sentence)
#convert each sentence's words to a vector of 50 dimension. Dont construct vec if wor
#and 4 core processor
w2v_model=gensim.models.Word2Vec(list_of_sent_train,min_count=5,size=50, workers=4)

# average Word2Vec
```

```
# for each sentence make average of vectors by (vectors of each words)/(total no of w
# compute average word2vec for each review.
sent_vectors_train = []; # the avg-w2v for each sentence/review is stored in this lis
for sent in list_of_sent_train: # 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_model.wv[word]
            sent_vec += vec
            cnt_words += 1
        except:
            pass
    sent_vec /= cnt_words
    sent_vectors_train.append(sent_vec)


#convert W2V test data
i=0
#create a list of list to be used in W2V
list_of_sent_test=[]
for sent in X_test_raw:  #clean_data['CleanedText'].values:
    filtered_sentence=[]
    #sent=cleanhtml(sent)
    for w in sent.split():
        #for cleaned_words in cleanpunc(w).split():
         for cleaned_words in w.split():
            if(cleaned_words.isalpha()):
                filtered_sentence.append(cleaned_words.lower().decode('utf8'))
            else:
                continue
    list_of_sent_test.append(filtered_sentence)
#convert each sentence's words to a vector of 50 dimension. Dont construct vec if wor
#and 4 core processor
w2v_model=gensim.models.Word2Vec(list_of_sent_test,min_count=5,size=50, workers=4)

# average Word2Vec
# for each sentence make average of vectors by (vectors of each words)/(total no of w
# compute average word2vec for each review.
sent_vectors_test = []; # the avg-w2v for each sentence/review is stored in this list
for sent in list_of_sent_test: # 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_model.wv[word]
            sent_vec += vec
            cnt_words += 1
```

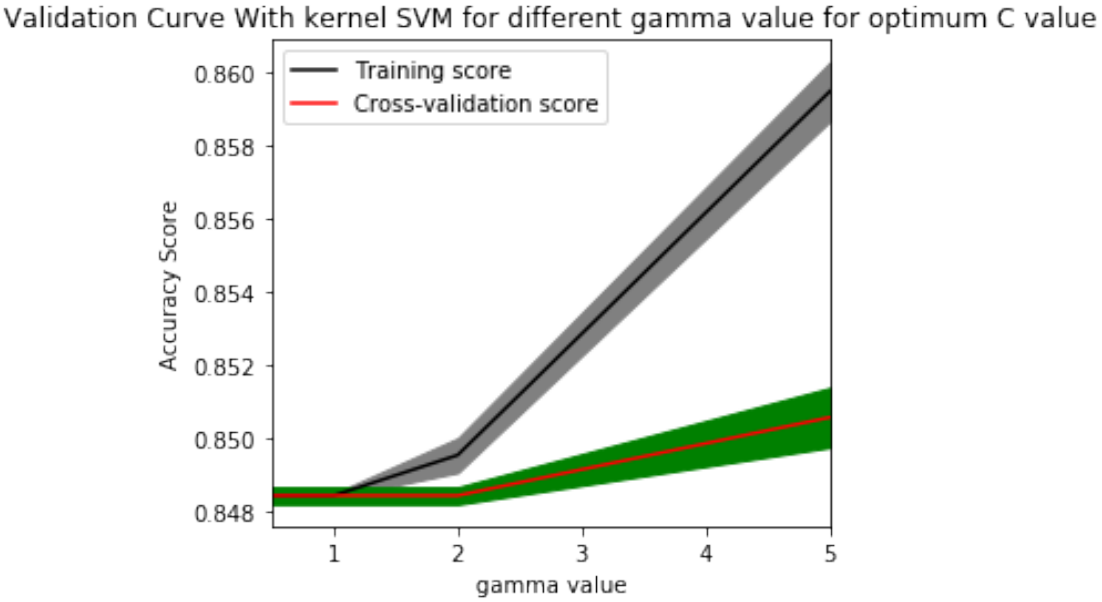
```
            except:
                pass
        sent_vec /= cnt_words
        sent_vectors_test.append(sent_vec)

# try
X_train = pd.DataFrame(sent_vectors_train)
X_test = pd.DataFrame(sent_vectors_test)

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
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=Tr
print('confusion matrix\n',mat)
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0] ;fp=mat.iloc[0,1];fn=mat.iloc[1,0];precision=tp/(t
recall=tp/(tp+fn)
fscoretest=2*precision*recall/(precision+recall)
```

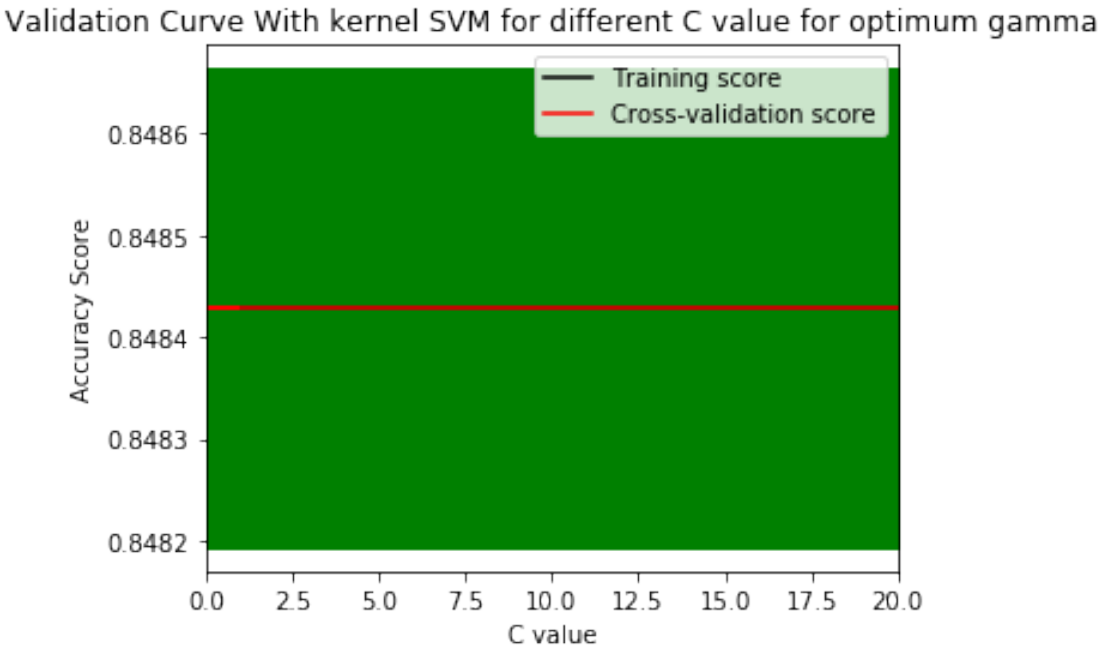
```
pred=model.predict(X_train)
mat=pd.crosstab(y_train, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tr
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
recall=tp/(tp+fn)
fscoretrain=2*precision*recall/(precision+recall)


bb=pd.DataFrame({'type':['Grid search AVG W2V'],'kernel':['rbf'],'accuracy_train':[mod
                 'fscore_train':[fscoretrain],'accuracy_test':[model.score(X_test,y_te
                 'C':[model.C],'gamma':[model.gamma]})
aa=aa.append(bb)

print("Test accuracy using linear kernel AVG W2V",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 AVG W2V\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
print('confusion matrix\n',mat)
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
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
recall=tp/(tp+fn)
fscoretrain=2*precision*recall/(precision+recall)
bb=pd.DataFrame({'type':['Random search AVG W2V'],'kernel':['rbf'],'accuracy_train':[m
```

```
                '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",model.score(X_test, y_test))



# 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_train
                                             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("C value")
plt.ylabel("Accuracy Score")
plt.xlim(.01,20)
```

```
        plt.tight_layout()
        plt.legend(loc="best")
        plt.show()


        #******************************
        #TRY SGD classifier for better performance
        alpha=[.001,.01,.1,1,10,100]
        tuned_parameters=dict(alpha=alpha)

        from sklearn.linear_model import SGDClassifier
        start_time=time.clock()
        model = GridSearchCV(SGDClassifier(penalty='l2',loss='hinge'),tuned_parameters, scorin
        print('Time took for preprocessing the text SGDclassifier grid search:',time.clock() -

        model.fit(X_train, y_train)
        optimumalpha=model.best_estimator_.alpha
        #build model with best parameter
        model = SGDClassifier(penalty='l2',loss='hinge',alpha=optimumalpha)
        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
        tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
        recall=tp/(tp+fn)
        fscoretrain=2*precision*recall/(precision+recall)
        bb=pd.DataFrame({'type':['SGD AVGW2V'],'kernel':['linear'],'accuracy_train':[model.sco
                         'fscore_train':[fscoretrain],'accuracy_test':[model.score(X_test,y_te
                         'C':[model.C],'gamma':['na']})
        aa=aa.append(bb)

size of X_train, X_test, y_train , y_test  (7000, 50) (3000, 50) (7000,) (3000,)
Best parameters with rbf karnel and grid search using TFIDF
 SVC(C=10, cache_size=200, class_weight=None, coef0=0.0,
  decision_function_shape='ovr', degree=3, gamma=1, kernel='rbf',
  max_iter=-1, probability=False, random_state=None, shrinking=True,
  tol=0.001, verbose=False)
confusion matrix
 Predicted     1   All
Actual
0           507   507
1          2493  2493
All        3000  3000
Test accuracy using linear kernel AVG W2V 0.831
```

```
Best parameters using rbf kernel and random search AVG W2V
 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)
confusion matrix
 Predicted     1   All
Actual
0            507   507
1           2493  2493
All         3000  3000
Test accuracy 0.831
```






```
Time took for preprocessing the text SGDclassifier grid search: 0.0002672724294825457 seconds
```

10 AVG W2V TFIDF

```
In [18]: tf_idf_vect = TfidfVectorizer()
         final_tf_idf=tf_idf_vect.fit_transform(X_train_raw)
         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

         tfidf_sent_vectors_train = []; # the tfidf-w2v for each sentence/review is stored in
         row=0;
         #calculate avg tfidf score for each sentences
         for sent in list_of_sent_train: # 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_model.wv[word]#calculate w2v for each word
                     # obtain the tf_idfidf of a word in a sentence/review
                     tf_idf = final_tf_idf[row, tfidf_feat.index(word)]#get tfidf score of eac
                     sent_vec += (vec * tf_idf) # multiply vec with tfidf of each word and cum
                     weight_sum += tf_idf # also add tfidf sums in each sentence
                 except:
                     pass
```

```
    sent_vec /= weight_sum
    tfidf_sent_vectors_train.append(sent_vec)
    row += 1
#tfidf_sent_vectors.

# do for test
final_tf_idf=tf_idf_vect.transform(X_test_raw)
tfidf_sent_vectors_test = []; # the tfidf-w2v for each sentence/review is stored in t
row=0;
#calculate avg tfidf score for each sentences
for sent in list_of_sent_test: # 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_model.wv[word]#calculate w2v for each word
            # obtain the tf_idfidf of a word in a sentence/review
            tf_idf = final_tf_idf[row, tfidf_feat.index(word)]#get tfidf score of eac
            sent_vec += (vec * tf_idf) # multiply vec with tfidf of each word and cum
            weight_sum += tf_idf # also add tfidf sums in each sentence
        except:
            pass
    sent_vec /= weight_sum
    tfidf_sent_vectors_test.append(sent_vec)
    row += 1

X_train = pd.DataFrame(tfidf_sent_vectors_train)
X_test = pd.DataFrame(tfidf_sent_vectors_test)
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)
```

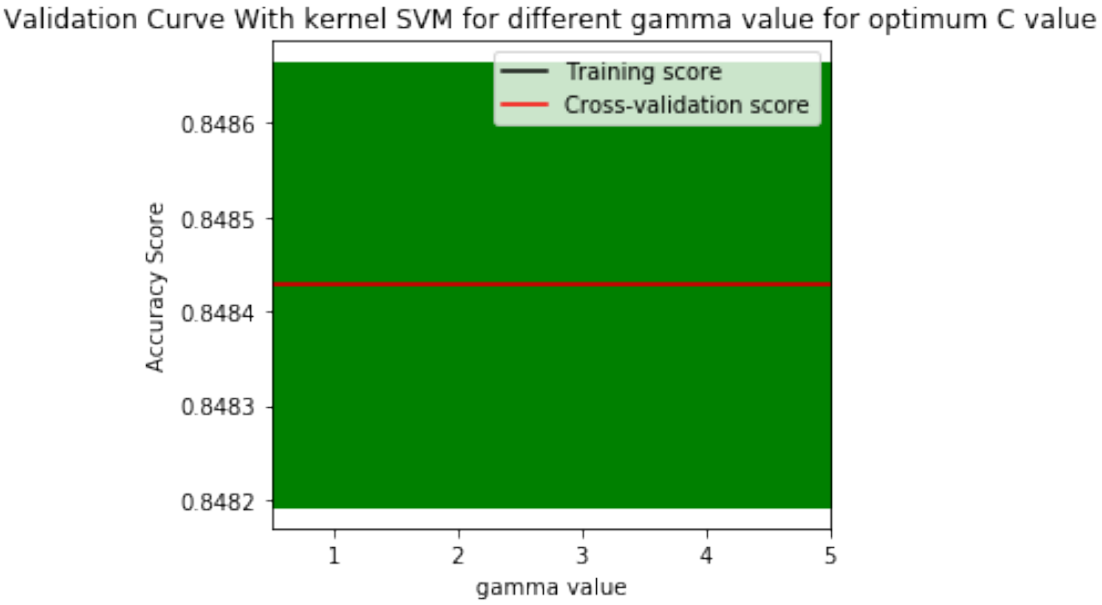
```
print('Best parameters with rbf karnel and grid search using TFIDF\n',model.best_estim
#print('Model test score', model.score(X_test, y_test))

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
print('confusion matrix\n',mat)
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
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
recall=tp/(tp+fn)
fscoretrain=2*precision*recall/(precision+recall)


bb=pd.DataFrame({'type':['Grid search AVG W2V TFIDF'],'kernel':['rbf'],'accuracy_train
                 '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)
```

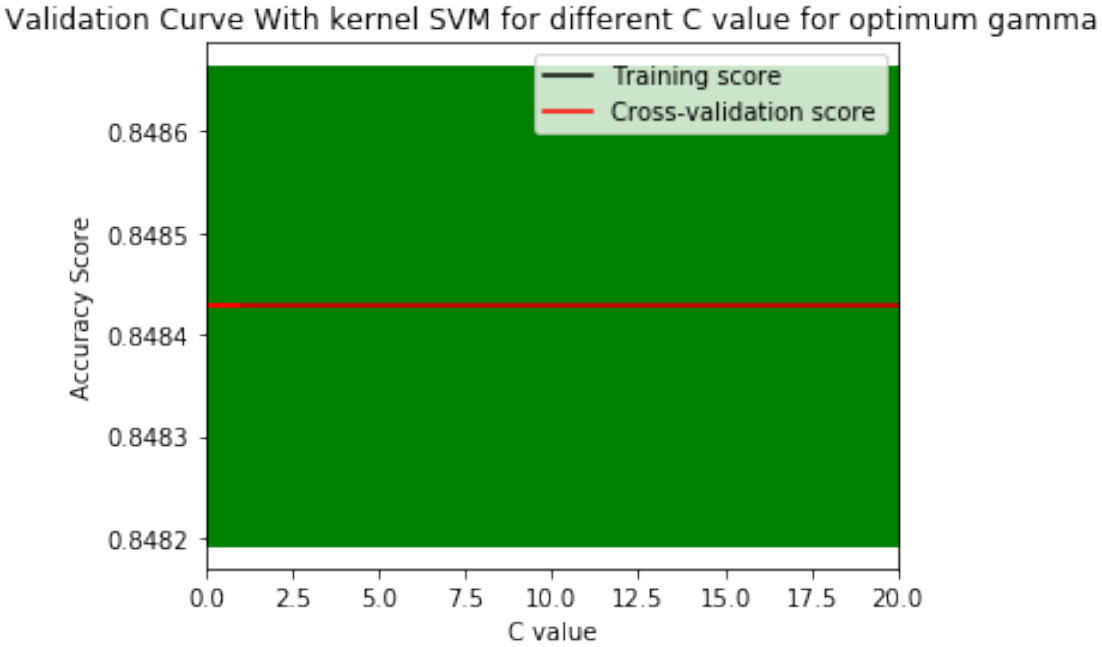
```
#Using random search
model = RandomizedSearchCV(svm.SVC(), tuned_parameters, random_state=1, scoring = 'f1

#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)

pred=model.predict(X_test)
mat=pd.crosstab(y_test, pred, rownames=['Actual'], colnames=['Predicted'], margins=Tru
print('confusion matrix\n',mat)
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
tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
recall=tp/(tp+fn)
fscoretrain=2*precision*recall/(precision+recall)


bb=pd.DataFrame({'type':['Random search AVG W2V TFIDF'],'kernel':['rbf'],'accuracy_tra
                 '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",model.score(X_test, y_test))



# 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_train
                                             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("C value")
plt.ylabel("Accuracy Score")
plt.xlim(.01,20)
plt.tight_layout()
plt.legend(loc="best")
plt.show()


#*****************************
#TRY SGD classifier for better performance
alpha=[.001,.01,.1,1,10,100]
tuned_parameters=dict(alpha=alpha)

from sklearn.linear_model import SGDClassifier
start_time=time.clock()
model = GridSearchCV(SGDClassifier(penalty='l2',loss='hinge'),tuned_parameters, scorin
print('Time took for preprocessing the text SGDclassifier grid search:',time.clock() -

model.fit(X_train, y_train)
optimumalpha=model.best_estimator_.alpha
#build model with best parameter
```

```
        model = SGDClassifier(penalty='l2',loss='hinge',alpha=optimumalpha)
        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
        tp=mat.iloc[1,1] ;tn=mat.iloc[0,0];fp=mat.iloc[0,1] ;fn=mat.iloc[1,0] ;precision=tp/(t
        recall=tp/(tp+fn)
        fscoretrain=2*precision*recall/(precision+recall)
        bb=pd.DataFrame({'type':['SGD AVGW2V TFIDF'],'kernel':['linear'],'accuracy_train':[moc
                         'fscore_train':[fscoretrain],'accuracy_test':[model.score(X_test,y_te
                         'C':[model.C],'gamma':['na']})
        aa=aa.append(bb)
```

```
size of X_train, X_test, y_train , y_test  (7000, 50) (3000, 50) (7000,) (3000,)
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)
confusion matrix
 Predicted     1   All
Actual
0           507   507
1          2493  2493
All        3000  3000
Test accuracy using linear kernel TFIDF 0.831
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)
confusion matrix
 Predicted     1   All
Actual
0           507   507
1          2493  2493
All        3000  3000
Test accuracy 0.831
```






```
Time took for preprocessing the text SGDclassifier grid search: 0.00028395022673066705 seconds
```

Second graph x axis name is mentioned wrongly[copy paste error for all graph]. Please consider that. If I execute again it will take 8-9 hrs

11 Conclusion

The below steps are taken to complete this Only !=3 reviews are taken Mark >3 as positive and <3 as negative. Sort data as per product id in ascending order Deduplication of entries for same profilename,userid, time, text and take first element Get stratified sampling of 10k data Clean html and punctuation Convert to uppercase and word<3 are rejected data sorted on time Split the data in train and test to 70:30

BOW BOW BOW vec created using train data test data is converted using above X is standarize on train and same applied to test y is converted to 1 and 0 from positive and negative

do grid search and random search for different value of kernel and C best model is established with best hyperparameter. model metric is stored in dataframe and crosstable is printed.Plot cv error with C and penalty

TFIDF form tfidf vec using train same is used in test to convert rest are same

AVG W2V gensim is used to convert train and test text to

W2V AVG TFIDF form tfidf vec using train same is used in test to convert. TFIDF and gensim is used to convert test data. rest are same

The scores are below

```
In [19]: aa
```

```
Out[19]:       C  accuracy_test  accuracy_train  fscore_test  fscore_train gamma  \
          0   0.1       0.831000        0.848429     0.624343      0.629198  auto
          0   1.0       0.872000        0.965429     0.926913      0.980003    na
          0   1.0       0.833333        0.932143     0.908859      0.961548  auto
          0   0.1       0.831000        0.848429     0.624343      0.629198  0.01
          0   0.1       0.831000        0.848429     0.624343      0.629198  0.01
          0   1.0       0.831000        0.932143     0.624343      0.961548  auto
          0   1.0       0.834333        0.966000     0.909323      0.980327    na
          0  10.0       0.831000        0.873429     0.624343      0.930335     1
          0   1.0       0.831000        0.848429     0.624343      0.629198  auto
          0   1.0       0.831000        0.848429     0.624343      0.629198    na
          0   0.1       0.831000        0.848429     0.624343      0.629198  0.01
          0   1.0       0.831000        0.848429     0.624343      0.629198  auto
          0   1.0       0.831000        0.848429     0.624343      0.629198    na

             kernel                          type
          0  linear                Grid search BOW
          0  linear                       SGD BOW
          0  linear              Random Search BOW
          0     rbf                Grid search BOW
          0     rbf              Grid search TFIDF
          0     rbf            Random search TFIDF
          0  linear                     SGD TFIDF
          0     rbf            Grid search AVG W2V
          0     rbf          Random search AVG W2V
          0  linear                    SGD AVGW2V
          0     rbf     Grid search AVG W2V TFIDF
          0     rbf   Random search AVG W2V TFIDF
          0  linear               SGD AVGW2V TFIDF
```

```
In [10]: aa
```

```
Out[10]:      C  accuracy_test  accuracy_train  fscore_test  fscore_train gamma  \
         0  0.1       0.831000        0.848429     0.624343      0.629198  auto
         0  1.0       0.870667        0.965286     0.926208      0.979916

            kernel             type
         0  linear  Grid search BOW
         0  linear          SGD BOW
```