OBJECTIVE

1. APPLYING RANDOM FOREST WITH TFIDF_WORD2VEC VECTORIZATION
   - FINDING THE BEST HYPERPARAMETER USING GRIDSEARCHCV WITH TRAIN DATA AND CROSS-VALIDATION DATA BY PLOTTING THE RESLUTS OF VAROIUS TRAIN DATA AND CROSS VALIDATION DATA
   - USING THE APROPRIATE VALUE OF HYPERPARAMETER ,TESTING ACCURACY ON TEST DATA USING F1-SCORE
   - PLOTTING THE CONFUSION MATRIX TO GET THE PRECISOIN ,RECALL VALUE WITH HELP OF HEATMAP
   - PRINTING THE TOP 30 MOST IMPORTANT FEATURES

In [0]:

```
from sklearn.model_selection import train_test_split          #importin
g the necessary libraries
from sklearn.model_selection import RandomizedSearchCV
from sklearn.datasets import *
from sklearn import naive_bayes
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfVectorizer
import numpy as np
import pandas as pd
from sklearn import *
import warnings
warnings.filterwarnings("ignore")
from sklearn.ensemble import RandomForestClassifier
from gensim.models import Word2Vec
from tqdm import tqdm
```

In [2]:

```
from google.colab import drive
drive.mount('/content/gdrive')#geeting the content from the google driv
e
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?
```

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```
client_id=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i.apps.googleuser
content.com&redirect_uri=urn%3Aietf%3Awg%3Aoauth%3A2.0%3Aoob&scope=emai
l%20https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fdocs.test%20https%3A%2F%2
Fwww.googleapis.com%2Fauth%2Fdrive%20https%3A%2F%2Fwww.googleapis.com%2
Fauth%2Fdrive.photos.readonly%20https%3A%2F%2Fwww.googleapis.com%2Faut
h%2Fpeopleapi.readonly&response_type=code

Enter your authorization code:
··········
Mounted at /content/gdrive
```

In [0]:

```
final_processed_data=pd.read_csv("gdrive/My Drive/final_new_data.csv")#
loading the preprocessed data  with 100k points into dataframe
```

In [4]:

```
# getting the counts of 0 and 1 in "SCORE" column to know whether it is
 unbalanced data or not
count_of_1=0
count_of_0=0
for i in final_processed_data['Score']:
   if i==1:
    count_of_1+=1
   else:
    count_of_0+=1
print(count_of_1)
print(count_of_0)
#it is an imbalanced dataset
```

```
88521
11479
```

In [0]:

```
#spliiting the data into train and test data
x_train,x_test,y_train,y_test=model_selection.train_test_split(final_pr
ocessed_data['CleanedText'].values,final_processed_data['Score'].values
,test_size=0.3,shuffle=False)
```

In [6]:

```
# Training my own Word2Vec model using your own text corpus
list_of_sent=[]
for sent in x_train:
```

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```
 list_of_sent.append(sent.split())#splitting of sentences into words AN
D appending them to list
print(x_train[0])
print("*****************************************************************
*")
print(list_of_sent[0])
word_to_vector=Word2Vec(list_of_sent,min_count=5,size=100,workers=2)#co
nstructing my our word to vector
w_t_c_words=list(word_to_vector.wv.vocab)
print("*****************************************************************
*******")
print("sample words ", w_t_c_words[0:20])
```

```
witti littl book make son laugh loud recit car drive along alway sing r
efrain hes learn whale india droop love new word book introduc silli cl
assic book will bet son still abl recit memori colleg
*****************************************************************
['witti', 'littl', 'book', 'make', 'son', 'laugh', 'loud', 'recit', 'ca
r', 'drive', 'along', 'alway', 'sing', 'refrain', 'hes', 'learn', 'whal
e', 'india', 'droop', 'love', 'new', 'word', 'book', 'introduc', 'sill
i', 'classic', 'book', 'will', 'bet', 'son', 'still', 'abl', 'recit',
'memori', 'colleg']
***********************************************************************
sample words  ['witti', 'littl', 'book', 'make', 'son', 'laugh', 'lou
d', 'car', 'drive', 'along', 'alway', 'sing', 'hes', 'learn', 'india',
'droop', 'love', 'new', 'word', 'introduc']
```

In [7]:

```
###### NOW STARTING TFIDF WORD TO VEC FOR TRAIN DATA##################
##############################################
#NOW STARTING TF-IDF WEIGHTED WORD-TO-VEC
model = TfidfVectorizer()
tf_idf_matrix = model.fit_transform(x_train)
# we are converting a dictionary with word as a key, and the idf as a v
alue
dictionary = dict(zip(model.get_feature_names(), list(model.idf_)))
train_tfidf_sent_vectors =[]# the tfidf-w2v for each sentence/review is
 stored in this list

for sent in tqdm(list_of_sent): # for each review/sentence
```

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```
  sent_vec = np.zeros(100) # as word vectors are of zero length
  weight_sum =0; # num of words with a valid vector in the sentence/rev
iew
  for word in sent: # for each word in a review/sentence
   if word in w_t_c_words:
     vec = word_to_vector.wv[word]
     tf_idf = dictionary[word]*(sent.count(word)/len(sent))# dictionary
[word] = idf value of word in whole courpus
     sent_vec += (vec * tf_idf)# sent.count(word) = tf valeus of word i
n this review
     weight_sum += tf_idf
  if weight_sum != 0:
   sent_vec /= weight_sum
   train_tfidf_sent_vectors.append(sent_vec)
```

```
100%|██████████| 70000/70000 [01:52<00:00, 619.75it/s]
```

In [8]:
```
from sklearn.preprocessing import StandardScaler #standarizing the trai
ning  data
x_train_data=StandardScaler( with_mean=False).fit_transform(train_tfidf
_sent_vectors)
print(x_train_data.shape)
```

```
(70000, 100)
```

In [9]:
```
list_of_sent=[]
for sent in x_test:
 list_of_sent.append(sent.split())#splitting of sentences into words AN
D appending them to list
print(x_test[0])
print("*****************************************************************
*")
print(list_of_sent[0])
print('*****************************************************************
***')
```

```
product carbon fruit juic high fructos corn syrup pack calori littl pro
duct prefer drink calori plain water tast wasnt pleas left unpleas afte
rtast also sweet drink made less thirst quencher
```

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```
*****************************************************************
['product', 'carbon', 'fruit', 'juic', 'high', 'fructos', 'corn', 'syru
p', 'pack', 'calori', 'littl', 'product', 'prefer', 'drink', 'calori',
'plain', 'water', 'tast', 'wasnt', 'pleas', 'left', 'unpleas', 'afterta
st', 'also', 'sweet', 'drink', 'made', 'less', 'thirst', 'quencher']
*******************************************************************
```

In [10]:
```
###### NOW STARTING TFIDF WORD TO VEC FOR TEST DATA###################
#############################################
#NOW STARTING TF-IDF WEIGHTED WORD-TO-VEC
model = TfidfVectorizer()
model.fit_transform(x_train)
model.transform(x_test)
# we are converting a dictionary with word as a key, and the idf as a v
alue
dictionary = dict(zip(model.get_feature_names(), list(model.idf_)))
test_tfidf_sent_vectors =[]# the tfidf-w2v for each sentence/review is
 stored in this list

for sent in tqdm(list_of_sent): # for each review/sentence
  sent_vec = np.zeros(100) # as word vectors are of zero length
  weight_sum =0; # num of words with a valid vector in the sentence/rev
iew
  for word in sent: # for each word in a review/sentence
   if word in w_t_c_words:
     vec = word_to_vector.wv[word]
     tf_idf = dictionary[word]*(sent.count(word)/len(sent))# dictionary
[word] = idf value of word in whole courpus
     sent_vec += (vec * tf_idf)# sent.count(word) = tf valeus of word i
n this review
     weight_sum += tf_idf
  if weight_sum != 0:
   sent_vec /= weight_sum
   test_tfidf_sent_vectors.append(sent_vec)
```

```
100%|██████████| 30000/30000 [00:50<00:00, 594.46it/s]
```

In [12]:
```
from sklearn.preprocessing import StandardScaler #standarizing the trai
ning  data
```

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```
x_test_data=StandardScaler( with_mean=False).fit_transform(test_tfidf_s
ent_vectors)
print(x_test_data.shape)
```

```
(30000, 100)
```

In [0]:
```
#biudling the model
#using time series split method for cross-validation score
from sklearn.model_selection import TimeSeriesSplit
tscv = TimeSeriesSplit(n_splits=5)
rf=RandomForestClassifier(criterion='gini',class_weight={1:.5,0:.5})
tuned_parameters=[{'max_depth':[20,30,40,50,60,80],'n_estimators':[21,3
0,40,50,70,100]}]
#applying the model of decision tree and using gridsearchcv to find the
 best hyper parameter
%time
from sklearn.model_selection import GridSearchCV
model = GridSearchCV(rf, tuned_parameters, scoring = 'f1', cv=tscv,n_jo
bs=-1)#building the gridsearchcv model
```

```
CPU times: user 3 µs, sys: 0 ns, total: 3 µs
Wall time: 7.15 µs
```

In [0]:
```
%%time
model.fit(x_train_data, y_train)#fiitting the training data
```

```
CPU times: user 43 s, sys: 384 ms, total: 43.4 s
Wall time: 51min 7s
```

Out[0]:
```
GridSearchCV(cv=TimeSeriesSplit(max_train_size=None, n_splits=5),
       error_score='raise-deprecating',
       estimator=RandomForestClassifier(bootstrap=True, class_weight=
{1: 0.5, 0: 0.5},
            criterion='gini', max_depth=None, max_features='auto',
            max_leaf_nodes=None, min_impurity_decrease=0.0,
            min_impurity_split=None, min_samples_leaf=1,
            min_samples_split=2, min_weight_fraction_leaf=0.0,
            n_estimators='warn', n_jobs=None, oob_score=False,
            random_state=None, verbose=0, warm_start=False),
       fit_params=None, iid='warn', n_jobs=-1,
```

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```
          param_grid=[{'max_depth': [20, 30, 40, 50, 60, 80], 'n_estimator
s': [21, 30, 40, 50, 70, 100]}],
          pre_dispatch='2*n_jobs', refit=True, return_train_score='warn',
          scoring='f1', verbose=0)
```

In [0]:
```
print(model.best_estimator_)#printing the best_estimator
```

```
RandomForestClassifier(bootstrap=True, class_weight={1: 0.5, 0: 0.5},
            criterion='gini', max_depth=80, max_features='auto',
            max_leaf_nodes=None, min_impurity_decrease=0.0,
            min_impurity_split=None, min_samples_leaf=1,
            min_samples_split=2, min_weight_fraction_leaf=0.0,
            n_estimators=40, n_jobs=None, oob_score=False,
            random_state=None, verbose=0, warm_start=False)
```

In [0]:
```
results=pd.DataFrame(model.cv_results_)# getting varoius cv_scores and
 train_scores various values of hyperparameter given as parameter and s
toring it in a dataframe
results.head()#printing the dataframe
```

Out[0]:

	mean_fit_time	mean_score_time	mean_test_score	mean_train_score	param_max_de
0	12.983693	0.064387	0.943818	0.995695	20
1	18.296815	0.089172	0.943961	0.996532	20
2	24.447854	0.117207	0.944163	0.996857	20

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	mean_fit_time	mean_score_time	mean_test_score	mean_train_score	param_max_de
3	30.142504	0.138907	0.943967	0.997148	20
4	42.804373	0.196317	0.943715	0.997414	20

5 rows × 22 columns

In [0]:
```
results['mean_test_score']=results['mean_test_score']*100
results=results.round(decimals=2)
results['cv_error_score']=100-results['mean_test_score']
```

PLOTTING THE HEATMAP WITH HYPERPARAMETERS FOR CV_ERROR SCORE

In [0]:
```
test_score_heatmap=results.pivot(        'param_max_depth'        ,'param
_n_estimators','cv_error_score' )
```

In [0]:
```
test_score_heatmap
```

Out[0]:

param_n_estimators	21	30	40	50	70	100
param_max_depth						
20	5.62	5.60	5.58	5.60	5.63	5.54

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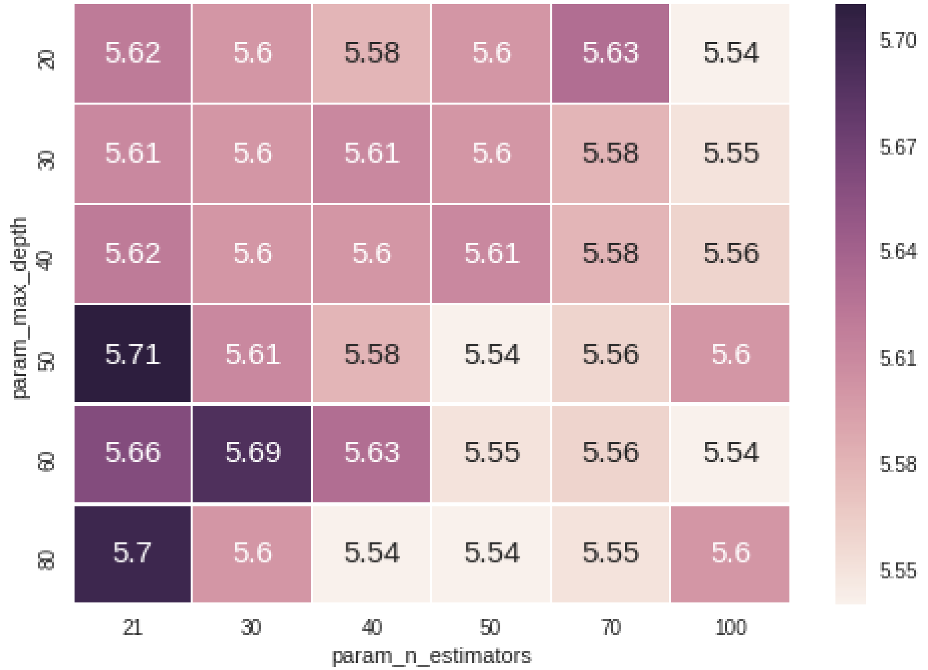
param_n_estimators	21	30	40	50	70	100
param_max_depth						
30	5.61	5.60	5.61	5.60	5.58	5.55
40	5.62	5.60	5.60	5.61	5.58	5.56
50	5.71	5.61	5.58	5.54	5.56	5.60
60	5.66	5.69	5.63	5.55	5.56	5.54
80	5.70	5.60	5.54	5.54	5.55	5.60

In [0]:
```
import seaborn as sns
sns.heatmap(test_score_heatmap,annot=True,annot_kws={"size": 15}, fmt=
'g',linewidths=.3)
```

Out[0]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f129a9e9898>
```



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In [0]:
```
print(model.best_estimator_)#printing the best_estimator
```

```
RandomForestClassifier(bootstrap=True, class_weight={1: 0.5, 0: 0.5},
            criterion='gini', max_depth=80, max_features='auto',
            max_leaf_nodes=None, min_impurity_decrease=0.0,
            min_impurity_split=None, min_samples_leaf=1,
            min_samples_split=2, min_weight_fraction_leaf=0.0,
            n_estimators=40, n_jobs=None, oob_score=False,
            random_state=None, verbose=0, warm_start=False)
```

FROM THE ABOVE HEATMAPS RESULTS FOR CV DATA,WE FOUND THAT BEST HYPERPARAMETERS AS MAX_DEPTH=80 AND N_ESTIMATORS=40

PLOTTING THE ROC CURVE FOR GETTING AUC SCORE

In [0]:
```
rf=RandomForestClassifier(criterion='gini',class_weight={1:.5,0:.5},max
_depth=80 ,n_estimators=40)
rf.fit(x_train_data,y_train)#fitting the model
probs = rf.predict_proba(x_test_data)
preds = probs[:,1]
fpr, tpr, threshold = metrics.roc_curve(y_test, preds)
roc_auc = metrics.auc(fpr, tpr)

#plotting the auc curve with best hyperparameters to get auc value
import matplotlib.pyplot as plt
plt.title('Receiver Operating Characteristic')
plt.plot(fpr, tpr, 'b', label = 'AUC = %0.2f' % roc_auc)
plt.legend(loc = 'best')
plt.plot([0, 1], [0, 1],'r--')
plt.xlim([0, 1])
```

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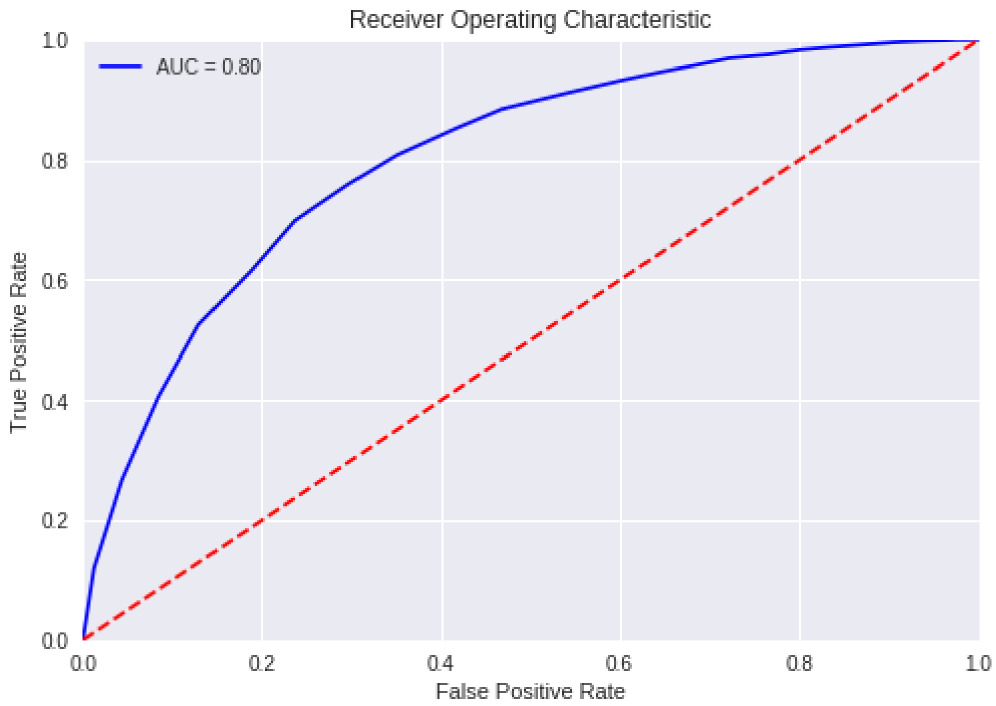
```
plt.ylim([0, 1])
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```



In [0]:
```
print('accuracy from the ROC curve is found as ',roc_auc*100)
```

```
accuracy from the ROC curve is found as  80.30889220018497
```

TESTING OUR MODEL ON TEST DATA AND CHECKING ITS PRECISION ,RECALL ,F1_FCORE

In [0]:
```
#Testing Accuracy on Test data
```

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```python
import seaborn as sns #importing seaborn as sns
from sklearn.metrics import *#importing varoius metrics from sklearn
#building the model
y_pred = rf.predict(x_test_data)
print("Accuracy on test set: %0.3f%%"%(accuracy_score(y_test, y_pred)*1
00))#printing accuracy
print("Precision on test set: %0.3f"%(precision_score(y_test, y_pred)))
#printing precision score
print("Recall on test set: %0.3f"%(recall_score(y_test, y_pred))) #prin
ting recall
print("F1-Score on test set: %0.3f"%(f1_score(y_test, y_pred)))
print("Confusion Matrix of test set:\n [ [TN  FP]\n [FN TP] ]\n")
df_cm = pd.DataFrame(confusion_matrix(y_test, y_pred), range(2),range(2
)) #generating the heatmap for confusion matrix
sns.set(font_scale=1.4)#for label size
sns.heatmap(df_cm, annot=True,annot_kws={"size": 16}, fmt='g',cmap="YlG
nBu")
```

```
Accuracy on test set: 88.497%
Precision on test set: 0.888
Recall on test set: 0.994
F1-Score on test set: 0.938
Confusion Matrix of test set:
 [ [TN  FP]
 [FN TP] ]
```

Out[0]: <matplotlib.axes._subplots.AxesSubplot at 0x7f1293d5c208>

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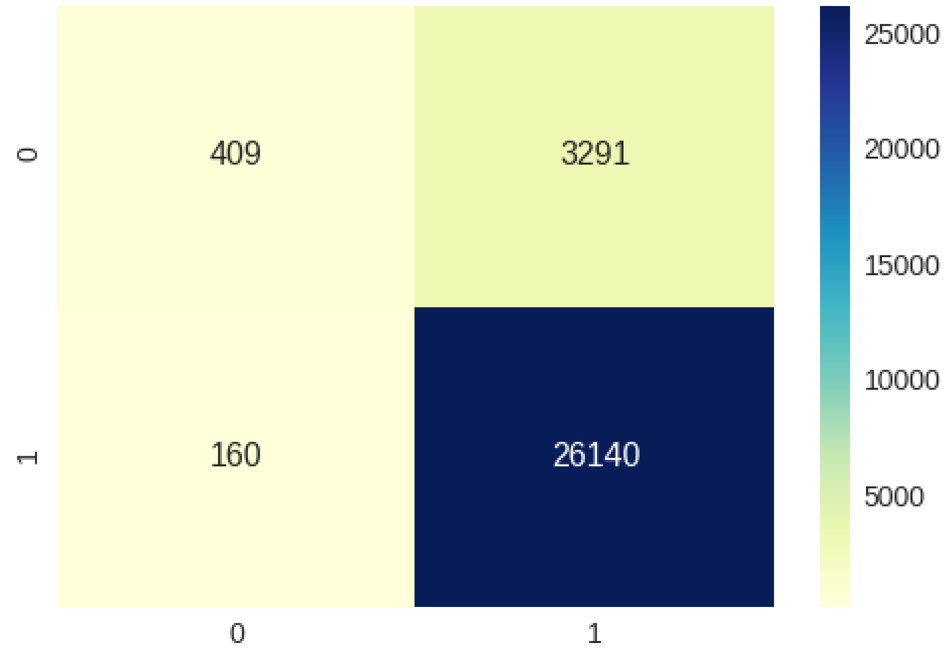

AVG WORD2VEC VECTORIZATION FOR RANDOM FOREST IS COMPLETED

OBJECTIVE

1. APPLYING GBDT WITH TFIDF_WORD2VEC VECTORIZATION
    - FINDING THE BEST HYPERPARAMETER USING GRIDSEARCHCV WITH TRAIN DATA AND CROSS-VALIDATION DATA BY PLOTTING THE RESLUTS OF VAROIUS TRAIN DATA AND CROSS VALIDATION DATA
    - USING THE APROPRIATE VALUE OF HYPERPARAMETER ,TESTING ACCURACY ON TEST DATA USING F1-SCORE
    - PLOTTING THE CONFUSION MATRIX TO GET THE PRECISOIN ,RECALL VALUE WITH HELP OF HEATMAP

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- **PRINTING THE TOP 30 MOST IMPORTANT FEATURES**

In [13]:
```
from xgboost import XGBClassifier
#biudling the model
#using time series split method for cross-validation score
from sklearn.model_selection import TimeSeriesSplit
tscv = TimeSeriesSplit(n_splits=2)
xg=XGBClassifier(n_jobs=-1)
tuned_parameters=[{'max_depth':[20,30,40,50,80],'n_estimators':[30,40,5
0,70,100]}]
#applying the model of decision tree and using gridsearchcv to find the
 best hyper parameter
%time
from sklearn.model_selection import GridSearchCV
model = GridSearchCV(xg, tuned_parameters, scoring = 'f1', cv=tscv,n_jo
bs=-1)#building the gridsearchcv model
```

```
CPU times: user 3 µs, sys: 0 ns, total: 3 µs
Wall time: 5.96 µs
```

In [14]:
```
%%time
model.fit(x_train_data, y_train)#fiitting the training data
```

```
CPU times: user 3min 55s, sys: 200 ms, total: 3min 55s
Wall time: 48min 21s
```

Out[14]:
```
GridSearchCV(cv=TimeSeriesSplit(max_train_size=None, n_splits=2),
       error_score='raise-deprecating',
       estimator=XGBClassifier(base_score=0.5, booster='gbtree', colsam
ple_bylevel=1,
       colsample_bytree=1, gamma=0, learning_rate=0.1, max_delta_step=
0,
       max_depth=3, min_child_weight=1, missing=None, n_estimators=100,
       n_jobs=-1, nthread=None, objective='binary:logistic',
       random_state=0, reg_alpha=0, reg_lambda=1, scale_pos_weight=1,
       seed=None, silent=True, subsample=1),
       fit_params=None, iid='warn', n_jobs=-1,
       param_grid=[{'max_depth': [20, 30, 40, 50, 80], 'n_estimators':
[30, 40, 50, 70, 100]}],
```

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```
             pre_dispatch='2*n_jobs', refit=True, return_train_score='warn',
             scoring='f1', verbose=0)
```

In [15]:
```
print(model.best_estimator_)#printing the best_estimator
```

```
XGBClassifier(base_score=0.5, booster='gbtree', colsample_bylevel=1,
       colsample_bytree=1, gamma=0, learning_rate=0.1, max_delta_step=
0,
       max_depth=30, min_child_weight=1, missing=None, n_estimators=10
0,
       n_jobs=-1, nthread=None, objective='binary:logistic',
       random_state=0, reg_alpha=0, reg_lambda=1, scale_pos_weight=1,
       seed=None, silent=True, subsample=1)
```

In [16]:
```
results=pd.DataFrame(model.cv_results_)# getting varoius cv_scores and
 train_scores various values of hyperparameter given as parameter and s
toring it in a dataframe
results.head()#printing the dataframe
```

Out[16]:

	mean_fit_time	mean_score_time	mean_test_score	mean_train_score	param_max_de
0	56.692909	0.240994	0.943103	0.998652	20
1	74.767461	0.288751	0.943172	0.999622	20
2	86.954333	0.336272	0.944159	0.999964	20

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	mean_fit_time	mean_score_time	mean_test_score	mean_train_score	param_max_de
3	122.297282	0.449713	0.944691	1.000000	20
4	160.436852	0.621527	0.944944	1.000000	20

In [0]:
```
results['mean_test_score']=results['mean_test_score']*100

results=results.round(decimals=2)

results['cv_error_score']=100-results['mean_test_score']
```

PLOTTING THE HEATMAP WITH HYPERPARAMETERS FOR CV_ERROR SCORE

In [18]:
```
test_score_heatmap=results.pivot( 'param_max_depth' ,'param_n_estimator
s','cv_error_score'  )

test_score_heatmap
```

Out[18]:

param_n_estimators	30	40	50	70	100
param_max_depth					
20	5.69	5.68	5.58	5.53	5.51

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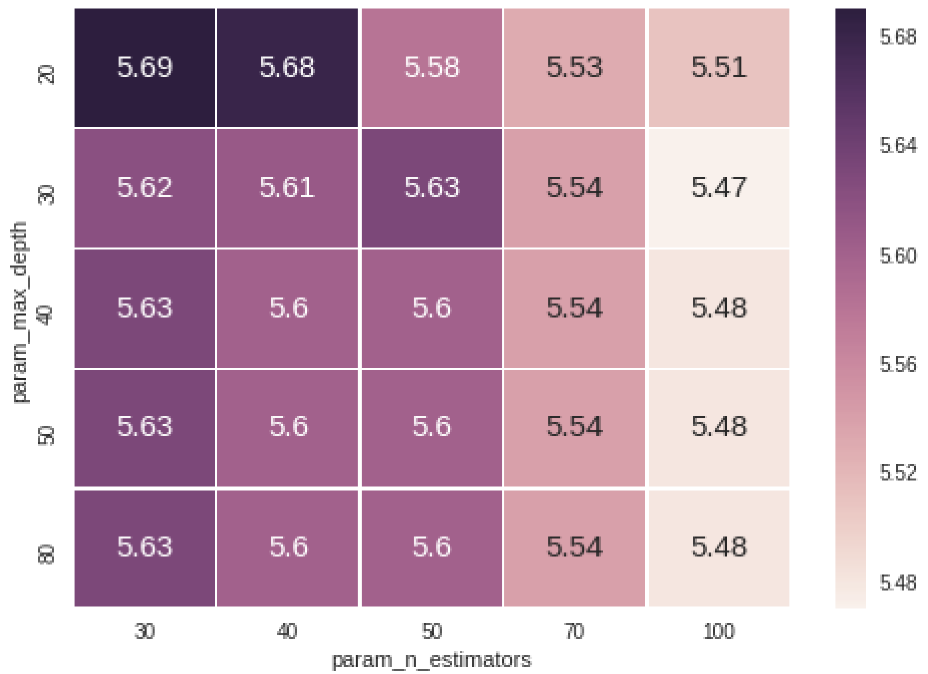
param_n_estimators	30	40	50	70	100
param_max_depth					
30	5.62	5.61	5.63	5.54	5.47
40	5.63	5.60	5.60	5.54	5.48
50	5.63	5.60	5.60	5.54	5.48
80	5.63	5.60	5.60	5.54	5.48

In [19]:
```
import seaborn as sns
sns.heatmap(test_score_heatmap,annot=True,annot_kws={"size": 15}, fmt=
'g',linewidths=.3)
```

Out[19]: <matplotlib.axes._subplots.AxesSubplot at 0x7f6c983e6400>



In [20]:
```
print(model.best_estimator_)#printing the best_estimator
```

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```
XGBClassifier(base_score=0.5, booster='gbtree', colsample_bylevel=1,
       colsample_bytree=1, gamma=0, learning_rate=0.1, max_delta_step=
0,
       max_depth=30, min_child_weight=1, missing=None, n_estimators=10
0,
       n_jobs=-1, nthread=None, objective='binary:logistic',
       random_state=0, reg_alpha=0, reg_lambda=1, scale_pos_weight=1,
       seed=None, silent=True, subsample=1)
```

FROM THE ABOVE HEATMAPS RESULTS FOR CV DATA,WE FOUND THAT BEST HYPERPARAMETERS AS MAX_DEPTH=30 AND N_ESTIMATORS=100

PLOTTING THE ROC CURVE FOR GETTING AUC SCORE

In [21]:
```
xg=XGBClassifier(n_jobs=-1,max_depth=30 ,n_estimators=100)
xg.fit(x_train_data,y_train)#fitting the model
```

Out[21]:
```
XGBClassifier(base_score=0.5, booster='gbtree', colsample_bylevel=1,
       colsample_bytree=1, gamma=0, learning_rate=0.1, max_delta_step=
0,
       max_depth=30, min_child_weight=1, missing=None, n_estimators=10
0,
       n_jobs=-1, nthread=None, objective='binary:logistic',
       random_state=0, reg_alpha=0, reg_lambda=1, scale_pos_weight=1,
       seed=None, silent=True, subsample=1)
```

In [22]:
```
probs = xg.predict_proba(x_test_data)
preds = probs[:,1]
fpr, tpr, threshold = metrics.roc_curve(y_test, preds)
roc_auc = metrics.auc(fpr, tpr)
```

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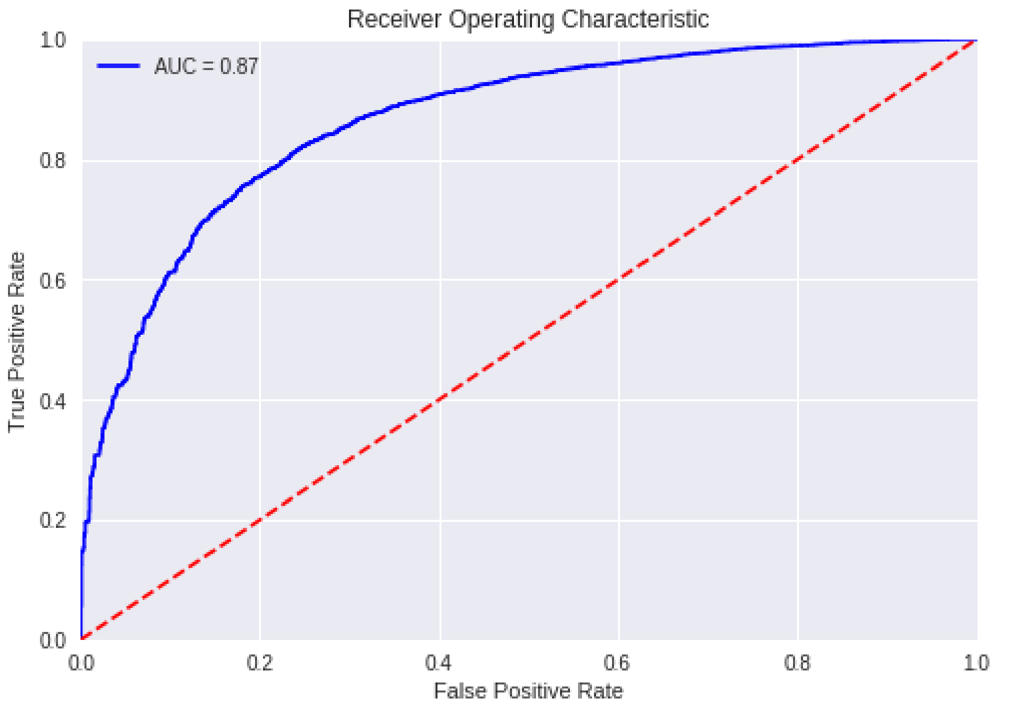
```python
import matplotlib.pyplot as plt
plt.title('Receiver Operating Characteristic')
plt.plot(fpr, tpr, 'b', label = 'AUC = %0.2f' % roc_auc)
plt.legend(loc = 'best')
plt.plot([0, 1], [0, 1],'r--')
plt.xlim([0, 1])
plt.ylim([0, 1])
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```



In [23]:
```python
print('accuracy from the ROC curve is found as ',roc_auc*100)
```

```
accuracy from the ROC curve is found as  86.60876014798069
```

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TESTING OUR MODEL ON TEST DATA AND CHECKING ITS PRECISION ,RECALL ,F1_FCORE

In [25]:

```
from sklearn.metrics import *
y_pred = xg.predict(x_test_data)
print("Accuracy on test set: %0.3f%%"%(accuracy_score(y_test, y_pred)*1
00))#printing accuracy
print("Precision on test set: %0.3f"%(precision_score(y_test, y_pred)))
#printing precision score
print("Recall on test set: %0.3f"%(recall_score(y_test, y_pred))) #prin
ting recall
print("F1-Score on test set: %0.3f"%(f1_score(y_test, y_pred)))
print("Confusion Matrix of test set:\n [ [TN  FP]\n [FN TP] ]\n")
df_cm = pd.DataFrame(confusion_matrix(y_test, y_pred), range(2),range(2
)) #generating the heatmap for confusion matrix
sns.set(font_scale=1.4)#for label size
sns.heatmap(df_cm, annot=True,annot_kws={"size": 16}, fmt='g')
```

```
Accuracy on test set: 89.213%
Precision on test set: 0.899
Recall on test set: 0.989
F1-Score on test set: 0.941
Confusion Matrix of test set:
 [ [TN  FP]
 [FN TP] ]
```

Out[25]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f6c991ec470>
```

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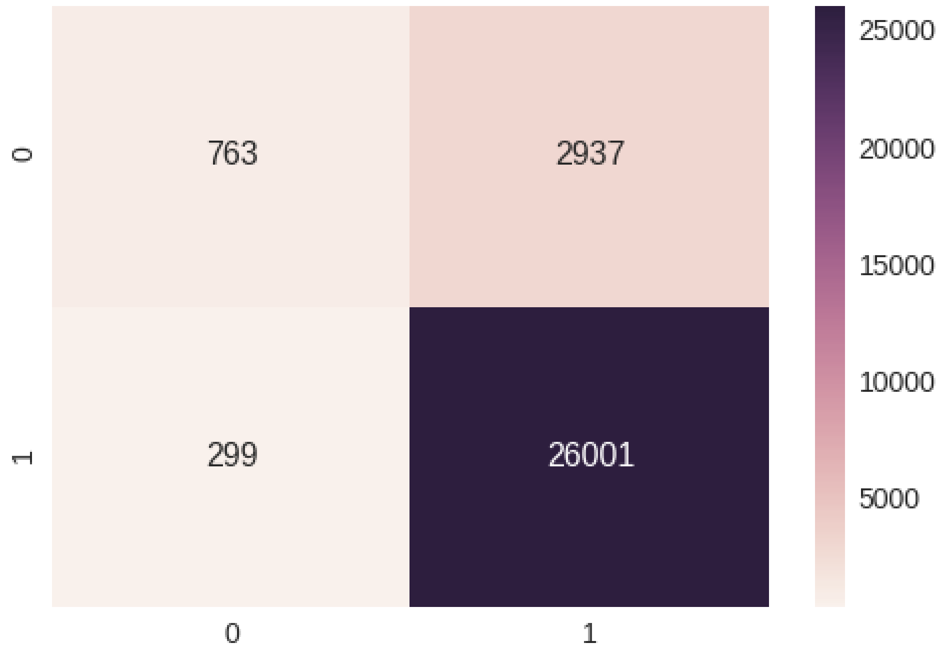

TFIDF WORD2VEC VECTORIZATION IS COMPLETED FOR GBDT

COMPARING ALL MODELS PERFORMANCE WITH DIFFERENT VECTORIZATIONS

In [2]:
```
from tabulate import tabulate
```

In [9]:
```
print("PERFORMANCE EVALUATION for RANDOM FOREST FOR ALL VECTORIZATIONS"
)
table = [["BOW",'77','35','93.5%','86.3%'],["TF-IDF",'73','21','93.2%',
'85.6%'], ["AVG_WORD_2_VEC",'80','70','94.1%','84.1%'],["TFIDF_AVG_WORD
_2_VEC",80,40,'93.1%','80.1%']]
```

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```
headers=['VECTORIZATION','MAX_DEPTH','N_ESTIMATORS','F1_SCORE','ACCURACY']
print (tabulate(table, headers, tablefmt="fancy_grid"))
```

PERFORMANCE EVALUATION for RANDOM FOREST FOR ALL VECTORIZATIONS

VECTORIZATION	MAX_DEPTH	N_ESTIMATORS	F1_SCORE	ACCURACY
BOW	77	35	93.5%	86.3%
TF-IDF	73	21	93.2%	85.6%
AVG_WORD_2_VEC	80	70	94.1%	84.1%
TFIDF_AVG_WORD_2_VEC	80	40	93.1%	80.1%

In [10]:
```
print("PERFORMANCE EVALUATION for XG BOOST FOR ALL VECTORIZATIONS")
table = [["BOW",'27','50','87.9%','94.2%'],["TF-IDF",'30','50','94.6%','87.3%'], ["AVG_WORD_2_VEC",'40','100','94.4%','88.6%'],["TFIDF_AVG_WORD_2_VEC",30,100,'94.9%','86.6%']]
headers=['VECTORIZATION','MAX_DEPTH','N_ESTIMATORS','F1_SCORE','ACCURACY']
print (tabulate(table, headers, tablefmt="fancy_grid"))
```

PERFORMANCE EVALUATION for XG BOOST FOR ALL VECTORIZATIONS

VECTORIZATION	MAX_DEPTH	N_ESTIMATORS	F1_SCORE	AC

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```
CURACY    │
╞═══════════════════════╪═══════════╪═════════════╪══════════╪══
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│ BOW                   │        27 │          50 │ 87.9%    │ 9
4.2%        │
├───────────────────────┼───────────┼─────────────┼──────────┼──
─────────┤
│ TF-IDF                │        30 │          50 │ 94.6%    │ 8
7.3%        │
├───────────────────────┼───────────┼─────────────┼──────────┼──
─────────┤
│ AVG_WORD_2_VEC        │        40 │         100 │ 94.4%    │ 8
8.6%        │
├───────────────────────┼───────────┼─────────────┼──────────┼──
─────────┤
│ TFIDF_AVG_WORD_2_VEC │        30 │         100 │ 94.9%    │ 8
6.6%        │
╘═══════════════════════╧═══════════╧═════════════╧══════════╧══
═════════╛
```

#####RANDOM FOREST AND XG_BOOST IS COMPLETED FOR ALL 4 VECTORIZATIONS

In [12]:

```
print("### RANDOM FOREST AND XG_BOOST IS COMPLETED FOR ALL 4 VECTORIZAT
IONS")
```

```
### RANDOM FOREST AND XG_BOOST IS COMPLETED FOR ALL 4 VECTORIZATIONS
```

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