Amazon Fine Food Reviews Analysis

Data Source: https://www.kaggle.com/snap/amazon-fine-food-reviews (https://www.kaggle.com/snap/amazon-fine-food-reviews)

EDA: https://nycdatascience.com/blog/student-works/amazon-fine-foods-visualization/ (https://nycdatascience.com/blog/student-works/amazon-fine-foods-visualization/)

The Amazon Fine Food Reviews dataset consists of reviews of fine foods from Amazon.

Number of reviews: 568,454
Number of users: 256,059
Number of products: 74,258
Timespan: Oct 1999 - Oct 2012
Number of Attributes/Columns in data: 10

Attribute Information:

1. Id
2. ProductId - unique identifier for the product
3. UserId - unqiue identifier for the user
4. ProfileName
5. HelpfulnessNumerator - number of users who found the review helpful
6. HelpfulnessDenominator - number of users who indicated whether they found the review helpful or not
7. Score - rating between 1 and 5
8. Time - timestamp for the review
9. Summary - brief summary of the review
10. Text - text of the review

Objective:

Given a review, determine whether the review is positive (rating of 4 or 5) or negative (rating of 1 or 2).

[Q] How to determine if a review is positive or negative?

[Ans] We could use Score/Rating. A rating of 4 or 5 can be cosnidered as a positive review. A rating of 1 or 2 can be considered as negative one. A review of rating 3 is considered nuetral and such reviews are ignored from our analysis. This is an approximate and proxy way of determining the polarity (positivity/negativity) of a review.

[1]. Reading Data

[1.1] Loading the data

The dataset is available in two forms

1. .csv file
2. SQLite Database

In order to load the data, We have used the SQLITE dataset as it is easier to query the data and visualise the data efficiently.

Here as we only want to get the global sentiment of the recommendations (positive or negative), we will purposefully ignore all Scores equal to 3. If the score is above 3, then the recommendation wil be set to "positive". Otherwise, it will be set to "negative".

In [1]:
```
%matplotlib inline
import warnings
warnings.filterwarnings("ignore")


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

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

from gensim.models import Word2Vec
from gensim.models import KeyedVectors
import pickle

from tqdm import tqdm
import os
```

In [0]:
```
# using SQLite Table to read data.
con = sqlite3.connect('database.sqlite')

# filtering only positive and negative reviews i.e.
# not taking into consideration those reviews with Score=3
# SELECT * FROM Reviews WHERE Score != 3 LIMIT 500000, will give top 500000 da
ta points
# you can change the number to any other number based on your computing power

# filtered_data = pd.read_sql_query(""" SELECT * FROM Reviews WHERE Score != 3
LIMIT 500000""", con)
# for tsne assignment you can take 5k data points

filtered_data = pd.read_sql_query(""" SELECT * FROM Reviews WHERE Score != 3 L
IMIT 5000""", con)

# Give reviews with Score>3 a positive rating(1), and reviews with a score<3 a
negative rating(0).
def partition(x):
    if x < 3:
        return 0
    return 1

#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
print("Number of data points in our data", filtered_data.shape)
filtered_data.head(3)
```

```
Number of data points in our data (5000, 10)
```

Out[0]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenomi
0	1	B001E4KFG0	A3SGXH7AUHU8GW	delmartian	1	
1	2	B00813GRG4	A1D87F6ZCVE5NK	dll pa	0	
2	3	B000LQOCH0	ABXLMWJIXXAIN	Natalia Corres "Natalia Corres"	1	

In [0]:
```
display = pd.read_sql_query("""
SELECT UserId, ProductId, ProfileName, Time, Score, Text, COUNT(*)
FROM Reviews
GROUP BY UserId
HAVING COUNT(*)>1
""", con)
```

In [0]:
```
print(display.shape)
display.head()
```

```
(80668, 7)
```

Out[0]:

	UserId	ProductId	ProfileName	Time	Score	Text	COUNT(*)
0	#oc-R115TNMSPFT9I7	B007Y59HVM	Breyton	1331510400	2	Overall its just OK when considering the price...	2
1	#oc-R11D9D7SHXIJB9	B005HG9ET0	Louis E. Emory "hoppy"	1342396800	5	My wife has recurring extreme muscle spasms, u...	3
2	#oc-R11DNU2NBKQ23Z	B007Y59HVM	Kim Cieszykowski	1348531200	1	This coffee is horrible and unfortunately not ...	2
3	#oc-R11O5J5ZVQE25C	B005HG9ET0	Penguin Chick	1346889600	5	This will be the bottle that you grab from the...	3
4	#oc-R12KPBODL2B5ZD	B007OSBE1U	Christopher P. Presta	1348617600	1	I didnt like this coffee. Instead of telling y...	2

In [0]:
```
display[display['UserId']=='AZY10LLTJ71NX']
```

Out[0]:

	UserId	ProductId	ProfileName	Time	Score	Text	COUNT(*
80638	AZY10LLTJ71NX	B006P7E5ZI	undertheshrine "undertheshrine"	1334707200	5	I was recommended to try green tea extract to ...	5

In [0]:
```
display['COUNT(*)'].sum()
```

Out[0]:
```
393063
```

[2] Exploratory Data Analysis

[2.1] Data Cleaning: Deduplication

It is observed (as shown in the table below) that the reviews data had many duplicate entries. Hence it was necessary to remove duplicates in order to get unbiased results for the analysis of the data. Following is an example:

In [0]:
```
display= pd.read_sql_query("""
SELECT *
FROM Reviews
WHERE Score != 3 AND UserId="AR5J8UI46CURR"
ORDER BY ProductID
""", con)
display.head()
```

Out[0]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenor
0	78445	B000HDL1RQ	AR5J8UI46CURR	Geetha Krishnan	2	
1	138317	B000HDOPYC	AR5J8UI46CURR	Geetha Krishnan	2	
2	138277	B000HDOPYM	AR5J8UI46CURR	Geetha Krishnan	2	
3	73791	B000HDOPZG	AR5J8UI46CURR	Geetha Krishnan	2	
4	155049	B000PAQ75C	AR5J8UI46CURR	Geetha Krishnan	2	

As it can be seen above that same user has multiple reviews with same values for HelpfulnessNumerator, HelpfulnessDenominator, Score, Time, Summary and Text and on doing analysis it was found that

ProductId=B000HDOPZG was Loacker Quadratini Vanilla Wafer Cookies, 8.82-Ounce Packages (Pack of 8)

ProductId=B000HDL1RQ was Loacker Quadratini Lemon Wafer Cookies, 8.82-Ounce Packages (Pack of 8) and so on

It was inferred after analysis that reviews with same parameters other than ProductId belonged to the same product just having different flavour or quantity. Hence in order to reduce redundancy it was decided to eliminate the rows having same parameters.

The method used for the same was that we first sort the data according to ProductId and then just keep the first similar product review and delelte the others. for eg. in the above just the review for ProductId=B000HDL1RQ remains. This method ensures that there is only one representative for each product and deduplication without sorting would lead to possibility of different representatives still existing for the same product.

In [0]:
```
#Sorting data according to ProductId in ascending order
sorted_data=filtered_data.sort_values('ProductId', axis=0, ascending=True, inp
lace=False, kind='quicksort', na_position='last')
```

In [0]:
```
#Deduplication of entries
final=sorted_data.drop_duplicates(subset={"UserId","ProfileName","Time","Text"
}, keep='first', inplace=False)
final.shape
```

Out[0]: (4986, 10)

In [0]:
```
#Checking to see how much % of data still remains
(final['Id'].size*1.0)/(filtered_data['Id'].size*1.0)*100
```

Out[0]: 99.72

Observation:- It was also seen that in two rows given below the value of HelpfulnessNumerator is greater than HelpfulnessDenominator which is not practically possible hence these two rows too are removed from calcualtions

In [0]:
```
display= pd.read_sql_query("""
SELECT *
FROM Reviews
WHERE Score != 3 AND Id=44737 OR Id=64422
ORDER BY ProductID
""", con)

display.head()
```

Out[0]:

	Id	ProductId	UserId	ProfileName	HelpfulnessNumerator	HelpfulnessDenor
0	64422	B000MIDROQ	A161DK06JJMCYF	J. E. Stephens "Jeanne"	3	
1	44737	B001EQ55RW	A2V0I904FH7ABY	Ram	3	

In [0]:
```
final=final[final.HelpfulnessNumerator<=final.HelpfulnessDenominator]
```

In [0]:
```
#Before starting the next phase of preprocessing lets see the number of entrie
s left
print(final.shape)

#How many positive and negative reviews are present in our dataset?
final['Score'].value_counts()
```

```
(4986, 10)
```

Out[0]:
```
1    4178
0     808
Name: Score, dtype: int64
```

[3] Preprocessing

[3.1]. Preprocessing Review Text

Now that we have finished deduplication our data requires some preprocessing before we go on further with analysis and making the prediction model.

Hence in the Preprocessing phase we do the following in the order below:-

1. Begin by removing the html tags
2. Remove any punctuations or limited set of special characters like , or . or # etc.
3. Check if the word is made up of english letters and is not alpha-numeric
4. Check to see if the length of the word is greater than 2 (as it was researched that there is no adjective in 2-letters)
5. Convert the word to lowercase
6. Remove Stopwords
7. Finally Snowball Stemming the word (it was obsereved to be better than Porter Stemming)

After which we collect the words used to describe positive and negative reviews

In [0]:
```
# printing some random reviews
sent_0 = final['Text'].values[0]
print(sent_0)
print("="*50)

sent_1000 = final['Text'].values[1000]
print(sent_1000)
print("="*50)

sent_1500 = final['Text'].values[1500]
print(sent_1500)
print("="*50)

sent_4900 = final['Text'].values[4900]
print(sent_4900)
print("="*50)
```

```
Why is this $[...] when the same product is available for $[...] here?<br />h
ttp://www.amazon.com/VICTOR-FLY-MAGNET-BAIT-REFILL/dp/B00004RBDY<br /><br />T
he Victor M380 and M502 traps are unreal, of course -- total fly genocide. Pr
etty stinky, but only right nearby.
==================================================
I recently tried this flavor/brand and was surprised at how delicious these c
hips are.  The best thing was that there were a lot of "brown" chips in the b
sg (my favorite), so I bought some more through amazon and shared with family
and friends.  I am a little disappointed that there are not, so far, very man
y brown chips in these bags, but the flavor is still very good.  I like them
better than the yogurt and green onion flavor because they do not seem to be
as salty, and the onion flavor is better.  If you haven't eaten Kettle chips
before, I recommend that you try a bag before buying bulk.  They are thicker
and crunchier than Lays but just as fresh out of the bag.
==================================================
Wow.  So far, two two-star reviews.  One obviously had no idea what they were
ordering; the other wants crispy cookies.  Hey, I'm sorry; but these reviews
do nobody any good beyond reminding us to look  before ordering.<br /><br />T
hese are chocolate-oatmeal cookies.  If you don't like that combination, do
n't order this type of cookie.  I find the combo quite nice, really.  The oat
meal sort of "calms" the rich chocolate flavor and gives the cookie sort of a
coconut-type consistency.  Now let's also remember that tastes differ; so,
I've given my opinion.<br /><br />Then, these are soft, chewy cookies -- as a
dvertised.  They are not "crispy" cookies, or the blurb would say "crispy," r
ather than "chewy."  I happen to like raw cookie dough; however, I don't see
where these taste like raw cookie dough.  Both are soft, however, so is this
the confusion?  And, yes, they stick together.  Soft cookies tend to do that.
They aren't individually wrapped, which would add to the cost.  Oh yeah, choc
olate chip cookies tend to be somewhat sweet.<br /><br />So, if you want some
thing hard and crisp, I suggest Nabiso's Ginger Snaps.  If you want a cookie
that's soft, chewy and tastes like a combination of chocolate and oatmeal, gi
ve these a try.  I'm here to place my second order.
==================================================
love to order my coffee on amazon.  easy and shows up quickly.<br />This k cu
p is great coffee.  dcaf is very good as well
==================================================
```

In [0]:
```
# remove urls from text python: https://stackoverflow.com/a/40823105/4084039
sent_0 = re.sub(r"http\S+", "", sent_0)
sent_1000 = re.sub(r"http\S+", "", sent_1000)
sent_150 = re.sub(r"http\S+", "", sent_1500)
sent_4900 = re.sub(r"http\S+", "", sent_4900)

print(sent_0)
```

```
Why is this $[...] when the same product is available for $[...] here?<br />
/><br />The Victor M380 and M502 traps are unreal, of course -- total fly gen
ocide. Pretty stinky, but only right nearby.
```

In [0]:
```
# https://stackoverflow.com/questions/16206380/python-beautifulsoup-how-to-remove-all-tags-from-an-element
from bs4 import BeautifulSoup

soup = BeautifulSoup(sent_0, 'lxml')
text = soup.get_text()
print(text)
print("="*50)

soup = BeautifulSoup(sent_1000, 'lxml')
text = soup.get_text()
print(text)
print("="*50)

soup = BeautifulSoup(sent_1500, 'lxml')
text = soup.get_text()
print(text)
print("="*50)

soup = BeautifulSoup(sent_4900, 'lxml')
text = soup.get_text()
print(text)
```

```
Why is this $[...] when the same product is available for $[...] here? />The
Victor M380 and M502 traps are unreal, of course -- total fly genocide. Prett
y stinky, but only right nearby.
==================================================
I recently tried this flavor/brand and was surprised at how delicious these c
hips are.  The best thing was that there were a lot of "brown" chips in the b
sg (my favorite), so I bought some more through amazon and shared with family
and friends.  I am a little disappointed that there are not, so far, very man
y brown chips in these bags, but the flavor is still very good.  I like them
better than the yogurt and green onion flavor because they do not seem to be
as salty, and the onion flavor is better.  If you haven't eaten Kettle chips
before, I recommend that you try a bag before buying bulk.  They are thicker
and crunchier than Lays but just as fresh out of the bag.
==================================================
Wow.  So far, two two-star reviews.  One obviously had no idea what they were
ordering; the other wants crispy cookies.  Hey, I'm sorry; but these reviews
do nobody any good beyond reminding us to look  before ordering.These are cho
colate-oatmeal cookies.  If you don't like that combination, don't order this
type of cookie.  I find the combo quite nice, really.  The oatmeal sort of "c
alms" the rich chocolate flavor and gives the cookie sort of a coconut-type c
onsistency.  Now let's also remember that tastes differ; so, I've given my op
inion.Then, these are soft, chewy cookies -- as advertised.  They are not "cr
ispy" cookies, or the blurb would say "crispy," rather than "chewy."  I happe
n to like raw cookie dough; however, I don't see where these taste like raw c
ookie dough.  Both are soft, however, so is this the confusion?  And, yes, th
ey stick together.  Soft cookies tend to do that.  They aren't individually w
rapped, which would add to the cost.  Oh yeah, chocolate chip cookies tend to
be somewhat sweet.So, if you want something hard and crisp, I suggest Nabis
o's Ginger Snaps.  If you want a cookie that's soft, chewy and tastes like a
combination of chocolate and oatmeal, give these a try.  I'm here to place my
second order.
==================================================
love to order my coffee on amazon.  easy and shows up quickly.This k cup is g
reat coffee.  dcaf is very good as well
```

In [0]:

```
# https://stackoverflow.com/a/47091490/4084039
import re

def decontracted(phrase):
    # specific
    phrase = re.sub(r"won't", "will not", phrase)
    phrase = re.sub(r"can\'t", "can not", phrase)

    # general
    phrase = re.sub(r"n\'t", " not", phrase)
    phrase = re.sub(r"\'re", " are", phrase)
    phrase = re.sub(r"\'s", " is", phrase)
    phrase = re.sub(r"\'d", " would", phrase)
    phrase = re.sub(r"\'ll", " will", phrase)
    phrase = re.sub(r"\'t", " not", phrase)
    phrase = re.sub(r"\'ve", " have", phrase)
    phrase = re.sub(r"\'m", " am", phrase)
    return phrase
```

In [0]:
```
sent_1500 = decontracted(sent_1500)
print(sent_1500)
print("="*50)
```

```
Wow.  So far, two two-star reviews.  One obviously had no idea what they were
ordering; the other wants crispy cookies.  Hey, I am sorry; but these reviews
do nobody any good beyond reminding us to look  before ordering.<br /><br />T
hese are chocolate-oatmeal cookies.  If you do not like that combination, do
not order this type of cookie.  I find the combo quite nice, really.  The oat
meal sort of "calms" the rich chocolate flavor and gives the cookie sort of a
coconut-type consistency.  Now let is also remember that tastes differ; so, I
have given my opinion.<br /><br />Then, these are soft, chewy cookies -- as a
dvertised.  They are not "crispy" cookies, or the blurb would say "crispy," r
ather than "chewy."  I happen to like raw cookie dough; however, I do not see
where these taste like raw cookie dough.  Both are soft, however, so is this
the confusion?  And, yes, they stick together.  Soft cookies tend to do that.
They are not individually wrapped, which would add to the cost.  Oh yeah, cho
colate chip cookies tend to be somewhat sweet.<br /><br />So, if you want som
ething hard and crisp, I suggest Nabiso is Ginger Snaps.  If you want a cooki
e that is soft, chewy and tastes like a combination of chocolate and oatmeal,
give these a try.  I am here to place my second order.
==================================================
```

In [0]:
```
#remove words with numbers python: https://stackoverflow.com/a/18082370/4084039
sent_0 = re.sub("\S*\d\S*", "", sent_0).strip()
print(sent_0)
```

```
Why is this $[...] when the same product is available for $[...] here?<br />
/><br />The Victor  and  traps are unreal, of course -- total fly genocide. P
retty stinky, but only right nearby.
```

In [0]:
```
#remove spacial character: https://stackoverflow.com/a/5843547/4084039
sent_1500 = re.sub('[^A-Za-z0-9]+', ' ', sent_1500)
print(sent_1500)
```

```
Wow So far two two star reviews One obviously had no idea what they were orde
ring the other wants crispy cookies Hey I am sorry but these reviews do nobod
y any good beyond reminding us to look before ordering br br These are chocol
ate oatmeal cookies If you do not like that combination do not order this typ
e of cookie I find the combo quite nice really The oatmeal sort of calms the
rich chocolate flavor and gives the cookie sort of a coconut type consistency
Now let is also remember that tastes differ so I have given my opinion br br
Then these are soft chewy cookies as advertised They are not crispy cookies o
r the blurb would say crispy rather than chewy I happen to like raw cookie do
ugh however I do not see where these taste like raw cookie dough Both are sof
t however so is this the confusion And yes they stick together Soft cookies t
end to do that They are not individually wrapped which would add to the cost
Oh yeah chocolate chip cookies tend to be somewhat sweet br br So if you want
something hard and crisp I suggest Nabiso is Ginger Snaps If you want a cooki
e that is soft chewy and tastes like a combination of chocolate and oatmeal g
ive these a try I am here to place my second order
```

In [0]:
```
# https://gist.github.com/sebleier/554280
# we are removing the words from the stop words list: 'no', 'nor', 'not'
# <br /><br /> ==> after the above steps, we are getting "br br"
# we are including them into stop words list
# instead of <br /> if we have <br/> these tags would have revmoved in the 1st step

stopwords= set(['br', 'the', 'i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', "you're", "you've",\
            "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his', 'himself', \
            'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itself', 'they', 'them', 'their',\
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that', "that'll", 'these', 'those', \
            'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'have', 'has', 'had', 'having', 'do', 'does', \
            'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'because', 'as', 'until', 'while', 'of', \
            'at', 'by', 'for', 'with', 'about', 'against', 'between', 'into', 'through', 'during', 'before', 'after',\
            'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under', 'again', 'further',\
            'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all', 'any', 'both', 'each', 'few', 'more',\
            'most', 'other', 'some', 'such', 'only', 'own', 'same', 'so', 'than', 'too', 'very', \
            's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "should've", 'now', 'd', 'll', 'm', 'o', 're', \
            've', 'y', 'ain', 'aren', "aren't", 'couldn', "couldn't", 'didn', "didn't", 'doesn', "doesn't", 'hadn',\
            "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma', 'mightn', "mightn't", 'mustn',\
            "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'wasn', "wasn't", 'weren', "weren't", \
            'won', "won't", 'wouldn', "wouldn't"])
```

In [0]:
```
# Combining all the above stundents
from tqdm import tqdm
preprocessed_reviews = []
# tqdm is for printing the status bar
for sentance in tqdm(final['Text'].values):
    sentance = re.sub(r"http\S+", "", sentance)
    sentance = BeautifulSoup(sentance, 'lxml').get_text()
    sentance = decontracted(sentance)
    sentance = re.sub("\S*\d\S*", "", sentance).strip()
    sentance = re.sub('[^A-Za-z]+', ' ', sentance)
    # https://gist.github.com/sebleier/554280
    sentance = ' '.join(e.lower() for e in sentance.split() if e.lower() not in stopwords)
    preprocessed_reviews.append(sentance.strip())
```

```
100%|██████████| 4986/4986 [00:01<00:00, 3137.37it/s]
```

In [0]:
```
preprocessed_reviews[1500]
```

Out[0]:
```
'wow far two two star reviews one obviously no idea ordering wants crispy coo
kies hey sorry reviews nobody good beyond reminding us look ordering chocolat
e oatmeal cookies not like combination not order type cookie find combo quite
nice really oatmeal sort calms rich chocolate flavor gives cookie sort coconu
t type consistency let also remember tastes differ given opinion soft chewy c
ookies advertised not crispy cookies blurb would say crispy rather chewy happ
en like raw cookie dough however not see taste like raw cookie dough soft how
ever confusion yes stick together soft cookies tend not individually wrapped
would add cost oh yeah chocolate chip cookies tend somewhat sweet want someth
ing hard crisp suggest nabiso ginger snaps want cookie soft chewy tastes like
combination chocolate oatmeal give try place second order'
```

[3.2] Preprocessing Review Summary

In [0]:
```
## Similartly you can do preprocessing for review summary also.
```

[4] Featurization

[4.1] BAG OF WORDS

In [0]:
```
#BoW
count_vect = CountVectorizer() #in scikit-learn
count_vect.fit(preprocessed_reviews)
print("some feature names ", count_vect.get_feature_names()[:10])
print('='*50)

final_counts = count_vect.transform(preprocessed_reviews)
print("the type of count vectorizer ",type(final_counts))
print("the shape of out text BOW vectorizer ",final_counts.get_shape())
print("the number of unique words ", final_counts.get_shape()[1])
```

```
some feature names  ['aa', 'aahhhs', 'aback', 'abandon', 'abates', 'abbott',
'abby', 'abdominal', 'abiding', 'ability']
==================================================
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (4986, 12997)
the number of unique words  12997
```

[4.2] Bi-Grams and n-Grams.

In [0]:
```
#bi-gram, tri-gram and n-gram

#removing stop words like "not" should be avoided before building n-grams
# count_vect = CountVectorizer(ngram_range=(1,2))
# please do read the CountVectorizer documentation http://scikit-learn.org/sta
ble/modules/generated/sklearn.feature_extraction.text.CountVectorizer.html

# you can choose these numebrs min_df=10, max_features=5000, of your choice
count_vect = CountVectorizer(ngram_range=(1,2), min_df=10, max_features=5000)
final_bigram_counts = count_vect.fit_transform(preprocessed_reviews)
print("the type of count vectorizer ",type(final_bigram_counts))
print("the shape of out text BOW vectorizer ",final_bigram_counts.get_shape())
print("the number of unique words including both unigrams and bigrams ", final
_bigram_counts.get_shape()[1])
```

```
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text BOW vectorizer  (4986, 3144)
the number of unique words including both unigrams and bigrams  3144
```

[4.3] TF-IDF

In [0]:
```
tf_idf_vect = TfidfVectorizer(ngram_range=(1,2), min_df=10)
tf_idf_vect.fit(preprocessed_reviews)
print("some sample features(unique words in the corpus)",tf_idf_vect.get_featu
re_names()[0:10])
print('='*50)

final_tf_idf = tf_idf_vect.transform(preprocessed_reviews)
print("the type of count vectorizer ",type(final_tf_idf))
print("the shape of out text TFIDF vectorizer ",final_tf_idf.get_shape())
print("the number of unique words including both unigrams and bigrams ", final
_tf_idf.get_shape()[1])
```

```
some sample features(unique words in the corpus) ['ability', 'able', 'able fi
nd', 'able get', 'absolute', 'absolutely', 'absolutely delicious', 'absolutel
y love', 'absolutely no', 'according']
==================================================
the type of count vectorizer  <class 'scipy.sparse.csr.csr_matrix'>
the shape of out text TFIDF vectorizer  (4986, 3144)
the number of unique words including both unigrams and bigrams  3144
```

[4.4] Word2Vec

In [0]:
```
# Train your own Word2Vec model using your own text corpus
i=0
list_of_sentance=[]
for sentance in preprocessed_reviews:
    list_of_sentance.append(sentance.split())
```

In [0]:
```
# Using Google News Word2Vectors

# in this project we are using a pretrained model by google
# its 3.3G file, once you load this into your memory
# it occupies ~9Gb, so please do this step only if you have >12G of ram
# we will provide a pickle file wich contains a dict ,
# and it contains all our courpus words as keys and  model[word] as values
# To use this code-snippet, download "GoogleNews-vectors-negative300.bin"
# from https://drive.google.com/file/d/0B7XkCwpI5KDYNlNUTTlSS21pQmM/edit
# it's 1.9GB in size.


# http://kavita-ganesan.com/gensim-word2vec-tutorial-starter-code/#.W17SRFAzZPY
# you can comment this whole cell
# or change these varible according to your need

is_your_ram_gt_16g=False
want_to_use_google_w2v = False
want_to_train_w2v = True

if want_to_train_w2v:
    # min_count = 5 considers only words that occured atleast 5 times
    w2v_model=Word2Vec(list_of_sentance,min_count=5,size=50, workers=4)
    print(w2v_model.wv.most_similar('great'))
    print('='*50)
    print(w2v_model.wv.most_similar('worst'))

elif want_to_use_google_w2v and is_your_ram_gt_16g:
    if os.path.isfile('GoogleNews-vectors-negative300.bin'):
        w2v_model=KeyedVectors.load_word2vec_format('GoogleNews-vectors-negative300.bin', binary=True)
        print(w2v_model.wv.most_similar('great'))
        print(w2v_model.wv.most_similar('worst'))
    else:
        print("you don't have gogole's word2vec file, keep want_to_train_w2v = True, to train your own w2v ")
```

```
[('snack', 0.9951335191726685), ('calorie', 0.9946465492248535), ('wonderful', 0.9946032166481018), ('excellent', 0.9944332838058472), ('especially', 0.9941144585609436), ('baked', 0.9940600395202637), ('salted', 0.994047224521637), ('alternative', 0.9937226176261902), ('tasty', 0.9936816692352295), ('healthy', 0.9936649799346924)]
==================================================
[('varieties', 0.9994194507598877), ('become', 0.9992934465408325), ('popcorn', 0.9992750883102417), ('de', 0.9992610216140747), ('miss', 0.9992451071739197), ('melitta', 0.999218761920929), ('choice', 0.9992102384567261), ('american', 0.9991837739944458), ('beef', 0.9991780519485474), ('finish', 0.9991567134857178)]
```

In [0]:
```
w2v_words = list(w2v_model.wv.vocab)
print("number of words that occured minimum 5 times ",len(w2v_words))
print("sample words ", w2v_words[0:50])
```

```
number of words that occured minimum 5 times  3817
sample words  ['product', 'available', 'course', 'total', 'pretty', 'stinky',
'right', 'nearby', 'used', 'ca', 'not', 'beat', 'great', 'received', 'shipmen
t', 'could', 'hardly', 'wait', 'try', 'love', 'call', 'instead', 'removed',
'easily', 'daughter', 'designed', 'printed', 'use', 'car', 'windows', 'beauti
fully', 'shop', 'program', 'going', 'lot', 'fun', 'everywhere', 'like', 'tv',
'computer', 'really', 'good', 'idea', 'final', 'outstanding', 'window', 'ever
ybody', 'asks', 'bought', 'made']
```

[4.4.1] Converting text into vectors using Avg W2V, TFIDF-W2V

[4.4.1.1] Avg W2v

In [0]:
```
# average Word2Vec
# compute average word2vec for each review.
sent_vectors = []; # the avg-w2v for each sentence/review is stored in this li
st
for sent in tqdm(list_of_sentance): # for each review/sentence
    sent_vec = np.zeros(50) # as word vectors are of zero length 50, you might
need to change this to 300 if you use google's w2v
    cnt_words =0; # num of words with a valid vector in the sentence/review
    for word in sent: # for each word in a review/sentence
        if word in w2v_words:
            vec = w2v_model.wv[word]
            sent_vec += vec
            cnt_words += 1
    if cnt_words != 0:
        sent_vec /= cnt_words
    sent_vectors.append(sent_vec)
print(len(sent_vectors))
print(len(sent_vectors[0]))
```

```
100%|████████████████████████████████████████████████████████████████████
████| 4986/4986 [00:03<00:00, 1330.47it/s]

4986
50
```

[4.4.1.2] TFIDF weighted W2v

In [0]:
```
# S = ["abc def pqr", "def def def abc", "pqr pqr def"]
model = TfidfVectorizer()
tf_idf_matrix = model.fit_transform(preprocessed_reviews)
# we are converting a dictionary with word as a key, and the idf as a value
dictionary = dict(zip(model.get_feature_names(), list(model.idf_)))
```

In [0]:
```
# TF-IDF weighted Word2Vec
tfidf_feat = model.get_feature_names() # tfidf words/col-names
# final_tf_idf is the sparse matrix with row= sentence, col=word and cell_val
 = tfidf

tfidf_sent_vectors = []; # the tfidf-w2v for each sentence/review is stored in
this list
row=0;
for sent in tqdm(list_of_sentance): # for each review/sentence
    sent_vec = np.zeros(50) # as word vectors are of zero length
    weight_sum =0; # num of words with a valid vector in the sentence/review
    for word in sent: # for each word in a review/sentence
        if word in w2v_words and word in tfidf_feat:
            vec = w2v_model.wv[word]
#             tf_idf = tf_idf_matrix[row, tfidf_feat.index(word)]
            # to reduce the computation we are
            # dictionary[word] = idf value of word in whole courpus
            # sent.count(word) = tf valeus of word in this review
            tf_idf = dictionary[word]*(sent.count(word)/len(sent))
            sent_vec += (vec * tf_idf)
            weight_sum += tf_idf
    if weight_sum != 0:
        sent_vec /= weight_sum
    tfidf_sent_vectors.append(sent_vec)
    row += 1
```

```
100%|██████████| 4986/4986 [00:20<00:00, 245.63it/s]
```

[5] Assignment 9: Random Forests

1. **Apply Random Forests & GBDT on these feature sets**

   - SET 1:Review text, preprocessed one converted into vectors using (BOW)
   - SET 2:Review text, preprocessed one converted into vectors using (TFIDF)
   - SET 3:Review text, preprocessed one converted into vectors using (AVG W2v)
   - SET 4:Review text, preprocessed one converted into vectors using (TFIDF W2v)

2. **The hyper paramter tuning (Consider two hyperparameters: n_estimators & max_depth)**

   - Find the best hyper parameter which will give the maximum AUC (https://www.appliedaicourse.com/course/applied-ai-course-online/lessons/receiver-operating-characteristic-curve-roc-curve-and-auc-1/) value
   - Find the best hyper paramter using k-fold cross validation or simple cross validation data
   - Use gridsearch cv or randomsearch cv or you can also write your own for loops to do this task of hyperparameter tuning

3. **Feature importance**

   - Get top 20 important features and represent them in a word cloud. Do this for BOW & TFIDF.

4. **Feature engineering**

   - To increase the performance of your model, you can also experiment with with feature engineering like :
     - Taking length of reviews as another feature.
     - Considering some features from review summary as well.

5. **Representation of results**

   - You need to plot the performance of model both on train data and cross validation data for each hyper parameter, like shown in the figure
     with X-axis as **n_estimators**, Y-axis as **max_depth**, and Z-axis as **AUC Score** , we have given the notebook which explains how to plot this 3d plot, you can find it in the same drive *3d_scatter_plot.ipynb*

(or)

   - You need to plot the performance of model both on train data and cross validation data for each hyper parameter, like shown in the figure
     seaborn heat maps (https://seaborn.pydata.org/generated/seaborn.heatmap.html) with rows as **n_estimators**, columns as **max_depth**, and values inside the cell representing **AUC Score**
   - You choose either of the plotting techniques out of 3d plot or heat map
   - Once after you found the best hyper parameter, you need to train your model with it, and find the AUC on test data and plot the ROC curve on both train and test.
   - Along with plotting ROC curve, you need to print the confusion matrix (https://www.appliedaicourse.com/course/applied-ai-course-online/lessons/confusion-matrix-tpr-fpr-fnr-tnr-1/) with predicted and original labels of test data points. Please visualize your confusion matrices using seaborn heatmaps.
     (https://seaborn.pydata.org/generated/seaborn.heatmap.html)
     (https://seaborn.pydata.org/generated/seaborn.heatmap.html)

(https://seaborn.pydata.org/generated/seaborn.heatmap.html)

(https://seaborn.pydata.org/generated/seaborn.heatmap.html)

6. **Conclusion** (https://seaborn.pydata.org/generated/seaborn.heatmap.html)

(https://seaborn.pydata.org/generated/seaborn.heatmap.html)

- You need to summarize the results at the end of the notebook, summarize it in the table format. To print out a table please refer to this prettytable library (https://seaborn.pydata.org/generated/seaborn.heatmap.html) link (http://zetcode.com/python/prettytable/)

Note: Data Leakage

1. There will be an issue of data-leakage if you vectorize the entire data and then split it into train/cv/test.
2. To avoid the issue of data-leakag, make sure to split your data first and then vectorize it.
3. While vectorizing your data, apply the method fit_transform() on you train data, and apply the method transform() on cv/test data.
4. For more details please go through this link. (https://soundcloud.com/applied-ai-course/leakage-bow-and-tfidf)

[5.1] Applying RF

Code for Data Vectorizers

In [ ]:
```
#%matplotlib inline
import warnings
warnings.filterwarnings("ignore")


import sqlite3
import pandas as pd
import numpy as np


import matplotlib.pyplot as plt

from sklearn.feature_extraction.text import CountVectorizer
from sklearn.feature_extraction.text import TfidfTransformer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.neighbors import NearestNeighbors
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import classification_report,accuracy_score,confusion_mat
rix
from sklearn.model_selection import train_test_split
from sklearn.model_selection import cross_val_score
from sklearn.model_selection import cross_validate
from sklearn.preprocessing import StandardScaler
from sklearn.metrics import roc_curve,auc
from sklearn.metrics import roc_auc_score
from sklearn.model_selection import GridSearchCV
from sklearn.model_selection import train_test_split
from imblearn.over_sampling import SMOTE


from bs4 import BeautifulSoup
import re
# Tutorial about Python regular expressions: https://pymotw.com/2/re/
import string
import nltk
from nltk import word_tokenize, sent_tokenize
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
from nltk.stem.wordnet import WordNetLemmatizer


from gensim.models import Word2Vec
from gensim.models import KeyedVectors
import pickle

from tqdm import tqdm
import os
import time

class assign7SVM_dtcrea:

        def __init__(self):
                print('nothing in the constructo\n')
                self.X_train = pd.DataFrame()  #for gridsearchcv
                self.X_test = pd.DataFrame()   #for gridsearchcv
                self.y_train = pd.Series([])   #y_train for gridsearchcv
```

```
            self.xtrain = pd.DataFrame()
            self.xtest = pd.DataFrame()
            self.xval = pd.DataFrame()

            self.ytrain = pd.Series([])
            self.ytest = pd.Series([])
            self.yval = pd.Series([])

    #gridsearchcv parameters -- start
    @property
    def X_train(self):
        return self._X_train

    @X_train.setter
    def X_train(self,new_X_train):
        self._X_train = new_X_train

    @property
    def X_test(self):
        return self._X_test

    @X_test.setter
    def X_test(self,new_X_test):
        self._X_test = new_X_test

    @property
    def y_train(self):
        return self._y_train

    @y_train.setter
    def y_train(self,new_y_train):
        self._y_train = new_y_train

    @property
    def y_test(self):
        return self._y_test

    @y_test.setter
    def y_test(self,new_y_test):
        self._y_test = new_y_test
    #gridsearchcv parameters -- end

    @property
    def xtrain(self):
        return self._xtrain

    @xtrain.setter
    def xtrain(self,new_xtrain):
        self._xtrain = new_xtrain


    @property
    def ytrain(self):
        return self._ytrain

    @ytrain.setter
```

```
        def ytrain(self,new_ytrain):
            self._ytrain = new_ytrain

        @property
        def xval(self):
            return self._xval

        @xval.setter
        def xval(self,new_xval):
            self._xval = new_xval

        @property
        def yval(self):
            return self._yval

        @yval.setter
        def yval(self,new_yval):
            self._yval = new_yval

        # Give reviews with Score>3 a positive rating(1), and reviews with a s
core<3 a negative rating(0).
        def partition(self,x):
                if x < 3:
                        return 0
                return 1

        def write_ft_data(self,fnme,opdata):

                #fname = 'E:/appliedaicourse/assignments/dblite/kdtree_50k/' +
fnme
                fname = 'E:/appliedaicourse/assignments/dblite/1kpts' + fnme
                with open(fname, 'wb') as fp:
                        pickle.dump(opdata, fp)

        def write_data(self,fnme,opdata):

                #fname = 'E:/appliedaicourse/assignments/dblite/kdtree_50k/' +
fnme

                fname = 'E:/appliedaicourse/assignments/dblite/1kpts' + fnme
                print(fname)
                with open(fname, 'wb') as fp:
                        pickle.dump(opdata, fp)


        def decontracted(self,phrase):
                # specific
                phrase = re.sub(r"won't", "will not", phrase)
                phrase = re.sub(r"can\'t", "can not", phrase)

                # general
                phrase = re.sub(r"n\'t", " not", phrase)
                phrase = re.sub(r"\'re", " are", phrase)
                phrase = re.sub(r"\'s", " is", phrase)
                phrase = re.sub(r"\'d", " would", phrase)
                phrase = re.sub(r"\'ll", " will", phrase)
                phrase = re.sub(r"\'t", " not", phrase)
```

```
                phrase = re.sub(r"\'ve", " have", phrase)
                phrase = re.sub(r"\'m", " am", phrase)

                return phrase



        # Combining all the above statements
        def rw_preproc(self,xdata):
                stopwords= set(['br', 'the', 'i', 'me', 'my', 'myself', 'we',
'our', 'ours', 'ourselves', 'you', "you're", "you've",\
                "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves',
'he', 'him', 'his', 'himself', \
                'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its',
'itself', 'they', 'them', 'their',\
                'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this'
, 'that', "that'll", 'these', 'those', \
                'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'hav
e', 'has', 'had', 'having', 'do', 'does', \
                'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'b
ecause', 'as', 'until', 'while', 'of', \
                'at', 'by', 'for', 'with', 'about', 'against', 'between', 'int
o', 'through', 'during', 'before', 'after',\
                'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'o
n', 'off', 'over', 'under', 'again', 'further',\
                'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how'
, 'all', 'any', 'both', 'each', 'few', 'more',\
                'most', 'other', 'some', 'such', 'only', 'own', 'same', 'so',
'than', 'too', 'very', \
                's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "sh
ould've", 'now', 'd', 'll', 'm', 'o', 're', \
                've', 'y', 'ain', 'aren', "aren't", 'couldn', "couldn't", 'did
n', "didn't", 'doesn', "doesn't", 'hadn',\
                "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't"
, 'ma', 'mightn', "mightn't", 'mustn',\
                "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "s
houldn't", 'wasn', "wasn't", 'weren', "weren't", \
                'won', "won't", 'wouldn', "wouldn't"])

                preprocessed_reviews = []

                # tqdm is for printing the status bar

                for sentance in tqdm(xdata.values):
                        sentance = re.sub(r"http\S+", "", sentance)
                        sentance = BeautifulSoup(sentance, 'lxml').get_text()
                        sentance = self.decontracted(sentance)
                        sentance = re.sub("\S*\d\S*", "", sentance).strip()
                        sentance = re.sub('[^A-Za-z]+', ' ', sentance)
                        # https://gist.github.com/sebleier/554280
                        sentance = ' '.join(e.lower() for e in sentance.split
() if e.lower() not in stopwords)
                        preprocessed_reviews.append(sentance.strip())
                return preprocessed_reviews


        def getreviews(self, nrows):
```

```
                X_trn = pd.DataFrame()
                # using SQLite Table to read data.
                filepath = os.path.abspath('E:/appliedaicourse/assignments/dbl
ite/database.db')
                assert os.path.exists(filepath), 'the file does not exist'
                con = sqlite3.connect(filepath)
                #filtered_data = pd.read_sql_query(""" SELECT * FROM Reviews W
HERE Score != 3 LIMIT 50000""", con)
                filtered_data = pd.read_sql_query(""" SELECT * FROM Reviews WH
ERE Score != 3 LIMIT """ + str(nrows), con)

                #changing reviews with score less than 3 to be positive and vi
ce-versa
                actualScore = filtered_data['Score']
                positiveNegative = actualScore.map(self.partition)
                filtered_data['Score'] = positiveNegative
                #Sorting data according to ProductId in ascending order
                sorted_data=filtered_data.sort_values('ProductId', axis=0, asc
ending=True, inplace=False, kind='quicksort', na_position='last')
                #Deduplication of entries
                final=sorted_data.drop_duplicates(subset={"UserId","ProfileNam
e","Time","Text"}, keep='first', inplace=False)
                final.shape

                final=final[final.HelpfulnessNumerator<=final.HelpfulnessDenom
inator]

                #Before starting the next phase of preprocessing lets see the
 number of entries left
                print(final.shape)

                #How many positive and negative reviews are present in our dat
aset?
                final['Score'].value_counts()

                X_trn, X_tst, self.y_train, self.y_test = train_test_split(fin
al['Text'], final['Score'], stratify= final['Score'],test_size=0.2, random_sta
te=42)
                xtrn, xval, self.ytrain, self.yval   = train_test_split(X_trn,
self.y_train, test_size=0.2, random_state=42)

                self.X_train = self.rw_preproc(X_trn)
                self.X_test  = self.rw_preproc(X_tst)
                self.xtrain   = self.rw_preproc(xtrn)
                self.xval   = self.rw_preproc(xval)


        def BOWVect_WSmote(self):
                xvtrain = []
                xvval = []
                X_v_train = []
                X_v_test = []
                bowsvmXtrain_scaled = []
                bowsvmXtest_scaled = []
                bowsvmxtrain_scaled = []
                bowsvmxval_scaled = []
```

```
                #this is for the roc auc score
                count_vect = CountVectorizer(max_features=500) #in scikit-lear
n
                xvtrain = count_vect.fit_transform(self.xtrain)
                xvval = count_vect.transform(self.xval)

                x_res_xvtrn, y_res_trn = SMOTE().fit_sample(xvtrain, self.ytra
in)
                x_res_xvval, y_res_val = SMOTE().fit_sample(xvval, self.yval)

                print("Shape after resampling x:", x_res_xvtrn.shape)
                print("Shape after resampling y:", x_res_xvval.shape)
                print("Shape after resampling x:", len(y_res_trn))
                print("Shape after resampling y:", len(y_res_val))

                #this is for gridsearchcv
                count_vect_1 = CountVectorizer(max_features=500) #in scikit-le
arn
                X_v_train = count_vect_1.fit_transform(self.X_train)
                X_v_test = count_vect_1.transform(self.X_test)

                x_res_Xvtrain, y_res_train = SMOTE().fit_sample(X_v_train, sel
f.y_train)
                x_res_Xvtest, y_res_test = SMOTE().fit_sample(X_v_test, self.y
_test)


                # checking the shape of x_resample and y_resample
                print("Shape after resampling x:", x_res_Xvtrain.shape)
                print("Shape after resampling y:", x_res_Xvtest.shape)
                print("Shape after resampling x:", len(y_res_train))
                print("Shape after resampling y:", len(y_res_test))
                print('\n\n')
                print('='*50)
                print("some feature names ", count_vect.get_feature_names()[:1
00])
                print('='*50)

                print("the type of count vectorizer ",type(xvtrain))
                print("the shape of out text BOW vectorizer ",xvtrain.get_shap
e())
                print("the number of unique words ", xvtrain.get_shape()[1])

                scaler_1 = StandardScaler(with_mean=False)
                bowsvmXtrain_scaled = scaler_1.fit_transform(x_res_Xvtrain)
                bowsvmXtest_scaled = scaler_1.transform(x_res_Xvtest)


                scaler = StandardScaler(with_mean=False)
                bowsvmxtrain_scaled = scaler.fit_transform(x_res_xvtrn)
                bowsvmxval_scaled = scaler.transform(x_res_xvval)


                self.write_data('/balanced/bowvectorizer/ppvectscld_x_train',b
owsvmXtrain_scaled)
                self.write_data('/balanced/bowvectorizer/ppvectscld_x_test',bo
wsvmXtest_scaled)
```

```
                self.write_data('/balanced/bowvectorizer/ppvectscld_xtrain',bo
wsvmxtrain_scaled)
                self.write_data('/balanced/bowvectorizer/ppvectscld_xval',bows
vmxval_scaled)
                self.write_data('/balanced/bowvectorizer/y_train',y_res_train)
                self.write_data('/balanced/bowvectorizer/y_test',y_res_test)
                self.write_data('/balanced/bowvectorizer/ytrain',y_res_trn)
                self.write_data('/balanced/bowvectorizer/yval',y_res_val)
                self.write_ft_data('/balanced/bowvectorizer/bow_feat',count_ve
ct_1.get_feature_names())

        def BOWVectorizer(self):
                xvtrain = []
                xvval = []
                X_v_train = []
                X_v_test = []
                bowsvmXtrain_scaled = []
                bowsvmXtest_scaled = []
                bowsvmxtrain_scaled = []
                bowsvmxval_scaled = []

                #this is for the roc auc score
                count_vect = CountVectorizer(max_features=1000) #in scikit-lea
rn
                xvtrain = count_vect.fit_transform(self.xtrain)
                xvval = count_vect.transform(self.xval)

                #this is for gridsearchcv
                count_vect_1 = CountVectorizer(max_features=1000) #in scikit-l
earn
                X_v_train = count_vect_1.fit_transform(self.X_train)
                X_v_test = count_vect_1.transform(self.X_test)

                print("some feature names ", count_vect.get_feature_names()[:1
00])
                print('='*50)

                print("the type of count vectorizer ",type(xvtrain))
                print("the shape of out text BOW vectorizer ",xvtrain.get_shap
e())
                print("the number of unique words ", xvtrain.get_shape()[1])

                scaler_1 = StandardScaler(with_mean=False)
                bowsvmXtrain_scaled = scaler_1.fit_transform(X_v_train)
                bowsvmXtest_scaled = scaler_1.transform(X_v_test)


                scaler = StandardScaler(with_mean=False)
                bowsvmxtrain_scaled = scaler.fit_transform(xvtrain)
                bowsvmxval_scaled = scaler.transform(xvval)

                print("the shape of Xtrain BOW vectorizer ",bowsvmXtrain_scale
d.get_shape())
                print("the shape of Xtest BOW vectorizer ",bowsvmXtest_scaled.
get_shape())
                print("the shape of xtrain BOW vectorizer ",bowsvmxtrain_scale
d.get_shape())
```

```
                print("the shape of xtest BOW vectorizer ",bowsvmxval_scaled.g
et_shape())

                self.write_data('/unbalanced/bowvectorizer/ppvectscld_x_train'
,bowsvmXtrain_scaled)
                self.write_data('/unbalanced/bowvectorizer/ppvectscld_x_test',
bowsvmXtest_scaled)
                self.write_data('/unbalanced/bowvectorizer/ppvectscld_xtrain',
bowsvmxtrain_scaled)
                self.write_data('/unbalanced/bowvectorizer/ppvectscld_xval',bo
wsvmxval_scaled)
                self.write_data('/unbalanced/bowvectorizer/y_train',self.y_tra
in)
                self.write_data('/unbalanced/bowvectorizer/y_test',self.y_test
)
                self.write_data('/unbalanced/bowvectorizer/ytrain',self.ytrain
)
                self.write_data('/unbalanced/bowvectorizer/yval',self.yval)
                self.write_ft_data('/unbalanced/bowvectorizer/bow_feat',count_
vect_1.get_feature_names())

        def TFIDFVect_WSmote(self):
                xvtrain = []
                xvval = []
                X_v_train = []
                X_v_test = []
                tidfsvmXtrain_scaled = []
                tidfsvmXtest_scaled = []
                tidfsvmxtrain_scaled = []
                tidfsvmxval_scaled = []

                #this is for the roc auc score
                tf_idf_vect = TfidfVectorizer(ngram_range=(1,2), min_df=10,max
_features=500)  #in scikit-learn
                xvtrain = tf_idf_vect.fit_transform(self.xtrain)
                xvval = tf_idf_vect.transform(self.xval)

                x_res_xvtrn, y_res_trn = SMOTE().fit_sample(xvtrain, self.ytra
in)
                x_res_xvval, y_res_val = SMOTE().fit_sample(xvval, self.yval)

                print("Shape after resampling x:", x_res_xvtrn.shape)
                print("Shape after resampling y:", x_res_xvval.shape)
                print("Shape after resampling x:", len(y_res_trn))
                print("Shape after resampling y:", len(y_res_val))

                #this is for gridsearchcv
                tf_idf_vect_1 = TfidfVectorizer(ngram_range=(1,2), min_df=10,m
ax_features=500) #in scikit-learn
                X_v_train = tf_idf_vect_1.fit_transform(self.X_train)
                X_v_test = tf_idf_vect_1.transform(self.X_test)

                x_res_Xvtrain, y_res_train = SMOTE().fit_sample(X_v_train, sel
f.y_train)
                x_res_Xvtest, y_res_test = SMOTE().fit_sample(X_v_test, self.y
_test)
```

```
                # checking the shape of x_resample and y_resample
                print("Shape after resampling x:", x_res_Xvtrain.shape)
                print("Shape after resampling y:", x_res_Xvtest.shape)
                print("Shape after resampling x:", len(y_res_train))
                print("Shape after resampling y:", len(y_res_test))

                scaler_1 = StandardScaler(with_mean=False)
                tidfsvmXtrain_scaled = scaler_1.fit_transform(x_res_Xvtrain)
                tidfsvmXtest_scaled = scaler_1.transform(x_res_Xvtest)


                scaler = StandardScaler(with_mean=False)
                tidfsvmxtrain_scaled = scaler.fit_transform(x_res_xvtrn)
                tidfsvmxval_scaled = scaler.transform(x_res_xvval)


                self.write_data('/balanced/tfidfvectorizer/ppvectscld_x_train'
,tidfsvmXtrain_scaled)
                self.write_data('/balanced/tfidfvectorizer/ppvectscld_x_test',
tidfsvmXtest_scaled)
                self.write_data('/balanced/tfidfvectorizer/ppvectscld_xtrain',
tidfsvmxtrain_scaled)
                self.write_data('/balanced/tfidfvectorizer/ppvectscld_xval',ti
dfsvmxval_scaled)
                self.write_data('/balanced/tfidfvectorizer/y_train',y_res_trai
n)
                self.write_data('/balanced/tfidfvectorizer/y_test',y_res_test)
                self.write_data('/balanced/tfidfvectorizer/ytrain',y_res_trn)
                self.write_data('/balanced/tfidfvectorizer/yval',y_res_val)

                self.write_ft_data('/balanced/tfidfvectorizer/tfidf_feat',tf_i
df_vect_1.get_feature_names())
                print("some sample features(unique words in the corpus)",tf_id
f_vect.get_feature_names()[0:10])
                print('='*50)

        def TFIDFVectorizer(self):
                xvtrain = []
                xvval = []
                X_v_train = []
                X_v_test = []
                tidfsvmXtrain_scaled = []
                tidfsvmXtest_scaled = []
                tidfsvmxtrain_scaled = []
                tidfsvmxval_scaled = []

                #this is for the roc auc score
                tf_idf_vect = TfidfVectorizer(ngram_range=(1,2), min_df=10,max
_features=500)  #in scikit-learn
                xvtrain = tf_idf_vect.fit_transform(self.xtrain)
                xvval = tf_idf_vect.transform(self.xval)

                #this is for gridsearchcv
                tf_idf_vect_1 = TfidfVectorizer(ngram_range=(1,2), min_df=10,m
ax_features=500) #in scikit-learn
                X_v_train = tf_idf_vect_1.fit_transform(self.X_train)
```

```
                X_v_test = tf_idf_vect_1.transform(self.X_test)


                scaler_1 = StandardScaler(with_mean=False)
                tidfsvmXtrain_scaled = scaler_1.fit_transform(X_v_train.toarra
y())
                tidfsvmXtest_scaled = scaler_1.transform(X_v_test)


                scaler = StandardScaler(with_mean=False)
                tidfsvmxtrain_scaled = scaler.fit_transform(xvtrain.toarray())
                tidfsvmxval_scaled = scaler.transform(xvval)


                self.write_data('/unbalanced/tfidfvectorizer/ppvectscld_x_trai
n',tidfsvmXtrain_scaled)
                self.write_data('/unbalanced/tfidfvectorizer/ppvectscld_x_tes
t',tidfsvmXtest_scaled)
                self.write_data('/unbalanced/tfidfvectorizer/ppvectscld_xtrai
n',tidfsvmxtrain_scaled)
                self.write_data('/unbalanced/tfidfvectorizer/ppvectscld_xval',
tidfsvmxval_scaled)
                self.write_data('/unbalanced/tfidfvectorizer/y_train',self.y_t
rain)
                self.write_data('/unbalanced/tfidfvectorizer/y_test',self.y_te
st)
                self.write_data('/unbalanced/tfidfvectorizer/ytrain',self.ytra
in)
                self.write_data('/unbalanced/tfidfvectorizer/yval',self.yval)

                self.write_ft_data('/unbalanced/tfidfvectorizer/tfidf_feat',tf
_idf_vect_1.get_feature_names())
                print("some sample features(unique words in the corpus)",tf_id
f_vect.get_feature_names()[0:10])
                print('='*50)

        # average Word2Vec
        # compute average word2vec for each review.
        def w2vec_crea(self, list_of_sentance,w2v_model,w2v_words):
                sent_vectors = []; # the avg-w2v for each sentence/review is s
tored in this list
                for sent in tqdm(list_of_sentance): # for each review/sentence
                        sent_vec = np.zeros(50) # as word vectors are of zero
 length 50, you might need to change this to 300 if you use google's w2v
                        cnt_words =0; # num of words with a valid vector in th
e sentence/review
                        for word in sent: # for each word in a review/sentence
                                if word in w2v_words:
                                        vec = w2v_model.wv[word]
                                        sent_vec += vec
                                        cnt_words += 1
                        if cnt_words != 0:
                                sent_vec /= cnt_words
                        sent_vectors.append(sent_vec)

                #print(sent_vectors[0],len(sent_vectors[0]))
                print('w2vec_crea')
```

```
                #val=input('w2vecrea')
                return sent_vectors

        def tfidfwtw2v_crea(self,tfidf_feat, list_of_sentance, w2v_model,w2v_w
ords,diction,fnme):
            tfidf_sent_vectors = []; # the tfidf-w2v for each sentence/review
 is stored in this list
            row=0;
            time1 = time.time()
            svec_reinit = np.zeros(50)
            for sent in tqdm(list_of_sentance): # 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 sente
nce/review
                for word in sent: # for each word in a review/sentence
                    if ((word in w2v_words) and (word in tfidf_feat) and (word
in diction)):
                        vec = w2v_model.wv[word]
            #             tf_idf = tf_idf_matrix[row, tfidf_feat.index(word)]
                        # to reduce the computation we are
                        # dictionary[word] = idf value of word in whole courpu
s
                        # sent.count(word) = tf valeus of word in this review

                        #print(diction[word],sent.count(word),len(sent))
                        denom = sent.count(word)/len(sent)

                        tf_idf = diction[word]*(denom)

                        sent_vec += (vec * tf_idf)
                        weight_sum += tf_idf
                if weight_sum != 0:
                    sent_vec /= weight_sum
                tfidf_sent_vectors.append(sent_vec)
                print('tfidfwtw2v_crea',tfidf_sent_vectors)
                #val=input('tfidfw2vecrea')
                row += 1
            print("time takes for function \t {0}\n".format(time.time() - time
1))
            return tfidf_sent_vectors


        def word2vect_WSmote(self):

                listsent_X_train=[]
                listsent_X_test=[]
                listsent_xtrain=[]
                listsent_xval=[]

                for sentance in self.X_train : #preprocessed_reviews:
                        listsent_X_train.append(sentance.split())

                for sentance in self.X_test : #preprocessed_reviews:
                        listsent_X_test.append(sentance.split())

                for sentance in self.xtrain : #preprocessed_reviews:
                        listsent_xtrain.append(sentance.split())
```

```
                for sentance in self.xval : #preprocessed_reviews:
                        listsent_xval.append(sentance.split())

                # min_count = 5 considers only words that occured atleast 5 ti
mes
                val = input('damn it wait.'
                        )
                w2v_mdl_X_train=Word2Vec(listsent_X_train,min_count=5,size=50,
workers=4)
                w2v_mdl_X_test=Word2Vec(listsent_X_test,min_count=5,size=50, w
orkers=4)
                w2v_mdl_xtrain=Word2Vec(listsent_xtrain,min_count=5,size=50, w
orkers=4)
                w2v_mdl_xval=Word2Vec(listsent_xval,min_count=5,size=50, worke
rs=4)
                print(w2v_mdl_xtrain.wv.most_similar('great'))
                print('='*50)
                print(w2v_mdl_xtrain.wv.most_similar('worst'))

                w2v_words_X_train = list(w2v_mdl_X_train.wv.vocab)
                w2v_words_X_test = list(w2v_mdl_X_test.wv.vocab)
                w2v_words_xtrain = list(w2v_mdl_xtrain.wv.vocab)
                w2v_words_xval = list(w2v_mdl_xval.wv.vocab)


                w2v_X_train = self.w2vec_crea(listsent_X_train,w2v_mdl_X_train
,w2v_words_X_train)
                w2v_X_test = self.w2vec_crea(listsent_X_test,w2v_mdl_X_test,w2
v_words_X_test)
                w2v_xtrain = self.w2vec_crea(listsent_xtrain,w2v_mdl_xtrain,w2
v_words_xtrain)
                w2v_xval = self.w2vec_crea(listsent_xval,w2v_mdl_xval,w2v_word
s_xval)


                x_res_xvtrn, y_res_trn = SMOTE().fit_sample(w2v_xtrain, self.y
train)
                x_res_xvval, y_res_val = SMOTE().fit_sample(w2v_xval, self.yva
l)

                print("Shape after resampling x:", x_res_xvtrn.shape)
                print("Shape after resampling y:", x_res_xvval.shape)
                print("Shape after resampling x:", len(y_res_trn))
                print("Shape after resampling y:", len(y_res_val))

                x_res_Xvtrain, y_res_train = SMOTE().fit_sample(w2v_X_train, s
elf.y_train)
                x_res_Xvtest, y_res_test = SMOTE().fit_sample(w2v_X_test, self
.y_test)


                # checking the shape of x_resample and y_resample
                print("Shape after resampling x:", x_res_Xvtrain.shape)
                print("Shape after resampling y:", x_res_Xvtest.shape)
                print("Shape after resampling x:", len(y_res_train))
                print("Shape after resampling y:", len(y_res_test))
```

```
                scaler = StandardScaler()
                avgw2vxtrain_scaled = scaler.fit_transform(x_res_xvtrn)
                avgw2vxval_scaled = scaler.transform(x_res_xvval)

                scaler1 = StandardScaler()
                avgw2vXtrain_scaled = scaler1.fit_transform(x_res_Xvtrain)
                avgw2vXtest_scaled = scaler1.transform(x_res_Xvtest)

                self.write_data('/balanced/avgw2vectorizer/ppvectscld_x_train'
,avgw2vXtrain_scaled)
                self.write_data('/balanced/avgw2vectorizer/ppvectscld_x_test',
avgw2vXtest_scaled)
                self.write_data('/balanced/avgw2vectorizer/ppvectscld_xtrain',
avgw2vxtrain_scaled)
                self.write_data('/balanced/avgw2vectorizer/ppvectscld_xval',av
gw2vxval_scaled)
                self.write_data('/balanced/avgw2vectorizer/y_train',y_res_trai
n)
                self.write_data('/balanced/avgw2vectorizer/y_test',y_res_test)
                self.write_data('/balanced/avgw2vectorizer/ytrain',y_res_trn)
                self.write_data('/balanced/avgw2vectorizer/yval',y_res_val)

                """
                        this part is for the tfidf weighted word2vec. Most of
 the above code is common
                        for this part so we will write that code here
                """
                #this is for the roc auc score
                tf_idf_vect = TfidfVectorizer(ngram_range=(1,2), min_df=10,max
_features=500)  #in scikit-learn
                xvtrain = tf_idf_vect.fit_transform(self.xtrain)
                xvval = tf_idf_vect.transform(self.xval)

                #this is for gridsearchcv
                tf_idf_vect_1 = TfidfVectorizer(ngram_range=(1,2), min_df=10,m
ax_features=500) #in scikit-learn
                X_v_train = tf_idf_vect_1.fit_transform(self.X_train)
                X_v_test = tf_idf_vect_1.transform(self.X_test)

                # we are converting a dictionary with word as a key, and the i
df as a value
                dict_xtrain = dict(zip(tf_idf_vect.get_feature_names(), list(x
vtrain[0,:].nonzero()[1])))
                dict_xval = dict(zip(tf_idf_vect.get_feature_names(), list(xvv
al[0,:].nonzero()[1])))


                dict_X_train = dict(zip(tf_idf_vect_1.get_feature_names(), lis
t(X_v_train[0,:].nonzero()[1])))
                dict_X_test = dict(zip(tf_idf_vect_1.get_feature_names(), list
(X_v_test[0,:].nonzero()[1])))

                tfidf_feat = tf_idf_vect.get_feature_names()
                tfidf_feat_1 = tf_idf_vect_1.get_feature_names()

                tfidf_avgw2vXtrain = self.tfidfwtw2v_crea(tfidf_feat_1,listsen
```

```
t_X_train,w2v_mdl_X_train,w2v_words_X_train,dict_X_train,'sent_vect_xtrain')
                tfidf_avgw2vXtest= self.tfidfwtw2v_crea(tfidf_feat_1,listsent_
X_test,w2v_mdl_X_test,w2v_words_X_test,dict_X_test,'sent_vect_xtest')
                tfidf_avgw2vxtrain = self.tfidfwtw2v_crea(tfidf_feat,listsent_
xtrain,w2v_mdl_xtrain,w2v_words_xtrain,dict_xtrain,'sent_vect_xtrain')
                tfidf_avgw2vxval= self.tfidfwtw2v_crea(tfidf_feat,listsent_xva
l,w2v_mdl_xval,w2v_words_xval,dict_xval,'sent_vect_xval')

                x_res_xvtrn, y_res_trn = SMOTE().fit_sample(tfidf_avgw2vxtrain
, self.ytrain)
                x_res_xvval, y_res_val = SMOTE().fit_sample(tfidf_avgw2vxval,
self.yval)

                print("Shape after resampling x:", x_res_xvtrn.shape)
                print("Shape after resampling y:", x_res_xvval.shape)
                print("Shape after resampling x:", len(y_res_trn))
                print("Shape after resampling y:", len(y_res_val))

                x_res_Xvtrain, y_res_train = SMOTE().fit_sample(tfidf_avgw2vXt
rain, self.y_train)
                x_res_Xvtest, y_res_test = SMOTE().fit_sample(tfidf_avgw2vXtes
t, self.y_test)


                # checking the shape of x_resample and y_resample
                print("Shape after resampling x:", x_res_Xvtrain.shape)
                print("Shape after resampling y:", x_res_Xvtest.shape)
                print("Shape after resampling x:", len(y_res_train))
                print("Shape after resampling y:", len(y_res_test))

                scaler2 = StandardScaler()
                tidfavgw2vxtrain_scaled = scaler2.fit_transform(x_res_xvtrn)
                tidfavgw2vxval_scaled = scaler2.transform(x_res_xvval)

                scaler3 = StandardScaler()
                tidfavgw2vXtrain_scaled = scaler3.fit_transform(x_res_Xvtrain)
                tidfavgw2vXtest_scaled = scaler3.transform(x_res_Xvtest)

                self.write_data('/balanced/tfidfwtw2vectorizer/ppvectscld_x_tr
ain',tidfavgw2vXtrain_scaled)
                self.write_data('/balanced/tfidfwtw2vectorizer/ppvectscld_x_te
st',tidfavgw2vXtest_scaled)
                self.write_data('/balanced/tfidfwtw2vectorizer/ppvectscld_xtra
in',tidfavgw2vxtrain_scaled)
                self.write_data('/balanced/tfidfwtw2vectorizer/ppvectscld_xva
l',tidfavgw2vxval_scaled)
                self.write_data('/balanced/tfidfwtw2vectorizer/y_train',y_res_
train)
                self.write_data('/balanced/tfidfwtw2vectorizer/y_test',y_res_t
est)
                self.write_data('/balanced/tfidfwtw2vectorizer/ytrain',y_res_t
rn)
                self.write_data('/balanced/tfidfwtw2vectorizer/yval',y_res_val
)


        def word2vectorizer(self):
```

```
                listsent_X_train=[]
                listsent_X_test=[]
                listsent_xtrain=[]
                listsent_xval=[]

                for sentance in self.X_train : #preprocessed_reviews:
                        listsent_X_train.append(sentance.split())

                for sentance in self.X_test : #preprocessed_reviews:
                        listsent_X_test.append(sentance.split())

                for sentance in self.xtrain : #preprocessed_reviews:
                        listsent_xtrain.append(sentance.split())

                for sentance in self.xval : #preprocessed_reviews:
                        listsent_xval.append(sentance.split())

                # min_count = 5 considers only words that occured atleast 5 ti
mes
                w2v_mdl_X_train=Word2Vec(listsent_X_train,min_count=5,size=50,
workers=4)
                w2v_mdl_X_test=Word2Vec(listsent_X_test,min_count=5,size=50, w
orkers=4)
                w2v_mdl_xtrain=Word2Vec(listsent_xtrain,min_count=5,size=50, w
orkers=4)
                w2v_mdl_xval=Word2Vec(listsent_xval,min_count=5,size=50, worke
rs=4)
                print(w2v_mdl_xtrain.wv.most_similar('great'))
                print('='*50)
                print(w2v_mdl_xtrain.wv.most_similar('worst'))

                w2v_words_X_train = list(w2v_mdl_X_train.wv.vocab)
                w2v_words_X_test = list(w2v_mdl_X_test.wv.vocab)
                w2v_words_xtrain = list(w2v_mdl_xtrain.wv.vocab)
                w2v_words_xval = list(w2v_mdl_xval.wv.vocab)


                w2v_X_train = self.w2vec_crea(listsent_X_train,w2v_mdl_X_train
,w2v_words_X_train)
                w2v_X_test = self.w2vec_crea(listsent_X_test,w2v_mdl_X_test,w2
v_words_X_test)
                w2v_xtrain = self.w2vec_crea(listsent_xtrain,w2v_mdl_xtrain,w2
v_words_xtrain)
                w2v_xval = self.w2vec_crea(listsent_xval,w2v_mdl_xval,w2v_word
s_xval)

                scaler = StandardScaler()
                avgw2vxtrain_scaled = scaler.fit_transform(w2v_xtrain)
                avgw2vxval_scaled = scaler.transform(w2v_xval)

                scaler1 = StandardScaler()
                avgw2vXtrain_scaled = scaler1.fit_transform(w2v_X_train)
                avgw2vXtest_scaled = scaler1.transform(w2v_X_test)


                self.write_data('/unbalanced/avgw2vectorizer/ppvectscld_x_trai
```

```
n',avgw2vXtrain_scaled)
                self.write_data('/unbalanced/avgw2vectorizer/ppvectscld_x_tes
t',avgw2vXtest_scaled)
                self.write_data('/unbalanced/avgw2vectorizer/ppvectscld_xtrai
n',avgw2vxtrain_scaled)
                self.write_data('/unbalanced/avgw2vectorizer/ppvectscld_xval',
avgw2vxval_scaled)
                self.write_data('/unbalanced/avgw2vectorizer/y_train',self.y_t
rain)
                self.write_data('/unbalanced/avgw2vectorizer/y_test',self.y_te
st)
                self.write_data('/unbalanced/avgw2vectorizer/ytrain',self.ytra
in)
                self.write_data('/unbalanced/avgw2vectorizer/yval',self.yval)


                """
                        this part is for the tfidf weighted word2vec. Most of
 the above code is common
                        for this part so we will write that code here
                """
                #this is for the roc auc score
                tf_idf_vect = TfidfVectorizer(ngram_range=(1,2), min_df=10,max
_features=500)  #in scikit-learn
                xvtrain = tf_idf_vect.fit_transform(self.xtrain)
                xvval = tf_idf_vect.transform(self.xval)

                #this is for gridsearchcv
                tf_idf_vect_1 = TfidfVectorizer(ngram_range=(1,2), min_df=10,m
ax_features=500) #in scikit-learn
                X_v_train = tf_idf_vect_1.fit_transform(self.X_train)
                X_v_test = tf_idf_vect_1.transform(self.X_test)

                # we are converting a dictionary with word as a key, and the i
df as a value
                dict_xtrain = dict(zip(tf_idf_vect.get_feature_names(), list(x
vtrain[0,:].nonzero()[1])))
                dict_xval = dict(zip(tf_idf_vect.get_feature_names(), list(xvv
al[0,:].nonzero()[1])))


                dict_X_train = dict(zip(tf_idf_vect_1.get_feature_names(), lis
t(X_v_train[0,:].nonzero()[1])))
                dict_X_test = dict(zip(tf_idf_vect_1.get_feature_names(), list
(X_v_test[0,:].nonzero()[1])))

                tfidf_feat = tf_idf_vect.get_feature_names()
                tfidf_feat_1 = tf_idf_vect_1.get_feature_names()

                tfidf_avgw2vXtrain = self.tfidfwtw2v_crea(tfidf_feat_1,listsen
t_X_train,w2v_mdl_X_train,w2v_words_X_train,dict_X_train,'sent_vect_xtrain')
                tfidf_avgw2vXtest= self.tfidfwtw2v_crea(tfidf_feat_1,listsent_
X_test,w2v_mdl_X_test,w2v_words_X_test,dict_X_test,'sent_vect_xtest')
                tfidf_avgw2vxtrain = self.tfidfwtw2v_crea(tfidf_feat,listsent_
xtrain,w2v_mdl_xtrain,w2v_words_xtrain,dict_xtrain,'sent_vect_xtrain')
                tfidf_avgw2vxval= self.tfidfwtw2v_crea(tfidf_feat,listsent_xva
l,w2v_mdl_xval,w2v_words_xval,dict_xval,'sent_vect_xval')
```

```
                """
                scaler2 = StandardScaler()
                tidfavgw2vxtrain_scaled = scaler2.fit_transform(tfidf_avgw2vxt
rain)
                tidfavgw2vxval_scaled = scaler2.transform(tfidf_avgw2vxval)

                scaler3 = StandardScaler()
                tidfavgw2vXtrain_scaled = scaler3.fit_transform(tfidf_avgw2vXt
rain)
                tidfavgw2vXtest_scaled = scaler3.transform(tfidf_avgw2vXtest)
                """

                self.write_data('/unbalanced/tfidfwtw2vectorizer/ppvectscld_x_
train',tfidf_avgw2vXtrain)
                self.write_data('/unbalanced/tfidfwtw2vectorizer/ppvectscld_x_
test',tfidf_avgw2vXtest)
                self.write_data('/unbalanced/tfidfwtw2vectorizer/ppvectscld_xt
rain',tfidf_avgw2vxtrain)
                self.write_data('/unbalanced/tfidfwtw2vectorizer/ppvectscld_xv
al',tfidf_avgw2vxval)
                self.write_data('/unbalanced/tfidfwtw2vectorizer/y_train',self
.y_train)
                self.write_data('/unbalanced/tfidfwtw2vectorizer/y_test',self.
y_test)
                self.write_data('/unbalanced/tfidfwtw2vectorizer/ytrain',self.
ytrain)
                self.write_data('/unbalanced/tfidfwtw2vectorizer/yval',self.yv
al)

                self.write_ft_data('/unbalanced/tfidfwtw2vectorizer/tfidf_fea
t',tf_idf_vect_1.get_feature_names())
                print("some sample features(unique words in the corpus)",tf_id
f_vect.get_feature_names()[0:10])
                print('='*50)

        def writeTfidfVetorizer(self):
                #this is for gridsearchcv
                tf_idf_vect_1 = TfidfVectorizer(ngram_range=(1,2), min_df=10,m
ax_features=500) #in scikit-learn
                X_v_train = tf_idf_vect_1.fit_transform(self.X_train)
                X_v_test = tf_idf_vect_1.transform(self.X_test)
                tfidf_feat_1 = tf_idf_vect_1.get_feature_names()


if __name__ == "__main__" :
        print('coming into main')
        linearsvm = assign7SVM_dtcrea()
        """
        linearsvm.getreviews(100000)
        linearsvm.BOWVect_WSmote()
        linearsvm.TFIDFVect_WSmote()
        linearsvm.BOWVectorizer()
        linearsvm.TFIDFVectorizer()
        linearsvm.word2vect_WSmote()
        """
        linearsvm.getreviews(10000)
```

```
    linearsvm.word2vectorizer()
```

Common Class for Randomforest

In [124]:
```
import warnings
warnings.filterwarnings("ignore")

from xgboost.sklearn import XGBClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.calibration import CalibratedClassifierCV
from sklearn.model_selection import GridSearchCV
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import classification_report,accuracy_score,confusion_mat
rix
from sklearn.metrics import roc_curve, auc
from sklearn.metrics import roc_auc_score
from sklearn.utils.class_weight import compute_sample_weight
from xgboost.sklearn import XGBClassifier

import sqlite3
import pandas as pd
import numpy as np
import xgboost as xgb


import string
import matplotlib.pyplot as plt
import re
from tqdm import tqdm
import os
import pickle


class assign9RndFrst:

    def __init__(self):
        self.X_train=pd.DataFrame()
        self.X_test=pd.DataFrame()
        self.xtrain=pd.DataFrame()
        self.xval=pd.DataFrame()
        self.y_train= pd.Series([])
        self.ytrain= pd.Series([])
        self.y_test= pd.Series([])
        self.yval= pd.Series([])
        self.rndfrst_clf = None
        self.xgbst_clf=None
        self.rndfrst_max_depth = []
        self.rndfrst_min_smp_split = []
        self.rndfrst_hmap_train = pd.DataFrame(columns=('mxdpth','minsmpsplit'
,'rocaucscore'))
        self.rndfrst_hmap_val = pd.DataFrame(columns=('mxdpth','minsmpsplit',
'rocaucscore'))
        self.yprdprobatrn = []
        self.yprdprobaval = []
        self.yprdprobatest = []
        self.rocaucscoretrn = []
        self.rocaucscoreval = []
        self.rocaucscoretest = []
        self.predicted = []
```

```
        self.test_predict = []
        self.accuracy_score_val = []
        self.accuracy_score_test = []
        self.clasify_report = []
        self.confsnmtxytstpred = {}
        self.roc_curve_test = {}
        self.clasify_params = {}
        self.feat_names = []


    #data for gridseatch
    @property
    def X_train(self):
        return self._X_train

    @X_train.setter
    def X_train(self,new_X_train):
        self._X_train = new_X_train

    #unseen data for testing
    @property
    def X_test(self):
        return self._X_test

    @X_test.setter
    def X_test(self,new_X_test):
        self._X_test = new_X_test

    #data for roc_auc_score
    @property
    def xtrain(self):
        return self._xtrain

    @xtrain.setter
    def xtrain(self,new_xtrain):
        self._xtrain = new_xtrain

    @property
    def xval(self):
        return self._xval

    @xval.setter
    def xval(self,new_xval):
        self._xval = new_xval

    @property
    def y_train(self):
        return self._y_train

    @y_train.setter
    def y_train(self,new_y_train):
        self._y_train = new_y_train

    @property
    def y_test(self):
        return self._y_test
```

```
    @y_test.setter
    def y_test(self,new_y_test):
        self._y_test = new_y_test

    @property
    def ytrain(self):
        return self._ytrain

    @ytrain.setter
    def ytrain(self,new_ytrain):
        self._ytrain = new_ytrain

    @property
    def yval(self):
        return self._yval

    @yval.setter
    def yval(self,new_yval):
        self._yval = new_yval

    @property
    def yprdprobatrn(self):
        return self._yprdprobatrn

    @yprdprobatrn.setter
    def yprdprobatrn(self,new_yprdprobatrn):
        self._yprdprobatrn = new_yprdprobatrn

    @property
    def yprdprobaval (self):
        return self._yprdprobaval

    @yprdprobaval.setter
    def yprdprobaval (self,new_yprdprobaval):
        self._yprdprobaval = new_yprdprobaval


    @property
    def yprdprobatest (self):
        return self._yprdprobatest

    @yprdprobatest.setter
    def yprdprobatest (self,new_yprdprobatest):
        self._yprdprobatest = new_yprdprobatest

    def load_data(self,mltype):
        #E:\appliedaiacourse\assignments\dblite\dtree\balanced\bowvectorizer\1
k
        f1name = 'E:/appliedaicourse/assignments/dblite/1kpts'
        if mltype == 'BOW':
            fname1 = f1name + '/unbalanced/bowvectorizer/ppvectscld_x_train'
            fname2 = f1name + '/unbalanced/bowvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/unbalanced/bowvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/unbalanced/bowvectorizer/ppvectscld_xval'
            fname5 = f1name + '/unbalanced/bowvectorizer/y_train'
            fname6 = f1name + '/unbalanced/bowvectorizer/y_test'
            fname7 = f1name + '/unbalanced/bowvectorizer/ytrain'
```

```
            fname8 = f1name + '/unbalanced/bowvectorizer/yval'
            fname9 = f1name + '/unbalanced/bowvectorizer/bow_feat'
        elif mltype == 'BOWBAL':
            f1name = 'E:/appliedaicourse/assignments/dblite/1kpts'
            fname1 = f1name + '/balanced/bowvectorizer/ppvectscld_x_train'
            fname2=  f1name + '/balanced/bowvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/balanced/bowvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/balanced/bowvectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/bowvectorizer/y_train'
            fname6 = f1name + '/balanced/bowvectorizer/y_test'
            fname7 = f1name + '/balanced/bowvectorizer/ytrain'
            fname8 = f1name + '/balanced/bowvectorizer/yval'
            fname9 = f1name + '/balanced/bowvectorizer/bow_feat'

        elif mltype == 'TFIDF':
            fname1 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_x_train'
            fname2 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_xval'
            fname5 = f1name + '/unbalanced/tfidfvectorizer/y_train'
            fname6 = f1name + '/unbalanced/tfidfvectorizer/y_test'
            fname7 = f1name + '/unbalanced/tfidfvectorizer/ytrain'
            fname8 = f1name + '/unbalanced/tfidfvectorizer/yval'
            fname9 = f1name + '/unbalanced/tfidfvectorizer/tfidf_feat'

        elif mltype == 'TFIDFBAL':
            fname1 = f1name + '/balanced/tfidfvectorizer/ppvectscld_x_train'
            fname2 = f1name + '/balanced/tfidfvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/balanced/tfidfvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/balanced/tfidfvectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/tfidfvectorizer/y_train'
            fname6 = f1name + '/balanced/tfidfvectorizer/y_test'
            fname7 = f1name + '/balanced/tfidfvectorizer/ytrain'
            fname8 = f1name + '/balanced/tfidfvectorizer/yval'
            fname9 = f1name + '/balanced/tfidfvectorizer/tfidf_feat'

        elif mltype == 'AVGW2V':
            fname1 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_x_train'
            fname2 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_x_test'
            fname3 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_xval'
            fname5 = f1name + '/unbalanced/avgw2vectorizer/y_train'
            fname6 = f1name + '/unbalanced/avgw2vectorizer/y_test'
            fname7 = f1name + '/unbalanced/avgw2vectorizer/ytrain'
            fname8 = f1name + '/unbalanced/avgw2vectorizer/yval'
        elif mltype == 'WTW2V':
            fname1 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_x_tr
ain'
            fname2 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_x_te
st'
            fname3 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_xtra
in'
            fname4 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_xva
l'
            fname5 = f1name + '/unbalanced/tfidfwtw2vectorizer/y_train'
            fname6 = f1name + '/unbalanced/tfidfwtw2vectorizer/y_test'
            fname7 = f1name + '/unbalanced/tfidfwtw2vectorizer/ytrain'
```

```
            fname8 = f1name + '/unbalanced/tfidfwtw2vectorizer/yval'
            fname9 = f1name + '/unbalanced/tfidfwtw2vectorizer/tfidf_feat'

        elif mltype == 'AVGW2VBAL':
            fname1 = f1name + '/balanced/avgw2vectorizer/ppvectscld_x_train'
            fname2 = f1name + '/balanced/avgw2vectorizer/ppvectscld_x_test'
            fname3 = f1name + '/balanced/avgw2vectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/balanced/avgw2vectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/avgw2vectorizer/y_train'
            fname6 = f1name + '/balanced/avgw2vectorizer/y_test'
            fname7 = f1name + '/balanced/avgw2vectorizer/ytrain'
            fname8 = f1name + '/balanced/avgw2vectorizer/yval'
        elif mltype == 'WTW2VBAL':
            fname1 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_x_trai
n'
            fname2 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_x_tes
t'
            fname3 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_xtrai
n'
            fname4 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/tfidfwtw2vectorizer/y_train'
            fname6 = f1name + '/balanced/tfidfwtw2vectorizer/y_test'
            fname7 = f1name + '/balanced/tfidfwtw2vectorizer/ytrain'
            fname8 = f1name + '/balanced/tfidfwtw2vectorizer/yval'


        with open (fname1, 'rb') as fp:
            self.X_train = pickle.load(fp)

        with open (fname2, 'rb') as fp:
            self.X_test = pickle.load(fp)

        with open (fname3, 'rb') as fp:
            self.xtrain = pickle.load(fp)

        with open (fname4, 'rb') as fp:
            self.xval = pickle.load(fp)

        with open (fname5, 'rb') as fp:
            self.y_train = pickle.load(fp)

        with open (fname6, 'rb') as fp:
            self.y_test = pickle.load(fp)

        with open (fname7, 'rb') as fp:
            self.ytrain = pickle.load(fp)

        with open (fname8, 'rb') as fp:
            self.yval = pickle.load(fp)

        if (mltype == 'BOW' or mltype=='TFIDF' or mltype == 'BOWBAL' or mltype
== 'TFIDFBAL' or mltype=='WTW2V'):
            with open (fname9, 'rb') as fp:
                self.feat_names = pickle.load(fp)
        """
        print('X_train shape', self.X_train.shape)
        print('y_train shape', self.y_train.shape)
```

```
        print('X_test shape', self.X_test.shape)
        print('y_test shape', self.y_test.shape)
        """


    def RndFrstClasifier(self):
        self.rndfrst_clf = RandomForestClassifier(bootstrap=True, criterion='g
ini',
                                                  max_depth=50, max_features='au
to',
                                                  min_samples_leaf=15, min_sampl
es_split=35,
                                                  n_estimators=500, n_jobs=2,
                                                  class_weight={0:5.1895,1:1},ra
ndom_state=42,
                                                  verbose=100)
        return self.rndfrst_clf

    def RndFrstClasifierwNoWts(self):
        self.rndfrst_clf = RandomForestClassifier(bootstrap=True, criterion='g
ini',
                                                  max_depth=50, max_features='au
to',
                                                  min_samples_leaf=15, min_sampl
es_split=35,
                                                  n_estimators=500, n_jobs=2,
                                                  random_state=42,
                                                  verbose=100)
        return self.rndfrst_clf


    def getRndFrstClasifier(self):
        return self.rndfrst_clf


    @property
    def rndfrst_clf(self):
        return self._rndfrst_clf

    @rndfrst_clf.setter
    def rndfrst_clf(self,new_rndfrst_clf):
        self._rndfrst_clf = new_rndfrst_clf


    #set max_depth parameter for classifier
    def setmaxdepthparm(self,prmval):
        params = {'max_depth': prmval}
        (self.rndfrst_clf).set_params(**params)

        return self.rndfrst_clf

    #set min_samples_split parameter for classifier
    def setminsmpsplitparm(self,prmval):
        params = {'min_samples_split': prmval}
        (self.rndfrst_clf).set_params(**params)
        return self.rndfrst_clf
```

```
    #set number of estimators
    def setnestparm(self,prmval):
        params = {'n_estimators': prmval}
        (self.rndfrst_clf).set_params(**params)
        return self.rndfrst_clf

    # set min samples leaf
    def setminsamplfparm(self,prmval):
        params = {'min_samples_leaf': prmval}
        (self.rndfrst_clf).set_params(**params)
        return self.rndfrst_clf


    def rndfrst_hyperparamtuning(self,measure,cvfold=5,verbose=100):


        param_grid = {'max_depth': [3, 5, 6, 7, 9, 12, 14, 15, 20],
                      'min_samples_leaf': [70, 60, 50],
                      'n_estimators': [200,300,400,500,600,700,800,900,1000]
                      }

        meas_scoring = {'roc_auc_score': 'roc_auc'}

        cvfold=5
        vbose=100
        #get the classifier
        grdsch_clf = self.rndfrstClasifier()

        grdschcv = GridSearchCV(grdsch_clf,param_grid,scoring='roc_auc',cv=cvf
old, verbose=vbose,n_jobs=2)

        #fit the data with the classifier
        grdschcv.fit(self.X_train,self.y_train)

        #y_pred = grdschcv.predict(self.X_test)
        #y_scores = grdschcv.predict_proba(self.X_test)[:, 1]

        print('Best params for {}'.format(measure))
        print(grdschcv.best_params_)
        print(grdschcv.best_estimator_)

        fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/grd_srch_no
clswts_tfidf_params.out'
        with open(fname, 'wb') as fp:
            pickle.dump(grdschcv.best_params_, fp)

        fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/grd_srch_no
clswts_tfidf_estim.out'
        with open(fname, 'wb') as fp:
            pickle.dump(grdschcv.best_estimator_, fp)

        fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/grd_srch_no
clswts_tfidf_score.out'
        with open(fname, 'wb') as fp:
            pickle.dump(grdschcv.best_score_, fp)

        #print('\nConfusion matrix of Random Forest optimized for {} on the te
```

```
st data:'.format(measure))

        #return [grdschcv.best_estimator_,grdschcv.best_score_,grdschcv.best_p
arams_,grdschcv,y_pred,y_scores]
        return [grdschcv.best_estimator_,grdschcv.best_score_,grdschcv.best_pa
rams_,grdschcv]

    def RNDFRST_calcrocaucscore(self):

        """
            this function uses CalibratedClasifierCV for prediciting probabili
ties
            this is an imbalanced dataset hence we are using class weights and
            sample weights in the fit process
        """

        max_depth = [3, 5, 6, 7, 9, 12, 14, 15, 20]

        n_est = [200,300,400,500,600,700,800,900,1000]

        #trn_smp_wts=compute_sample_weight(class_weight={0:5.14,1:1}, y=self.y
train)
        #val_smp_wts=compute_sample_weight(class_weight={0:5.14,1:1}, y=self.y
val)

        rocaucval_trn = 0.0
        rocaucval_val = 0.0

        for mxdpth in max_depth:

            # set max_depth param for classifier
            self.setmaxdepthparm(mxdpth)

            for nest in n_est :

                # set min_samples_split param for classifier
                self.setnestparm(nest)

                # fit the x-train model
                #(self.rndfrst_clf).fit(self.xtrain,self.ytrain,sample_weight=
trn_smp_wts)
                (self.rndfrst_clf).fit(self.xtrain,self.ytrain)

                my_calib = CalibratedClassifierCV((self.rndfrst_clf),method='s
igmoid',cv='prefit')
                my_calib.fit(self.xtrain,self.ytrain)

                self.yprdprobatrn =  (my_calib).predict_proba(self.xtrain)[:,1
]
                rocaucval_trn = roc_auc_score(self.ytrain,self.yprdprobatrn)
                #great python appending a row to dataframe doesnt happen impla
ce you need to store the output back
                (self.rndfrst_hmap_train)= (self.rndfrst_hmap_train).append([{
'mxdpth': mxdpth,'numestim':nest,'rocaucscore': rocaucval_trn}])

                #fit the validation model
                (self.rndfrst_clf).fit(self.xval,self.yval)
```

```
                my_calib_1 = CalibratedClassifierCV((self.rndfrst_clf),method=
'sigmoid',cv='prefit')
                my_calib_1.fit(self.xval,self.yval)

                self.yprdprobaval =  (my_calib_1).predict_proba(self.xval)[:,1
]
                rocaucval_val = roc_auc_score(self.yval,self.yprdprobaval)

                print('max depth {0}. no of estimators {1} probability and roc
auc score generation for training validation data complete..'.format(mxdpth,ne
st))

                #apppend minsmpsplit value to list for  plotting
                (self.rndfrst_min_smp_split).append(nest)
                (self.rndfrst_hmap_val)= (self.rndfrst_hmap_val).append([{'mxd
pth': mxdpth,'numestim':nest,'rocaucscore': rocaucval_val}])

            #append maxdepth value to the list for plotting
            (self.rndfrst_max_depth).append(mxdpth)


        print('Function exiting...')


    def RNDFRST_actClasifier(self,n_ests,max_dpth,minsmpleaf,fitsmpwts=False):

        """
            this function uses CalibratedClasifierCV for prediciting probabili
ties
            this is an imbalanced dataset hence we are using class weights and
            sample weights in the fit process
        """
        if fitsmpwts == True :
            train_clf = self.RndFrstClasifier()
            test_clf = self.RndFrstClasifier()
        else:
            train_clf = self.RndFrstClasifierwNoWts()
            test_clf = self.RndFrstClasifierwNoWts()

        params = {'max_depth': max_dpth}
        (train_clf).set_params(**params)

        params = {'n_estimators': n_ests}
        (train_clf).set_params(**params)

        params = {'min_samples_leaf': minsmpleaf}
        (train_clf).set_params(**params)

        #compute all the sanple weughts
        trn_smp_wts=compute_sample_weight(class_weight={0:5.19,1:1}, y=self.yt
rain)
        val_smp_wts=compute_sample_weight(class_weight={0:5.19,1:1}, y=self.yv
al)
        train_smp_wts=compute_sample_weight(class_weight={0:5.19,1:1}, y=self.
y_train)
        test_smp_wts=compute_sample_weight(class_weight={0:5.19,1:1}, y=self.y
```

```
_test)

        # fit train again and predict probabilites  from xtrain
        if (fitsmpwts):
            (train_clf).fit(self.xtrain,self.ytrain,sample_weight=trn_smp_wts)
        else:
            (train_clf).fit(self.xtrain,self.ytrain)

        #Calibratedcv for predicting probabilities
        my_calib_1 = CalibratedClassifierCV((train_clf),method='sigmoid',cv='p
refit')

        # fit train with sample weights
        my_calib_1.fit(self.xtrain,self.ytrain,sample_weight=trn_smp_wts)

        # predict probabilites using predict_proba  from calibratedcv
        self.ytrn_predprob_actclf = (my_calib_1).predict_proba(self.xtrain)[:,
1]

        # compute the false-positive r, true positive rates and thresholds
        fpr_trn, tpr_trn, thrshld_trn = roc_curve(self.ytrain, self.ytrn_predp
rob_actclf)

        # cailbratedCv for validation dataset
        my_calib_2 = CalibratedClassifierCV((train_clf),method='sigmoid',cv='p
refit')
        #fit the validation dataset with sample weights
        my_calib_2.fit(self.xval,self.yval,sample_weight=val_smp_wts)

        # predict the labels for validation
        self.predicted = (my_calib_2).predict(self.xval)

        # calculate accuracy_score for validation dataset
        self.accuracy_score_val = accuracy_score(self.yval, self.predicted)

        #setting parameters for the test classifier
        params = {'max_depth': max_dpth}
        (test_clf).set_params(**params)

        params = {'n_estimators': n_ests}
        (test_clf).set_params(**params)

        params = {'min_samples_leaf': minsmpleaf}
        (test_clf).set_params(**params)

        if(fitsmpwts):
            (test_clf).fit(self.X_test,self.y_test,sample_weight=test_smp_wts)
        else:
            (test_clf).fit(self.X_test,self.y_test)


        #calibratedclasifierCV using my model prefit with X_test
        my_calib = CalibratedClassifierCV((test_clf),method='sigmoid',cv='pref
it')

        #predicting probabilities for X_test setweights test sample weights
        my_calib.fit(self.X_test,self.y_test,sample_weight=test_smp_wts)
```

```
        # predict xtest labels
        self.test_predict = (my_calib).predict(self.X_test)

        print('***X_test predict',self.test_predict)

        #store the classifier parameters
        self.clasify_params['clfparams'] = (test_clf).get_params(deep=True)

        #calculate accuracy_score for X_test
        self.accuracy_score_test = accuracy_score(self.y_test, self.test_predi
ct)

        # generate classification report for X_test
        print(classification_report(self.y_test, self.test_predict))

        # confusion matrix for ytest
        tn, fp, fn, tp = confusion_matrix(self.y_test, self.test_predict ).rav
el()
        self.confsnmtxytstpred['tn'] = tn
        self.confsnmtxytstpred['fp'] = fp
        self.confsnmtxytstpred['fn'] = fn
        self.confsnmtxytstpred['tp'] = tp

        # predict probabilites  from xtest for roc_curve
        self.ytst_predprob_actclf = (my_calib).predict_proba(self.X_test)[:,1]

        print('*** predict probabilities***',self.ytst_predprob_actclf)

        fpr, tpr, thrshld_test = roc_curve(self.y_test,self.ytst_predprob_actc
lf)

        # store the above into the dictionary
        self.roc_curve_test['fpr_trn'] = fpr_trn
        self.roc_curve_test['tpr_trn'] =  tpr_trn
        self.roc_curve_test['thrshld_trn'] = thrshld_trn
        self.roc_curve_test['fpr'] = fpr
        self.roc_curve_test['tpr'] = tpr
        self.roc_curve_test['thrshld_test'] = thrshld_test

        self.rndfrst_clf = test_clf

    def genwrdcldwords(self):
        top10_negve = sorted(zip((self.rndfrst_clf).feature_importances_, self
.feat_names))[-20:]
        top10_posve = sorted(zip((self.rndfrst_clf).feature_importances_, self
.feat_names))[:20]
        feat_pos=[]
        feat_neg=[]
        features=""
        for coef,feat in (top10_negve):
            feat_pos.append(feat)

        for cef,feat in (top10_posve):
            feat_neg.append(feat)

        i=0
```

```
        while i< int(len(feat_pos)):
            feat_item=[]
            features = features + " " + feat_pos[i]
            features = features + " " + feat_neg[i]

            i +=1
        return features
```

Common code for displaying results

In [12]:
```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
import seaborn as sn


class drawgraphs:
    def __init__(self):
        self.graph_parameters= {}
        self.plt = None

    #self.graph_parameters['']=
    def setdefaultparm(self):
        self.Xdata=pd.DataFrame()
        self.ydatatrn=pd.DataFrame()
        self.ydataval=pd.DataFrame()
        self.graph_parameters['figsize_x']= 16
        self.graph_parameters['figsize_y']= 16
        self.graph_parameters['show_legnd']= False
        self.graph_parameters['show_grid']= True
        self.graph_title = None
        self.legnd_1x = None
        self.legnd_2 = None
        self.label_x = None
        self.label_y = None


    @property
    def Xdata(self):
        return self._Xdata

    @Xdata.setter
    def Xdata(self,new_Xdata):
        self._Xdata = new_Xdata


    @property
    def ydatatrn(self):
        return self._ydatatrn

    @ydatatrn.setter
    def ydatatrn(self,new_ydatatrn):
        self._ydatatrn = new_ydatatrn

    @property
    def ydataval(self):
        return self._ydataval

    @ydataval.setter
    def ydataval(self,new_ydataval):
        self._ydataval = new_ydataval


    @property
    def graph_title(self):
        return self._graph_title
```

```
    @graph_title.setter
    def graph_title(self,new_title):
        self._graph_title = new_title


    @property
    def legnd_1(self):
        return self._legnd_1

    @legnd_1.setter
    def legnd_1(self,new_legnd1):
        self._legnd_1 = new_legnd1


    @property
    def legnd_2(self):
        return self._legnd_2

    @legnd_2.setter
    def legnd_2(self,new_legnd2):
        self._legnd_2 = new_legnd2


    @property
    def label_x(self):
        return self._label_x

    @label_x.setter
    def label_x(self,new_lblx):
        self._label_x = new_lblx


    @property
    def label_y(self):
        return self._label_y

    @label_y.setter
    def label_y(self,new_labely):
        self._label_y = new_labely


    #this should be changed so that data is not stored as an instance variable
    #data is atored as an instance variable and then this fn is called
    def rocacuscoregraph(self):
        plt.figure(figsize=(self.graph_parameters['figsize_x'],self.graph_para
meters['figsize_y']))
        y1=np.asarray(self.ydatatrn)
        y1 = y1.reshape(-1,1)
        y2=np.asarray(self.ydataval)
        y2 = y2.reshape(-1,1)
        x = np.log(self.Xdata)
        plt.plot(x,y1, label=self.legnd_1)
        plt.plot(x,y2, label=self.legnd_2)
        plt.xlabel(self.label_x)
        plt.ylabel(self.label_y)
        plt.title(self.graph_title)
```

```
        plt.grid(self.graph_parameters['show_grid'])

        if self.graph_parameters['show_legnd'] :
            plt.legend()
        plt.show()

    # the calling fn passes the data
    def constructgraph(self, fpr_trn, tpr_trn, fpr, tpr):
        plt.figure(figsize=(self.graph_parameters['figsize_x'],self.graph_para
meters['figsize_y']))
        plt.plot([0,1],[0,1],'k--')
        plt.plot(fpr_trn,tpr_trn, label=self.legnd_1)
        plt.plot(fpr,tpr, label=self.legnd_2)
        plt.xlabel(self.label_x)
        plt.ylabel(self.label_y)
        plt.title(self.graph_title)
        plt.grid(self.graph_parameters['show_grid'])

        if self.graph_parameters['show_legnd'] :
            plt.legend()
        plt.show()

    def draw_table(self,data):
        colors = [["#56b5fd","w"],[ "w","#1ac3f5"]]
        table = plt.table(cellText=data,rowLabels=['Predicted:\n NO','Predicte
d: \nYES'], colLabels=['Actual: \n NO', 'Actual: \n YES'], loc='center',
                          cellLoc='center',cellColours=colors, colColours=['Re
d', 'Green'],rowColours=['Yellow','Green'])

        table.set_fontsize(24)
        for i in range(0,3):
            for j in range(-1,2):
                if (i==0 and j == -1):
                    continue
                table.get_celld()[(i,j)].set_height(0.5)
                table.get_celld()[(i,j)].set_width(0.5)
                table.get_celld()[(i,j)].set_linewidth(4)
        plt.axis('off')
        plt.show()

    def draw_accscore(self,data):
        #colors = [["#56b5fd","w"]]
        table = plt.table(cellText=data,colLabels=['Validation','Test'], rowLa
bels=['Accuracy\nScore'], loc='center',
                          cellLoc='center', rowColours=['Green'],colColours=[
"#56b5fd","#1ac3f5"])

        table.set_fontsize(24)
        for i in range(0,2):
            for j in range(-1,2):
                if (i==0 and j == -1):
                    continue
                table.get_celld()[(i,j)].set_height(0.5)
                table.get_celld()[(i,j)].set_width(0.8)
                table.get_celld()[(i,j)].set_linewidth(4)
        plt.axis('off')
        plt.show()
```

```
    #the calling fn passes the values for the cells
    def draw_posnegwords(self,data,topn):
        rowlbls = []

        rwlbl = [i for i in np.arange(1,topn+1)]

        #colors = [["#56b5fd","w"]]
        #table = plt.table(cellText=data,colLabels=['Postive','Negative'], row
Labels=['1','2','3','4','5','6','7','8','9','10'], loc='center',
                          #cellLoc='center',colColours=["#56b5fd","#1ac3f5"])
        table = plt.table(cellText=data,colLabels=['Postive','Negative'], rowL
abels=rwlbl, loc='center',
                  cellLoc='center',colColours=["#56b5fd","#1ac3f5"])

        table.set_fontsize(20)
        for i in range(0,topn+1):
            for j in range(-1,2):
                if (i==0 and j == -1):
                    continue
                #if (i==0 and j == 2):
                    #continue
                table.get_celld()[(i,j)].set_height(0.3)
                table.get_celld()[(i,j)].set_width(0.8)
                table.get_celld()[(i,j)].set_linewidth(4)
        plt.axis('off')
        plt.show()

    #graphing the feature names
    def visual_featname(self,feature_names,coef,top_coefs,num_feat):
         # create plot
        plt.figure(figsize=(21, 7))
        colors = ['red' if c < 0 else 'blue' for c in coef[top_coefs]]
        plt.bar(np.arange(2 * num_feat), coef[top_coefs], color=colors)
        feature_names = np.array(feature_names)
        plt.xticks(np.arange(0, 1 + 2 * num_feat), feature_names[top_coefs], r
otation=60, ha='right')
        plt.show()


    def draw_heatmap(self,pvotable,hmtitle,xhdg,yhdg,desgn='cubehelix'):
        plt.figure(figsize=(9,9))
        plt.title(hmtitle, size=20)
        ax= sn.heatmap(pivot_tbl, annot=True,fmt='0.2f',linewidths=.5,square=T
rue,cmap= desgn)
        ax.set_xlabel(xhdg, size=15)
        ax.set_ylabel(yhdg, size=15)
        plt.show()

    def draw_wordcloud(self,features):
        from wordcloud import WordCloud
        wordcloud = WordCloud(width=480, height=480, max_font_size=20,backgrou
nd_color="black",colormap="PiYG", min_font_size=10).generate(features)

        # plot the WordCloud image
        plt.figure(figsize=(16,16))
```

```
        plt.imshow(wordcloud, interpolation="bilinear")
        plt.axis("off")
        plt.margins(x=0, y=0)
        plt.show()
```

[5.1.1] Applying Random Forests on BOW, SET 1

In [57]:
```
# Please write all the code with proper documentation
```

In [125]:
```
rndfrst_bow = assign9RndFrst()
rndfrst_bow.load_data('BOWBAL')
print(rndfrst_bow.xtrain.shape)
print(rndfrst_bow.xval.shape)
rndfrst_bow_clf = rndfrst_bow.RndFrstClasifierwNoWts()
```

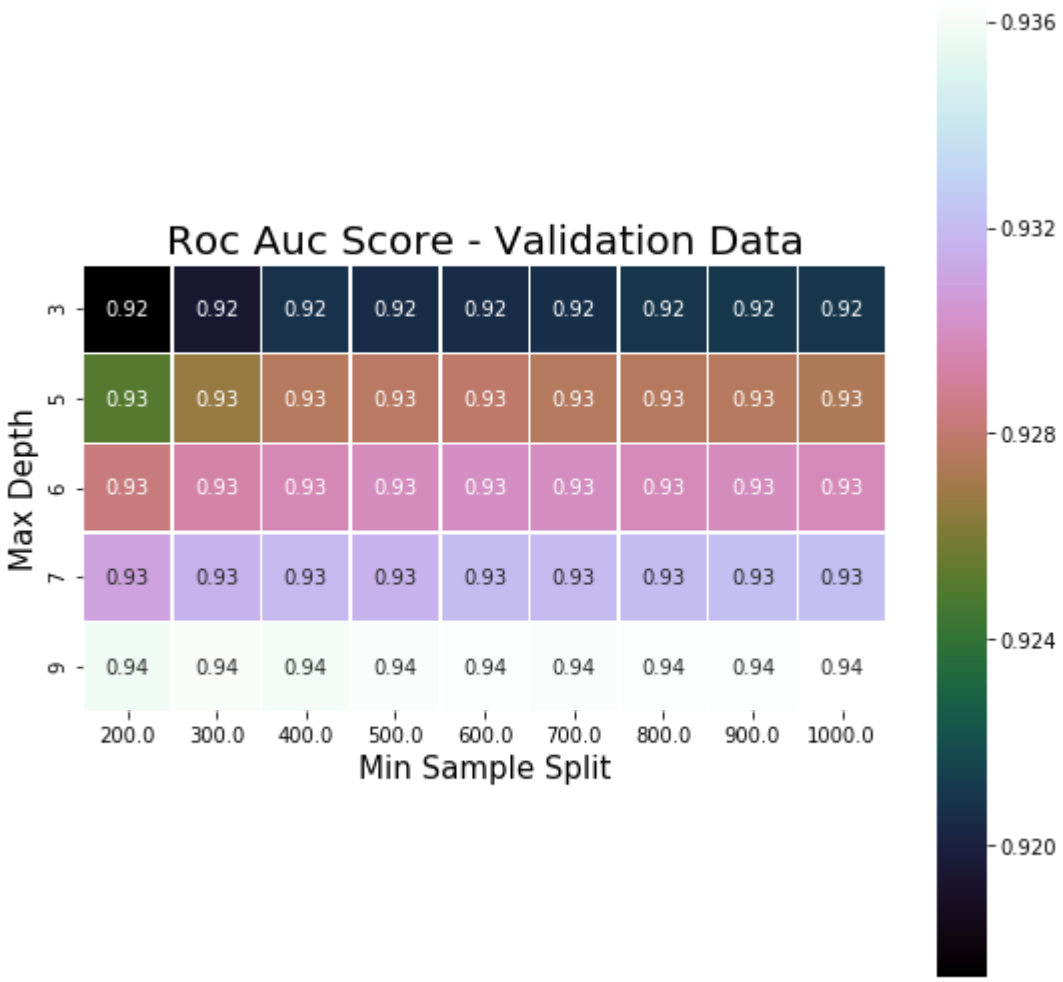
```
(94272, 500)
(23474, 500)
```

Calculate ROC_AUC curve

In [ ]:
```
#rndfrst_bow_clf = rndfrst_bow.RndFrstClasifierwNoWts()
#rndfrst_bow.RNDFRST_calcrocaucscore()
```

In [35]:
```
displayhmap = drawgraphs()

pivot_tbl = rndfrst_bow.rndfrst_hmap_train.pivot(index='mxdpth',columns='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','Num of Estimators','Max Depth')
```

In [36]:
```
pivot_tbl = rndfrst_bow.rndfrst_hmap_val.pivot(index='mxdpth',columns='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','Min Sample Split','Max Depth')
```



Process the actual classifier using Random Forest with no class weights

Data set has not been balanced using SMOTE

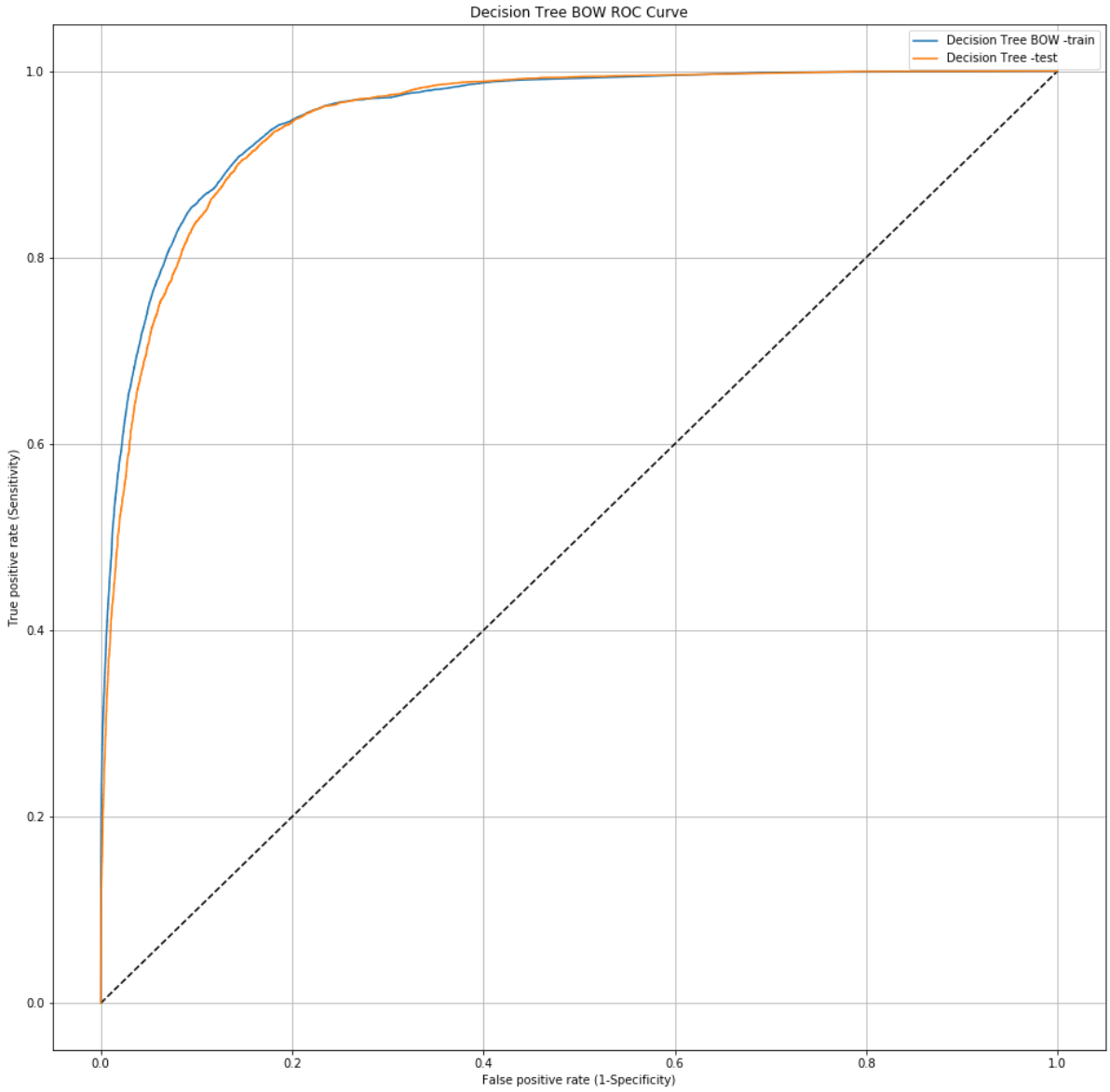
In [ ]:
```
rndfrst_bow.RNDFRST_actClasifier(300,20,50,True)
```

In [130]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[rndfrst_bow.confsnmtxytstpred['tn'] ,rndfrst_bow.confsnmtxytstpred['f
n']],[rndfrst_bow.confsnmtxytstpred['fp'],rndfrst_bow.confsnmtxytstpred['tp'
]]]
displaygraph.draw_table(data)
data1= [[rndfrst_bow.accuracy_score_val,rndfrst_bow.accuracy_score_test]]
displaygraph.draw_accscore(data1)
#tree.export_graphviz(dtree.getDTreClasifier(),feature_names=dtree.feat_names,
class_names=dtree.y_test,\
#                     filled=True, rounded=True,,out_file='D:/Graphviz2.38/bin/
tree_bow_1.dot')
```

	Actual: NO	Actual: YES
Predicted: NO	14200	5302
Predicted: YES	519	9417

	Validation	Test
Accuracy Score	0.7895970009372071	0.8022623819552959

In [131]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='Decision Tree BOW ROC Curve'
displaygraph.legnd_1 = 'Decision Tree BOW -train'
displaygraph.legnd_2 = 'Decision Tree -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(rndfrst_bow.roc_curve_test['fpr_trn'],rndfrst_bow.
roc_curve_test['tpr_trn'],\
                            rndfrst_bow.roc_curve_test['fpr'],rndfrst_bow.roc_
curve_test['tpr'])
```

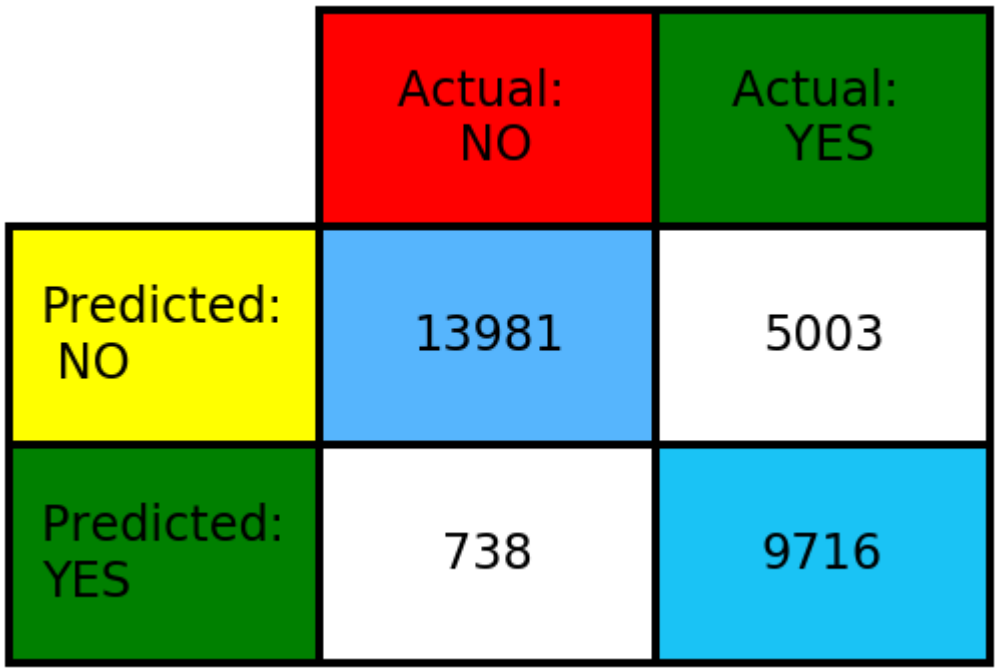


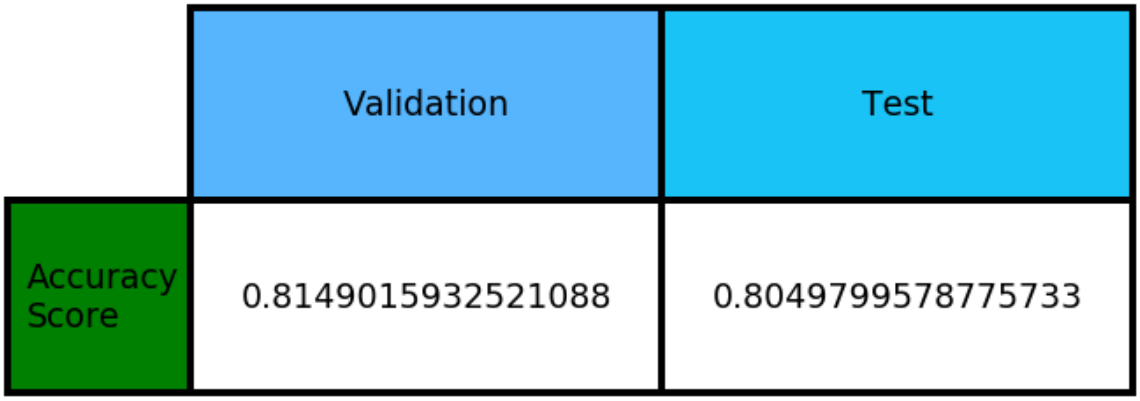
Process the actual classifier using Random Forest with class weights

Data set has not been balanced using SMOTE

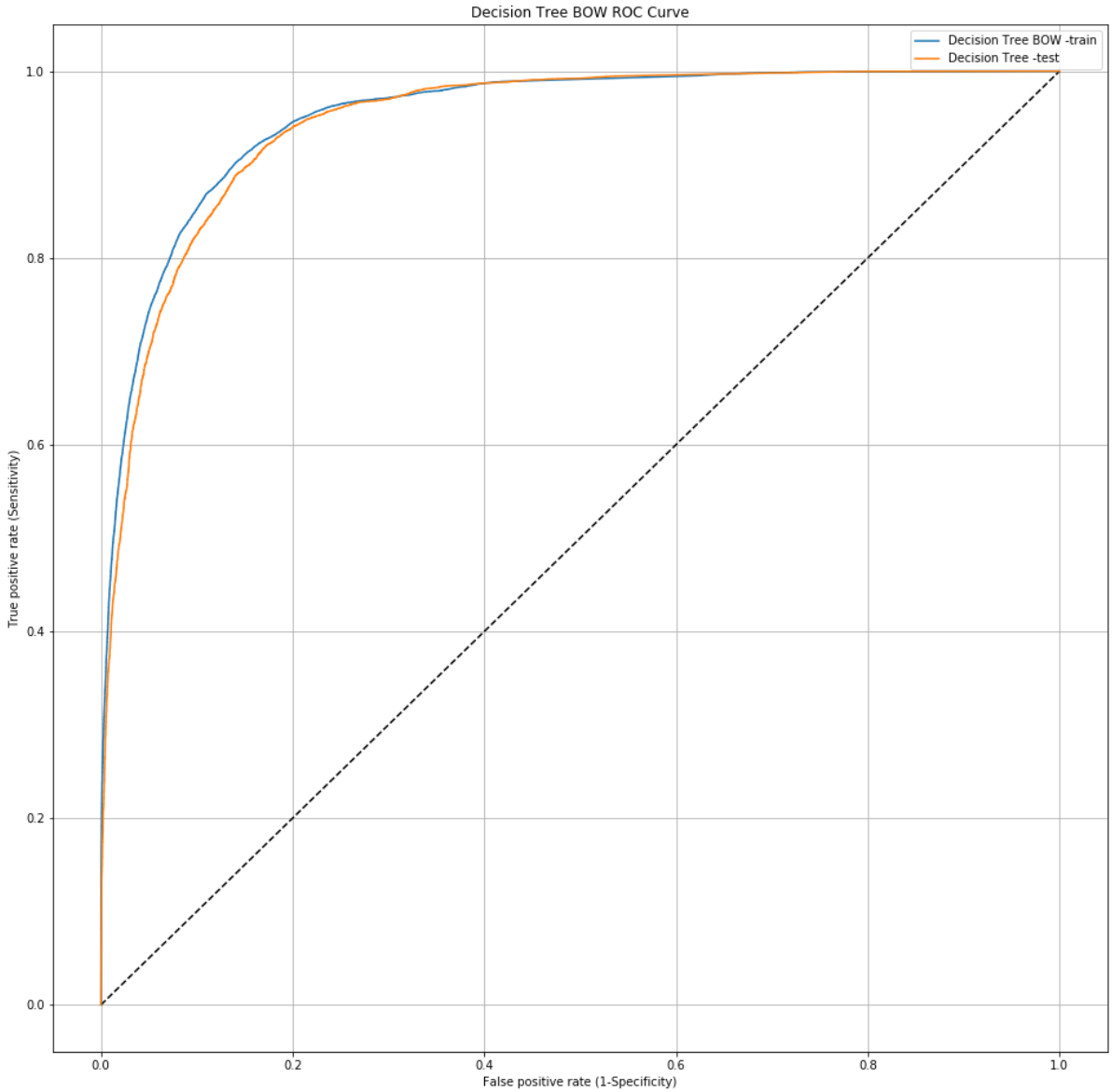
In [ ]:
```
rndfrst_bow.RNDFRST_actClasifier(800,20,50,False)
```

In [133]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[rndfrst_bow.confsnmtxytstpred['tn'] ,rndfrst_bow.confsnmtxytstpred['f
n']],[rndfrst_bow.confsnmtxytstpred['fp'],rndfrst_bow.confsnmtxytstpred['tp'
]]]
displaygraph.draw_table(data)
data1= [[rndfrst_bow.accuracy_score_val,rndfrst_bow.accuracy_score_test]]
displaygraph.draw_accscore(data1)
#tree.export_graphviz(dtree.getDTreClasifier(),feature_names=dtree.feat_names,
class_names=dtree.y_test,\
#                     filled=True, rounded=True,,out_file='D:/Graphviz2.38/bin/
tree_bow_1.dot')
```





In [40]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='Decision Tree BOW ROC Curve'
displaygraph.legnd_1 = 'Decision Tree BOW -train'
displaygraph.legnd_2 = 'Decision Tree -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(rndfrst_bow.roc_curve_test['fpr_trn'],rndfrst_bow.
roc_curve_test['tpr_trn'],\
                            rndfrst_bow.roc_curve_test['fpr'],rndfrst_bow.roc_
curve_test['tpr'])
```



Wordcloud of top 20 important features from SET 1

Wordcloud of top 20 important features from SET 1 with im-balanced dataset

In [134]:
```
rndfrst_clf = rndfrst_bow.getRndFrstClasifier()
feature_names = rndfrst_bow.feat_names
top10_negve = sorted(zip(rndfrst_clf.feature_importances_, feature_names))[-20
:]
top10_posve = sorted(zip(rndfrst_clf.feature_importances_, feature_names))[:20
]
feat_pos=[]
feat_neg=[]
features=""
for coef,feat in (top10_negve):
    feat_pos.append(feat)

for cef,feat in (top10_posve):
    feat_neg.append(feat)

i=0
while i< int(len(feat_pos)):
    feat_item=[]
    features = features + " " + feat_pos[i]
    features = features + " " + feat_neg[i]

    i +=1

print(features)
```

```
 always aftertaste easy almonds well although tasty aroma day artificial also
ate nice beans not beef make believe little bite perfect bottles favorite bow
l use boxes loves bread find brew delicious brown good caffeine best cake lov
e canned great cannot
```

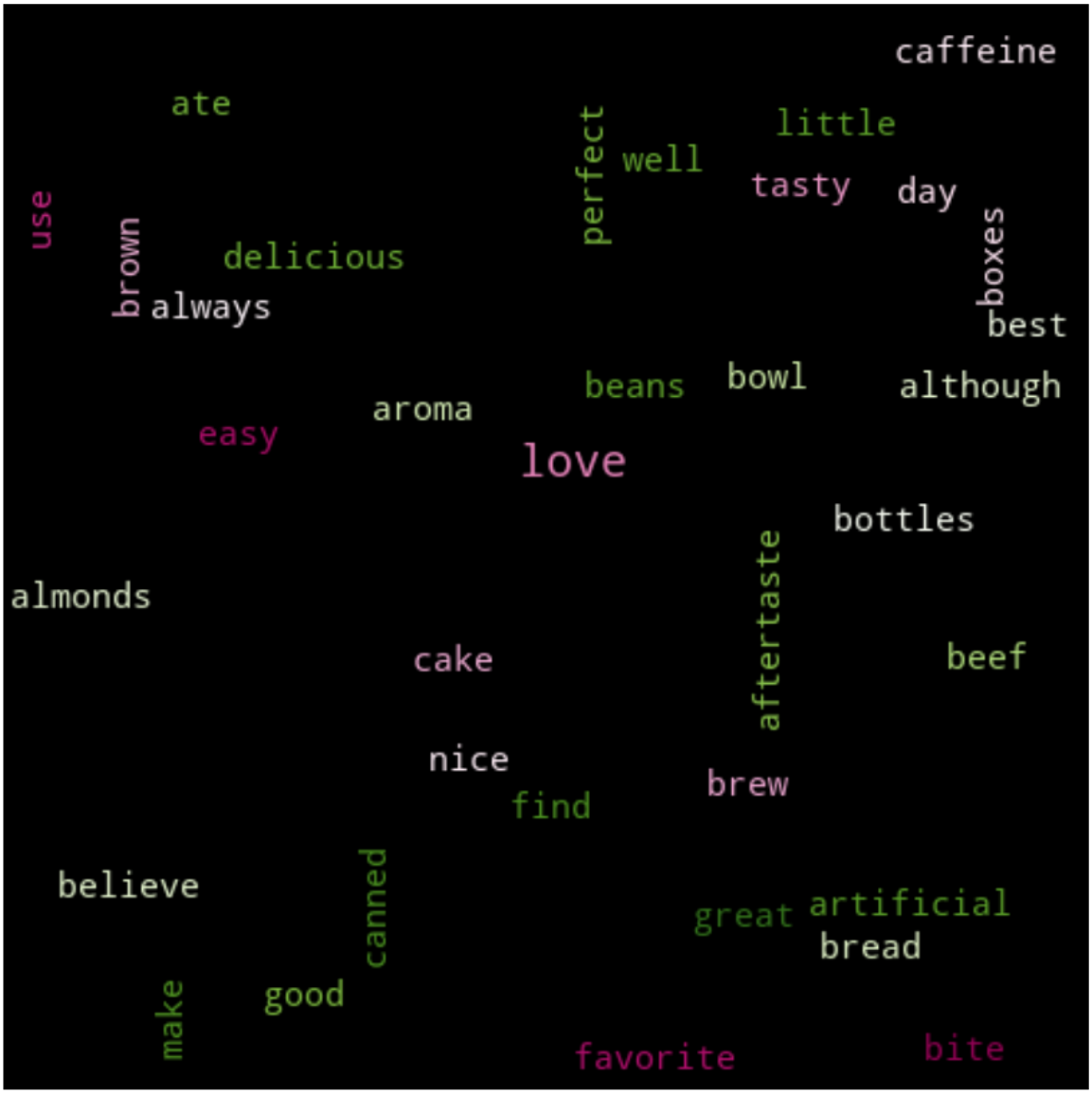
In [135]:
```
feat = rndfrst_bow.genwrdcldwords()
displaygraph.draw_wordcloud(feat)
```

Wordcloud of top 20 important features from SET 1 with balanced dataset

In [136]:
```
rndfrst_clf = rndfrst_bow.getRndFrstClasifier()
feature_names = rndfrst_bow.feat_names
top10_negve = sorted(zip(rndfrst_clf.feature_importances_, feature_names))[-20
:]
top10_posve = sorted(zip(rndfrst_clf.feature_importances_, feature_names))[:20
]
feat_pos=[]
feat_neg=[]
features=""
for coef,feat in (top10_negve):
    feat_pos.append(feat)

for cef,feat in (top10_posve):
    feat_neg.append(feat)

i=0
while i< int(len(feat_pos)):
    feat_item=[]
    features = features + " " + feat_pos[i]
    features = features + " " + feat_neg[i]

    i +=1

print(features)
```

```
 always aftertaste easy almonds well although tasty aroma day artificial also
ate nice beans not beef make believe little bite perfect bottles favorite bow
l use boxes loves bread find brew delicious brown good caffeine best cake lov
e canned great cannot
```

In [137]:
```
feat = rndfrst_bow.genwrdcldwords()
displaygraph.draw_wordcloud(feat)
```



[5.1.2] Applying Random Forests on TFIDF, SET 2

Data has been balanced using Smote

In [0]:
```
# Please write all the code with proper documentation
```

In [139]:
```
rndfrst_tfidf = assign9RndFrst()
```

In [142]:
```
rndfrst_tfidf_clf = rndfrst_tfidf.RndFrstClasifier()
rndfrst_tfidf.load_data('TFIDFBAL')
print(rndfrst_tfidf.xtrain.shape)
print(rndfrst_tfidf.xval.shape)
```

```
(94272, 500)
(23474, 500)
```

Calculate ROC_AUC curve

In [ ]:
```
#rndfrst_tfidf.RNDFRST_calcrocaucscore()
```

In [45]:
```
displayhmap = drawgraphs()
pivot_tbl = rndfrst_tfidf.rndfrst_hmap_train.pivot(index='mxdpth',columns='num estim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','Num of Estimators','Max Depth')
```

In [46]:
```
pivot_tbl = rndfrst_tfidf.rndfrst_hmap_val.pivot(index='mxdpth',columns='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','Num of Estimators','Max Depth')
```

Process the actual classifier using Random Forest with class weights

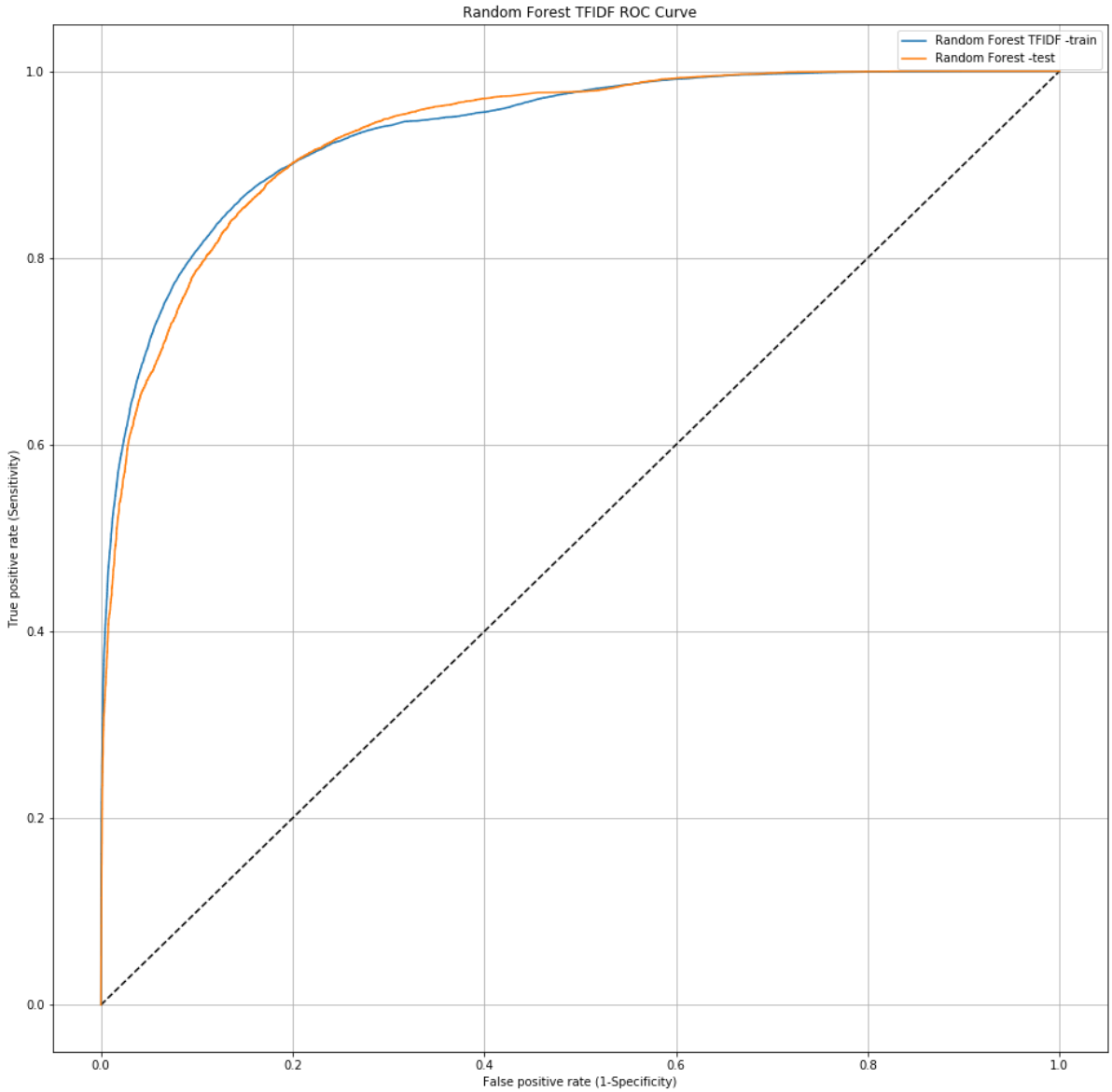
In [ ]:
```
rndfrst_tfidf.RNDFRST_actClasifier(800,20,50,True)
```

In [49]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[rndfrst_tfidf.confsnmtxytstpred['tn'] ,rndfrst_tfidf.confsnmtxytstpre
d['fn']],[rndfrst_tfidf.confsnmtxytstpred['fp'],rndfrst_tfidf.confsnmtxytstpre
d['tp']]]
displaygraph.draw_table(data)
data1= [[rndfrst_tfidf.accuracy_score_val,rndfrst_tfidf.accuracy_score_test]]
displaygraph.draw_accscore(data1)
#tree.export_graphviz(dtree.getDTreClasifier(),feature_names=dtree.feat_names,
class_names=dtree.y_test,\
#                     filled=True, rounded=True,,out_file='D:/Graphviz2.38/bin/
tree_tfidf_1.dot')
```

	Actual: NO	Actual: YES
Predicted: NO	14351	6306
Predicted: YES	368	8413

	Validation	Test
Accuracy Score	0.7395842208400784	0.7732862286840139

In [48]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='Random Forest TFIDF ROC Curve'
displaygraph.legnd_1 = 'Random Forest TFIDF -train'
displaygraph.legnd_2 = 'Random Forest -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(rndfrst_tfidf.roc_curve_test['fpr_trn'],rndfrst_tf
idf.roc_curve_test['tpr_trn'],\
                            rndfrst_tfidf.roc_curve_test['fpr'],rndfrst_tfidf.
roc_curve_test['tpr'])
```



Wordcloud of top 20 important features from SET 2

In [0]:
```
# Please write all the code with proper documentation
```

In [144]:
```
feat = rndfrst_tfidf.genwrdcldwords()
displaygraph.draw_wordcloud(feat)
```

Data has not been balanced

In [0]:
```
# Please write all the code with proper documentation
```

In [145]:
```
rndfrst_tfidf_nbal = assign9RndFrst()
```

In [147]:
```
rndfrst_tfidfnbal_clf = rndfrst_tfidf_nbal.RndFrstClasifierwNoWts()
rndfrst_tfidf_nbal.load_data('TFIDF')
print(rndfrst_tfidf_nbal.xtrain.shape)
print(rndfrst_tfidf_nbal.xval.shape)
```

```
(56174, 500)
(14044, 500)
```

Calculate ROC_AUC curve

In [ ]:
```
#rndfrst_tfidf_nbal.RNDFRST_calcrocaucscore()
```

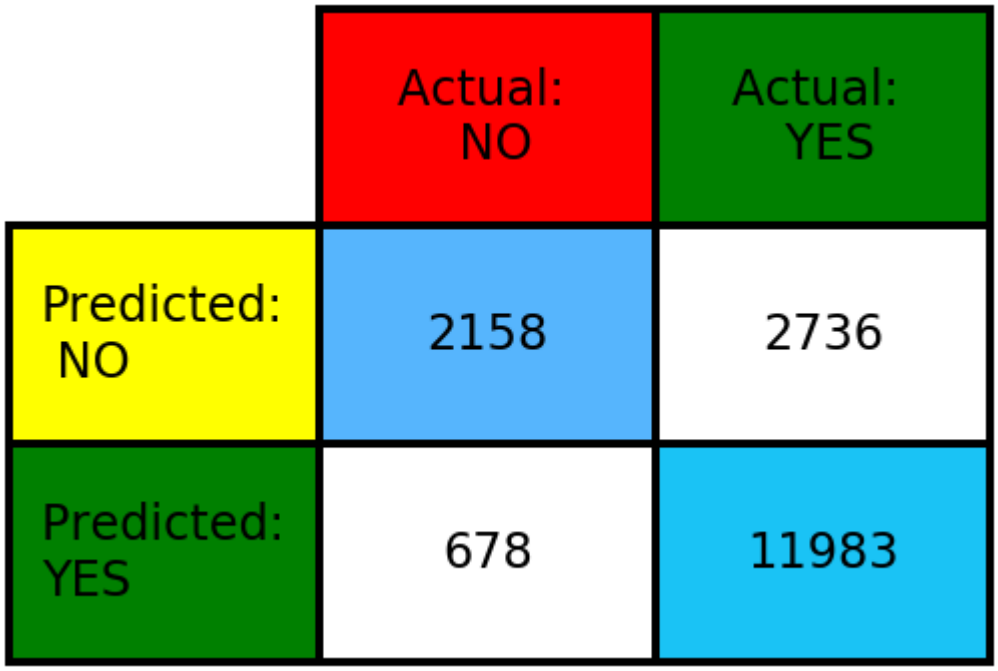
In [53]:
```
displayhmap = drawgraphs()
pivot_tbl = rndfrst_tfidf_nbal.rndfrst_hmap_train.pivot(index='mxdpth',columns
='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','Num of Est
imators','Max Depth')
```

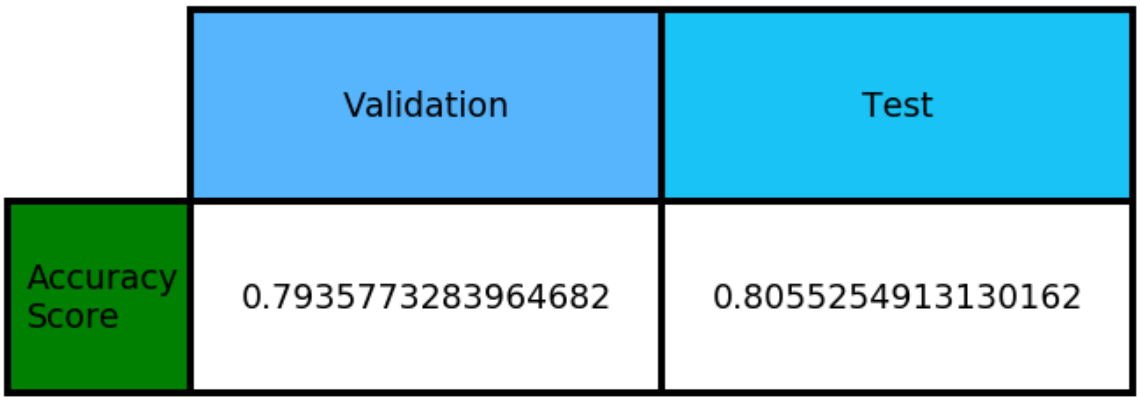
In [54]:
```
pivot_tbl = rndfrst_tfidf_nbal.rndfrst_hmap_val.pivot(index='mxdpth',columns=
'numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','Num of Est
imators','Max Depth')
```

Process the actual classifier using Random Forest

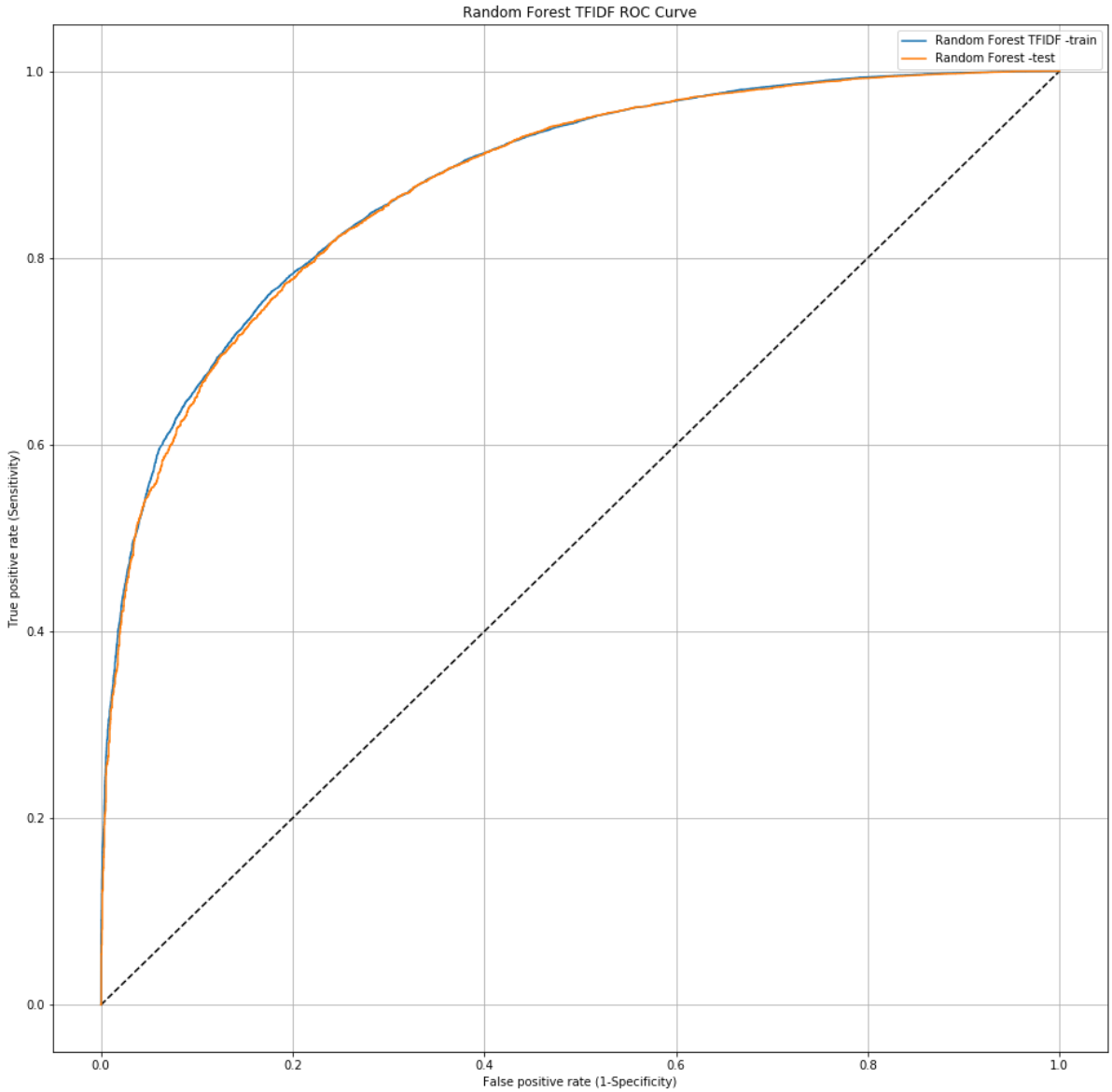
In [ ]:
```
rndfrst_tfidf_nbal.RNDFRST_actClasifier(700,20,50,False)
```

In [56]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[rndfrst_tfidf_nbal.confsnmtxytstpred['tn'] ,rndfrst_tfidf_nbal.confsn
mtxytstpred['fn']],[rndfrst_tfidf_nbal.confsnmtxytstpred['fp'],rndfrst_tfidf_n
bal.confsnmtxytstpred['tp']]]
displaygraph.draw_table(data)
data1= [[rndfrst_tfidf_nbal.accuracy_score_val,rndfrst_tfidf_nbal.accuracy_sco
re_test]]
displaygraph.draw_accscore(data1)
#tree.export_graphviz(dtree.getDTreClasifier(),feature_names=dtree.feat_names,
class_names=dtree.y_test,\
#                     filled=True, rounded=True,,out_file='D:/Graphviz2.38/bin/
tree_tfidf_1.dot')
```





In [57]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='Random Forest TFIDF ROC Curve'
displaygraph.legnd_1 = 'Random Forest TFIDF -train'
displaygraph.legnd_2 = 'Random Forest -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(rndfrst_tfidf_nbal.roc_curve_test['fpr_trn'],rndfr
st_tfidf_nbal.roc_curve_test['tpr_trn'],\
                            rndfrst_tfidf_nbal.roc_curve_test['fpr'],rndfrst_t
fidf_nbal.roc_curve_test['tpr'])
```



Wordcloud of top 20 important features from SET 1 with im-balanced dataset

In [149]:
```
rndfrst_clf = rndfrst_tfidf_nbal.getRndFrstClasifier()
feature_names = rndfrst_bow.feat_names
top10_negve = sorted(zip(rndfrst_clf.feature_importances_, feature_names))[-20
:]
top10_posve = sorted(zip(rndfrst_clf.feature_importances_, feature_names))[:20
]
feat_pos=[]
feat_neg=[]
features=""
for coef,feat in (top10_negve):
    feat_pos.append(feat)

for cef,feat in (top10_posve):
    feat_neg.append(feat)

i=0
while i< int(len(feat_pos)):
    feat_item=[]
    features = features + " " + feat_pos[i]
    features = features + " " + feat_neg[i]

    i +=1

print(features)
```

```
 rich also take alternative making anything night awesome product bags ordere
d bars available beans decided bit goes bitter would blend recipe bottles loo
ked brand three bread believe breakfast back cake wrong cannot milk care got
cats difference chicken nice chips
```

In [150]:
```
feat = rndfrst_bow.genwrdcldwords()
displaygraph.draw_wordcloud(feat)
```

[5.1.3] Applying Random Forests on AVG W2V, SET 3

In [0]:
```
# Please write all the code with proper documentation
```

Data set has been balanced using SMOTE

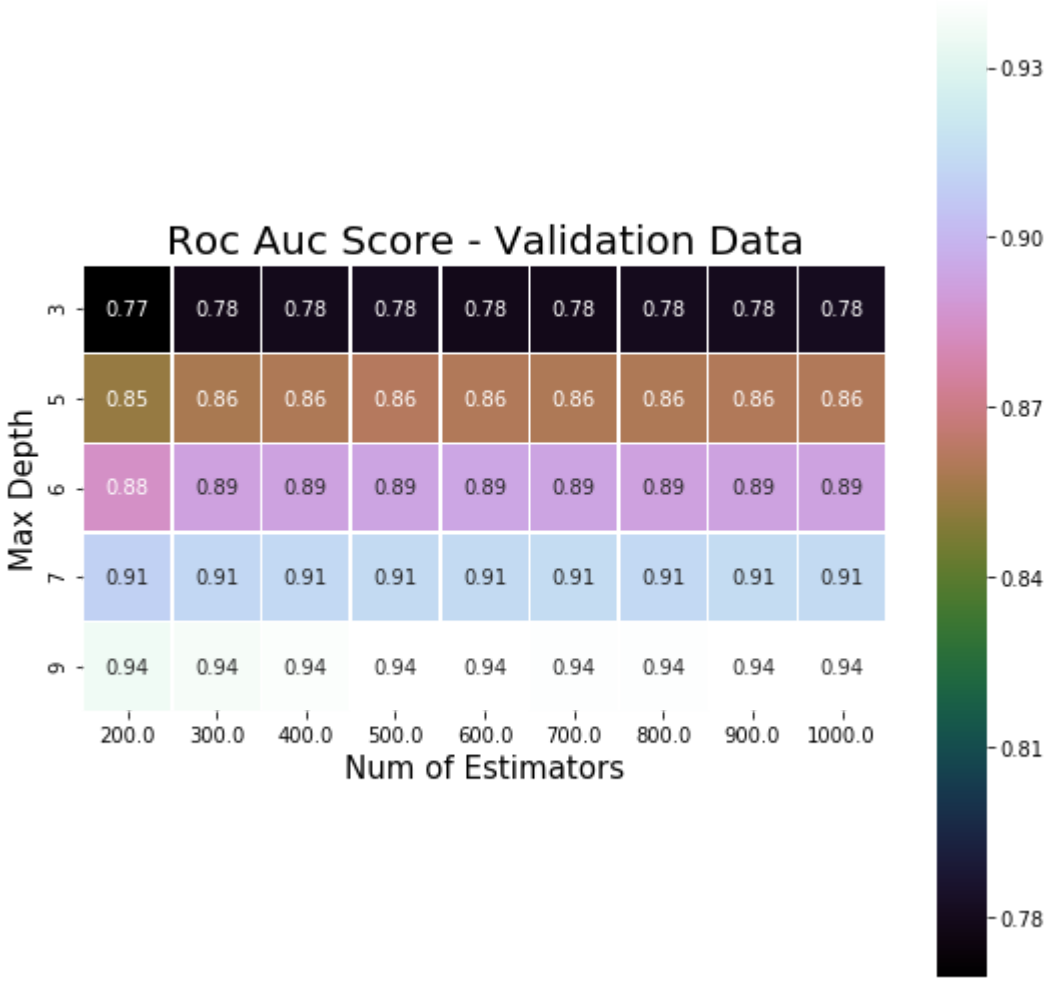
In [3]:
```
rndfrst_avgw2v = assign9RndFrst()
rndfrst_avgw2v.load_data('AVGW2VBAL')
print(rndfrst_avgw2v.xtrain.shape)
print(rndfrst_avgw2v.xval.shape)
rndfrst_avgw2v_clf = rndfrst_avgw2v.RndFrstClasifier()
```

```
X_train shape (12762, 50)
y_train shape (12762,)
X_test shape (3190, 50)
y_test shape (3190,)
(10250, 50)
(2512, 50)
```

In [ ]:
```
#rndfrst_avgw2v.RNDFRST_calcrocaucscore()
```

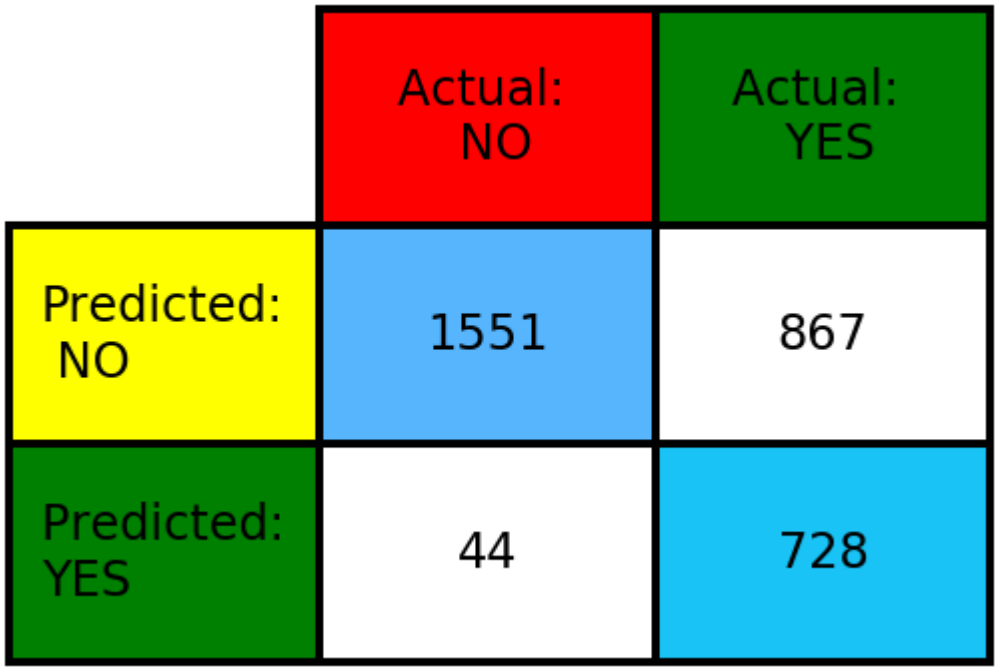
In [5]:
```
displayhmap = drawgraphs()
pivot_tbl = rndfrst_avgw2v.rndfrst_hmap_train.pivot(index='mxdpth',columns='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','Num of Estimators','Max Depth')
```

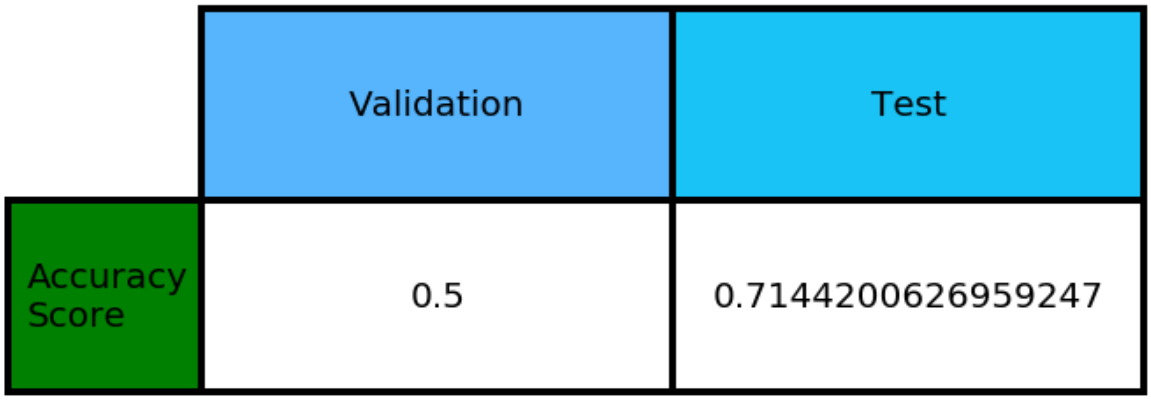
In [6]:
```
pivot_tbl = rndfrst_avgw2v.rndfrst_hmap_val.pivot(index='mxdpth',columns='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','Num of Estimators','Max Depth')
```



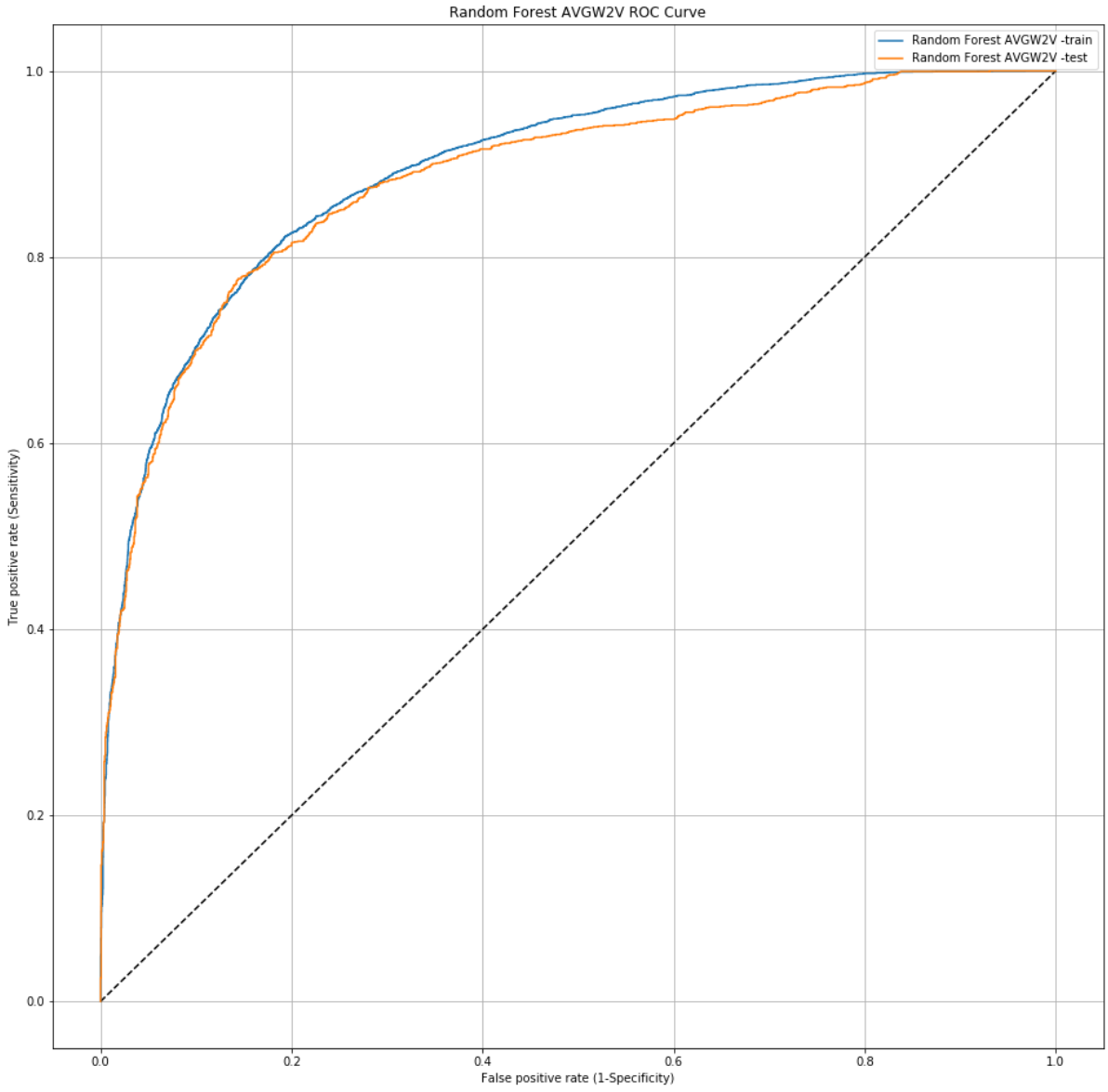
In [ ]:
```
rndfrst_avgw2v.RNDFRST_actClasifier(1000,20,50,True)

#tree.export_graphviz(dtree.getDTreClasifier(),feature_names=dtree.feat_names,class_names=dtree.y_test,\
#                      filled=True, rounded=True,,out_file='D:/Graphviz2.38/bin/tree_avgw2v_1.dot')
```

In [15]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[rndfrst_avgw2v.confsnmtxytstpred['tn'] ,rndfrst_avgw2v.confsnmtxytstp
red['fn']],[rndfrst_avgw2v.confsnmtxytstpred['fp'],rndfrst_avgw2v.confsnmtxyts
tpred['tp']]]
displaygraph.draw_table(data)
data1= [[rndfrst_avgw2v.accuracy_score_val,rndfrst_avgw2v.accuracy_score_test
]]
displaygraph.draw_accscore(data1)
```





In [14]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='Random Forest AVGW2V ROC Curve'
displaygraph.legnd_1 = 'Random Forest AVGW2V -train'
displaygraph.legnd_2 = 'Random Forest AVGW2V -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(rndfrst_avgw2v.roc_curve_test['fpr_trn'],rndfrst_a
vgw2v.roc_curve_test['tpr_trn'],\
                            rndfrst_avgw2v.roc_curve_test['fpr'],rndfrst_avgw2
v.roc_curve_test['tpr'])
```



Data set has not been balanced

In [9]:
```
rndfrst_avgw2v_nbal = assign9RndFrst()
rndfrst_avgw2v_nbal.load_data('AVGW2V')
print(rndfrst_avgw2v_nbal.xtrain.shape)
print(rndfrst_avgw2v_nbal.xval.shape)
rndfrst_avgw2vnbal_clf = rndfrst_avgw2v_nbal.RndFrstClasifier()
```

```
X_train shape (7651, 50)
y_train shape (7651,)
X_test shape (1913, 50)
y_test shape (1913,)
(6120, 50)
(1531, 50)
```

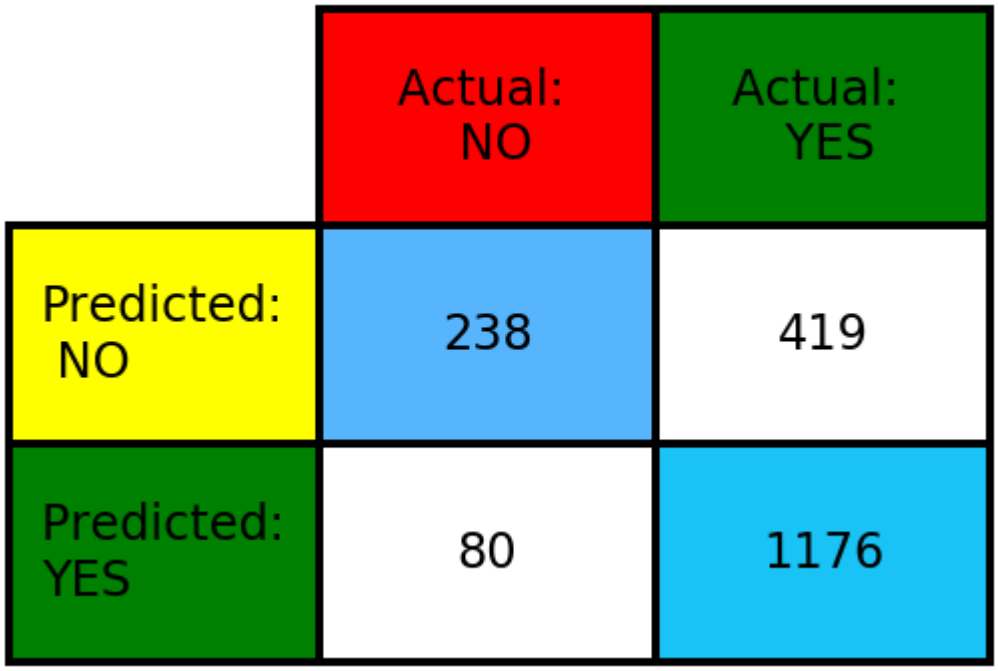
rndfrst_avgw2v_nbal.RNDFRST_calcrocaucscore()

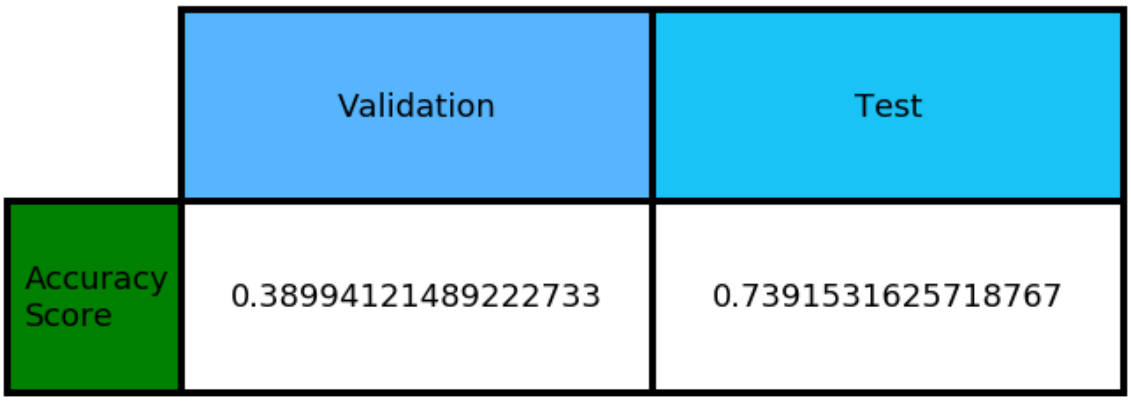
In [11]:
```
displayhmap = drawgraphs()
pivot_tbl = rndfrst_avgw2v_nbal.rndfrst_hmap_train.pivot(index='mxdpth',columns='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','Num of Estimators','Max Depth')
```

In [12]:
```
pivot_tbl = rndfrst_avgw2v_nbal.rndfrst_hmap_val.pivot(index='mxdpth',columns='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','Num of Estimators','Max Depth')
```

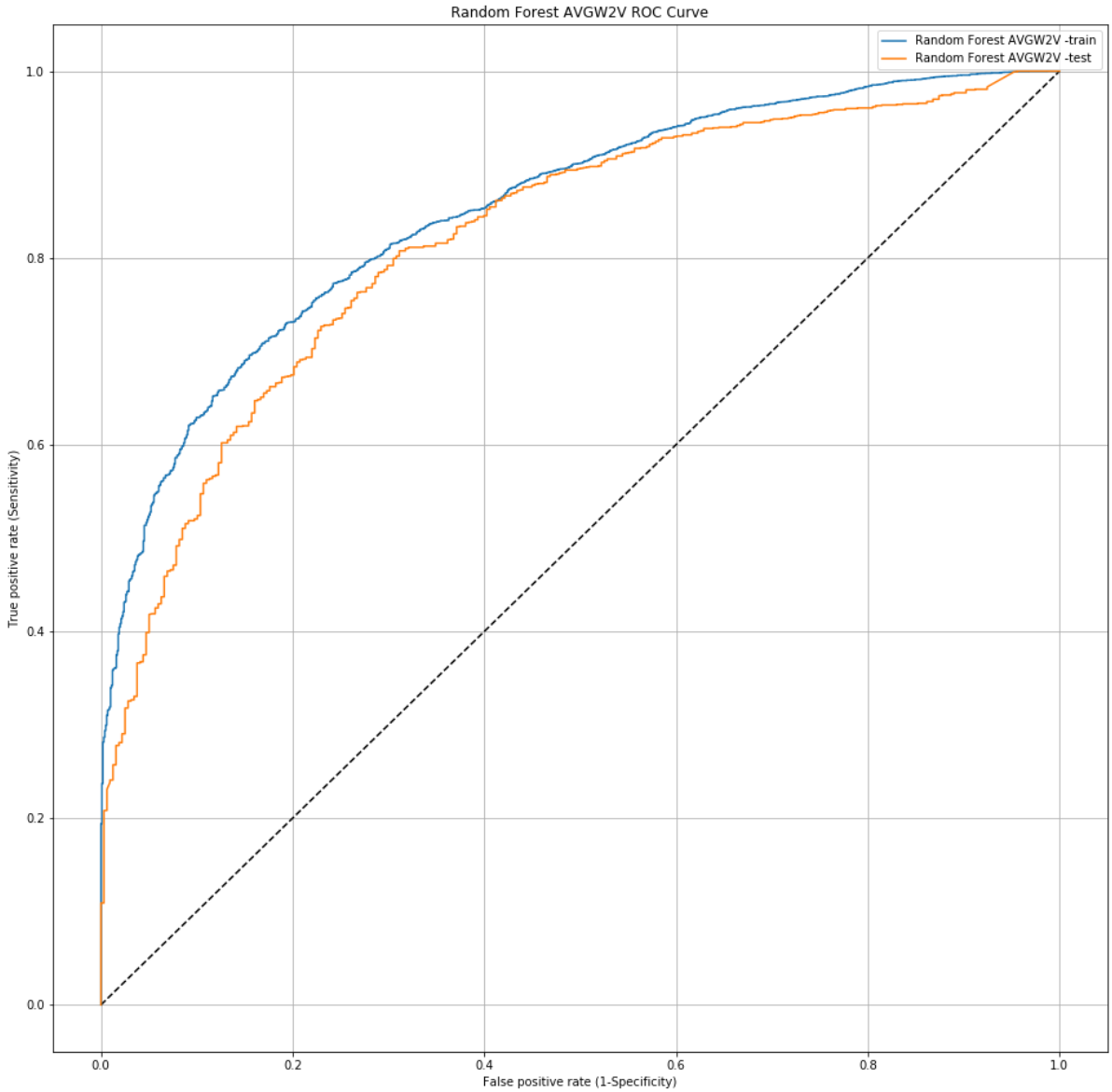
rndfrst_avgw2v_nbal.RNDFRST_actClasifier(900,15,50,False)

In [17]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[rndfrst_avgw2v_nbal.confsnmtxytstpred['tn'] ,rndfrst_avgw2v_nbal.confsnmtxytstpred['fn']],[rndfrst_avgw2v_nbal.confsnmtxytstpred['fp'],rndfrst_avgw2v_nbal.confsnmtxytstpred['tp']]]
displaygraph.draw_table(data)
data1= [[rndfrst_avgw2v_nbal.accuracy_score_val,rndfrst_avgw2v_nbal.accuracy_score_test]]
displaygraph.draw_accscore(data1)
#tree.export_graphviz(dtree.getDTreClasifier(),feature_names=dtree.feat_names,class_names=dtree.y_test,\
#                     filled=True, rounded=True,,out_file='D:/Graphviz2.38/bin/tree_avgw2v_1.dot')
```





In [18]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='Random Forest AVGW2V ROC Curve'
displaygraph.legnd_1 = 'Random Forest AVGW2V -train'
displaygraph.legnd_2 = 'Random Forest AVGW2V -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(rndfrst_avgw2v_nbal.roc_curve_test['fpr_trn'],rndf
rst_avgw2v_nbal.roc_curve_test['tpr_trn'],\
                            rndfrst_avgw2v_nbal.roc_curve_test['fpr'],rndfrst_
avgw2v_nbal.roc_curve_test['tpr'])
```



[5.1.4] Applying Random Forests on TFIDF W2V, SET 4

In [0]:
```
# Please write all the code with proper documentation
```

Data set has been balanced

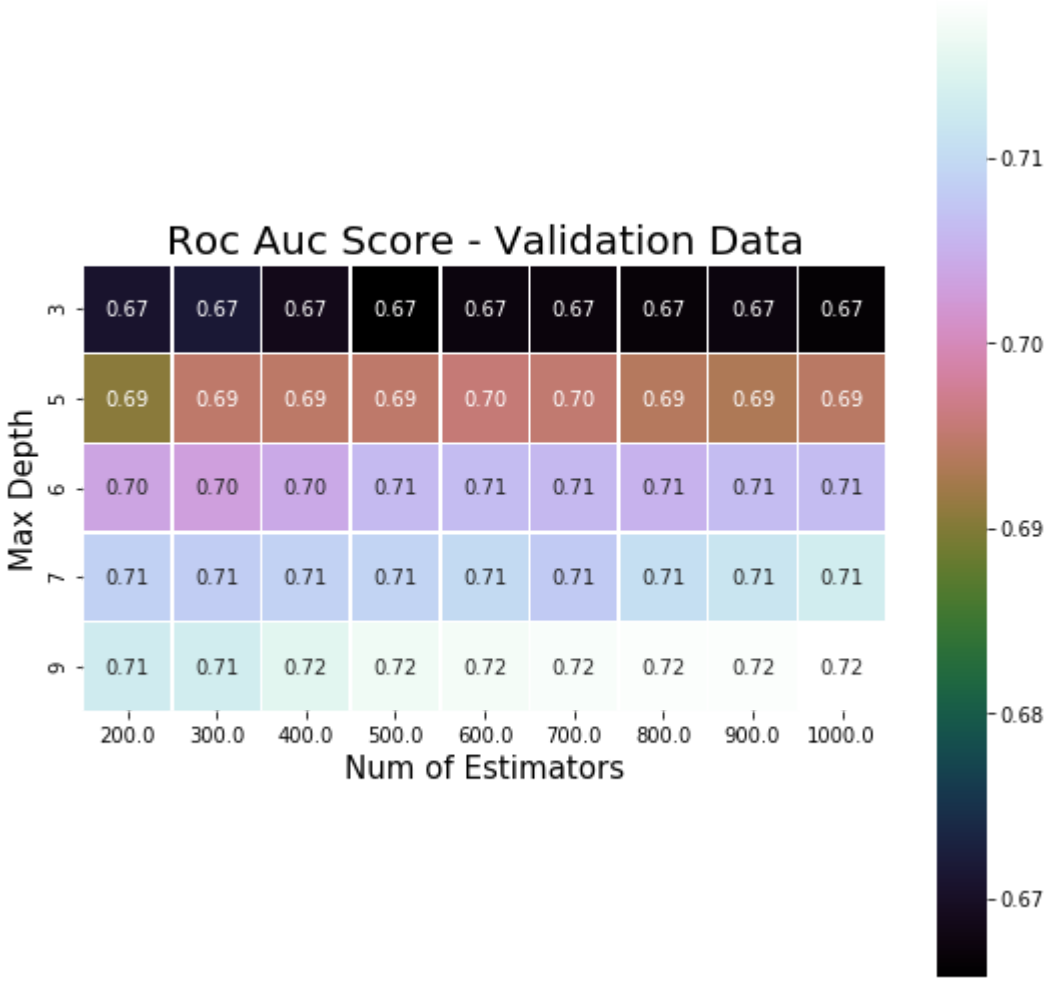
In [4]:
```
rndfrst_wtw2v = assign9RndFrst()
rndfrst_wtw2v.load_data('WTW2VBAL')
print(rndfrst_wtw2v.xtrain.shape)
print(rndfrst_wtw2v.xval.shape)
rndfrst_wtw2v_clf = rndfrst_wtw2v.RndFrstClasifier()
```

```
(10250, 50)
(2512, 50)
```

rndfrst_wtw2v.RNDFRST_calcrocaucscore()

In [6]:
```
displayhmap = drawgraphs()
pivot_tbl = rndfrst_wtw2v.rndfrst_hmap_train.pivot(index='mxdpth',columns='num
estim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','Num of Est
imators','Max Depth')
```

In [7]:
```
pivot_tbl = rndfrst_wtw2v.rndfrst_hmap_val.pivot(index='mxdpth',columns='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','Num of Estimators','Max Depth')
```



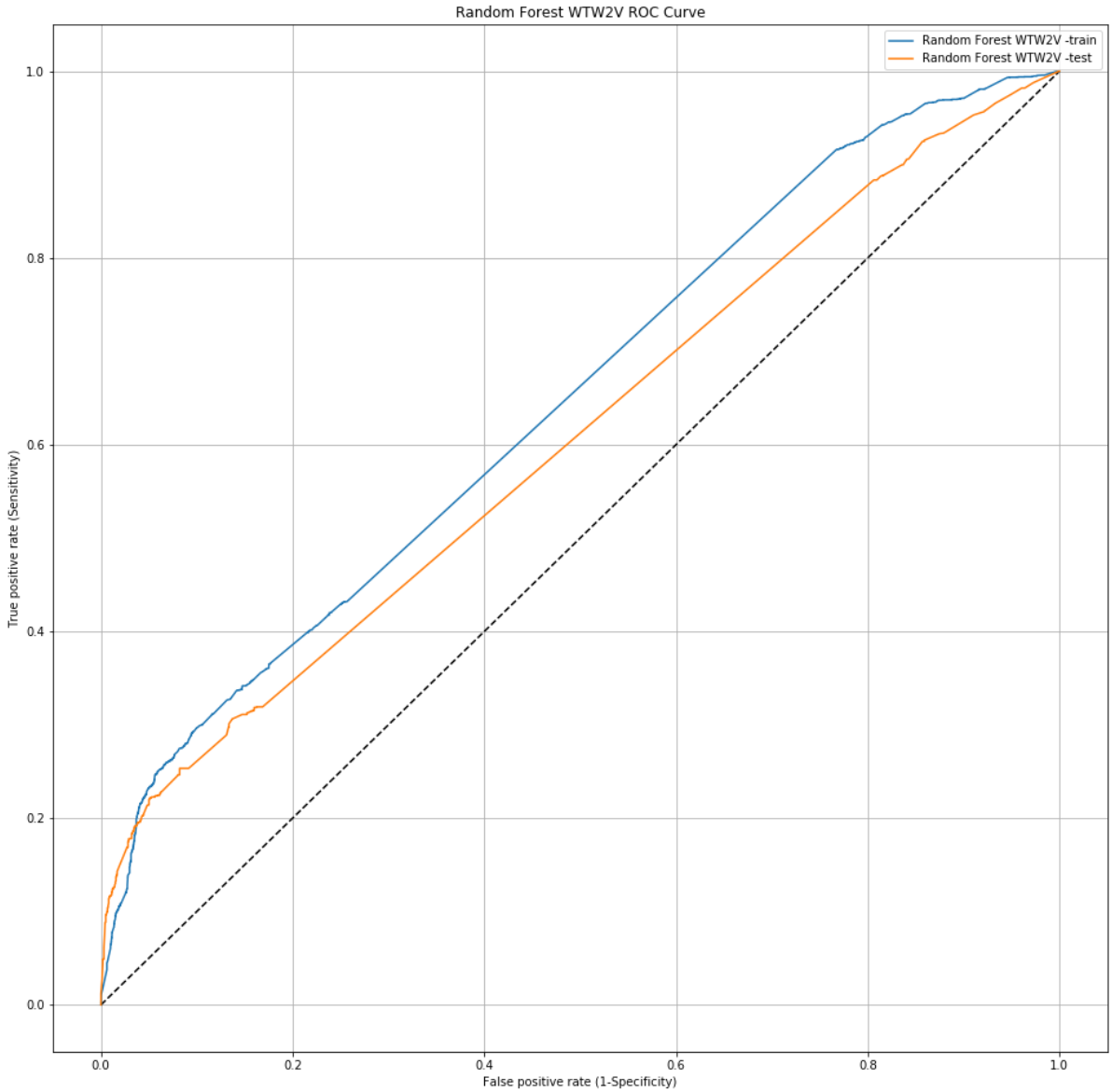
In [ ]:
```
rndfrst_wtw2v.RNDFRST_actClasifier(700,14,50,True)
```

In [9]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[rndfrst_wtw2v.confsnmtxytstpred['tn'] ,rndfrst_wtw2v.confsnmtxytstpre
d['fn']],[rndfrst_wtw2v.confsnmtxytstpred['fp'],rndfrst_wtw2v.confsnmtxytstpre
d['tp']]]
displaygraph.draw_table(data)
data1= [[rndfrst_wtw2v.accuracy_score_val,rndfrst_wtw2v.accuracy_score_test]]
displaygraph.draw_accscore(data1)
#tree.export_graphviz(dtree.getDTreClasifier(),feature_names=dtree.feat_names,
class_names=dtree.y_test,\
#                     filled=True, rounded=True,,out_file='D:/Graphviz2.38/bin/
tree_wtw2v_1.dot')
```

	Actual: NO	Actual: YES
Predicted: NO	1582	1419
Predicted: YES	13	176

	Validation	Test
Accuracy Score	0.5	0.5510971786833856

In [10]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='Random Forest WTW2V ROC Curve'
displaygraph.legnd_1 = 'Random Forest WTW2V -train'
displaygraph.legnd_2 = 'Random Forest WTW2V -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(rndfrst_wtw2v.roc_curve_test['fpr_trn'],rndfrst_wt
w2v.roc_curve_test['tpr_trn'],\
                            rndfrst_wtw2v.roc_curve_test['fpr'],rndfrst_wtw2v.
roc_curve_test['tpr'])
```



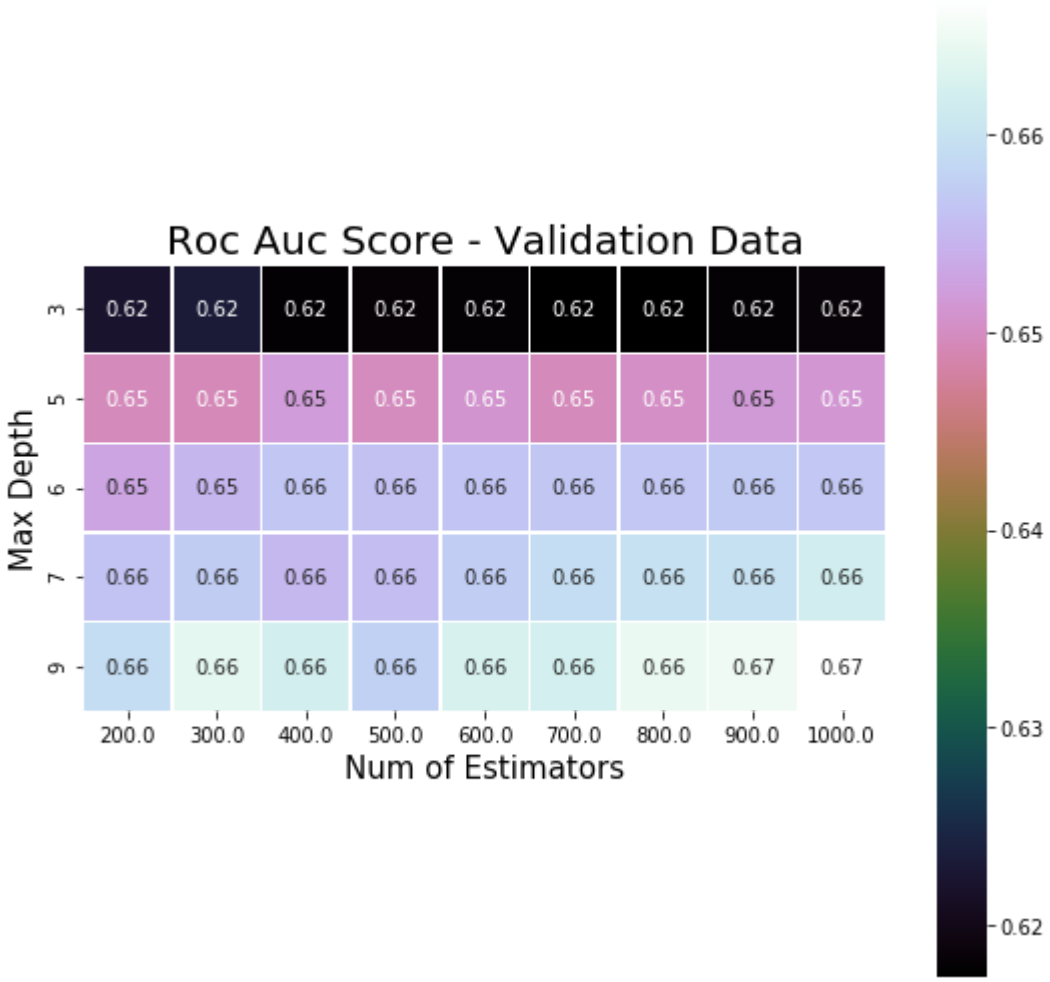
Data set has not been balanced

In [23]:
```
rndfrst_wtw2v_nbal = assign9RndFrst()
rndfrst_wtw2v_nbal.load_data('WTW2V')
rndfrst_wtw2vnbal_clf = rndfrst_wtw2v_nbal.RndFrstClasifier()
```

rndfrst_wtw2v_nbal.RNDFRST_calcrocaucscore()

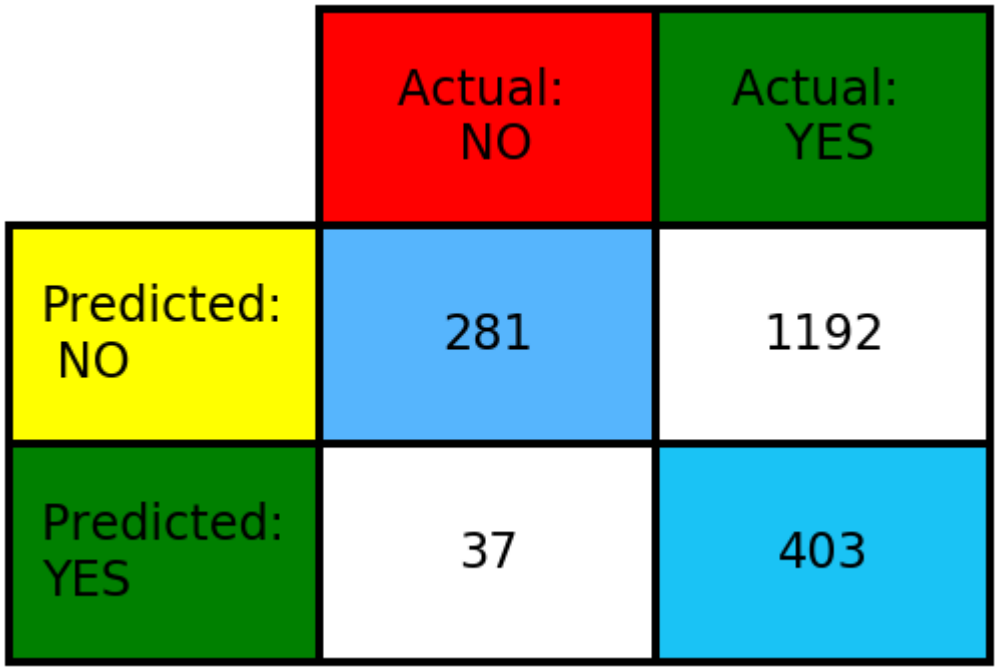
In [26]:
```
displayhmap = drawgraphs()
pivot_tbl = rndfrst_wtw2v_nbal.rndfrst_hmap_train.pivot(index='mxdpth',columns
='numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','Num of Est
imators','Max Depth')
```

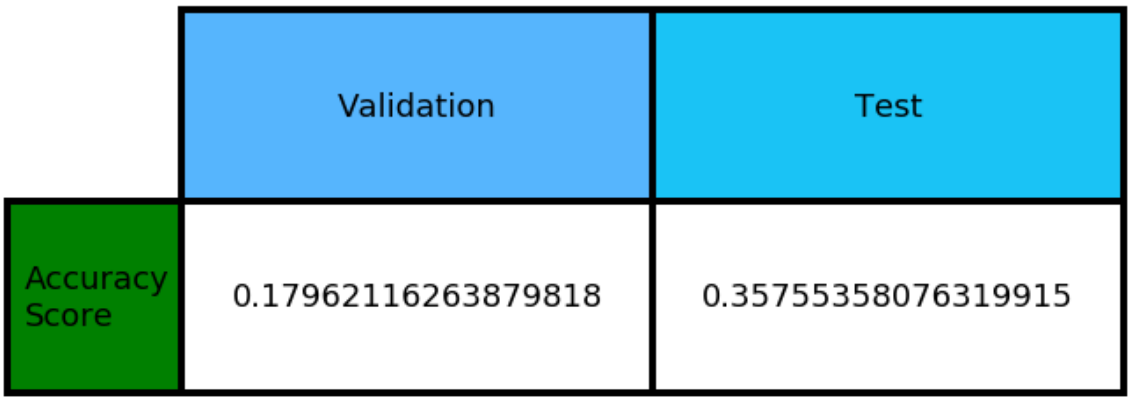
In [27]:
```
pivot_tbl = rndfrst_wtw2v_nbal.rndfrst_hmap_val.pivot(index='mxdpth',columns=
'numestim',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','Num of E
stimators','Max Depth')
```



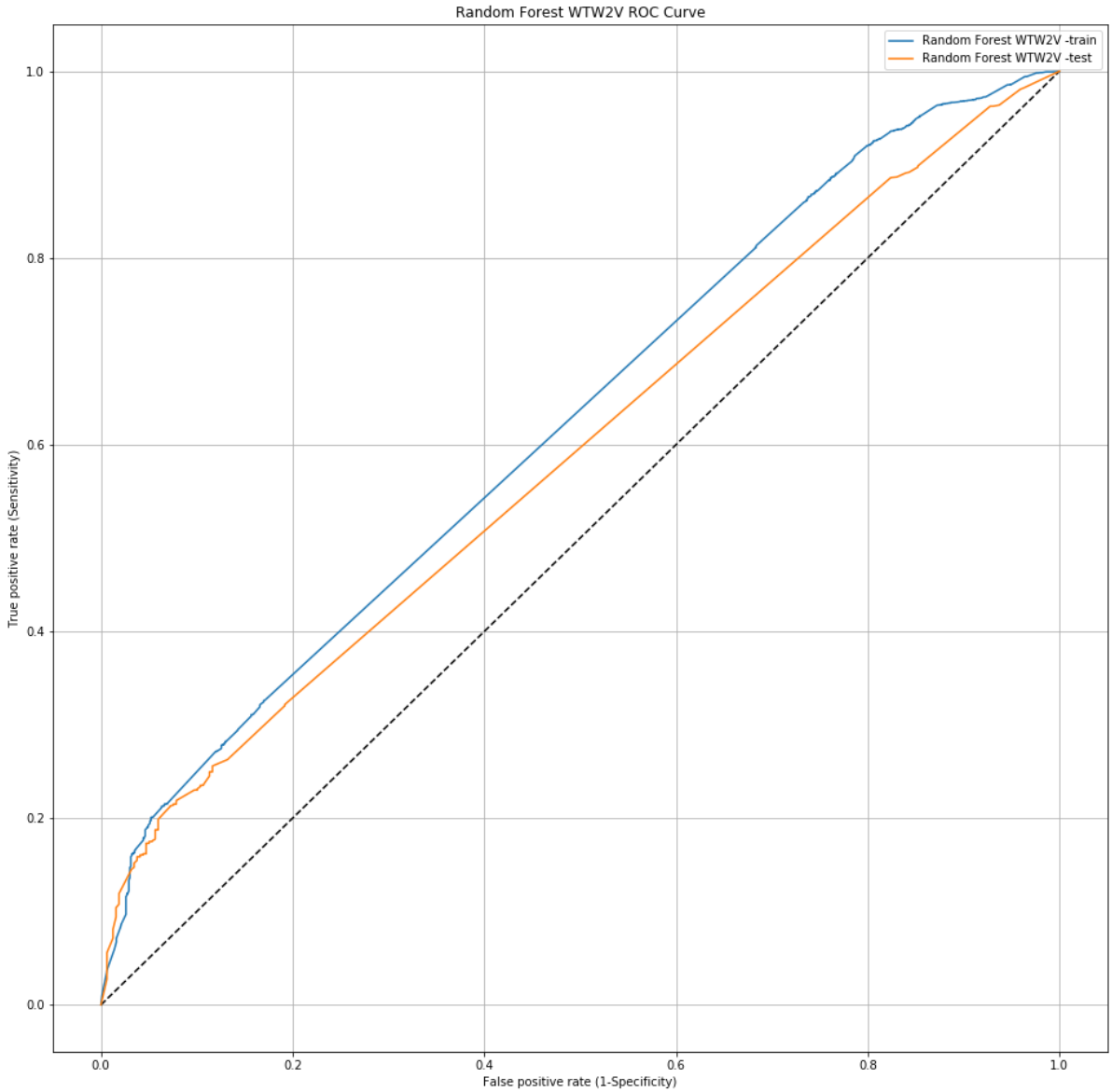
In [ ]:
```
rndfrst_wtw2v_nbal.RNDFRST_actClasifier(500,15,50,False)
```

In [29]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[rndfrst_wtw2v_nbal.confsnmtxytstpred['tn'] ,rndfrst_wtw2v_nbal.confsn
mtxytstpred['fn']],[rndfrst_wtw2v_nbal.confsnmtxytstpred['fp'],rndfrst_wtw2v_n
bal.confsnmtxytstpred['tp']]]
displaygraph.draw_table(data)
data1= [[rndfrst_wtw2v_nbal.accuracy_score_val,rndfrst_wtw2v_nbal.accuracy_sco
re_test]]
displaygraph.draw_accscore(data1)
#tree.export_graphviz(dtree.getDTreClasifier(),feature_names=dtree.feat_names,
class_names=dtree.y_test,\
#                     filled=True, rounded=True,,out_file='D:/Graphviz2.38/bin/
tree_wtw2v_1.dot')
```





In [30]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='Random Forest WTW2V ROC Curve'
displaygraph.legnd_1 = 'Random Forest WTW2V -train'
displaygraph.legnd_2 = 'Random Forest WTW2V -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(rndfrst_wtw2v_nbal.roc_curve_test['fpr_trn'],rndfr
st_wtw2v_nbal.roc_curve_test['tpr_trn'],\
                            rndfrst_wtw2v_nbal.roc_curve_test['fpr'],rndfrst_w
tw2v_nbal.roc_curve_test['tpr'])
```



[5.2] Applying GBDT using XGBOOST

Common code for XGBoost

In [34]:
```
import warnings
warnings.filterwarnings("ignore")

from xgboost.sklearn import XGBClassifier
from sklearn.calibration import CalibratedClassifierCV
from sklearn.model_selection import GridSearchCV
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import classification_report,accuracy_score,confusion_mat
rix
from sklearn.metrics import roc_curve, auc
from sklearn.metrics import roc_auc_score
from sklearn.utils.class_weight import compute_sample_weight
from xgboost.sklearn import XGBClassifier

import sqlite3
import pandas as pd
import numpy as np
import xgboost as xgb


import string
import matplotlib.pyplot as plt
import re
from tqdm import tqdm
import os
import pickle

class assign9XGBoost:

    def __init__(self):
        self.X_train=pd.DataFrame()
        self.X_test=pd.DataFrame()
        self.xtrain=pd.DataFrame()
        self.xval=pd.DataFrame()
        self.y_train= pd.Series([])
        self.ytrain= pd.Series([])
        self.y_test= pd.Series([])
        self.yval= pd.Series([])
        self.xgbst_clf=None
        self.xgbst_max_depth = []
        self.xgbst_n_estimators = []
        self.xgbst_hmap_train = pd.DataFrame(columns=('nestimators','learnrat
e','rocaucscore'))
        self.xgbst_hmap_val = pd.DataFrame(columns=('nestimators','learnrate',
'rocaucscore'))
        self.yprdprobatrn = []
        self.yprdprobaval = []
        self.yprdprobatest = []
        self.rocaucscoretrn = []
        self.rocaucscoreval = []
        self.rocaucscoretest = []
        self.predicted = []
        self.test_predict = []
        self.accuracy_score_val = []
        self.accuracy_score_test = []
```

```
        self.clasify_report = []
        self.confsnmtxytstpred = {}
        self.roc_curve_test = {}
        self.clasify_params = {}
        self.feat_names = []
        self.vectrizer = None

    #data for gridseatch
    @property
    def X_train(self):
        return self._X_train

    @X_train.setter
    def X_train(self,new_X_train):
        self._X_train = new_X_train

    #unseen data for testing
    @property
    def X_test(self):
        return self._X_test

    @X_test.setter
    def X_test(self,new_X_test):
        self._X_test = new_X_test

    #data for roc_auc_score
    @property
    def xtrain(self):
        return self._xtrain

    @xtrain.setter
    def xtrain(self,new_xtrain):
        self._xtrain = new_xtrain

    @property
    def xval(self):
        return self._xval

    @xval.setter
    def xval(self,new_xval):
        self._xval = new_xval

    @property
    def y_train(self):
        return self._y_train

    @y_train.setter
    def y_train(self,new_y_train):
        self._y_train = new_y_train

    @property
    def y_test(self):
        return self._y_test

    @y_test.setter
    def y_test(self,new_y_test):
        self._y_test = new_y_test
```

```
    @property
    def ytrain(self):
        return self._ytrain

    @ytrain.setter
    def ytrain(self,new_ytrain):
        self._ytrain = new_ytrain

    @property
    def yval(self):
        return self._yval

    @yval.setter
    def yval(self,new_yval):
        self._yval = new_yval

    @property
    def yprdprobatrn(self):
        return self._yprdprobatrn

    @yprdprobatrn.setter
    def yprdprobatrn(self,new_yprdprobatrn):
        self._yprdprobatrn = new_yprdprobatrn

    @property
    def yprdprobaval (self):
        return self._yprdprobaval

    @yprdprobaval.setter
    def yprdprobaval (self,new_yprdprobaval):
        self._yprdprobaval = new_yprdprobaval


    @property
    def yprdprobatest (self):
        return self._yprdprobatest

    @yprdprobatest.setter
    def yprdprobatest (self,new_yprdprobatest):
        self._yprdprobatest = new_yprdprobatest

    @property
    def vectrizer(self):
        return self._vectrizer

    @vectrizer.setter
    def vectrizer(self,new_vectrizer):
        self._vectrizer = new_vectrizer

    def convtodf(self,lstarr):
        df = pd.DataFrame()
        df['col1'] = lstarr
        d1 = pd.DataFrame(df.col1.values.tolist())
        print(d1.shape)
        return d1
```

```
    def load_data(self,mltype):
        #E:\appliedaiacourse\assignments\dblite\dtree\balanced\bowvectorizer\1
k
        f1name = 'E:/appliedaicourse/assignments/dblite/1kpts'
        if mltype == 'BOW':
            fname1 = f1name + '/unbalanced/bowvectorizer/ppvectscld_x_train'
            fname2 = f1name + '/unbalanced/bowvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/unbalanced/bowvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/unbalanced/bowvectorizer/ppvectscld_xval'
            fname5 = f1name + '/unbalanced/bowvectorizer/y_train'
            fname6 = f1name + '/unbalanced/bowvectorizer/y_test'
            fname7 = f1name + '/unbalanced/bowvectorizer/ytrain'
            fname8 = f1name + '/unbalanced/bowvectorizer/yval'
            fname9 = f1name + '/unbalanced/bowvectorizer/bow_feat'
        elif mltype == 'BOWBAL':
            f1name = 'E:/appliedaicourse/assignments/dblite/1kpts'
            fname1 = f1name + '/balanced/bowvectorizer/ppvectscld_x_train'
            fname2=  f1name + '/balanced/bowvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/balanced/bowvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/balanced/bowvectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/bowvectorizer/y_train'
            fname6 = f1name + '/balanced/bowvectorizer/y_test'
            fname7 = f1name + '/balanced/bowvectorizer/ytrain'
            fname8 = f1name + '/balanced/bowvectorizer/yval'
            fname9 = f1name + '/balanced/bowvectorizer/bow_feat'

        elif mltype == 'TFIDF':
            fname1 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_x_train'
            fname2 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_xval'
            fname5 = f1name + '/unbalanced/tfidfvectorizer/y_train'
            fname6 = f1name + '/unbalanced/tfidfvectorizer/y_test'
            fname7 = f1name + '/unbalanced/tfidfvectorizer/ytrain'
            fname8 = f1name + '/unbalanced/tfidfvectorizer/yval'
            fname9 = f1name + '/unbalanced/tfidfvectorizer/tfidf_feat'

        elif mltype == 'TFIDFBAL':
            fname1 = f1name + '/balanced/tfidfvectorizer/ppvectscld_x_train'
            fname2 = f1name + '/balanced/tfidfvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/balanced/tfidfvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/balanced/tfidfvectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/tfidfvectorizer/y_train'
            fname6 = f1name + '/balanced/tfidfvectorizer/y_test'
            fname7 = f1name + '/balanced/tfidfvectorizer/ytrain'
            fname8 = f1name + '/balanced/tfidfvectorizer/yval'
            fname9 = f1name + '/balanced/tfidfvectorizer/tfidf_feat'

        elif mltype == 'AVGW2V':
            fname1 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_x_train'
            fname2 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_x_test'
            fname3 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_xval'
            fname5 = f1name + '/unbalanced/avgw2vectorizer/y_train'
            fname6 = f1name + '/unbalanced/avgw2vectorizer/y_test'
            fname7 = f1name + '/unbalanced/avgw2vectorizer/ytrain'
            fname8 = f1name + '/unbalanced/avgw2vectorizer/yval'
```

```
        elif mltype == 'WTW2V':
            fname1 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_x_tr
ain'
            fname2 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_x_te
st'
            fname3 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_xtra
in'
            fname4 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_xva
l'
            fname5 = f1name + '/unbalanced/tfidfwtw2vectorizer/y_train'
            fname6 = f1name + '/unbalanced/tfidfwtw2vectorizer/y_test'
            fname7 = f1name + '/unbalanced/tfidfwtw2vectorizer/ytrain'
            fname8 = f1name + '/unbalanced/tfidfwtw2vectorizer/yval'
            fname9 = f1name + '/unbalanced/tfidfwtw2vectorizer/tfidf_feat'

        elif mltype == 'AVGW2VBAL':
            fname1 = f1name + '/balanced/avgw2vectorizer/ppvectscld_x_train'
            fname2 = f1name + '/balanced/avgw2vectorizer/ppvectscld_x_test'
            fname3 = f1name + '/balanced/avgw2vectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/balanced/avgw2vectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/avgw2vectorizer/y_train'
            fname6 = f1name + '/balanced/avgw2vectorizer/y_test'
            fname7 = f1name + '/balanced/avgw2vectorizer/ytrain'
            fname8 = f1name + '/balanced/avgw2vectorizer/yval'
        elif mltype == 'WTW2VBAL':
            fname1 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_x_trai
n'
            fname2 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_x_tes
t'
            fname3 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_xtrai
n'
            fname4 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/tfidfwtw2vectorizer/y_train'
            fname6 = f1name + '/balanced/tfidfwtw2vectorizer/y_test'
            fname7 = f1name + '/balanced/tfidfwtw2vectorizer/ytrain'
            fname8 = f1name + '/balanced/tfidfwtw2vectorizer/yval'


        with open (fname1, 'rb') as fp:
            self.X_train = pickle.load(fp)

        with open (fname2, 'rb') as fp:
            self.X_test = pickle.load(fp)

        with open (fname3, 'rb') as fp:
            self.xtrain = pickle.load(fp)

        with open (fname4, 'rb') as fp:
            self.xval = pickle.load(fp)

        with open (fname5, 'rb') as fp:
            self.y_train = pickle.load(fp)

        with open (fname6, 'rb') as fp:
            self.y_test = pickle.load(fp)

        with open (fname7, 'rb') as fp:
```

```
            self.ytrain = pickle.load(fp)

        with open (fname8, 'rb') as fp:
            self.yval = pickle.load(fp)

        if (mltype == 'BOW' or mltype=='TFIDF' or mltype == 'BOWBAL' or mltype
== 'TFIDFBAL' or mltype=='WTW2V'):
            with open (fname9, 'rb') as fp:
                self.feat_names = pickle.load(fp)

        print('X_train shape', self.X_train.shape)
        print('y_train shape', self.y_train.shape)
        print('X_test shape', self.X_test.shape)
        print('y_test shape', self.y_test.shape)

    def XgBstClasifier(self):
        self.xgbst_clf = XGBClassifier(learning_rate =0.01, n_estimators=100,m
ax_depth=5,\
                                       min_child_weight=1,gamma=0.0,subsample=0.
8, colsample_bytree=0.8,\
                                       objective='binary:logistic',nthread=2,ver
bosity=3,scale_pos_weight=5.1895,seed=42)

        return self.xgbst_clf

    def XgBstClasifierNoWts(self):
        self.xgbst_clf = XGBClassifier(learning_rate =0.01, n_estimators=100,m
ax_depth=5,\
                                       min_child_weight=1,gamma=0.0,subsample=0.
8, colsample_bytree=0.8,\
                                       objective='binary:logistic',nthread=2,ver
bosity=3,seed=42)

        return self.xgbst_clf


    def getXgBstClasifier(self):
        return self.xgbst_clf

    @property
    def xgbst_clf(self):
        return self._xgbst_clf

    @xgbst_clf.setter
    def xgbst_clf(self,new_xgbst_clf):
        self._xgbst_clf = new_xgbst_clf

    #set max_depth parameter for classifier
    def setmaxdepthparm(self,prmval):
        params = {'max_depth': prmval}
        (self.xgbst_clf).set_params(**params)
        return self.xgbst_clf

    #set number of estimators
    def setnestparm(self,prmval):
        params = {'n_estimators': prmval}
        (self.xgbst_clf).set_params(**params)
```

```
        return self.xgbst_clf

    # set learning rate
    def setlearnrateparm(self,prmval):
        params = {'learning_rate': prmval}
        (self.xgbst_clf).set_params(**params)
        return self.xgbst_clf

    # set gamma
    def setgammaparm(self,prmval):
        params = {'gamma': prmval}
        (self.xgbst_clf).set_params(**params)
        return self.xgbst_clf


    def XGBST_calcrocaucscore(self):

        """
            this function uses CalibratedClasifierCV for prediciting probabili
ties
            this is an imbalanced dataset hence we are using class weights and
            sample weights in the fit process
        """
        """
            this is  for BOW
        max_depth =  [3, 5, 6, 7, 9, 12, 14, 15, 20,26,30,35,40,50]
        mnsmp_split = [5,10,25,50,75,100,250,500,600,700,800,900,1000]

        min_sample_split = [2, 5, 10, 30, 50, 75, 100]
        max_depth = [2, 5, 7, 9, 10, 12, 14, 15]
        """
        self.xgbst_hmap_train = pd.DataFrame(columns=('nestimators','learnrat
e','rocaucscore'))
        self.xgbst_hmap_val = pd.DataFrame(columns=('nestimators','learnrate',
'rocaucscore'))

        n_est = [200,300,400,500,600,700,800,900,1000]

        learn_rate = [1e-3, 1e-2, 0.1,1]

        #trn_smp_wts=compute_sample_weight(class_weight={0:5.14,1:1}, y=self.y
train)
        #val_smp_wts=compute_sample_weight(class_weight={0:5.14,1:1}, y=self.y
val)

        rocaucval_trn = 0.0
        rocaucval_val = 0.0


        for nest in n_est :

            # set number of estimators param for classifier
            self.setnestparm(nest)

            # loop thru learning rate for the classifier
            for lrate in learn_rate:
```

```
                    #set learning rate for the classifier
                    self.setlearnrateparm(lrate)

                    # fit the x-train model
                    #(self.xgbst_clf).fit(self.xtrain,self.ytrain,sample_weigh
t=trn_smp_wts)
                    (self.xgbst_clf).fit(self.xtrain,self.ytrain)

                    my_calib = CalibratedClassifierCV((self.xgbst_clf),method=
'sigmoid',cv='prefit')
                    my_calib.fit(self.xtrain,self.ytrain)

                    self.yprdprobatrn =  ((self.xgbst_clf)).predict_proba(self
.xtrain)[:,1]
                    rocaucval_trn = roc_auc_score(self.ytrain,self.yprdprobatr
n)



                    #fit the validation model
                    (self.xgbst_clf).fit(self.xval,self.yval)

                    my_calib_1 = CalibratedClassifierCV((self.xgbst_clf),metho
d='sigmoid',cv='prefit')
                    my_calib_1.fit(self.xval,self.yval)

                    self.yprdprobaval =  ((self.xgbst_clf)).predict_proba(self
.xval)[:,1]
                    rocaucval_val = roc_auc_score(self.yval,self.yprdprobaval)

                    #print('max depth {0}.min samp split {1} probability and r
oc auc score generation for training validation data complete..'.format(mxdpt
h,mnsmpsplt))


            (self.xgbst_hmap_val)= (self.xgbst_hmap_val).append([{'nest': nest
,'learnrate':lrate,'rocaucscore': rocaucval_val}])

            #great python appending a row to dataframe doesnt happen implace y
ou need to store the output back
            (self.xgbst_hmap_train)= (self.xgbst_hmap_train).append([{'nest':
nest,'learnrate':lrate,'rocaucscore': rocaucval_trn}])


        print('Function exiting...')

    def XGBST_actClasifier(self,n_ests,max_dpth,lrngrte,fitsmpwts=False):

        """
            this function uses CalibratedClasifierCV for prediciting probabili
ties
            this is an imbalanced dataset hence we are using class weights and
            sample weights in the fit process
        """

        if fitsmpwts == True :
            train_clf = self.XgBstClasifier()
            test_clf = self.XgBstClasifier()
```

```
        else:
            train_clf = self.XgBstClasifierNoWts()
            test_clf = self.XgBstClasifierNoWts()

        params = {'max_depth': max_dpth}
        (train_clf).set_params(**params)

        params = {'learning_rate': lrngrte}
        (train_clf).set_params(**params)

        params = {'n_estimators': n_ests}
        (train_clf).set_params(**params)


        (train_clf).fit(self.xtrain,self.ytrain)

        #Calibratedcv for predicting probabilities
        my_calib_1 = CalibratedClassifierCV((train_clf),method='sigmoid',cv='p
refit')

        # fit train with sample weights
        my_calib_1.fit(self.xtrain,self.ytrain)

        # predict probabilites using predict_proba  from calibratedcv
        self.ytrn_predprob_actclf = (my_calib_1).predict_proba(self.xtrain)[:,
1]

        # compute the false-positive r, true positive rates and thresholds
        fpr_trn, tpr_trn, thrshld_trn = roc_curve(self.ytrain, self.ytrn_predp
rob_actclf)

        # cailbratedCv for validation dataset
        my_calib_2 = CalibratedClassifierCV((train_clf),method='sigmoid',cv='p
refit')
        #fit the validation dataset with sample weights
        my_calib_2.fit(self.xval,self.yval)

        # predict the labels for validation
        self.predicted = (my_calib_2).predict(self.xval)

        # calculate accuracy_score for validation dataset
        self.accuracy_score_val = accuracy_score(self.yval, self.predicted)

        #setting parameters for the test classifier
        params = {'max_depth': max_dpth}
        (test_clf).set_params(**params)

        params = {'learning_rate': lrngrte}
        (test_clf).set_params(**params)

        params = {'n_estimators': n_ests}
        (test_clf).set_params(**params)

        (test_clf).fit(self.X_train,self.y_train)

        #calibratedclasifierCV using my model prefit with X_test
        my_calib = CalibratedClassifierCV((test_clf),method='sigmoid',cv='pref
```

```
it')

        #predicting probabilities for X_test setweights test sample weights
        my_calib.fit(self.X_test,self.y_test)

        # predict xtest labels
        self.test_predict = (my_calib).predict(self.X_test)

        print('***X_test predict',self.test_predict)

        #store the classifier parameters
        self.clasify_params['clfparams'] = (test_clf).get_params(deep=True)

        #calculate accuracy_score for X_test
        self.accuracy_score_test = accuracy_score(self.y_test, self.test_predi
ct)

        # generate classification report for X_test
        print(classification_report(self.y_test, self.test_predict))

        # confusion matrix for ytest
        tn, fp, fn, tp = confusion_matrix(self.y_test, self.test_predict ).rav
el()
        self.confsnmtxytstpred['tn'] = tn
        self.confsnmtxytstpred['fp'] = fp
        self.confsnmtxytstpred['fn'] = fn
        self.confsnmtxytstpred['tp'] = tp

        # predict probabilites  from xtest for roc_curve
        self.ytst_predprob_actclf = (my_calib).predict_proba(self.X_test)[:,1]

        print('*** predict probabilities***',self.ytst_predprob_actclf)

        fpr, tpr, thrshld_test = roc_curve(self.y_test,self.ytst_predprob_actc
lf)

        # store the above into the dictionary
        self.roc_curve_test['fpr_trn'] = fpr_trn
        self.roc_curve_test['tpr_trn'] =  tpr_trn
        self.roc_curve_test['thrshld_trn'] = thrshld_trn
        self.roc_curve_test['fpr'] = fpr
        self.roc_curve_test['tpr'] = tpr
        self.roc_curve_test['thrshld_test'] = thrshld_test

        self.xgbst_clf = test_clf

    def genwrdcldwords(self):

        top10_negve = sorted(zip((self.xgbst_clf).feature_importances_, self.f
eat_names))[-20:]
        top10_posve = sorted(zip((self.xgbst_clf).feature_importances_, self.f
eat_names))[:20]

        feat_pos=[]
        feat_neg=[]

        features=""
```

```
    for coef,feat in (top10_negve):
        feat_pos.append(feat)

    for cef,feat in (top10_posve):
        feat_neg.append(feat)

    i=0
    while i< int(len(feat_pos)):
        feat_item=[]
        features = features + " " + feat_pos[i]
        features = features + " " + feat_neg[i]

        i +=1
    return features
```

Common code for calculating ROC_AUC Scores

In [ ]:
```
import warnings
warnings.filterwarnings("ignore")

from xgboost.sklearn import XGBClassifier
from sklearn.calibration import CalibratedClassifierCV
from sklearn.model_selection import GridSearchCV
from sklearn.metrics import confusion_matrix
from sklearn import metrics
from sklearn.metrics import classification_report,accuracy_score,confusion_mat
rix
from sklearn.metrics import roc_curve, auc
from sklearn.metrics import roc_auc_score
from sklearn.utils.class_weight import compute_sample_weight
from xgboost.sklearn import XGBClassifier

import sqlite3
import pandas as pd
import numpy as np
import xgboost as xgb


import string
import matplotlib.pyplot as plt
import re
from tqdm import tqdm
import os
import pickle

class assign9XGBoost:

    def __init__(self):
        self.X_train=pd.DataFrame()
        self.X_test=pd.DataFrame()
        self.xtrain=pd.DataFrame()
        self.xval=pd.DataFrame()
        self.y_train= pd.Series([])
        self.ytrain= pd.Series([])
        self.y_test= pd.Series([])
        self.yval= pd.Series([])
        self.xgbst_clf=None
        self.xgbst_max_depth = []
        self.xgbst_n_estimators = []
        self.xgbst_hmap_train = pd.DataFrame(columns=('nestimators','learnrat
e','rocaucscore'))
        self.xgbst_hmap_val = pd.DataFrame(columns=('nestimators','learnrate',
'rocaucscore'))
        self.yprdprobatrn = []
        self.yprdprobaval = []
        self.yprdprobatest = []
        self.rocaucscoretrn = []
        self.rocaucscoreval = []
        self.rocaucscoretest = []
        self.predicted = []
        self.test_predict = []
        self.accuracy_score_val = []
        self.accuracy_score_test = []
```

```
        self.clasify_report = []
        self.confsnmtxytstpred = {}
        self.roc_curve_test = {}
        self.clasify_params = {}
        self.feat_names = []
        self.vectrizer = None
        self.mdlname =None

    #data for gridseatch
    @property
    def X_train(self):
        return self._X_train

    @X_train.setter
    def X_train(self,new_X_train):
        self._X_train = new_X_train

    #unseen data for testing
    @property
    def X_test(self):
        return self._X_test

    @X_test.setter
    def X_test(self,new_X_test):
        self._X_test = new_X_test

    #data for roc_auc_score
    @property
    def xtrain(self):
        return self._xtrain

    @xtrain.setter
    def xtrain(self,new_xtrain):
        self._xtrain = new_xtrain

    @property
    def xval(self):
        return self._xval

    @xval.setter
    def xval(self,new_xval):
        self._xval = new_xval

    @property
    def y_train(self):
        return self._y_train

    @y_train.setter
    def y_train(self,new_y_train):
        self._y_train = new_y_train

    @property
    def y_test(self):
        return self._y_test

    @y_test.setter
    def y_test(self,new_y_test):
```

```
        self._y_test = new_y_test

    @property
    def ytrain(self):
        return self._ytrain

    @ytrain.setter
    def ytrain(self,new_ytrain):
        self._ytrain = new_ytrain

    @property
    def yval(self):
        return self._yval

    @yval.setter
    def yval(self,new_yval):
        self._yval = new_yval

    @property
    def yprdprobatrn(self):
        return self._yprdprobatrn

    @yprdprobatrn.setter
    def yprdprobatrn(self,new_yprdprobatrn):
        self._yprdprobatrn = new_yprdprobatrn

    @property
    def yprdprobaval (self):
        return self._yprdprobaval

    @yprdprobaval.setter
    def yprdprobaval (self,new_yprdprobaval):
        self._yprdprobaval = new_yprdprobaval


    @property
    def yprdprobatest (self):
        return self._yprdprobatest

    @yprdprobatest.setter
    def yprdprobatest (self,new_yprdprobatest):
        self._yprdprobatest = new_yprdprobatest

    @property
    def vectrizer(self):
        return self._vectrizer

    @vectrizer.setter
    def vectrizer(self,new_vectrizer):
        self._vectrizer = new_vectrizer

    def convtodf(self,lstarr):
        df = pd.DataFrame()
        df['col1'] = lstarr
        d1 = pd.DataFrame(df.col1.values.tolist())
        print(d1.shape)
        return d1
```

```
    def setmdl(self, model):
        self.mdlname =  model

    def getmdl(self):
        return self.mdlname

    def load_data(self,mltype):
        #E:\appliedaiacourse\assignments\dblite\dtree\balanced\bowvectorizer\1
k
        f1name = 'E:/appliedaicourse/assignments/dblite/1kpts'
        if mltype == 'BOW':
            fname1 = f1name + '/unbalanced/bowvectorizer/ppvectscld_x_train'
            fname2 = f1name + '/unbalanced/bowvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/unbalanced/bowvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/unbalanced/bowvectorizer/ppvectscld_xval'
            fname5 = f1name + '/unbalanced/bowvectorizer/y_train'
            fname6 = f1name + '/unbalanced/bowvectorizer/y_test'
            fname7 = f1name + '/unbalanced/bowvectorizer/ytrain'
            fname8 = f1name + '/unbalanced/bowvectorizer/yval'
            fname9 = f1name + '/unbalanced/bowvectorizer/bow_feat'
        elif mltype == 'BOWBAL':
            f1name = 'E:/appliedaicourse/assignments/dblite/1kpts'
            fname1 = f1name + '/balanced/bowvectorizer/ppvectscld_x_train'
            fname2=  f1name + '/balanced/bowvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/balanced/bowvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/balanced/bowvectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/bowvectorizer/y_train'
            fname6 = f1name + '/balanced/bowvectorizer/y_test'
            fname7 = f1name + '/balanced/bowvectorizer/ytrain'
            fname8 = f1name + '/balanced/bowvectorizer/yval'
            fname9 = f1name + '/balanced/bowvectorizer/bow_feat'

        elif mltype == 'TFIDF':
            fname1 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_x_train'
            fname2 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/unbalanced/tfidfvectorizer/ppvectscld_xval'
            fname5 = f1name + '/unbalanced/tfidfvectorizer/y_train'
            fname6 = f1name + '/unbalanced/tfidfvectorizer/y_test'
            fname7 = f1name + '/unbalanced/tfidfvectorizer/ytrain'
            fname8 = f1name + '/unbalanced/tfidfvectorizer/yval'
            fname9 = f1name + '/unbalanced/tfidfvectorizer/tfidf_feat'

        elif mltype == 'TFIDFBAL':
            fname1 = f1name + '/balanced/tfidfvectorizer/ppvectscld_x_train'
            fname2 = f1name + '/balanced/tfidfvectorizer/ppvectscld_x_test'
            fname3 = f1name + '/balanced/tfidfvectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/balanced/tfidfvectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/tfidfvectorizer/y_train'
            fname6 = f1name + '/balanced/tfidfvectorizer/y_test'
            fname7 = f1name + '/balanced/tfidfvectorizer/ytrain'
            fname8 = f1name + '/balanced/tfidfvectorizer/yval'
            fname9 = f1name + '/balanced/tfidfvectorizer/tfidf_feat'

        elif mltype == 'AVGW2V':
            fname1 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_x_train'
```

```
            fname2 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_x_test'
            fname3 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/unbalanced/avgw2vectorizer/ppvectscld_xval'
            fname5 = f1name + '/unbalanced/avgw2vectorizer/y_train'
            fname6 = f1name + '/unbalanced/avgw2vectorizer/y_test'
            fname7 = f1name + '/unbalanced/avgw2vectorizer/ytrain'
            fname8 = f1name + '/unbalanced/avgw2vectorizer/yval'
        elif mltype == 'WTW2V':
            fname1 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_x_tr
ain'
            fname2 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_x_te
st'
            fname3 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_xtra
in'
            fname4 = f1name + '/unbalanced/tfidfwtw2vectorizer/ppvectscld_xva
l'
            fname5 = f1name + '/unbalanced/tfidfwtw2vectorizer/y_train'
            fname6 = f1name + '/unbalanced/tfidfwtw2vectorizer/y_test'
            fname7 = f1name + '/unbalanced/tfidfwtw2vectorizer/ytrain'
            fname8 = f1name + '/unbalanced/tfidfwtw2vectorizer/yval'
            fname9 = f1name + '/unbalanced/tfidfwtw2vectorizer/tfidf_feat'

        elif mltype == 'AVGW2VBAL':
            fname1 = f1name + '/balanced/avgw2vectorizer/ppvectscld_x_train'
            fname2 = f1name + '/balanced/avgw2vectorizer/ppvectscld_x_test'
            fname3 = f1name + '/balanced/avgw2vectorizer/ppvectscld_xtrain'
            fname4 = f1name + '/balanced/avgw2vectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/avgw2vectorizer/y_train'
            fname6 = f1name + '/balanced/avgw2vectorizer/y_test'
            fname7 = f1name + '/balanced/avgw2vectorizer/ytrain'
            fname8 = f1name + '/balanced/avgw2vectorizer/yval'
        elif mltype == 'WTW2VBAL':
            fname1 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_x_trai
n'
            fname2 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_x_tes
t'
            fname3 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_xtrai
n'
            fname4 = f1name + '/balanced/tfidfwtw2vectorizer/ppvectscld_xval'
            fname5 = f1name + '/balanced/tfidfwtw2vectorizer/y_train'
            fname6 = f1name + '/balanced/tfidfwtw2vectorizer/y_test'
            fname7 = f1name + '/balanced/tfidfwtw2vectorizer/ytrain'
            fname8 = f1name + '/balanced/tfidfwtw2vectorizer/yval'


        with open (fname1, 'rb') as fp:
            self.X_train = pickle.load(fp)

        with open (fname2, 'rb') as fp:
            self.X_test = pickle.load(fp)

        with open (fname3, 'rb') as fp:
            self.xtrain = pickle.load(fp)

        with open (fname4, 'rb') as fp:
            self.xval = pickle.load(fp)
```

```
        with open (fname5, 'rb') as fp:
            self.y_train = pickle.load(fp)

        with open (fname6, 'rb') as fp:
            self.y_test = pickle.load(fp)

        with open (fname7, 'rb') as fp:
            self.ytrain = pickle.load(fp)

        with open (fname8, 'rb') as fp:
            self.yval = pickle.load(fp)

        if (mltype == 'BOW' or mltype=='TFIDF' or mltype == 'BOWBAL' or mltype
== 'TFIDFBAL' or mltype=='WTW2V'):
            with open (fname9, 'rb') as fp:
                self.feat_names = pickle.load(fp)
        """
        print('X_train shape', self.X_train.shape)
        print('y_train shape', self.y_train.shape)
        print('X_test shape', self.X_test.shape)
        print('y_test shape', self.y_test.shape)
        """
    def XgBstClasifier(self):
        self.xgbst_clf = XGBClassifier(learning_rate =0.01, n_estimators=100,m
ax_depth=5,\
                                       min_child_weight=1,gamma=0.0,subsample=0.
8, colsample_bytree=0.8,\
                                       objective='binary:logistic',nthread=3,ver
bosity=3,scale_pos_weight=5.1895,seed=42)

        return self.xgbst_clf

    def XgBstClasifierNoWts(self):
        self.xgbst_clf = XGBClassifier(learning_rate =0.01, n_estimators=100,m
ax_depth=5,\
                                       min_child_weight=1,gamma=0.0,subsample=0.
8, colsample_bytree=0.8,\
                                       objective='binary:logistic',nthread=3,ver
bosity=3,seed=42)

        return self.xgbst_clf


    def getXgBstClasifier(self):
        return self.xgbst_clf

    @property
    def xgbst_clf(self):
        return self._xgbst_clf

    @xgbst_clf.setter
    def xgbst_clf(self,new_xgbst_clf):
        self._xgbst_clf = new_xgbst_clf

    #set max_depth parameter for classifier
    def setmaxdepthparm(self,prmval):
        params = {'max_depth': prmval}
```

```
        (self.xgbst_clf).set_params(**params)
        return self.xgbst_clf

    #set number of estimators
    def setnestparm(self,prmval):
        params = {'n_estimators': prmval}
        (self.xgbst_clf).set_params(**params)
        return self.xgbst_clf

    # set learning rate
    def setlearnrateparm(self,prmval):
        params = {'learning_rate': prmval}
        (self.xgbst_clf).set_params(**params)
        return self.xgbst_clf

    # set gamma
    def setgammaparm(self,prmval):
        params = {'gamma': prmval}
        (self.xgbst_clf).set_params(**params)
        return self.xgbst_clf


    def XGBST_calcrocaucscore(self):

        """
            this function uses CalibratedClasifierCV for prediciting probabili
ties
            this is an imbalanced dataset hence we are using class weights and
            sample weights in the fit process
        """
        """
            this is  for BOW
        max_depth =  [3, 5, 6, 7, 9, 12, 14, 15, 20,26,30,35,40,50]
        mnsmp_split = [5,10,25,50,75,100,250,500,600,700,800,900,1000]

        min_sample_split = [2, 5, 10, 30, 50, 75, 100]
        max_depth = [2, 5, 7, 9, 10, 12, 14, 15]
        """
        self.xgbst_hmap_train = pd.DataFrame(columns=('nestimators','learnrat
e','rocaucscore'))
        self.xgbst_hmap_val = pd.DataFrame(columns=('nestimators','learnrate',
'rocaucscore'))

        n_est = [200,300,400,500,600,700,800,900,1000]

        learn_rate = [1e-3, 1e-2, 0.1,1]

        #trn_smp_wts=compute_sample_weight(class_weight={0:5.14,1:1}, y=self.y
train)
        #val_smp_wts=compute_sample_weight(class_weight={0:5.14,1:1}, y=self.y
val)

        rocaucval_trn = 0.0
        rocaucval_val = 0.0


        for nest in n_est :
```

```
            # set number of estimators param for classifier
            self.setnestparm(nest)

            # loop thru learning rate for the classifier
            for lrate in learn_rate:

                    #set learning rate for the classifier
                    self.setlearnrateparm(lrate)

                    # fit the x-train model
                    #(self.xgbst_clf).fit(self.xtrain,self.ytrain,sample_weigh
t=trn_smp_wts)
                    if self.getmdl() == 'WTW2V' :
                        self.xtrain = pd.DataFrame(self.xtrain)

                    (self.xgbst_clf).fit(self.xtrain,self.ytrain)


                    my_calib = CalibratedClassifierCV((self.xgbst_clf),method=
'sigmoid',cv='prefit')
                    my_calib.fit(self.xtrain,self.ytrain)

                    self.yprdprobatrn =  ((self.xgbst_clf)).predict_proba(self
.xtrain)[:,1]
                    rocaucval_trn = roc_auc_score(self.ytrain,self.yprdprobatr
n)



                    #fit the validation model
                    (self.xgbst_clf).fit(self.xval,self.yval)

                    my_calib_1 = CalibratedClassifierCV((self.xgbst_clf),metho
d='sigmoid',cv='prefit')
                    my_calib_1.fit(self.xval,self.yval)

                    self.yprdprobaval =  ((self.xgbst_clf)).predict_proba(self
.xval)[:,1]
                    rocaucval_val = roc_auc_score(self.yval,self.yprdprobaval)

                    #print('max depth {0}.min samp split {1} probability and r
oc auc score generation for training validation data complete..'.format(mxdpt
h,mnsmpsplt))

                    self.xgbst_hmap_val = (self.xgbst_hmap_val).append([{'nest
imators': nest,'learnrate':lrate,'rocaucscore': rocaucval_val}])
                    print(nest,lrate,rocaucval_val, self.xgbst_hmap_val)
                    #great python appending a row to dataframe doesnt happen i
mplace you need to store the output back
                    self.xgbst_hmap_train = (self.xgbst_hmap_train).append([{
'nestimators': nest,'learnrate':lrate,'rocaucscore': rocaucval_trn}])
                    print(nest,lrate,rocaucval_trn,self.xgbst_hmap_train)

        fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/'+ self.get
mdl() +'_xgbst_hmap_cval.out'
        with open(fname, 'wb') as fp:
            pickle.dump(self.xgbst_hmap_val, fp)
```

```
        fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/'+ self.get
mdl() +'_xgbst_hmap_train.out'
        with open(fname, 'wb') as fp:
            pickle.dump(self.xgbst_hmap_train, fp)

        print('Function exiting...')

    def XGBST_actClasifier(self,n_ests,max_dpth,lrngrte,fitsmpwts=False):

        """
            this function uses CalibratedClasifierCV for prediciting probabili
ties
            this is an imbalanced dataset hence we are using class weights and
            sample weights in the fit process
        """

        if fitsmpwts == True :
            train_clf = self.XgBstClasifier()
            test_clf = self.XgBstClasifier()
        else:
            train_clf = self.XgBstClasifierNoWts()
            test_clf = self.XgBstClasifierNoWts()

        params = {'max_depth': max_dpth}
        (train_clf).set_params(**params)

        params = {'learning_rate': lrngrte}
        (train_clf).set_params(**params)

        params = {'n_estimators': n_ests}
        (train_clf).set_params(**params)


        (train_clf).fit(self.xtrain.as_matrix(),self.ytrain)

        #Calibratedcv for predicting probabilities
        my_calib_1 = CalibratedClassifierCV((train_clf),method='sigmoid',cv='p
refit')

        # fit train with sample weights
        my_calib_1.fit(self.xtrain,self.ytrain)

        # predict probabilites using predict_proba  from calibratedcv
        self.ytrn_predprob_actclf = ((self.xgbst_clf)).predict_proba(self.xtra
in.as_matrix(),validate_features=False)[:,1]

        # compute the false-positive r, true positive rates and thresholds
        fpr_trn, tpr_trn, thrshld_trn = roc_curve(self.ytrain, self.ytrn_predp
rob_actclf)

        # cailbratedCv for validation dataset
        my_calib_2 = CalibratedClassifierCV((train_clf),method='sigmoid',cv='p
refit')
        #fit the validation dataset with sample weights
        my_calib_2.fit(self.xval.as_matrix(),self.yval)
```

```
        # predict the labels for validation
        self.predicted = ((self.xgbst_clf)).predict(self.xval.as_matrix(),vali
date_features=False)

        # calculate accuracy_score for validation dataset
        self.accuracy_score_val = accuracy_score(self.yval, self.predicted)

        #setting parameters for the test classifier
        params = {'max_depth': max_dpth}
        (test_clf).set_params(**params)

        params = {'learning_rate': lrngrte}
        (test_clf).set_params(**params)

        params = {'n_estimators': n_ests}
        (test_clf).set_params(**params)

        (test_clf).fit(self.X_train.as_matrix(),self.y_train)

        #calibratedclasifierCV using my model prefit with X_test
        my_calib = CalibratedClassifierCV((test_clf),method='sigmoid',cv='pref
it')

        #predicting probabilities for X_test setweights test sample weights
        my_calib.fit(self.X_test,self.y_test)

        # predict xtest labels
        self.test_predict = ((self.xgbst_clf)).predict(self.X_test.as_matrix
(),validate_features=False)

        print('***X_test predict',self.test_predict)

        #store the classifier parameters
        self.clasify_params['clfparams'] = (test_clf).get_params(deep=True)

        #calculate accuracy_score for X_test
        self.accuracy_score_test = accuracy_score(self.y_test, self.test_predi
ct)

        # generate classification report for X_test
        print(classification_report(self.y_test, self.test_predict))

        # confusion matrix for ytest
        tn, fp, fn, tp = confusion_matrix(self.y_test, self.test_predict ).rav
el()
        self.confsnmtxytstpred['tn'] = tn
        self.confsnmtxytstpred['fp'] = fp
        self.confsnmtxytstpred['fn'] = fn
        self.confsnmtxytstpred['tp'] = tp

        # predict probabilites  from xtest for roc_curve
        self.ytst_predprob_actclf = ((self.xgbst_clf)).predict_proba(self.X_te
st.as_matrix(),validate_features=False)[:,1]

        print('*** predict probabilities***',self.ytst_predprob_actclf)

        fpr, tpr, thrshld_test = roc_curve(self.y_test,self.ytst_predprob_actc
```

```
lf)

        # store the above into the dictionary
        self.roc_curve_test['fpr_trn'] = fpr_trn
        self.roc_curve_test['tpr_trn'] =  tpr_trn
        self.roc_curve_test['thrshld_trn'] = thrshld_trn
        self.roc_curve_test['fpr'] = fpr
        self.roc_curve_test['tpr'] = tpr
        self.roc_curve_test['thrshld_test'] = thrshld_test

        self.xgbst_clf = test_clf

    def genwrdcldwords(self):

        top10_negve = sorted(zip((self.xgbst_clf).feature_importances_, self.f
eat_names))[-20:]
        top10_posve = sorted(zip((self.xgbst_clf).feature_importances_, self.f
eat_names))[:20]

        feat_pos=[]
        feat_neg=[]

        features=""

        for coef,feat in (top10_negve):
            feat_pos.append(feat)

        for cef,feat in (top10_posve):
            feat_neg.append(feat)

        i=0
        while i< int(len(feat_pos)):
            feat_item=[]
            features = features + " " + feat_pos[i]
            features = features + " " + feat_neg[i]

            i +=1
        return features

if __name__ == "__main__":


    xgbst = assign9XGBoost()

    xgbst.load_data('BOWBAL')
    xgbst.setmdl('BOWBAL')
    print('BOWBAL')
    xgbst_clf = xgbst.XgBstClasifier()
    xgbst.XGBST_calcrocaucscore()

    xgbst.load_data('BOW')
    xgbst.setmdl('BOW')
    print('BOW')
    xgbst_clf = xgbst.XgBstClasifier()
    xgbst.XGBST_calcrocaucscore()

    xgbst.load_data('TFIDFBAL')
```

```
xgbst.setmdl('TFIDFBAL')
print('TFIDFBAL')
xgbst_clf = xgbst.XgBstClasifier()
xgbst.XGBST_calcrocaucscore()

xgbst.load_data('TFIDF')
xgbst.setmdl('TFIDF')
print('TFIDF')
xgbst_clf = xgbst.XgBstClasifierNoWts()
xgbst.XGBST_calcrocaucscore()

xgbst.load_data('AVGW2VBAL')
xgbst.setmdl('AVGW2VBAL')
print('AVGW2VBAL')
xgbst_clf = xgbst.XgBstClasifier()
xgbst.XGBST_calcrocaucscore()

xgbst.load_data('AVGW2V')
xgbst.setmdl('AVGW2V')
print('AVGW2V')
xgbst_clf = xgbst.XgBstClasifierNoWts()
xgbst.XGBST_calcrocaucscore()

xgbst.load_data('WTW2VBAL')
xgbst.setmdl('WTW2VBAL')
print('WTW2VBAL')
xgbst_clf = xgbst.XgBstClasifier()
xgbst.XGBST_calcrocaucscore()

xgbst.load_data('WTW2V')
xgbst.setmdl('WTW2V')
print('WTW2V')
xgbst_clf = xgbst.XgBstClasifierNoWts()
xgbst.XGBST_calcrocaucscore()
```

[5.2.1] Applying XGBOOST on BOW, SET 1

In [0]:
```
# Please write all the code with proper documentation
```

Data set has been balanced

In [35]:
```
xgbst_bow = assign9XGBoost()
xgbst_bow.load_data('BOWBAL')
print(xgbst_bow.xtrain.shape)
print(xgbst_bow.xval.shape)
xgbst_bow_clf = xgbst_bow.XgBstClasifier()
```

```
X_train shape (117746, 500)
y_train shape (117746,)
X_test shape (29438, 500)
y_test shape (29438,)
(94272, 500)
(23474, 500)
```

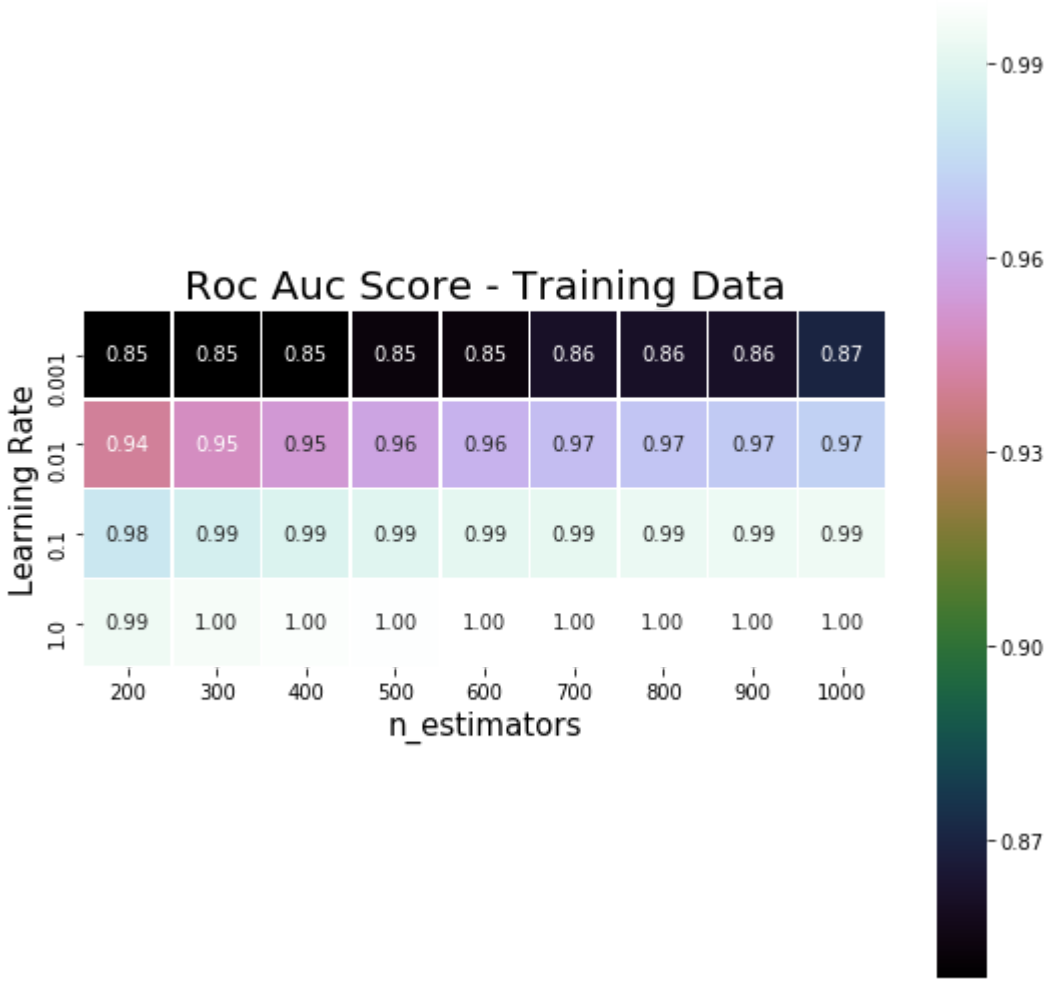
In [7]:
```
xgbst_bow_clf = xgbst_bow.XgBstClasifier()
xgbst_bow.XGBST_calcrocaucscore()
```

```
Function exiting...
```

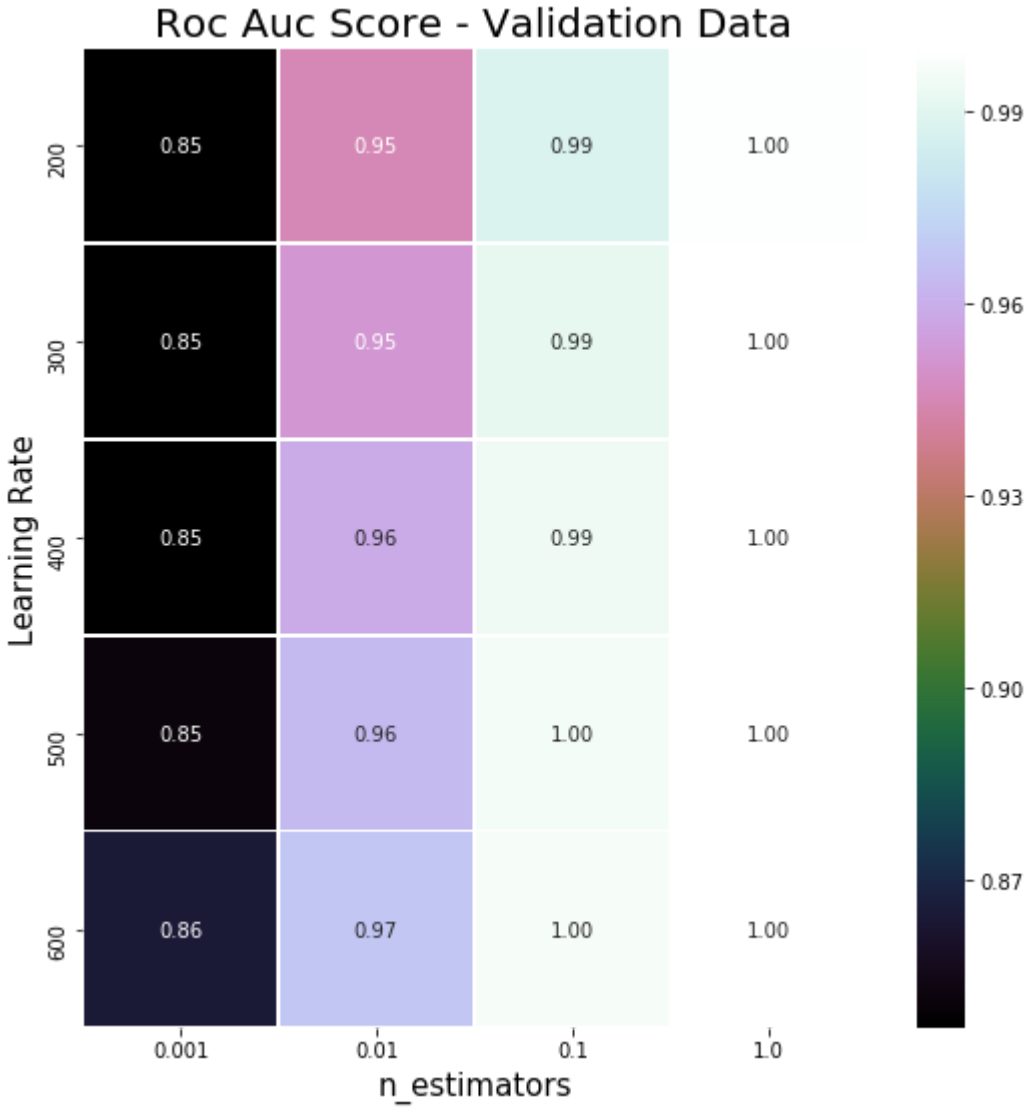
In [64]:
```
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/BOWBAL_xgbst_hmap_train.out'
with open (fname, 'rb') as fp:
     xgbst_bow.xgbst_hmap_trainB = pickle.load(fp)
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/BOWBAL_xgbst_hmap_cval.out'
with open (fname, 'rb') as fp:
    xgbst_bow.xgbst_hmap_valB = pickle.load(fp)
print(xgbst_bow.xgbst_hmap_trainB.shape,xgbst_bow.xgbst_hmap_valB.shape)
```

```
(36, 3) (36, 3)
```

In [65]:
```
displayhmap = drawgraphs()

pivot_tbl = xgbst_bow.xgbst_hmap_trainB.pivot(index='learnrate',columns='nestimators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','n_estimators','Learning Rate')
```



In [8]:
```
pivot_tbl = xgbst_bow.xgbst_hmap_valB.pivot(index='learnrate',columns='nestimators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','n_estimators','Learning Rate')
```



In [36]:
```
xgbst_bow.XGBST_actClasifier(900,10,0.1,True)
```

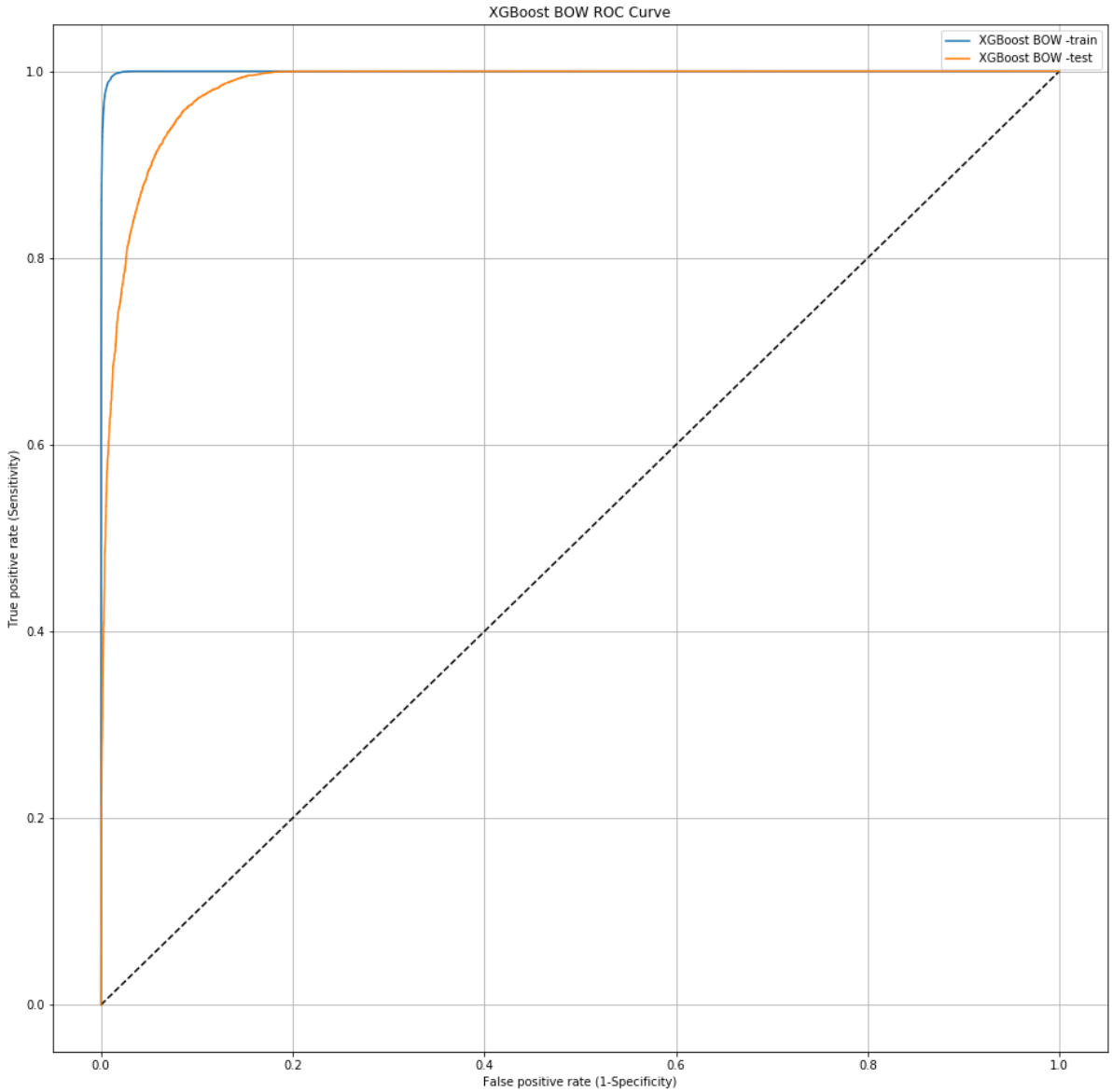
```
***X_test predict [1 0 1 ... 0 0 0]
              precision    recall  f1-score   support

           0       0.97      0.90      0.93     14719
           1       0.90      0.97      0.94     14719

   micro avg       0.93      0.93      0.93     29438
   macro avg       0.94      0.93      0.93     29438
weighted avg       0.94      0.93      0.93     29438

*** predict probabilities*** [0.93366659 0.00386214 0.9167012  ... 0.00358285
0.00358273 0.00393021]
```

In [37]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[xgbst_bow.confsnmtxytstpred['tn'] ,xgbst_bow.confsnmtxytstpred['fn'
]],[xgbst_bow.confsnmtxytstpred['fp'],xgbst_bow.confsnmtxytstpred['tp']]]
displaygraph.draw_table(data)
data1= [[xgbst_bow.accuracy_score_val,xgbst_bow.accuracy_score_test]]
displaygraph.draw_accscore(data1)
```

	Actual: NO	Actual: YES
Predicted: NO	13181	404
Predicted: YES	1538	14315

	Validation	Test
Accuracy Score	0.934054698815711	0.9340308444867178

In [38]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='XGBoost BOW ROC Curve'
displaygraph.legnd_1 = 'XGBoost BOW -train'
displaygraph.legnd_2 = 'XGBoost BOW -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(xgbst_bow.roc_curve_test['fpr_trn'],xgbst_bow.roc_
curve_test['tpr_trn'],\
                            xgbst_bow.roc_curve_test['fpr'],xgbst_bow.roc_curv
e_test['tpr'])
```



In [ ]:

Data set has not been balanced

In [39]:
```
xgbst_bow = assign9XGBoost()
xgbst_bow.load_data('BOW')
print(xgbst_bow.xtrain.shape)
print(xgbst_bow.xval.shape)
xgbst_bow_clf = xgbst_bow.XgBstClasifierNoWts()
```

```
X_train shape (70218, 1000)
y_train shape (70218,)
X_test shape (17555, 1000)
y_test shape (17555,)
(56174, 1000)
(14044, 1000)
```

In [9]:
```
xgbst_bow_clf = xgbst_bow.XgBstClasifierNoWts()
#xgbst_bow.XGBST_calcrocaucscore()
```

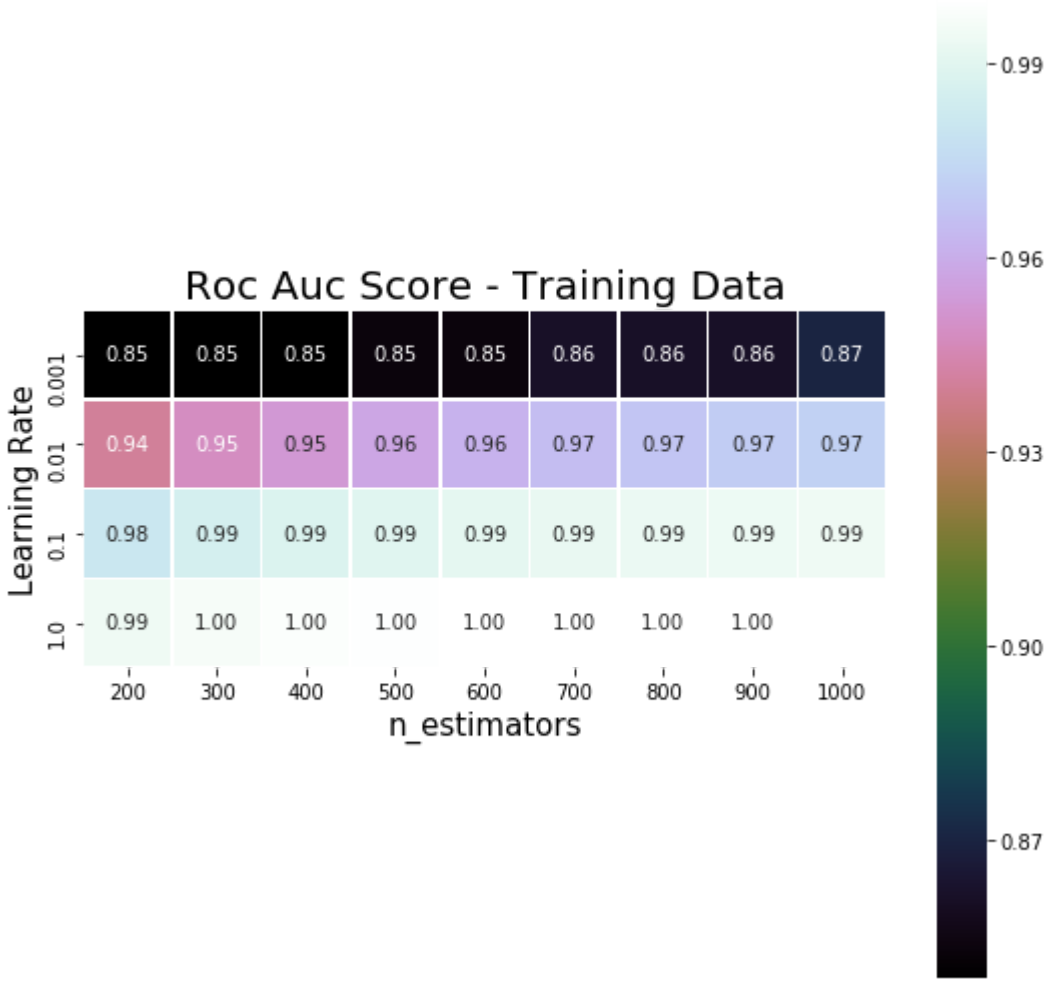
```
Function exiting...
```

In [40]:
```
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/BOW_xgbst_hmap_train.out'
with open (fname, 'rb') as fp:
     xgbst_bow.xgbst_hmap_train = pickle.load(fp)
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/BOW_xgbst_hmap_cval.out'
with open (fname, 'rb') as fp:
    xgbst_bow.xgbst_hmap_val = pickle.load(fp)
```

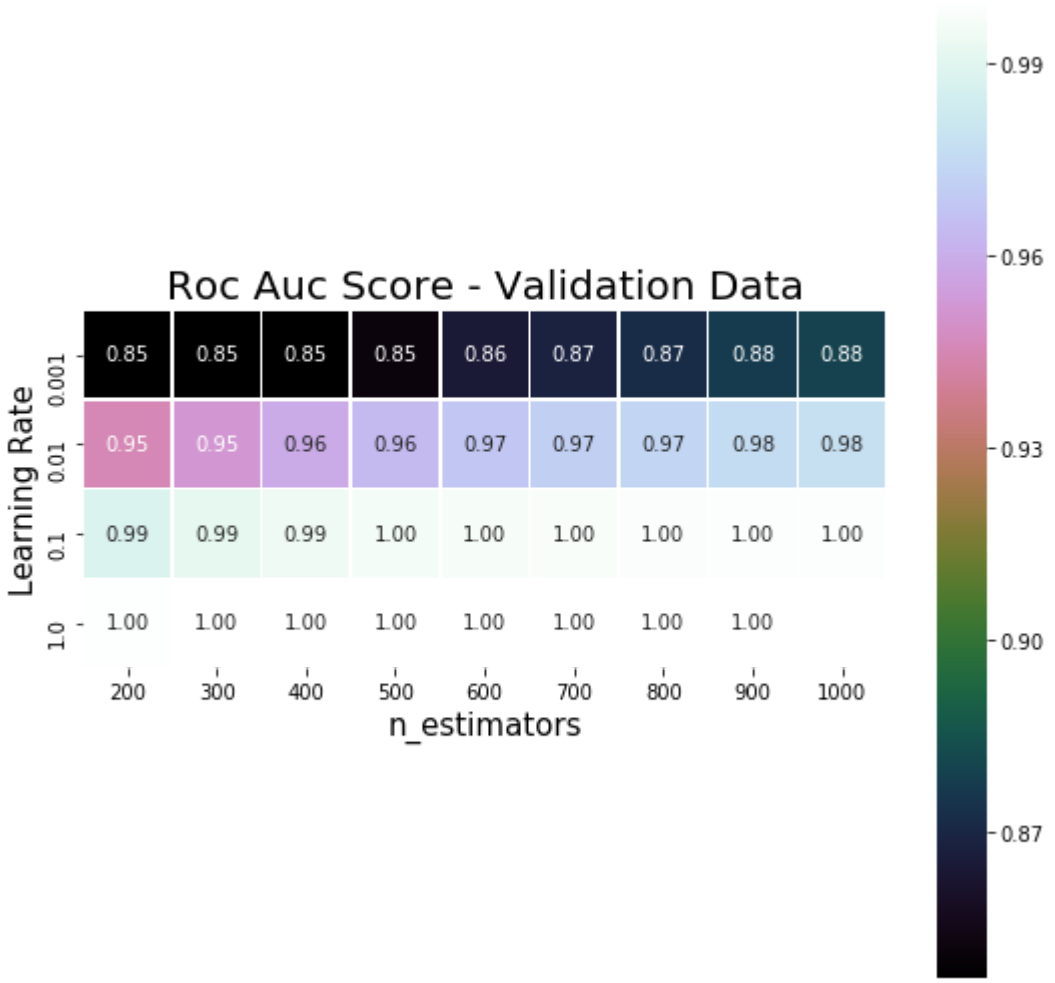
In [41]:
```
print(xgbst_bow.xgbst_hmap_train.shape,xgbst_bow.xgbst_hmap_val.shape)
```

```
(72, 3) (72, 3)
```

In [66]:
```
displayhmap = drawgraphs()
xgbst_bow.xgbst_hmap_train = xgbst_bow.xgbst_hmap_train[0:35]
pivot_tbl = xgbst_bow.xgbst_hmap_train.pivot(index='learnrate',columns='nestimators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','n_estimators','Learning Rate')
```



In [67]:
```
xgbst_bow.xgbst_hmap_val = xgbst_bow.xgbst_hmap_val[0:35]
pivot_tbl = xgbst_bow.xgbst_hmap_val.pivot(index='learnrate',columns='nestimat
ors',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','n_estima
tors','Learning Rate')
```



In [44]:
```
xgbst_bow.XGBST_actClasifier(1000,9,0.1,False)
```

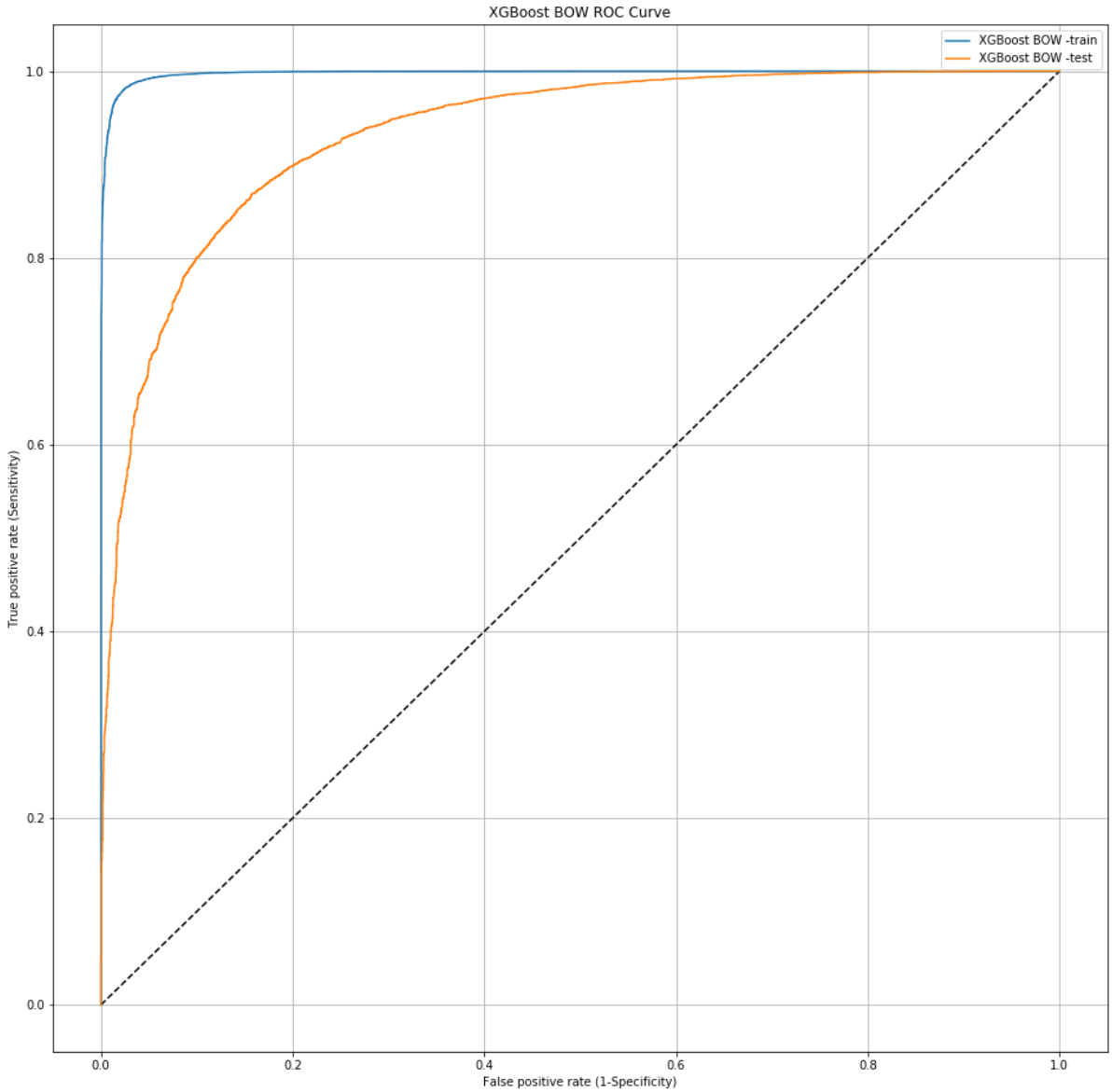
```
***X_test predict [1 0 1 ... 1 1 1]
              precision    recall  f1-score   support

           0       0.80      0.60      0.68      2836
           1       0.93      0.97      0.95     14719

   micro avg       0.91      0.91      0.91     17555
   macro avg       0.86      0.78      0.82     17555
weighted avg       0.91      0.91      0.91     17555

*** predict probabilities*** [0.96052414 0.03349579 0.86684066 ... 0.91363317
0.9606722  0.96045882]
```

In [45]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[xgbst_bow.confsnmtxytstpred['tn'] ,xgbst_bow.confsnmtxytstpred['fn'
]],[xgbst_bow.confsnmtxytstpred['fp'],xgbst_bow.confsnmtxytstpred['tp']]]
displaygraph.draw_table(data)
data1= [[xgbst_bow.accuracy_score_val,xgbst_bow.accuracy_score_test]]
displaygraph.draw_accscore(data1)
```

	Actual: NO	Actual: YES
Predicted: NO	1694	423
Predicted: YES	1142	14296

	Validation	Test
Accuracy Score	0.9086442608943321	0.9108516092281401

In [46]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='XGBoost BOW ROC Curve'
displaygraph.legnd_1 = 'XGBoost BOW -train'
displaygraph.legnd_2 = 'XGBoost BOW -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(xgbst_bow.roc_curve_test['fpr_trn'],xgbst_bow.roc_
curve_test['tpr_trn'],\
                            xgbst_bow.roc_curve_test['fpr'],xgbst_bow.roc_curv
e_test['tpr'])
```



In [ ]:

[5.2.2] Applying XGBOOST on TFIDF, SET 2

In [0]:
```
# Please write all the code with proper documentation
```

Data has been balanced

In [47]:
```
xgbst_tfidf = assign9XGBoost()
xgbst_tfidf.load_data('TFIDFBAL')
print(xgbst_tfidf.xtrain.shape)
print(xgbst_tfidf.xval.shape)
xgbst_tfidf_clf = xgbst_tfidf.XgBstClasifier()
```

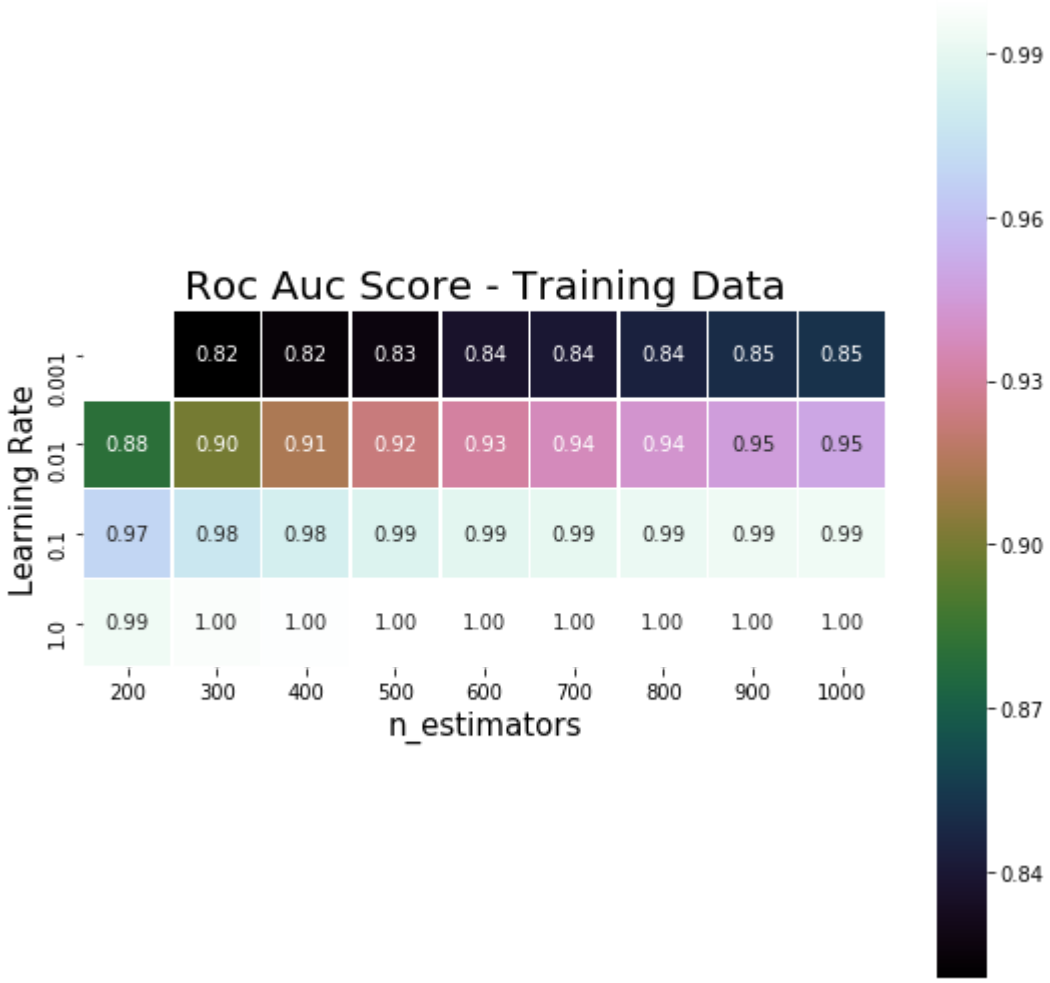
```
X_train shape (117746, 500)
y_train shape (117746,)
X_test shape (29438, 500)
y_test shape (29438,)
(94272, 500)
(23474, 500)
```

In [15]:
```
xgbst_tfidf_clf = xgbst_tfidf.XgBstClasifier()
xgbst_tfidf.XGBST_calcrocaucscore()
```

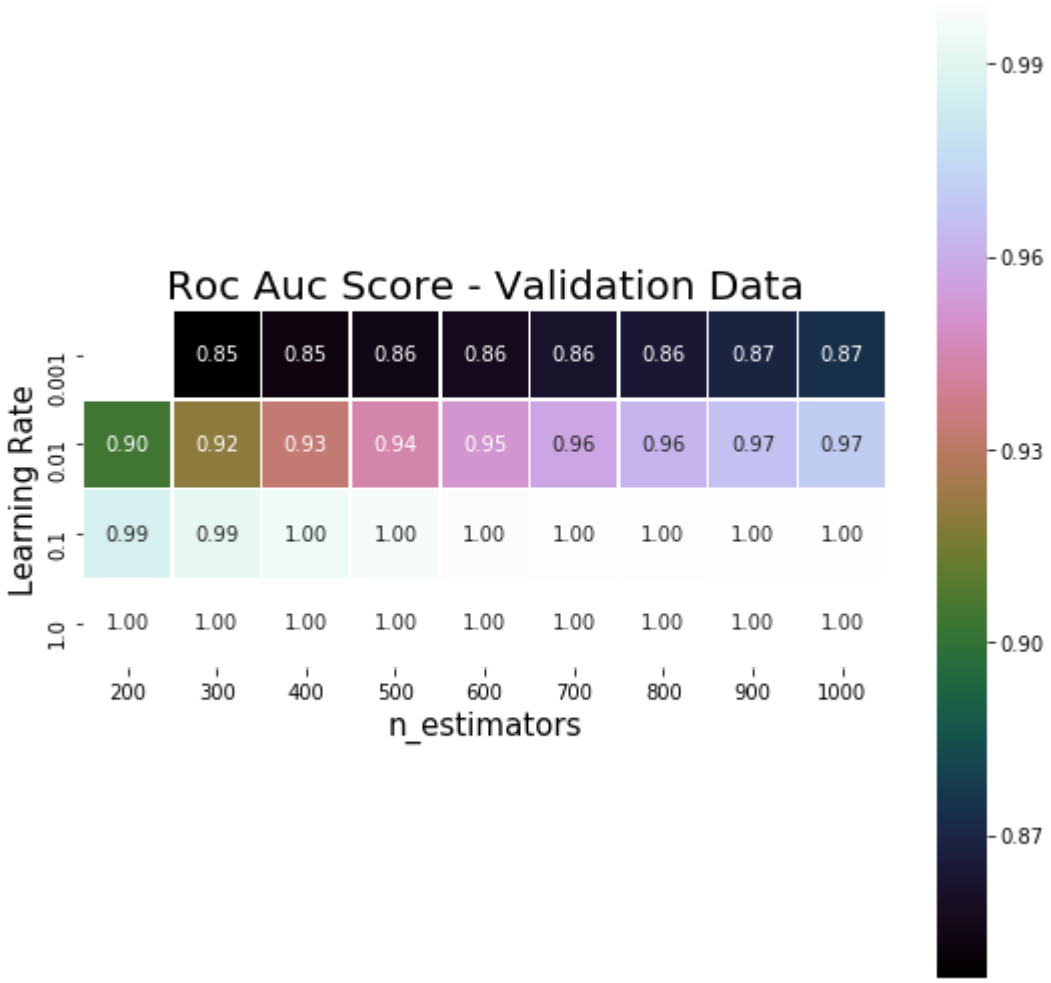
```
Function exiting...
```

In [70]:
```
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/TFIDFBAL_xgbst_hmap
_train.out'
with open (fname, 'rb') as fp:
     xgbst_tfidf.xgbst_hmap_train = pickle.load(fp)
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/TFIDFBAL_xgbst_hmap
_cval.out'
with open (fname, 'rb') as fp:
    xgbst_tfidf.xgbst_hmap_val = pickle.load(fp)
```

In [72]:
```
displayhmap = drawgraphs()
xgbst_tfidf.xgbst_hmap_train = xgbst_tfidf.xgbst_hmap_train[73:108]
pivot_tbl = xgbst_tfidf.xgbst_hmap_train.pivot(index='learnrate',columns='nest
imators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','n_estimato
rs','Learning Rate')
```



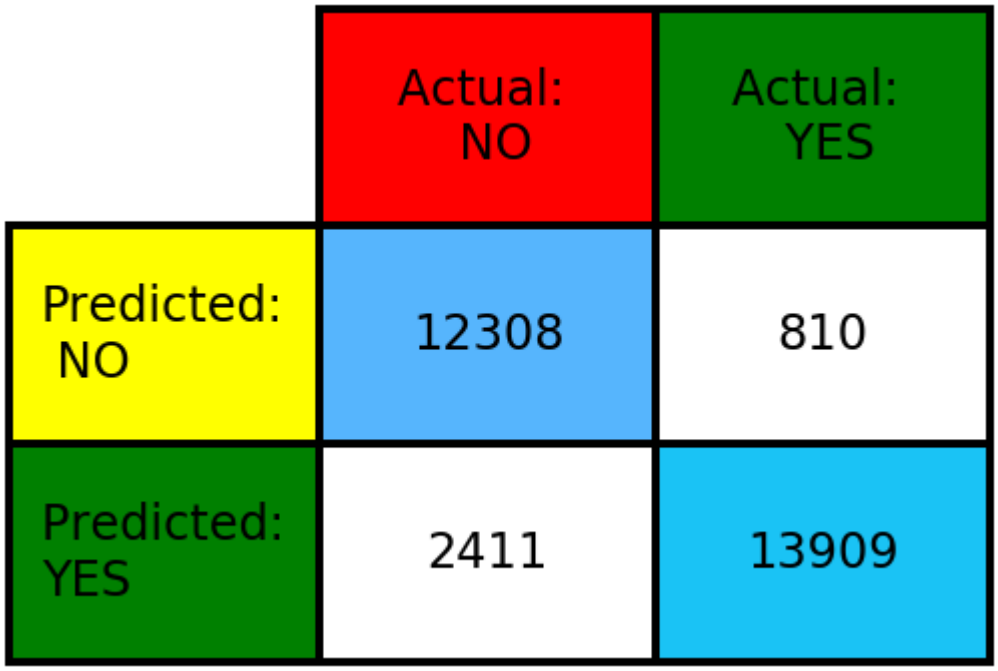
In [73]:
```
xgbst_tfidf.xgbst_hmap_val = xgbst_tfidf.xgbst_hmap_val[73:108]
pivot_tbl = xgbst_tfidf.xgbst_hmap_val.pivot(index='learnrate',columns='nestim
ators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','n_estima
tors','Learning Rate')
```

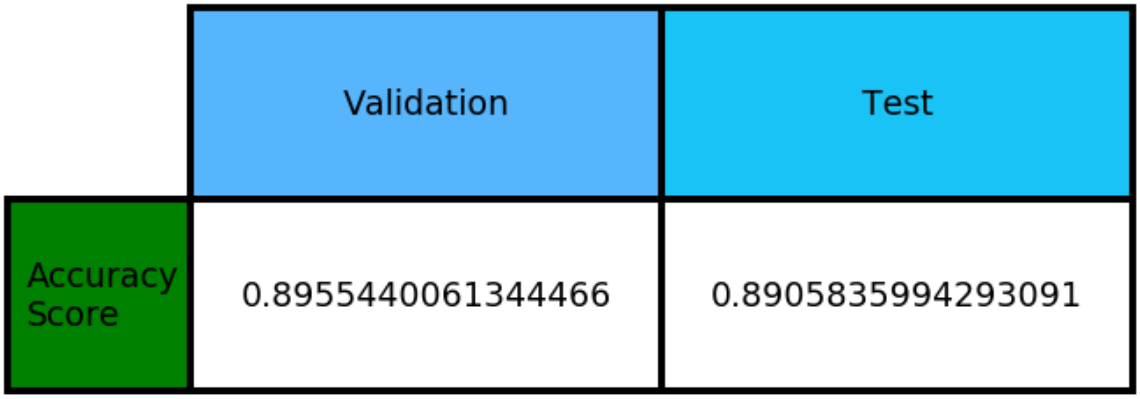


In [74]:
```
xgbst_tfidf.XGBST_actClasifier(1000,10,0.1,True)
```

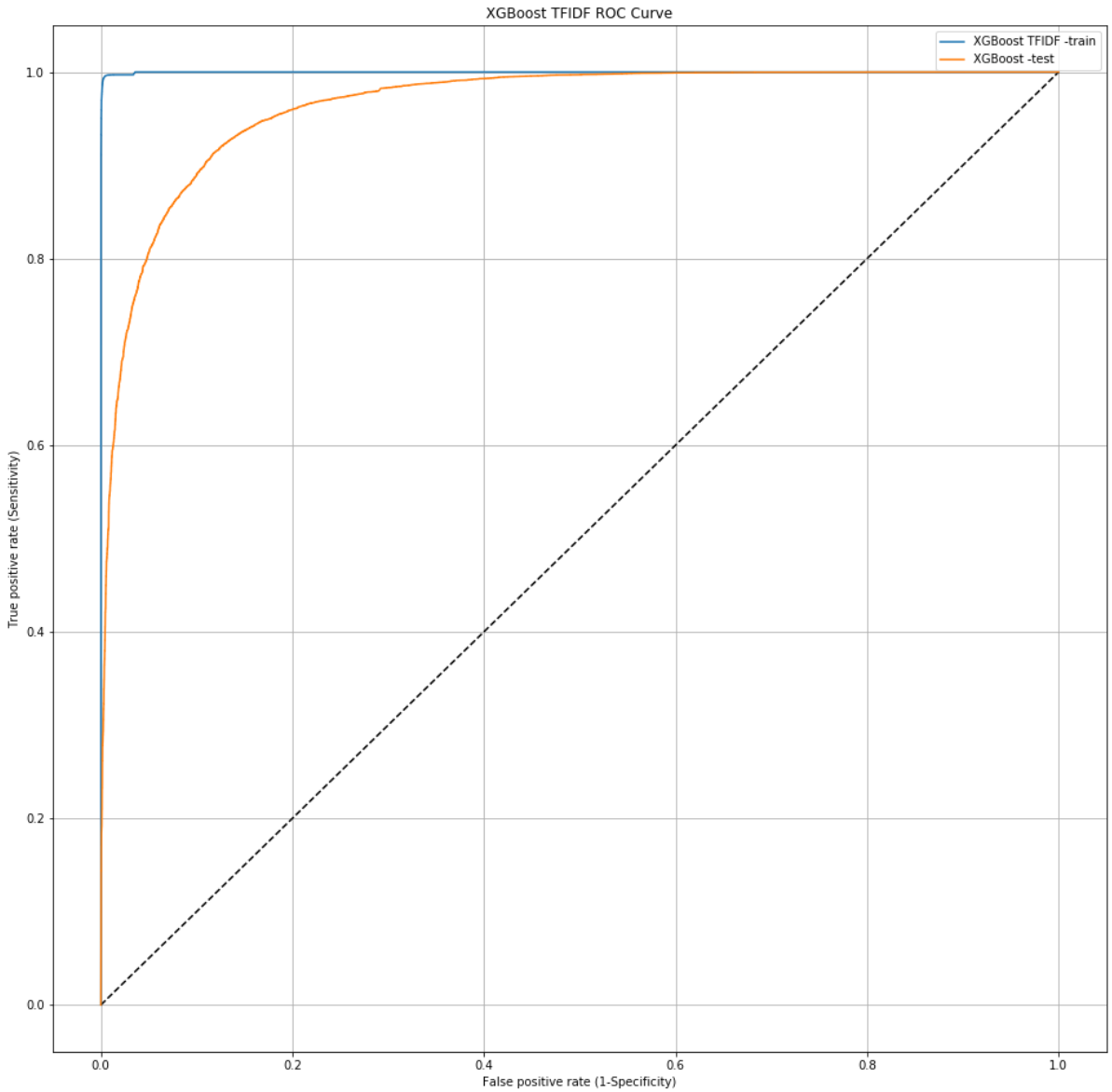
```
***X_test predict [1 0 1 ... 0 0 0]
              precision    recall  f1-score   support

           0       0.94      0.84      0.88     14719
           1       0.85      0.94      0.90     14719

   micro avg       0.89      0.89      0.89     29438
   macro avg       0.90      0.89      0.89     29438
weighted avg       0.90      0.89      0.89     29438

*** predict probabilities*** [0.89079881 0.00441198 0.86349833 ... 0.1838163
0.00446226 0.00575043]
```

In [75]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[xgbst_tfidf.confsnmtxytstpred['tn'] ,xgbst_tfidf.confsnmtxytstpred['f
n']],[xgbst_tfidf.confsnmtxytstpred['fp'],xgbst_tfidf.confsnmtxytstpred['tp'
]]]
displaygraph.draw_table(data)
data1= [[xgbst_tfidf.accuracy_score_val,xgbst_tfidf.accuracy_score_test]]
displaygraph.draw_accscore(data1)
```





In [76]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='XGBoost TFIDF ROC Curve'
displaygraph.legnd_1 = 'XGBoost TFIDF -train'
displaygraph.legnd_2 = 'XGBoost -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(xgbst_tfidf.roc_curve_test['fpr_trn'],xgbst_tfidf.
roc_curve_test['tpr_trn'],\
                            xgbst_tfidf.roc_curve_test['fpr'],xgbst_tfidf.roc_
curve_test['tpr'])
```



Data has not been balanced

In [77]:
```
xgbst_tfidf = assign9XGBoost()
xgbst_tfidf.load_data('TFIDF')
print(xgbst_tfidf.xtrain.shape)
print(xgbst_tfidf.xval.shape)
xgbst_tfidf_clf = xgbst_tfidf.XgBstClasifierNoWts()
```

```
X_train shape (70218, 500)
y_train shape (70218,)
X_test shape (17555, 500)
y_test shape (17555,)
(56174, 500)
(14044, 500)
```

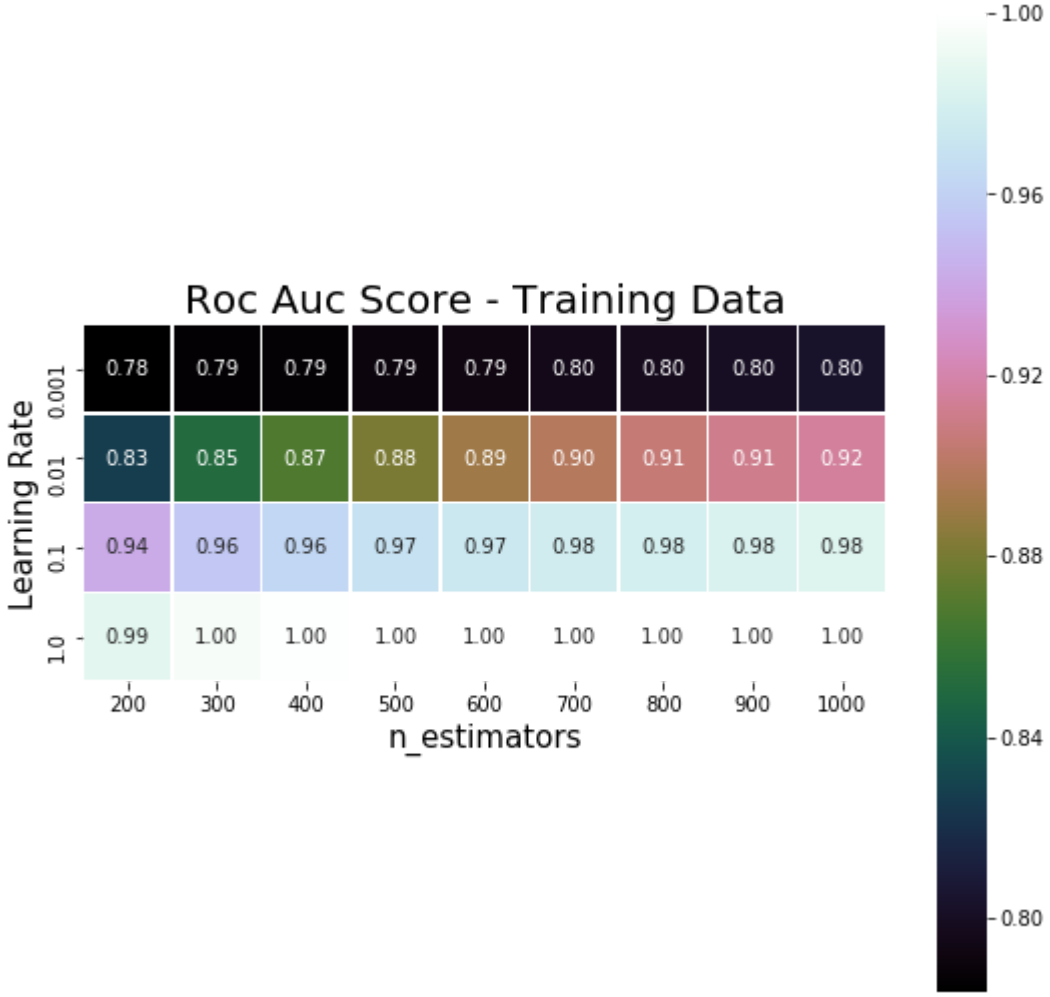
In [ ]:
```
xgbst_tfidf_clf = xgbst_tfidf.XgBstClasifierNoWts()
xgbst_tfidf.XGBST_calcrocaucscore()
```

In [78]:
```
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/TFIDF_xgbst_hmap_train.out'
with open (fname, 'rb') as fp:
     xgbst_tfidf.xgbst_hmap_train = pickle.load(fp)
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/TFIDF_xgbst_hmap_cval.out'
with open (fname, 'rb') as fp:
    xgbst_tfidf.xgbst_hmap_val = pickle.load(fp)
```

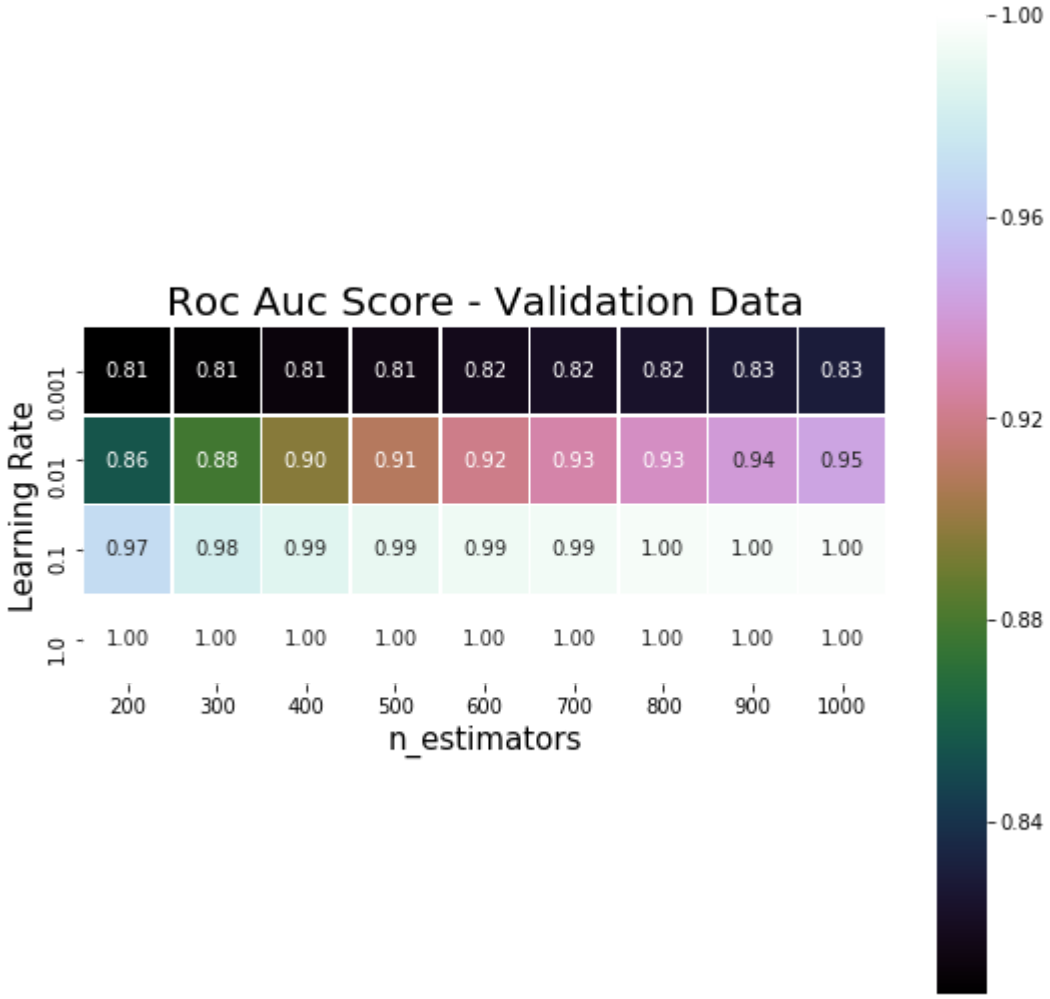
In [80]:
```
print(xgbst_tfidf.xgbst_hmap_train.shape,xgbst_tfidf.xgbst_hmap_val.shape)
```

```
(144, 3) (144, 3)
```

In [81]:
```
displayhmap = drawgraphs()
xgbst_tfidf.xgbst_hmap_train = xgbst_tfidf.xgbst_hmap_train[108:144]
pivot_tbl = xgbst_tfidf.xgbst_hmap_train.pivot(index='learnrate',columns='nest
imators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','n_estimato
rs','Learning Rate')
```



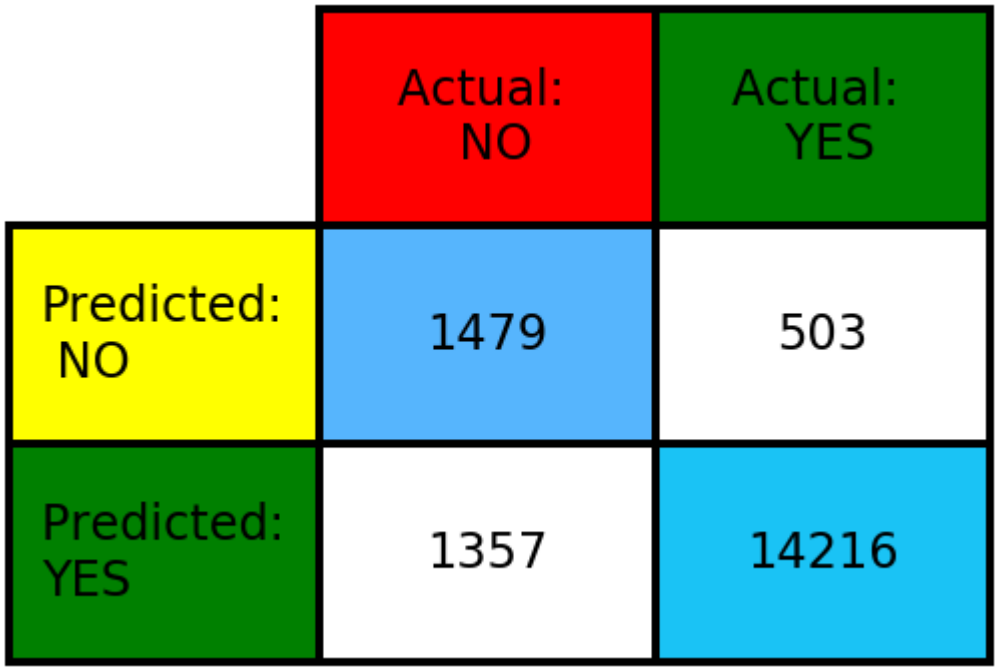
In [82]:
```
xgbst_tfidf.xgbst_hmap_val = xgbst_tfidf.xgbst_hmap_val[108:144]
pivot_tbl = xgbst_tfidf.xgbst_hmap_val.pivot(index='learnrate',columns='nestimators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','n_estimators','Learning Rate')
```

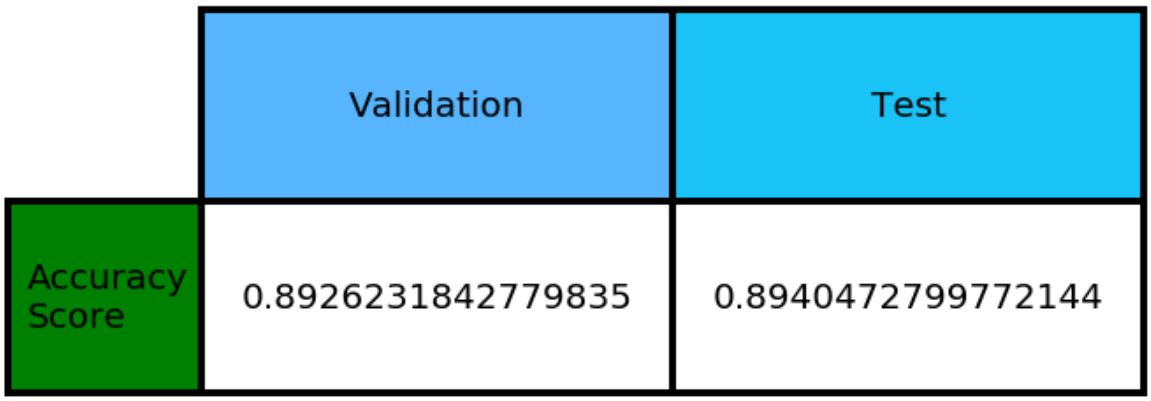


In [83]:
```
xgbst_tfidf.XGBST_actClasifier(1000,5,0.1,False)
```

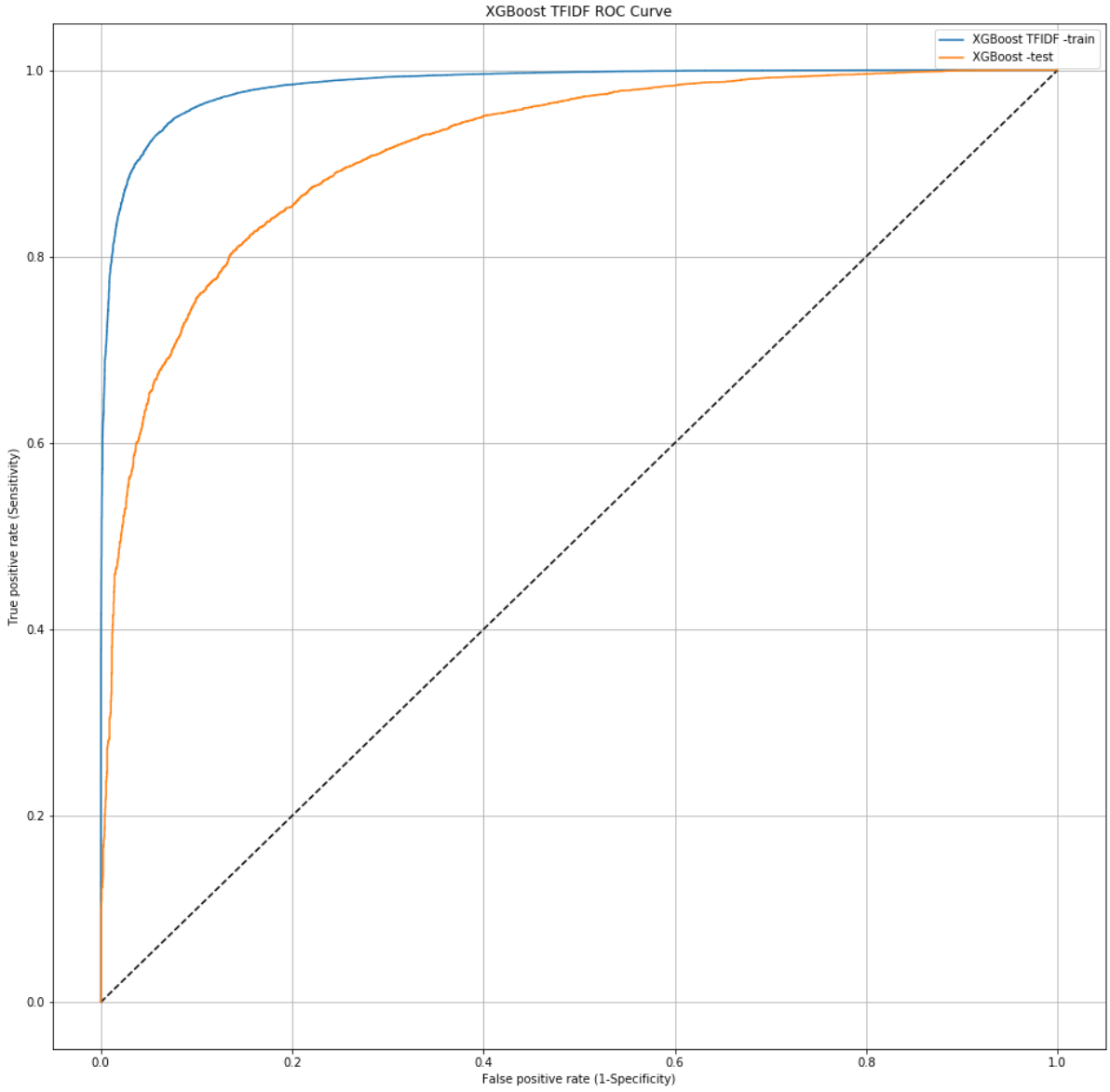
```
***X_test predict [1 0 1 ... 1 1 1]
              precision    recall  f1-score   support

           0       0.75      0.52      0.61      2836
           1       0.91      0.97      0.94     14719

   micro avg       0.89      0.89      0.89     17555
   macro avg       0.83      0.74      0.78     17555
weighted avg       0.89      0.89      0.89     17555

*** predict probabilities*** [0.95544279 0.03319743 0.93258989 ... 0.90138251
0.96176481 0.96134073]
```

In [84]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[xgbst_tfidf.confsnmtxytstpred['tn'] ,xgbst_tfidf.confsnmtxytstpred['f
n']],[xgbst_tfidf.confsnmtxytstpred['fp'],xgbst_tfidf.confsnmtxytstpred['tp'
]]]
displaygraph.draw_table(data)
data1= [[xgbst_tfidf.accuracy_score_val,xgbst_tfidf.accuracy_score_test]]
displaygraph.draw_accscore(data1)
```





In [85]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='XGBoost TFIDF ROC Curve'
displaygraph.legnd_1 = 'XGBoost TFIDF -train'
displaygraph.legnd_2 = 'XGBoost -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(xgbst_tfidf.roc_curve_test['fpr_trn'],xgbst_tfidf.
roc_curve_test['tpr_trn'],\
                            xgbst_tfidf.roc_curve_test['fpr'],xgbst_tfidf.roc_
curve_test['tpr'])
```



[5.2.3] Applying XGBOOST on AVG W2V, SET 3

In [0]:
```
# Please write all the code with proper documentation
```

Dataset has been balanced

In [86]:
```
xgbst_avgw2v = assign9XGBoost()
xgbst_avgw2v.load_data('AVGW2VBAL')
xgbst_avgw2v.vectrizer= 'AVGW2VBAL'
print(xgbst_avgw2v.xtrain.shape)
print(xgbst_avgw2v.xval.shape)
xgbst_avgw2v_clf = xgbst_avgw2v.XgBstClasifier()
```

```
X_train shape (12762, 50)
y_train shape (12762,)
X_test shape (3190, 50)
y_test shape (3190,)
(10250, 50)
(2512, 50)
```

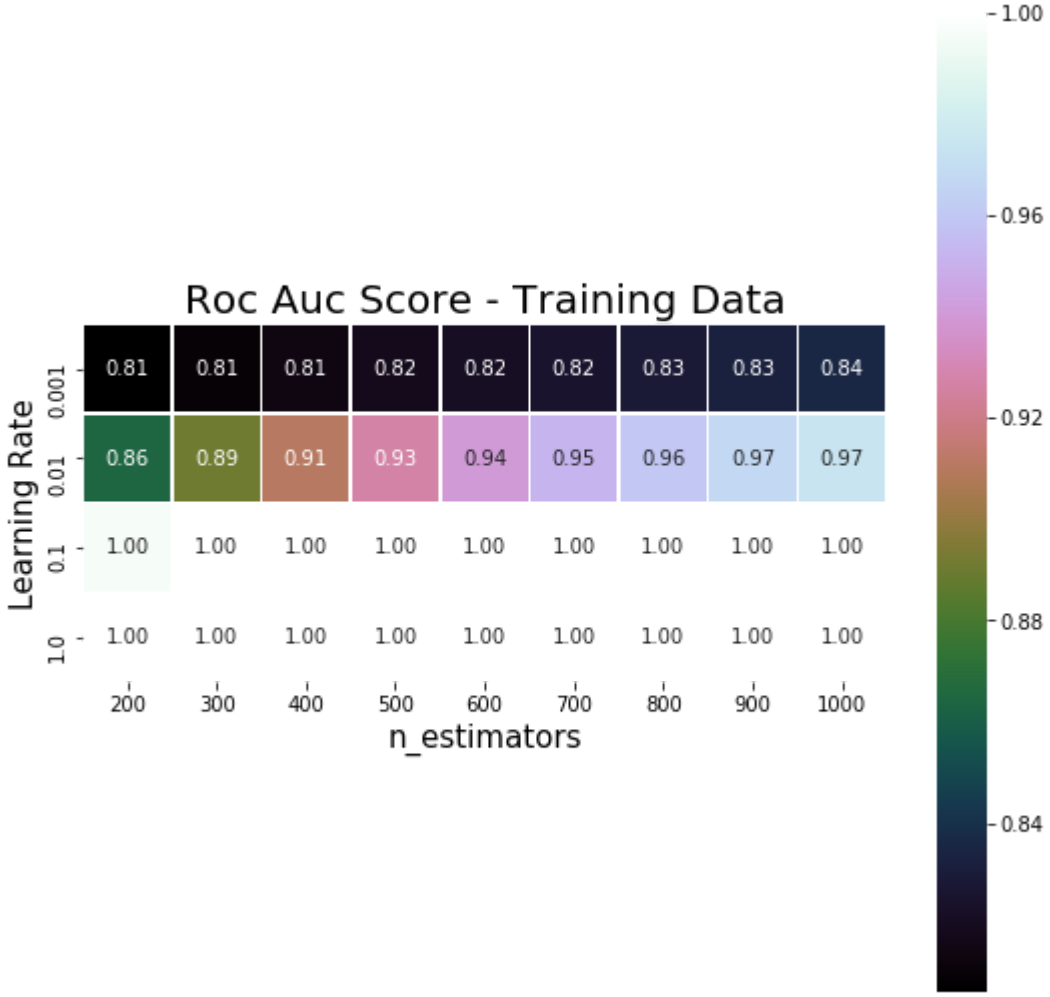
In [ ]:
```
xgbst_avgw2v_clf = xgbst_avgw2v.XgBstClasifier()
xgbst_avgw2v.XGBST_calcrocaucscore()
```

In [93]:
```
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/AVGW2VBAL_xgbst_hmap_train.out'
with open (fname, 'rb') as fp:
     xgbst_avgw2v.xgbst_hmap_train = pickle.load(fp)
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/AVGW2VBAL_xgbst_hmap_cval.out'
with open (fname, 'rb') as fp:
    xgbst_avgw2v.xgbst_hmap_val = pickle.load(fp)
```

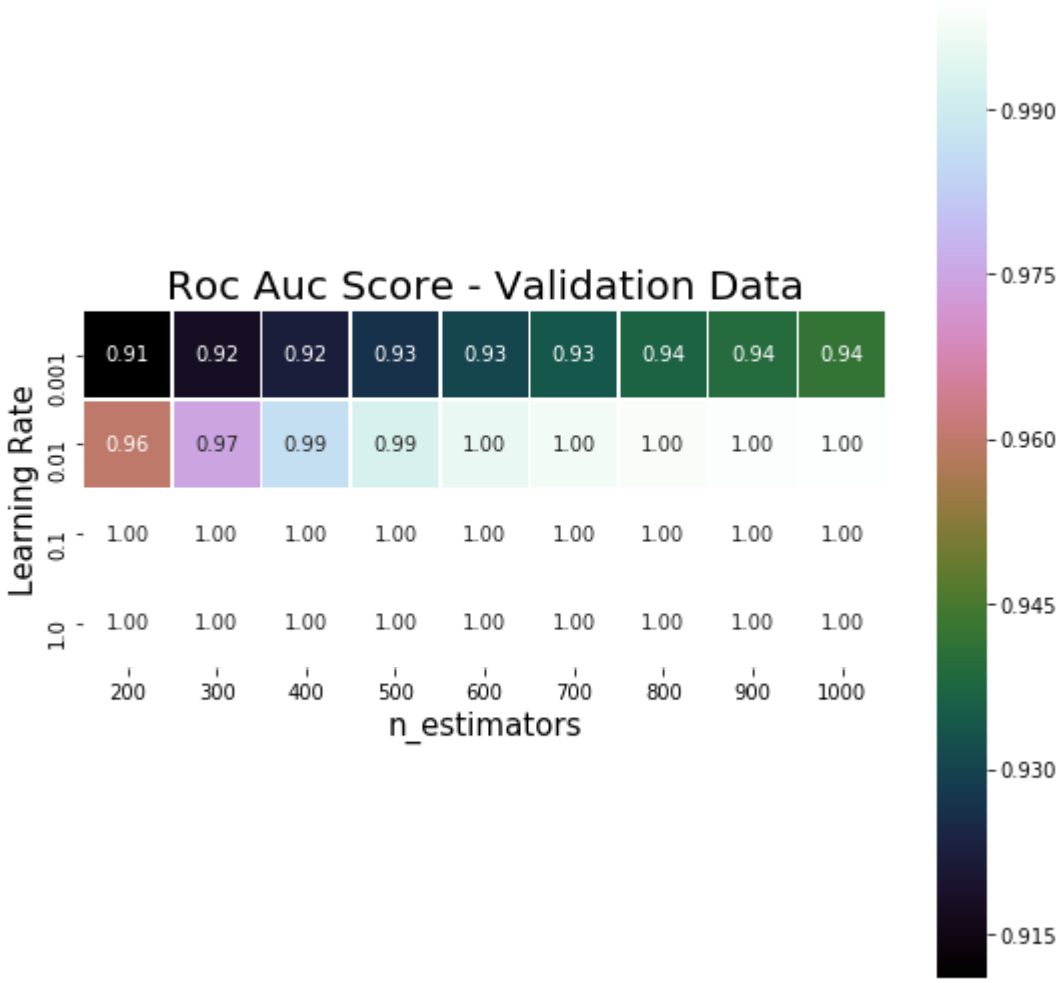
In [94]:
```
print(xgbst_avgw2v.xgbst_hmap_train.shape,xgbst_avgw2v.xgbst_hmap_val.shape)
```

```
(180, 3) (180, 3)
```

In [95]:
```
displayhmap = drawgraphs()
xgbst_avgw2v.xgbst_hmap_train = xgbst_avgw2v.xgbst_hmap_train[144:180]
pivot_tbl = xgbst_avgw2v.xgbst_hmap_train.pivot(index='learnrate',columns='nestimators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','n_estimators','Learning Rate')
```



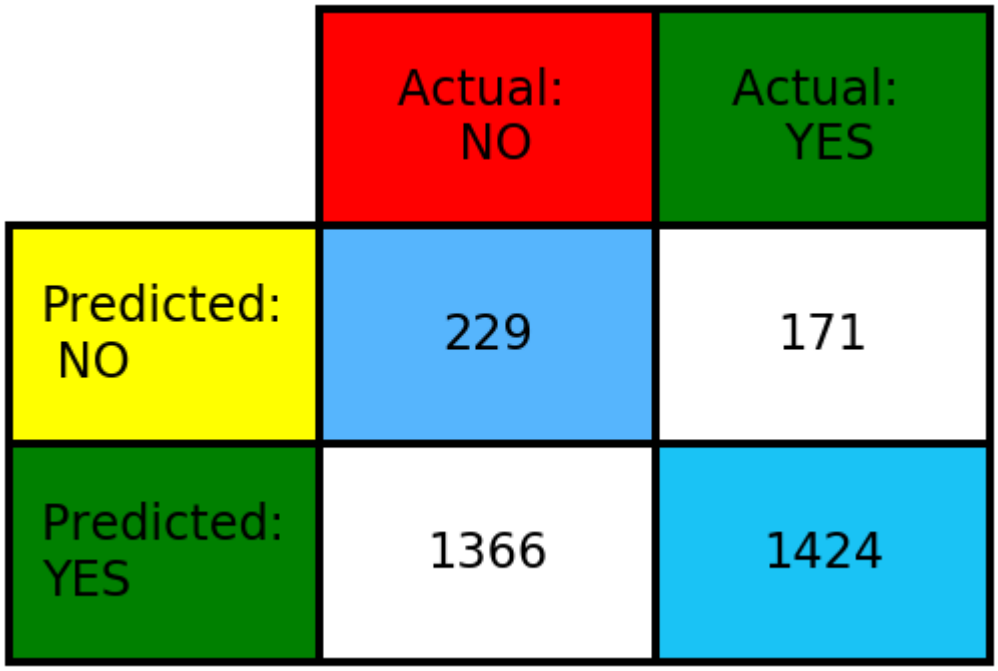
In [96]:
```
xgbst_avgw2v.xgbst_hmap_val = xgbst_avgw2v.xgbst_hmap_val[144:180]
pivot_tbl = xgbst_avgw2v.xgbst_hmap_val.pivot(index='learnrate',columns='nesti
mators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','n_estima
tors','Learning Rate')
```

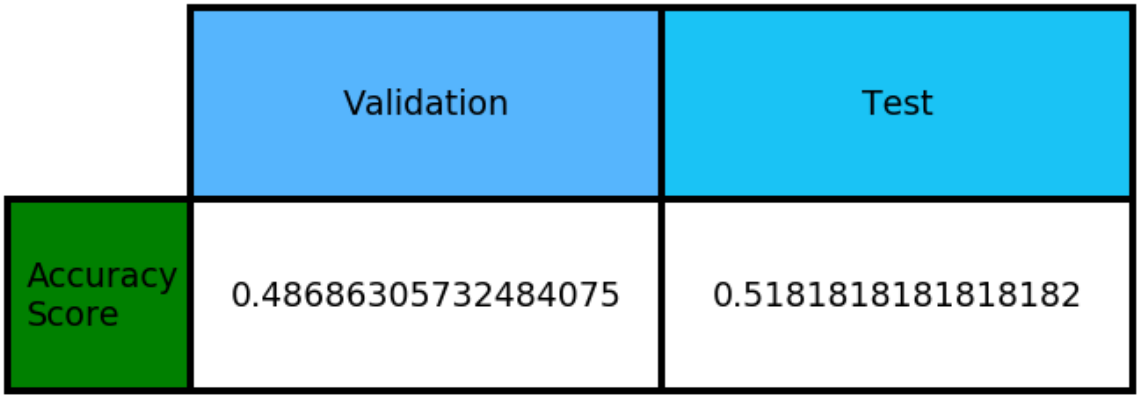


In [97]:
```
xgbst_avgw2v.XGBST_actClasifier(1000,10,0.1,True)
```

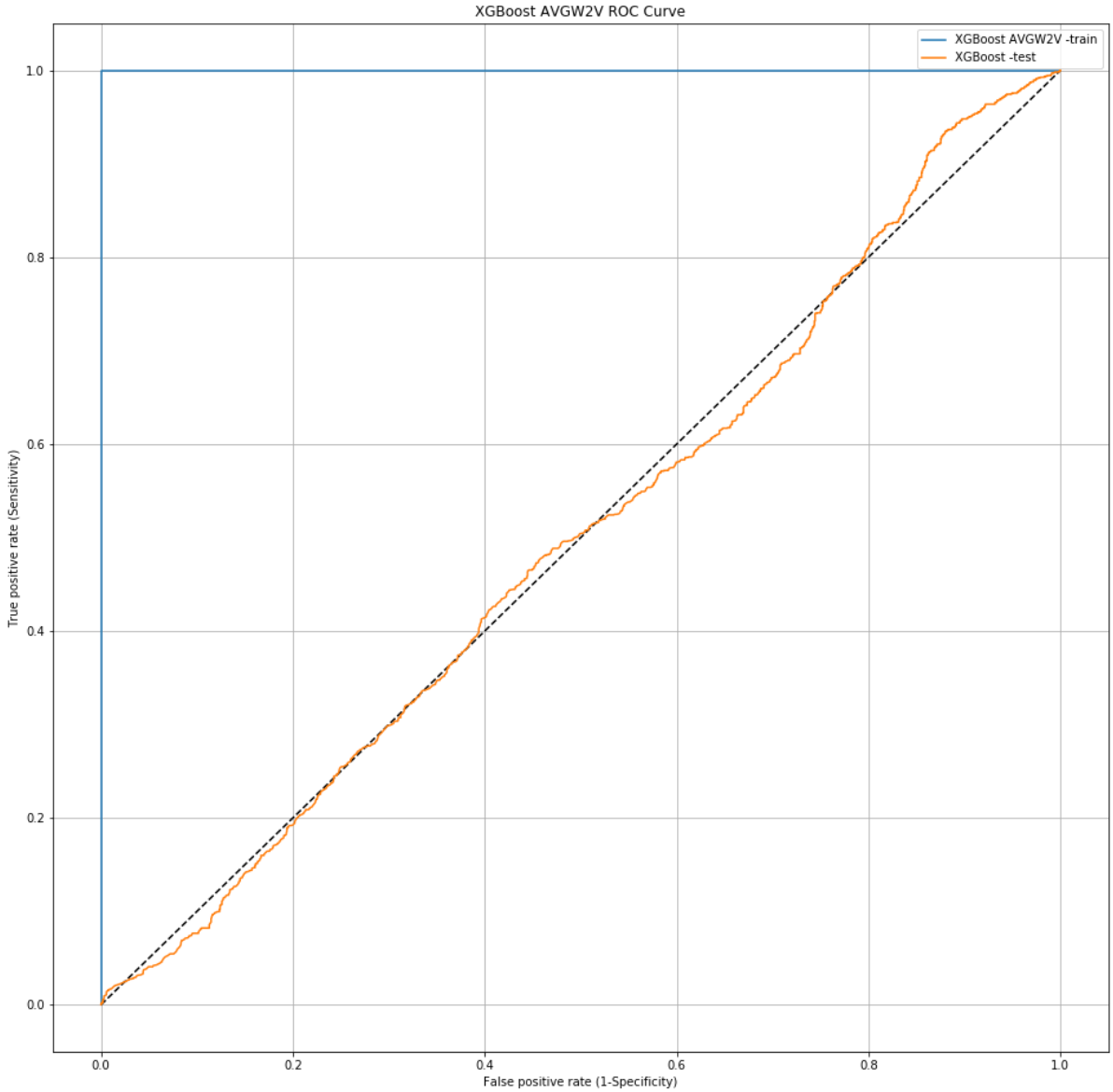
```
***X_test predict [1 1 1 ... 1 1 1]
              precision    recall  f1-score   support

           0       0.57      0.14      0.23      1595
           1       0.51      0.89      0.65      1595

   micro avg       0.52      0.52      0.52      3190
   macro avg       0.54      0.52      0.44      3190
weighted avg       0.54      0.52      0.44      3190

*** predict probabilities*** [0.51086253 0.51037067 0.51121336 ... 0.5086776
0.50902456 0.50399774]
```

In [98]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[xgbst_avgw2v.confsnmtxytstpred['tn'] ,xgbst_avgw2v.confsnmtxytstpred[
'fn']],[xgbst_avgw2v.confsnmtxytstpred['fp'],xgbst_avgw2v.confsnmtxytstpred['t
p']]]
displaygraph.draw_table(data)
data1= [[xgbst_avgw2v.accuracy_score_val,xgbst_avgw2v.accuracy_score_test]]
displaygraph.draw_accscore(data1)
```





In [99]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='XGBoost AVGW2V ROC Curve'
displaygraph.legnd_1 = 'XGBoost AVGW2V -train'
displaygraph.legnd_2 = 'XGBoost -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(xgbst_avgw2v.roc_curve_test['fpr_trn'],xgbst_avgw2
v.roc_curve_test['tpr_trn'],\
                            xgbst_avgw2v.roc_curve_test['fpr'],xgbst_avgw2v.ro
c_curve_test['tpr'])
```



Data set has not been balanced

In [100]:
```
xgbst_avgw2v = assign9XGBoost()
xgbst_avgw2v.load_data('AVGW2V')
xgbst_avgw2v.vectrizer= 'AVGW2V'
print(xgbst_avgw2v.xtrain.shape)
print(xgbst_avgw2v.xval.shape)
xgbst_avgw2v_clf = xgbst_avgw2v.XgBstClasifier()
```

```
X_train shape (7651, 50)
y_train shape (7651,)
X_test shape (1913, 50)
y_test shape (1913,)
(6120, 50)
(1531, 50)
```

In [23]:
```
xgbst_avgw2v_clf = xgbst_avgw2v.XgBstClasifier()
xgbst_avgw2v.XGBST_calcrocaucscore()
```

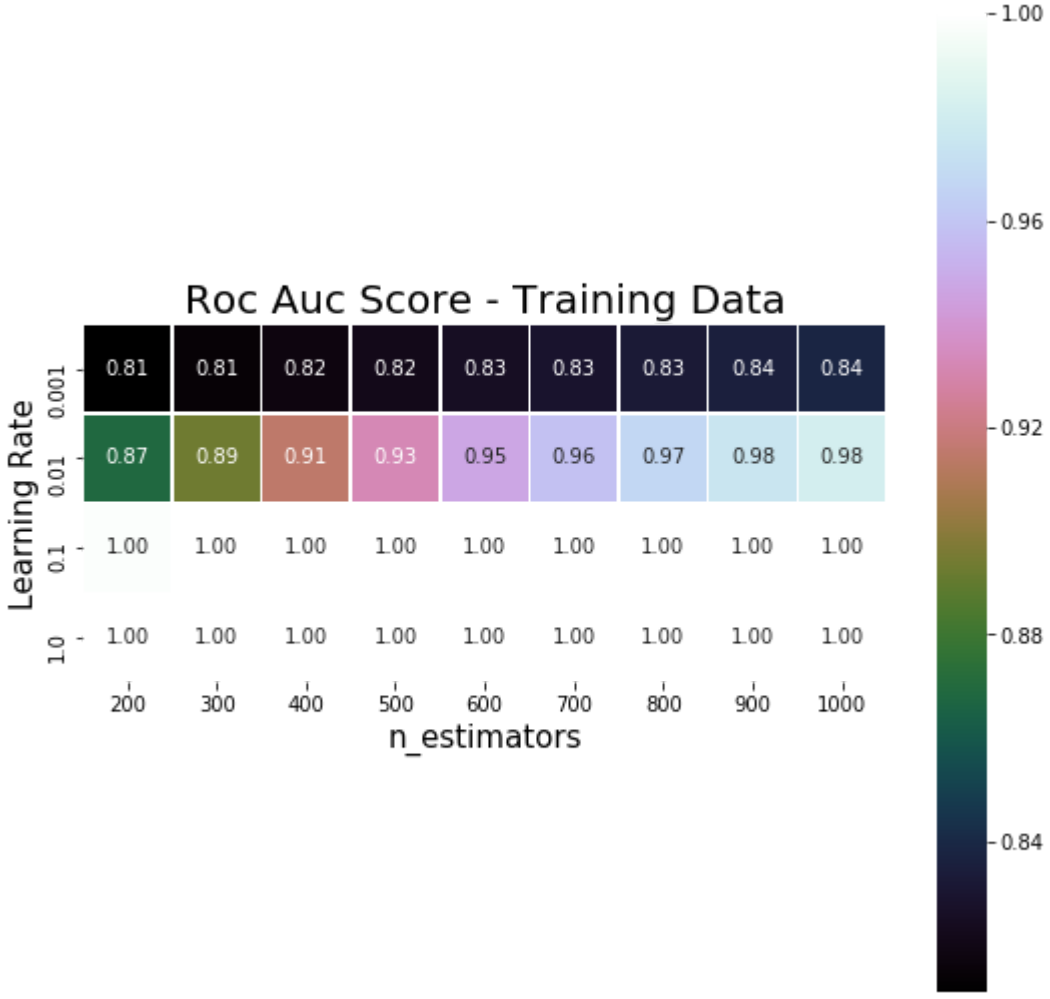
```
Function exiting...
```

In [101]:
```
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/AVGW2V_xgbst_hmap_train.out'
with open (fname, 'rb') as fp:
     xgbst_avgw2v.xgbst_hmap_train = pickle.load(fp)
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/AVGW2V_xgbst_hmap_cval.out'
with open (fname, 'rb') as fp:
    xgbst_avgw2v.xgbst_hmap_val = pickle.load(fp)
```

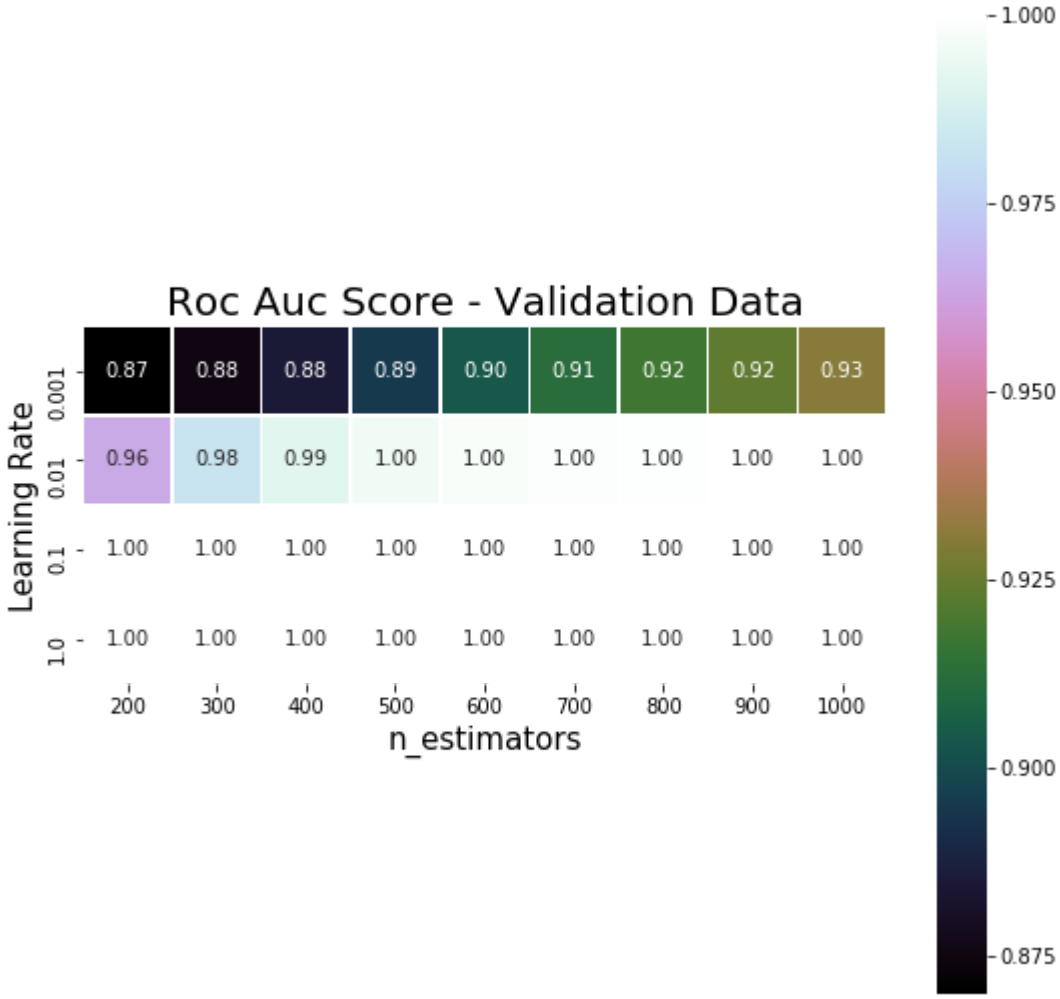
In [102]:
```
print(xgbst_avgw2v.xgbst_hmap_train.shape,xgbst_avgw2v.xgbst_hmap_val.shape)
```

```
(216, 3) (216, 3)
```

In [103]:
```
displayhmap = drawgraphs()
xgbst_avgw2v.xgbst_hmap_train = xgbst_avgw2v.xgbst_hmap_train[180:216]
pivot_tbl = xgbst_avgw2v.xgbst_hmap_train.pivot(index='learnrate',columns='nestimators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','n_estimators','Learning Rate')
```



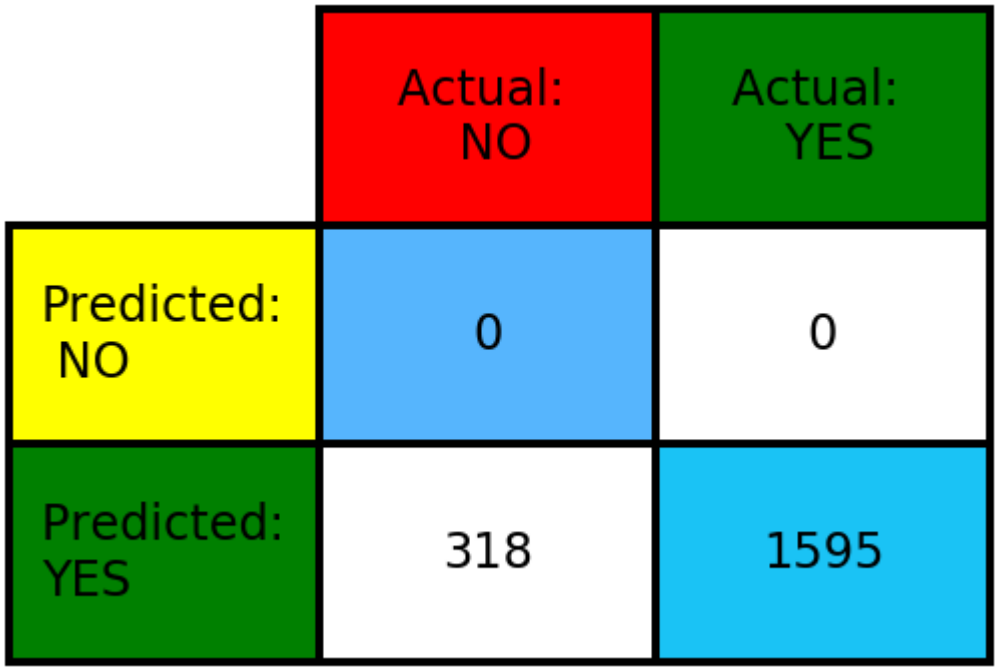
In [104]:
```
xgbst_avgw2v.xgbst_hmap_val = xgbst_avgw2v.xgbst_hmap_val[180:216]
pivot_tbl = xgbst_avgw2v.xgbst_hmap_val.pivot(index='learnrate',columns='nesti
mators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','n_estima
tors','Learning Rate')
```

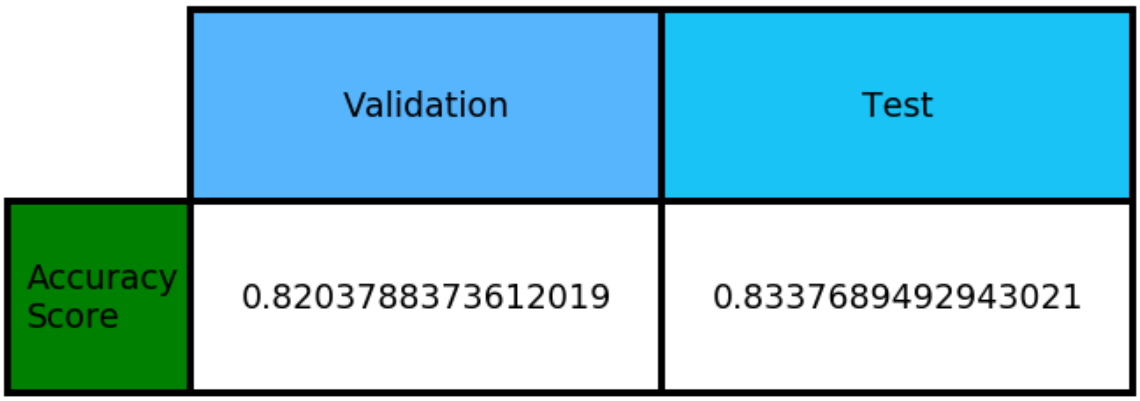


In [105]:
```
xgbst_avgw2v.XGBST_actClasifier(1000,5,0.01,False)
```

```
***X_test predict [1 1 1 ... 1 1 1]
              precision    recall  f1-score   support

           0       0.00      0.00      0.00       318
           1       0.83      1.00      0.91      1595

   micro avg       0.83      0.83      0.83      1913
   macro avg       0.42      0.50      0.45      1913
weighted avg       0.70      0.83      0.76      1913

*** predict probabilities*** [0.81372517 0.8137821  0.82606673 ... 0.82021099
0.85202777 0.82298708]
```

In [106]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[xgbst_avgw2v.confsnmtxytstpred['tn'] ,xgbst_avgw2v.confsnmtxytstpred[
'fn']],[xgbst_avgw2v.confsnmtxytstpred['fp'],xgbst_avgw2v.confsnmtxytstpred['t
p']]]
displaygraph.draw_table(data)
data1= [[xgbst_avgw2v.accuracy_score_val,xgbst_avgw2v.accuracy_score_test]]
displaygraph.draw_accscore(data1)
```





In [ ]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='XGBoost AVGW2V ROC Curve'
displaygraph.legnd_1 = 'XGBoost AVGW2V -train'
displaygraph.legnd_2 = 'XGBoost -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(xgbst_avgw2v.roc_curve_test['fpr_trn'],xgbst_avgw2
v.roc_curve_test['tpr_trn'],\
                            xgbst_avgw2v.roc_curve_test['fpr'],xgbst_avgw2v.ro
c_curve_test['tpr'])
```

[5.2.4] Applying XGBOOST on TFIDF W2V, SET 4

In [0]:
```
# Please write all the code with proper documentation
```

Dataset has been balanced

In [116]:
```
xgbst_wtw2v = assign9XGBoost()
xgbst_wtw2v.load_data('WTW2VBAL')
xgbst_wtw2v.vectrizer= 'WTW2VBAL'
print(xgbst_wtw2v.xtrain.shape)
print(xgbst_wtw2v.xval.shape)
xgbst_wtw2v_clf = xgbst_wtw2v.XgBstClasifier()
```

```
X_train shape (12762, 50)
y_train shape (12762,)
X_test shape (3190, 50)
y_test shape (3190,)
(10250, 50)
(2512, 50)
```

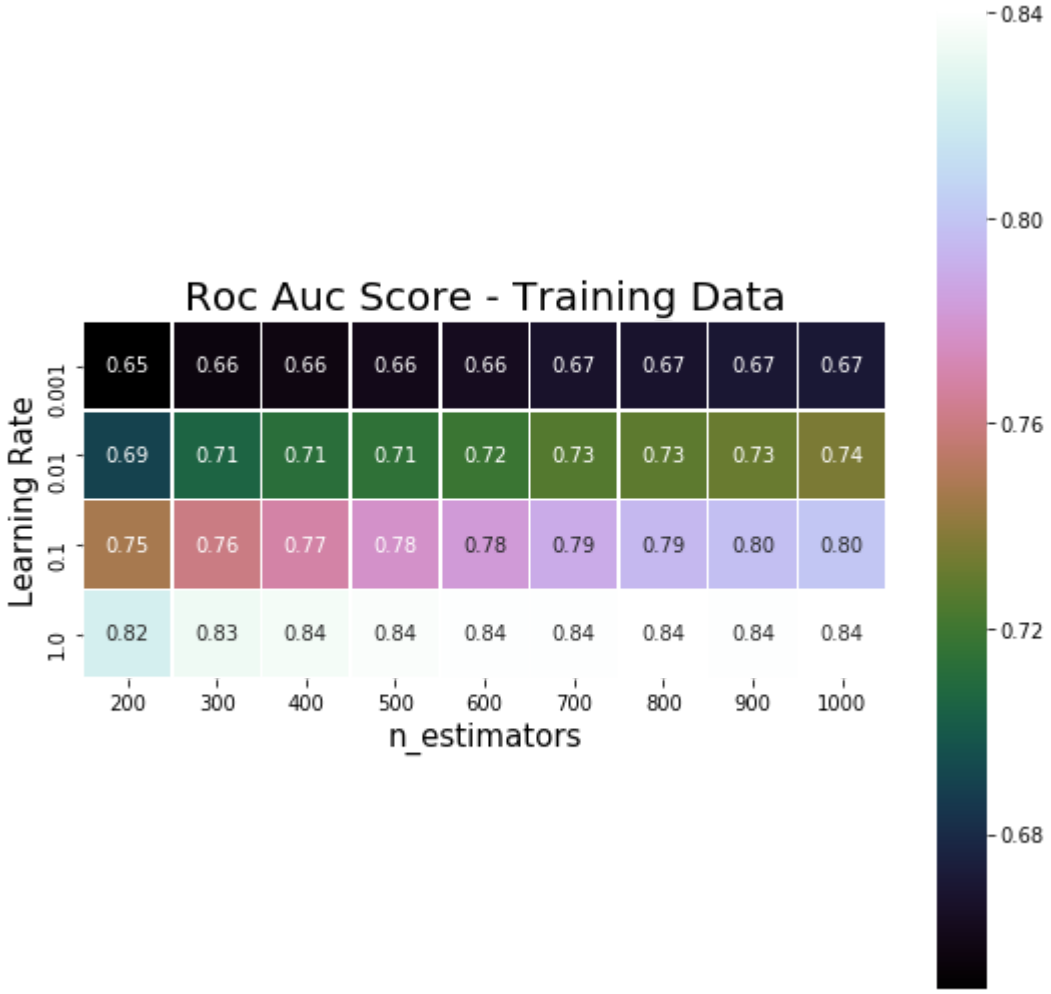
In [ ]:
```
xgbst_wtw2v_clf = xgbst_wtw2v.XgBstClasifier()
xgbst_wtw2v.XGBST_calcrocaucscore()
```

In [117]:
```
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/WTW2VBAL_xgbst_hmap
_train.out'
with open (fname, 'rb') as fp:
    xgbst_wtw2v.xgbst_hmap_train = pickle.load(fp)
fname = 'E:/appliedaicourse/assignments/assign-9-rndforest/WTW2VBAL_xgbst_hmap
_cval.out'
with open (fname, 'rb') as fp:
    xgbst_wtw2v.xgbst_hmap_val = pickle.load(fp)
```

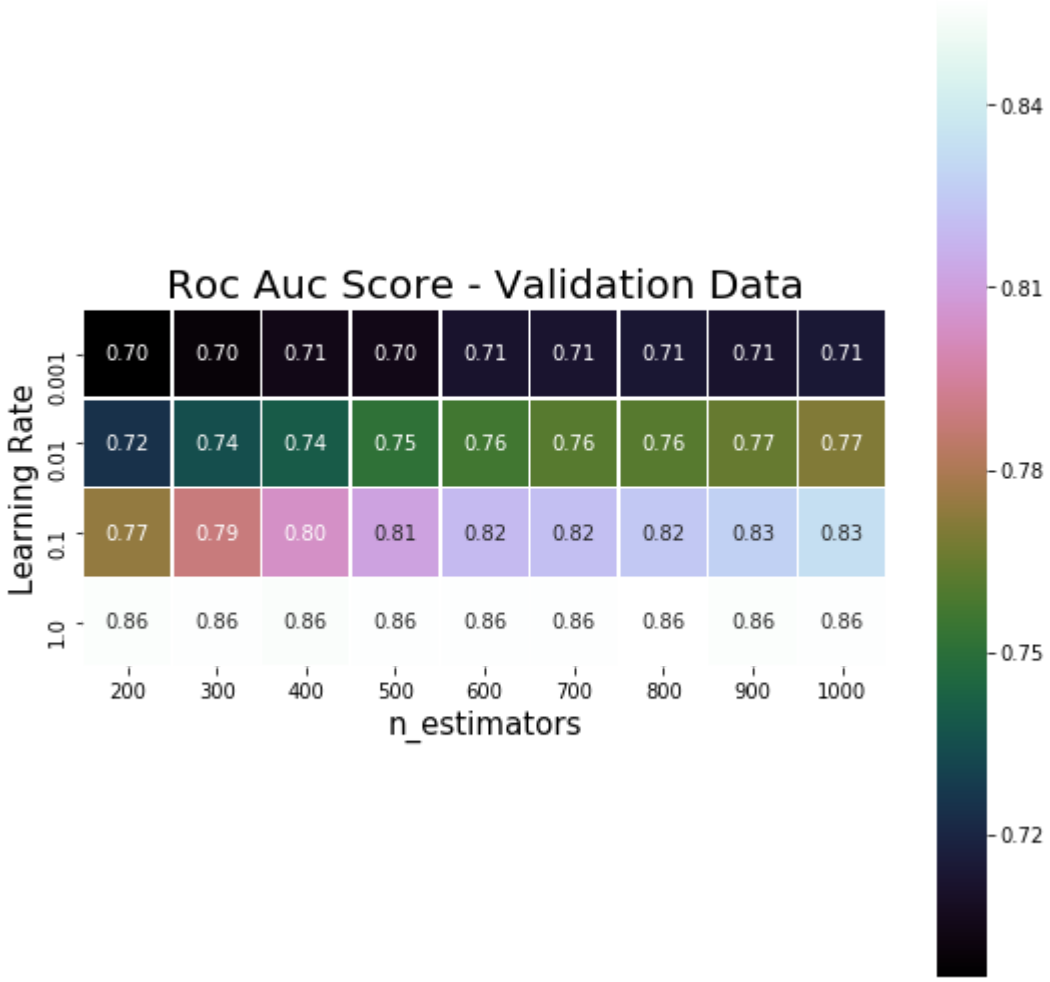
In [118]:
```
print(xgbst_wtw2v.xgbst_hmap_train.shape,xgbst_wtw2v.xgbst_hmap_val.shape)
```

```
(36, 3) (36, 3)
```

In [119]:
```
displayhmap = drawgraphs()

pivot_tbl = xgbst_wtw2v.xgbst_hmap_train.pivot(index='learnrate',columns='nest
imators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Training Data','n_estimato
rs','Learning Rate')
```



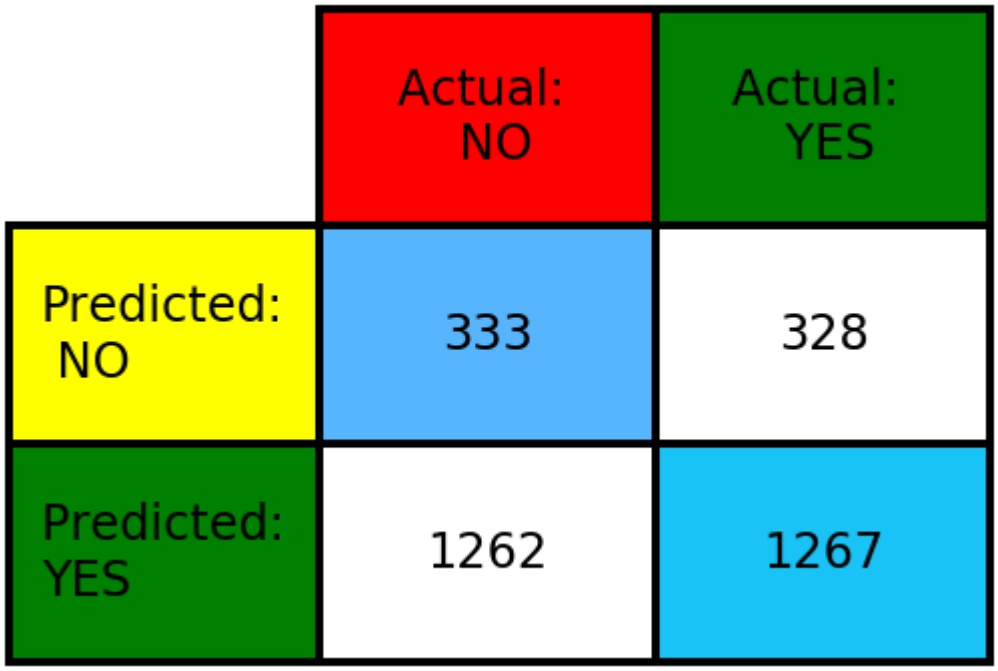
In [120]:
```
pivot_tbl = xgbst_wtw2v.xgbst_hmap_val.pivot(index='learnrate',columns='nestimators',values='rocaucscore').head()
displayhmap.draw_heatmap(pivot_tbl,'Roc Auc Score - Validation Data','n_estimators','Learning Rate')
```

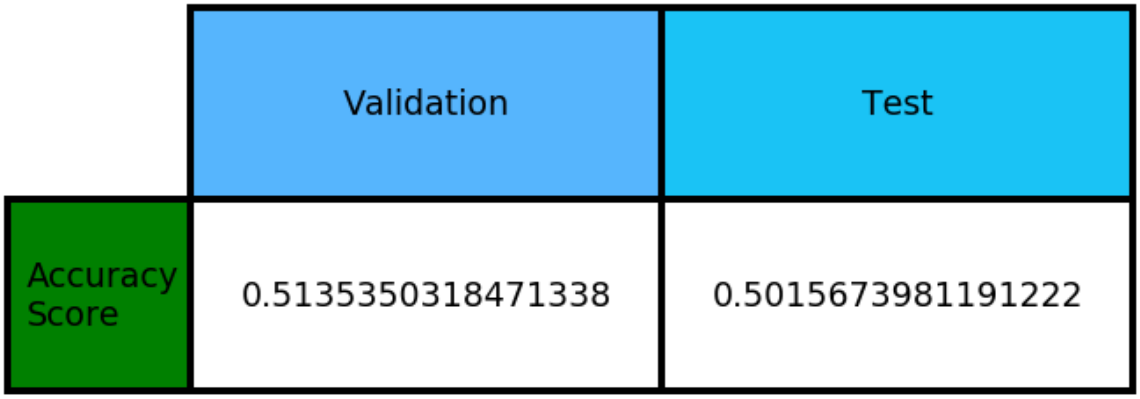


In [121]:
```
xgbst_wtw2v.XGBST_actClasifier(500,10,1,True)
```

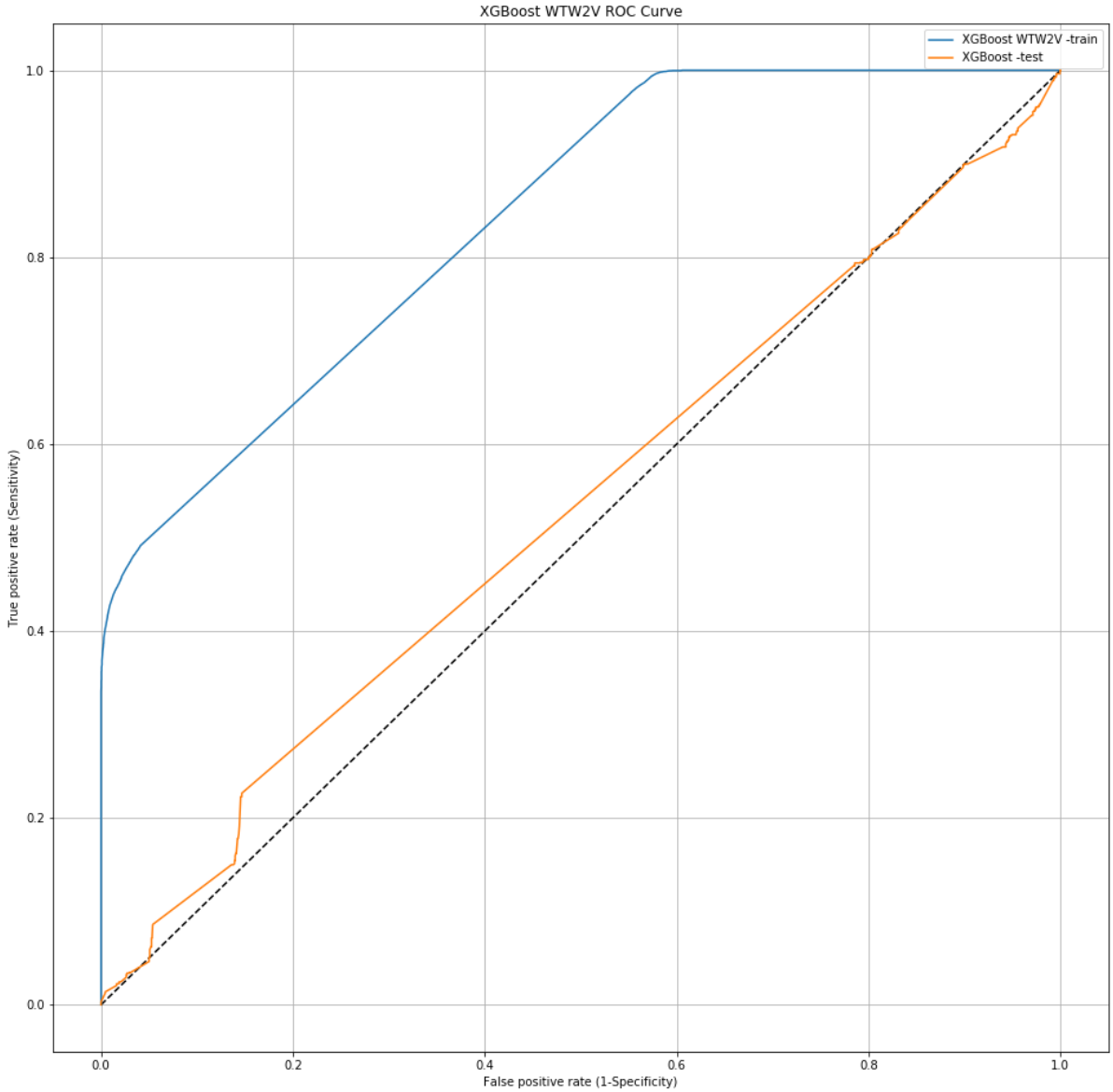
```
***X_test predict [1 0 0 ... 1 1 1]
              precision    recall  f1-score   support

           0       0.50      0.21      0.30      1595
           1       0.50      0.79      0.61      1595

   micro avg       0.50      0.50      0.50      3190
   macro avg       0.50      0.50      0.45      3190
weighted avg       0.50      0.50      0.45      3190

*** predict probabilities*** [0.50217056 0.48830903 0.49008268 ... 0.50217056
0.50217056 0.50217056]
```

In [122]:
```
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
data = [[xgbst_wtw2v.confsnmtxytstpred['tn'] ,xgbst_wtw2v.confsnmtxytstpred['f
n']],[xgbst_wtw2v.confsnmtxytstpred['fp'],xgbst_wtw2v.confsnmtxytstpred['tp'
]]]
displaygraph.draw_table(data)
data1= [[xgbst_wtw2v.accuracy_score_val,xgbst_wtw2v.accuracy_score_test]]
displaygraph.draw_accscore(data1)
```





In [123]:
```
# testing code for displayig graphs
displaygraph = drawgraphs()
displaygraph.setdefaultparm()
displaygraph.graph_title='XGBoost WTW2V ROC Curve'
displaygraph.legnd_1 = 'XGBoost WTW2V -train'
displaygraph.legnd_2 = 'XGBoost -test'
displaygraph.graph_parameters['show_legnd']= True
displaygraph.label_x='False positive rate (1-Specificity)'
displaygraph.label_y='True positive rate (Sensitivity)'
displaygraph.constructgraph(xgbst_wtw2v.roc_curve_test['fpr_trn'],xgbst_wtw2v.
roc_curve_test['tpr_trn'],\
                            xgbst_wtw2v.roc_curve_test['fpr'],xgbst_wtw2v.roc_
curve_test['tpr'])
```



[6] Conclusions

In [0]:
```
# Please compare all your models using Prettytable library
```

Summary of Results - Random forest

In [1]:
```
import tabulate
```

In [5]:
```
final_concln_param_rf = [['Parameters','BOW \nBalanced','BOW','TfIdf \nBalanced','TfIdf','AVGW2V \nBalanced','AVGW2V','WTW2V \nBalanced','WTW2V'],
                  ['Max_Depth',20,20,20,20,20,15,14,15],
                  ['Min_samples \nLeaf',50,50,50,50,50,50,50,50],
                  ['n_estimators',300,800,800,700,1000,900,700,500]
                   ]
print(tabulate.tabulate(final_concln_param_rf,tablefmt='fancy_grid'))
```

```
╒═══════════════╤═══════════╤═══════╤═══════════╤═══════╤═══════════╤═══════╤═══════════╤═══════╕
│ Parameters    │ BOW       │ BOW   │ TfIdf     │ TfIdf │ AVGW2V    │ AVGW2V │ WTW2V     │ WTW2V │
│               │ Balanced  │       │ Balanced  │       │ Balanced  │        │ Balanced  │       │
├───────────────┼───────────┼───────┼───────────┼───────┼───────────┼────────┼───────────┼───────┤
│ Max_Depth     │ 20        │ 20    │ 20        │ 20    │ 20        │ 15     │ 14        │ 15    │
├───────────────┼───────────┼───────┼───────────┼───────┼───────────┼────────┼───────────┼───────┤
│ Min_samples   │ 50        │ 50    │ 50        │ 50    │ 50        │ 50     │ 50        │ 50    │
│ Leaf          │           │       │           │       │           │        │           │       │
├───────────────┼───────────┼───────┼───────────┼───────┼───────────┼────────┼───────────┼───────┤
│ n_estimators  │ 300       │ 800   │ 800       │ 700   │ 1000      │ 900    │ 700       │ 500   │
╘═══════════════╧═══════════╧═══════╧═══════════╧═══════╧═══════════╧════════╧═══════════╧═══════╛
```

In [6]:
```
final_concln_metrix_rf = [['Evaluation \nMetric','BOW \nBalanced','BOW','TfIdf
\nBalanced','TfIdf','AVGW2V \nBalanced','AVGW2V','WTW2V \nBalanced','WTW2V'],
                  ['Accuracy',0.802,0.805,0.773,0.8055,0.714,0.739,0.55,0.35]
                   ]
print(tabulate.tabulate(final_concln_metrix_rf,tablefmt='fancy_grid'))
```

```
╒══════════════╤═══════════╤═══════╤═══════════╤═══════╤═══════════╤═══════╤═══
═══════╤═══════╕
│ Evaluation   │ BOW       │ BOW   │ TfIdf     │ TfIdf │ AVGW2V    │ AVGW2V │ WT
W2V    │ WTW2V │
│ Metric       │ Balanced  │       │ Balanced  │       │ Balanced  │        │ Ba
lanced │       │
├──────────────┼───────────┼───────┼───────────┼───────┼───────────┼────────┼──
──────┼───────┤
│ Accuracy     │ 0.802     │ 0.805 │ 0.773     │ 0.8055 │ 0.714    │ 0.739  │ 0.
55     │ 0.35  │
╘══════════════╧═══════════╧═══════╧═══════════╧═══════╧═══════════╧═══════╧═══
═══════╧═══════╛
```

Summary of Results - XGBoost

In [7]:
```
final_concln_param_xgb = [['Parameters','BOW \nBalanced','BOW','TfIdf \nBalanc
ed','TfIdf','AVGW2V \nBalanced','AVGW2V','WTW2V \nBalanced','WTW2V'],
                  ['Max_Depth',10,9,10,5,10,5,10,10],
                  ['Learning \nRate',0.1,0.1,0.1,0.1,0.1,0.01,1,0.01],
                  ['n_estimators',900,1000,1000,1000,1000,1000,500,50]
                   ]
print(tabulate.tabulate(final_concln_param_xgb,tablefmt='fancy_grid'))
```

```
╒══════════════╤═══════════╤═══════╤═══════════╤═══════╤═══════════╤═══════╤═══
═══════╤═══════╕
│ Parameters   │ BOW       │ BOW   │ TfIdf     │ TfIdf │ AVGW2V    │ AVGW2V │ WTW
2V     │ WTW2V │
│              │ Balanced  │       │ Balanced  │       │ Balanced  │        │ Bal
anced  │       │
├──────────────┼───────────┼───────┼───────────┼───────┼───────────┼────────┼──
──────┼───────┤
│ Max_Depth    │ 10        │ 9     │ 10        │ 5     │ 10        │ 5      │ 10
     │    10 │
├──────────────┼───────────┼───────┼───────────┼───────┼───────────┼────────┼──
──────┼───────┤
│ Learning     │ 0.1       │ 0.1   │ 0.1       │ 0.1   │ 0.1       │ 0.01   │ 1
     │  0.01 │
│ Rate         │           │       │           │       │           │        │
     │       │
├──────────────┼───────────┼───────┼───────────┼───────┼───────────┼────────┼──
──────┼───────┤
│ n_estimators │ 900       │ 1000  │ 1000      │ 1000  │ 1000      │ 1000   │ 500
     │    50 │
╘══════════════╧═══════════╧═══════╧═══════════╧═══════╧═══════════╧═══════╧═══
═══════╧═══════╛
```

In [11]:
```
final_concln_metrix_xgb = [['Evaluation \nMetric','BOW \nBalanced','BOW','TfId
f \nBalanced','TfIdf','AVGW2V \nBalanced','AVGW2V','WTW2V \nBalanced','WTW2V
\n*'],
                    ['Accuracy',0.934,0.9109,0.8906,0.8940,0.5181,0.8338,0.5015
,0.0]
                     ]
print(tabulate.tabulate(final_concln_metrix_xgb,tablefmt='fancy_grid'))
print('* With an un-balanced dataset vectorized using Tfidf weighted Word2Vect
or, processing it using an XGBoost classifier \
        is overfitting hence that models results have been excluded ')
```

```
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│ Evaluation    │ BOW       │ BOW   │ TfIdf     │ TfIdf │ AVGW2V    │ AVGW2V │ WT
W2V    │ WTW2V │
│ Metric        │ Balanced  │       │ Balanced  │       │ Balanced  │        │ Ba
lanced │ *     │
├───────────────┼───────────┼───────┼───────────┼───────┼───────────┼────────┼──
──────┼───────┤
│ Accuracy      │ 0.934     │ 0.9109 │ 0.8906   │ 0.894 │ 0.5181    │ 0.8338 │ 0.
5015   │ 0.0   │
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* With an un-balanced dataset vectorized using Tfidf weighted Word2Vector, pr
ocessing it using an XGBoost classifier         is overfitting hence that mod
els results have been excluded
```