In [ ]:

In [1]:
```
import pandas as pd

import numpy as np


from sklearn.model_selection import GridSearchCV

from sklearn.metrics import roc_curve,auc
from sklearn.model_selection import cross_val_score

from sklearn.metrics import accuracy_score
from sklearn.model_selection import cross_validate



from sklearn.metrics import accuracy_score,confusion_matrix,f1_score,precision
_score,recall_score,roc_auc_score
from sklearn.model_selection import GridSearchCV


import xgboost as xgb
from sklearn.model_selection import RandomizedSearchCV
from xgboost import XGBRegressor

from sklearn.tree import DecisionTreeRegressor

from imblearn.over_sampling import SMOTE
from sklearn.model_selection import train_test_split

import warnings
warnings.filterwarnings('ignore')

from sklearn.preprocessing import StandardScaler

from sklearn.ensemble import RandomForestClassifier

from sklearn.metrics import roc_auc_score
from sklearn import metrics
from sklearn.metrics import accuracy_score,confusion_matrix,f1_score,precision
_score,recall_score,roc_auc_score

import numpy as np;
import seaborn as sns; sns.set()
import matplotlib.pyplot as plt

from xgboost import XGBClassifier
from sklearn import linear_model
```

```
Using TensorFlow backend.
```

In [2]:
```
df_tri=pd.read_csv('train.csv')
```

In [11]:
```
df_tri.head(2)
```

Out[11]:

	ID	Attr1	Attr2	Attr3	Attr4	Attr5	Attr6	Attr7	Attr8	Attr9	...	Attı
0	1	0.135370	0.45185	0.31162	2.0469	10.2340	0.16768	0.167630	1.2131	2.2554	...	0.0787
1	2	0.005861	0.39858	0.19768	1.9390	9.5771	0.00000	0.007237	1.5089	0.9788	...	0.2697

2 rows × 66 columns

In [3]:
```
df_tei=pd.read_csv('test.csv')
```

In [13]:
```
df_tei.head(2)
```

Out[13]:

	ID	Attr1	Attr2	Attr3	Attr4	Attr5	Attr6	Attr7	Attr8	Attr9	...	
0	36554	0.20055	0.37951	0.396410	2.0472	32.351	0.38825	0.249760	1.33050	1.1389	...	3
1	36555	0.00902	0.63202	0.053735	1.1263	-37.842	0.00000	0.014434	0.58223	1.3332	...	

2 rows × 65 columns

In [14]:
```
df_tri['target'].value_counts()
```

Out[14]:
```
0    29772
1     1511
Name: target, dtype: int64
```

OBSERVATION: As we can see here this is highly imbalance dataset:

In [16]:
```
yees=df_tri['target']
df_tr_after_drop=df_tri.drop(['target'],axis=1)
```

Splitting DATA into Train Test and C.V with stratification in 49:30:21 ratio:

In [17]:
```
# split the data set into train and test
X_1, X_test, y_1, y_test = train_test_split(df_tr_after_drop, yees, test_size=
0.3, random_state=42,stratify=yees)

# split the train data set into cross validation train and cross validation te
st
X_tr, X_cv, y_tr, y_cv = train_test_split(X_1, y_1, test_size=0.3)
```

Replacing NaN with mean value of feature:

In [18]:
```
X_tr.fillna(X_tr.mean(), inplace=True)
X_test.fillna(X_test.mean(), inplace=True)
X_cv.fillna(X_cv.mean(), inplace=True)
```

Standardisation of data:

In [19]:
```
sc = StandardScaler(with_mean=True)
Xbow_tr_std = sc.fit_transform(X_tr)
Xbow_test_std = sc.transform(X_test)
Xbow_cv_std = sc.transform(X_cv)

df_tei1 = sc.fit_transform(df_tei)
df_tri1 = sc.transform(df_tr_after_drop)
```

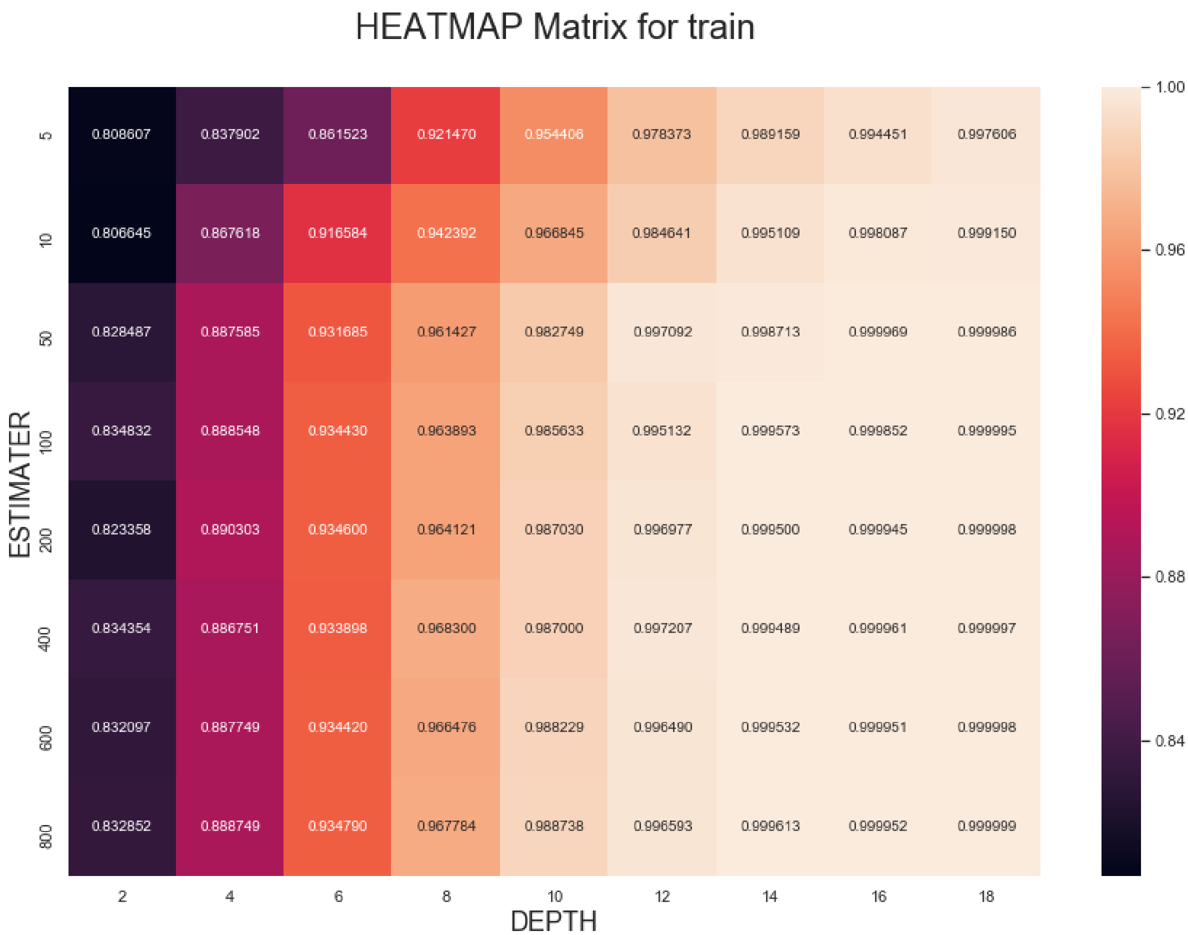
```
C:\Users\all\AppData\Local\conda\conda\envs\tf\lib\site-packages\sklearn\prep
rocessing\data.py:645: DataConversionWarning: Data with input dtype int64, fl
oat64 were all converted to float64 by StandardScaler.
  return self.partial_fit(X, y)
C:\Users\all\AppData\Local\conda\conda\envs\tf\lib\site-packages\sklearn\bas
e.py:464: DataConversionWarning: Data with input dtype int64, float64 were al
l converted to float64 by StandardScaler.
  return self.fit(X, **fit_params).transform(X)
C:\Users\all\AppData\Local\conda\conda\envs\tf\lib\site-packages\ipykernel_la
uncher.py:3: DataConversionWarning: Data with input dtype int64, float64 were
all converted to float64 by StandardScaler.
  This is separate from the ipykernel package so we can avoid doing imports u
ntil
C:\Users\all\AppData\Local\conda\conda\envs\tf\lib\site-packages\ipykernel_la
uncher.py:4: DataConversionWarning: Data with input dtype int64, float64 were
all converted to float64 by StandardScaler.
  after removing the cwd from sys.path.
C:\Users\all\AppData\Local\conda\conda\envs\tf\lib\site-packages\sklearn\prep
rocessing\data.py:645: DataConversionWarning: Data with input dtype int64, fl
oat64 were all converted to float64 by StandardScaler.
  return self.partial_fit(X, y)
C:\Users\all\AppData\Local\conda\conda\envs\tf\lib\site-packages\sklearn\bas
e.py:464: DataConversionWarning: Data with input dtype int64, float64 were al
l converted to float64 by StandardScaler.
  return self.fit(X, **fit_params).transform(X)
C:\Users\all\AppData\Local\conda\conda\envs\tf\lib\site-packages\ipykernel_la
uncher.py:7: DataConversionWarning: Data with input dtype int64, float64 were
all converted to float64 by StandardScaler.
  import sys
```

HYPER_PARAMETER TUNING WITH DEPTH AND NO.OF ESTIMATERS OF DECISION TREE:

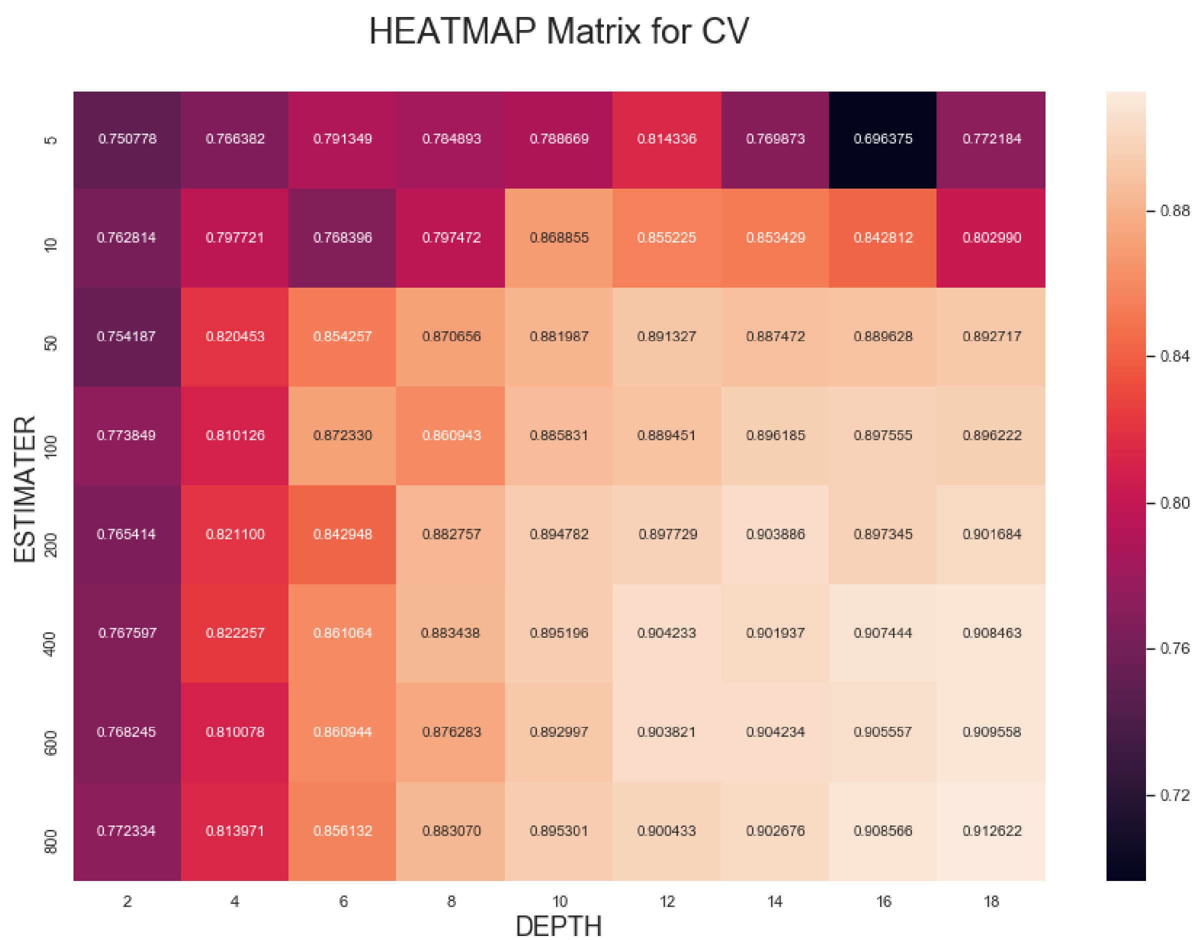
In [21]:
```
#code for hyperparameter tuning
import numpy as np
hyper1 =  [5, 10, 50, 100, 200,400, 600, 800]
hyper2 =  [2, 4, 6, 8, 10, 12, 14, 16, 18]

auc1=np.empty((8,9))
auc2=np.empty((8,9))
l=0
for j in hyper1:
    m=0
    for k in hyper2:

        model = RandomForestClassifier(n_estimators=j,max_depth=k)
        model.fit(Xbow_tr_std, y_tr)

        probs = model.predict_proba(Xbow_tr_std)
        preds = probs[:,1]
        roc_auc1=metrics.roc_auc_score(y_tr, preds)
        auc1[l][m]=(roc_auc1)


        probs = model.predict_proba(Xbow_cv_std)
        preds = probs[:,1]
        roc_auc2=metrics.roc_auc_score(y_cv, preds)
        auc2[l][m]=(roc_auc2)
        m=m+1

    l=l+1
```

PLOTTING SEABORN HEATMAP:

In [22]:
```
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc1, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for train\n",size=24)
plt.show()
```



In [23]:
```
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc2, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for CV\n",size=24)
plt.show()
```



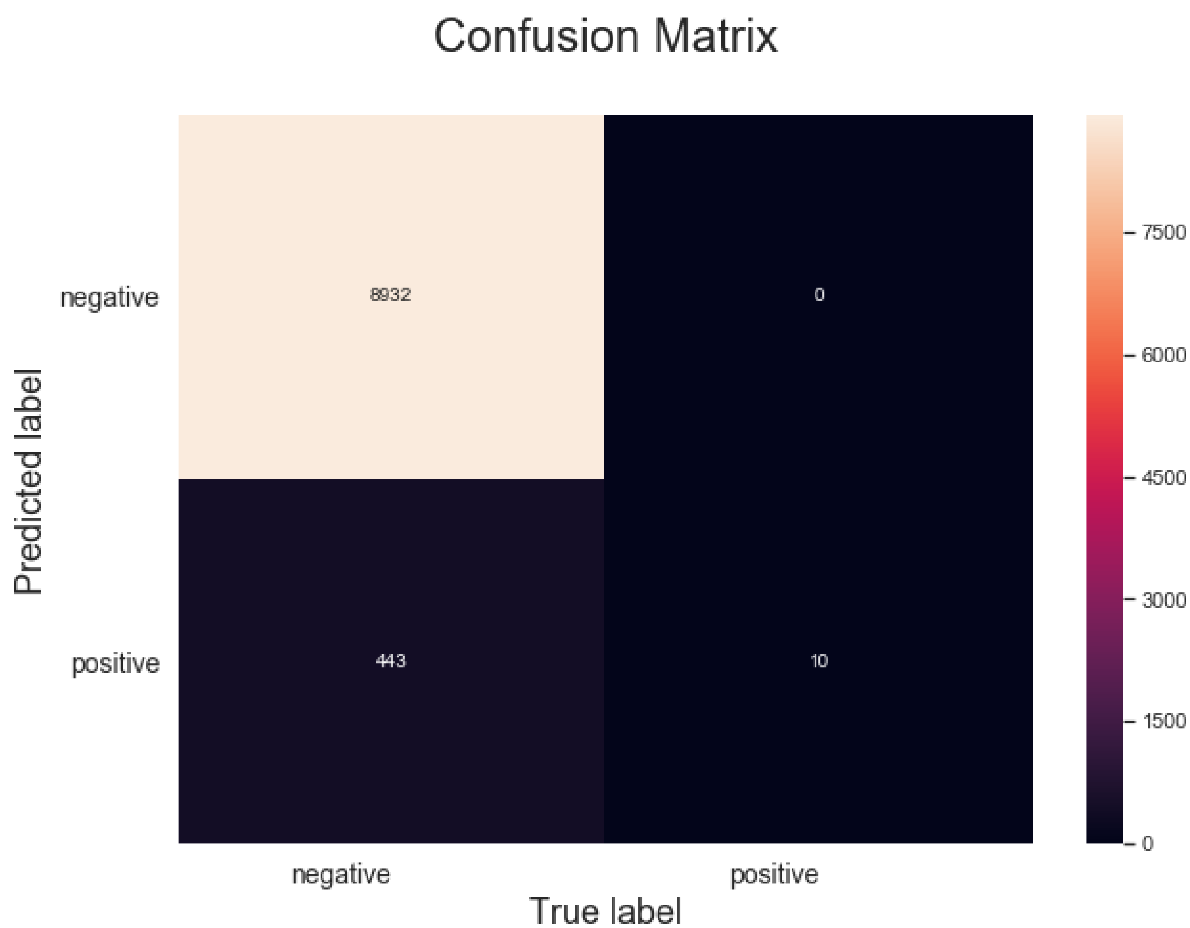
FITTING AND TESTING MODEL ON OUR SPLITTED TEST DATA:

In [24]:
```
rf = RandomForestClassifier(n_estimators=50,max_depth=8)

# fitting the model
rf.fit(Xbow_tr_std, y_tr)

# predict the response
pred = rf.predict(Xbow_test_std)

# evaluate accuracy
acc = accuracy_score(y_test, pred) * 100

precision_score1=precision_score(y_test, pred )

recall_score1=recall_score(y_test, pred )
f1 = f1_score(y_test, pred)


print('\nThe accuracy of the Random forest classifier for n_estimaters=%f and
 Depth = %f is %f%%' % (50,8, acc))



print('\nThe precision_score of the  Random forest classifier  for n_estimater
s=%d and Depth = %d is %f' % (50,8,precision_score1))

print('\nThe recall_score of the  Random forest classifier  for n_estimaters=%
d and Depth = %d is %f' % (50,8,recall_score1))

print('\nThe f1_score of the  Random forest classifier  for n_estimaters=%d an
d Depth = %d is %f' % (50,8,f1))
```

```
The accuracy of the Random forest classifier for n_estimaters=50.000000 and D
epth = 8.000000 is 95.279702%

The precision_score of the  Random forest classifier  for n_estimaters=50 and
Depth = 8 is 1.000000

The recall_score of the  Random forest classifier  for n_estimaters=50 and De
pth = 8 is 0.022075

The f1_score of the  Random forest classifier  for n_estimaters=50 and Depth
= 8 is 0.043197
```

PLOTTING CONFUSION MATRIX:

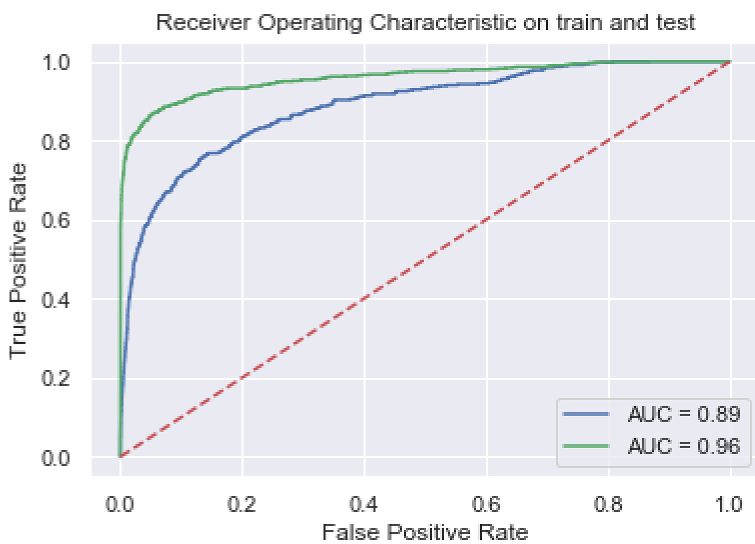
In [25]:
```
# Code for drawing seaborn heatmaps
class_names = ['negative','positive']
df_heatmap = pd.DataFrame(confusion_matrix(y_test, pred), index=class_names, c
olumns=class_names )
fig = plt.figure(figsize=(10,7))
heatmap = sns.heatmap(df_heatmap, annot=True, fmt="d")

# Setting tick labels for heatmap
heatmap.yaxis.set_ticklabels(heatmap.yaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
heatmap.xaxis.set_ticklabels(heatmap.xaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
plt.ylabel('Predicted label',size=18)
plt.xlabel('True label',size=18)
plt.title("Confusion Matrix\n",size=24)
plt.show()
```



PLOTTING AUC_ROC CURVE FOR TRAIN AND TEST DATA:

In [26]:
```
rf.fit(Xbow_tr_std, y_tr)
probs2 = rf.predict_proba(Xbow_tr_std)
preds2 = probs2[:,1]
fpr2, tpr2, threshold2 = metrics.roc_curve(y_tr, preds2)
roc_auc2 = metrics.auc(fpr2, tpr2)


probs1 = rf.predict_proba(Xbow_test_std)
preds1 = probs1[:,1]
fpr1, tpr1, threshold1 = metrics.roc_curve(y_test, preds1)
roc_auc1 = metrics.auc(fpr1, tpr1)
```

In [27]:
```
plt.title('Receiver Operating Characteristic on train and test')
plt.plot(fpr1, tpr1, 'b', label = 'AUC = %0.2f' % roc_auc1)
plt.plot(fpr2, tpr2, 'g', label = 'AUC = %0.2f' % roc_auc2)
#plt.plot(neighbors, auc1,'g')
#plt.plot(neighbors, auc2,'r')
plt.legend(loc = 'lower right')
plt.plot([0, 1], [0, 1],'r--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```

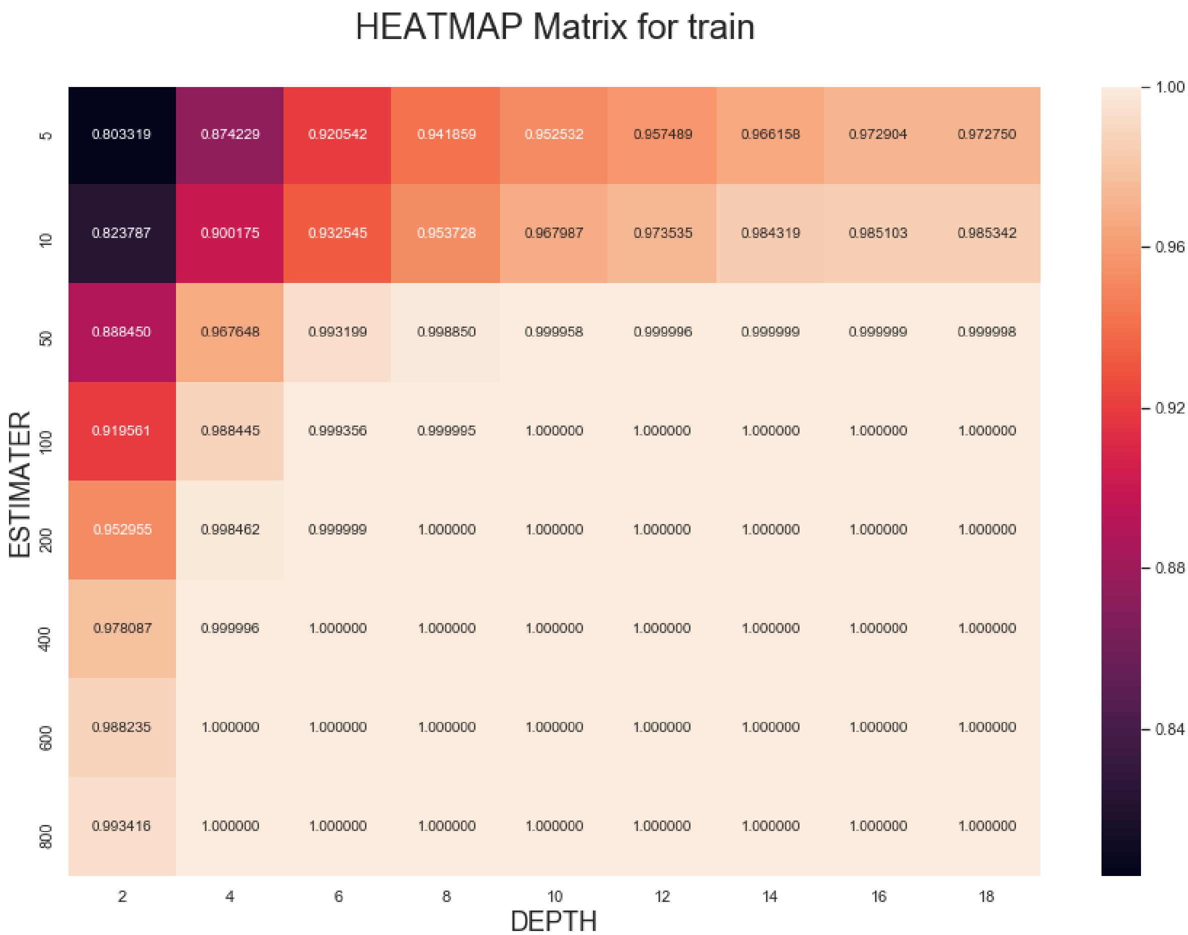


HYPERPARAMETER TUNING WITH DEPTH AND NO.OF ESTIMATERS for XGBClassifier

In [28]:
```
#code for hyperparameter tuning
import numpy as np
hyper1 =  [5, 10, 50, 100, 200,400, 600, 800]
hyper2 =  [2, 4, 6, 8, 10, 12, 14, 16, 18]

auc1=np.empty((8,9))
auc2=np.empty((8,9))
l=0
for j in hyper1:
    m=0
    for k in hyper2:

        model = XGBClassifier(n_estimators=j,max_depth=k)
        model.fit(Xbow_tr_std, y_tr)

        probs = model.predict_proba(Xbow_tr_std)
        preds = probs[:,1]
        roc_auc1=metrics.roc_auc_score(y_tr, preds)
        auc1[l][m]=(roc_auc1)


        probs = model.predict_proba(Xbow_cv_std)
        preds = probs[:,1]
        roc_auc2=metrics.roc_auc_score(y_cv, preds)
        auc2[l][m]=(roc_auc2)
        m=m+1

    l=l+1
```

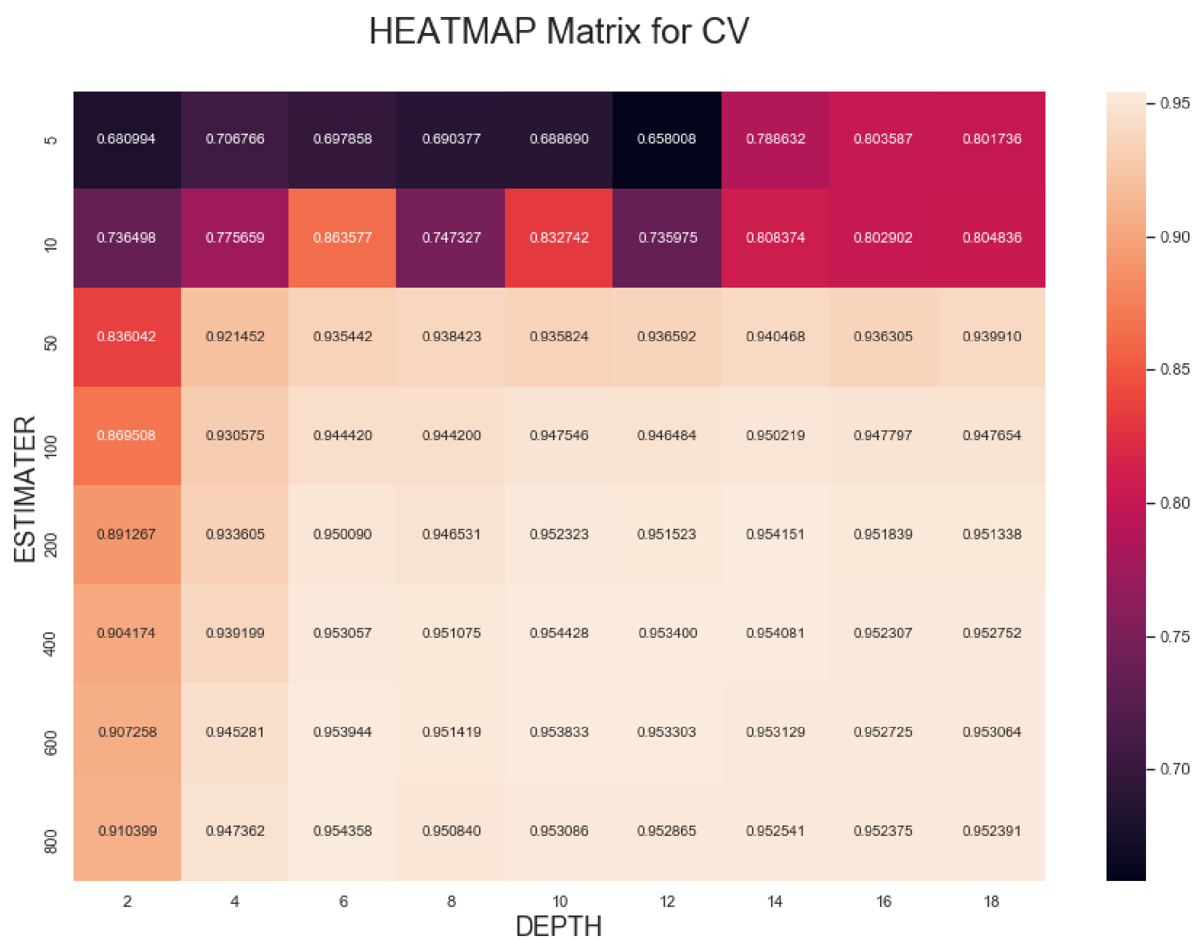
PLOTTING SEABORN HEATMAP:

In [29]:
```python
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc1, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for train\n",size=24)
plt.show()
```



In [30]:

```python
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc2, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for CV\n",size=24)
plt.show()
```



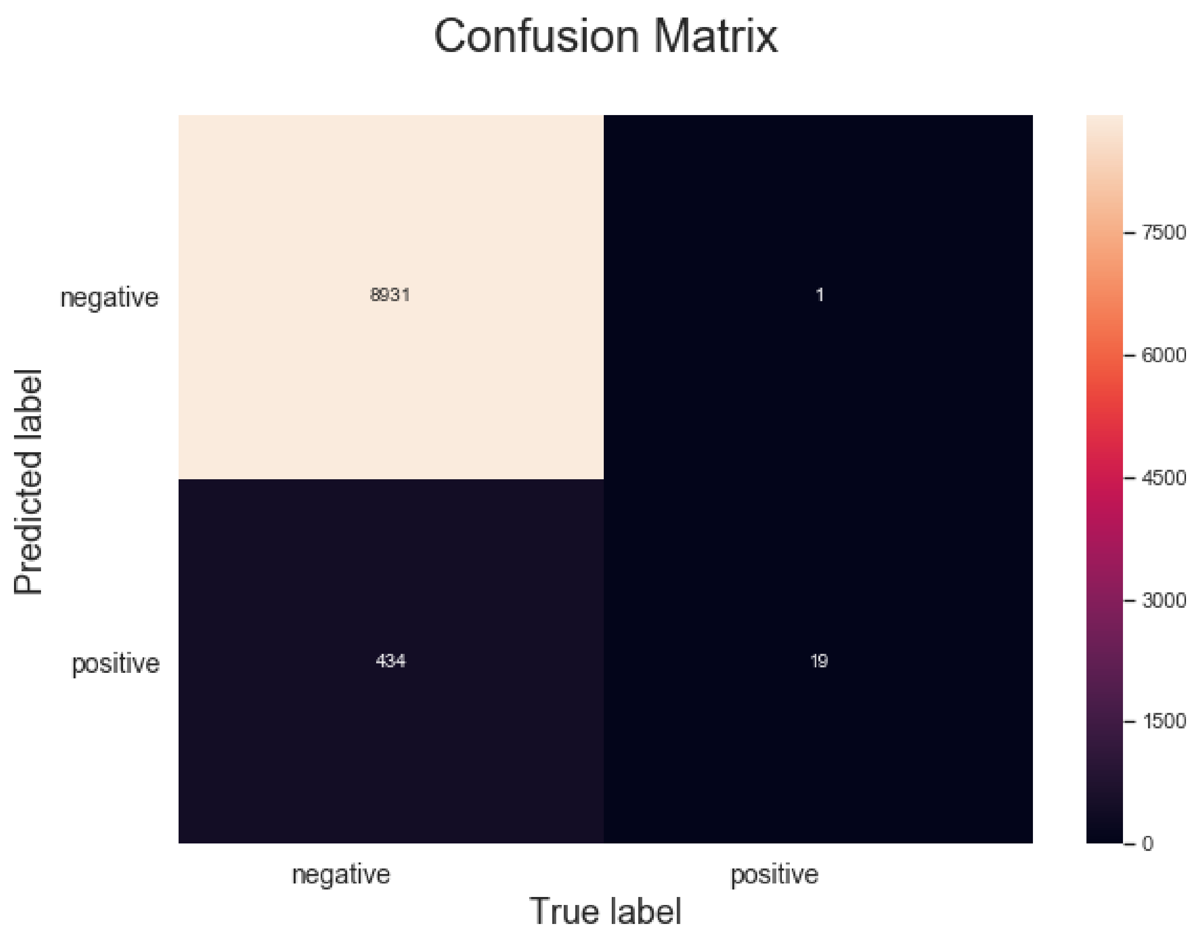
FITTING AND TESTING MODEL ON OUR SPLITTED TEST DATA:

In [34]:
```
rf = RandomForestClassifier(n_estimators=50,max_depth=8)

# fitting the model
rf.fit(Xbow_tr_std, y_tr)

# predict the response
pred = rf.predict(Xbow_test_std)

# evaluate accuracy
acc = accuracy_score(y_test, pred) * 100

precision_score1=precision_score(y_test, pred )

recall_score1=recall_score(y_test, pred )

f1 = f1_score(y_test, pred)

print('\nThe accuracy of the Random forest classifier for n_estimaters=%f and
 Depth = %f is %f%%' % (50,8, acc))


print('\nThe precision_score of the  Random forest classifier  for n_estimater
s=%d and Depth = %d is %f' % (50,8,precision_score1))

print('\nThe recall_score of the  Random forest classifier  for n_estimaters=%
d and Depth = %d is %f' % (50,8,recall_score1))

print('\nThe f1_score of the  Random forest classifier  for n_estimaters=%d an
d Depth = %d is %f' % (50,8,f1))
```

```
The accuracy of the Random forest classifier for n_estimaters=50.000000 and D
epth = 8.000000 is 95.364944%

The precision_score of the  Random forest classifier  for n_estimaters=50 and
Depth = 8 is 0.950000

The recall_score of the  Random forest classifier  for n_estimaters=50 and De
pth = 8 is 0.041943

The f1_score of the  Random forest classifier  for n_estimaters=50 and Depth
= 8 is 0.080338
```

PLOTTING CONFUSION MATRIX:

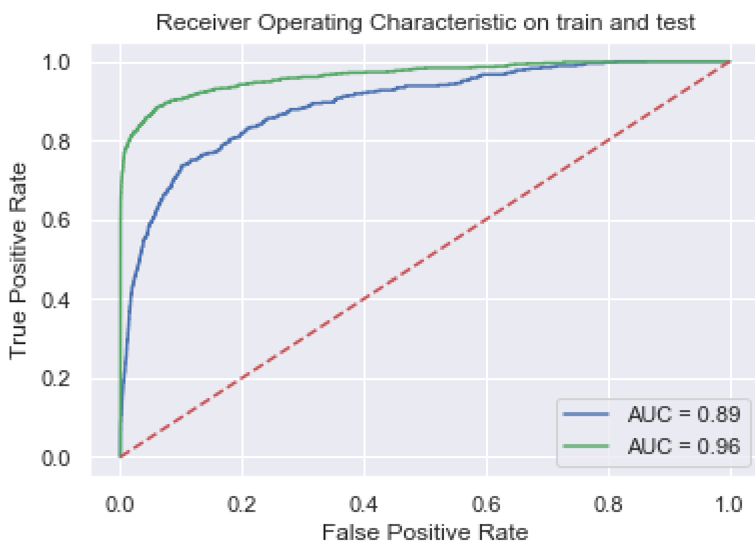
In [35]:
```
# Code for drawing seaborn heatmaps
class_names = ['negative','positive']
df_heatmap = pd.DataFrame(confusion_matrix(y_test, pred), index=class_names, c
olumns=class_names )
fig = plt.figure(figsize=(10,7))
heatmap = sns.heatmap(df_heatmap, annot=True, fmt="d")

# Setting tick labels for heatmap
heatmap.yaxis.set_ticklabels(heatmap.yaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
heatmap.xaxis.set_ticklabels(heatmap.xaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
plt.ylabel('Predicted label',size=18)
plt.xlabel('True label',size=18)
plt.title("Confusion Matrix\n",size=24)
plt.show()
```



PLOTTING AUC_ROC CURVE FOR TRAIN AND TEST DATA

In [36]:
```
rf.fit(Xbow_tr_std, y_tr)
probs2 = rf.predict_proba(Xbow_tr_std)
preds2 = probs2[:,1]
fpr2, tpr2, threshold2 = metrics.roc_curve(y_tr, preds2)
roc_auc2 = metrics.auc(fpr2, tpr2)


probs1 = rf.predict_proba(Xbow_test_std)
preds1 = probs1[:,1]
fpr1, tpr1, threshold1 = metrics.roc_curve(y_test, preds1)
roc_auc1 = metrics.auc(fpr1, tpr1)
```

In [37]:
```
plt.title('Receiver Operating Characteristic on train and test')
plt.plot(fpr1, tpr1, 'b', label = 'AUC = %0.2f' % roc_auc1)
plt.plot(fpr2, tpr2, 'g', label = 'AUC = %0.2f' % roc_auc2)
#plt.plot(neighbors, auc1,'g')
#plt.plot(neighbors, auc2,'r')
plt.legend(loc = 'lower right')
plt.plot([0, 1], [0, 1],'r--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```



SMOTE

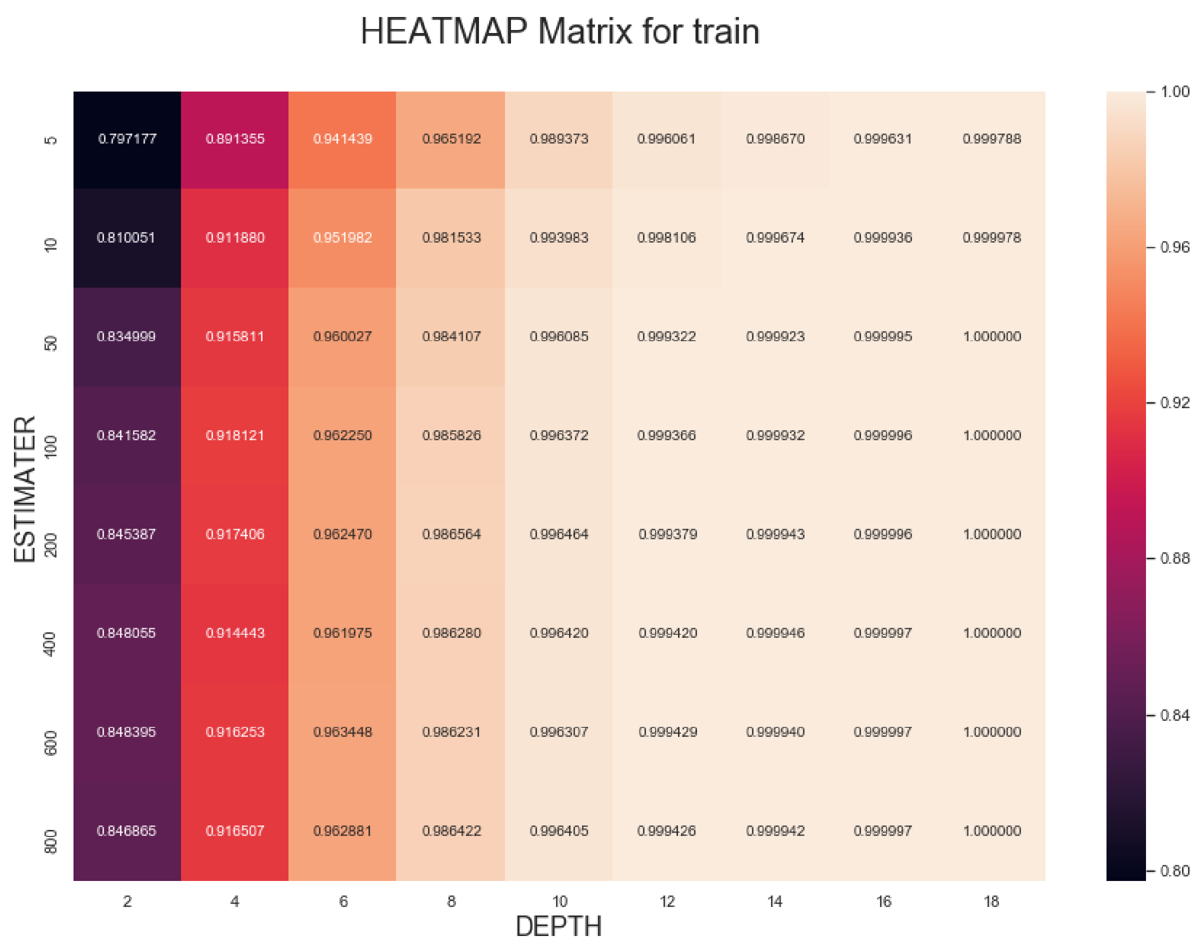
In [4]:
```
df_tr=pd.read_csv('train.csv')
yees=df_tr['target']
df_tr_after_drop=df_tr.drop(['target'],axis=1)
#spilliting data


# split the data set into train and test
X_1, X_test, y_1, y_test = train_test_split(df_tr_after_drop, yees, test_size=
0.3, random_state=42,stratify=yees)

# split the train data set into cross validation train and cross validation te
st
X_tr, X_cv, y_tr, y_cv = train_test_split(X_1, y_1, test_size=0.3)

X_tr.fillna(X_tr.mean(), inplace=True)
X_test.fillna(X_test.mean(), inplace=True)
X_cv.fillna(X_cv.mean(), inplace=True)


sm = SMOTE(random_state=27, ratio=1.0)

X_tr, y_tr = sm.fit_sample(X_tr, y_tr)

sc = StandardScaler(with_mean=True)
Xbow_tr_std = sc.fit_transform(X_tr)
Xbow_test_std = sc.transform(X_test)
Xbow_cv_std = sc.transform(X_cv)
```

HYPER_PARAMETER TUNING WITH DEPTH AND NO.OF ESTIMATERS OF DECISION TREE:

In [5]:
```
#code for hyperparameter tuning
import numpy as np
hyper1 =  [5, 10, 50, 100, 200,400, 600, 800]
hyper2 =  [2, 4, 6, 8, 10, 12, 14, 16, 18]

auc1=np.empty((8,9))
auc2=np.empty((8,9))
l=0
for j in hyper1:
    m=0
    for k in hyper2:

        model = RandomForestClassifier(n_estimators=j,max_depth=k)
        model.fit(Xbow_tr_std, y_tr)

        probs = model.predict_proba(Xbow_tr_std)
        preds = probs[:,1]
        roc_auc1=metrics.roc_auc_score(y_tr, preds)
        auc1[l][m]=(roc_auc1)


        probs = model.predict_proba(Xbow_cv_std)
        preds = probs[:,1]
        roc_auc2=metrics.roc_auc_score(y_cv, preds)
        auc2[l][m]=(roc_auc2)
        m=m+1

    l=l+1
```

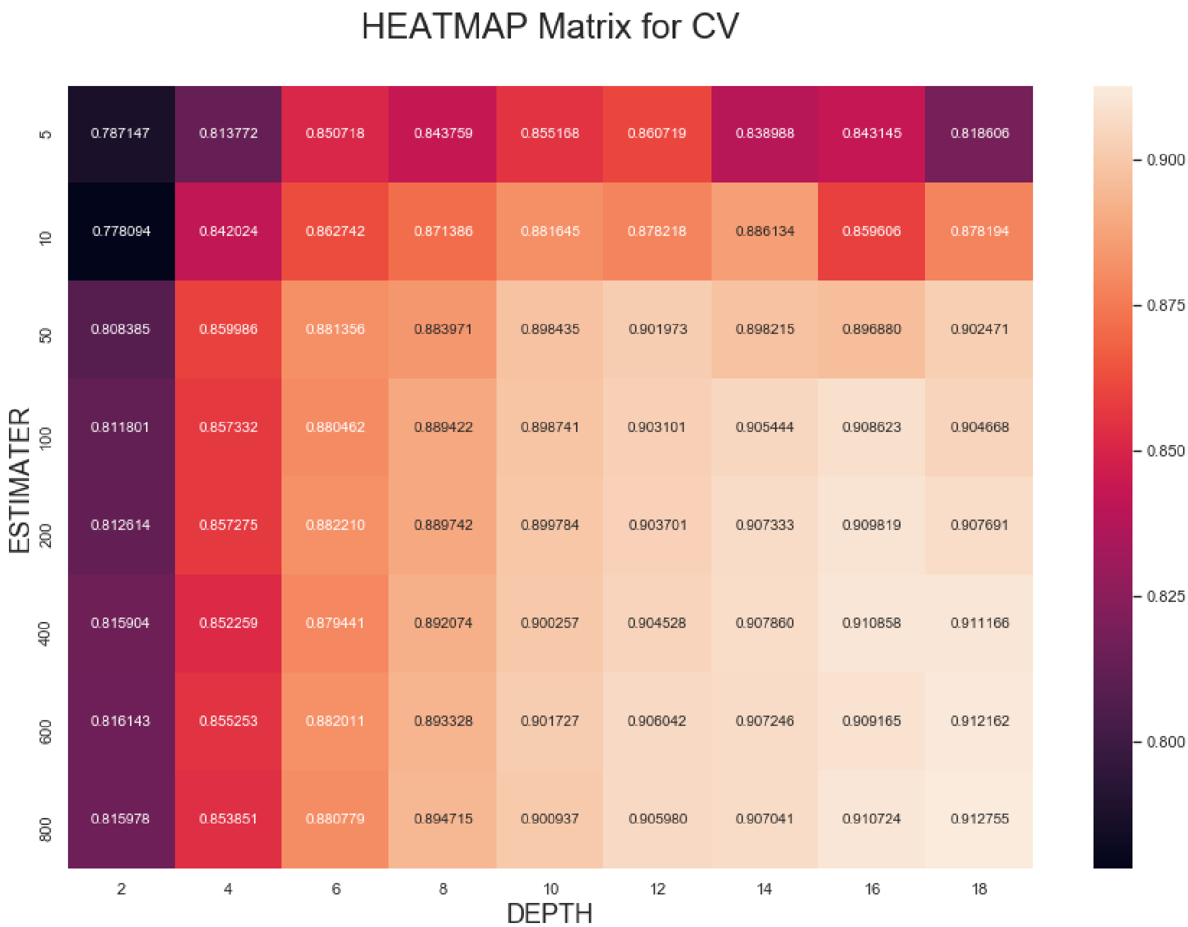
PLOTTING SEABORN HEATMAP:

In [6]:
```python
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc1, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for train\n",size=24)
plt.show()
```



In [7]:

```
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc2, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for CV\n",size=24)
plt.show()
```



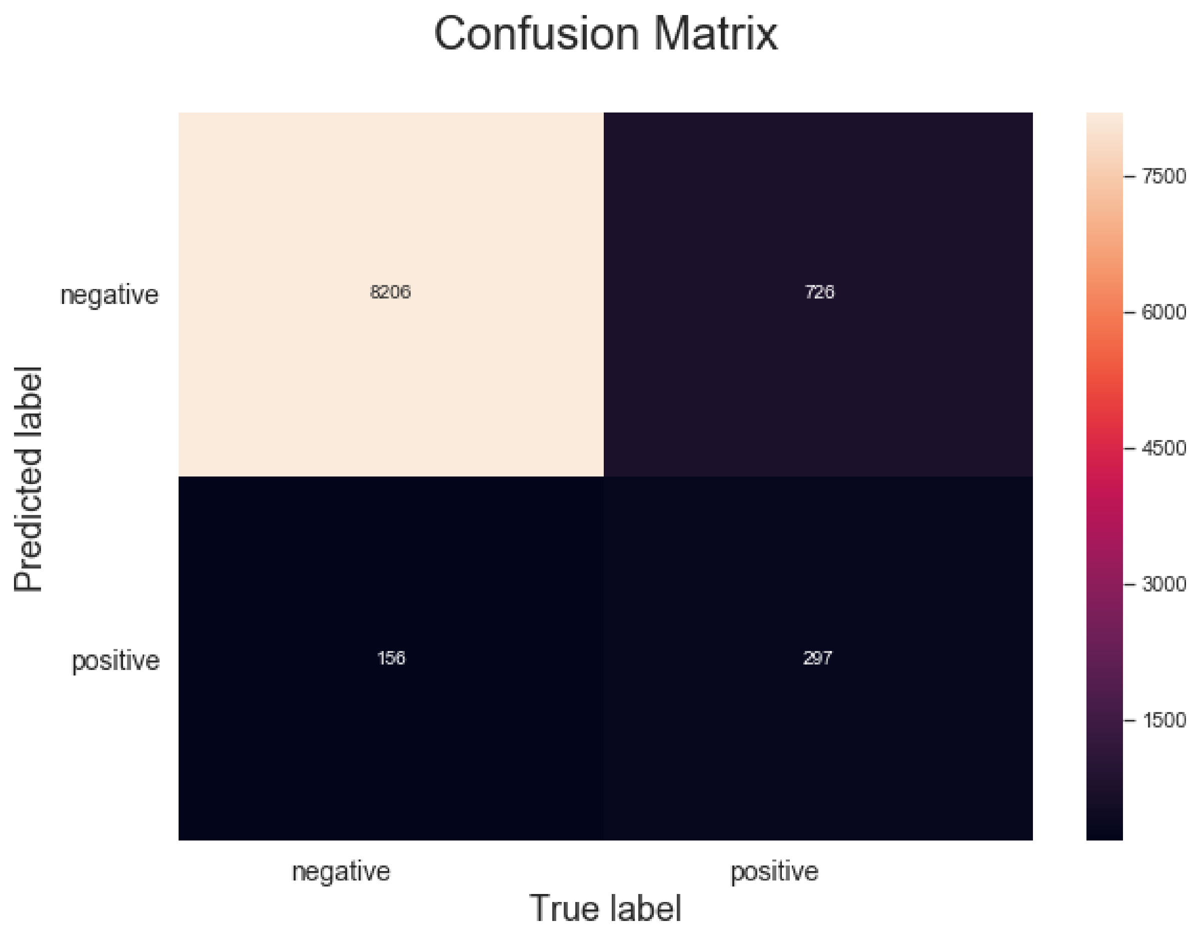
FITTING AND TESTING MODEL ON OUR SPLITTED TEST DATA:

In [8]:
```
rf = RandomForestClassifier(n_estimators=50,max_depth=10)

# fitting the model
rf.fit(Xbow_tr_std, y_tr)

# predict the response
pred = rf.predict(Xbow_test_std)

# evaluate accuracy
acc = accuracy_score(y_test, pred) * 100

precision_score1=precision_score(y_test, pred )

recall_score1=recall_score(y_test, pred )

print('\nThe accuracy of the Random forest classifier for n_estimaters=%f and
 Depth = %f is %f%%' % (50,10, acc))


f1 = f1_score(y_test, pred)
print('\nThe precision_score of the  Random forest classifier  for n_estimater
s=%d and Depth = %d is %f' % (50,10,precision_score1))

print('\nThe recall_score of the  Random forest classifier  for n_estimaters=%
d and Depth = %d is %f' % (50,10,recall_score1))

print('\nThe f1_score of the  Random forest classifier  for n_estimaters=%d an
d Depth = %d is %f' % (50,10,f1))
```

```
The accuracy of the Random forest classifier for n_estimaters=50.000000 and D
epth = 10.000000 is 90.602025%

The precision_score of the  Random forest classifier  for n_estimaters=50 and
Depth = 10 is 0.290323

The recall_score of the  Random forest classifier  for n_estimaters=50 and De
pth = 10 is 0.655629

The f1_score of the  Random forest classifier  for n_estimaters=50 and Depth
= 10 is 0.402439
```

PLOTTING CONFUSION MATRIX:

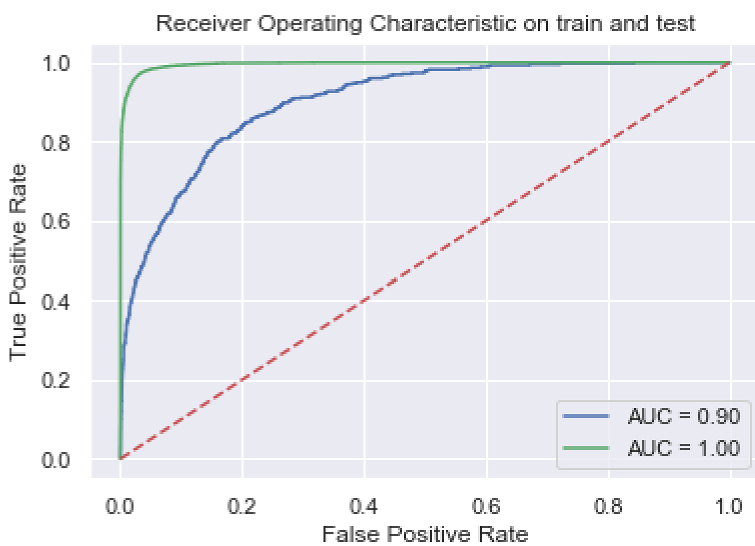
In [9]:
```
# Code for drawing seaborn heatmaps
class_names = ['negative','positive']
df_heatmap = pd.DataFrame(confusion_matrix(y_test, pred), index=class_names, c
olumns=class_names )
fig = plt.figure(figsize=(10,7))
heatmap = sns.heatmap(df_heatmap, annot=True, fmt="d")

# Setting tick labels for heatmap
heatmap.yaxis.set_ticklabels(heatmap.yaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
heatmap.xaxis.set_ticklabels(heatmap.xaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
plt.ylabel('Predicted label',size=18)
plt.xlabel('True label',size=18)
plt.title("Confusion Matrix\n",size=24)
plt.show()
```



PLOTTING AUC_ROC CURVE FOR TRAIN AND TEST DATA:

In [10]:
```
rf.fit(Xbow_tr_std, y_tr)
probs2 = rf.predict_proba(Xbow_tr_std)
preds2 = probs2[:,1]
fpr2, tpr2, threshold2 = metrics.roc_curve(y_tr, preds2)
roc_auc2 = metrics.auc(fpr2, tpr2)


probs1 = rf.predict_proba(Xbow_test_std)
preds1 = probs1[:,1]
fpr1, tpr1, threshold1 = metrics.roc_curve(y_test, preds1)
roc_auc1 = metrics.auc(fpr1, tpr1)
```

In [11]:
```
plt.title('Receiver Operating Characteristic on train and test')
plt.plot(fpr1, tpr1, 'b', label = 'AUC = %0.2f' % roc_auc1)
plt.plot(fpr2, tpr2, 'g', label = 'AUC = %0.2f' % roc_auc2)
#plt.plot(neighbors, auc1,'g')
#plt.plot(neighbors, auc2,'r')
plt.legend(loc = 'lower right')
plt.plot([0, 1], [0, 1],'r--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```

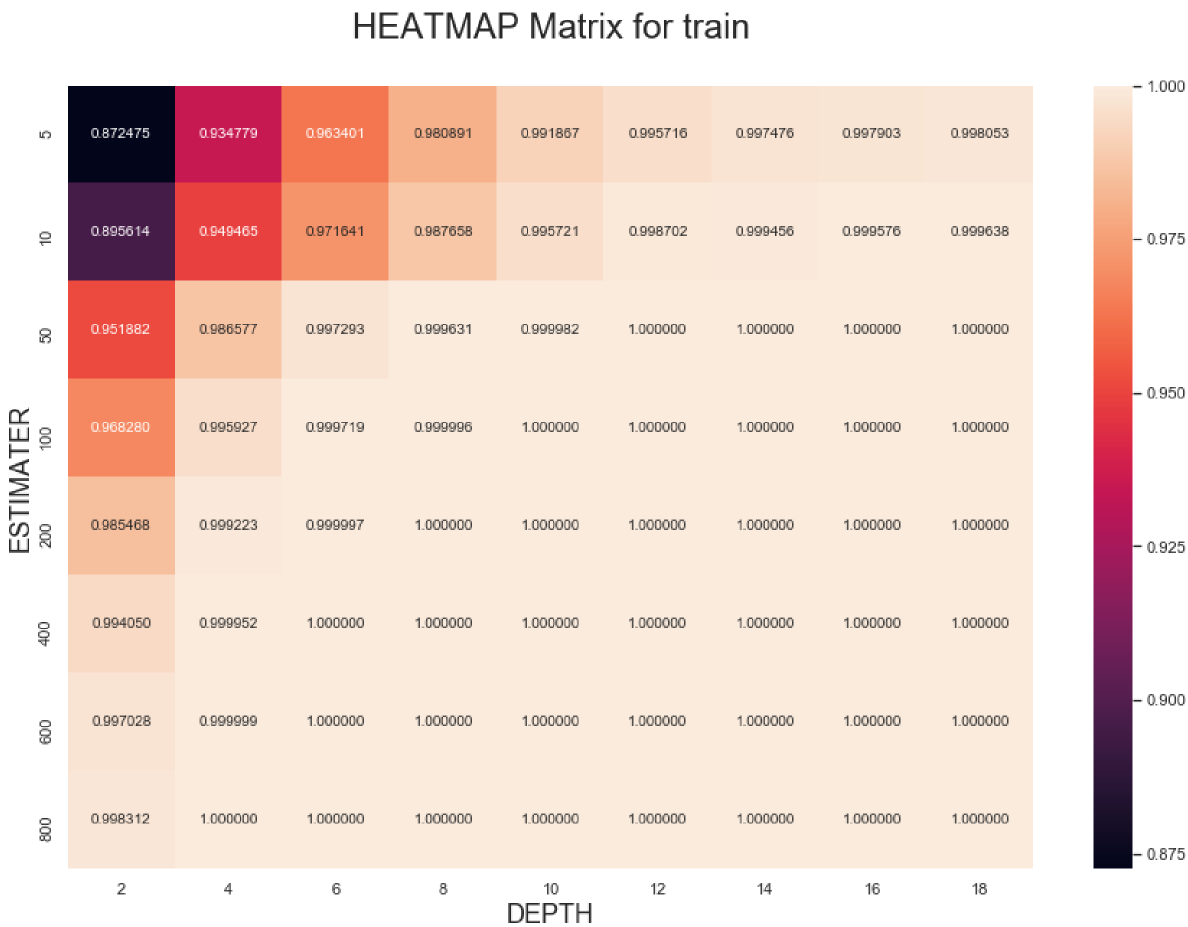


HYPERPARAMETER TUNING WITH DEPTH AND NO.OF ESTIMATERS for XGBClassifier

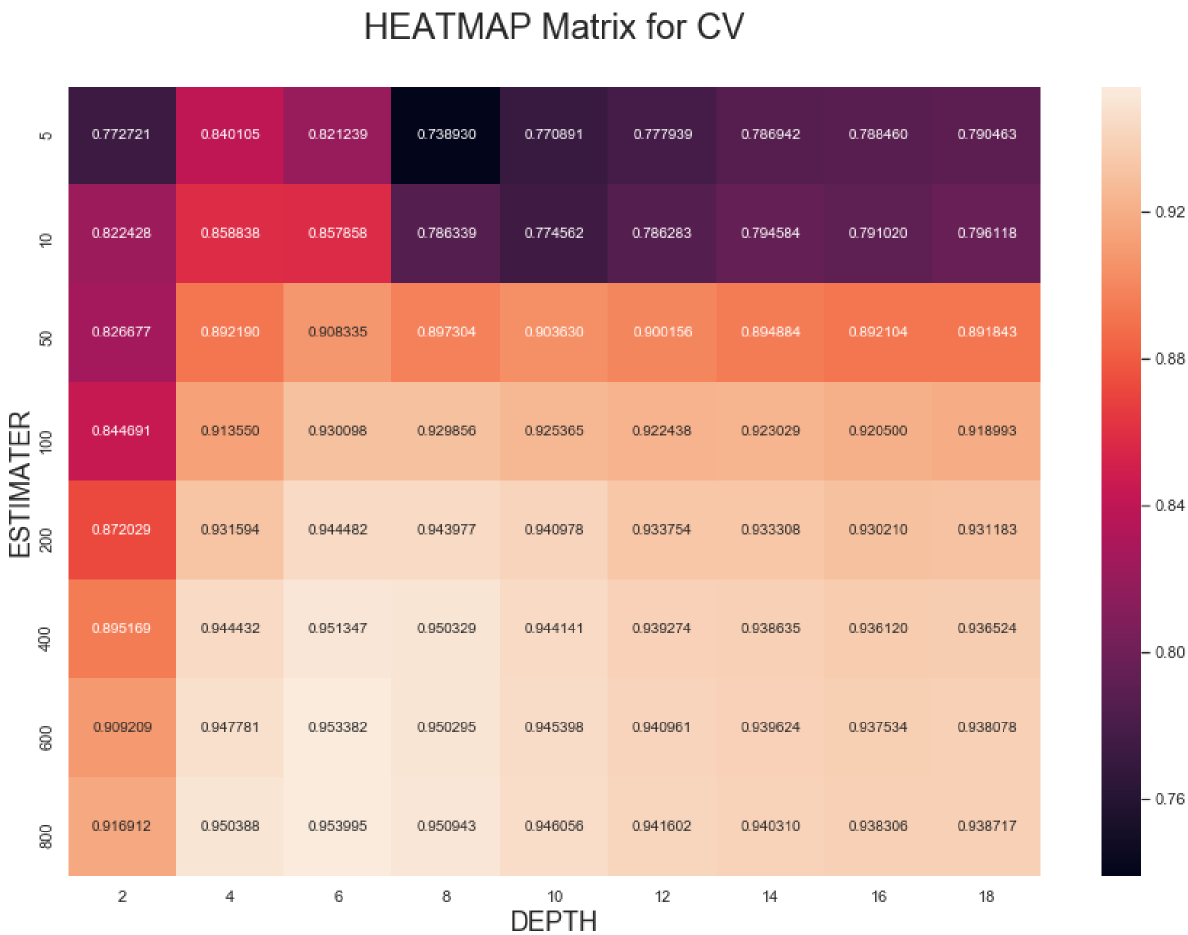
In [12]:
```
#code for hyperparameter tuning
import numpy as np
hyper1 =  [5, 10, 50, 100, 200,400, 600, 800]
hyper2 =  [2, 4, 6, 8, 10, 12, 14, 16, 18]

auc1=np.empty((8,9))
auc2=np.empty((8,9))

l=0
for j in hyper1:
    m=0
    for k in hyper2:

        model = XGBClassifier(n_estimators=j,max_depth=k)
        model.fit(Xbow_tr_std, y_tr)

        probs = model.predict_proba(Xbow_tr_std)
        preds = probs[:,1]
        roc_auc1=metrics.roc_auc_score(y_tr, preds)
        auc1[l][m]=(roc_auc1)


        probs = model.predict_proba(Xbow_cv_std)
        preds = probs[:,1]
        roc_auc2=metrics.roc_auc_score(y_cv, preds)
        auc2[l][m]=(roc_auc2)
        m=m+1

    l=l+1
```

PLOTTING SEABORN HEATMAP:

In [13]:
```python
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc1, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for train\n",size=24)
plt.show()
```



In [14]:
```
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc2, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for CV\n",size=24)
plt.show()
```



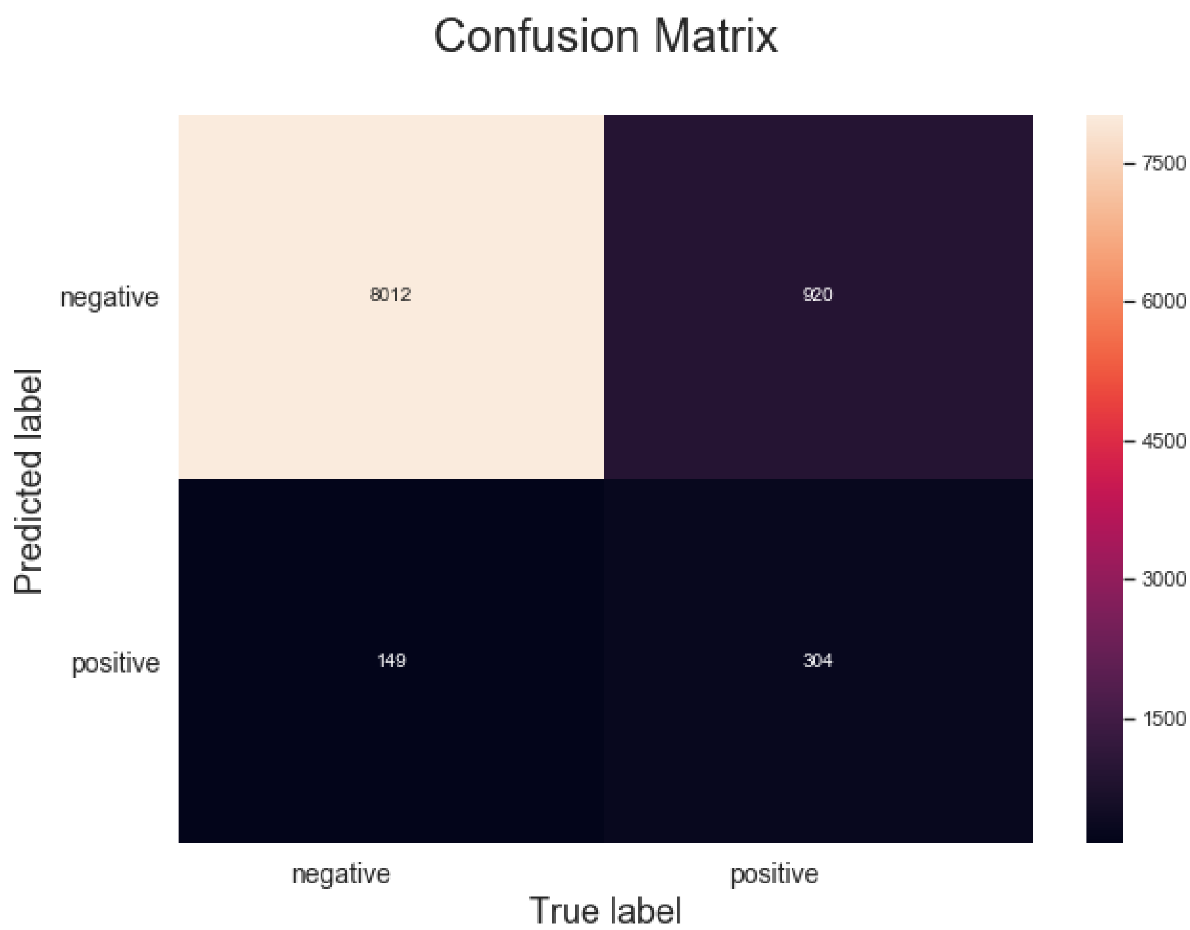
FITTING AND TESTING MODEL ON OUR SPLITTED TEST DATA:

In [15]:
```
rf = RandomForestClassifier(n_estimators=100,max_depth=8)

# fitting the model
rf.fit(Xbow_tr_std, y_tr)

# predict the response
pred = rf.predict(Xbow_test_std)

# evaluate accuracy
acc = accuracy_score(y_test, pred) * 100

precision_score1=precision_score(y_test, pred )

recall_score1=recall_score(y_test, pred )

f1 = f1_score(y_test, pred)

print('\nThe accuracy of the Random forest classifier for n_estimaters=%f and
 Depth = %f is %f%%' % (100,8, acc))



print('\nThe precision_score of the  Random forest classifier  for n_estimater
s=%d and Depth = %d is %f' % (100,8,precision_score1))

print('\nThe recall_score of the  Random forest classifier  for n_estimaters=%
d and Depth = %d is %f' % (100,8,recall_score1))

print('\nThe f1_score of the  Random forest classifier  for n_estimaters=%d an
d Depth = %d is %f' % (100,8,f1))
```

```
The accuracy of the Random forest classifier for n_estimaters=100.000000 and
Depth = 8.000000 is 88.609483%

The precision_score of the  Random forest classifier  for n_estimaters=100 an
d Depth = 8 is 0.248366

The recall_score of the  Random forest classifier  for n_estimaters=100 and D
epth = 8 is 0.671082

The f1_score of the  Random forest classifier  for n_estimaters=100 and Depth
= 8 is 0.362552
```

PLOTTING CONFUSION MATRIX:

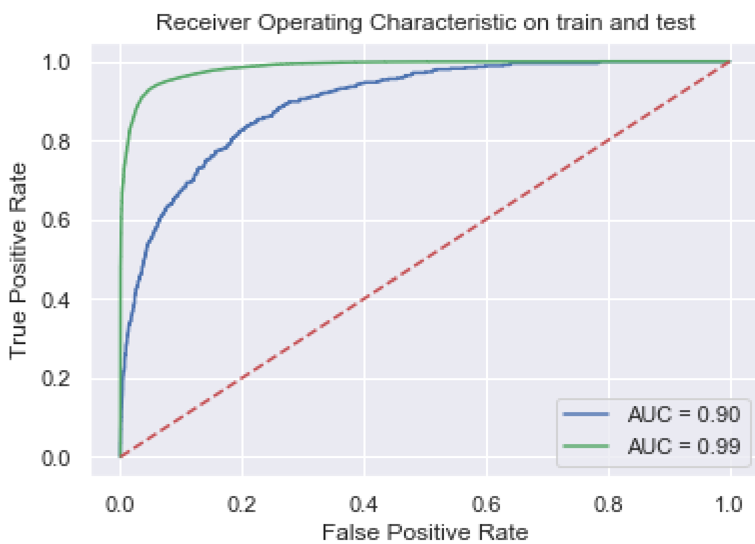
In [16]:
```
# Code for drawing seaborn heatmaps
class_names = ['negative','positive']
df_heatmap = pd.DataFrame(confusion_matrix(y_test, pred), index=class_names, c
olumns=class_names )
fig = plt.figure(figsize=(10,7))
heatmap = sns.heatmap(df_heatmap, annot=True, fmt="d")

# Setting tick labels for heatmap
heatmap.yaxis.set_ticklabels(heatmap.yaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
heatmap.xaxis.set_ticklabels(heatmap.xaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
plt.ylabel('Predicted label',size=18)
plt.xlabel('True label',size=18)
plt.title("Confusion Matrix\n",size=24)
plt.show()
```



PLOTTING AUC_ROC CURVE FOR TRAIN AND TEST DATA:

In [17]:
```
rf.fit(Xbow_tr_std, y_tr)
probs2 = rf.predict_proba(Xbow_tr_std)
preds2 = probs2[:,1]
fpr2, tpr2, threshold2 = metrics.roc_curve(y_tr, preds2)
roc_auc2 = metrics.auc(fpr2, tpr2)


probs1 = rf.predict_proba(Xbow_test_std)
preds1 = probs1[:,1]
fpr1, tpr1, threshold1 = metrics.roc_curve(y_test, preds1)
roc_auc1 = metrics.auc(fpr1, tpr1)
```

In [18]:
```
plt.title('Receiver Operating Characteristic on train and test')
plt.plot(fpr1, tpr1, 'b', label = 'AUC = %0.2f' % roc_auc1)
plt.plot(fpr2, tpr2, 'g', label = 'AUC = %0.2f' % roc_auc2)
#plt.plot(neighbors, auc1,'g')
#plt.plot(neighbors, auc2,'r')
plt.legend(loc = 'lower right')
plt.plot([0, 1], [0, 1],'r--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```



UP-SAMPLING TECHNIQUE:

In [19]:
```
#spilliting data


from sklearn.model_selection import train_test_split

# split the data set into train and test
X_1, X_test, y_1, y_test = train_test_split(df_tr_after_drop, yees, test_size=
0.3, random_state=42,stratify=yees)

# split the train data set into cross validation train and cross validation te
st
X_tr, X_cv, y_tr, y_cv = train_test_split(X_1, y_1, test_size=0.3)
```

In [20]:
```
y_tr = pd.DataFrame(y_tr)
X_tr = pd.DataFrame(X_tr)
X_tr['target']=y_tr['target']
X_tr.head(2)
```

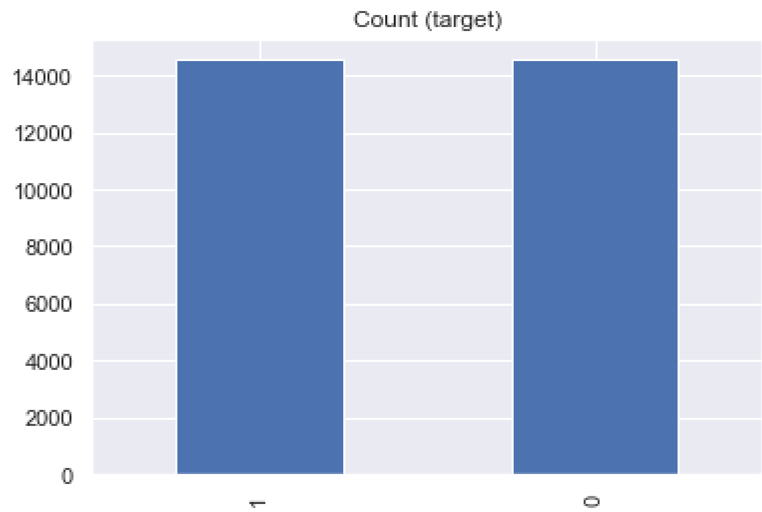
Out[20]:

	ID	Attr1	Attr2	Attr3	Attr4	Attr5	Attr6	Attr7	Attr8	Att
13653	13654	-0.317430	0.76524	0.044714	1.1245	-3.4901	-1.903000	-0.31743	0.30678	0.654
23002	23003	0.076737	0.26259	0.448000	3.0413	54.0490	0.076737	0.09711	2.51650	1.060

2 rows × 66 columns

In [21]:
```
# Class count
X_tr = pd.DataFrame(X_tr)
print(type(X_tr))
count_class_0, count_class_1 = X_tr.target.value_counts()
print(count_class_0, count_class_1)

# Divide by class
df_class_0 = X_tr[X_tr.target == 0]
df_class_1 = X_tr[X_tr.target == 1]
print(count_class_0, count_class_1)


df_class_1_over = df_class_1.sample(count_class_0, replace=True)
X_tr = pd.concat([df_class_0, df_class_1_over], axis=0)

print('Random over-sampling:')
print(X_tr.target.value_counts())

X_tr.target.value_counts().plot(kind='bar', title='Count (target)');
```

```
<class 'pandas.core.frame.DataFrame'>
14569 759
14569 759
Random over-sampling:
1    14569
0    14569
Name: target, dtype: int64
```



In [22]:
```
y_tr=X_tr['target']
X_tr=X_tr.drop(['target'],axis=1)
```

In [23]:
```
X_tr.fillna(X_tr.mean(), inplace=True)
X_test.fillna(X_test.mean(), inplace=True)
X_cv.fillna(X_cv.mean(), inplace=True)


sc = StandardScaler(with_mean=True)
Xbow_tr_std = sc.fit_transform(X_tr)
Xbow_test_std = sc.transform(X_test)
Xbow_cv_std = sc.transform(X_cv)
```

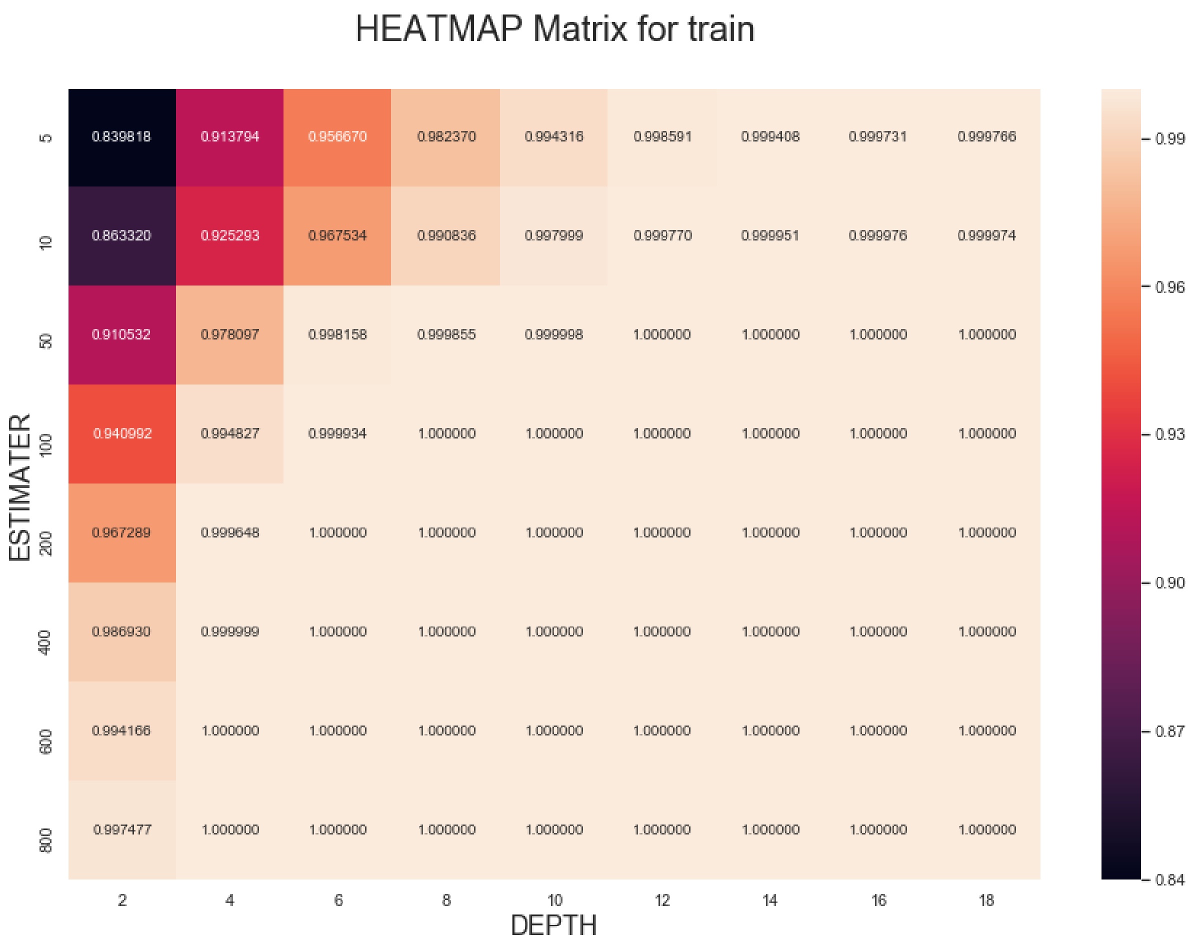
HYPERPARAMETER TUNING WITH DEPTH AND NO.OF ESTIMATERS for XGBClassifier

In [24]:
```
#code for hyperparameter tuning
import numpy as np
hyper1 =  [5, 10, 50, 100, 200,400, 600, 800]
hyper2 =  [2, 4, 6, 8, 10, 12, 14, 16, 18]

auc1=np.empty((8,9))
auc2=np.empty((8,9))
l=0
for j in hyper1:
    m=0
    for k in hyper2:

        model = XGBClassifier(n_estimators=j,max_depth=k)
        model.fit(Xbow_tr_std, y_tr)

        probs = model.predict_proba(Xbow_tr_std)
        preds = probs[:,1]
        roc_auc1=metrics.roc_auc_score(y_tr, preds)
        auc1[l][m]=(roc_auc1)


        probs = model.predict_proba(Xbow_cv_std)
        preds = probs[:,1]
        roc_auc2=metrics.roc_auc_score(y_cv, preds)
        auc2[l][m]=(roc_auc2)
        m=m+1

    l=l+1
```

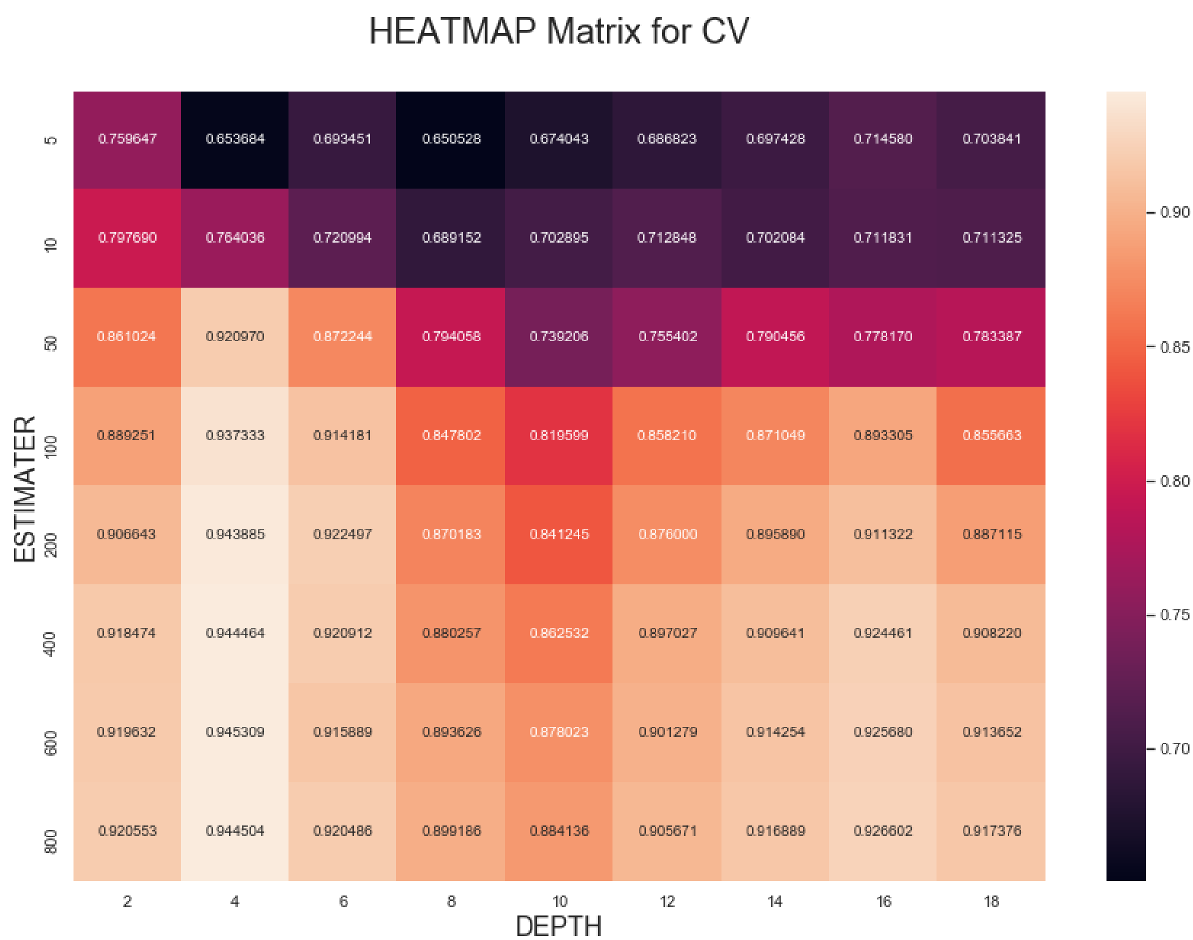
PLOTTING SEABORN HEATMAP:

In [25]:

```
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc1, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for train\n",size=24)
plt.show()
```



In [26]:
```
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc2, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for CV\n",size=24)
plt.show()
```



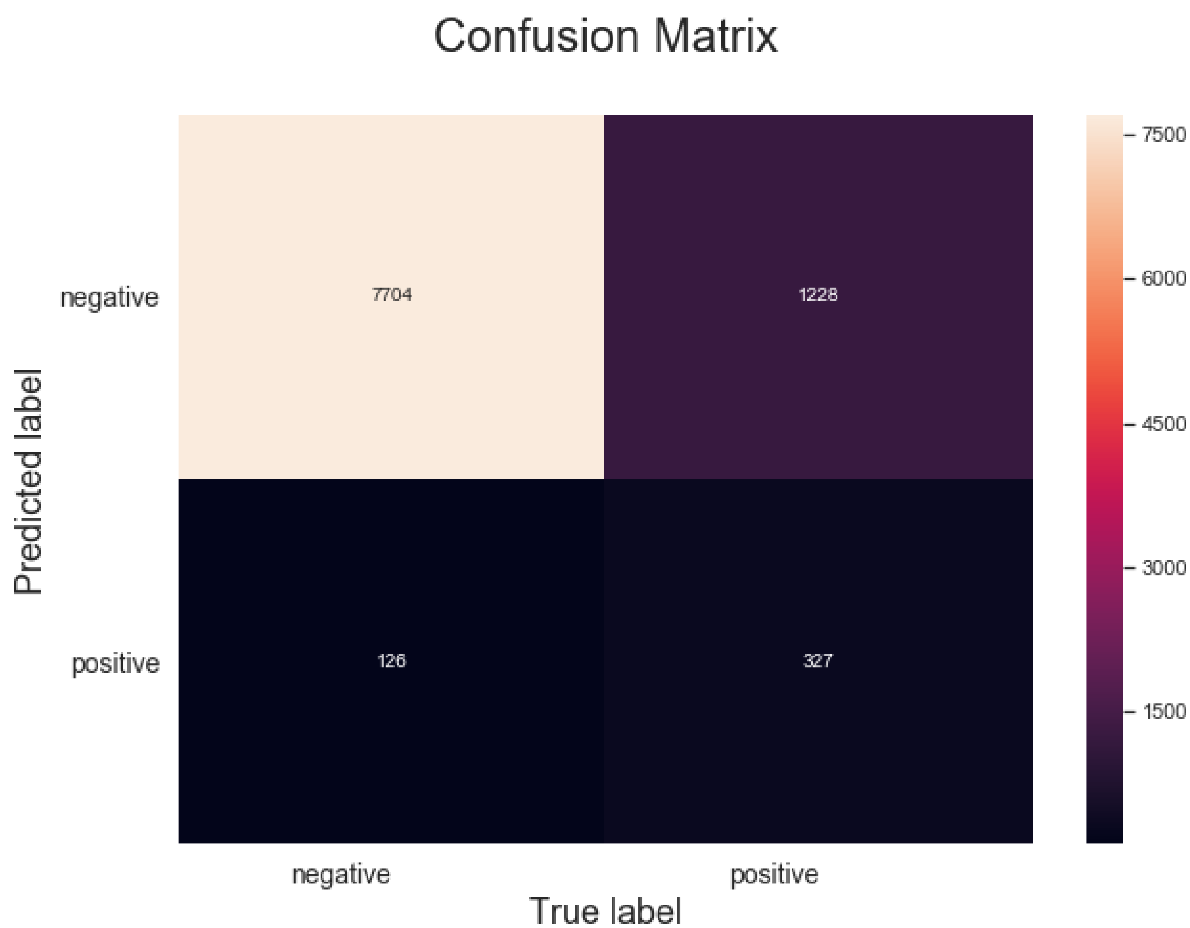
FITTING AND TESTING MODEL ON OUR SPLITTED TEST DATA:

In [27]:
```
rf = RandomForestClassifier(n_estimators=100,max_depth=6)

# fitting the model
rf.fit(Xbow_tr_std, y_tr)

# predict the response
pred = rf.predict(Xbow_test_std)

# evaluate accuracy
acc = accuracy_score(y_test, pred) * 100

precision_score1=precision_score(y_test, pred )

recall_score1=recall_score(y_test, pred )

f1 = f1_score(y_test, pred)

print('\nThe accuracy of the Random forest classifier for n_estimaters=%f and
 Depth = %f is %f%%' % (100,6, acc))



print('\nThe precision_score of the  Random forest classifier  for n_estimater
s=%d and Depth = %d is %f' % (100,6,precision_score1))

print('\nThe recall_score of the  Random forest classifier  for n_estimaters=%
d and Depth = %d is %f' % (100,6,recall_score1))

print('\nThe f1_score of the  Random forest classifier  for n_estimaters=%d an
d Depth = %d is %f' % (100,6,f1))
```

```
The accuracy of the Random forest classifier for n_estimaters=100.000000 and
Depth = 6.000000 is 85.572722%

The precision_score of the  Random forest classifier  for n_estimaters=100 an
d Depth = 6 is 0.210289

The recall_score of the  Random forest classifier  for n_estimaters=100 and D
epth = 6 is 0.721854

The f1_score of the  Random forest classifier  for n_estimaters=100 and Depth
= 6 is 0.325697
```

PLOTTING CONFUSION MATRIX:

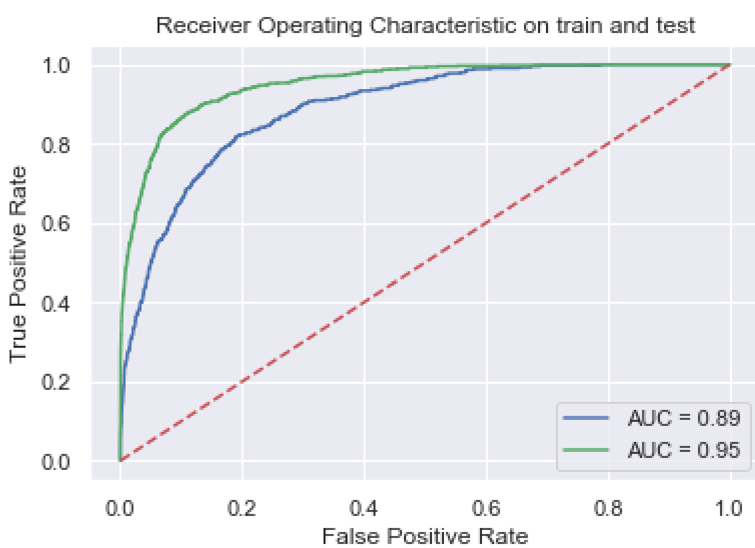
In [28]:
```
# Code for drawing seaborn heatmaps
class_names = ['negative','positive']
df_heatmap = pd.DataFrame(confusion_matrix(y_test, pred), index=class_names, c
olumns=class_names )
fig = plt.figure(figsize=(10,7))
heatmap = sns.heatmap(df_heatmap, annot=True, fmt="d")

# Setting tick labels for heatmap
heatmap.yaxis.set_ticklabels(heatmap.yaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
heatmap.xaxis.set_ticklabels(heatmap.xaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
plt.ylabel('Predicted label',size=18)
plt.xlabel('True label',size=18)
plt.title("Confusion Matrix\n",size=24)
plt.show()
```



PLOTTING AUC_ROC CURVE FOR TRAIN AND TEST DATA:

In [29]:
```
rf.fit(Xbow_tr_std, y_tr)
probs2 = rf.predict_proba(Xbow_tr_std)
preds2 = probs2[:,1]
fpr2, tpr2, threshold2 = metrics.roc_curve(y_tr, preds2)
roc_auc2 = metrics.auc(fpr2, tpr2)


probs1 = rf.predict_proba(Xbow_test_std)
preds1 = probs1[:,1]
fpr1, tpr1, threshold1 = metrics.roc_curve(y_test, preds1)
roc_auc1 = metrics.auc(fpr1, tpr1)
```

In [30]:
```
plt.title('Receiver Operating Characteristic on train and test')
plt.plot(fpr1, tpr1, 'b', label = 'AUC = %0.2f' % roc_auc1)
plt.plot(fpr2, tpr2, 'g', label = 'AUC = %0.2f' % roc_auc2)
#plt.plot(neighbors, auc1,'g')
#plt.plot(neighbors, auc2,'r')
plt.legend(loc = 'lower right')
plt.plot([0, 1], [0, 1],'r--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```

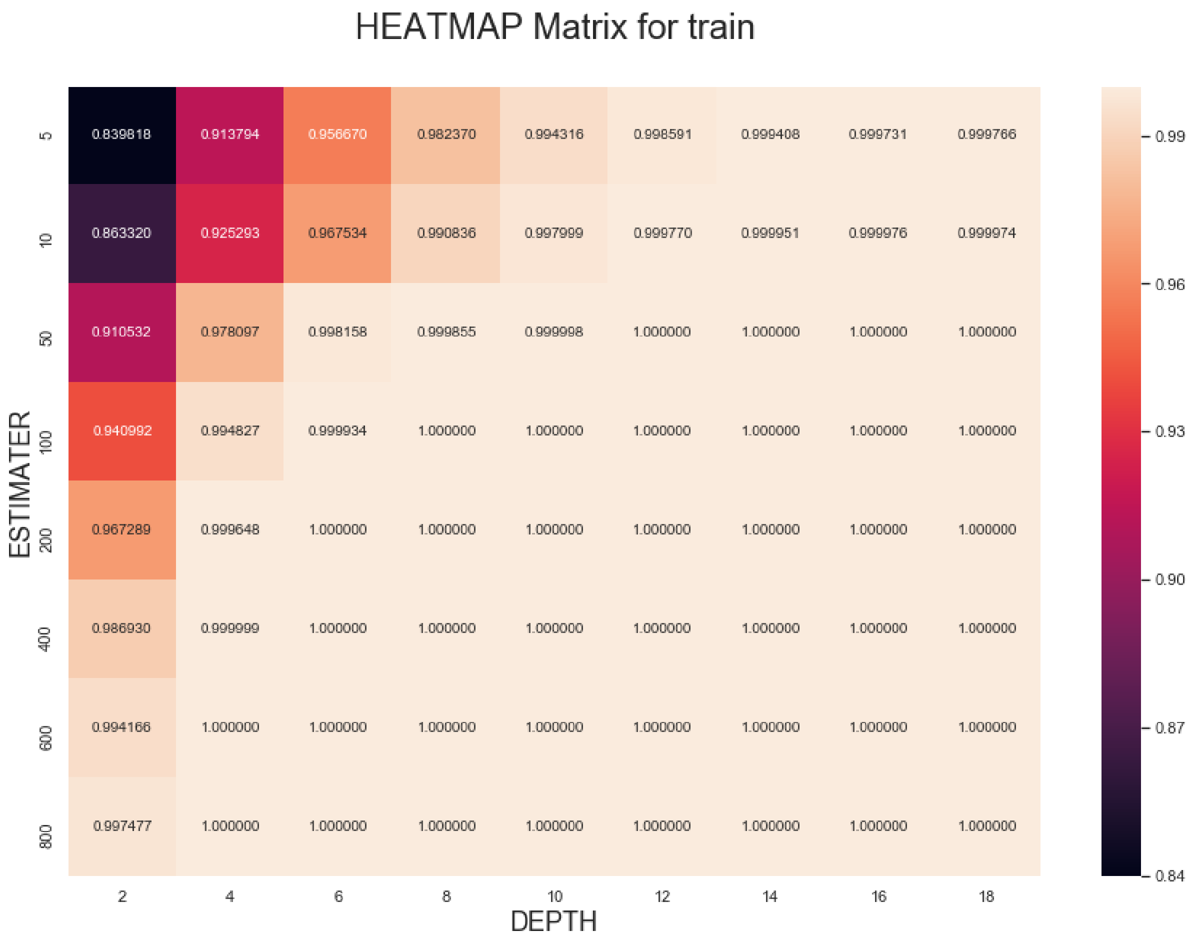


HYPERPARAMETER TUNING WITH DEPTH AND NO.OF ESTIMATERS for XGBClassifier

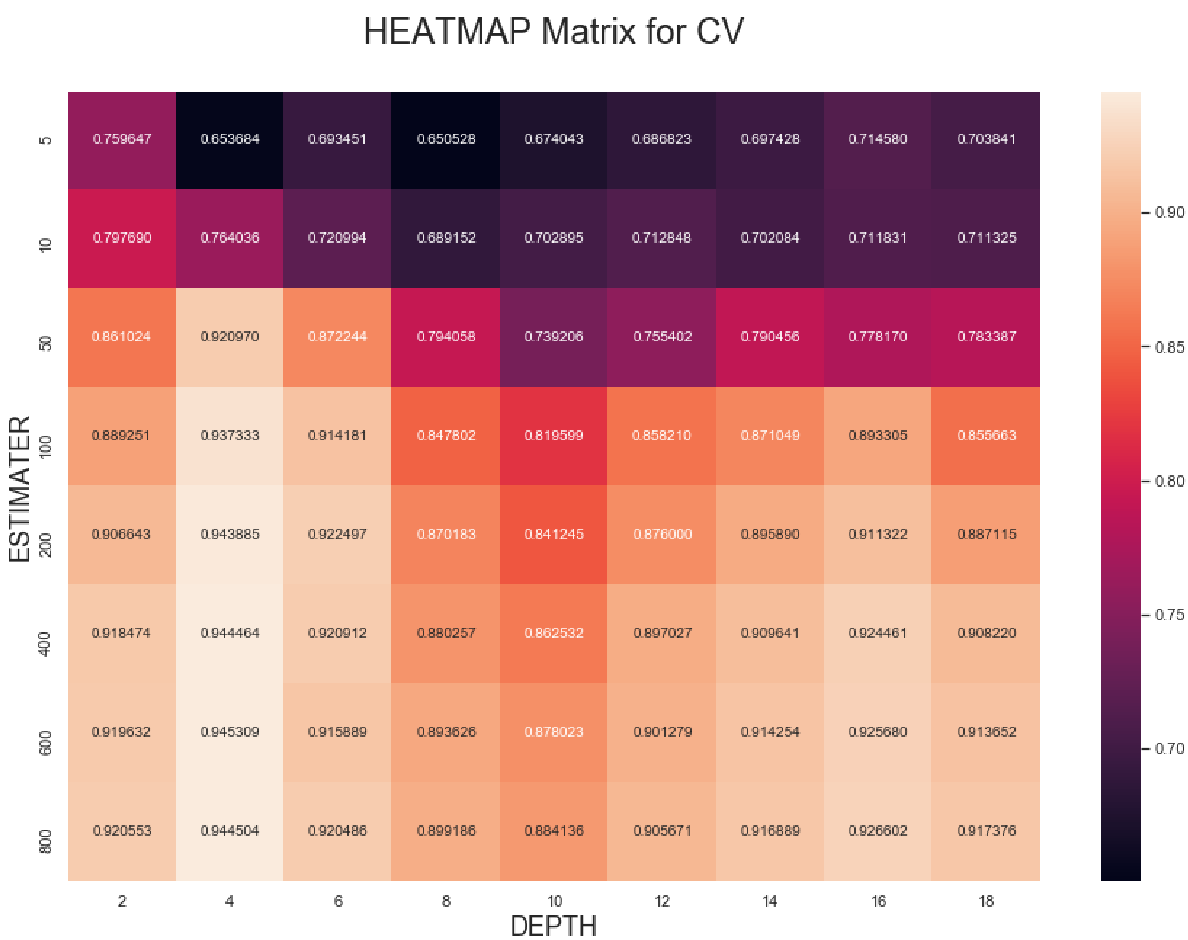
In [31]:
```
#code for hyperparameter tuning
import numpy as np
hyper1 =  [5, 10, 50, 100, 200,400, 600, 800]
hyper2 =  [2, 4, 6, 8, 10, 12, 14, 16, 18]

auc1=np.empty((8,9))
auc2=np.empty((8,9))
l=0
for j in hyper1:
    m=0
    for k in hyper2:

        model = XGBClassifier(n_estimators=j,max_depth=k)
        model.fit(Xbow_tr_std, y_tr)

        probs = model.predict_proba(Xbow_tr_std)
        preds = probs[:,1]
        roc_auc1=metrics.roc_auc_score(y_tr, preds)
        auc1[l][m]=(roc_auc1)


        probs = model.predict_proba(Xbow_cv_std)
        preds = probs[:,1]
        roc_auc2=metrics.roc_auc_score(y_cv, preds)
        auc2[l][m]=(roc_auc2)
        m=m+1

    l=l+1
```

PLOTTING SEABORN HEATMAP:

In [32]:
```
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc1, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for train\n",size=24)
plt.show()
```



In [33]:
```
# Code for drawing seaborn heatmaps

df_heatmap =pd.DataFrame(auc2, hyper1, hyper2 )
fig = plt.figure(figsize=(15,10))
ax = sns.heatmap(df_heatmap, annot=True, fmt="f")

plt.ylabel('ESTIMATER',size=18)
plt.xlabel('DEPTH',size=18)
plt.title("HEATMAP Matrix for CV\n",size=24)
plt.show()
```



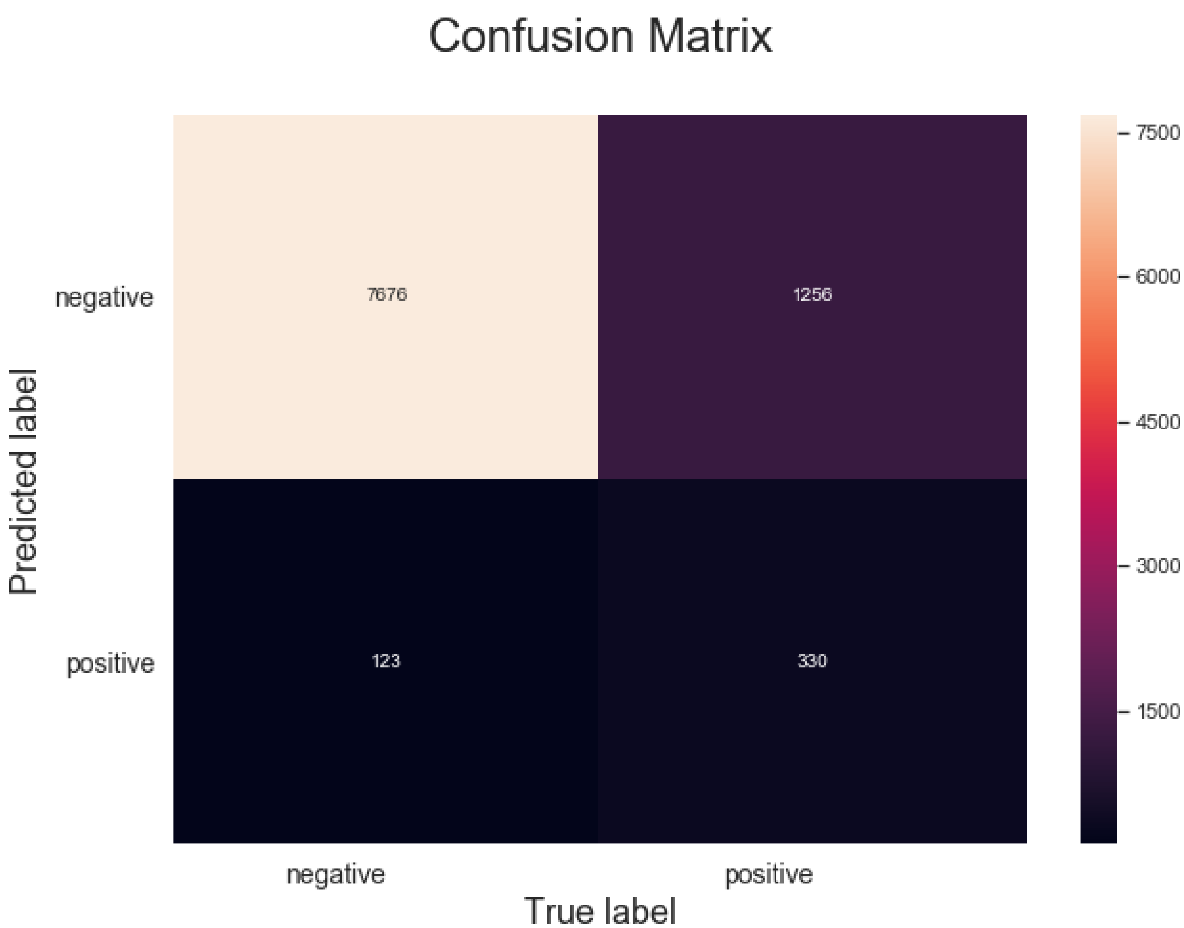
FITTING AND TESTING MODEL ON OUR SPLITTED TEST DATA:

In [39]:
```
rf = RandomForestClassifier(n_estimators=100,max_depth=6)

# fitting the model
rf.fit(Xbow_tr_std, y_tr)

# predict the response
pred = rf.predict(Xbow_test_std)

# evaluate accuracy
acc = accuracy_score(y_test, pred) * 100

precision_score1=precision_score(y_test, pred )

recall_score1=recall_score(y_test, pred )

f1 = f1_score(y_test, pred)

print('\nThe accuracy of the Random forest classifier for n_estimaters=%f and
 Depth = %f is %f%%' % (100,6, acc))



print('\nThe precision_score of the  Random forest classifier  for n_estimater
s=%d and Depth = %d is %f' % (100,6,precision_score1))

print('\nThe recall_score of the  Random forest classifier  for n_estimaters=%
d and Depth = %d is %f' % (100,6,recall_score1))

print('\nThe f1_score of the  Random forest classifier  for n_estimaters=%d an
d Depth = %d is %f' % (100,6,f1))
```

```
The accuracy of the Random forest classifier for n_estimaters=100.000000 and
Depth = 6.000000 is 86.638253%

The precision_score of the  Random forest classifier  for n_estimaters=100 an
d Depth = 6 is 0.222453

The recall_score of the  Random forest classifier  for n_estimaters=100 and D
epth = 6 is 0.708609

The f1_score of the  Random forest classifier  for n_estimaters=100 and Depth
= 6 is 0.338608
```

PLOTTING CONFUSION MATRIX:

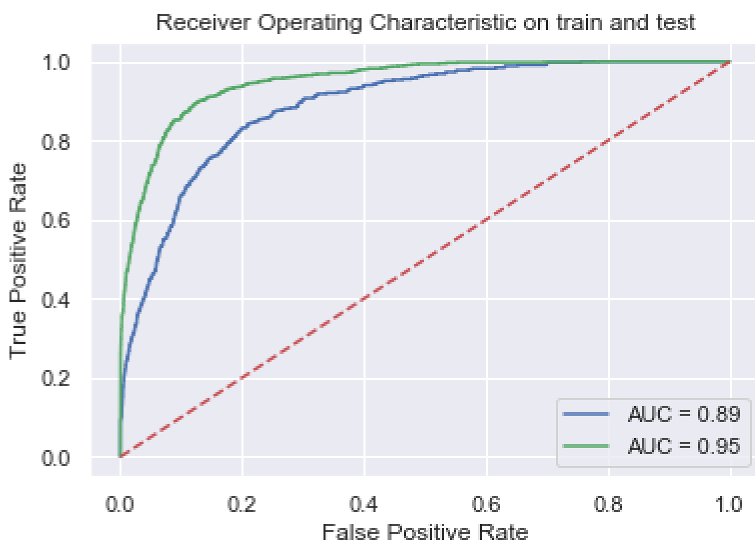
In [35]:
```
# Code for drawing seaborn heatmaps
class_names = ['negative','positive']
df_heatmap = pd.DataFrame(confusion_matrix(y_test, pred), index=class_names, c
olumns=class_names )
fig = plt.figure(figsize=(10,7))
heatmap = sns.heatmap(df_heatmap, annot=True, fmt="d")

# Setting tick labels for heatmap
heatmap.yaxis.set_ticklabels(heatmap.yaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
heatmap.xaxis.set_ticklabels(heatmap.xaxis.get_ticklabels(), rotation=0, ha='r
ight', fontsize=14)
plt.ylabel('Predicted label',size=18)
plt.xlabel('True label',size=18)
plt.title("Confusion Matrix\n",size=24)
plt.show()
```



PLOTTING AUC_ROC CURVE FOR TRAIN AND TEST DATA:

In [36]:
```
rf.fit(Xbow_tr_std, y_tr)
probs2 = rf.predict_proba(Xbow_tr_std)
preds2 = probs2[:,1]
fpr2, tpr2, threshold2 = metrics.roc_curve(y_tr, preds2)
roc_auc2 = metrics.auc(fpr2, tpr2)


probs1 = rf.predict_proba(Xbow_test_std)
preds1 = probs1[:,1]
fpr1, tpr1, threshold1 = metrics.roc_curve(y_test, preds1)
roc_auc1 = metrics.auc(fpr1, tpr1)
```

In [37]:
```
plt.title('Receiver Operating Characteristic on train and test')
plt.plot(fpr1, tpr1, 'b', label = 'AUC = %0.2f' % roc_auc1)
plt.plot(fpr2, tpr2, 'g', label = 'AUC = %0.2f' % roc_auc2)
#plt.plot(neighbors, auc1,'g')
#plt.plot(neighbors, auc2,'r')
plt.legend(loc = 'lower right')
plt.plot([0, 1], [0, 1],'r--')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```



PREETY_TABLE_OBSERVATION:

In [40]:
```
from prettytable import PrettyTable

x = PrettyTable()

x.field_names = ["Technique", "Model","DEPTH","ESTIMATER", "Precession","recal
l","F1","ACCURACY"]

x.add_row(["No_Sampling", "Decision Tree",     8,     50,     1.000000,    0.02
2075,      0.043197,    95.279702])

x.add_row(["No_Sampling", "XGB_Regressor",     8,     50,     0.950000 ,    0.04
1943 ,      0.080338,    95.364944])

x.add_row(["SMOTE", "Decision Tree",           10,     50,     0.290323,    0.65
5629 ,      0.402439,    90.602025])

x.add_row(["SMOTE", "XGB_Regressor",           8,     100,     0.248366,    0.67
1082  ,      0.362552,    88.609483])

x.add_row(["UP_SAMPLING", "Decision Tree",     6,    100,     0.210289,    0.721
854  ,     0.325697,    85.572722])

x.add_row(["UP_SAMPLING", "XGB_Regressor",      8,    100,     0.208071,    0.72
8477  ,      0.323688,   85.306340])


print(x)
```

```
+-------------+---------------+-------+-----------+------------+----------+--
--------+-----------+
|  Technique  |     Model     | DEPTH | ESTIMATER | Precession |  recall  |
F1      |  ACCURACY |
+-------------+---------------+-------+-----------+------------+----------+--
--------+-----------+
| No_Sampling | Decision Tree |   8   |     50    |    1.0     | 0.022075 |
0.043197 | 95.279702 |
| No_Sampling | XGB_Regressor |   8   |     50    |    0.95    | 0.041943 |
0.080338 | 95.364944 |
|    SMOTE    | Decision Tree |   10  |     50    |  0.290323  | 0.655629 |
0.402439 | 90.602025 |
|    SMOTE    | XGB_Regressor |   8   |    100    |  0.248366  | 0.671082 |
0.362552 | 88.609483 |
| UP_SAMPLING | Decision Tree |   6   |    100    |  0.210289  | 0.721854 |
0.325697 | 85.572722 |
| UP_SAMPLING | XGB_Regressor |   8   |    100    |  0.208071  | 0.728477 |
0.323688 |  85.30634 |
+-------------+---------------+-------+-----------+------------+----------+--
--------+-----------+
```

-----------------------SAVING_RESULT_WITHOUT_SAMPLING-------------------------

In [170]:
```
df_tr1=pd.read_csv('train.csv')
df_te1=pd.read_csv('test.csv')
yees=df_tr['target']
df_tr_after_drop=df_tr.drop(['target'],axis=1)
```

In [171]:
```
df_tr_after_drop.fillna(df_tr_after_drop.mean(), inplace=True)
df_te1.fillna(df_te1.mean(), inplace=True)


Xbow_tr_std = sc.fit_transform(df_tr_after_drop)
Xbow_test_std = sc.transform(df_te1)
```

In [173]:
```
rf = XGBClassifier(n_estimators=150,max_depth=10)

# fitting the model
rf.fit(Xbow_tr_std, yees)

# predict the response
pred = rf.predict(Xbow_test_std)
```

In [174]:
```
df_te['TARGET'] = pred
df_te.to_csv('test_with_target_finel1.csv', index=True)
```

-------------------------------SAVING_RESULT_WITH_SMOTE-------------------------------

In [175]:
```
X_tr, y_tr = sm.fit_sample(df_tr_after_drop, yees)
Xbow_tr_std = sc.fit_transform(X_tr)
```

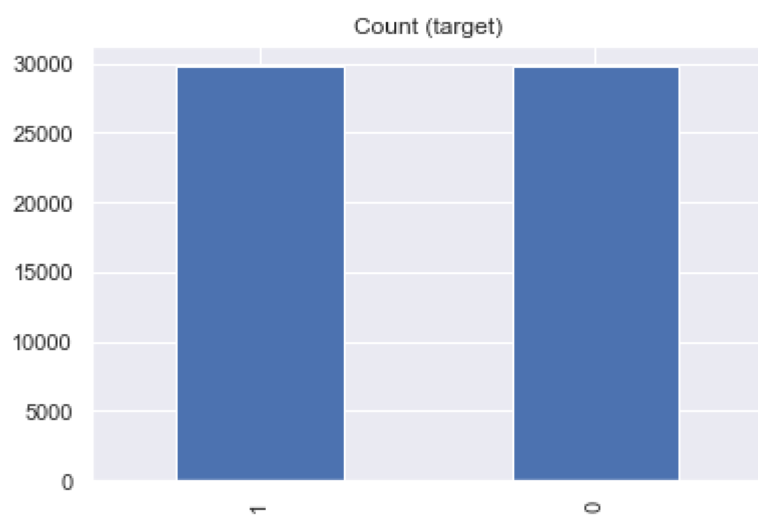
In [176]:
```
rf = XGBClassifier(n_estimators=150,max_depth=10)

# fitting the model
rf.fit(Xbow_tr_std, y_tr)

# predict the response
pred = rf.predict(Xbow_test_std)
```

In [177]:
```
df_te['TARGET'] = pred
df_te.to_csv('test_with_target_finel2.csv', index=True)
```

------SAVING_RESULT_WITH_OVERSAMPLING_MINORITY_CL--------

In [178]:
```
# Class count
X_tr = pd.DataFrame(df_tr1)
print(type(X_tr))
count_class_0, count_class_1 = X_tr.target.value_counts()
print(count_class_0, count_class_1)

# Divide by class
df_class_0 = X_tr[X_tr.target == 0]
df_class_1 = X_tr[X_tr.target == 1]
print(count_class_0, count_class_1)


df_class_1_over = df_class_1.sample(count_class_0, replace=True)
X_tr = pd.concat([df_class_0, df_class_1_over], axis=0)

print('Random over-sampling:')
print(X_tr.target.value_counts())

X_tr.target.value_counts().plot(kind='bar', title='Count (target)');
```

```
<class 'pandas.core.frame.DataFrame'>
29772 1511
29772 1511
Random over-sampling:
1    29772
0    29772
Name: target, dtype: int64
```



In [179]:
```
y_tr=X_tr['target']
X_tr=X_tr.drop(['target'],axis=1)
```

In [180]:
```
X_tr.fillna(X_tr.mean(), inplace=True)

Xbow_tr_std = sc.fit_transform(X_tr)
```

In [181]:
```
rf = XGBClassifier(n_estimators=100,max_depth=8)

# fitting the model
rf.fit(Xbow_tr_std, y_tr)

# predict the response
pred = rf.predict(Xbow_test_std)
```

In [182]:
```
df_te['TARGET'] = pred
df_te.to_csv('test_with_target_finel3.csv', index=True)
```

In [ ]: