kaggle-xgboost

May 9, 2017

In [1]:
```
import numpy as np
import pandas as pd
from subprocess import check_output
```

In [3]:
```
from sklearn.grid_search import GridSearchCV
import sklearn
import xgboost as xgb
import matplotlib.pyplot as plt
```

In [4]:
```
train = pd.read_csv("/Users/jyothi/Desktop/santender/train.csv") # the trai
test = pd.read_csv("/Users/jyothi/Desktop/santender/test.csv")
```

In [47]:
```
train.shape
```

Out[47]:
```
(76020, 306)
```

In [5]:
```
train.columns
```

Out[5]:
```
Index(['ID', 'var3', 'var15', 'imp_ent_var16_ult1', 'imp_op_var39_comer_ult
       'imp_op_var39_comer_ult3', 'imp_op_var40_comer_ult1',
       'imp_op_var40_comer_ult3', 'imp_op_var40_efect_ult1',
       'imp_op_var40_efect_ult3',
       ...
       'saldo_medio_var33_hace2', 'saldo_medio_var33_hace3',
       'saldo_medio_var33_ult1', 'saldo_medio_var33_ult3',
       'saldo_medio_var44_hace2', 'saldo_medio_var44_hace3',
       'saldo_medio_var44_ult1', 'saldo_medio_var44_ult3', 'var38', 'TARGET
      dtype='object', length=371)
```

In [7]:
```
# happy customers have TARGET==0, unhappy custormers have TARGET==1
```

In [8]:
```
# var3 is suspected to be the nationality of the customer
```

In [8]:
```
# Top-10 most common values
train.var3.value_counts()[:10]
```

Out[8]:
```
 2         74165
 8           138
-999999      116
```

```
9           110
3           108
1           105
13           98
7            97
4            86
12           85
Name: var3, dtype: int64
```

In [9]:
```
# 116 values in column var3 are -999999

train.loc[train.var3==-999999].shape
```

Out[9]:
```
(116, 371)
```

In [ ]:
```
X = train.iloc[:,:-1]
y = train.TARGET

X['n0'] = (X==0).sum(axis=1)
train['n0'] = X['n0']
```

In [10]:
```
# Seperate out predictors and target from the training data set
# Remove the ID field from the test dataset and save it.
# Drop the ID field from the training set
train_y = train['TARGET']
train.drop(['ID', 'TARGET'], axis=1, inplace=True)
train_x = train
test_id = test['ID']
del test['ID']
```

In [11]:
```
# Fixing the outliers in column 'var3'
train_x['var3'].replace(-999999,0, inplace=True)
test['var3'].replace(-999999,0, inplace=True)
```

In [12]:
```
# Remove all the columns which have constant values.
# These columns have zero std deviation.
rm_col=[]
for col in train_x.columns:
    if train_x[col].std()==0:
        rm_col.append(col)

train_x.drop(rm_col, axis=1, inplace=True)
test.drop(rm_col, axis=1, inplace=True)
```

In [13]:
```
# Remove the duplicate columns.
# Here we have columns with different name but exactly same values for ea

dups_col = []
for ii in range(len(train_x.columns)-1):
```

```
            for jj in range(ii+1,len(train_x.columns)):
                col1=train_x.columns[ii]
                col2=train_x.columns[jj]
                # take the columns as arrays adn then compare the values.
                if np.array_equal(train_x[col1].values, train_x[col2].values) and
                    dups_col.append(col2)

        train_x.drop(dups_col, axis=1, inplace=True)
        test.drop(dups_col, axis=1, inplace=True)
```

```
In [14]: import numpy as np
         import pandas as pd
         import matplotlib
         import matplotlib.pyplot as plt
         from sklearn import cross_validation
         import sklearn
         from sklearn.metrics import roc_auc_score
         X_train, X_test, y_train , y_test =  cross_validation.train_test_split(tra
```

```
In [15]: xgb_clf = xgb.XGBClassifier(learning_rate=0.1, n_estimators=100, max_depth
                                    gamma=0, subsample=0.8, colsample_bytree=0.8, c
                                    nthread=4,seed=10)

         # Learn the model with training data
         xgb_clf.fit(X_train,y_train)
```

```
Out[15]: XGBClassifier(base_score=0.5, colsample_bylevel=1, colsample_bytree=0.8,
                gamma=0, learning_rate=0.1, max_delta_step=0, max_depth=5,
                min_child_weight=1, missing=None, n_estimators=100, nthread=4,
                objective='binary:logistic', reg_alpha=0, reg_lambda=1,
                scale_pos_weight=1, seed=10, silent=True, subsample=0.8)
```

```
In [16]: #To find AUC
         xgb_clf.fit(X_train, y_train, early_stopping_rounds=50, eval_metric ="auc'
```

```
[0]        validation_0-auc:0.807282        validation_1-auc:0.813619
Multiple eval metrics have been passed: 'validation_1-auc' will be used for early s

Will train until validation_1-auc hasn't improved in 50 rounds.
[1]        validation_0-auc:0.820429        validation_1-auc:0.819487
[2]        validation_0-auc:0.820915        validation_1-auc:0.819262
[3]        validation_0-auc:0.82671        validation_1-auc:0.823365
[4]        validation_0-auc:0.829552        validation_1-auc:0.8281
[5]        validation_0-auc:0.831935        validation_1-auc:0.828947
[6]        validation_0-auc:0.834794        validation_1-auc:0.829387
[7]        validation_0-auc:0.835249        validation_1-auc:0.828132
[8]        validation_0-auc:0.837134        validation_1-auc:0.831281
[9]        validation_0-auc:0.838094        validation_1-auc:0.832101
[10]        validation_0-auc:0.839242        validation_1-auc:0.83167
```

```
[11]        validation_0-auc:0.839418        validation_1-auc:0.832874
[12]        validation_0-auc:0.840742        validation_1-auc:0.832639
[13]        validation_0-auc:0.841407        validation_1-auc:0.833586
[14]        validation_0-auc:0.843989        validation_1-auc:0.835865
[15]        validation_0-auc:0.844696        validation_1-auc:0.835575
[16]        validation_0-auc:0.846379        validation_1-auc:0.836998
[17]        validation_0-auc:0.847658        validation_1-auc:0.837814
[18]        validation_0-auc:0.84921         validation_1-auc:0.83873
[19]        validation_0-auc:0.850228        validation_1-auc:0.839842
[20]        validation_0-auc:0.850919        validation_1-auc:0.840498
[21]        validation_0-auc:0.851726        validation_1-auc:0.840705
[22]        validation_0-auc:0.852162        validation_1-auc:0.840578
[23]        validation_0-auc:0.852787        validation_1-auc:0.841578
[24]        validation_0-auc:0.853807        validation_1-auc:0.841576
[25]        validation_0-auc:0.854735        validation_1-auc:0.842208
[26]        validation_0-auc:0.85509         validation_1-auc:0.843193
[27]        validation_0-auc:0.856033        validation_1-auc:0.843572
[28]        validation_0-auc:0.856498        validation_1-auc:0.844038
[29]        validation_0-auc:0.856966        validation_1-auc:0.844671
[30]        validation_0-auc:0.857621        validation_1-auc:0.844906
[31]        validation_0-auc:0.858288        validation_1-auc:0.845298
[32]        validation_0-auc:0.858753        validation_1-auc:0.845207
[33]        validation_0-auc:0.859332        validation_1-auc:0.845678
[34]        validation_0-auc:0.859727        validation_1-auc:0.845531
[35]        validation_0-auc:0.860435        validation_1-auc:0.845942
[36]        validation_0-auc:0.860837        validation_1-auc:0.846051
[37]        validation_0-auc:0.861522        validation_1-auc:0.846568
[38]        validation_0-auc:0.862041        validation_1-auc:0.84629
[39]        validation_0-auc:0.862417        validation_1-auc:0.846162
[40]        validation_0-auc:0.863036        validation_1-auc:0.84601
[41]        validation_0-auc:0.86373         validation_1-auc:0.846414
[42]        validation_0-auc:0.864088        validation_1-auc:0.846308
[43]        validation_0-auc:0.864461        validation_1-auc:0.846407
[44]        validation_0-auc:0.864929        validation_1-auc:0.84663
[45]        validation_0-auc:0.865738        validation_1-auc:0.846708
[46]        validation_0-auc:0.866319        validation_1-auc:0.846875
[47]        validation_0-auc:0.866671        validation_1-auc:0.846781
[48]        validation_0-auc:0.867113        validation_1-auc:0.847121
[49]        validation_0-auc:0.86782         validation_1-auc:0.847009
[50]        validation_0-auc:0.868271        validation_1-auc:0.847239
[51]        validation_0-auc:0.86898         validation_1-auc:0.84723
[52]        validation_0-auc:0.869307        validation_1-auc:0.847215
[53]        validation_0-auc:0.869917        validation_1-auc:0.847607
[54]        validation_0-auc:0.870216        validation_1-auc:0.847769
[55]        validation_0-auc:0.870856        validation_1-auc:0.847804
[56]        validation_0-auc:0.871417        validation_1-auc:0.847478
[57]        validation_0-auc:0.87197         validation_1-auc:0.847598
[58]        validation_0-auc:0.872145        validation_1-auc:0.847791
```

```
[59]        validation_0-auc:0.872332        validation_1-auc:0.847724
[60]        validation_0-auc:0.872905        validation_1-auc:0.847488
[61]        validation_0-auc:0.873382        validation_1-auc:0.847522
[62]        validation_0-auc:0.873663        validation_1-auc:0.847535
[63]        validation_0-auc:0.873913        validation_1-auc:0.84759
[64]        validation_0-auc:0.874308        validation_1-auc:0.84763
[65]        validation_0-auc:0.874657        validation_1-auc:0.847783
[66]        validation_0-auc:0.875297        validation_1-auc:0.847738
[67]        validation_0-auc:0.875604        validation_1-auc:0.847806
[68]        validation_0-auc:0.876194        validation_1-auc:0.848062
[69]        validation_0-auc:0.876665        validation_1-auc:0.84807
[70]        validation_0-auc:0.876918        validation_1-auc:0.847971
[71]        validation_0-auc:0.876939        validation_1-auc:0.84794
[72]        validation_0-auc:0.877134        validation_1-auc:0.847929
[73]        validation_0-auc:0.877408        validation_1-auc:0.847883
[74]        validation_0-auc:0.878242        validation_1-auc:0.847832
[75]        validation_0-auc:0.879001        validation_1-auc:0.847794
[76]        validation_0-auc:0.87909         validation_1-auc:0.847812
[77]        validation_0-auc:0.879457        validation_1-auc:0.847562
[78]        validation_0-auc:0.880251        validation_1-auc:0.848039
[79]        validation_0-auc:0.880705        validation_1-auc:0.848094
[80]        validation_0-auc:0.880934        validation_1-auc:0.848209
[81]        validation_0-auc:0.881269        validation_1-auc:0.848195
[82]        validation_0-auc:0.881589        validation_1-auc:0.848126
[83]        validation_0-auc:0.881922        validation_1-auc:0.848357
[84]        validation_0-auc:0.882401        validation_1-auc:0.848296
[85]        validation_0-auc:0.88245         validation_1-auc:0.848281
[86]        validation_0-auc:0.882851        validation_1-auc:0.848104
[87]        validation_0-auc:0.883093        validation_1-auc:0.848181
[88]        validation_0-auc:0.883529        validation_1-auc:0.847972
[89]        validation_0-auc:0.883754        validation_1-auc:0.84799
[90]        validation_0-auc:0.884127        validation_1-auc:0.847936
[91]        validation_0-auc:0.884348        validation_1-auc:0.847955
[92]        validation_0-auc:0.884405        validation_1-auc:0.84797
[93]        validation_0-auc:0.884619        validation_1-auc:0.848041
[94]        validation_0-auc:0.885029        validation_1-auc:0.848168
[95]        validation_0-auc:0.885612        validation_1-auc:0.848132
[96]        validation_0-auc:0.885921        validation_1-auc:0.847956
[97]        validation_0-auc:0.886185        validation_1-auc:0.84802
[98]        validation_0-auc:0.886543        validation_1-auc:0.848294
[99]        validation_0-auc:0.886812        validation_1-auc:0.84841
```

```
Out[16]: XGBClassifier(base_score=0.5, colsample_bylevel=1, colsample_bytree=0.8,
                gamma=0, learning_rate=0.1, max_delta_step=0, max_depth=5,
                min_child_weight=1, missing=None, n_estimators=100, nthread=4,
                objective='binary:logistic', reg_alpha=0, reg_lambda=1,
                scale_pos_weight=1, seed=10, silent=True, subsample=0.8)
```

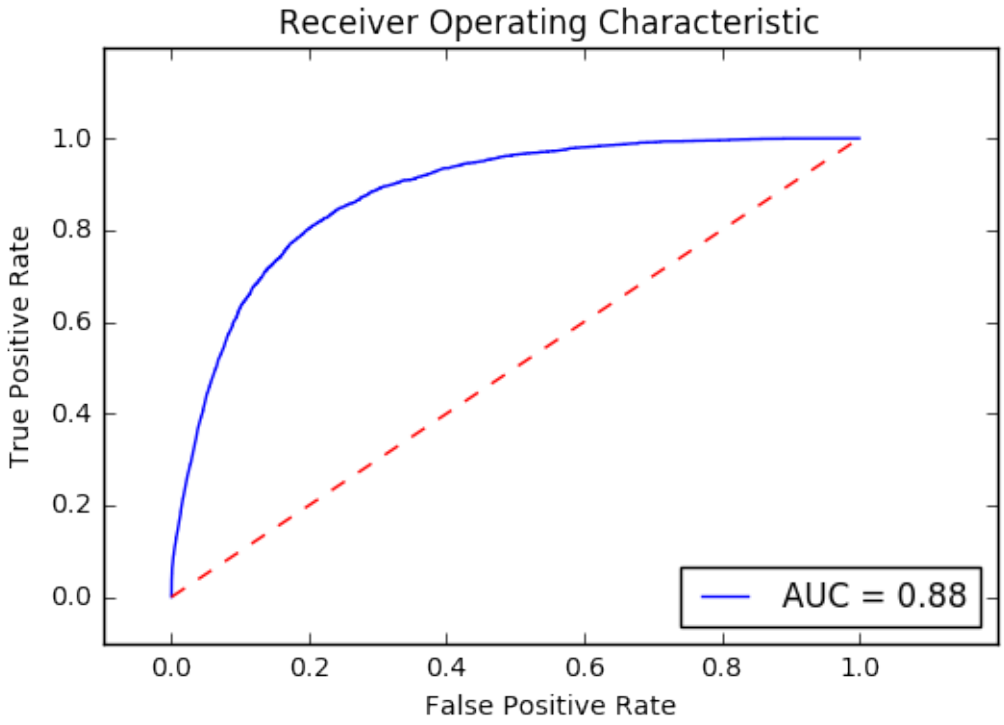
```
In [17]: print('Overall AUC:', roc_auc_score(train_y, xgb_clf.predict_proba(train_x

Overall AUC: 0.879216647369
```

```
In [18]: from sklearn.metrics import roc_curve, auc
         import matplotlib.pyplot as plt
         import random
```

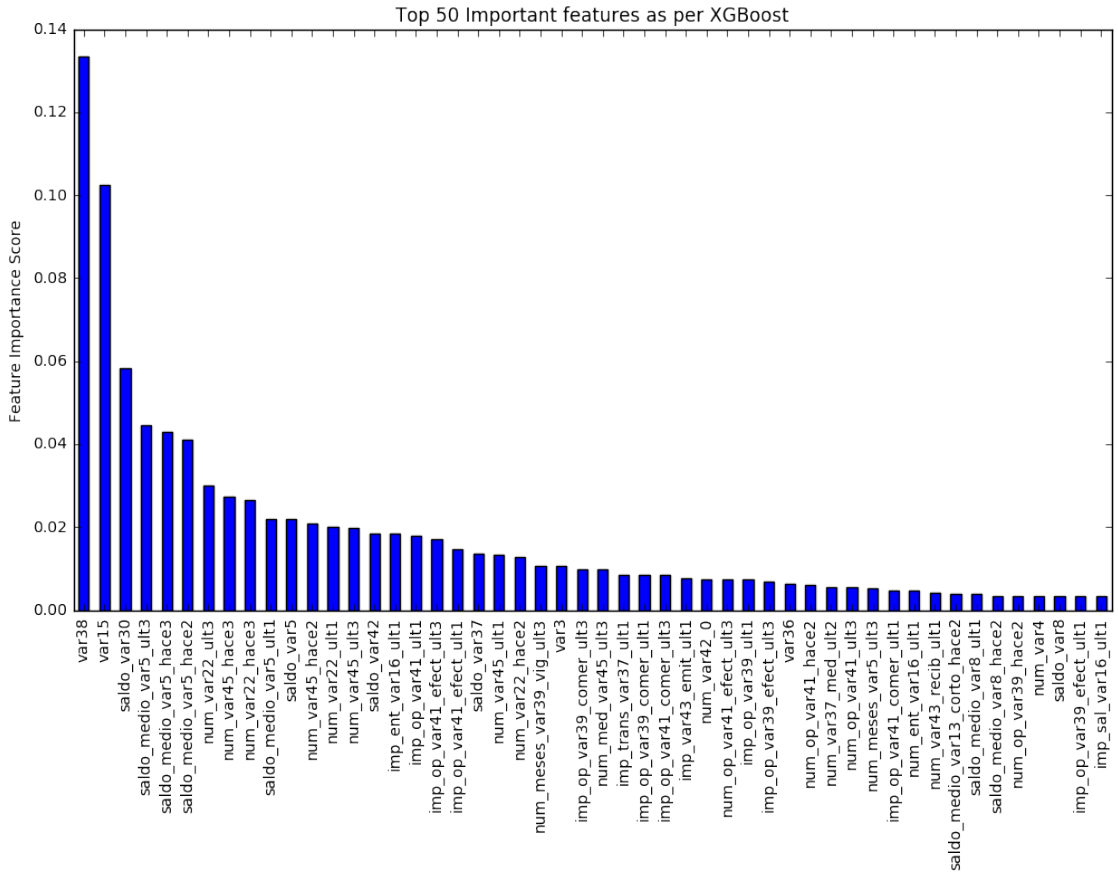
```
In [19]: false_positive_rate, true_positive_rate, thresholds = roc_curve(train_y, x
         roc_auc = auc(false_positive_rate, true_positive_rate)
```

```
In [20]: plt.title('Receiver Operating Characteristic')
         plt.plot(false_positive_rate, true_positive_rate, 'b',
         label='AUC = %0.2f'% roc_auc)
         plt.legend(loc='lower right')
         plt.plot([0,1],[0,1],'r--')
         plt.xlim([-0.1,1.2])
         plt.ylim([-0.1,1.2])
         plt.ylabel('True Positive Rate')
         plt.xlabel('False Positive Rate')
         plt.show()
```




```
In [21]: imp_feat_xgb=pd.Series(xgb_clf.feature_importances_, index=X_train.columns
         imp_feat_xgb[:50].plot(kind='bar',title='Top 50 Important features as per
```

```
        plt.ylabel('Feature Importance Score')
        plt.subplots_adjust(bottom=0.25)
        plt.savefig('FeatureImportance.png')
        plt.show()
```




```
In [22]: # Save indexes of the important features in descending order of their impo
         indices = np.argsort(xgb_clf.feature_importances_)[::-1]
         select_feat =[str(s) for s in X_train.columns[indices][:50]]
         train_x_sub = X_train[select_feat]
         test_sub = X_test[select_feat]

In [25]: y_test.shape

Out[25]: (15204,)

In [118]: y_train.shape

Out[118]: (45612,)

In [23]: test_sub.head()
```

Out[23]:

	var38	var15	saldo_var30	saldo_medio_var5_ult3	\
1019	48767.490000	23	3.00	3.00	
9086	117310.979016	25	3.00	2.88	
18757	97660.320000	47	60.00	69.66	
67548	203764.110000	23	0.00	0.00	
30003	187564.770000	23	675.36	0.00	

	saldo_medio_var5_hace3	saldo_medio_var5_hace2	num_var22_ult3	\
1019	0.00	3.00	0	
9086	2.61	3.00	0	
18757	34.26	114.69	6	
67548	0.00	0.00	0	
30003	2.61	0.00	21	

	num_var45_hace3	num_var22_hace3	saldo_medio_var5_ult1	\
1019	0	0	3.0	
9086	0	0	3.0	
18757	24	0	60.0	
67548	0	0	0.0	
30003	0	9	0.0	

	...	num_ent_var16_ult1	num_var43_recib_ult1	\
1019	...	0	0	
9086	...	0	0	
18757	...	0	0	
67548	...	0	0	
30003	...	0	0	

	saldo_medio_var13_corto_hace2	saldo_medio_var8_ult1	\
1019	0.0	0.00	
9086	0.0	0.00	
18757	0.0	0.00	
67548	0.0	0.00	
30003	0.0	1247.55	

	saldo_medio_var8_hace2	num_op_var39_hace2	num_var4	saldo_var8	\
1019	0.00	0	1	0.00	
9086	0.00	0	1	0.00	
18757	0.00	3	2	0.00	
67548	0.00	0	0	0.00	
30003	510.51	0	3	675.36	

	imp_op_var39_efect_ult1	imp_sal_var16_ult1
1019	0.0	0.0
9086	0.0	0.0
18757	0.0	0.0
67548	0.0	0.0
30003	600.0	0.0

```
[5 rows x 50 columns]
```

In [24]:
```
# Define a new XGBoost Classifier with default parameters
select_xgb_clf = xgb.XGBClassifier(learning_rate=0.1, n_estimators=100, se

param_grid = {

            'max_depth':[3,4,5],
            'min_child_weight':[3,4,5]
}
grid_clf = GridSearchCV(select_xgb_clf,param_grid,cv=5,scoring='roc_auc' )

# Train the model
grid_clf.fit(train_x_sub,y_train)
grid_clf.grid_scores_, grid_clf.best_params_, grid_clf.best_score_
```

Out[24]:
```
([mean: 0.83636, std: 0.00574, params: {'max_depth': 3, 'min_child_weight'
  mean: 0.83668, std: 0.00600, params: {'max_depth': 3, 'min_child_weight'
  mean: 0.83615, std: 0.00560, params: {'max_depth': 3, 'min_child_weight'
  mean: 0.83679, std: 0.00639, params: {'max_depth': 4, 'min_child_weight'
  mean: 0.83689, std: 0.00655, params: {'max_depth': 4, 'min_child_weight'
  mean: 0.83720, std: 0.00674, params: {'max_depth': 4, 'min_child_weight'
  mean: 0.83635, std: 0.00593, params: {'max_depth': 5, 'min_child_weight'
  mean: 0.83567, std: 0.00622, params: {'max_depth': 5, 'min_child_weight'
  mean: 0.83638, std: 0.00645, params: {'max_depth': 5, 'min_child_weight'
 {'max_depth': 4, 'min_child_weight': 5},
 0.8372022513492344)
```

In [25]:
```
# Define a new XGBoost Classifier setting the best value for the above par
# default for the rest
select_xgb_clf = xgb.XGBClassifier(learning_rate=0.1,n_estimators=100, max
                                   min_child_weight= 5,seed=10)

# Set a list of parameters
param_grid = {

            'subsample':[0.6,0.7,0.8,0.9],
            'colsample_bytree':[0.6,0.7,0.8,0.9]
}
grid_clf = GridSearchCV(select_xgb_clf,param_grid,cv=5, scoring='roc_auc')

# Train the model
grid_clf.fit(train_x_sub,y_train)
grid_clf.grid_scores_, grid_clf.best_params_, grid_clf.best_score_
```

Out[25]:
```
([mean: 0.83719, std: 0.00648, params: {'subsample': 0.6, 'colsample_bytre
  mean: 0.83792, std: 0.00633, params: {'subsample': 0.7, 'colsample_bytre
  mean: 0.83713, std: 0.00610, params: {'subsample': 0.8, 'colsample_bytre
```

```
  mean: 0.83733, std: 0.00618, params: {'subsample': 0.9, 'colsample_bytre
  mean: 0.83741, std: 0.00653, params: {'subsample': 0.6, 'colsample_bytre
  mean: 0.83755, std: 0.00543, params: {'subsample': 0.7, 'colsample_bytre
  mean: 0.83714, std: 0.00595, params: {'subsample': 0.8, 'colsample_bytre
  mean: 0.83848, std: 0.00558, params: {'subsample': 0.9, 'colsample_bytre
  mean: 0.83712, std: 0.00590, params: {'subsample': 0.6, 'colsample_bytre
  mean: 0.83778, std: 0.00670, params: {'subsample': 0.7, 'colsample_bytre
  mean: 0.83706, std: 0.00641, params: {'subsample': 0.8, 'colsample_bytre
  mean: 0.83797, std: 0.00630, params: {'subsample': 0.9, 'colsample_bytre
  mean: 0.83658, std: 0.00593, params: {'subsample': 0.6, 'colsample_bytre
  mean: 0.83747, std: 0.00709, params: {'subsample': 0.7, 'colsample_bytre
  mean: 0.83754, std: 0.00633, params: {'subsample': 0.8, 'colsample_bytre
  mean: 0.83780, std: 0.00636, params: {'subsample': 0.9, 'colsample_bytre
 {'colsample_bytree': 0.7, 'subsample': 0.9},
 0.8384795443038221)
```

In [26]:
```
# Define a new XGBoost Classifier with parameters setting so far.
select_xgb_clf = xgb.XGBClassifier(learning_rate=0.1,n_estimators=100, max
                                   gamma=0,subsample=0.9, colsample_bytree=

# Set a list of parameters
param_grid = {

        'reg_alpha':[0.001, 0.005, 0.01, 0.05]
}
grid_clf = GridSearchCV(select_xgb_clf,param_grid,cv=5, scoring='roc_auc')

# Train the model
grid_clf.fit(train_x_sub,y_train)
grid_clf.grid_scores_, grid_clf.best_params_, grid_clf.best_score_
```

Out[26]:
```
([mean: 0.83754, std: 0.00643, params: {'reg_alpha': 0.001},
  mean: 0.83761, std: 0.00624, params: {'reg_alpha': 0.005},
  mean: 0.83757, std: 0.00608, params: {'reg_alpha': 0.01},
  mean: 0.83765, std: 0.00587, params: {'reg_alpha': 0.05}],
 {'reg_alpha': 0.05},
 0.8376527127788085)
```

In [27]:
```
# Define a new XGBoost Classifier.
select_xgb_clf = xgb.XGBClassifier(n_estimators=75, max_depth= 5, min_chil
                                   reg_alpha= 0.05,subsample=0.7, colsampl

# Set a list of parameters
param_grid = {

        'learning_rate':[0.05,0.08, 0.1, 0.15]
}
grid_clf = GridSearchCV(select_xgb_clf,param_grid,cv=5, scoring='roc_auc')
```

```
          # Train the model
          grid_clf.fit(train_x_sub,y_train)
          grid_clf.grid_scores_, grid_clf.best_params_, grid_clf.best_score_
```

```
Out[27]: ([mean: 0.83573, std: 0.00491, params: {'learning_rate': 0.05},
           mean: 0.83808, std: 0.00528, params: {'learning_rate': 0.08},
           mean: 0.83712, std: 0.00595, params: {'learning_rate': 0.1},
           mean: 0.83556, std: 0.00670, params: {'learning_rate': 0.15}],
          {'learning_rate': 0.08},
          0.8380758891290577)
```

```
In [28]: best_xgb_clf = grid_clf.best_estimator_
          grid_clf.best_estimator_
```

```
Out[28]: XGBClassifier(base_score=0.5, colsample_bylevel=1, colsample_bytree=0.7,
                gamma=0, learning_rate=0.08, max_delta_step=0, max_depth=5,
                min_child_weight=5, missing=None, n_estimators=75, nthread=-1,
                objective='binary:logistic', reg_alpha=0.05, reg_lambda=1,
                scale_pos_weight=1, seed=10, silent=True, subsample=0.7)
```

```
In [29]: # Make prediction with test data
          predicted_proba = best_xgb_clf.predict_proba(test_sub)
```

```
In [30]: predicted_proba[:,1]
```

```
Out[30]: array([ 0.0074653 ,  0.0094148 ,  0.04694097, ...,  0.02624334,
                 0.03224584,  0.02001919], dtype=float32)
```

```
In [31]: print('Overall AUC:', roc_auc_score(y_test, best_xgb_clf.predict_proba(tes
```

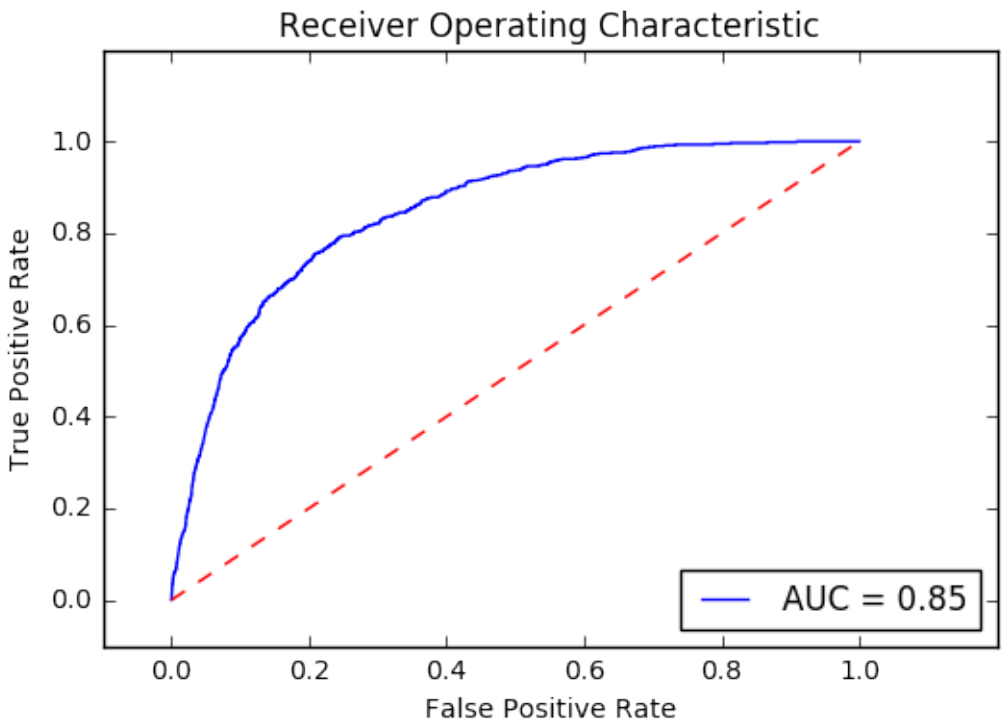
```
Overall AUC: 0.848667539136
```

```
In [32]: print('Overall AUC:', roc_auc_score(y_test, predicted_proba[:,1]))
```

```
Overall AUC: 0.848667539136
```

```
In [33]: false_positive_rate, true_positive_rate, thresholds = roc_curve(y_test, pr
          roc_auc = auc(false_positive_rate, true_positive_rate)
```

```
In [43]: plt.title('Receiver Operating Characteristic')
          plt.plot(false_positive_rate, true_positive_rate, 'b',
          label='AUC = %0.2f'% roc_auc)
          plt.legend(loc='lower right')
          plt.plot([0,1],[0,1],'r--')
          plt.xlim([-0.1,1.2])
          plt.ylim([-0.1,1.2])
          plt.ylabel('True Positive Rate')
          plt.xlabel('False Positive Rate')
          plt.show()
```



In [53]:
```
# Make prediction with test data
test_sub1 = test[select_feat]
predicted_proba = best_xgb_clf.predict_proba(test_sub1)

# Save the prediction in CSV file
# predicted_proba has probabilities for each Target class for each observa
# We are concerned about probability of class 1 and hence taking predicted
submission = pd.DataFrame({'ID':test_id,'TARGET':predicted_proba[:,1]})
submission.to_csv('/Users/jyothi/Desktop/submission.csv', index=False)
```