2_XGBOOST

September 21, 2019

1 XGBOOST Implementation

[1]:
```
# Load Python libraries
from sklearn import metrics, ensemble
from sklearn.model_selection import cross_validate,GridSearchCV,train_test_split
import xgboost as xgb
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import matplotlib as mpl
import warnings
warnings.filterwarnings('ignore')
plt.style.use('ggplot')
```

[2]:
```
# Load data
df = pd.read_csv('input/training/source_data/train.csv')

# 1% sample of items
df = df.sample(frac=0.01)
```

[3]:
```
# Load and join songs data
songs = pd.read_csv('input/training/source_data/songs.csv')
df = pd.merge(df, songs, on='song_id', how='left')
del songs

# Load and join songs data
members = pd.read_csv('input/training/source_data/members.csv')
df = pd.merge(df, members, on='msno', how='left')
del members
```

[4]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 15000 entries, 0 to 14999
Data columns (total 18 columns):
msno                    15000 non-null object
song_id                 15000 non-null object
```

```
source_system_tab         14964 non-null object
source_screen_name        14348 non-null object
source_type               14970 non-null object
target                    15000 non-null int64
song_length               15000 non-null int64
genre_ids                 14766 non-null object
artist_name               15000 non-null object
composer                  11745 non-null object
lyricist                  8788 non-null object
language                  15000 non-null float64
city                      15000 non-null int64
bd                        15000 non-null int64
gender                    9175 non-null object
registered_via            15000 non-null int64
registration_init_time    15000 non-null int64
expiration_date           15000 non-null int64
dtypes: float64(1), int64(7), object(10)
memory usage: 2.2+ MB
```

[5]:
```
# Count Na in %
df.isnull().sum()/df.isnull().count()*100
```

[5]:
```
msno                      0.000000
song_id                   0.000000
source_system_tab         0.240000
source_screen_name        4.346667
source_type               0.200000
target                    0.000000
song_length               0.000000
genre_ids                 1.560000
artist_name               0.000000
composer                 21.700000
lyricist                 41.413333
language                  0.000000
city                      0.000000
bd                        0.000000
gender                   38.833333
registered_via            0.000000
registration_init_time    0.000000
expiration_date           0.000000
dtype: float64
```

[6]:
```
# Replace NA
for i in df.select_dtypes(include=['object']).columns:
    df[i][df[i].isnull()] = 'unknown'
df = df.fillna(value=0)
```

[7]:
```
# Create Dates
```

```
# registration_init_time
df.registration_init_time = pd.to_datetime(df.registration_init_time,␣
 ↪format='%Y%m%d', errors='ignore')
df['registration_init_time_year'] = df['registration_init_time'].dt.year
df['registration_init_time_month'] = df['registration_init_time'].dt.month
df['registration_init_time_day'] = df['registration_init_time'].dt.day

# expiration_date
df.expiration_date = pd.to_datetime(df.expiration_date,  format='%Y%m%d',␣
 ↪errors='ignore')
df['expiration_date_year'] = df['expiration_date'].dt.year
df['expiration_date_month'] = df['expiration_date'].dt.month
df['expiration_date_day'] = df['expiration_date'].dt.day
```

[8]:
```
df.head()
```

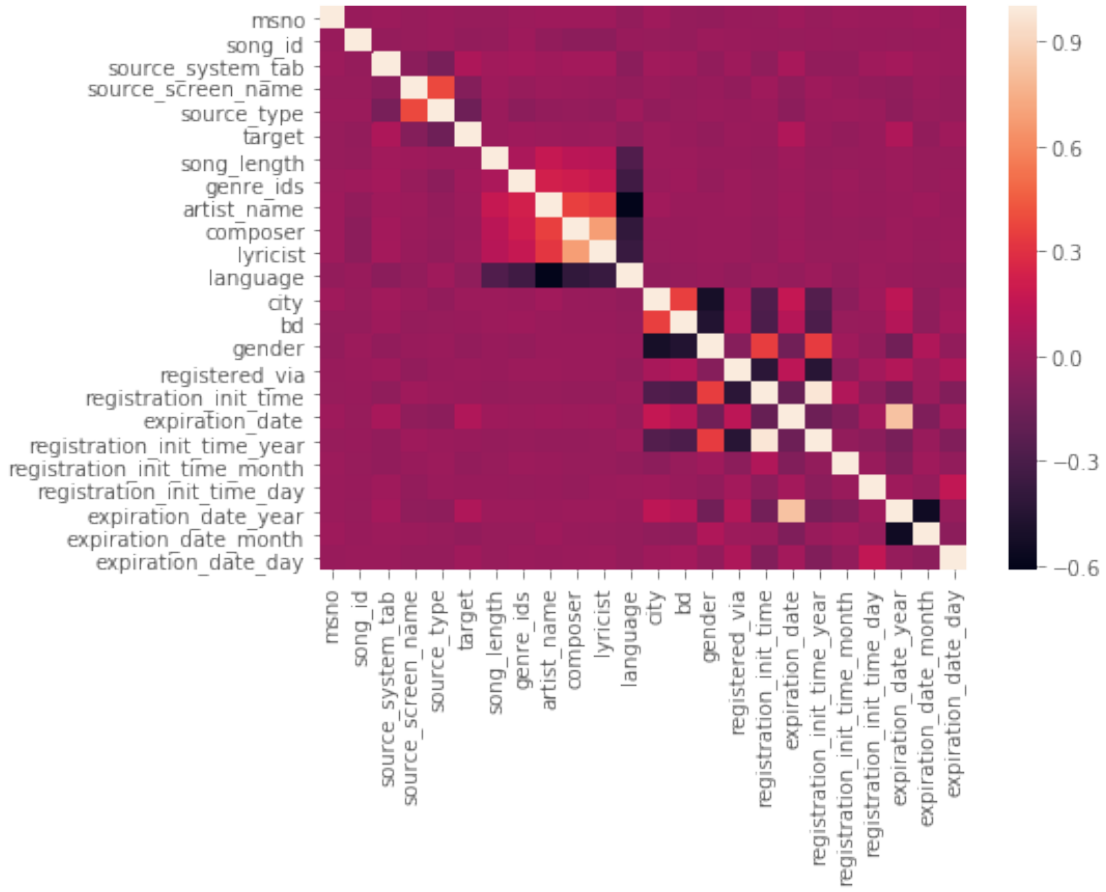
[8]:
```
                                           msno  \
0  5PbBykvNqwYVVepugrfvkMFjAJjciS8TAuv4qX9/r2o=
1  lnoxvmKGSqEhA/FDN9JxNUoz6sUlyMCu7AAJNMUE5ac=
2  K7obY5lUlZTd6a/byE9NG/e7Q/dlgHfppLbYk8OL7os=
3  a7CcAGHxrSitv6Sxs+R2x2MtlKDn69x7zZesc+uGrcc=
4  OfqZlbit7E0SHwkHA3nb9WbFYM3eFHtJiWqY+lgW7UQ=

                                        song_id source_system_tab  \
0  aRZlTjtdmMG2jifvMN/mBcl+SWyXB+zxbrZjoO5LdFE=        my library
1  Jw0CAzRAZCaiRzBJAjoGGqY+cVxBX4z+V/oeJ7muYfU=        my library
2  IdOjsvQSPcRRnjLTHjog6bPk2tD0t2mbIrRvgiIZE0A=        my library
3  oap6kpthib/IaDsMi1BBWWaTBJv4iyC8kIwLq5kZRks=        my library
4  DvHKv+E/ddqTfv7qcaWi9a9pQ1V/iViKK48l8y9+sjo=          discover

     source_screen_name      source_type  target  song_length genre_ids  \
0   Local playlist more    local-library       1       229172       465
1   Local playlist more    local-library       1       315373       465
2   Local playlist more    local-library       1       294164       465
3   Local playlist more            album       0       241449       465
4  Online playlist more  online-playlist       1       261590       465

        artist_name composer  ...  gender  registered_via  \
0      (R-chord)  R-chord  ...  female               3
1   (Shadya Lan)        ...  female               3
2       (JJ Lin)   JJ Lin  ...    male               3
3        Ed Sheeran  unknown  ...  female               9
4      (F.I.R.)   F.I.R.  ...    male               7

   registration_init_time  expiration_date registration_init_time_year  \
0              2014-12-12       2017-09-12                       2014
1              2013-09-12       2017-10-01                       2013
2              2014-03-17       2018-01-13                       2014
```

```
3              2012-12-25       2018-01-03                         2012
4              2010-10-30       2017-09-16                         2010

   registration_init_time_month registration_init_time_day  \
0                            12                         12
1                             9                         12
2                             3                         17
3                            12                         25
4                            10                         30

  expiration_date_year  expiration_date_month  expiration_date_day
0                 2017                     9                   12
1                 2017                    10                    1
2                 2018                     1                   13
3                 2018                     1                    3
4                 2017                     9                   16

[5 rows x 24 columns]
```

[9]:
```
# Dates to category
df['registration_init_time'] = df['registration_init_time'].astype('category')
df['expiration_date'] = df['expiration_date'].astype('category')
```

[10]:
```
# Object data to category
for col in df.select_dtypes(include=['object']).columns:
    df[col] = df[col].astype('category')

# Encoding categorical features
for col in df.select_dtypes(include=['category']).columns:
    df[col] = df[col].cat.codes
```

[11]:
```
# orrelation matrix
plt.figure(figsize=[7,5])
fig1 = sns.heatmap(df.corr())
plt.show()
#fig1 = plt.gcf()
#fig1.savefig('CoRelationMatrix.png')
fig = fig1.get_figure()
fig.savefig('XGBoostPlots/CoRelationMatrix.png', bbox_inches='tight')
```



[12]:
```
# Drop columns
df = df.drop(['expiration_date', 'lyricist'], 1)
```

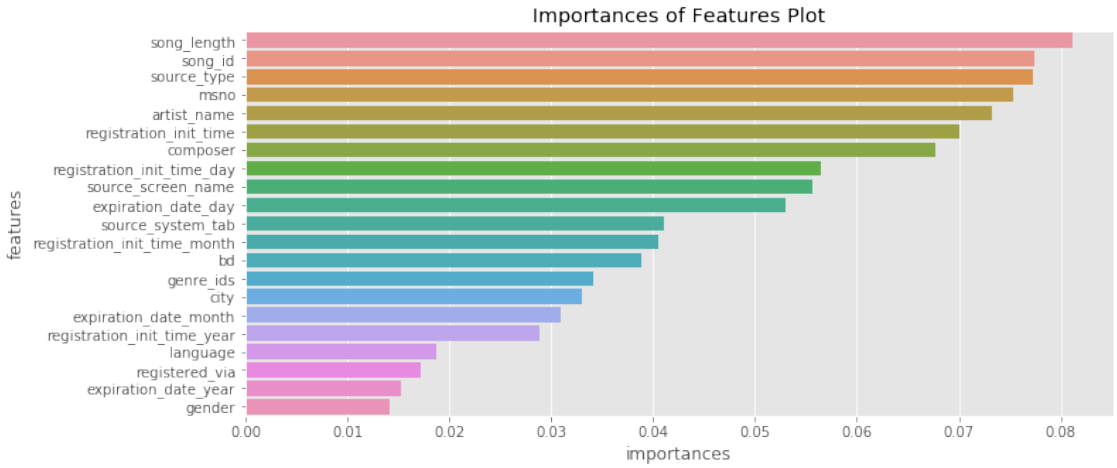
[13]:
```
# Model with the best estimator
model = ensemble.RandomForestClassifier(n_estimators=250, max_depth=25)
model.fit(df[df.columns[df.columns != 'target']], df.target)
```

[13]:
```
RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
                       max_depth=25, max_features='auto', max_leaf_nodes=None,
                       min_impurity_decrease=0.0, min_impurity_split=None,
                       min_samples_leaf=1, min_samples_split=2,
                       min_weight_fraction_leaf=0.0, n_estimators=250,
                       n_jobs=None, oob_score=False, random_state=None,
                       verbose=0, warm_start=False)
```

[14]:
```
df_plot = pd.DataFrame({'features': df.columns[df.columns != 'target'],
                        'importances': model.feature_importances_})
df_plot = df_plot.sort_values('importances', ascending=False)
```

[15]:
```
plt.figure(figsize=[11,5])
fig1 = sns.barplot(x = df_plot.importances, y = df_plot.features)
```

```
plt.title('Importances of Features Plot')
plt.show()
#fig1 = plt.gcf()
#fig1.savefig('FeatureImportance.png', dpi=100)
fig = fig1.get_figure()
fig.savefig('XGBoostPlots/FeatureImportance.png', bbox_inches='tight')
```



[16]:
```
# Drop columns with importances < 0.04
df = df.drop(df_plot.features[df_plot.importances < 0.04].tolist(), 1)
```

[17]:
```
# Selected columns
df.columns
```

[17]:
```
Index(['msno', 'song_id', 'source_system_tab', 'source_screen_name',
       'source_type', 'target', 'song_length', 'artist_name', 'composer',
       'registration_init_time', 'registration_init_time_month',
       'registration_init_time_day', 'expiration_date_day'],
      dtype='object')
```

2 XGBOOST

[18]:
```
target = df.pop('target')
target
```

[18]:
```
0        1
1        1
2        1
3        0
4        1
5        0
6        1
7        1
```

```
8       1
9       1
10      1
11      1
12      1
13      1
14      1
15      1
16      1
17      0
18      1
19      1
20      1
21      1
22      0
23      1
24      1
25      1
26      1
27      0
28      1
29      0
       ..
14970   1
14971   0
14972   1
14973   0
14974   0
14975   1
14976   1
14977   0
14978   1
14979   1
14980   1
14981   1
14982   1
14983   1
14984   1
14985   1
14986   1
14987   0
14988   1
14989   1
14990   1
14991   0
14992   0
14993   0
```

```
14994    0
14995    1
14996    1
14997    0
14998    1
14999    1
Name: target, Length: 15000, dtype: int64
```

[19]:
```
# Train & Test split
train_data, test_data, train_labels, test_labels = train_test_split(df, target,␣
 ↪test_size = 0.3)

# Delete df
del df
```

[23]:
```
# Create model
model = xgb.XGBClassifier(learning_rate=0.1, max_depth=15, min_child_weight=5,␣
 ↪n_estimators=300)
model.fit(train_data, train_labels)
```

[23]:
```
XGBClassifier(base_score=0.5, booster='gbtree', colsample_bylevel=1,
              colsample_bynode=1, colsample_bytree=1, gamma=0,
              learning_rate=0.1, max_delta_step=0, max_depth=15,
              min_child_weight=5, missing=None, n_estimators=300, n_jobs=1,
              nthread=None, objective='binary:logistic', random_state=0,
              reg_alpha=0, reg_lambda=1, scale_pos_weight=1, seed=None,
              silent=None, subsample=1, verbosity=1)
```

[24]:
```
# Predicting
predict_labels = model.predict(test_data)
```

[25]:
```
print(metrics.classification_report(test_labels, predict_labels))
```

```
              precision    recall  f1-score   support

           0       0.61      0.40      0.48      1529
           1       0.74      0.87      0.80      2971

    accuracy                           0.71      4500
   macro avg       0.67      0.63      0.64      4500
weighted avg       0.69      0.71      0.69      4500
```

[ ]: