CapstoneProject

September 26, 2019

[3]:
```
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')
```

[4]:
```
train = pd.read_csv('input/train.csv')
train = train.sample(frac=0.5)
```

[5]:
```
songs = pd.read_csv('input/songs.csv')
train = pd.merge(train, songs, on='song_id', how='left')
del songs

members = pd.read_csv('input/members.csv')
train = pd.merge(train, members, on='msno', how='left')
del members

song_extra_info = pd.read_csv('input/song_extra_info.csv')
train = pd.merge(train, song_extra_info, on='song_id', how='left')
del song_extra_info
```

[6]:
```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 750000 entries, 0 to 749999
Data columns (total 20 columns):
msno                    750000 non-null object
song_id                 750000 non-null object
source_system_tab       747638 non-null object
source_screen_name      715503 non-null object
source_type             747944 non-null object
target                  750000 non-null int64
```

```
song_length               749988 non-null float64
genre_ids                 738949 non-null object
artist_name               749988 non-null object
composer                  587570 non-null object
lyricist                  437793 non-null object
language                  749984 non-null float64
city                      750000 non-null int64
bd                        750000 non-null int64
gender                    452950 non-null object
registered_via            750000 non-null int64
registration_init_time    750000 non-null int64
expiration_date           750000 non-null int64
name                      749934 non-null object
isrc                      691080 non-null object
dtypes: float64(2), int64(6), object(12)
memory usage: 120.2+ MB
```

[7]:
```
train.describe()
```

[7]:

	target	song_length	language	city	bd	registered_via	registration_init_time	expiration_date
count	750000.000000	7.499880e+05	749984.000000	750000.000000	750000.000000	750000.000000	7.500000e+05	7.500000e+05
mean	0.665844	2.454337e+05	18.477625	7.567128	17.460075	6.775365	2.012778e+07	2.017149e+07
std	0.471695	5.928003e+04	21.163488	6.585206	21.108548	2.296369	2.978766e+04	3.869867e+03
min	0.000000	2.716000e+03	-1.000000	1.000000	-43.000000	3.000000	2.004033e+07	2.004102e+07
25%	0.000000	2.152020e+05	3.000000	1.000000	0.000000	4.000000	2.011071e+07	2.017091e+07
50%	1.000000	2.423110e+05	3.000000	5.000000	21.000000	7.000000	2.013102e+07	2.017093e+07
75%	1.000000	2.727180e+05	52.000000	13.000000	28.000000	9.000000	2.015101e+07	2.017101e+07
max	1.000000	7.371499e+06	59.000000	22.000000	1030.000000	13.000000	2.016121e+07	2.020102e+07

[8]:
```
train.head(10)
```

[8]:

	msno
0	ZlTSQ1AkVZHsqjmxT9LY720XxNAqkDyHspt2lpjZMm0=
1	BAN2f6KT+KXSbD3Tnau6aKDDAIF/tiBo4kMRFdArFXc=
2	UjuPJCQo/YoGVR/yJ+CocmWUk2czJE0BBKqaPpVYV64=
3	qv24DyXUmZVHzxwcgPJRy7qFeni3fdd2q47kxiCekjs=
4	lGDHl8s6FJTqb5a957xraHq7Z6tO00sDVMidb584ZjM=
5	lR7ML18COc/LyqGfeQiCojiuTgQ4a11/XIznJ58e9kQ=
6	6ZfzjO7RYXWvEQEQmXrC+Tqpy1QqgErMbbK6S5gN86M=

```
7  KP9C2DhtapjZuDpH3VNvtKQlI3LraMhMnkHw470H7XE=
8  SyjAwOJwRtBznliPX/ujk5jXIzMkiNxZ3taAHDWa3pY=
9  bIAx0XsFcmkAEFtfvVu1lxywiAigZEsmjhFPmzWZ78U=

                                      song_id source_system_tab  \
0  fWtBf0GSJnwaWiNisVGnnZjFAT8vmZ8n1SB7FAIlmOQ=        my library
1  fEAIgFRWmhXmo6m3ukQeqRksZCcO/7CjkqNckRHiVQo=          discover
2  WDhQhhbq+bwhBY642Fx3e5eGBdvqzzXmwiouCaVI0R0=        my library
3  4m+cvkd9Y5L16enjf9nRufbfV+HxYguQ7FgvazLQ3I8=        my library
4  +W5WCJFc7k7UJLArWZKMYmkrO3RoOm6VrmD7yJfVKRI=        my library
5  o+fLXtu2auUsQNTfB141c7dPE5HnkvVF9wjBK5dHSjk=        my library
6  5nsq4I7YcXGj0DKwMsuanz70I09xrCn8OmIJ6127pqg=        my library
7  FzqO7OTM1QVVssM6J7PHtA2l8MFKD7qejKSPcdqw03o=        my library
8  kgOSHwInwdvDK0rUu8OXvPDITvzPKfeNl2pA96PJBfs=             radio
9  Of6g3RC1YKF1eqWmOoAP81ao6HmB2zWvXzCUzwUdG1o=        my library

    source_screen_name      source_type  target  song_length genre_ids  \
0  Local playlist more   local-playlist       1     225280.0       465
1              Unknown  online-playlist       1     179258.0       458
2  Local playlist more    local-library       0     252000.0       458
3  Local playlist more    local-library       0     206576.0       465
4  Local playlist more    local-library       0     162168.0       465
5  Local playlist more   local-playlist       1     239258.0      1259
6  Local playlist more    local-library       1     195999.0       458
7                  NaN    local-library       1     218801.0       465
8               Radio             radio       0     292989.0       465
9  Local playlist more   local-playlist       1     260969.0       458

                        artist_name  \
0                     (Claire Kuo)
1                       (MISS KO)
2                    (Stanly Hsu)
3                       (Show Lo)
4                            Fergie
5  Machine Gun Kelly| Camila Cabello
6                    (Joanna Wang)
7                      (Aaron Yan)
8                    (Leehom Wang)
9                    (Rainie Yang)

                                          composer  \
0                                  Victor/
1                        Miss Ko| Razor 'n Guido
2                                          /
3                                              NaN
4  J. Donald| Jamal Jones| Stacy Ferguson| J. Sol...
5  Camila Cabello| Colson Baker pka "MGK" for EST...
```

```
6           Peter Sven Kvint| Vincent Paul Degiorgio
7                                             JerryC
8
9                                       Ying-Jian Chen

                                    lyricist  language  city  bd  gender  \
0                                      /       3.0     1   0     NaN
1                                         NaN       3.0    15  20    male
2                                               3.0    13  23  female
3                                         NaN       3.0     1   0     NaN
4                                         NaN      52.0     4  22  female
5                                         NaN      52.0     1   0     NaN
6  Peter Sven Kvint| Vincent Paul Degiorgio       3.0     1   0     NaN
7                                            3.0    13  43  female
8                           ///       3.0     1   0     NaN
9                            Zhuo-Xiong Li       3.0     4  28  female

   registered_via  registration_init_time  expiration_date  \
0               7                20131011         20170911
1               9                20100208         20170906
2               9                20130518         20171202
3               9                20151125         20170914
4               7                20110624         20171005
5               4                20151024         20171004
6               7                20150714         20170930
7               9                20151001         20170911
8               4                20161130         20161207
9               4                20151031         20180127

                        name          isrc
0    (Sorry to Say Goodbye)  TWA211551801
1                      TWUM71600104
2                        TWCG31600001
3                         TWEM31211002
4                M.I.L.F. $  USUM71604730
5                Bad Things  USUM71609854
6    (You Ni De Quai Le)  TWA470722014
7                         TWD951446201
8               Forever Love  TWA470473005
9   (Ni Ming De Hao You)  TWA470915006
```

[9]:
```
train.isnull().sum()
```

[9]:
```
msno                       0
song_id                    0
source_system_tab       2362
source_screen_name      34497
source_type              2056
```

```
target                          0
song_length                    12
genre_ids                   11051
artist_name                    12
composer                   162430
lyricist                   312207
language                       16
city                            0
bd                              0
gender                     297050
registered_via                  0
registration_init_time          0
expiration_date                 0
name                           66
isrc                        58920
dtype: int64
```

[10]:
```
for i in train.select_dtypes(include=['object']).columns:
    train[i][train[i].isnull()] = 'unknown'
train = train.fillna(value=0)
```

[11]:
```
train.registration_init_time = pd.to_datetime(train.registration_init_time,␣
 ↪format='%Y%m%d', errors='ignore')
train['registration_init_time_year'] = train['registration_init_time'].dt.year
train['registration_init_time_month'] = train['registration_init_time'].dt.month
train['registration_init_time_day'] = train['registration_init_time'].dt.day

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

del train['registration_init_time']
del train['expiration_date']
train.head(10)
```

[11]:

	msno
0	ZlTSQ1AkVZHsqjmxT9LY720XxNAqkDyHspt2lpjZMm0=
1	BAN2f6KT+KXSbD3Tnau6aKDDAIF/tiBo4kMRFdArFXc=
2	UjuPJCQo/YoGVR/yJ+CocmWUk2czJE0BBKqaPpVYV64=
3	qv24DyXUmZVHzxwcgPJRy7qFeni3fdd2q47kxiCekjs=
4	lGDHl8s6FJTqb5a957xraHq7Z6tO00sDVMidb584ZjM=
5	lR7ML18COc/LyqGfeQiCojiuTgQ4a11/XIznJ58e9kQ=
6	6ZfzjO7RYXWvEQEQmXrC+Tqpy1QqgErMbbK6S5gN86M=
7	KP9C2DhtapjZuDpH3VNvtKQlI3LraMhMnkHw470H7XE=
8	SyjAwOJwRtBznliPX/ujk5jXIzMkiNxZ3taAHDWa3pY=
9	bIAx0XsFcmkAEFtfvVu1lxywiAigZEsmjhFPmzWZ78U=

```
                                      song_id source_system_tab  \
0  fWtBf0GSJnwaWiNisVGnnZjFAT8vmZ8n1SB7FAIlmOQ=        my library
1  fEAIgFRWmhXmo6m3ukQeqRksZCcO/7CjkqNckRHiVQo=          discover
2  WDhQhhbq+bwhBY642Fx3e5eGBdvqzzXmwiouCaVI0RO=        my library
3  4m+cvkd9Y5L16enjf9nRufbfV+HxYguQ7FgvazLQ3I8=        my library
4  +W5WCJFc7k7UJLArWZKMYmkrO3RoOm6VrmD7yJfVKRI=        my library
5  o+fLXtu2auUsQNTfB141c7dPE5HnkvVF9wjBK5dHSjk=        my library
6  5nsq4I7YcXGj0DKwMsuanz70I09xrCn8OmIJ6127pqg=        my library
7  FzqO7OTM1QVVssM6J7PHtA2l8MFKD7qejKSPcdqw03o=        my library
8  kgOSHwInwdvDK0rUu8OXvPDITvzPKfeNl2pA96PJBfs=             radio
9  Of6g3RC1YKF1eqWmOoAP81ao6HmB2zWvXzCUzwUdG1o=        my library

    source_screen_name      source_type  target  song_length genre_ids  \
0  Local playlist more   local-playlist       1     225280.0       465
1              Unknown  online-playlist       1     179258.0       458
2  Local playlist more    local-library       0     252000.0       458
3  Local playlist more    local-library       0     206576.0       465
4  Local playlist more    local-library       0     162168.0       465
5  Local playlist more   local-playlist       1     239258.0      1259
6  Local playlist more    local-library       1     195999.0       458
7              unknown    local-library       1     218801.0       465
8                Radio            radio       0     292989.0       465
9  Local playlist more   local-playlist       1     260969.0       458

                        artist_name  \
0                     (Claire Kuo)
1                       (MISS KO)
2                    (Stanly Hsu)
3                       (Show Lo)
4                            Fergie
5  Machine Gun Kelly| Camila Cabello
6                    (Joanna Wang)
7                      (Aaron Yan)
8                    (Leehom Wang)
9                    (Rainie Yang)

                                          composer  ...   gender  \
0                                  Victor/  ...  unknown
1                        Miss Ko| Razor 'n Guido  ...     male
2                                        /  ...   female
3                                         unknown  ...  unknown
4  J. Donald| Jamal Jones| Stacy Ferguson| J. Sol...  ...   female
5  Camila Cabello| Colson Baker pka "MGK" for EST...  ...  unknown
6           Peter Sven Kvint| Vincent Paul Degiorgio  ...  unknown
7                                           JerryC  ...   female
8                                               ...  unknown
```

```
9                                  Ying-Jian Chen  ...   female

   registered_via                         name          isrc  \
0               7    (Sorry to Say Goodbye)  TWA211551801
1               9                           TWUM71600104
2               9                             TWCG31600001
3               9                              TWEM31211002
4               7                  M.I.L.F. $  USUM71604730
5               4                  Bad Things  USUM71609854
6               7    (You Ni De Quai Le)  TWA470722014
7               9                              TWD951446201
8               4                Forever Love  TWA470473005
9               4   (Ni Ming De Hao You)  TWA470915006

  registration_init_time_year  registration_init_time_month  \
0                        2013                            10
1                        2010                             2
2                        2013                             5
3                        2015                            11
4                        2011                             6
5                        2015                            10
6                        2015                             7
7                        2015                            10
8                        2016                            11
9                        2015                            10

  registration_init_time_day expiration_date_year  expiration_date_month  \
0                         11                 2017                      9
1                          8                 2017                      9
2                         18                 2017                     12
3                         25                 2017                      9
4                         24                 2017                     10
5                         24                 2017                     10
6                         14                 2017                      9
7                          1                 2017                      9
8                         30                 2016                     12
9                         31                 2018                      1

   expiration_date_day
0                   11
1                    6
2                    2
3                   14
4                    5
5                    4
6                   30
7                   11
```

```
8                    7
9                   27

[10 rows x 24 columns]
```

[12]:
```
categorical_feature = train.dtypes==object
categorical_cols = train.columns[categorical_feature].tolist()
categorical_cols
```

[12]:
```
['msno',
 'song_id',
 'source_system_tab',
 'source_screen_name',
 'source_type',
 'genre_ids',
 'artist_name',
 'composer',
 'lyricist',
 'gender',
 'name',
 'isrc']
```

[13]:
```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()

train[categorical_cols] = train[categorical_cols].apply(lambda col: le.
 ↪fit_transform(col))
train[categorical_cols].head(10)
```

[13]:
```
    msno  song_id  source_system_tab  source_screen_name  source_type  \
0  10936    68005                  3                   7            4
1   3719    67546                  0                  18            5
2   9380    53392                  3                   7            3
3  15924    10620                  3                   7            3
4  14257      849                  3                   7            3
5  14293    81085                  3                   7            4
6   2409    12182                  3                   7            3
7   6371    28068                  3                  19            3
8   8816    75977                  5                  13            6
9  11402    41703                  3                   7            4

   genre_ids  artist_name  composer  lyricist  gender   name   isrc
0        210        14186     20985     12416       2  49880  37792
1        206        13843     15145      8755       1  64765  56749
2        206        13977     26146     10446       0  50621  49012
3        210        13664     22429      8755       2  71965  51044
4        210         3451      8979      8755       0  22776  74163
5         53         6322      3318      8755       2   3721  74347
6        206        13434     16599      6394       2  60923  41091
```

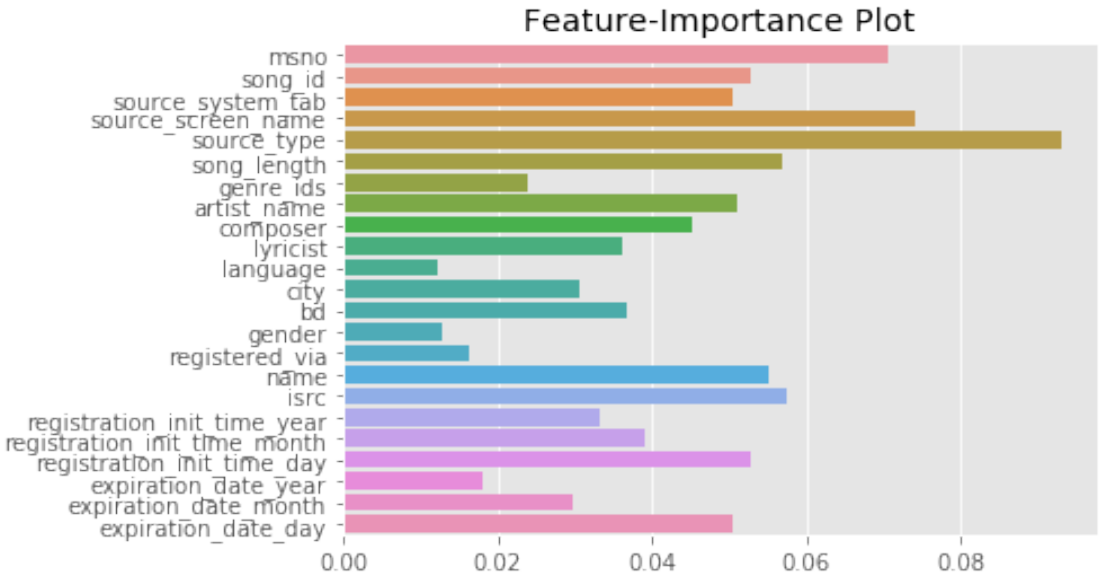
```
7        210        13334       9999       9689        0  44809  49990
8        210        13384      25339      11928        2  12372  40825
9        206        13094      21808       8621        0  49193  41253
```

[14]:
```
#train.to_csv('train_data.csv')
train.head(10)
```

[14]:
```
    msno  song_id  source_system_tab  source_screen_name  source_type  target  \
0  10936    68005                  3                   7            4       1
1   3719    67546                  0                  18            5       1
2   9380    53392                  3                   7            3       0
3  15924    10620                  3                   7            3       0
4  14257      849                  3                   7            3       0
5  14293    81085                  3                   7            4       1
6   2409    12182                  3                   7            3       1
7   6371    28068                  3                  19            3       1
8   8816    75977                  5                  13            6       0
9  11402    41703                  3                   7            4       1

   song_length  genre_ids  artist_name  composer  ...  gender  registered_via  \
0     225280.0        210        14186     20985  ...       2               7
1     179258.0        206        13843     15145  ...       1               9
2     252000.0        206        13977     26146  ...       0               9
3     206576.0        210        13664     22429  ...       2               9
4     162168.0        210         3451      8979  ...       0               7
5     239258.0         53         6322      3318  ...       2               4
6     195999.0        206        13434     16599  ...       2               7
7     218801.0        210        13334      9999  ...       0               9
8     292989.0        210        13384     25339  ...       2               4
9     260969.0        206        13094     21808  ...       0               4

    name   isrc  registration_init_time_year  registration_init_time_month  \
0  49880  37792                         2013                            10
1  64765  56749                         2010                             2
2  50621  49012                         2013                             5
3  71965  51044                         2015                            11
4  22776  74163                         2011                             6
5   3721  74347                         2015                            10
6  60923  41091                         2015                             7
7  44809  49990                         2015                            10
8  12372  40825                         2016                            11
9  49193  41253                         2015                            10

   registration_init_time_day  expiration_date_year  expiration_date_month  \
0                          11                  2017                      9
1                           8                  2017                      9
2                          18                  2017                     12
3                          25                  2017                      9
```

```
4                          24                2017                10
5                          24                2017                10
6                          14                2017                 9
7                           1                2017                 9
8                          30                2016                12
9                          31                2018                 1

   expiration_date_day
0                   11
1                    6
2                    2
3                   14
4                    5
5                    4
6                   30
7                   11
8                    7
9                   27

[10 rows x 24 columns]
```

[15]:
```
X = train[train.columns[train.columns != 'target']]
y = train.target

model = ensemble.RandomForestClassifier(n_estimators=100, max_depth=25)
model.fit(X, y)

features = train.columns[train.columns != 'target']
importance_values = model.feature_importances_

sns.barplot(x = importance_values, y =features )
plt.title('Feature-Importance Plot')
plt.show()
```



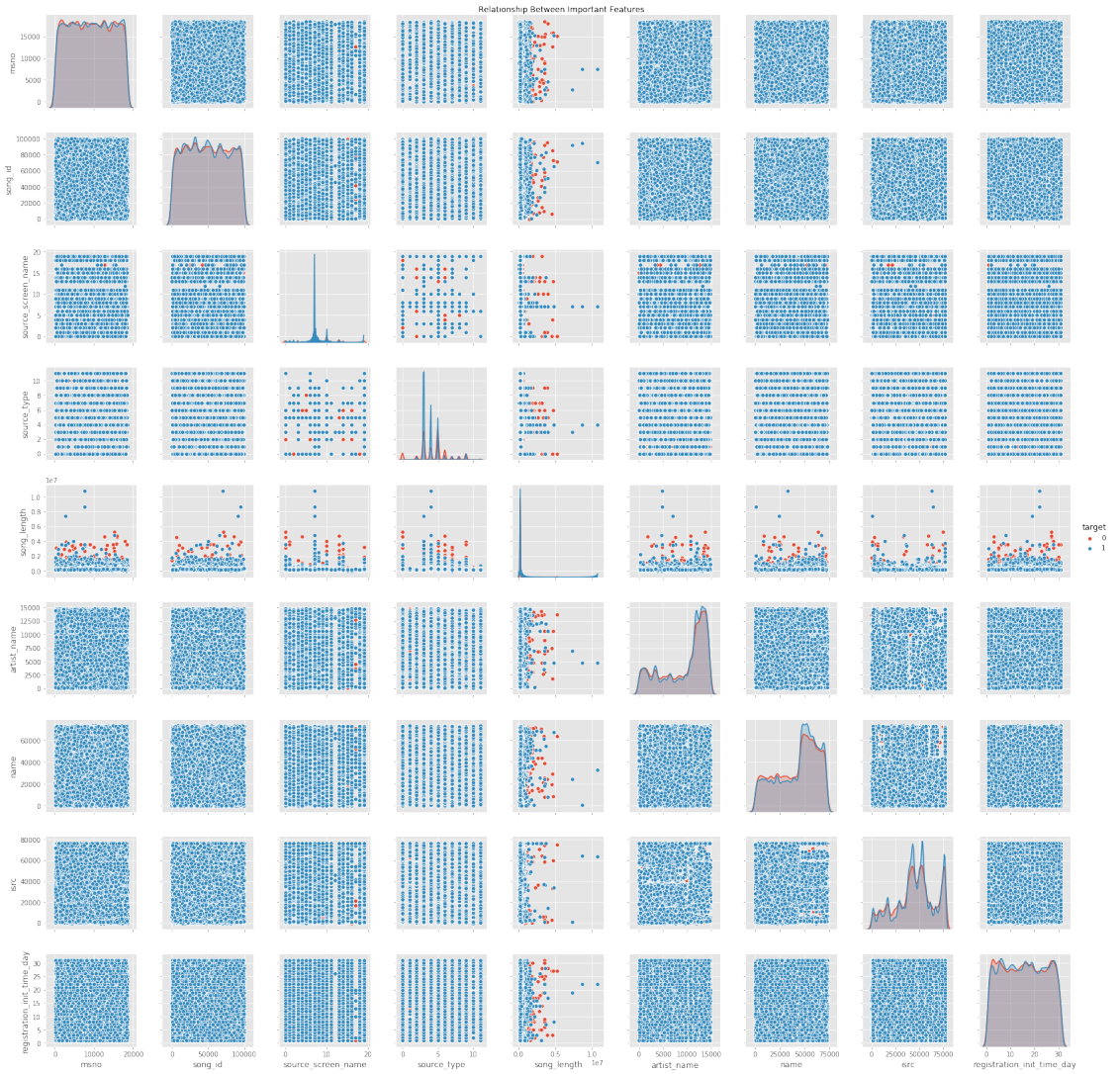
[16]:
```
imporant_feat = pd.concat([(features.to_series().reset_index(drop=True)), pd.
↪DataFrame(importance_values)], axis=1)
imporant_feat.columns = ['features', 'importance_values']
imporant_feat[importance_values>0.05]
```

[16]:

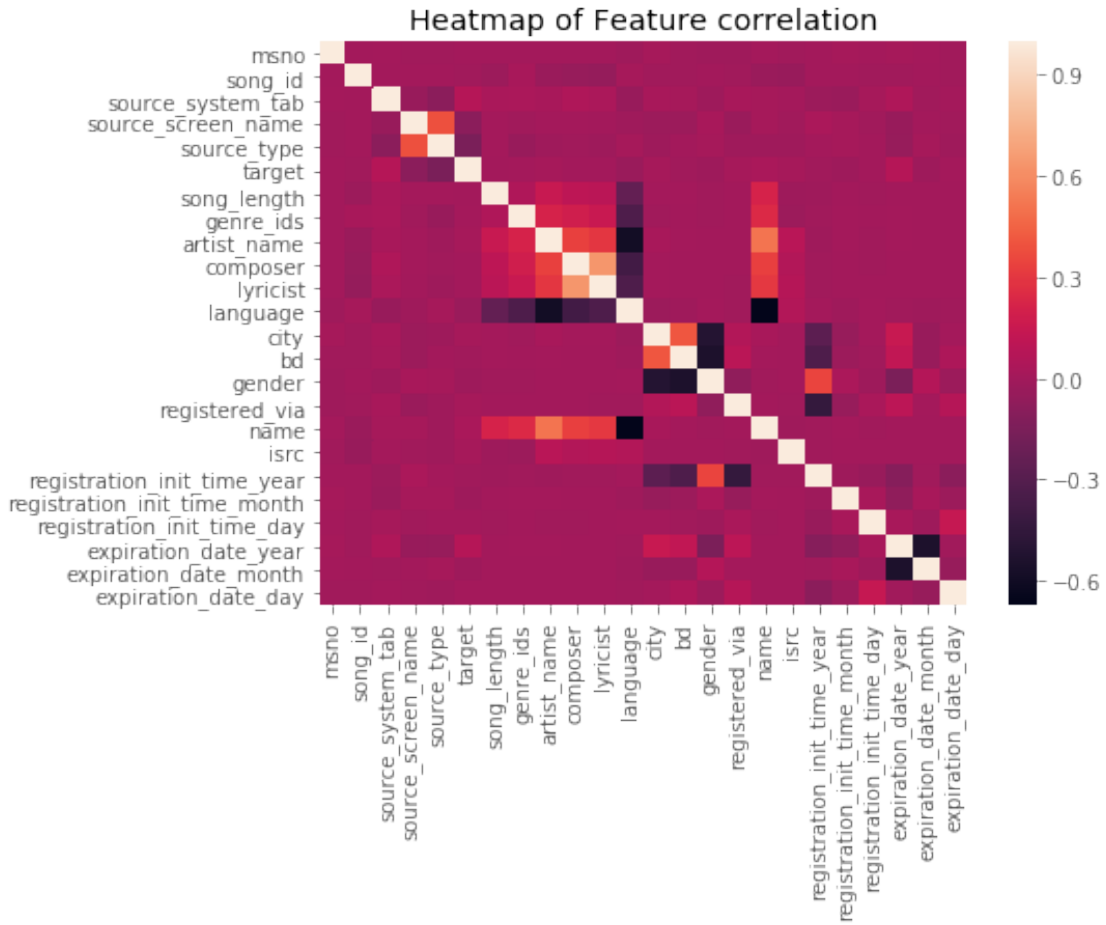
	features	importance_values
0	msno	0.070745
1	song_id	0.052876
2	source_system_tab	0.050610
3	source_screen_name	0.074082
4	source_type	0.093018
5	song_length	0.057001
7	artist_name	0.051044
15	name	0.055021
16	isrc	0.057585
19	registration_init_time_day	0.052867
22	expiration_date_day	0.050392

[18]:
```
# To have a look at relationship between the important Features >0.05
imporant_features = ['msno', 'song_id', 'source_screen_name','source_type',␣
↪'song_length','artist_name','name', 'isrc', 'registration_init_time_day']
pair_plot_imp = sns.pairplot(train, vars=imporant_features, hue='target')
pair_plot_imp.fig.suptitle("Relationship Between Important Features", y=1)
```

[18]:
```
Text(0.5, 1, 'Relationship Between Important Features')
```



[17]:
```
# Heatmap of the Feature correlation
plt.figure(figsize=[7,5])
sns.heatmap(train.corr())
plt.title('Heatmap of Feature correlation')
plt.show()
```



[18]:
```
train.columns
#train.count(axis='columns')
```

[18]:
```
Index(['msno', 'song_id', 'source_system_tab', 'source_screen_name',
       'source_type', 'target', 'song_length', 'genre_ids', 'artist_name',
       'composer', 'lyricist', 'language', 'city', 'bd', 'gender',
       'registered_via', 'name', 'isrc', 'registration_init_time_year',
       'registration_init_time_month', 'registration_init_time_day',
       'expiration_date_year', 'expiration_date_month', 'expiration_date_day'],
      dtype='object')
```

[19]:
```
target = train.pop('target')
```

[20]:
```
train_data, test_data, train_labels, test_labels = train_test_split(train,␣
↪target, test_size = 0.3)
```

[21]:
```
import lightgbm as lgb
d_train = lgb.Dataset(train_data, label= train_labels)
params = {}
params['learning_rate']= 0.003
```

```
params['boosting_type']='gbdt'
params['objective']='binary'
params['metric']='binary_logloss'
params['sub_feature']=0.5
params['num_leaves']= 10
params['min_data']=50
params['max_depth']=10
clf= lgb.train(params, d_train, 100)
y_pred = clf.predict(test_data)
y_pred = np.where(y_pred > 0.49, 1, 0)

len(y_pred)


from sklearn.metrics import accuracy_score
accuracy = accuracy_score(y_pred, test_labels)
accuracy

#from sklearn import metrics
#fpr, tpr, thresholds = metrics.roc_curve(test_labels, y_pred)
#metrics.auc(fpr, tpr)
```

[21]: 0.66304

[22]:
```
from sklearn import model_selection
from sklearn.linear_model import LogisticRegression

from sklearn.ensemble import RandomForestClassifier, GradientBoostingClassifier
from mlxtend.classifier import StackingCVClassifier
import numpy as np
import warnings

warnings.simplefilter('ignore')

RANDOM_SEED = 42

clf1 = GradientBoostingClassifier()
clf2 = RandomForestClassifier(random_state=RANDOM_SEED)

lr = LogisticRegression()

sclf = StackingCVClassifier(classifiers=[clf1, clf2],
                            meta_classifier=lr,
                            random_state=RANDOM_SEED)

print('3-fold cross validation:\n')

for clf, label in zip([clf1, clf2, sclf],
```

```
                      ['GradientBoostingClassifier',
                       'RandomForestClassifier',
                       'StackingClassifier']):

    scores = model_selection.cross_val_score(clf, train_data,␣
 ↪train_labels,cv=3, scoring='accuracy')
    print("Accuracy: %0.2f (+/- %0.2f) [%s]"
          % (scores.mean(), scores.std(), label))
```

```
3-fold cross validation:

Accuracy: 0.72 (+/- 0.00) [GradientBoostingClassifier]
Accuracy: 0.74 (+/- 0.00) [RandomForestClassifier]
Accuracy: 0.73 (+/- 0.00) [StackingClassifier]
```

[ ]:
```
from sklearn.metrics import accuracy_score, log_loss
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC, LinearSVC, NuSVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier, AdaBoostClassifier,␣
 ↪GradientBoostingClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
from sklearn.discriminant_analysis import QuadraticDiscriminantAnalysis
from sklearn import metrics

classifiers = [
    KNeighborsClassifier(3),
    #SVC(kernel="rbf", C=0.025, probability=True),
    NuSVC(probability=True),
    DecisionTreeClassifier(),
    RandomForestClassifier(),
    AdaBoostClassifier(),
    GradientBoostingClassifier(),
    GaussianNB(),
    LinearDiscriminantAnalysis(),
    QuadraticDiscriminantAnalysis()]

# Logging for Visual Comparison
log_cols=["Classifier", "Accuracy", "Log Loss"]
log = pd.DataFrame(columns=log_cols)

for clf in classifiers:
    print("="*30)
    name = clf.__class__.__name__
    print(name)
    print('****Results****')
```

```
    clf.fit(train_data, train_labels)

    train_predictions = clf.predict(test_data)
    acc = accuracy_score(test_labels, train_predictions)
    print("Accuracy: {:.4%}".format(acc))

    fpr, tpr, thresholds = metrics.roc_curve(test_labels, train_predictions)
    print(metrics.auc(fpr, tpr))

    train_predictions = clf.predict_proba(test_data)
    ll = log_loss(test_labels, train_predictions)
    print("Log Loss: {}".format(ll))


    #log_entry = pd.DataFrame([[name, acc*100, ll]], columns=log_cols)
    #log = log.append(log_entry)

print("="*30)
```

[ ]:
```
model = xgb.XGBClassifier(max_depth=20,
                          learning_rate=0.1,
                          min_child_weight=3,
                          n_estimators=300,
                         scale_pos_weight=1,
                         seed=1)
model.fit(train_data, train_labels, eval_metric='auc', #verbose=True,
         eval_set=[(test_data, test_labels)], early_stopping_rounds=100)
```

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

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

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

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

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

[ ]:
```
from keras.models import Sequential
from keras.layers import Dense, Dropout, MaxPooling1D
from keras.utils.vis_utils import model_to_dot
from IPython.display import SVG
model = Sequential()
model.add(Dense(64, input_dim=23, activation='relu'))
model.add(Dropout(0.5))
model.add(Dense(128, activation='relu'))
model.add(Dropout(0.25))
```

```
model.add(Dense(256, activation='relu'))
model.add(Dropout(0.25))
model.add(Dense(128, activation='relu'))
model.add(Dropout(0.25))
model.add(Dense(64, activation='relu'))
model.add(Dense(1, activation='softmax'))

model.summary()
#SVG(model_to_dot(model).create(prog='dot', format='svg'))
```

[ ]:
```
#model.compile(loss='binary_crossentropy', optimizer='adam',␣
↪metrics=['accuracy'])
model.compile(loss='binary_crossentropy', optimizer='rmsprop',␣
↪metrics=['accuracy'])
```

[ ]:
```
from keras.callbacks import EarlyStopping
early_stopping_monitor = EarlyStopping(patience=3)
print(train_data.size)
train_data.shape
```

[ ]:
```
model.fit(train_data, train_labels, epochs=25, batch_size=1000,␣
↪callbacks=[early_stopping_monitor])
```

[ ]:
```
accuracy = model.evaluate(test_data, test_labels)
```

[ ]:
```
#print('Accuracy: %.2f' % (accuracy*100))
print(model.metrics_names)
accuracy
```