Non-Negative Matrix Factorization

In [22]:
```
from sklearn import datasets
from sklearn import preprocessing
from sklearn.model_selection import train_test_split

from sklearn.decomposition import NMF

from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix
from sklearn.metrics import recall_score
from sklearn.metrics import roc_auc_score
from sklearn.model_selection import GridSearchCV
from sklearn.metrics import make_scorer
from sklearn.metrics import accuracy_score

import pandas as pd
import numpy as np
import itertools
import matplotlib.pyplot as plt
import datetime

%matplotlib inline
```

In [23]:
```
train_split = 0.80
nrows = 250_000
path = 'c:/users/ugy1/abs/'
df=pd.read_csv(path+'datasets/processed_abs_loan_'+str(nrows)+'.csv',
               #usecols=use_list,
               #sep='\t',
               #compression=bz2,
               nrows=nrows,
               low_memory=False,
              index_col=0,
               parse_dates=True
              )
df.shape
```

Out[23]: (237024, 58)

In [24]:
```
column_list=df.columns.tolist()
```

In [25]:
```
df.head()
```

Out[25]:

	originalloanamount	originalloanterm	originalinterestratepercentage	graceperiodnumber	obligorcr
0	66711.84	60	3.29	1	
1	16258.45	60	0.90	0	
2	31930.41	72	2.90	1	
3	26065.02	65	0.90	0	
4	42091.00	72	3.90	0	

5 rows × 58 columns

In [26]:
```
for cols in df.columns.tolist()[1:]:
    df = df.loc[df[cols] >= 0]
```

In [27]:
```
df.shape
```

Out[27]: (234912, 58)

In [28]:
```
# prepare label for scikit-learn
Y=df.label.values
Y.shape
```

Out[28]: (234912,)

In [29]:
```
# prepare input data for scikit-learn
input=df.values
input.shape
```

Out[29]: (234912, 58)

In [30]:
```
# calculate train/test split

len_train = int(len(input)*train_split)
print(len_train)
```

```
187929
```

In [31]:
```
# apply train/test split to labels
y_train = Y[0:len_train]
y_test = Y[len_train:]
x_train = input[0:len_train]
x_test = input[len_train:]
x_train.shape
```

Out[31]: (187929, 58)

In [32]:
```
export_x_test = pd.DataFrame(data=x_test)
```

In [33]:
```
export_x_test.columns=column_list
export_x_test.rename(columns={'label':'True Label'}, inplace=True)
export_x_test.head()
```

Out[33]:

	originalloanamount	originalloanterm	originalinterestratepercentage	graceperiodnumber	obligorcr
0	32729.19	60.0	1.90	1.0	
1	54876.70	36.0	0.90	1.0	
2	42827.47	72.0	3.90	1.0	
3	30912.69	60.0	1.90	1.0	
4	58896.31	72.0	3.49	1.0	

5 rows × 58 columns

In [34]:
```
from sklearn.preprocessing import MinMaxScaler
#from sklearn.preprocessing import minmax_scale
# from sklearn.preprocessing import MaxAbsScaler
#from sklearn.preprocessing import StandardScaler
# from sklearn.preprocessing import RobustScaler
# from sklearn.preprocessing import Normalizer
# from sklearn.preprocessing import QuantileTransformer
# from sklearn.preprocessing import PowerTransformer
```

In [35]:
```
x_scaler=MinMaxScaler()
x_train = x_scaler.fit_transform(x_train)
x_test = x_scaler.fit_transform(x_test)
```

In [36]:
```
nmf = NMF(n_components=x_test.shape[1], random_state=1, alpha=0.1, l1_ratio = 0.5
```

In [37]:
```
x_pred = x_test
```

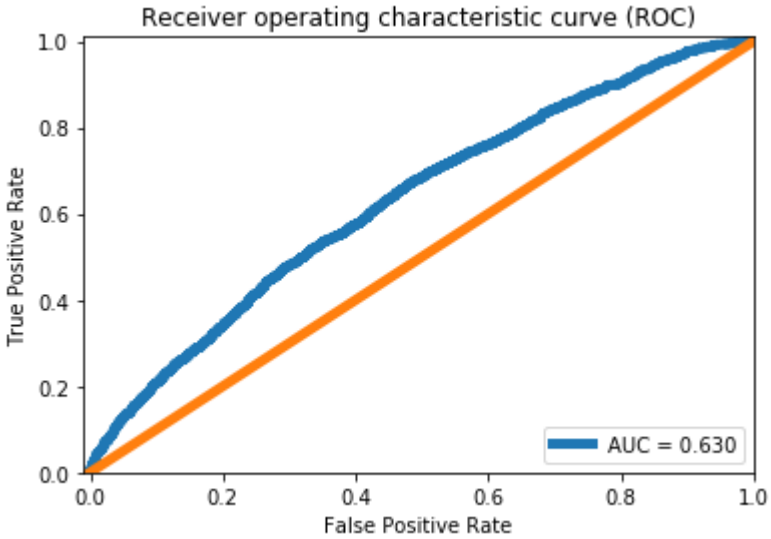
In [38]:
```
prediction_nmf = nmf.fit_transform(x_pred)
```

In [39]:
```
mse = np.mean(np.power(x_test - prediction_nmf, 2), axis=1)
error_df = pd.DataFrame({'Reconstruction_error': mse,
                         'True_class': y_test})
error_df.describe()
```

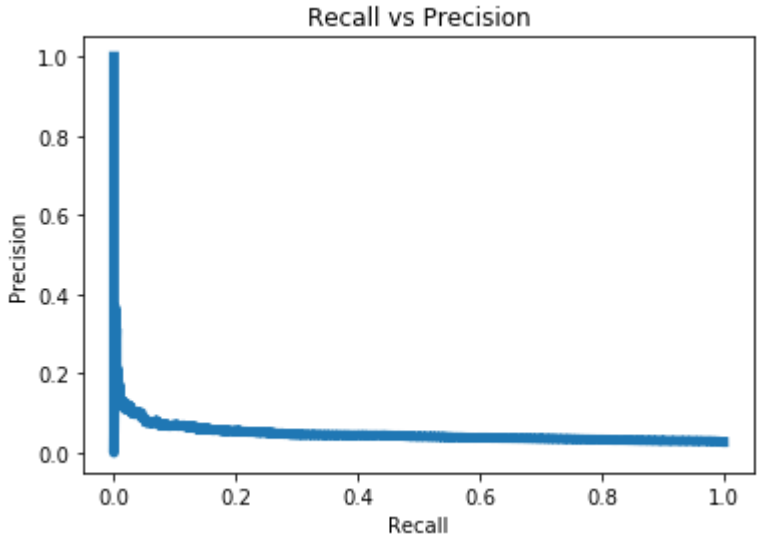
Out[39]:

	Reconstruction_error	True_class
count	46983.000000	46983.000000
mean	0.209399	0.026754
std	0.028453	0.161366
min	0.115265	0.000000
25%	0.188394	0.000000
50%	0.208616	0.000000
75%	0.229248	0.000000
max	0.314906	1.000000

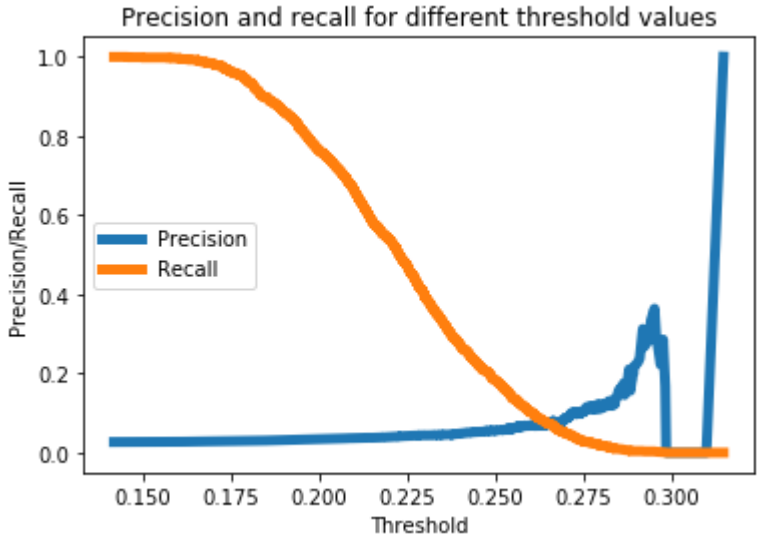
In [41]:
```
from sklearn.metrics import roc_auc_score, roc_curve, auc
false_pos_rate, true_pos_rate, thresholds = roc_curve(error_df.True_class, error_
roc_auc = auc(false_pos_rate, true_pos_rate,)

plt.plot(false_pos_rate, true_pos_rate, linewidth=5, label='AUC = %0.3f'% roc_auc
plt.plot([0,1],[0,1], linewidth=5)

plt.xlim([-0.01, 1])
plt.ylim([0, 1.01])
plt.legend(loc='lower right')
plt.title('Receiver operating characteristic curve (ROC)')
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()
```



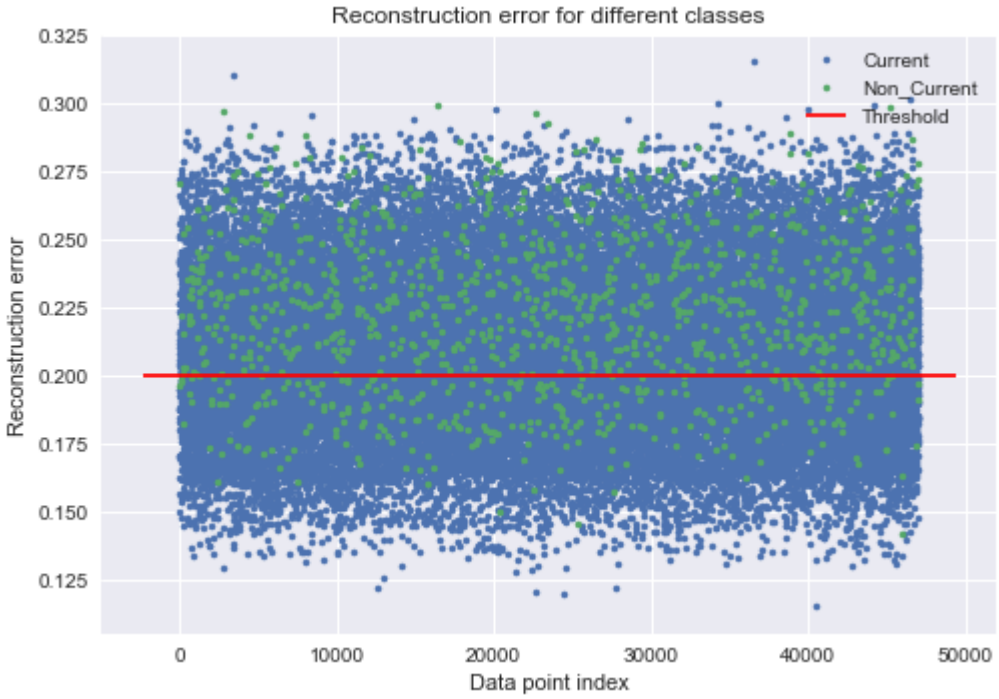
In [43]:
```
from sklearn.metrics import confusion_matrix, precision_recall_curve
precision_rt, recall_rt, threshold_rt = precision_recall_curve(error_df.True_clas
plt.plot(recall_rt, precision_rt, linewidth=5, label='Precision-Recall curve')
plt.title('Recall vs Precision')
plt.xlabel('Recall')
plt.ylabel('Precision')
plt.show()
```



In [44]:
```
plt.plot(threshold_rt, precision_rt[1:], label="Precision",linewidth=5)
plt.plot(threshold_rt, recall_rt[1:], label="Recall",linewidth=5)
plt.title('Precision and recall for different threshold values')
plt.xlabel('Threshold')
plt.ylabel('Precision/Recall')
plt.legend()
plt.show()
```



In [55]:
```
threshold_fixed = 0.2
groups = error_df.groupby('True_class')
fig, ax = plt.subplots()

for name, group in groups:
    ax.plot(group.index, group.Reconstruction_error, marker='o', ms=3.5, linestyl
            label= "Non_Current" if name == 1 else "Current")
ax.hlines(threshold_fixed, ax.get_xlim()[0], ax.get_xlim()[1], colors="r", zorder
ax.legend()
plt.title("Reconstruction error for different classes")
plt.ylabel("Reconstruction error")
plt.xlabel("Data point index")
plt.show();
```



In [48]:
```
import seaborn as sns
LABELS=['Current', 'Non_Current']
pred_y = [1 if e > threshold_fixed else 0 for e in error_df.Reconstruction_error.
conf_matrix = confusion_matrix(error_df.True_class, pred_y)

plt.figure(figsize=(7, 7))
sns.heatmap(conf_matrix, xticklabels=LABELS, yticklabels=LABELS, annot=True, fmt=
plt.title("Confusion matrix")
plt.ylabel('True class')
plt.xlabel('Predicted class')
plt.show()
```