MindWave_ML_models_project

May 30, 2019

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
```

In [2]:
```
sns.set_style('whitegrid')
viridis = lambda x: matplotlib.cm.get_cmap('viridis')(x)
warnings.filterwarnings('ignore')
%matplotlib inline
```

In [3]:
```
from sklearn.decomposition import PCA
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis as LDA
from sklearn.preprocessing import StandardScaler
```

In [4]:
```
from sklearn.metrics import accuracy_score
from sklearn.ensemble import RandomForestClassifier, ExtraTreesClassifier
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.neural_network import MLPClassifier
from sklearn.model_selection import train_test_split
```

In [5]:
```
from sklearn_porter import Porter
```

0.1 1. Analýza dát

In [6]:
```
df = pd.read_csv('train.csv', parse_dates=['Date']).set_index('Date')
```

In [7]:
```
print('Labels count = '+str(df['Label'].value_counts().sum())+':')
df['Label'].value_counts()
```

```
Labels count = 5247:
```

Out[7]:
```
2    3246
0    1311
1     690
Name: Label, dtype: int64
```

```
In [8]: print('data sample:')
        df.sample(1)
```

```
data sample:
```

Out[8]:

Date	Label	Alpha	Beta	Gamma	Delta	Theta
32:48.1	0	6.993395	1.239557	-1.743477	-0.783241	7.974503

```
In [9]: print('Feature means by label:')
        df.groupby('Label').mean()
```

```
Feature means by label:
```

Out[9]:

Label	Alpha	Beta	Gamma	Delta	Theta
0	10.697966	4.557121	1.971904	1.802673	10.180265
1	3.822989	1.482477	-1.116319	-1.255681	7.175921
2	5.917053	3.257057	0.765227	1.060584	8.963430

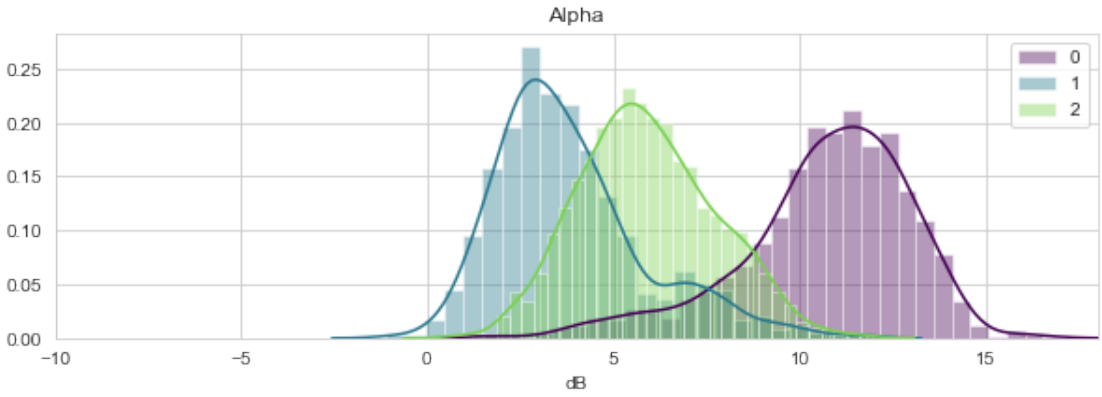
```
In [10]: print('Basic statistics:')
         df.describe().round(3)
```

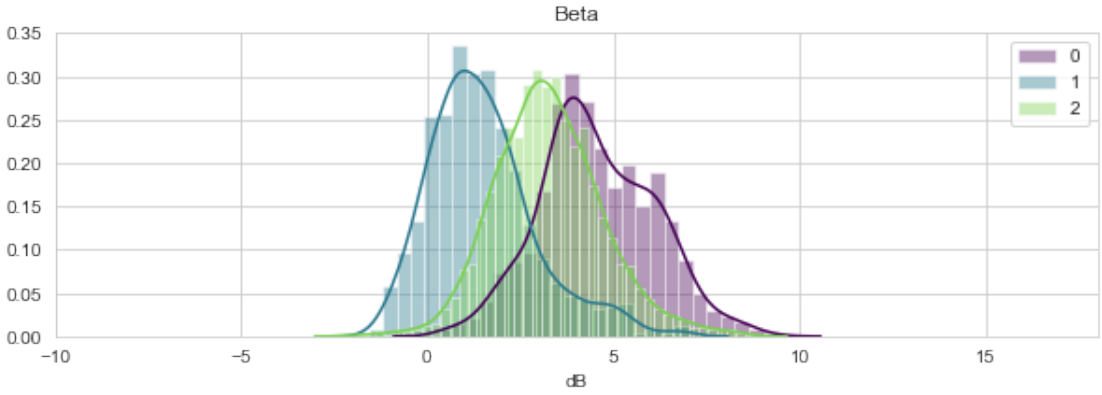
```
Basic statistics:
```

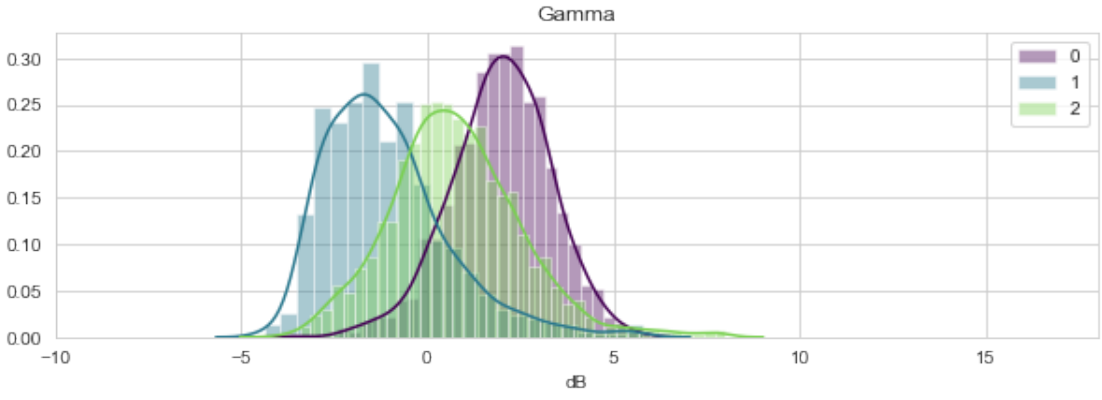
Out[10]:

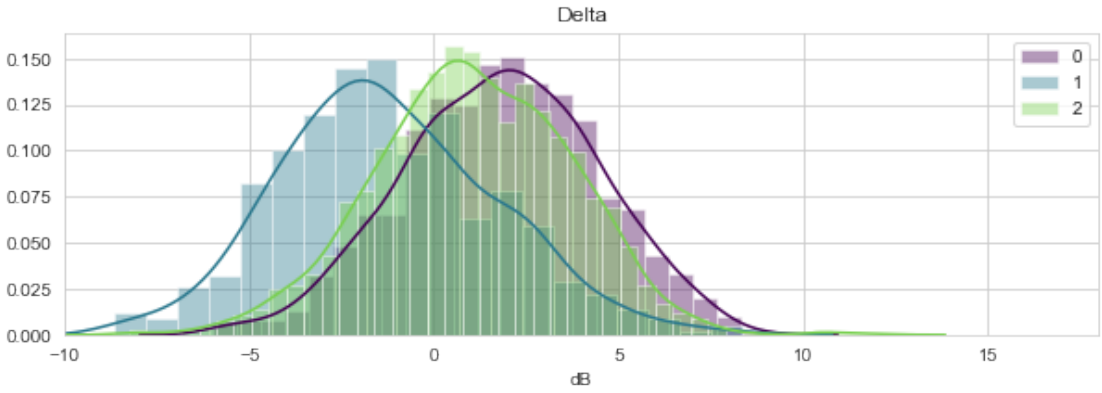
	Label	Alpha	Beta	Gamma	Delta	Theta
count	5247.000	5247.000	5247.000	5247.000	5247.000	5247.000
mean	1.369	6.836	3.349	0.819	0.941	9.032
std	0.856	3.066	1.734	1.891	2.835	2.215
min	0.000	-1.094	-2.143	-4.378	-8.660	0.956
25%	1.000	4.588	2.174	-0.457	-0.950	7.579
50%	2.000	6.273	3.320	0.828	0.994	9.014
75%	2.000	8.837	4.402	2.110	2.928	10.573
max	2.000	17.018	9.400	8.008	12.167	15.466

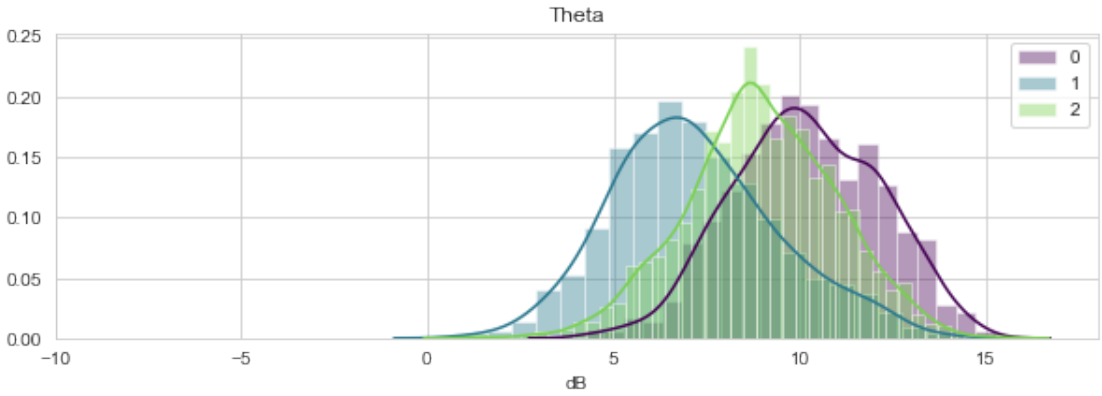
```
In [11]: for col in df.columns[1:]:
             fig, ax = plt.subplots(figsize=(10, 3))
             ax.set_title(col.capitalize())
             ax.set_xlim((-10, 18))
             ax.set_xlabel('dB')
             group = df.groupby('Label')[col].apply(list)

             for i in group.index:
                 sns.distplot(group[i], color=viridis(i*0.4), ax=ax, label=i)
             plt.legend()
```


Alpha
0
1
2
0.25
0.20
0.15
0.10
0.05
0.00
−10
−5
0
5
10
15
dB


Beta
0
1
2
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
−10
−5
0
5
10
15
dB

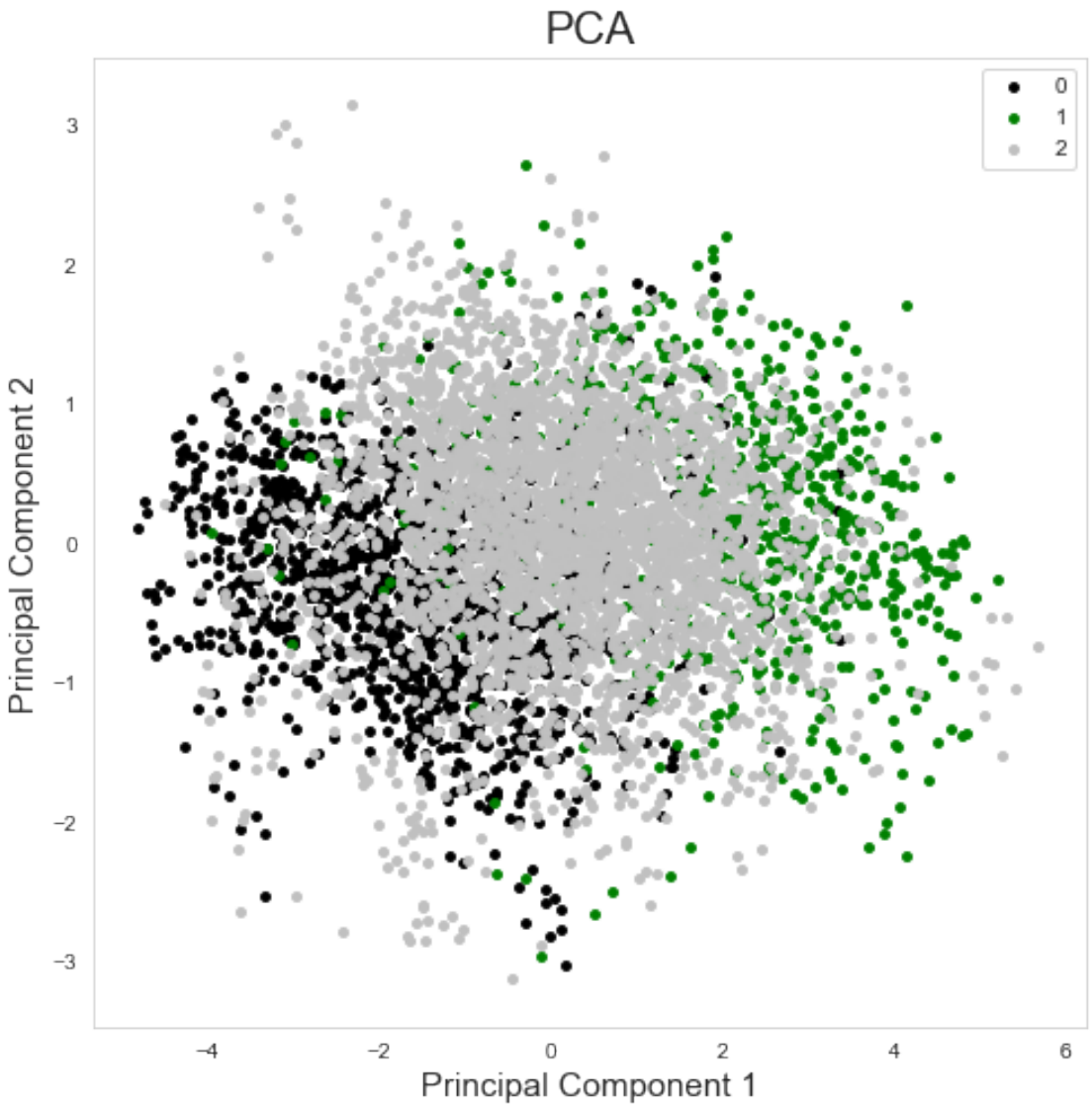

Gamma
0
1
2
0.30
0.25
0.20
0.15
0.10
0.05
0.00
−10
−5
0
5
10
15
dB





In [12]:
```
#naítanie dát, rozdelené poda dátumu, index od 0
dfa = pd.read_csv('train.csv', parse_dates=['Date'])

#Rozdelenie dát na features a labels
features = ['Alpha', 'Beta', 'Gamma', 'Delta', 'Theta']
x = dfa.loc[:, features].values
y = dfa.loc[:,['Label']].values

#kálovanie dát
x = StandardScaler().fit_transform(x)

#vytvorenie 2-rozmerného grafu z piatich rozmerov (features)
pca = PCA(n_components=2)
principalComponents = pca.fit_transform(x)
principalDf = pd.DataFrame(data = principalComponents
             , columns = ['principal component 1', 'principal component 2'])

# datagram kálovaných dát z PCA
```

```
finalDf = pd.concat([principalDf, dfa['Label']], axis = 1)

#graf kde sú farebne odlíené dáta pre jednotlivé triedy (labels)
fig = plt.figure(figsize = (8,8))
ax = fig.add_subplot(1,1,1)
ax.set_xlabel('Principal Component 1', fontsize = 15)
ax.set_ylabel('Principal Component 2', fontsize = 15)
ax.set_title('PCA', fontsize = 20)
targets = [0, 1, 2]
colors = ['black', 'green', 'silver']

for target, color in zip(targets,colors):
    indicesToKeep = finalDf['Label'] == target
    ax.scatter(finalDf.loc[indicesToKeep, 'principal component 1']
               , finalDf.loc[indicesToKeep, 'principal component 2']
               , c = color
               , s = 15)
ax.legend(targets)
ax.grid()
```

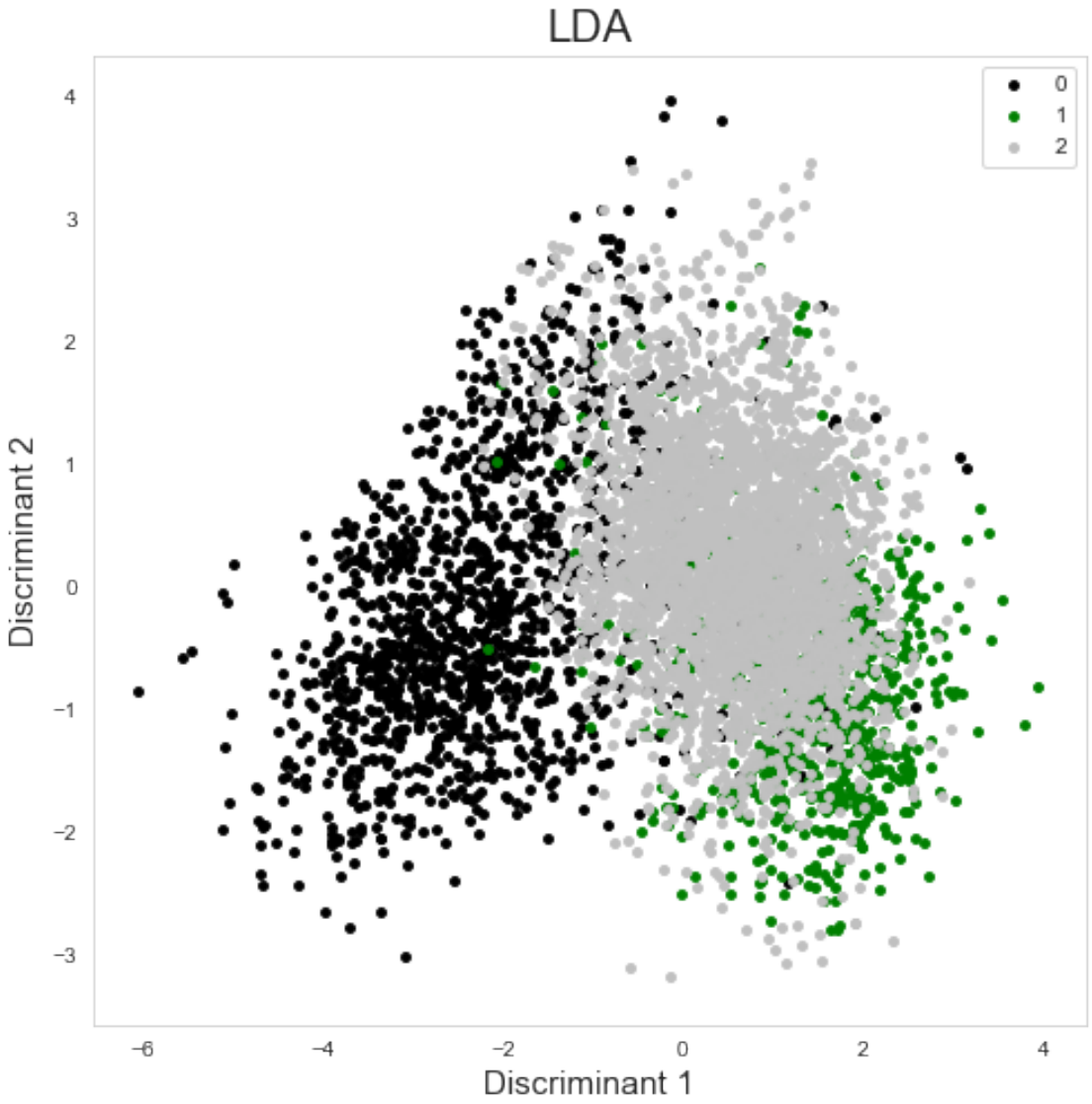



```
In [13]: print(pca.explained_variance_ratio_)
```

```
[0.69122026 0.14869451]
```

```
In [14]: #Rozdelenie dát na features a labels
         features = ['Alpha', 'Beta', 'Gamma', 'Delta', 'Theta']
         X = dfa.loc[:, features].values
         y = dfa.loc[:,['Label']].values

         #kálovanie dát
         X = StandardScaler().fit_transform(X)
```

```
#vytvorenie 2-rozmerného grafu z piatich rozmerov (features)
lda = LDA(n_components=2)
linearDiscriminants = lda.fit_transform(X, y)
linearDf = pd.DataFrame(data = linearDiscriminants
             , columns = ['Linear Discriminant 1', 'Linear Discriminant 2'])

# datagram kálovaných dát z LDA
finalLinearDf = pd.concat([linearDf, dfa['Label']], axis = 1)

#graf kde sú farebne odlíené dáta pre jednotlivé triedy (labels)
fig = plt.figure(figsize = (8,8))
ax = fig.add_subplot(1,1,1)
ax.set_xlabel('Discriminant 1', fontsize = 15)
ax.set_ylabel('Discriminant 2', fontsize = 15)
ax.set_title('LDA', fontsize = 20)
targets = [0, 1, 2]
colors = ['black', 'green', 'silver']

for target, color in zip(targets,colors):
    indicesToKeep = finalLinearDf['Label'] == target
    ax.scatter(finalLinearDf.loc[indicesToKeep, 'Linear Discriminant 1']
               , finalLinearDf.loc[indicesToKeep, 'Linear Discriminant 2']
               , c = color
               , s = 15)
ax.legend(targets)
ax.grid()
```



0.2 2. Modelovanie dát

```
In [15]: def train(df, estimator):
             X = df.drop('Label', 1)
             y = df['Label']

             X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_st
             estimator.fit(X_train, y_train)

             pred_train = estimator.predict(X_train)
             pred_test = estimator.predict(X_test)

             error_train = 1 - accuracy_score(y_train, pred_train)
```

```
        error_test = 1 - accuracy_score(y_test, pred_test)

        accuracy_train = 100*accuracy_score(y_train, pred_train)
        accuracy_test = 100*accuracy_score(y_test, pred_test)

        return accuracy_train, accuracy_test, error_train, error_test

    def Model_results(df, estimators):
        results = pd.DataFrame(index=['train_accuracy', 'test_accuracy','train_error', 'te
        for estimator in estimators:
            name = str(estimator).split('(')[0]
            results[name] = train(df, estimator)
        return results.transpose()
```

```
In [16]: estimators = [
            SVC(kernel='rbf', C=1.0, gamma='auto'),
            KNeighborsClassifier(7),
            RandomForestClassifier(30),
            ExtraTreesClassifier(30),
            MLPClassifier()
        ]
```

0.2.1 Vytváranie modelov pôvodných dát

```
In [17]: # Trénovanie modelov na pôvodných dátach.
         Model_results(df, estimators)
```

Out[17]:

	train_accuracy	test_accuracy	train_error	test_error
SVC	86.990708	85.809524	0.130093	0.141905
KNeighborsClassifier	86.752442	84.857143	0.132476	0.151429
RandomForestClassifier	99.880867	84.952381	0.001191	0.150476
ExtraTreesClassifier	100.000000	86.380952	0.000000	0.136190
MLPClassifier	85.013105	83.809524	0.149869	0.161905

0.2.2 vytváranie modelov s dátami z PCA

```
In [18]: #Trénovanie modelov s dátami z PCA.
         Model_results(finalDf, estimators)
```

Out[18]:

	train_accuracy	test_accuracy	train_error	test_error
SVC	73.600191	73.809524	0.263998	0.261905
KNeighborsClassifier	77.507744	70.476190	0.224923	0.295238
RandomForestClassifier	99.809388	68.761905	0.001906	0.312381
ExtraTreesClassifier	100.000000	67.809524	0.000000	0.321905
MLPClassifier	73.457231	73.714286	0.265428	0.262857

0.2.3 vytváranie modelov s dátami z LDA

```
In [19]: #Trénovanie modelov s dátami z LDA.
         Model_results(finalLinearDf, estimators)
```

Out[19]:

	train_accuracy	test_accuracy	train_error	test_error
SVC	83.678818	84.285714	0.163212	0.157143
KNeighborsClassifier	85.084584	82.952381	0.149154	0.170476
RandomForestClassifier	99.785561	83.047619	0.002144	0.169524
ExtraTreesClassifier	100.000000	81.714286	0.000000	0.182857
MLPClassifier	83.678818	84.857143	0.163212	0.151429

0.3 3. Konverzia modelov pôvodných dát do Javy

In [20]:
```
def trainModel(df, estimator):
    train(df, estimator)
    return estimator
```

In [21]:
```
for estimator in estimators:
    porter = Porter(trainModel(df, estimator), language='java')
    output = porter.export(embed_data=True)

    name = str(estimator).split('(')[0]
    with open(name + '.java', 'w') as out:
       out.write(output)
```

In [ ]: