PCA + LDA + KPCA

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1 Lab 10

2 Dimensionality Reduction

2.1 Submitted to: Prof. Sweetlin Hemlatha

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In [2]:
```
import random
import numpy as np
import pandas as pd
import seaborn as sn
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import precision_score, recall_score
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA, KernelPCA
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis

import matplotlib.pyplot as plt
from matplotlib.colors import ListedColormap
%matplotlib inline
```

In [3]:
```
sn.set(style='ticks', color_codes=True, font_scale=1)

white_wine = pd.read_csv('../Dataset/winequality-white.csv', sep=';')
white_wine['wine_type'] = 0
red_wine = pd.read_csv('../Dataset/winequality-red.csv', sep=';')
red_wine['wine_type'] = 1

wine_data = pd.concat([white_wine, red_wine])
wine_data.tail()
```

Out[3]:
```
      fixed acidity  volatile acidity  citric acid  residual sugar  chlorides  \
1594            6.2             0.600         0.08             2.0      0.090
1595            5.9             0.550         0.10             2.2      0.062
1596            6.3             0.510         0.13             2.3      0.076
1597            5.9             0.645         0.12             2.0      0.075
```

```
1598            6.0            0.310        0.47              3.6      0.067

      free sulfur dioxide  total sulfur dioxide  density    pH  sulphates  \
1594                 32.0                  44.0  0.99490  3.45       0.58
1595                 39.0                  51.0  0.99512  3.52       0.76
1596                 29.0                  40.0  0.99574  3.42       0.75
1597                 32.0                  44.0  0.99547  3.57       0.71
1598                 18.0                  42.0  0.99549  3.39       0.66

      alcohol  quality  wine_type
1594     10.5        5          1
1595     11.2        6          1
1596     11.0        6          1
1597     10.2        5          1
1598     11.0        6          1
```

In [4]:
```python
scaler = StandardScaler()

data = wine_data.iloc[:,:11].values
scaled_features = scaler.fit_transform(data)

wine_data_scaled = pd.DataFrame(scaled_features, index=wine_data.index, columns=wine_da
wine_data_scaled.head()
```

Out[4]:
```
   fixed acidity  volatile acidity  citric acid  residual sugar  chlorides  \
0      -0.166089         -0.423183     0.284686        3.206929  -0.314975
1      -0.706073         -0.240949     0.147046       -0.807837  -0.200790
2       0.682458         -0.362438     0.559966        0.306208  -0.172244
3      -0.011808         -0.666161     0.009406        0.642523   0.056126
4      -0.011808         -0.666161     0.009406        0.642523   0.056126

   free sulfur dioxide  total sulfur dioxide   density        pH  sulphates  \
0             0.815565              0.959976  2.102214 -1.359049  -0.546178
1            -0.931107              0.287618 -0.232332  0.506915  -0.277351
2            -0.029599             -0.331660  0.134525  0.258120  -0.613385
3             0.928254              1.243074  0.301278 -0.177272  -0.882212
4             0.928254              1.243074  0.301278 -0.177272  -0.882212

    alcohol
0 -1.418558
1 -0.831615
2 -0.328521
3 -0.496219
4 -0.496219
```

In [5]:
```python
X_train, X_test, Y_train, Y_test = train_test_split(wine_data_scaled,
                                                    wine_data.iloc[:, 12],
                                                    test_size=0.2,
                                                    random_state=42)
```

Applying logistic regression without any dimensionality reduction

```
In [6]: model_l1 = LogisticRegression(penalty='l2', solver='saga', max_iter=10, multi_class='o
        model_l1.fit(X_train, Y_train)

        print("Train Score: ", model_l1.score(X_train, Y_train))
        print("Test Score: ", model_l1.score(X_test, Y_test), '\n')
```

```
Train Score:  0.9926880892822783
Test Score:  0.9884615384615385
```

```
/home/prateek/anaconda3/envs/dltf/lib/python3.6/site-packages/sklearn/linear_model/sag.py:326:
  "the coef_ did not converge", ConvergenceWarning)
```

Applying PCA over the dataset

```
In [7]: wine_data_vals = wine_data_scaled.values

        pca = PCA(n_components=2, svd_solver='full', random_state=42)
        reduced_wine_data = pca.fit_transform(X_train)
        reduced_wine_data.shape
```

```
Out[7]: (5197, 2)
```

```
In [8]: model_l1 = LogisticRegression(penalty='l2', solver='saga', max_iter=10000, multi_class=
        model_l1.fit(reduced_wine_data, Y_train)
```

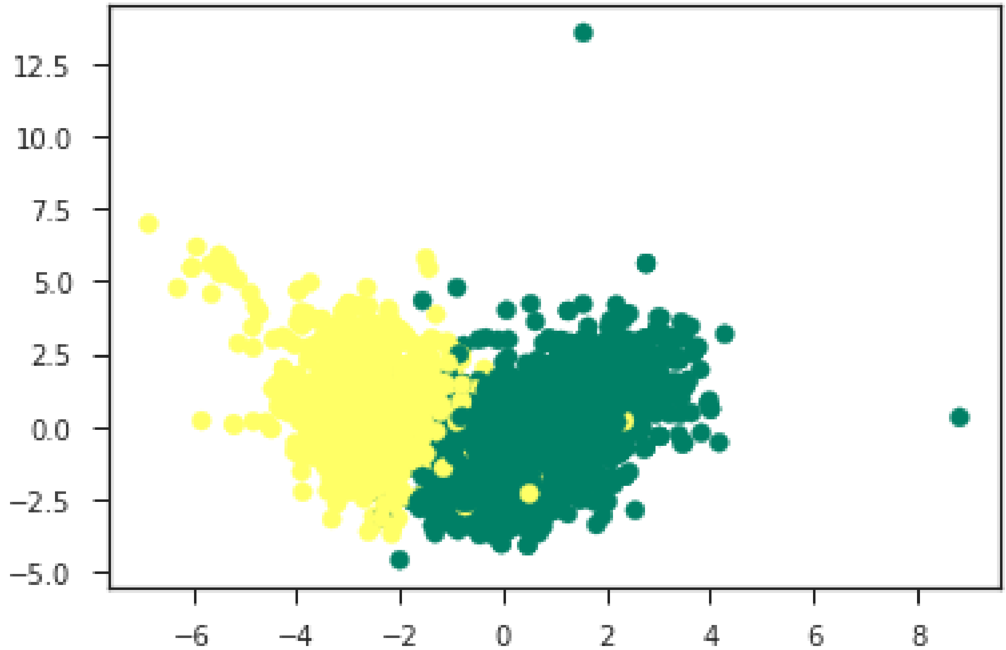
```
Out[8]: LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                  intercept_scaling=1, max_iter=10000, multi_class='multinomial',
                  n_jobs=1, penalty='l2', random_state=None, solver='saga',
                  tol=0.0001, verbose=0, warm_start=False)
```

```
In [1]: print(model_l1.score(reduced_wine_data, Y_train))
        print(model_l1.score(pca.transform(X_test), Y_test))
```

```
0.9659534346738503
0.9807692307692307
```

```
In [10]: plt.scatter(reduced_wine_data[:, 0], reduced_wine_data[:, 1], c=Y_train, cmap='summer
```

```
Out[10]: <matplotlib.collections.PathCollection at 0x7f442788de48>
```



Applying LDA over the dataset

```
In [11]: lda = LinearDiscriminantAnalysis(solver='eigen', n_components=3)
         wine_data_reduced = lda.fit_transform(X_train, Y_train)

In [12]: wine_data_reduced.shape

Out[12]: (5197, 1)

In [13]: wine_data_reduced

Out[13]: array([[-0.5634886 ],
                [-0.53612547],
                [-0.15322816],
                ...,
                [ 1.34187962],
                [ 1.35577714],
                [-0.22737771]])
```

Applying KPCA on the dataset

```
In [14]: kpca = KernelPCA(n_components=2, kernel='rbf', random_state=42)
         wine_data_reduced = kpca.fit_transform(X_train)

In [15]: print(model_ll.score(reduced_wine_data, Y_train))
         print(model_ll.score(kpca.transform(X_test), Y_test))
```

```
0.9859534346738503
0.7584615384615384
```

```
In [16]: plt.scatter(reduced_wine_data[:, 0], reduced_wine_data[:, 1], c=Y_train, cmap='summer
```

```
Out[16]: <matplotlib.collections.PathCollection at 0x7f4425ac13c8>
```