Final Exam NB

March 18, 2019

1 Final Exam Notebook

Problem 6 using Python packages:

```
In [42]: import pandas as pd
         import matplotlib.pyplot as plt
         %matplotlib inline
         import numpy as np
         import random
         from sklearn.decomposition import PCA
         from sklearn.naive_bayes import GaussianNB
```

```
In [5]: m = np.matrix([[5,-3,0], [-3, 5,0],[0,0,4]])
        print(m)
```

```
[[ 5 -3  0]
 [-3  5  0]
 [ 0  0  4]]
```

```
In [6]: lamda, evectors = np.linalg.eig(m)
        lamda = np.float64(lamda)
        evectors = np.float64(evectors)
```

```
In [7]: print(lamda)
        print(evectors)
```

```
[ 8.  2.  4.]
[[ 0.70710678  0.70710678  0.        ]
 [-0.70710678  0.70710678  0.        ]
 [ 0.          0.          1.        ]]
```

Problem 11:

```
In [29]: # Part a)
         iris_df = pd.read_csv('./Iris.csv')
         iris_df.set_index('Id',inplace=True)
         print(iris_df.shape)
         iris_df.head()
```

```
(150, 5)
```

Out[29]:

Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
1	5.1	3.5	1.4	0.2	Iris-setosa
2	4.9	3.0	1.4	0.2	Iris-setosa
3	4.7	3.2	1.3	0.2	Iris-setosa
4	4.6	3.1	1.5	0.2	Iris-setosa
5	5.0	3.6	1.4	0.2	Iris-setosa

In [30]:
```
# Target values
target_names = iris_df.Species.unique()
target_values = np.array(iris_df["Species"])
iris_df.drop(['Species'], axis=1,inplace=True)
print(target_names)
```

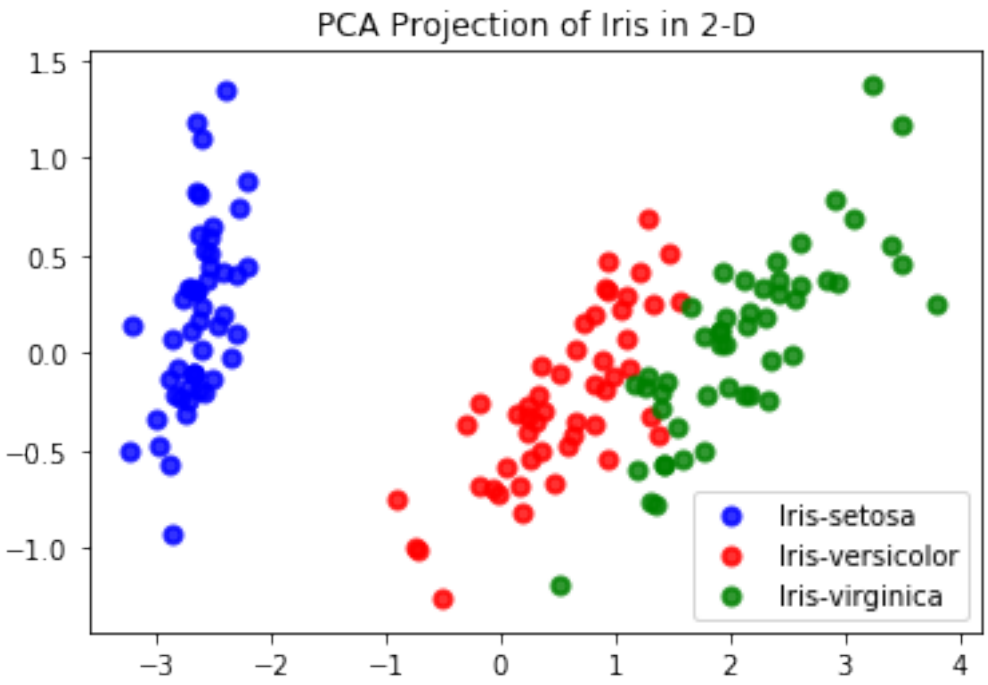
```
['Iris-setosa' 'Iris-versicolor' 'Iris-virginica']
```

In [31]:
```
# Fit 2 components to PCA
pca = PCA(n_components=2)
iris_2d = pca.fit(iris_df).transform(iris_df)
print('explained variance ratio (first two components): %s'
      % str(pca.explained_variance_ratio_))
```

```
explained variance ratio (first two components): [ 0.92461621  0.05301557]
```

In [33]:
```
plt.figure()
colors = ['blue', 'red', 'green']

for color, i, target_name in zip(colors, target_names, target_names):
    plt.scatter(iris_2d[target_values == i, 0], iris_2d[target_values == i, 1], color=c
                label=target_name)
plt.legend(loc='best', shadow=False, scatterpoints=1)
plt.title('PCA Projection of Iris in 2-D');
```



These classes appear to be very well separated from each other. While virginica and versicolor appear closer together, the transformation does an adequate job separating them.

```
In [35]: # Part b)
         # Load data-set again to make it easier:
         iris_df2 = pd.read_csv('./Iris.csv')
         df_train = iris_df2[iris_df2['Species'] == target_names[0]][0:35]
         for t in target_names[1:]:
             df_train = pd.concat([df_train, iris_df2[iris_df2['Species'] == t][0:35]])

         df_test = iris_df2[iris_df2['Species'] == target_names[0]][35:]
         for t in target_names[1:]:
             df_test = pd.concat([df_test, iris_df2[iris_df2['Species'] == t][35:]])
```

```
In [40]: print(df_train.shape)
         print(df_test.shape)
```

```
(105, 6)
(45, 6)
```

```
In [41]: df_train_y = df_train["Species"]
         df_train.drop(['Species'], axis=1,inplace=True)
         df_test_y = df_test["Species"]
         df_test.drop(["Species"],axis=1,inplace=True)
```

```
In [43]: # Use Gaussian Naive Bayes classifier
         classifier = GaussianNB()
         classifier.fit(df_train, df_train_y)

Out[43]: GaussianNB(priors=None)

In [46]: pred = classifier.predict(df_test)

         miss = (df_test_y != pred).sum()
         accuracy = 1.0 - miss / df_test_y.shape[0]
         print("Accuracy: ", accuracy*100,"%")

Accuracy:  100.0 %
```

It would appear no smoothing constant is necessary, or the input of prior probabilities, as the base classifier did exceptionally well on the held-out test set. As indicated, I achieved a 0% error rate.