Keshav Shankar

ECE 1395

Homework 6

0c)

```
----- Problem 0 -----
Size of X_train_1: 42
Size of X_train_2: 39
Size of X_train_3: 44
```

1a)

```
Class 1:
                Mean      Stdv
Feature 1   4.990476  0.344901
Feature 2   3.421429  0.337735
Feature 3   1.464286  0.178381
Feature 4   0.254762  0.107354

Class 2:
                Mean      Stdv
Feature 1   5.892308  0.513102
Feature 2   2.787179  0.317183
Feature 3   4.220513  0.481014
Feature 4   1.305128  0.201213

Class 3:
                Mean      Stdv
Feature 1   6.565909  0.602624
Feature 2   2.956818  0.315074
Feature 3   5.556818  0.536147
Feature 4   2.054545  0.274238
```

1c)

```
Accuracy: 96.0%
```

2a)

```
Covariance matrix 1 size: (4, 4)
[[0.1218583  0.09167247 0.01452962 0.01272938]
 [0.09167247 0.11684669 0.00566202 0.01513937]
 [0.01452962 0.00566202 0.03259582 0.00663763]
 [0.01272938 0.01513937 0.00663763 0.01180604]]

Covariance matrix 2 size: (4, 4)
[[0.27020243 0.10226721 0.19516194 0.05819838]
 [0.10226721 0.10325236 0.10474359 0.05348853]
 [0.19516194 0.10474359 0.23746289 0.07673414]
 [0.05819838 0.05348853 0.07673414 0.04155196]]

Covariance matrix 3 size: (4, 4)
[[0.37160148 0.08523784 0.2810518  0.05655391]
 [0.08523784 0.10158034 0.06832452 0.0554334 ]
 [0.2810518  0.06832452 0.29413848 0.05031712]
 [0.05655391 0.0554334  0.05031712 0.0769556 ]]
```

2b)

```
Class 1 mean vector: (4,)
[4.99047619 3.42142857 1.46428571 0.2547619 ]

Class 2 mean vector: (4,)
[5.89230769 2.78717949 4.22051282 1.30512821]

Class 3 mean vector: (4,)
[6.56590909 2.95681818 5.55681818 2.05454545]
```

2d)

```
Accuracy: 92.0%
```

After many trials, the naïve classifier always outperforms the MLE based classifier, in terms of accuracy.

This is most likely for a few reasons:

- with a small dataset, naive classifier requires fewer parameters
- the features are close to being conditionally independent, so naive classifier holds true given class label