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ECE 1395 – Dr. Dallal

Homework Assignment #6

3/23/23

Question 0: Data Preprocessing

Part a

```
Size of X_train_1: (40, 4)
Size of X_train_2: (42, 4)
Size of X_train_3: (43, 4)
```

Question 1: Naïve-Bayes Classifier

Part a

		Feature 1		Feature 2		Feature 3		Feature 4	
		Mean	Stdev	Mean	Stdev	Mean	Stdev	Mean	Stdev
Class 1		-0.955036	0.3770712	0.9008879	0.8781435	-1.283352	0.0899142	-1.235616	0.1403439
Class 2		0.0195521	0.5851605	-0.710571	0.7013402	0.2517313	0.2641113	0.1414381	0.2350211
Class 3		0.9222009	0.7661662	-0.163552	0.7674648	1.0342280	0.3145550	1.0900789	0.3759288

Part b

```
Accuracy:  0.88
```

Question 2: Max Likelihood and Discriminant Function for Classification

Part a

```
Size of Sigma_1: (4, 4)
Size of Sigma_2: (4, 4)
Size of Sigma_3: (4, 4)
Snapshot of covariance matrix for class 1:
[[0.1458284  0.26818473 0.00325823 0.01093794]
 [0.26818473 0.79090889 0.01216345 0.03357229]
 [0.00325823 0.01216345 0.00829186 0.0035682 ]
 [0.01093794 0.03357229 0.0035682  0.02020147]]
Snapshot of covariance matrix for class 2:
```

```
[[0.35076435 0.21090408 0.12086883 0.07852627]

 [0.21090408 0.50387511 0.0974818  0.10099519]

 [0.12086883 0.0974818  0.07145612 0.04965294]

 [0.07852627 0.10099519 0.04965294 0.05658212]]

Snapshot of covariance matrix for class 3:

[[0.35076435 0.21090408 0.12086883 0.07852627]

 [0.21090408 0.50387511 0.0974818  0.10099519]

 [0.12086883 0.0974818  0.07145612 0.04965294]

 [0.07852627 0.10099519 0.04965294 0.05658212]]
```

Part b

```
Size of u1: (4,)

Size of u2: (4,)

Size of u3: (4,)

Snapshot of mean vector for class 1:

[-0.95503645  0.90088791 -1.28335256 -1.23561636]

Snapshot of mean vector for class 2:

[ 0.01955215 -0.71057179  0.25173138  0.1414382 ]

Snapshot of mean vector for class 3:

[ 0.922201   -0.16355204  1.03422804  1.09007893]
```

Part c

```
Accuracy:  0.96
```

The accuracy of the MLE based classifier is higher than the naive classifier. This can be
explained by the use of the covariance matrix in the MLE classifier which is able to capture
dependent features better than the naive classifier which assumes independence between
features.