Pattern Recognition - Coursework 2

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1 Part 1

1.1 Sequential Delta Learning Algorithm

The Sequential Delta Learning Algorithm was applied with the parameters:

$$\theta = -7, \omega_1 = -3, \omega_2 = 8$$

the following results were obtained from applying the algorithm.

Iteration	w	x^t	y=H(wx)	t	w $\leftarrow w + (t-y)x^t$
1	(7,-3,8)	(1,0,2)	1	1	(7,-3,8)
2	(7,-3,8)	(1,1,2)	1	1	(7,-3,8)
3	(7,-3,8)	(1,2,1)	1	1	(7,-3,8)
4	(7,-3,8)	(1,-3,1)	1	0	(6,0,7)
5	(6,0,7)	(1,-2,-1)	0	0	(6,0,7)
6	(6,0,7)	(1,-3,-2)	0	0	(6,0,7)
7	(6,0,7)	(1,0.2)	1	1	(6,0,7)
8	(6,0,7)	(1,1,2)	1	1	(6,0,7)
9	(6,0,7)	(1,2,1)	1	1	(6,0,7)
10	(6,0,7)	(1,-3.1)	1	0	(5,3,6)
11	(5,3,6)	(1,-2,-1)	0	0	(5,3,6)
12	(5,3,6)	(1,-3,-2)	0	0	(5,3,6)
13	(5,3,6)	(1,0,2)	1	0	(5,3,6)

2 Part 2

2.1 Linear Seperability

There are three classes in this dataset; Class 1, Class 2, and Class 3. The four different feature dimensions were plotted against each other to determine whether any Classes are linearly seperable and which ones they are.

Class 1 and Class 2 are linearly seperable.
Class 1 and Class 3 are linearly seperable.
Class 2 and Class 3 are not linearly seperable.

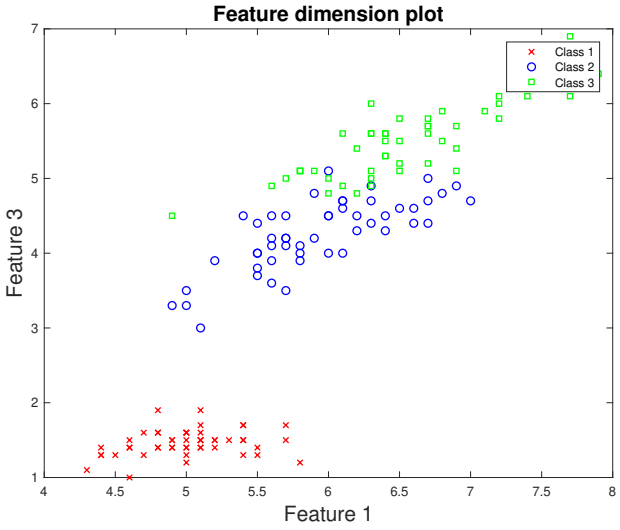

Figure 1: Data, which includes 3 classes, plotted onto the first and third feature dimensions.

This can be proven when looking at the plots generated through the above method. To demonstrate this, one plot is presented here, which will make the seperability of each class clear. The other plots had equal linear seperability.

As can be seen in the plot, the data from Class 1 (red crosses) can be seperated from Class 2 and 3 via a simple line, and hence is linearly seperable; whilst the data for Class 2 and 3 cannot be easily seperated to the point that some data points from classes 2 and 3 seem to overlap. This pattern of linear seperability of the classes is replicated across all other plots as well; though the spread of and the distance between the data clusters for each class may vary.

2.2 Karhunen-Love Transform

The Principle Componenet Analysis was carried out on the test data. This data was then projected on the first two principle components.

3 Part 3

[h!]

4 Class Classifier

The 7-digit KCl ID number used is: 1773869.

This gives the following Xtest matrix:

$$\begin{bmatrix} 4.4348 & 7.0435 & 7.0435 & 5.3043 & 7.4783 & 6.6087 & 7.9130 \\ 3.7500 & 3.7500 & 2.7500 & 4.0000 & 3.5000 & 4.2500 & 2.2500 \\ 5.6667 & 3.0000 & 6.3333 & 5.0000 & 7.0000 & 1.6667 & 5.6667 \\ 0.7500 & 2.0000 & 1.5000 & 2.2500 & 0.2500 & 1.7500 & 1.7500 \end{bmatrix}$$

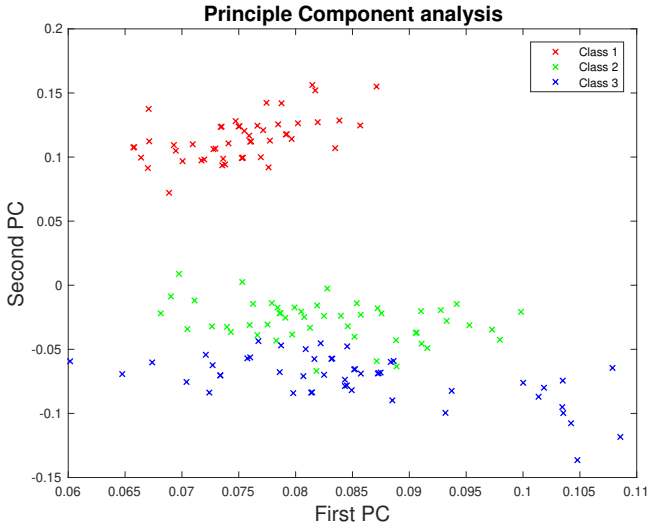

Figure 2: The data projected on to the first two principle componenets

A dictionary based sparse coding is applied to the test data and the datasets (columns in the above matrix) are classified. The following results were obtained.

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Class 2	Class 2	Class 3	CLass 3	Class 3	Class 1	Class 2