ML Homework 3

1) Average Classification Accuracy over the last 10 runs

   = 73.9 %

   To select the suitable principal components for PCA we do Singular Value Decomposition on matrix and then generates an eigen value matrix. We use few eigen values at first and try to retain maximum data using the variance. We select those pairs which retains the maximum variance.

2) Find in code:

   Variance inside the classes:

   [[17.6 2.55] [2.55 14]]

   Variance between classes:

   [[98.6 26.8] [26.8 8]]

3) Average accuracy over the last 10 runs = 77.6 %

4)

4)

Q4 The given 5D dataset :-

w_0	1	1	-1	0	2
w_1	0	0	1	2	0
w_2	-1	-1	1	1	0
w_3	4	0	1	2	1
w_4	-1	1	1	1	0
w_5	-1	-1	-1	1	0
w_6	-1	1	1	2	1

learning rate = 1

Given initial values:- $[3 \ 1 \ 1 \ -1 \ 2 \ -7]$

∴ Upon appending the given data with another column $w_0 = 1$, $w_6 = -1$

w_0:	-1	1	1	-1	0	2
w_1:	1	0	0	1	2	0
w_2:	-1	-1	-1	1	1	0
w_3:	1	4	0	1	2	1
w_4:	1	-1	1	1	1	0
w_5:	1	-1	-1	-1	1	0
w_6:	-1	-1	1	1	2	1

Taking the 1st sample $a^t y = \sum_{k=0}^{n}$

$a^{k+1} = a^k + y_k$

$a^t = [3 \ 1 \ 1 \ -1 \ 2 \ -7]$

$a^t y = [3 \times -1 + 1 \times 1 + 1 \times 1 + -1 \times 1 + 0 \times 2 + 2 \times -1]$

$= [-14] < 0$

∴ It is wrongly classified

$a^1 = x^1 \cdot y_n$

$= [3 \quad 1 \quad 1 \quad -1 \quad 2 \quad 7] + [-1 \quad 1 \quad 1 \quad -1 \quad 0 \quad 2]$

$a^1 = [2 \quad 2 \quad 2 \quad -2 \quad 2 \quad -5]$

Taking 2nd sample:-

$a_1 = [2 \quad 2 \quad 2 \quad -2 \quad 2 \quad -5]$

~~$a^1 y = [2 \times 1 + 2 \times 1 + 2 \times 0 + 2 \times 0$~~

$a^1 y = [2 \times 1 + 2 \times 0 + 2 \times 0 - 2 \times 1 + 2 \times 2 - 5 \times 0]$

$= [4] \quad 70$

$\therefore$ It is not misclassified

No weight updation is needed

Taking 3rd sample:-

$a^2 = [2 \quad 2 \quad 2 \quad -2 \quad 2 \quad -5]$

$a^{-1} y = [2 \times -1 + 2 \times -1 + 2 \times -1 - 2 \times 1 + 2 \times 1 - 5 \times 0]$

$= [-2 \quad -2 \quad -2 \quad -2 \quad 2 \quad 0]$

$= [-6] < 0$

$\therefore$ It is misclassified

$a^3 = [2 \quad 2 \quad 2 \quad -2 \quad 2 \quad -5] +$

$[-1 \quad -1 \quad -1 \quad 1 \quad 1 \quad 0]$

$= [1 \quad 1 \quad 1 \quad -1 \quad 3 \quad -5]$

Taking 4th sample

$a^3 = [1 \quad 1 \quad 1 \quad -1 \quad 3 \quad -5]$

$a^1 y = [1 \times 1 + 1 \times 4 + 1 \times 0 \quad -1 \times 3 + 3 \times -2 - 5 \times 1]$

$= [1 + 4 \quad 0 - 3 + 6 - 5]$

$= [3] \quad 70$

∴ If it is not misclassified, no weight update needed.

Taking 5th sample:-

$a^3 = [1 \quad 1 \quad 1 \quad -1 \quad 3 \quad -5]$

$a^t y = [1\times1 + 1\times1 + 1\times1 - 1\times1 + 3\times1 - 5\times0]$

$= [1 - 1 + 1 - 1 + 3 - 0]$

$= [3] > 0$

∴ If not misclassified

Taking 6th sample

$a^3 = [1 \quad 1 \quad 1 \quad -1 \quad 3 \quad -5]$

$a^t y = [1\times1 + 1\times-1 + 1\times-1 - 1\times-1 + 3\times1 - 5\times0]$

$= [1 - 1 - 1 + 1 + 3 - 0]$

$= [3] > 0$

∴ Not misclassified. No weight update needed

Taking 7th sample

$a^3 = [1 \quad 1 \quad 1 \quad -1 \quad 3 \quad -5]$

$a^t y = [1\times1 + 1\times1 + 1\times1 - 1\times1 + 3\times2 - 5\times1]$

$= [-1 - 1 + 1 - 1 + 6 - 5]$

$= [-1] < 0$

∴ It is misclassified

$a^0 = [1 \quad 1 \quad 1 \quad -1 \quad 3 \quad -5]$

$[-1 \quad -1 \quad 1 \quad 1 \quad 2 \quad 1]$

$a^1 = [0 \quad 0 \quad 2 \quad 0 \quad 5 \quad -4]$

∴ Final weight = $[0 \quad 0 \quad 2 \quad 0 \quad 5 \quad -4]$