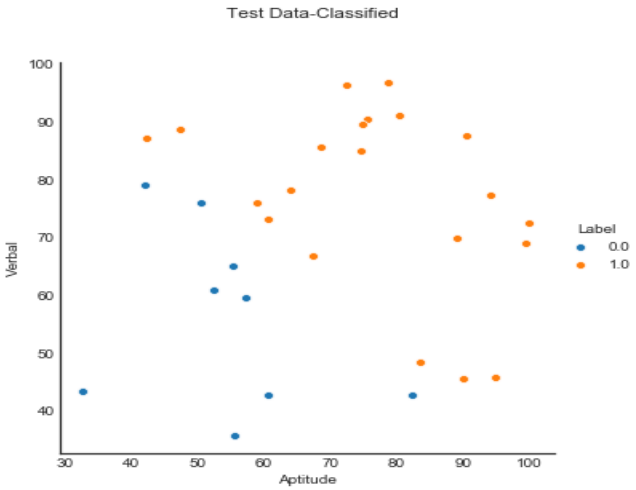
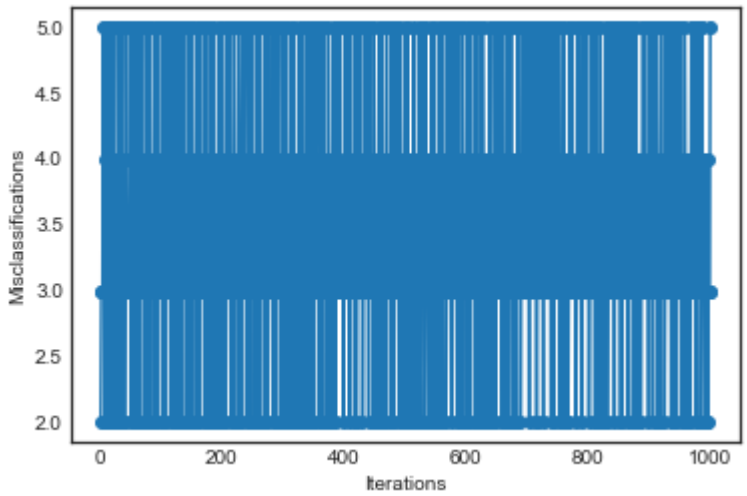
CLL 788 – Assignment 2
Solution

Q1

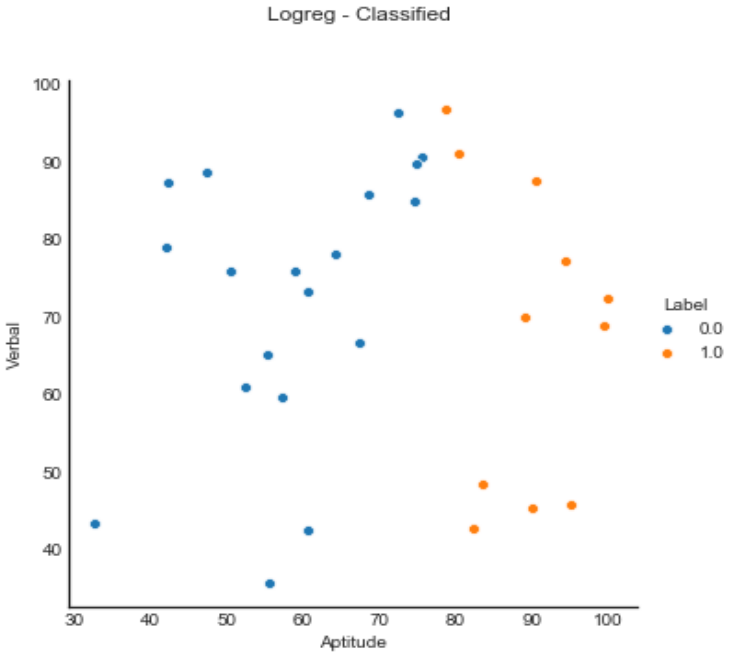
Codefile – perceptron__ at :
https://github.com/bhanu-IITD/CLL-788/blob/master/2019CEZ8621_Assignment2/perceptron__.ipynb

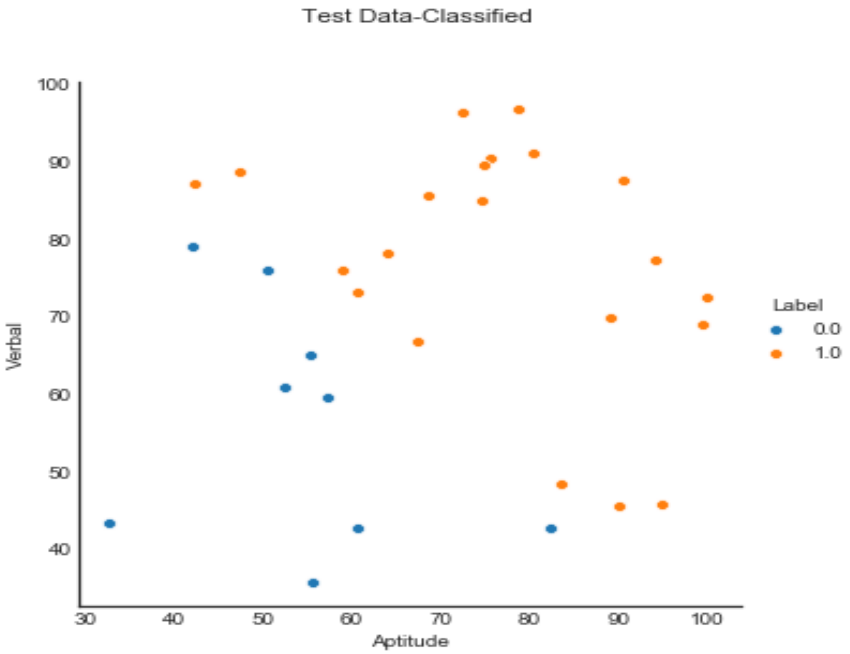
a. A single layer perceptron was trained using signum function as the activation function. As per data visualisation, it was seen that two classes were not linearly separable , hence the perceptron was expected to have some misclassification error. The classified data can be seen in Fig.2 where it can be seen that data has been classified reasonably. The misclassification error can be seen oscillating between 2-5.





b. In comparison to logisitc regression done for the same dataset in assignment 1, it can be seen that perceptron has performed much better in classifying the same data.





Q2

iit delhi

ASSIGNMENT-2

Q2

Given :-

$$C_1 = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 3 & 5 & 5 \end{bmatrix}$$

$$C_2 = \begin{bmatrix} 1 & 2 & 3 & 3 & 5 & 6 \\ 0 & 1 & 1 & 2 & 3 & 5 \end{bmatrix}$$

To find projections y_1 and y_2, we need to find

$y_1 = w^T x_1$

$y_2 = w^T x_2$

Using fisher's discriminant

$\Rightarrow w = S_W^{-1} (m_2 - m_1)$

where

$S_W = S_1 + S_2$

$S_1 = (D_1 - m_1)(D_1 - m_1)^T$

$S_2 = (D_2 - m_2)(D_2 - m_2)^T$

Now,

$$m_1 = \begin{bmatrix} 5.0 \\ 3.6 \end{bmatrix} \qquad m_2 = \begin{bmatrix} 3.33 \\ 2.0 \end{bmatrix}$$

$$m_1 - m_2 = \begin{bmatrix} 1.67 \\ 1.6 \end{bmatrix}$$

$S_1 = (D_1 - m_1)(D_1 - m_1)^T$

P.T.O

$$D_1 - m_1 = \begin{bmatrix} -4 & -3 & -2 & -1 & 0 \\ -1.6 & -0.6 & -0.6 & 1.4 & 1.4 \end{bmatrix}$$

$$(D_1 - m_1)(D_1 - m_1)^T = \begin{bmatrix} 30 & 8 \\ 8 & 7.2 \end{bmatrix}$$

$$S_1 = \begin{bmatrix} 30 & 8 \\ 8 & 7.2 \end{bmatrix}$$

$$S_2 = (D_2 - m_2)(D_2 - m_2)^T$$

$$D_2 - m_2 = \begin{bmatrix} -2.33 & -1.33 & -0.33 & -0.33 & 1.67 & 2.67 \\ -2 & -1 & -1 & 0 & 1 & 3 \end{bmatrix}$$

$$S_2 = \begin{bmatrix} 17.33 & 16 \\ 16 & 16 \end{bmatrix}$$

$$S_W = \begin{bmatrix} 47.33 & 24 \\ 24 & 23.2 \end{bmatrix}$$

$$S_W^{-1} = \begin{bmatrix} 0.044 & -0.0459 \\ -0.0459 & 0.0906 \end{bmatrix}$$

$$\therefore W = S_W^{-1}(m_2 - m_1)$$

$$= \begin{bmatrix} 0.044 & -0.0459 \\ -0.0459 & 0.0906 \end{bmatrix} \cdot \begin{bmatrix} 1.67 \\ 1.6 \end{bmatrix}$$

$$W = \begin{bmatrix} 0.00065 \\ 0.06828 \end{bmatrix}$$

Now,

$$y_1 = w_1^T x_1$$

$$\Rightarrow y_1 = \begin{bmatrix} 0.00065 \\ 0.06828 \end{bmatrix}^T \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 3 & 5 & 5 \end{bmatrix}$$

$$y_1 = \begin{bmatrix} 0.137 & 0.206 & 0.206 & 0.3440 & 0.3447 \end{bmatrix}$$

$$y_2 = w^T x_2$$

$$= \begin{bmatrix} 0.00065 \\ 0.06828 \end{bmatrix}^T \begin{bmatrix} 1 & 2 & 3 & 3 & 5 & 6 \\ 0 & 1 & 1 & 2 & 3 & 5 \end{bmatrix}$$

$$y_2 = \begin{bmatrix} 0.00065 & 0.0696 & 0.070 & 0.1385 & 0.2081 & 0.3453 \end{bmatrix}$$

Hence. solved. Y_1 and Y_2 are projections of C_1 and C_2.