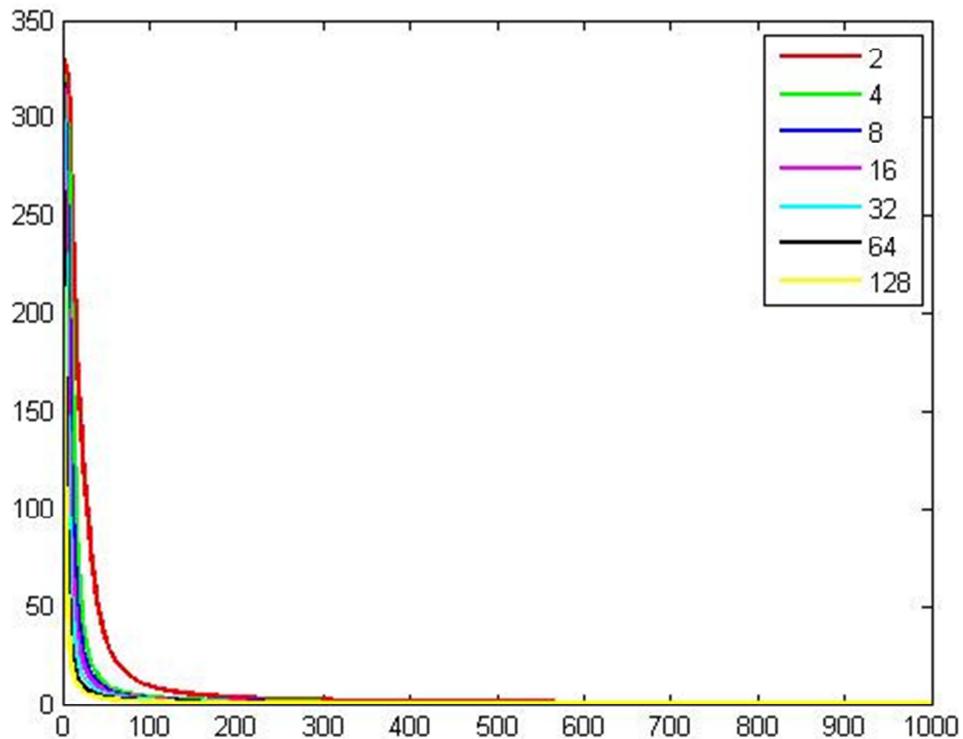


CSL 407 Machine Learning Homework 2

Question 1 :

1(d): Following is the plot of Training Error vs The number of Epochs for different values of Hidden Layers.



Observation : It can be observed from the plot that as the number of Epochs increases the training error converge to a very low value. As for Hidden Layers it can be said that higher the number of hidden layers the lower the training error .

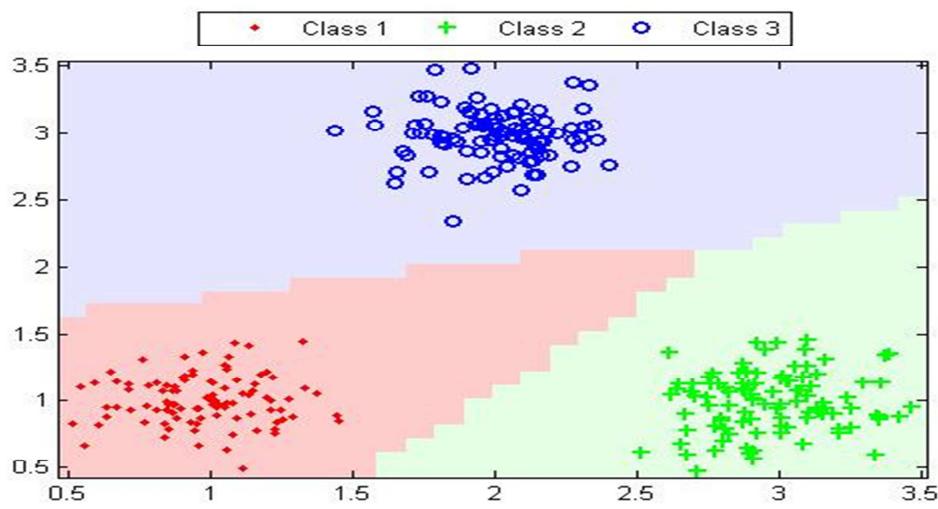


Figure 1 : Decision Boundary at hidden Layers =2 .

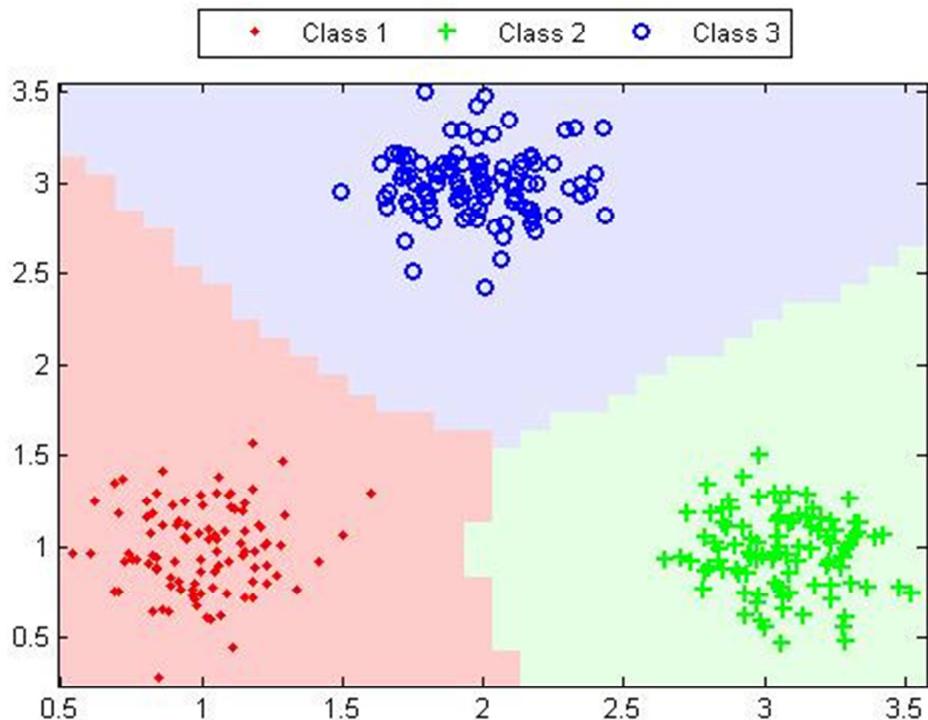


Figure 2: Decision Boundary at hidden Layers =4

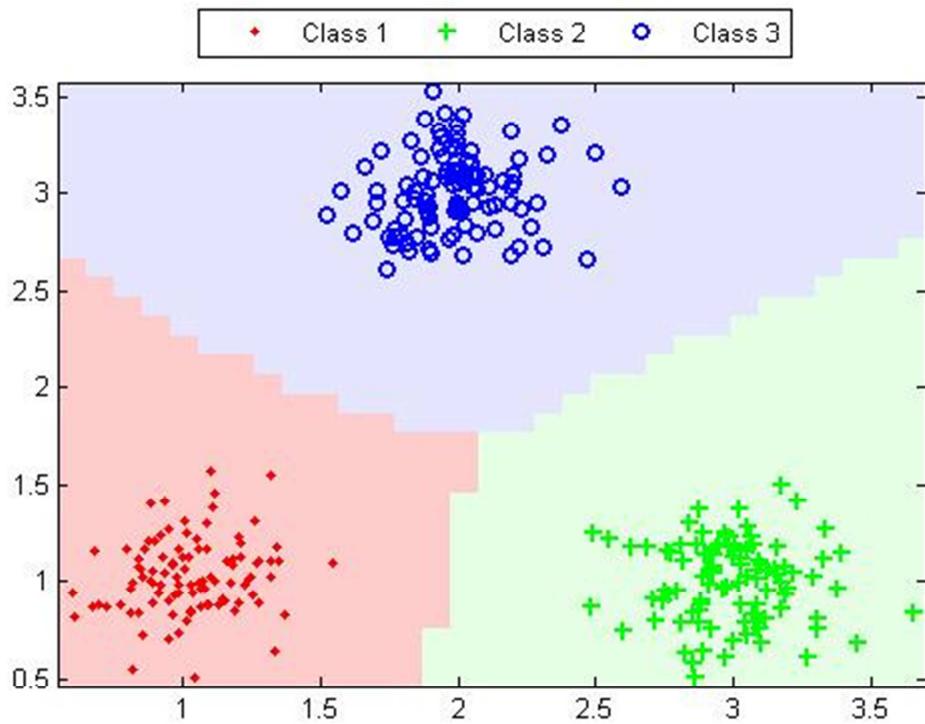


Figure 3: Decision Boundary at hidden Layers =64

Observation : It can be seen that the labels are classified correctly even for hidden layer = 2 but the decision boundary intersection is far from the centre . At hidden layer = 4 the intersection is almost at the centre .the decision boundary changes .But not much difference in the decision comes because of hidden layer =16.

1. (e) Figure $h = 16$, eta varying, 1000 epochs.

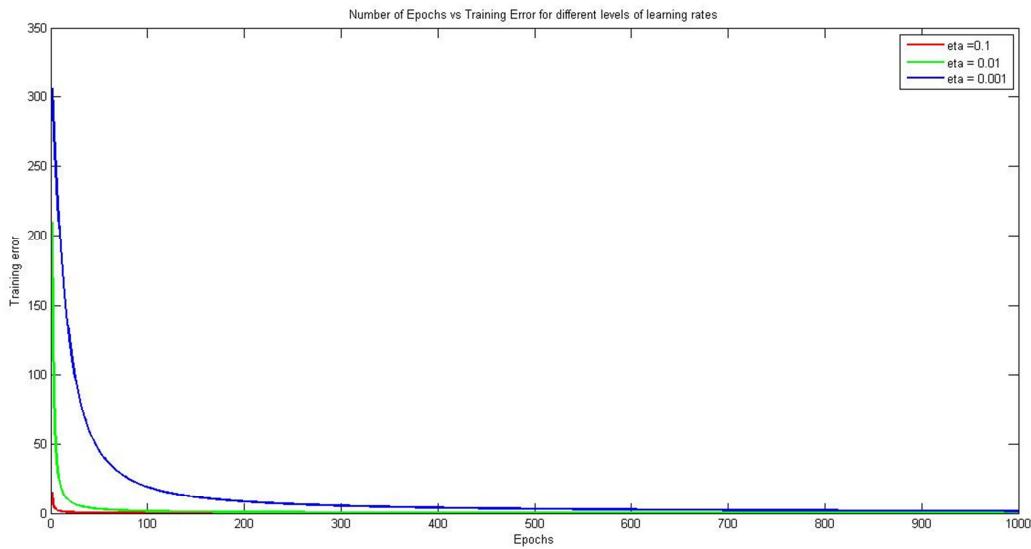


Figure : Training Error vs Number of Epochs with varying eta.

Observation : It can be seen from the plot that in general error decreases with increasing epoch but for higher value of eta the decline is faster .

1(f):

For standard deviation $sd = 0.75$. The training error at the end of

1000^{th} Epoch = 76.1499

5000^{th} Epoch = 63.5591

10000^{th} Epoch = 56.9388.

The plot of the decision boundary with class labels are :

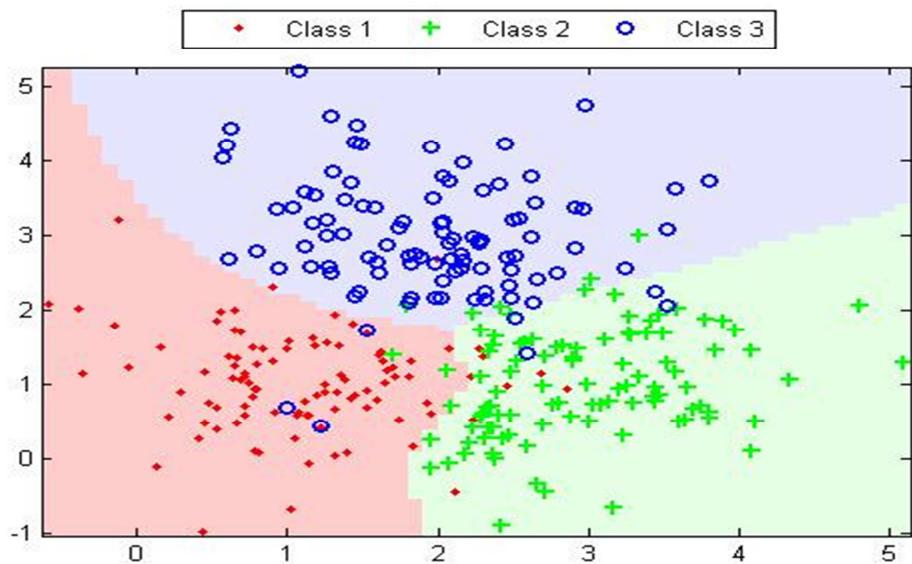


Figure : Decision Boundary for epochs = 1000.

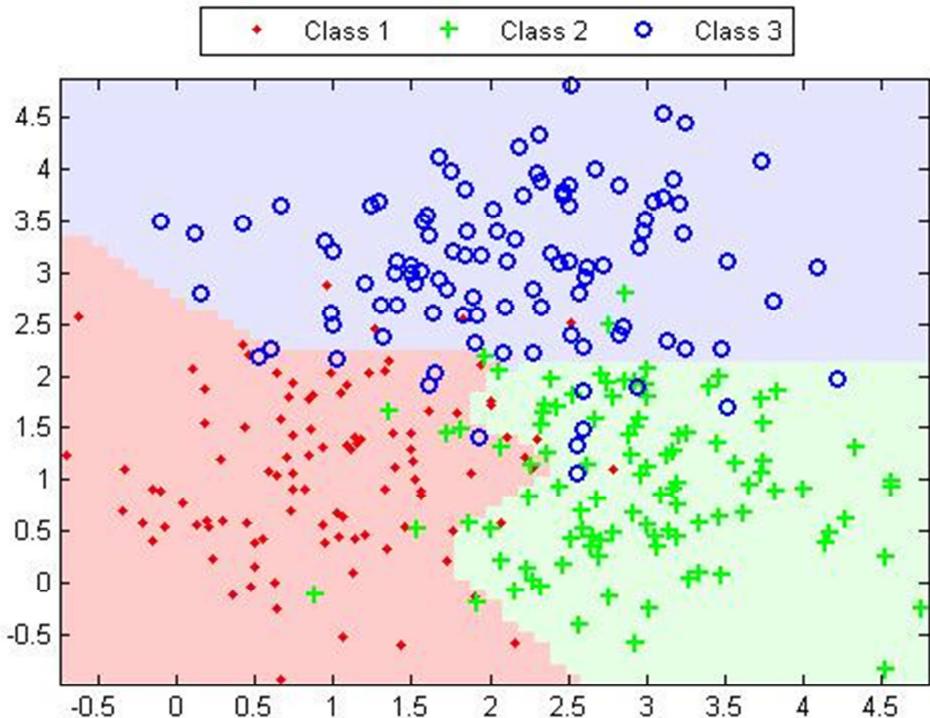


Figure : Decision Boundary for epochs = 5000.

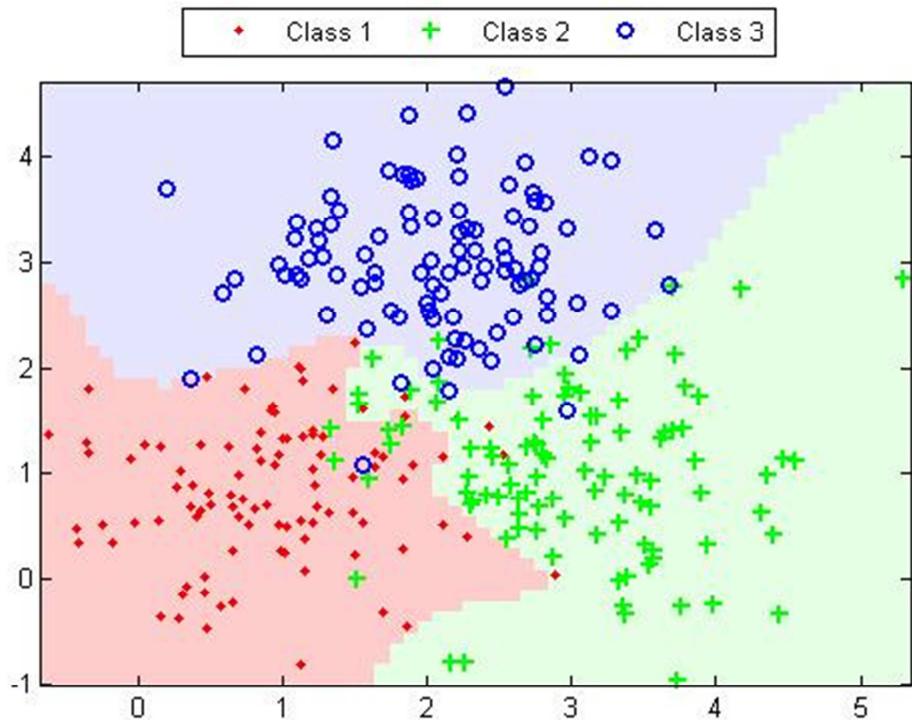


Figure : Decision Boundary for epochs = 10000.

Observation : It can be seen that as the number of epochs is increased the number of misclassification decreases and the decision boundary becomes more sharp to include more examples of a given class.

2.

2. The initial weights are $w_{00}, w_{01}, w_{02}, w_{03}, v_{00}$
 $= (0.1, 0.1, 0.1, 0.1, 0.1)$

Epoch 1:-

After the first training example the weights are :-

$$w = (0.1034 \quad 0.1034 \quad 0.100)$$

$$v = 0.2389 \quad 0.1761$$

After the second training example :-

$$w = (0.0989 \quad 0.0665 \quad 0.0924)$$

$$v = (0.1880 \quad 0.1483)$$

Epoch 2:-

After the first training example :-

$$w = (0.0996 \quad 0.1140 \quad 0.0855)$$

$$v = (0.2726 \quad 0.1948)$$

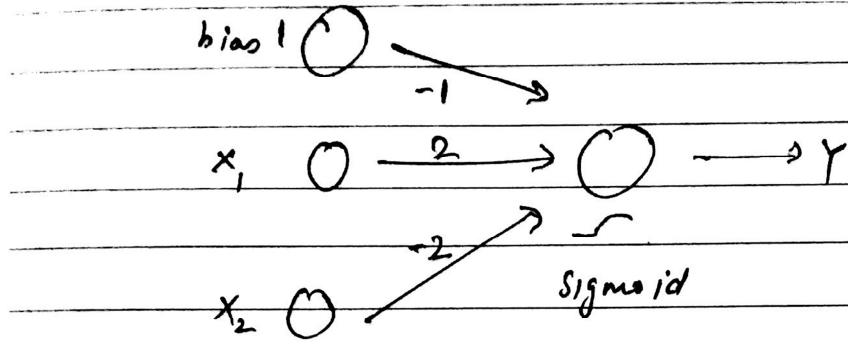
After the second training example :-

$$w = (0.0918 \quad 0.1203 \quad 0.0707)$$

$$v = (0.1706 \quad 0.1594)$$

3.

3. Two input perceptron for $A \wedge B$.



so if $y > 0.5 \rightarrow 1$

$y < 0.5 \rightarrow 0$

Result

$$\text{Test: } x_1 = 0, x_2 = 0 \Rightarrow -1 \Rightarrow y < 0.5 \Rightarrow 0$$

$$x_1 = 0, x_2 = 1 \Rightarrow -3 \Rightarrow y < 0.5 \Rightarrow 0$$

$$x_1 = 1, x_2 = 0 \Rightarrow 1 \Rightarrow y > 0.5 \Rightarrow 1$$

$$x_1 = 1, x_2 = 1 \Rightarrow -1 \Rightarrow y < 0.5 \Rightarrow 0$$