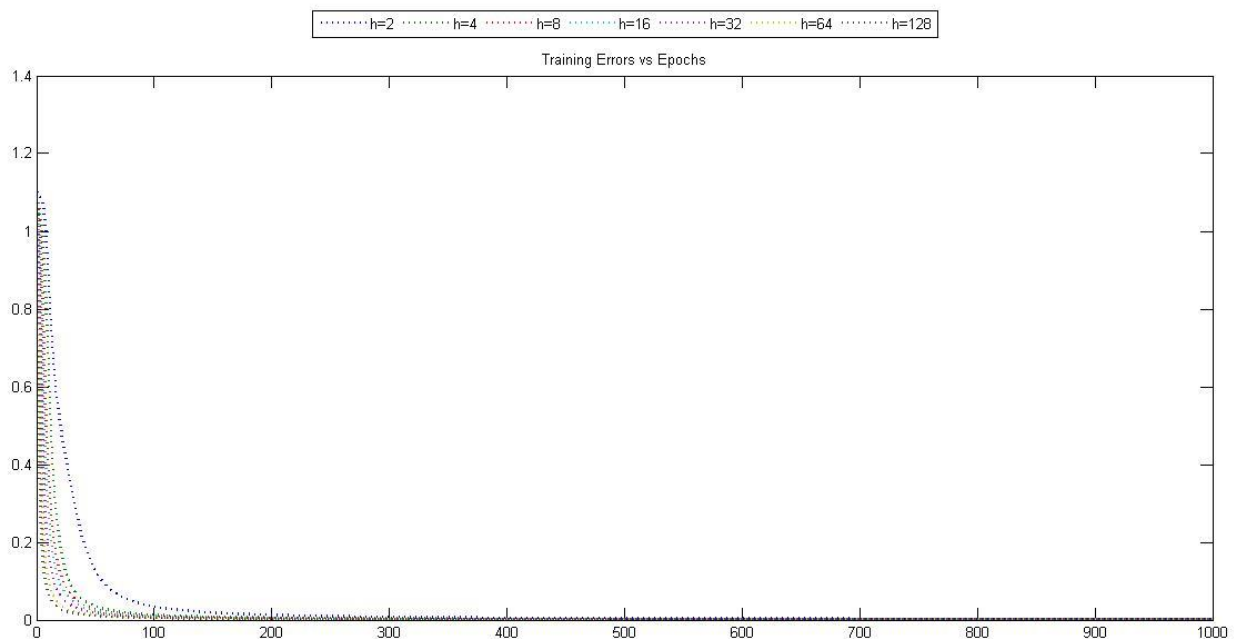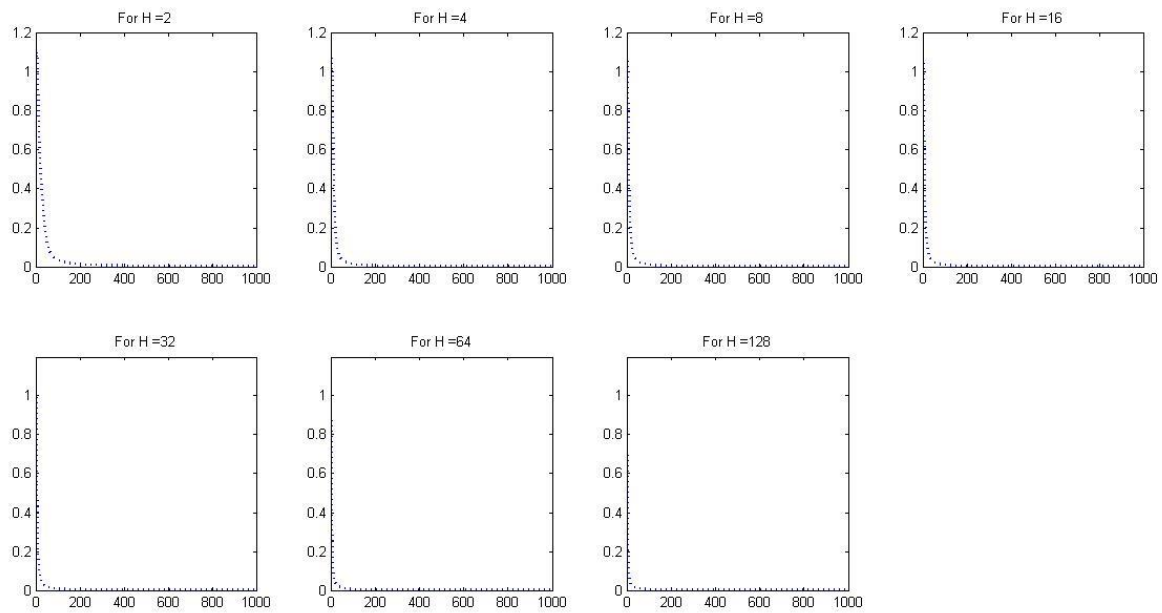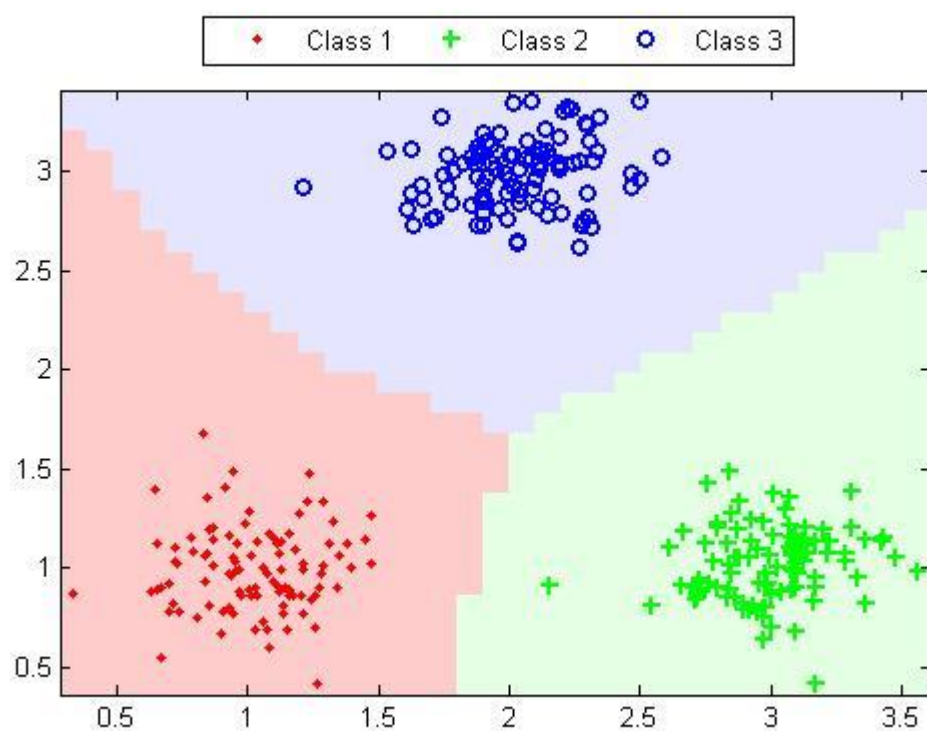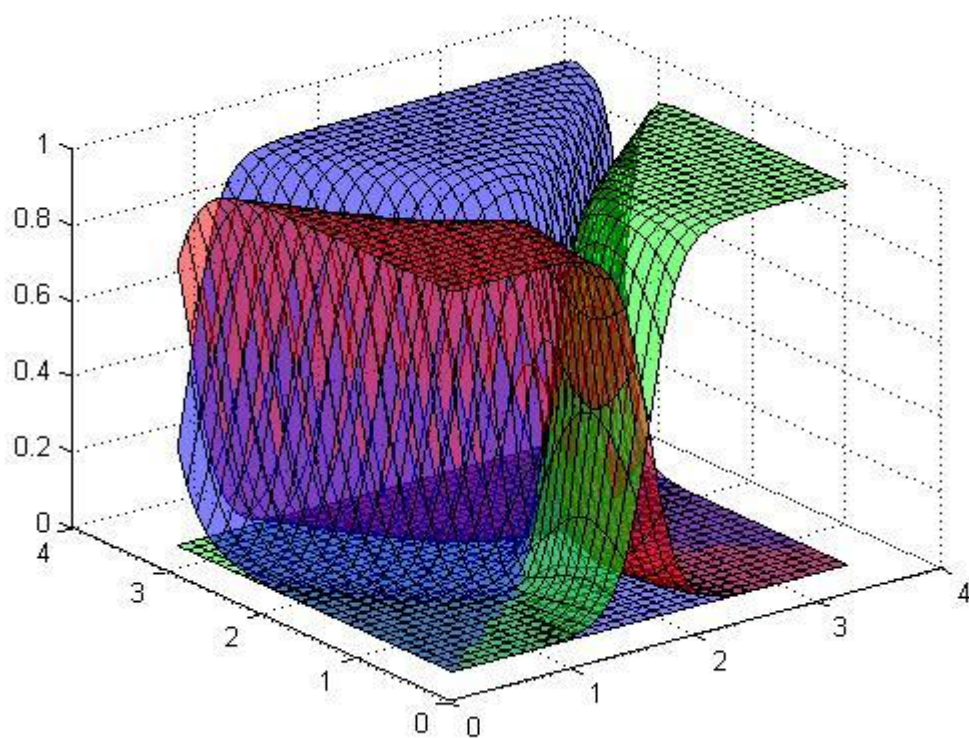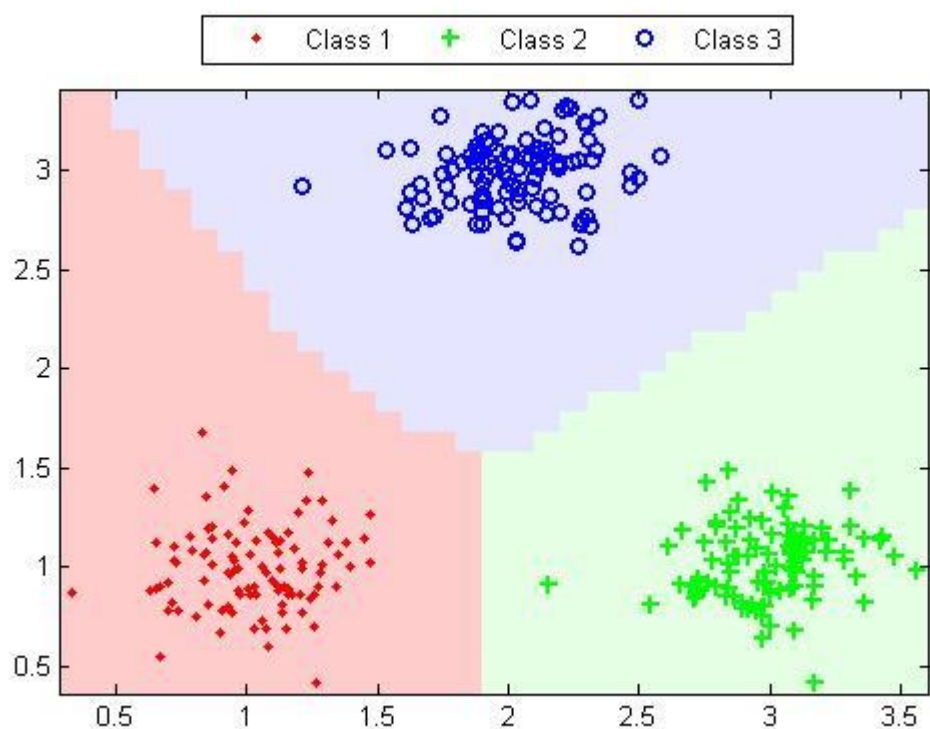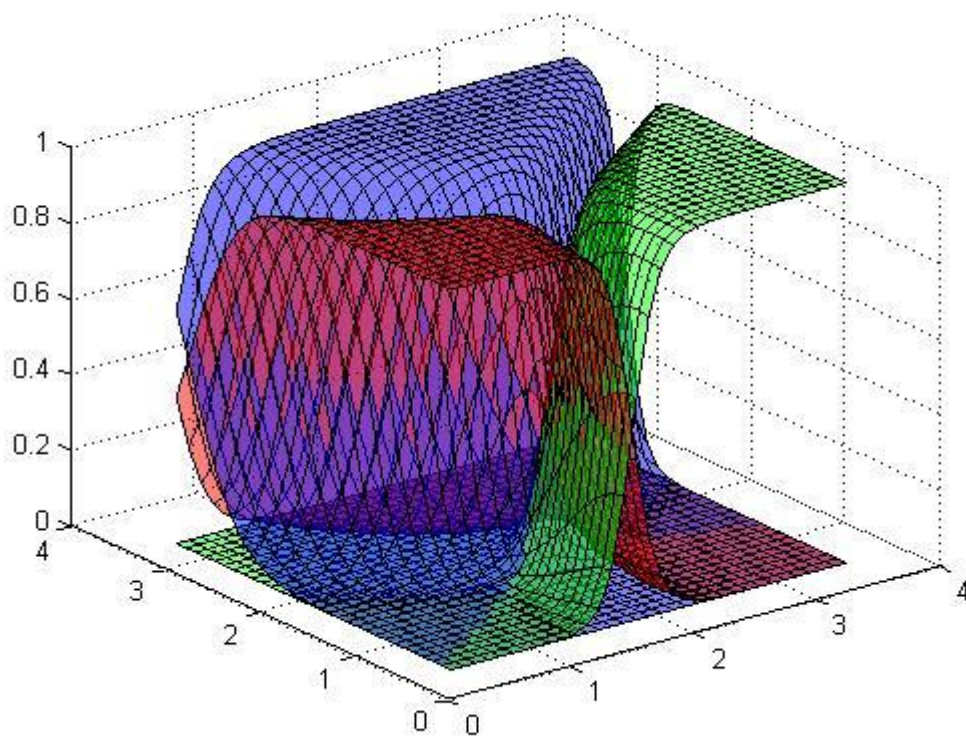# Assignment 3

Instructions:

1. MATLAB 2012b version for Ubuntu used to create the MATLAB scripts.
2. The directory where all the source code files are kept should be "Added to the path" in MATLAB.

Question 1

d) Fs
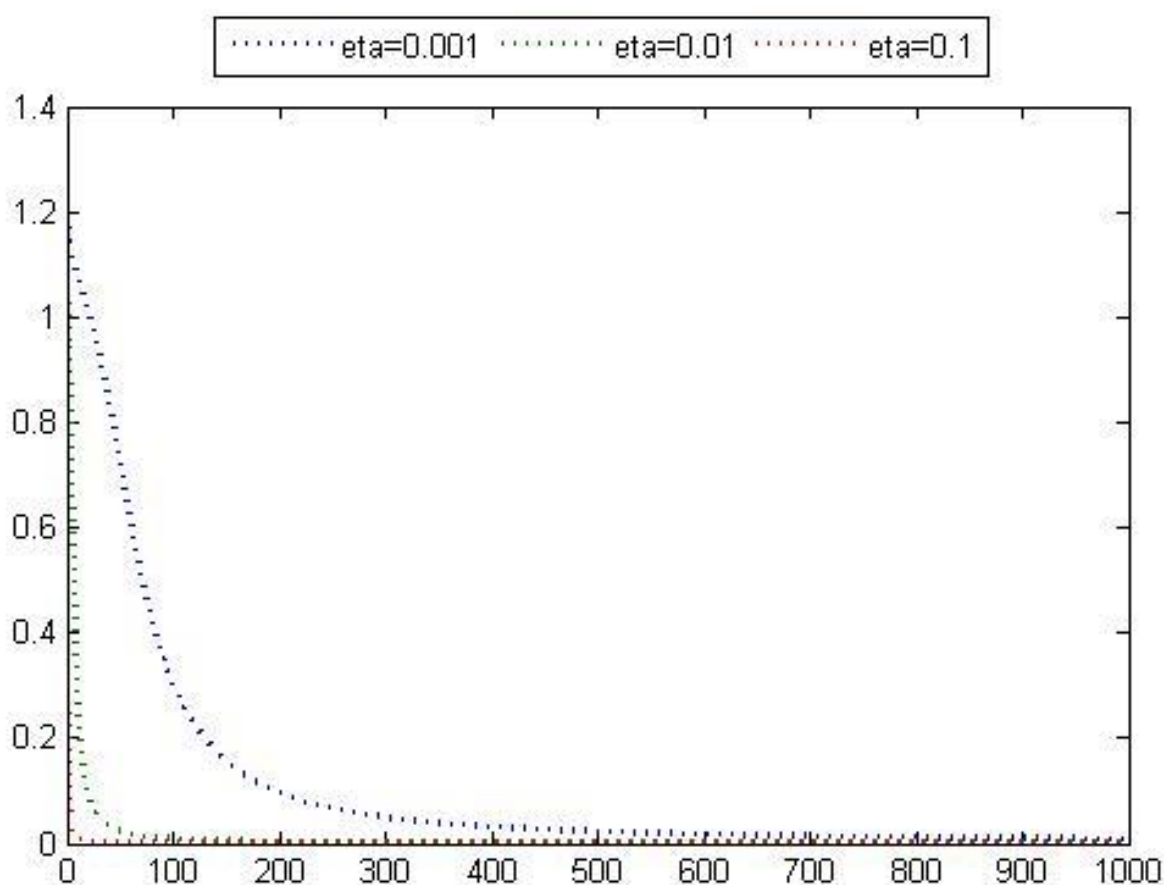
Decision boundary for h=2

Decision surface for h=2
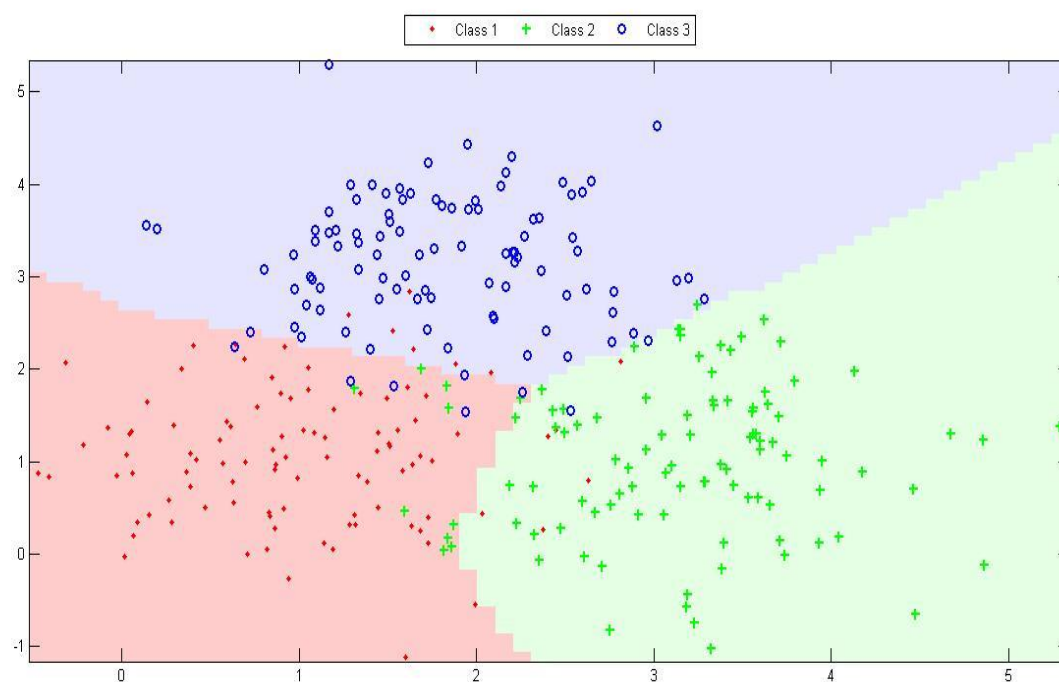
Decision boundary for h=4

Decision surface for h=4

decision boundary for h=64,

Observation : Decision boundaries separate farther as the no of H increases.

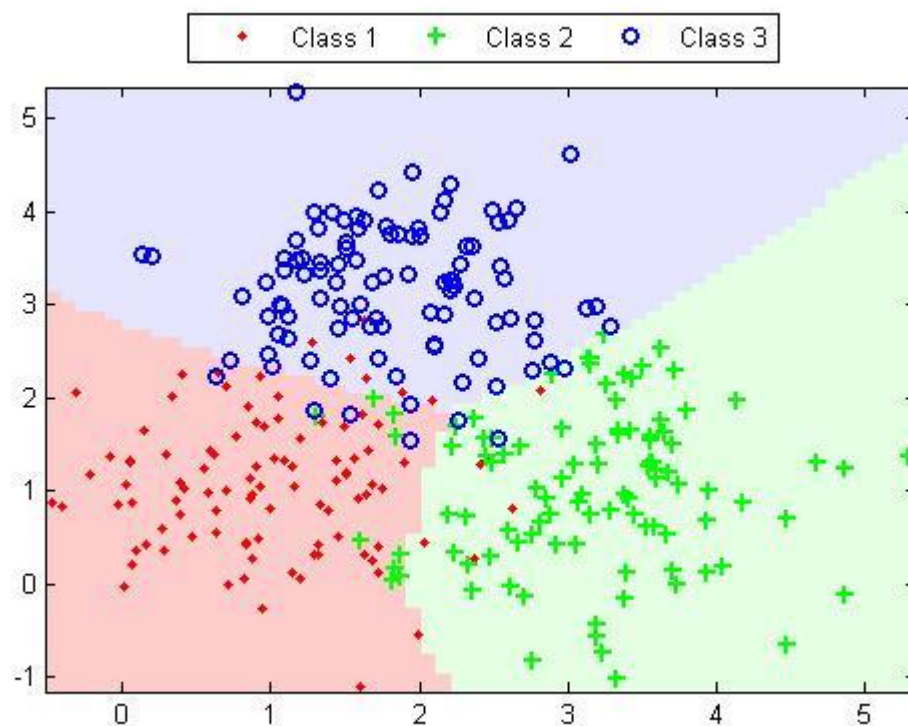e) Observation: As the learning rate increases, the rate of reduction in error increases.
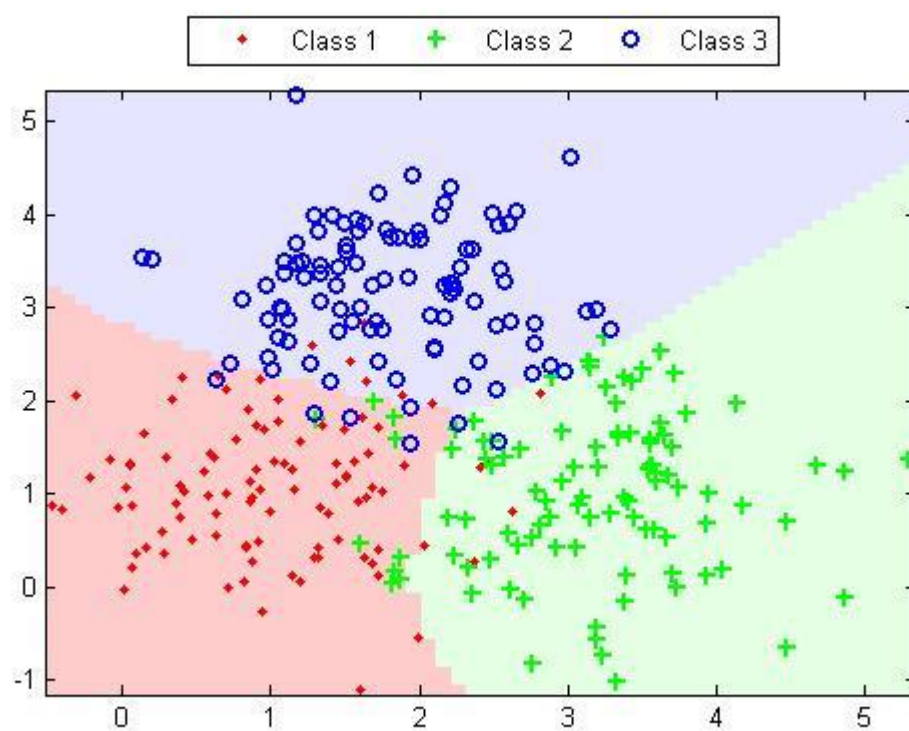
f) For nEpochs=1000

For nEpochs=5000

For nEpochs=10000

Question 3

Design a two input perceptron that implements the boolean function A ^ ¬B.
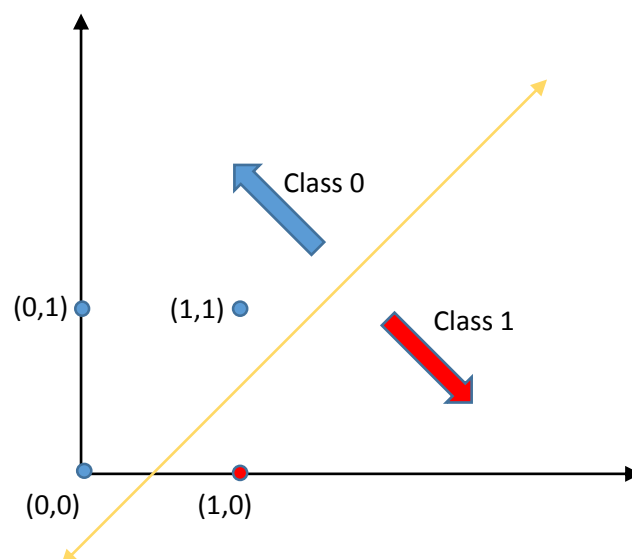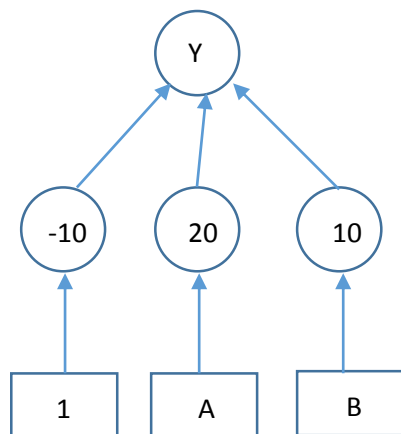
We get the equations as

$$w0 < 0$$

$$w0 + w2 < 0$$

$$w0 + w1 \geq 0$$

$$w0 + w1 + w2 < 0$$

Solving these for w0 = -10, we get,
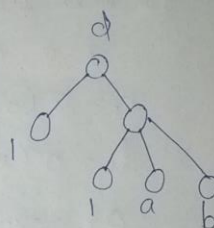
W0 = -10, W1 = 20, W2 = 10

Question 2

Q-2

$n = 0.3$

$\alpha = 0.9$

$w_{ca} = 0.1$ all weight equal.

$a = 1 \quad b = 0 \quad d = 1$

$\sigma(\cdot)$ denotes sigmoid

$C_0 = \sigma\left(0.1 + (0.1 \times 1) + (0.1 \times 0)\right)$

$= \dfrac{1}{1 + e^{-0.2}} \quad = 0.549$

$d_0 = \sigma\left(0.1 + (0.1 \times 0.549)\right)$

$= \dfrac{1}{1 + e^{-0.15}} \quad = 0.538$

$\Delta d_0 = d_0 (1 - d_0) + (d - d_0) = 0.1$

$\Delta C_0 = -C_0 (C_0 - 1) + w_{dc} + \Delta d = 0.002$

Weights updated ...

$\Delta w_{ca} = (0.3 \times 0.002 \times 1) + (0.9 \times 0) = 0.00085$

$\Delta w_{cb} = (0.3 \times 0.0028 \times 0) + 0 = 0$

$\Delta w_{co} = (0.3 \times 0.00283) + 0 = 0.0085$

$\Delta v_{dc} = 0.3 \times 0.114 \times 0.54 + 0 = 0.01$

$\Delta v_{do} = 0.3 \times 0.1146 + 0 = 0.034$

For next iteration,

$a = 0, \quad d = 0, \quad b = 1$

$c_1 = \sigma(0.1085 + 0.1 + 0.1) = 0.70$

$d_1 = \sigma(0.13 + (0.118 \times 0.55)) = 0.549$

$\Delta d = -0.13 \qquad \Delta c = -0.004$

$\Delta w_{ca} = 0.3 \times (-0.004) \times 0 + 0.9 \times 0.0085 \times 1 = 0.0007$

$\Delta w_{bc} = 0.3 \times (-0.004) + (0.9 \times 0) = 0.012$

$\Delta c_0 = -0.004$

$\Delta v_{dc} = -0.005$

$\Delta v_{do} = -0.09$

Weights are finally updated to

$w_{ca} = 0.10$

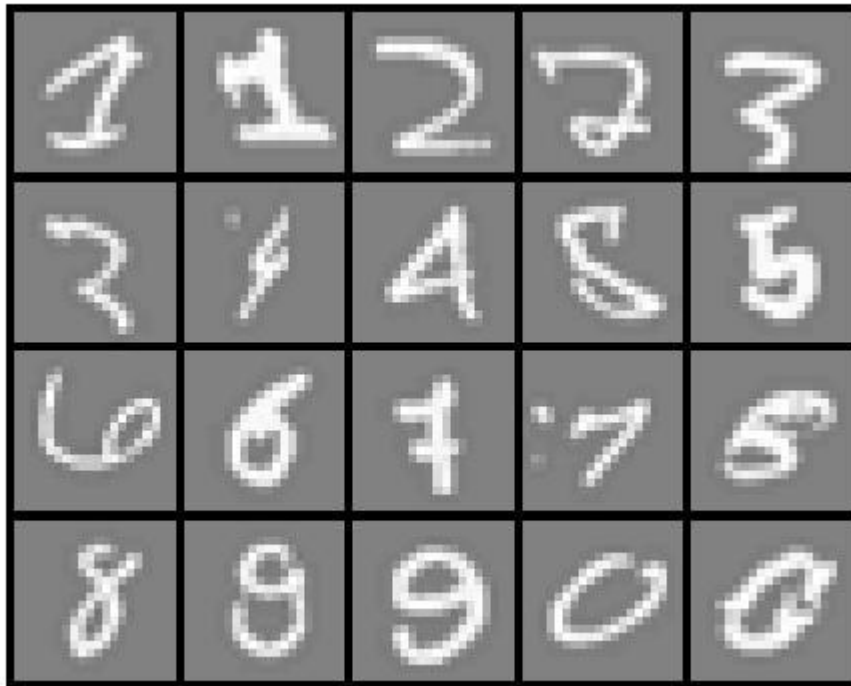$w_{cb} = 0.10988$

$w_{co} = 0.1004$

$w_{dc} = 0.1134$

$w_{do} = 0.124$

Question 4

```
a) deltav = (Y-ydash)' * z' ;
   deltaw = ( ((Y-ydash)*v(:,2:H+1))' .* ( ones(H,M) - ( z(2:H+1,:).*z(2:H+1,:)
   ) ) ) ) * [ones(M,1) , X ] ;
```
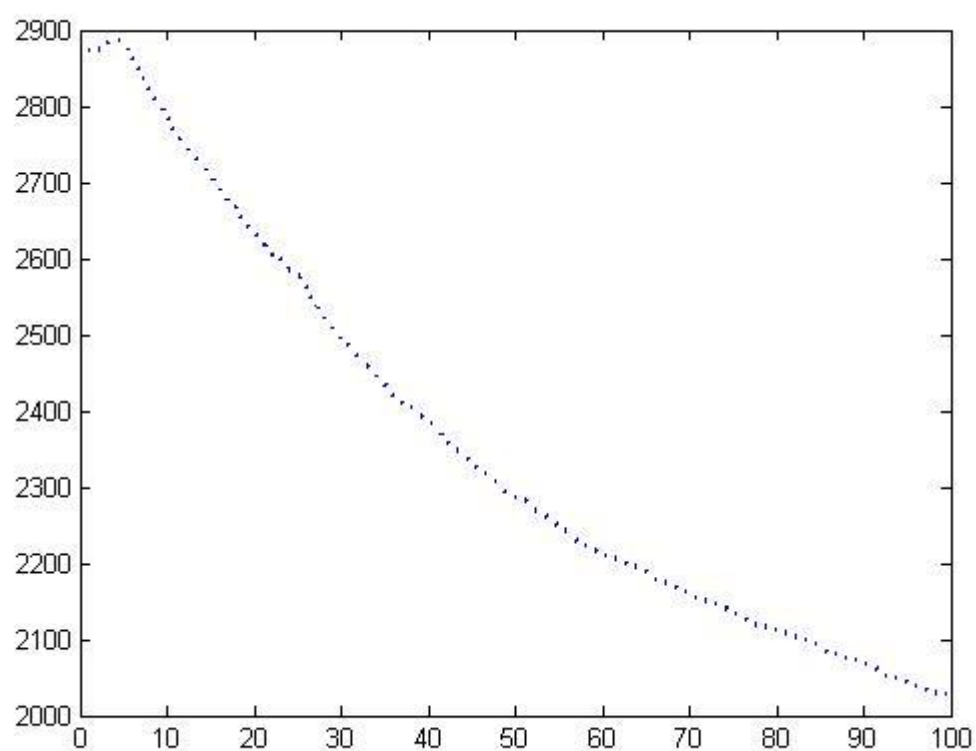
b)

c)   The misclassified points in the testing set

Training error for 100 epochs

Similarly validation error for 100 epochs