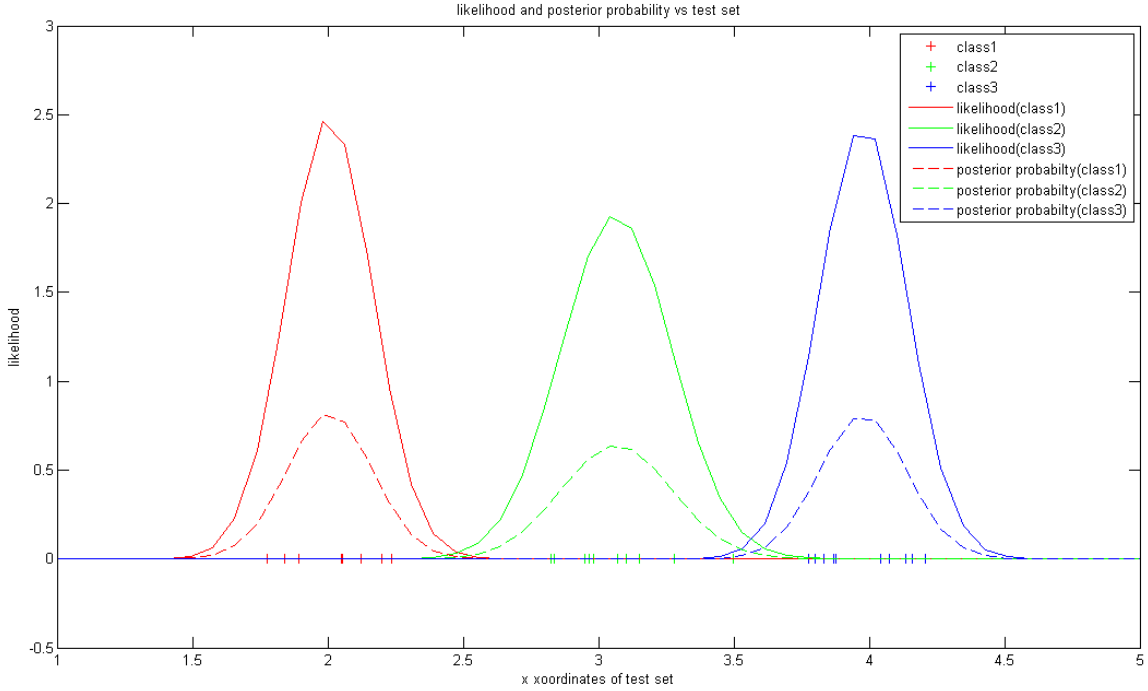
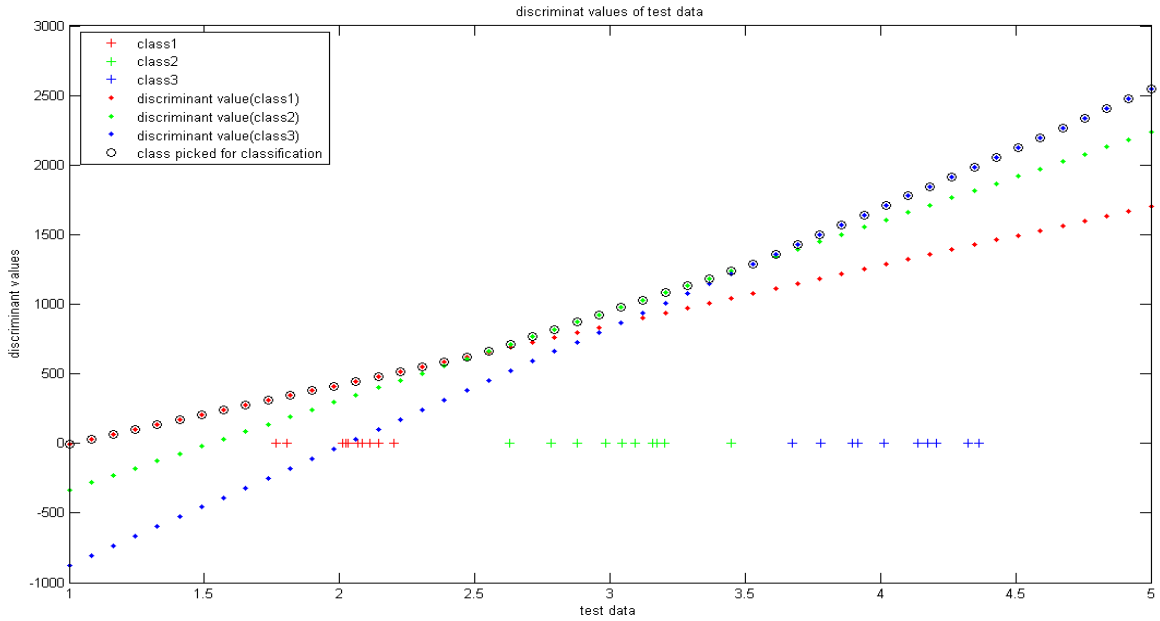
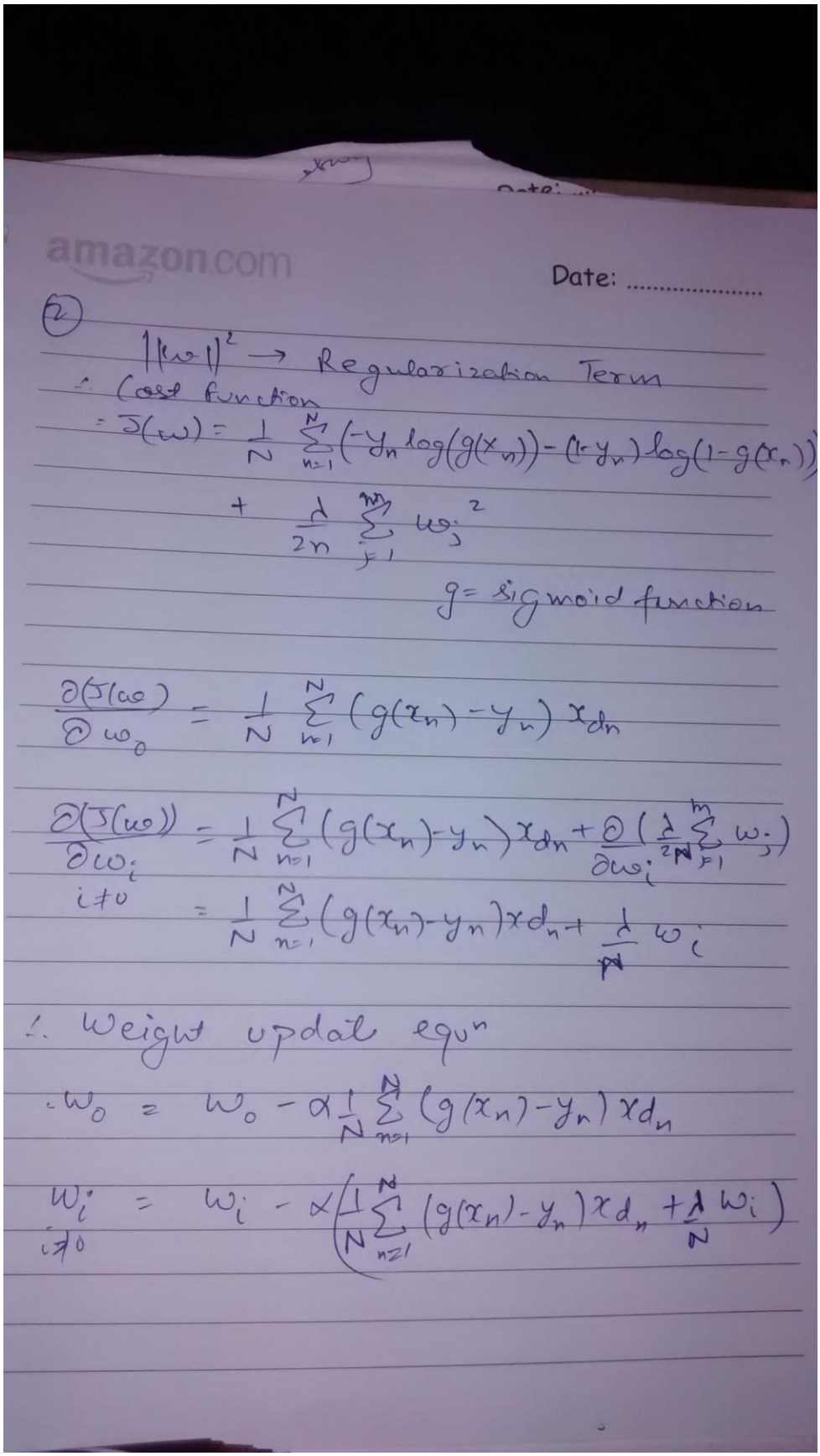
1. Following are the two plots





2.



amazon.com

Date: .....

(2)

$\|w\|^2 \rightarrow$ Regularization Term

∴ Cost function

$$= J(w) = \frac{1}{N} \sum_{n=1}^{N} \left(-y_n \log(g(x_n)) - (1-y_n) \log(1-g(x_n)) \right) + \frac{\lambda}{2n} \sum_{j=1}^{m} w_j^2$$

g = sigmoid function

$$\frac{\partial(J(w))}{\partial w_0} = \frac{1}{N} \sum_{n=1}^{N} (g(x_n) - y_n) x_{dn}$$

$$\frac{\partial(J(w))}{\partial w_i} = \frac{1}{N} \sum_{n=1}^{N} (g(x_n) - y_n) x_{dn} + \frac{\partial}{\partial w_i} \left(\frac{\lambda}{2N} \sum_{j=1}^{m} w_j \right)$$

$i \neq 0$

$$= \frac{1}{N} \sum_{n=1}^{N} (g(x_n) - y_n) x_{dn} + \frac{\lambda}{N} w_i$$

∴ Weight updat equⁿ

$$w_0 = w_0 - \alpha \frac{1}{N} \sum_{n=1}^{N} (g(x_n) - y_n) x_{dn}$$

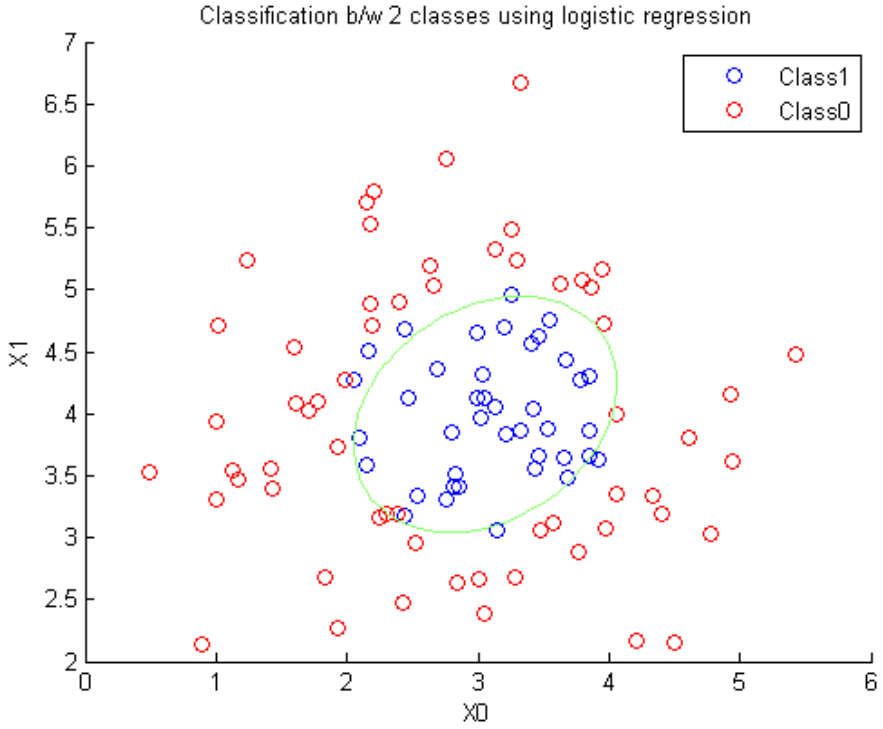
$$w_i = w_i - \alpha \left(\frac{1}{N} \sum_{n=1}^{N} (g(x_n) - y_n) x_{dn} + \frac{\lambda}{N} w_i \right)$$

$i \neq 0$

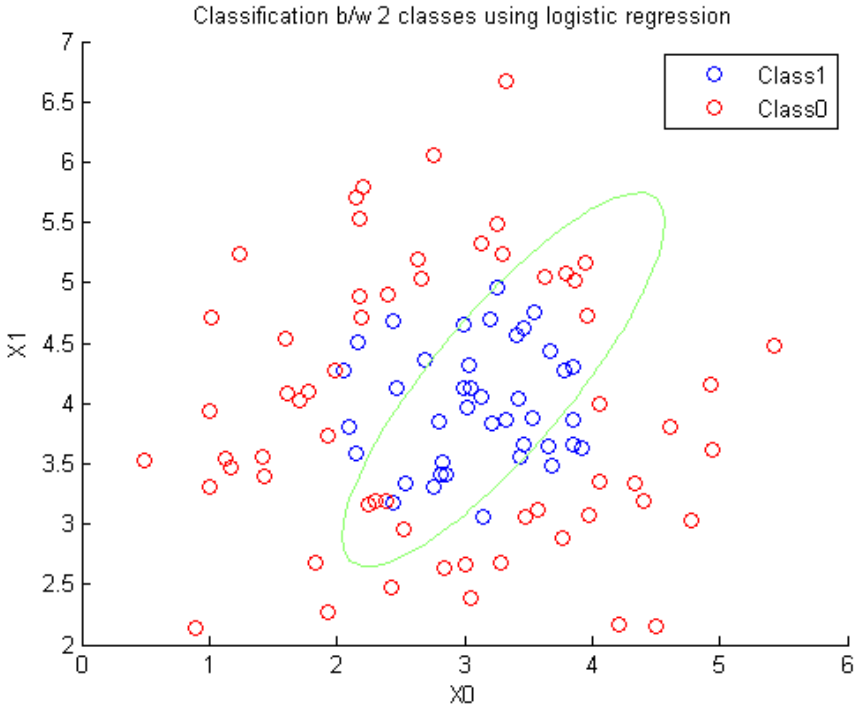
3.

Contour Plots using logistic regression in higher degree

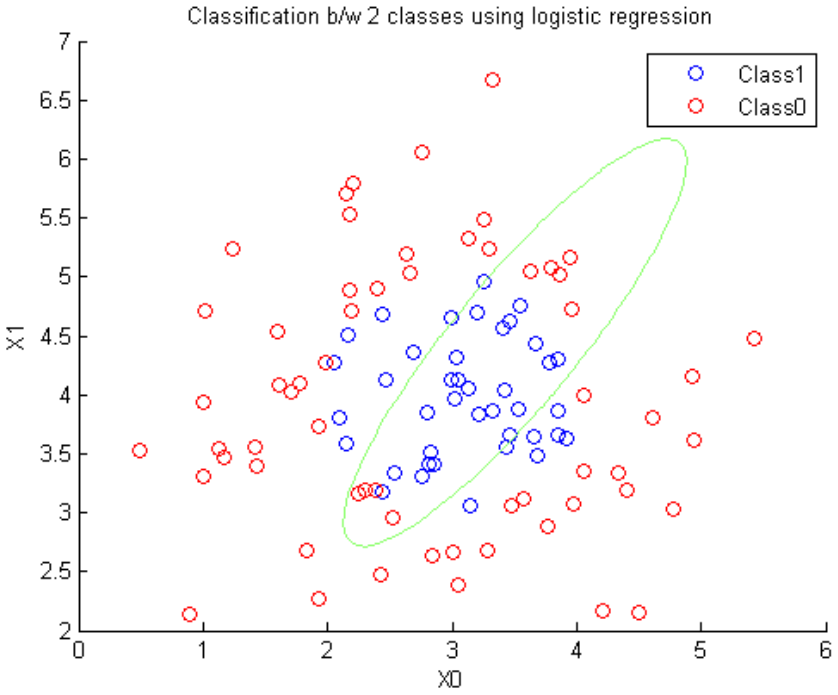
Degree=2, Lambda=0



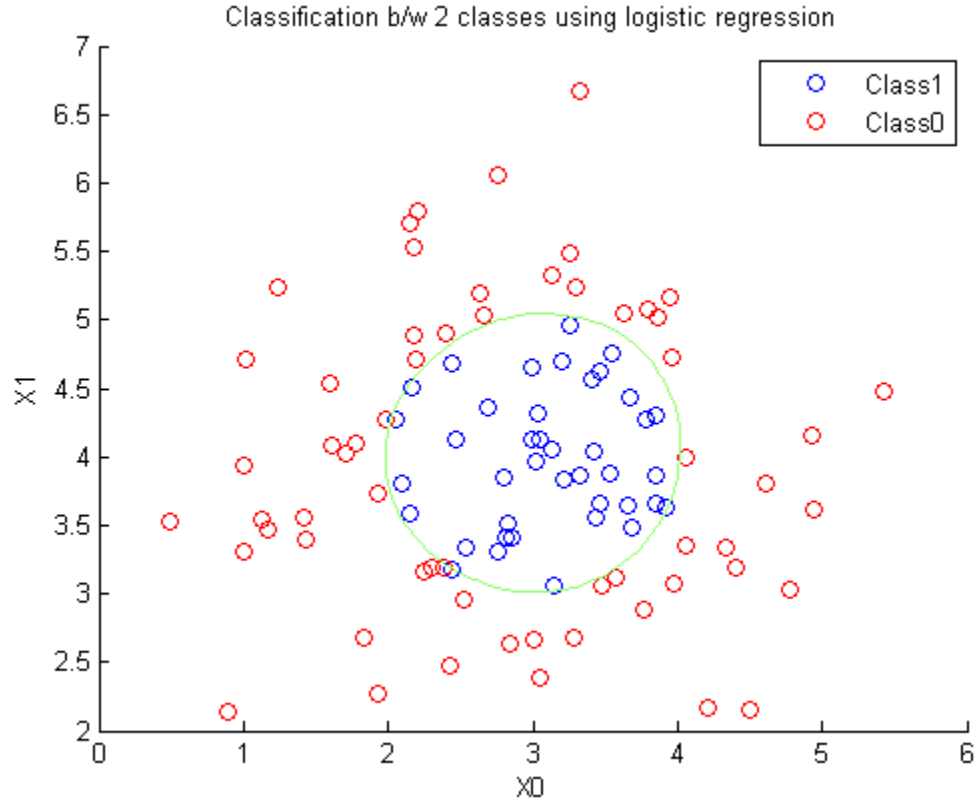
Degree=2, Lambda=0.2



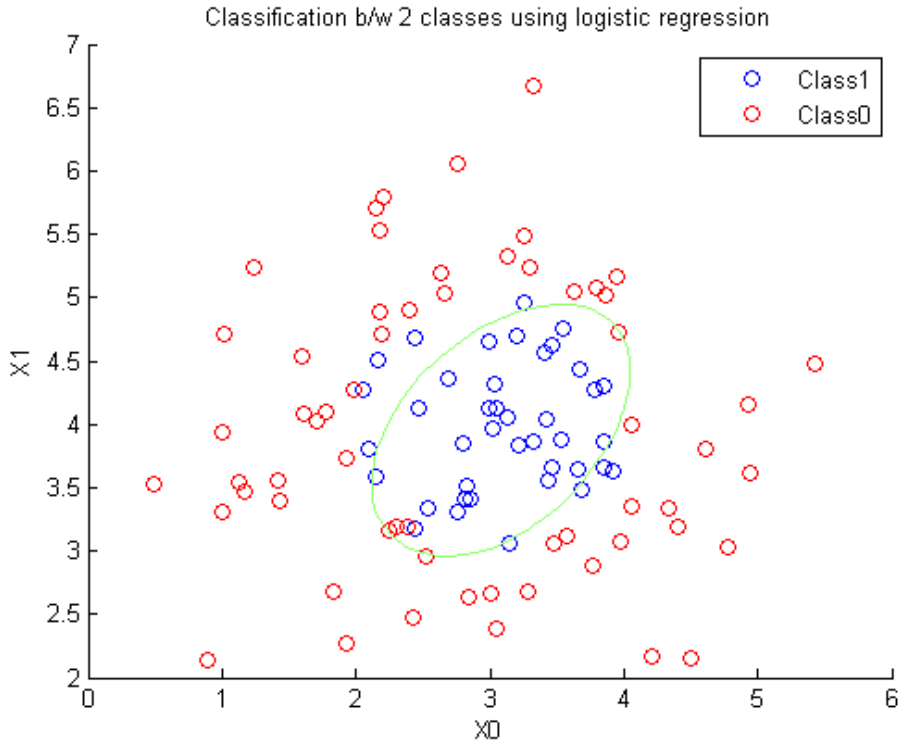
Degree=2, Lambda=0.4



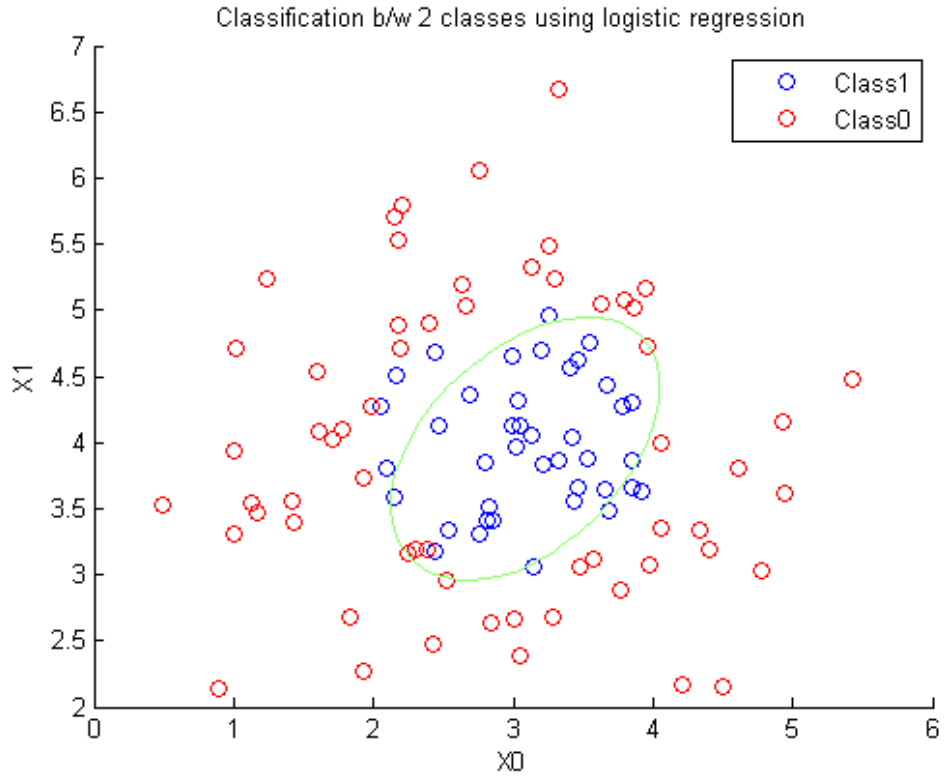
Degree=3, Lambda=0



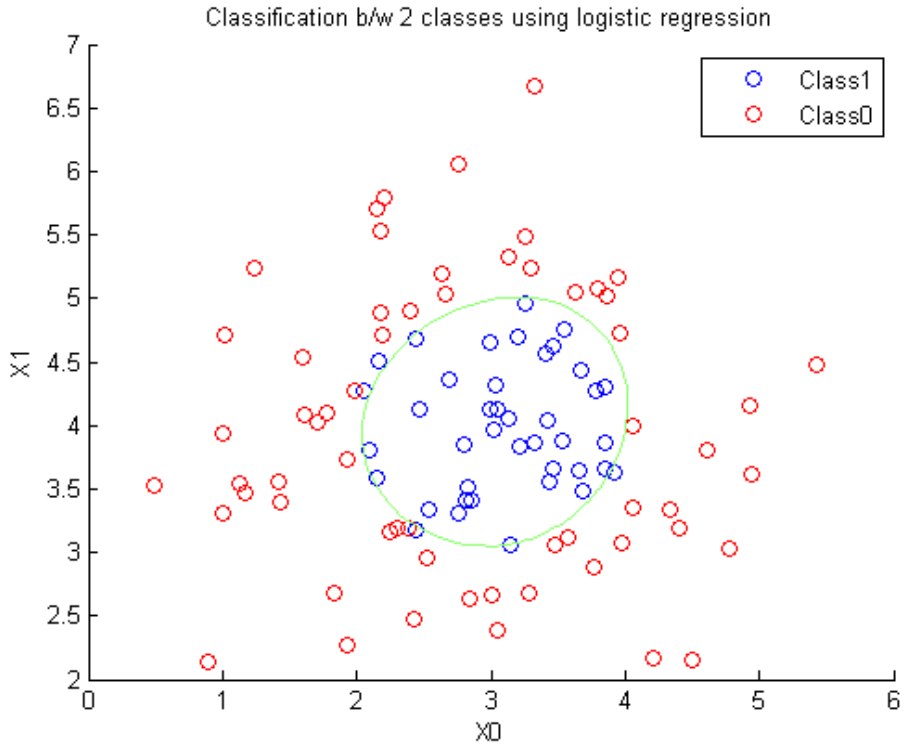
Degree=3, Lambda=0.4



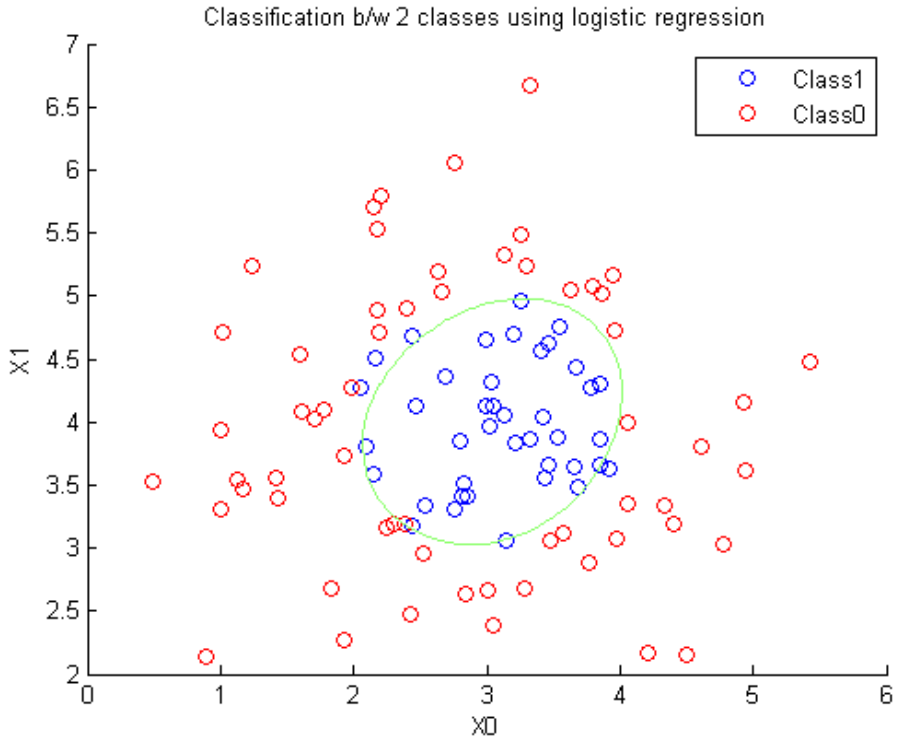
Degree=3, Lambda=0.6



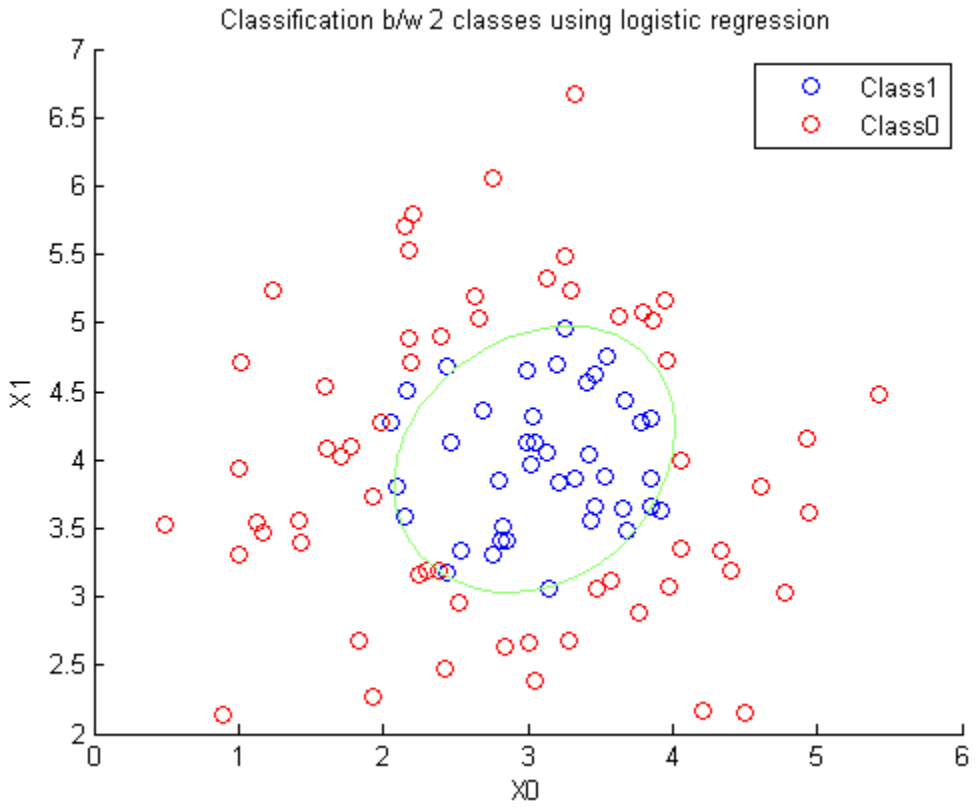
Degree=4, Lambda=0.2



Degree=4, Lambda=0.6



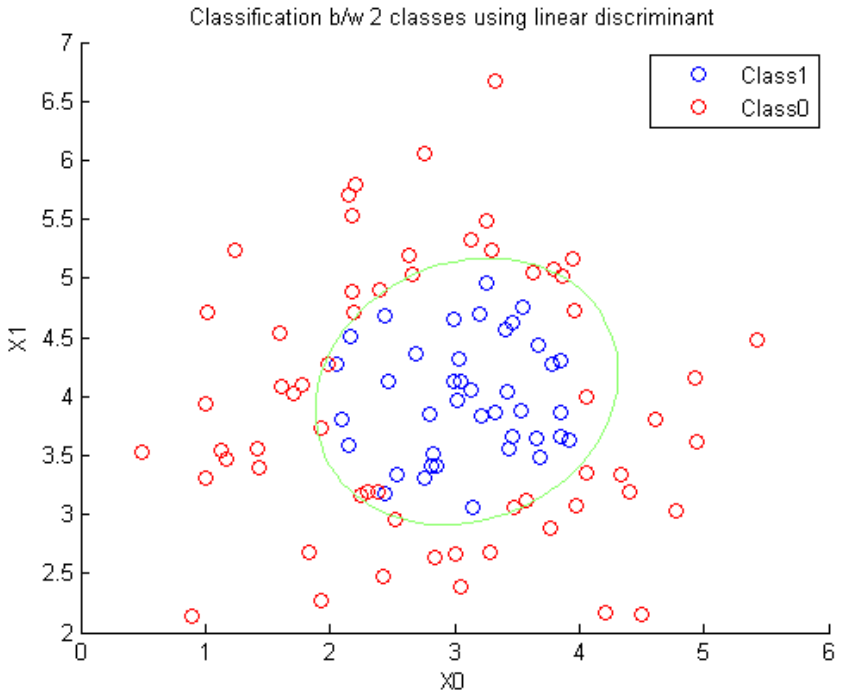
Degree=4, Lambda=0.8



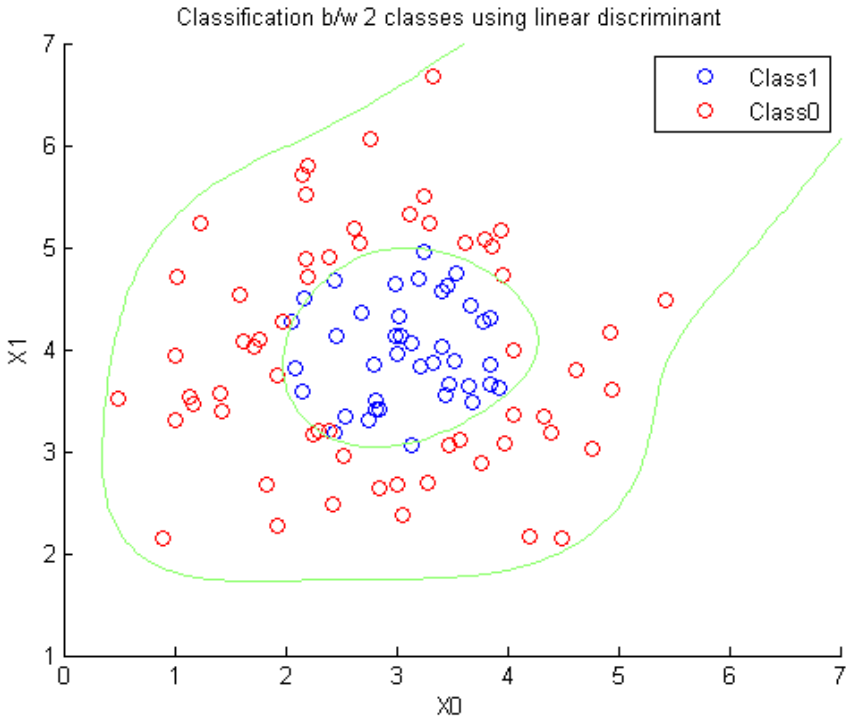
We can see that there is overfitting for (deg=2, lambda=0; deg=3,lambda=0) and underfitting for deg=2,lambda=0.6

Contour Plot using Discriminant Function

Deg =2



Deg=4



4. x1 = hours studied,
   x2 = undergrad GPA,
   Y = receive an A
   w0 = -8
   w1 = 0.05
   w2 =1

   (a) x1 = 5
       x2 = 7.5

       $W^TX = -8 + (0.05*5) + (1*7.5) = -0.25$

       Therfore, $g(w^Tx) = g(-0.25) = 0.4378$

   (b) Probability of student getting A in class = 0.6
       ⇨ $g(w^Tx) = 0.6$
       ⇨ $w^Tx = 0.4054 -8 + (0.05*x1) + (1*7.5)$
       ⇨ $0.4054(x1) = 18.108$

       Student need to study for 18.108 hours .