# ASSIGNMENT 3

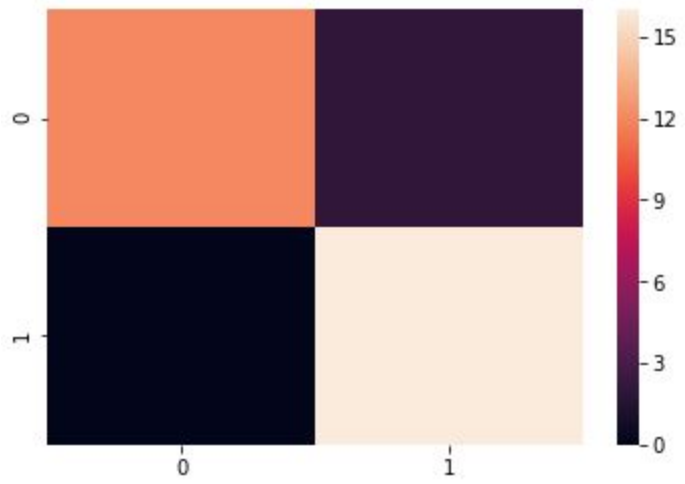
## Logistic Regression using Gradient Descent

### 1) Exam Dataset :-

For this particular dataset the decision boundary used is :-

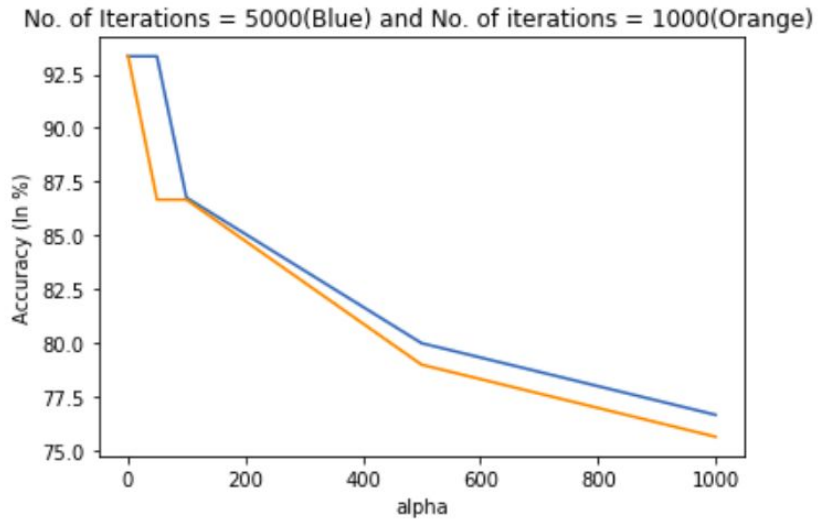
$D(theta) = (theta_1 * x_1) + (theta_2 * x_2) + (theta_3 * x_3)$

We measure the accuracy of the classifier using the confusion matrix. The confusion matrix obtained for this particular dataset looks like :-




The accuracy obtained for the model designed by logistic regression using gradient descent is :- 93.333333% when the number of iterations used is 7000 with the value of learning rate as 0.01 and with the training set values scaled using standardization. We have used regularisation to improve the accuracy. The value of the regularisation parameter is 0.05.

If we do not scale(pre-process) the training sample values, then the accuracy obtained is 47.22% when the number of iterations used is 7000 with the value of learning rate as 0.01.




The above graph shows the the variation of the accuracy of the classifier with respect to the values of alpha.We can see that for a value of alpha that is not very large, an increase in the number of iterations usually leads to an increase in the accuracy.

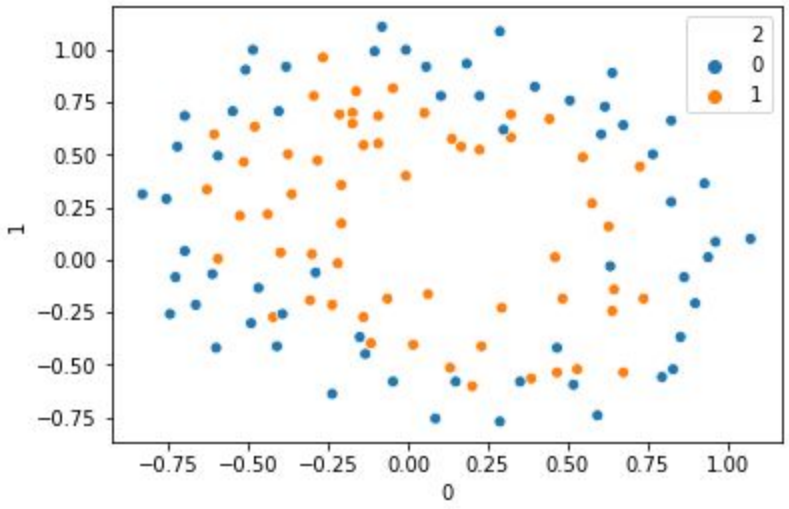
## 2) Microchip Dataset :-

For this dataset if we use

$D(theta) = (theta_1 * x_1) + (theta_2 * x_2) + (theta_3 * x_3)$

as the decision boundary the accuracy obtained with number of iterations as 7000 and value of learning rate as 0.01 is 52.77%

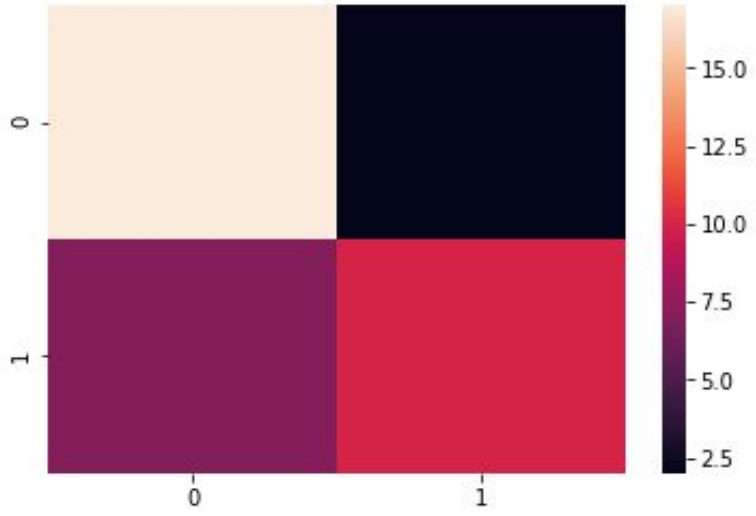
If we plot the input training dataset we get :-



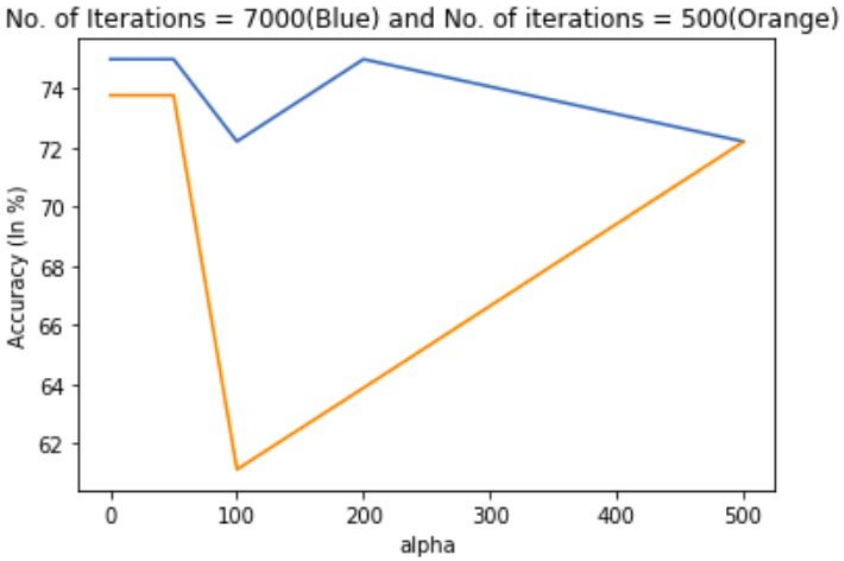

We can see that the decision boundary is circular in shape therefore we choose the decision boundary as :-

$D(theta) = (theta_1 * x_1) + (theta_2 * (x_2)^2) + (theta_3 * (x_3)^2)$

We measure the accuracy of the classifier using the confusion matrix. The confusion matrix obtained for this particular dataset looks like :-



The accuracy obtained now with number of iterations as 7000 and value of learning rate as 0.01 is 75.00%(The training sample values have been scaled using standardization)
If the training sample values have not been scaled then the accuracy obtained with number of iterations as 7000 and value of learning rate as 0.01 is 61.12%.
We can observe that in this case, the negative effect of not using standardization is lesser than in the case of exam dataset.




The above graph shows the the variation of the accuracy of the classifier with respect to the values of alpha. We can see that for very large values of alpha the accuracy becomes unpredictable because of the large step size.