Part 1:

1.1 N=10

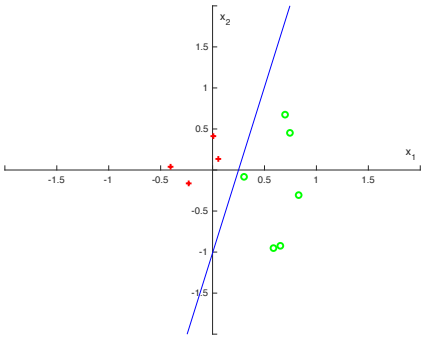

Fig 1: The above figure represents the binary classification of training dataset using Perceptron Learning algorithm. Here, data set points are 10 and final hypothesis line is represented by blue line.

Training Dataset Results:

Average number of iterations for convergence (1000 times repetition:) 4
final weight matrix after training is:
-0.5051
-1.8839
0.7387

Test Dataset Results:

Average number of misclassified data points for 1000 times repetition: 51

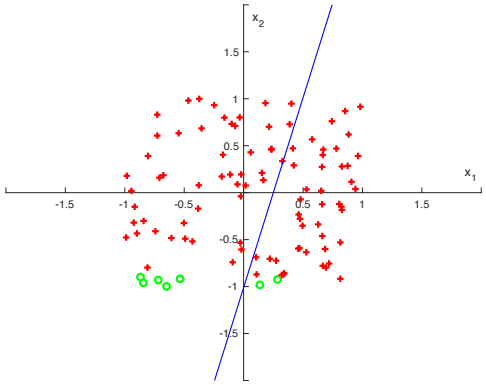

Fig 2: The above figure represents the binary classification of test dataset using Perceptron Learning algorithm. Here, data set points are 100 and final hypothesis line is represented by blue line. It shows that there are several misclassifications data points existed.

1.2 N=100

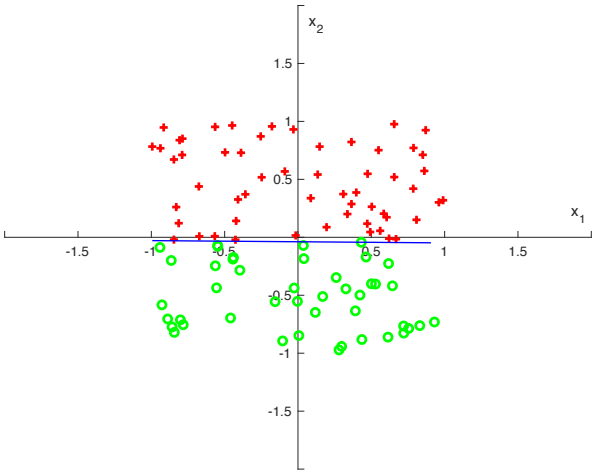

Fig 3: The above figure represents the binary classification of training dataset using Perceptron Learning algorithm. Here, data set points are 100 and final hypothesis line is represented by blue line.

Training Dataset Results:

Average number of iterations for convergence (1000 times repetition:) 27
final weight matrix after training is:
0.9271
0.2362
24.1393

Test Dataset Results:

Average number of misclassified data points for 1000 times repetition: 508

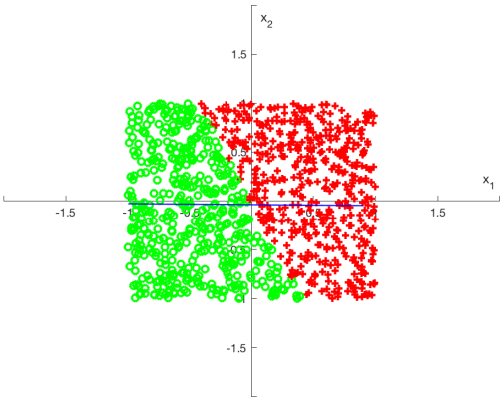

Fig 4: The above figure represents the binary classification of test dataset using Perceptron Learning algorithm. Here, data set points are 1000 and final hypothesis line is represented by blue line.

Part 2

Training Dataset, N=100 and Test Dataset, N =10,000

1. Learning rate, η=100

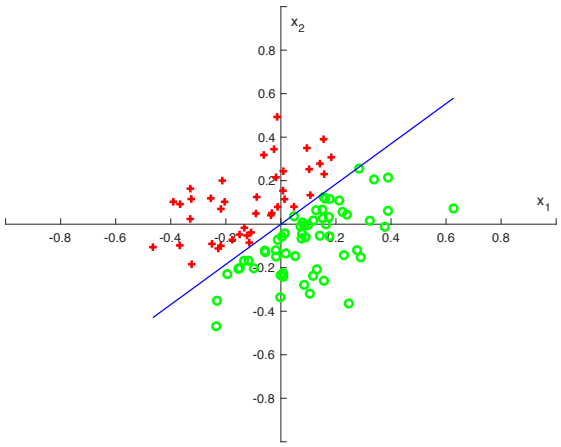

Fig 5: The above figure represents the binary classification of training dataset using Perceptron Learning algorithm. Here, data set points are 100, learning rate (η=100) and final hypothesis line is represented by blue line.

Training Dataset Results:

Number of iterations takes to final hypothesis convergence: 4

Test Dataset Results:

Error: 125

2. Learning rate, η=1

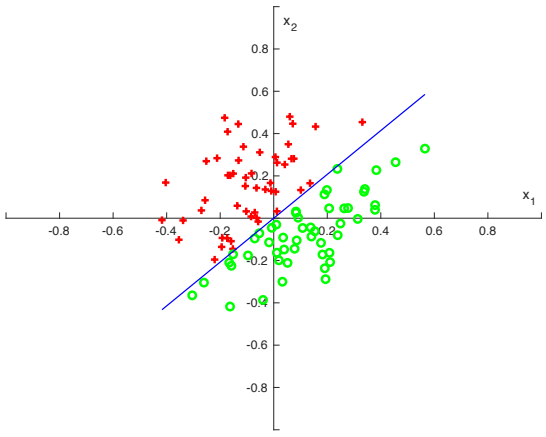

Fig 6: The above figure represents the binary classification of training dataset using Perceptron Learning algorithm. Here, data set points are 100, learning rate (η=1) and final hypothesis line is represented by blue line.

Training Dataset Results:

Number of iterations takes to final hypothesis convergence: 15

Test Dataset Results:

Error: 55

3. Learning rate, η=0.01

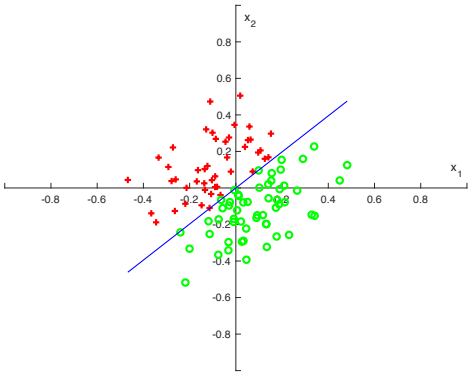

Fig 7: The above figure represents the binary classification of training dataset using Perceptron Learning algorithm. Here, data set points are 100, learning rate (η=0.01) and final hypothesis line is represented by blue line.

Training Dataset Results:

Number of iterations takes to final hypothesis convergence: 160

Test Dataset Results:

Error: 25

4. Learning rate, η=0.0001

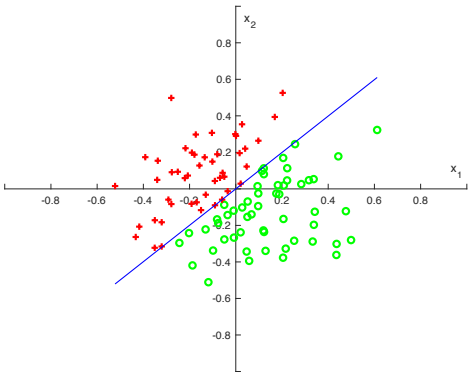

Fig 8: The above figure represents the binary classification of training dataset using Perceptron Learning algorithm. Here, data set points are 100, learning rate (η=0.0001) and final hypothesis line is represented by blue line.

Training Dataset Results:

Number of iterations takes to final hypothesis convergence: 498

Test Dataset Results:

Error: 3

Result Discussion:

The learning rate has direct impact on both the number of the required iteration for convergence on training set and the misclassified data on test dataset. From the above results implies that if the higher learning rate requires less iteration to convergent but it has higher error rate. On the other hand, smaller learning rate has less error but higher iterations.

Iteration Limit:

For very small learning rate, it requires very large number of iterations (theoretically it can go up to infinite). Therefore, iteration number limit is added to the equation.