Neural Networks **T.Raghu Bharadwaj**

Assignment 1 **18MCMT03**

Given Classes,

Class 1: {(1,6),(7,2),(8,9),(9,9),(4,8),(8,5)}

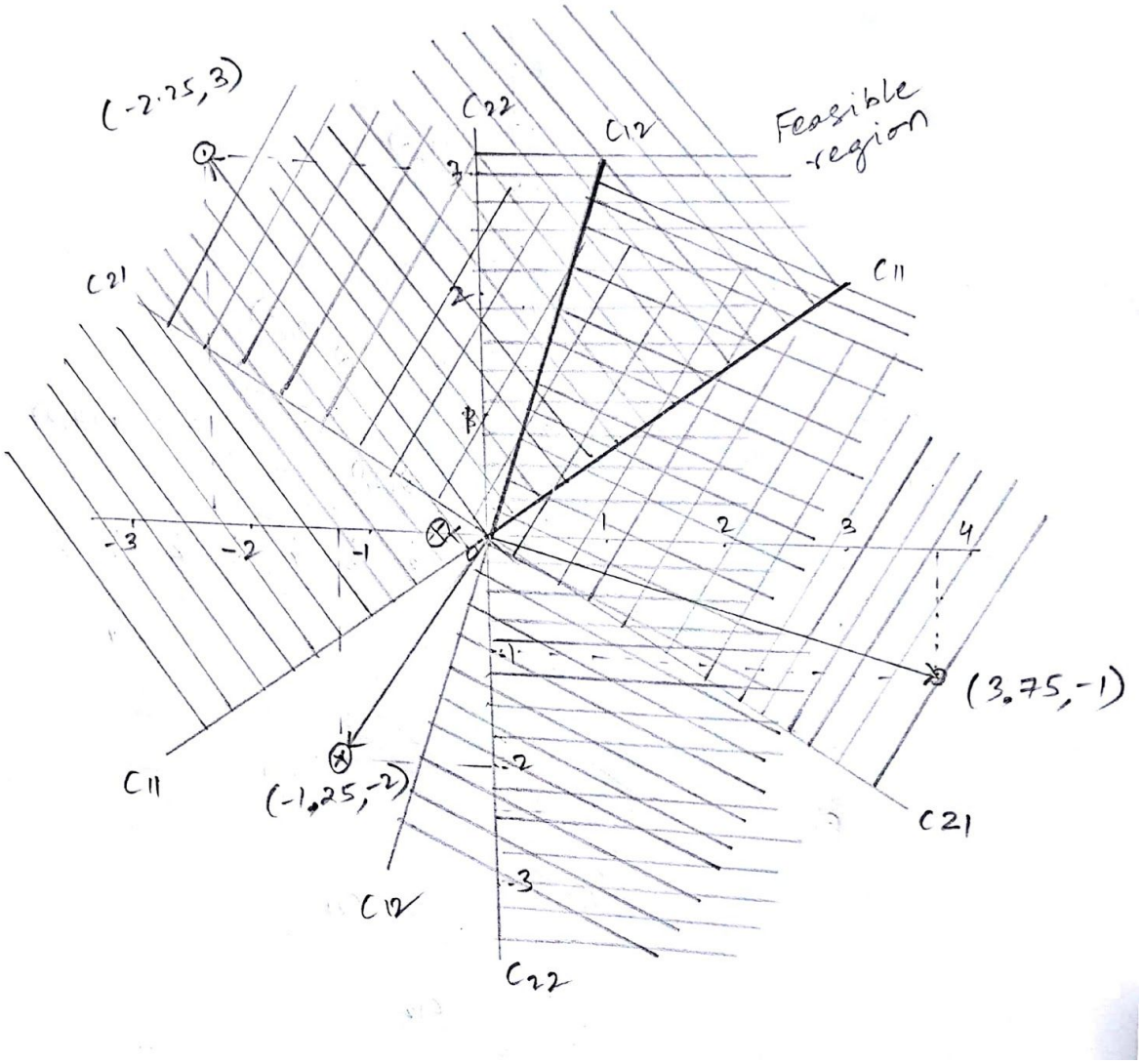
Class 2: {(2,1),(3,3),(2,4),(7,1),(1,3),(5,2)}

A. Yes,this data set is linearly separable.

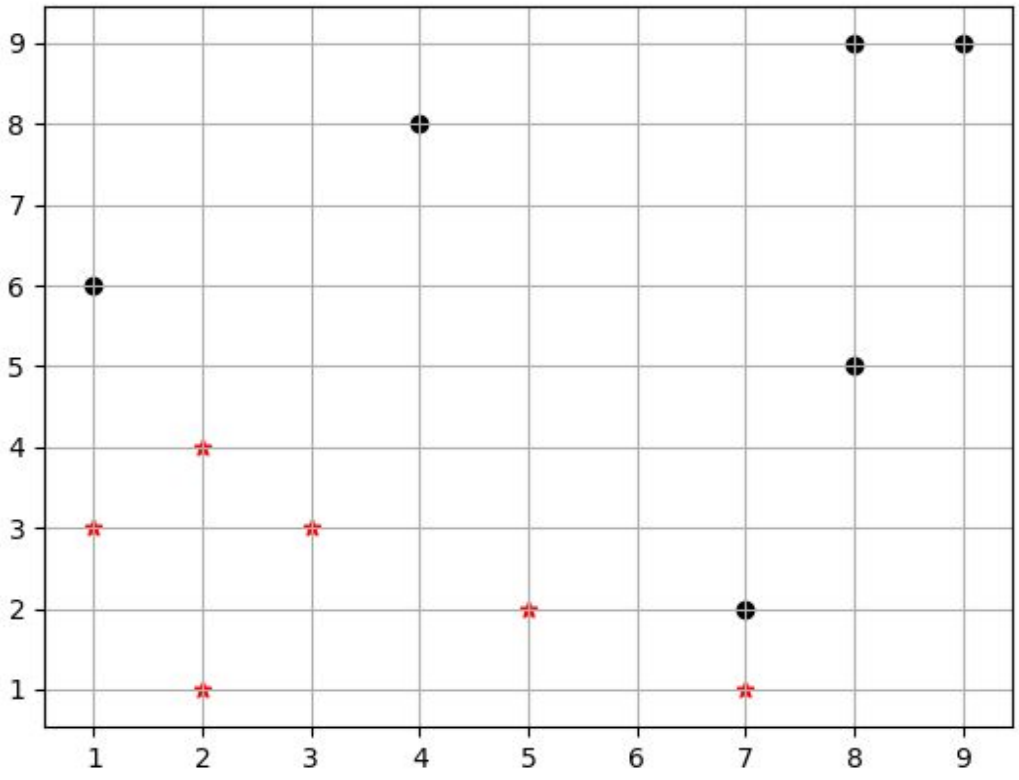
Hand drawn feasible region for the above classes (two points from each class) taken is

C_1: (1,6), (7,2) C_{1n}: (−2.25, 3), (3.75, −1)

C_2: (2,1), (3,3) C_{2n}: (−1.25, −2), (−0.25, 0)

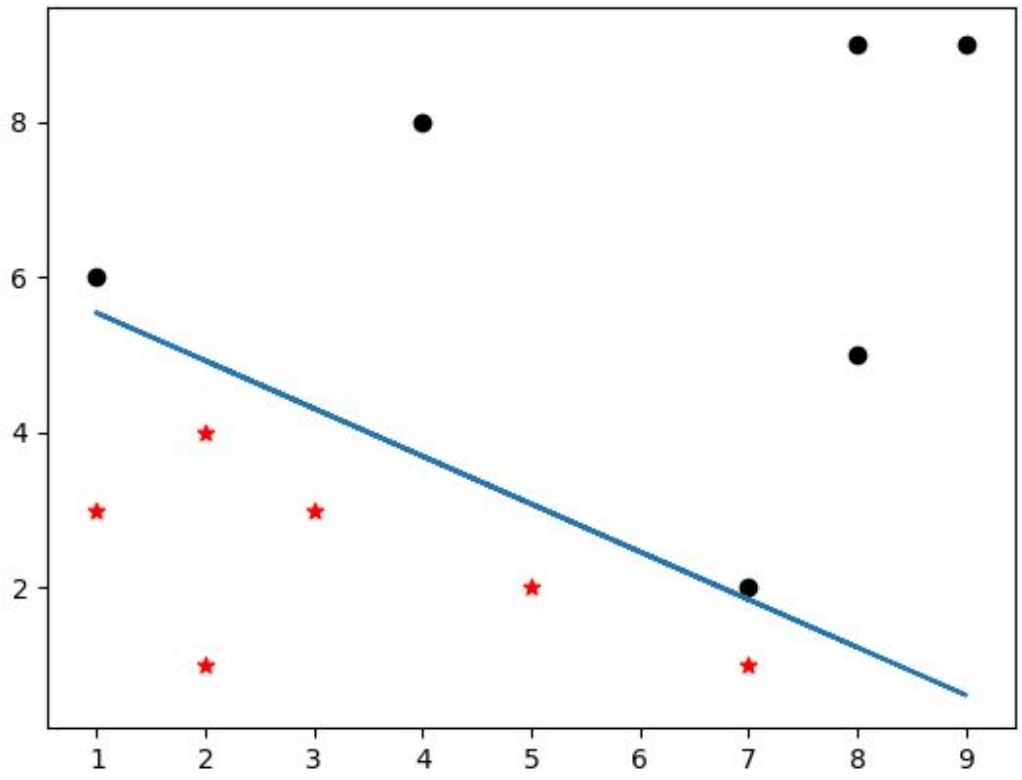


Graph plotting all the points according to the classes given(o - Class 1 ,* - Class 2)



1. Perceptron with threshold activation function :

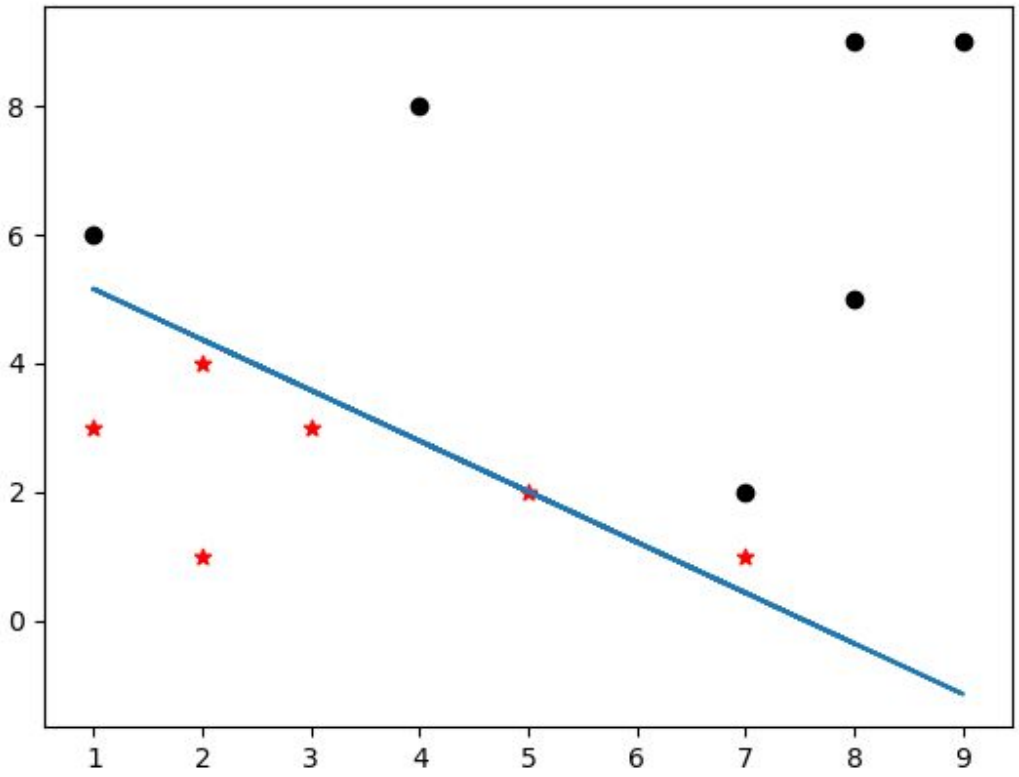
Perceptron with threshold activation function means plotting the output function in the range[0,1]. If the function of the class of data is above a threshold value(**θ**), the output is equal to 1 whereas the function of the class of data that is less than the threshold, the output is equal to 0. If the output for all the classes is equal to the desired output, the weights learnt by the learning algorithm is according to the function and satisfies the class of data into linearly separable one.



2. Perceptron with Widrow-Hoff rule / Least Mean Squared Error

Perceptron with Widrow-Hoff function means plotting the output function in the range(-inf,+inf). If the output for all the classes is equal to the desired output, the weights learnt by the learning algorithm is according to the function and satisfies the class of data into linearly separable one.

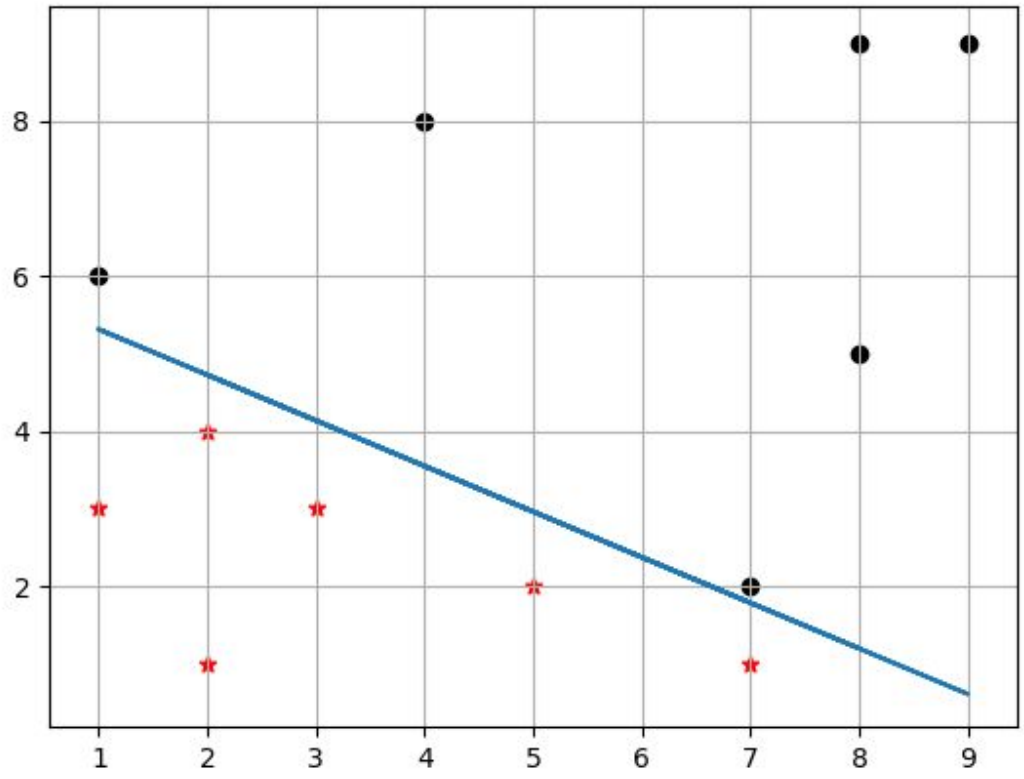
f(x)=x



3.Perceptron with Sigmoid function:

Perceptron with Sigmoid function means plotting the output function in the range(-inf,+inf). If the output for all the classes is equal to the desired output, the weights learnt by the learning algorithm is according to the function and satisfies the class of data into linearly separable one.

f(x)=1/(1+exp(-x))



B. Weights learnt by the algorithms

Function	Initial w1	Learnt w1	Initial w2	Learnt w2	Initial bias	Learnt bias
Threshold activation function	**-0.2**	**0.08**	**-0.3**	**0.13**	**threshold**	**threshold**
Widrow-Hoff Rule	**0.1**	**-0.12**	**0.2**	**-0.1522**	**0.9**	**0.9051**
Sigmoid function	**2**	**1.2322**	**1**	**2.0955**	**0.5**	**-12.3590**

C. Accuracy for the algorithms based on the learnt weights and adding new data to the classes

Class 1: {(1,1),(2,3),(3,2)}

Class 2: {(7,7),(6,5),(3,6)}

Function	Accuracy	Error
Threshold Activation Function	**100**	**0**
Widrow-Hoff Rule	**0**	**100**
Sigmoid Function	**0**	**100**

D.Run Time for each Algorithm

Function	Run time
Threshold Activation Function	**0.002701777000000072**
Widrow-Hoff Rule	**0.03934576000000001**
Sigmoid Function	**0.222109679**

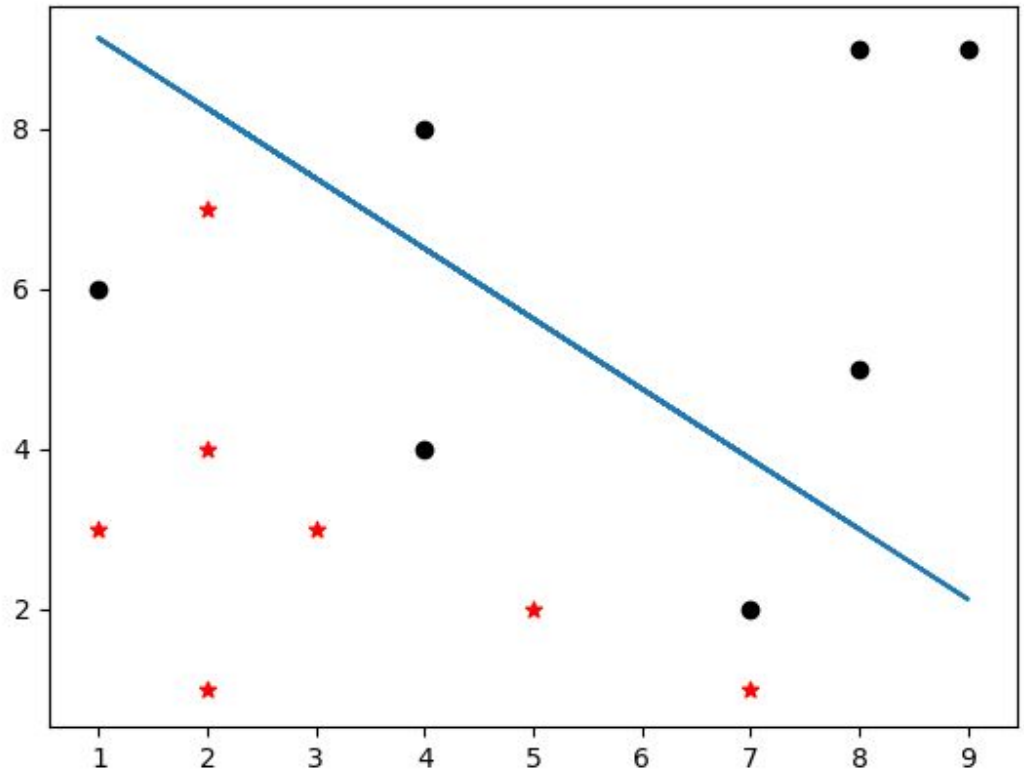
F.Modification of data set such that it becomes non linearly separable

Class 1: {(4,4)}

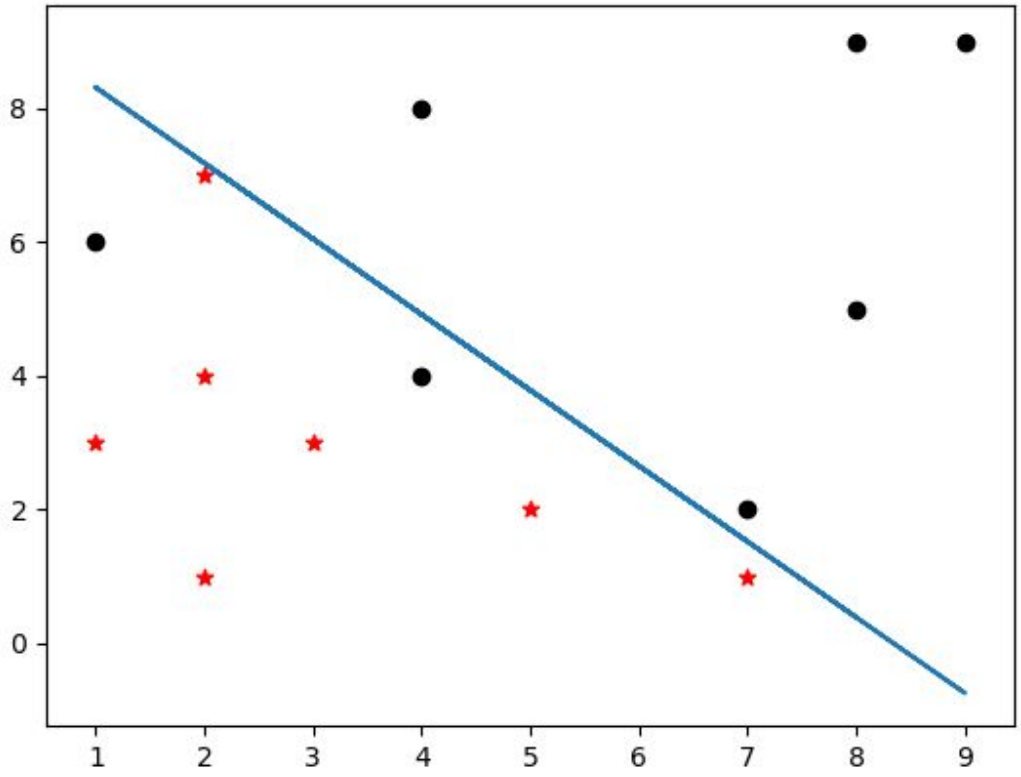
Class 2: {(2,7)}

Function	Learnt w1	Learnt w2	Learnt bias	Run time	Accuracy	Error
Threshold Activation Function	0.0700	0.0800	threshold	0.0030995539999999 49	71.4286	28.5714
Widrow-Hoff Rule	-0.1252	-0.1105	1.0438	0.0434124249999999 8	0	100
Sigmoid Function	1.0273	0.7181	-8.4999	0.9507529100000003	0	100

Graph of modified class of Algorithm 1



Graph of modified class of Algorithm 2



Graph of modified class of Algorithm 3