Machine Learning

Assignment - Fractal 3

Submitted by

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Problem 1: Perceptron [40 points]

Following training samples are given:

x_1	x_2	Class
1	1	+1
-1	-1	-1
0	0.5	-1
0.1	0.5	-1
0.2	0.2	+1
0.9	0.5	+1

Table 1: Sample data

Assuming weight vector of initial decision boundary wT x = 0 as w=[1, 1], solve the following:

1. In how many steps perception learning algorithm will converge. (15 points)

2. What will be the final decision boundary? Show step-wise-step update of weight vector using computation as well as hand-drawn plot. (15 points)

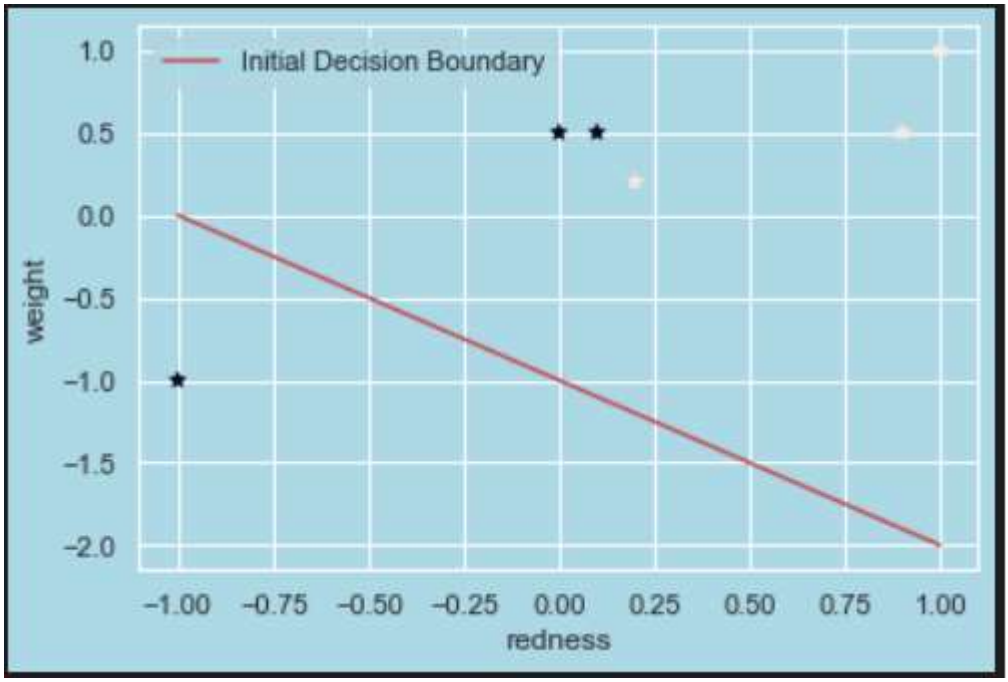
3. Prove that Perceptron Learning Algorithm converges in a finite number of steps. (10 points)

Solution:

Program Output Part:

(Hand Written part Added later)

Initial Decision Boundary: w=[1,1,1]



Iteration is : 1

Sample is : [1. 1. 1.]

Class is : 1

Dot Product of W & X is : 3.0

Positive Sample is correctly classified

Sample is : [-1. -1. 1.]

Class is : -1

Dot Product of W & X is : -1.0

Negative Sample is Correctly classified

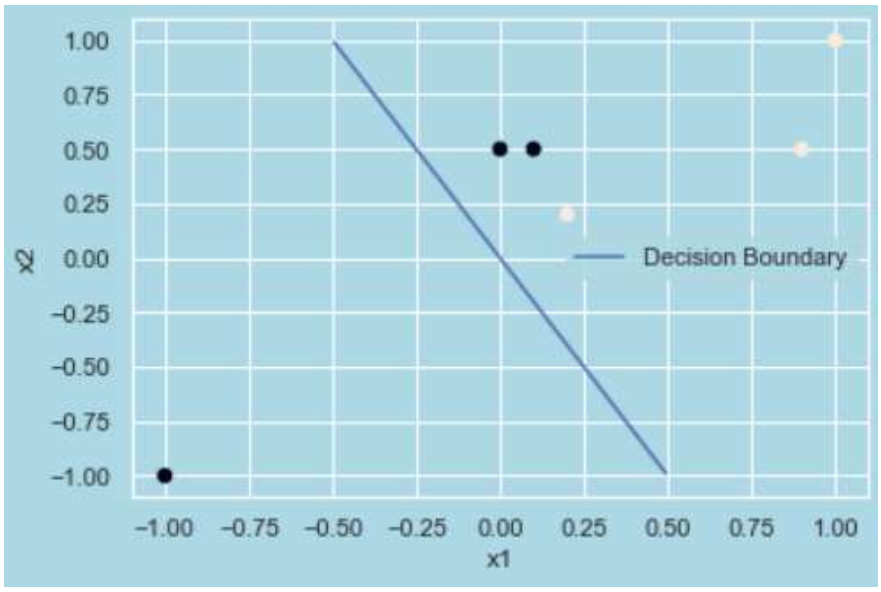
Sample is : [0. 0.5 1.]

Class is : -1

Dot Product of W & X is : 1.5

Negative Sample is classified positive

Updated W is : [1. 0.5 0.]



Sample is : [0.1 0.5 1.]

Class is : -1

Dot Product of W & X is : 0.35

Negative Sample is classified positive

Updated W is : [0.9 0. -1.]

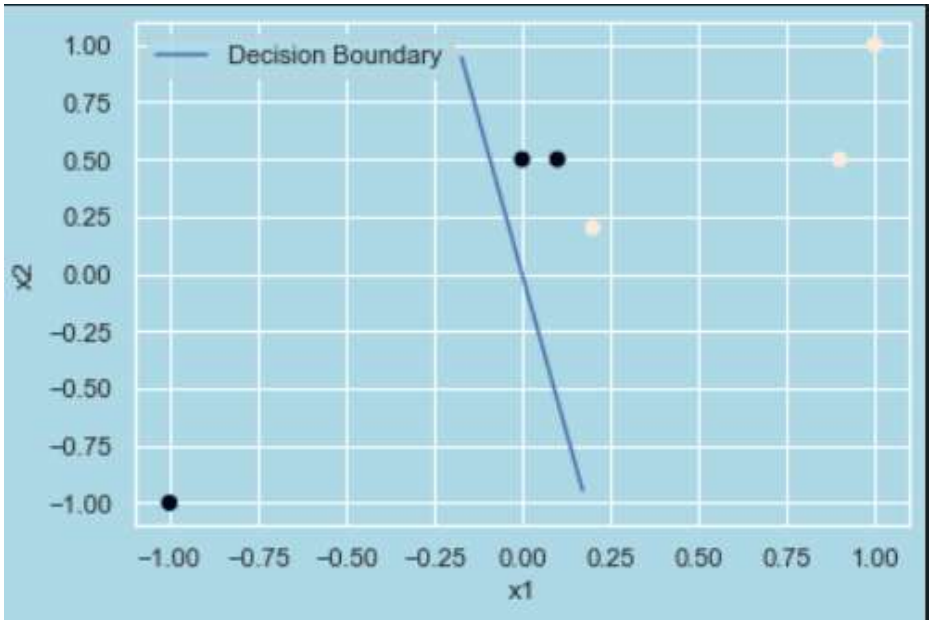
Sample is : [0.2 0.2 1.]

Class is : 1

Dot Product of W & X is : -0.82

Positive Sample is classified negative

Updated W is : [1.1 0.2 0.]



Sample is : [0.9 0.5 1.]

Class is : 1

Dot Product of W & X is : 1.09

Positive Sample is correctly classified

Iteration is : 2

Sample is : [1. 1. 1.]

Class is : 1

Dot Product of W & X is : 1.3

Positive Sample is correctly classified

Sample is : [-1. -1. 1.]

Class is : -1

Dot Product of W & X is : -1.3

Negative Sample is Correctly classified

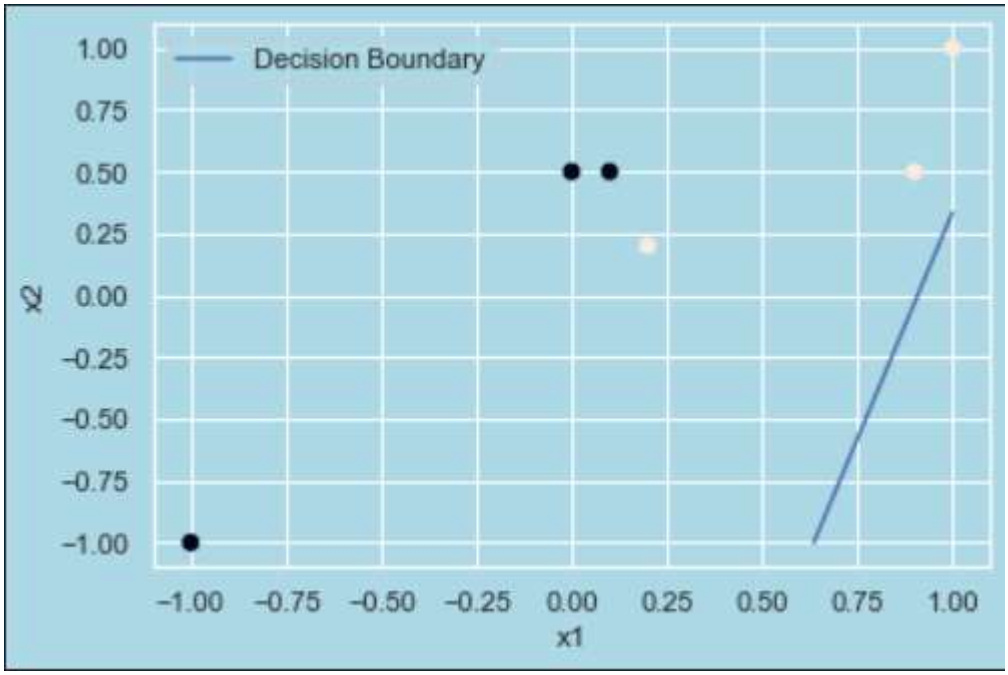
Sample is : [0. 0.5 1.]

Class is : -1

Dot Product of W & X is : 0.1

Negative Sample is classified positive

Updated W is : [1.1 -0.3 -1.]



Sample is : [0.1 0.5 1.]

Class is : -1

Dot Product of W & X is : -1.04

Negative Sample is Correctly classified

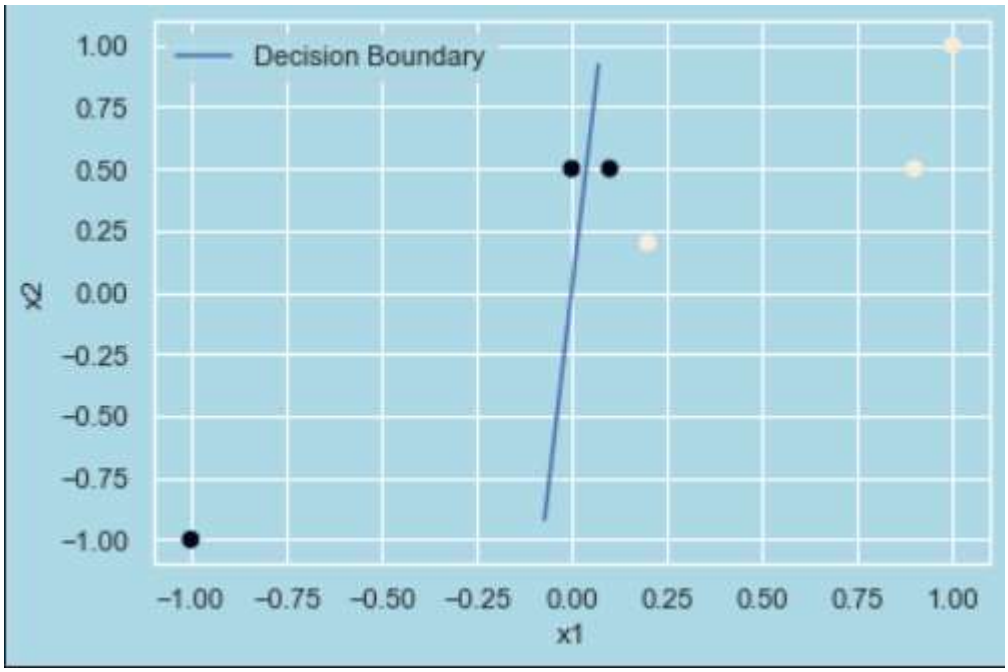
Sample is : [0.2 0.2 1.]

Class is : 1

Dot Product of W & X is : -0.84

Positive Sample is classified negative

Updated W is : [1.3 -0.1 0.]



Sample is : [0.9 0.5 1.]

Class is : 1

Dot Product of W & X is : 1.12

Positive Sample is correctly clasified

Iteration is : 3

Sample is : [1. 1. 1.]

Class is : 1

Dot Product of W & X is : 1.2000000000000002

Positive Sample is correctly clasified

Sample is : [-1. -1. 1.]

Class is : -1

Dot Product of W & X is : -1.2000000000000002

Negative Sample is Correctly classified

Sample is : [0. 0.5 1.]

Class is : -1

Dot Product of W & X is : -0.04999999999999999

Negative Sample is Correctly classified

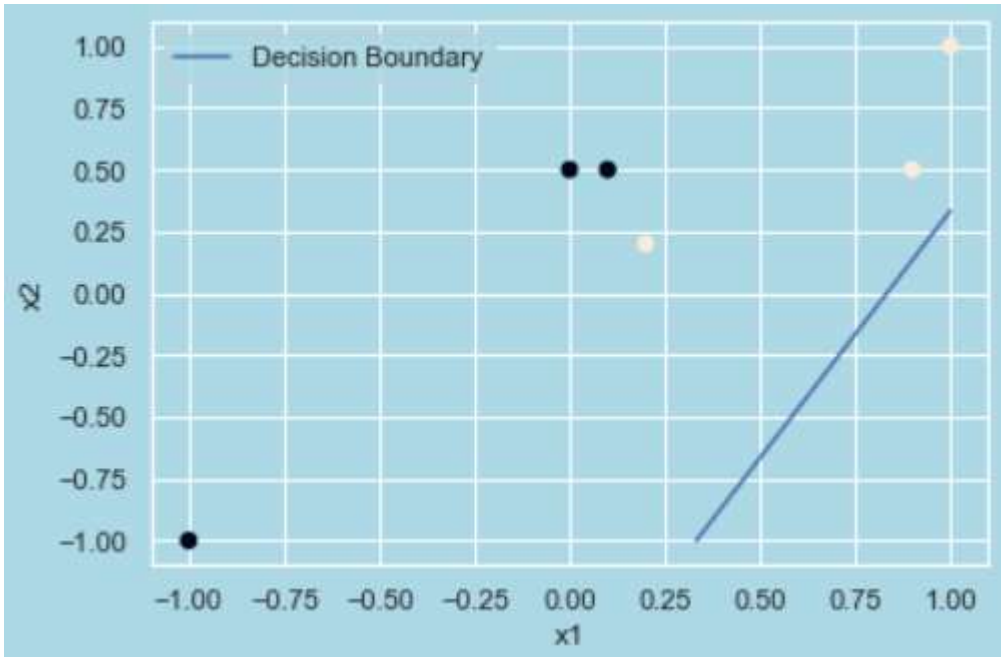
Sample is : [0.1 0.5 1.]

Class is : -1

Dot Product of W & X is : 0.08000000000000002

Negative Sample is classified positive

Updated W is : [1.2 -0.6 -1.]



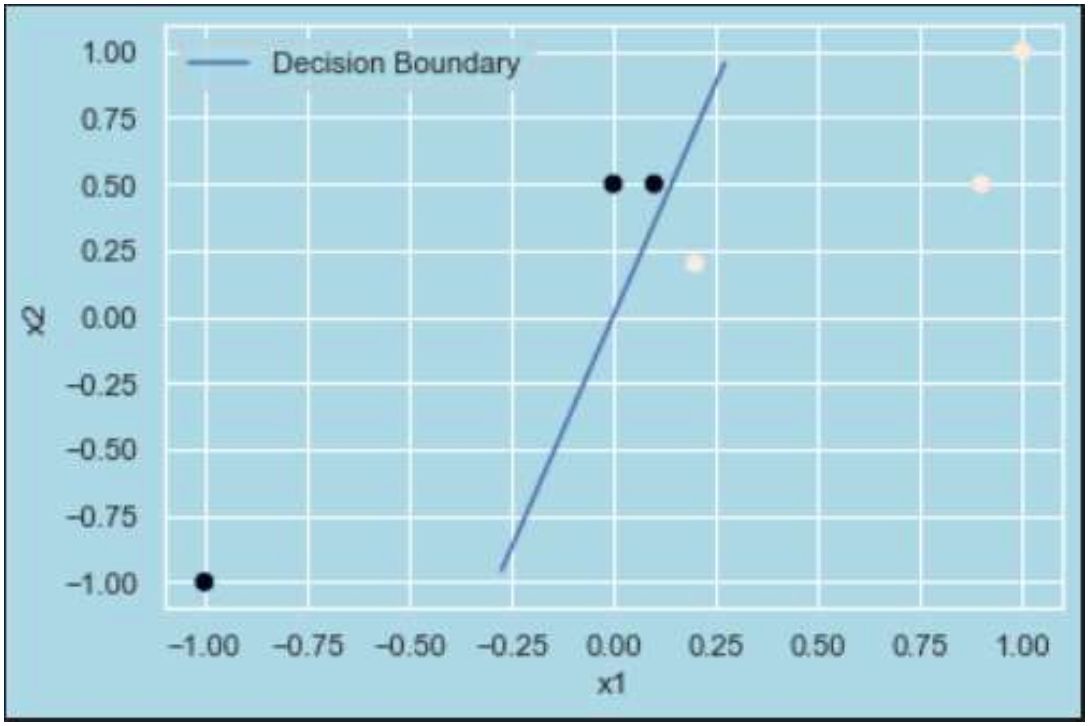
Sample is : [0.2 0.2 1.]

Class is : 1

Dot Product of W & X is : -0.88

Positive Sample is classified negative

Updated W is : [1.4 -0.4 0.]



Sample is : [0.9 0.5 1.]

Class is : 1

Dot Product of W & X is : 1.06

Positive Sample is correctly classified

Iteration is : 4

Sample is : [1. 1. 1.]

Class is : 1

Dot Product of W & X is : 1.0

Positive Sample is correctly classified

Sample is : [-1. -1. 1.]

Class is : -1

Dot Product of W & X is : -1.0

Negative Sample is Correctly classified

Sample is : [0. 0.5 1.]

Class is : -1

Dot Product of W & X is : -0.19999999999999998

Negative Sample is Correctly classified

Sample is : [0.1 0.5 1.]

Class is : -1

Dot Product of W & X is : -0.06

Negative Sample is Correctly classified

Sample is : [0.2 0.2 1.]

Class is : 1

Dot Product of W & X is : 0.19999999999999998

Positive Sample is correctly classified

Sample is : [0.9 0.5 1.]

Class is : 1

Dot Product of W & X is : 1.06

Positive Sample is correctly classified

[1.4 -0.4 0.]

Final Decision Boundary is: