Perceptron Algorithm Manual Calculation

Training Data Set

Sample ID	Feature vector (x_1, x_2)	True Class y
1	(-0.8,0.6)	0
2	(-0.55,0.7)	0
3	(-0.4,0.7)	0
4	(-0.1,-0.2)	0
5	(-0.75,0.95)	0
6	(0.2,0.75)	1
7	(0.9,0.9)	1
8	(0.45,0.3)	1
9	(0.4,-0.5)	1
10	(0.6,-0.9)	1

Goal: Run a Perceptron Algorithm (without bias)

$$h_\theta(x) = \begin{cases} 1 & \text{if } \theta^{\mathrm{T}} x \geq 0 \\ 0 & \text{if } \theta^{\mathrm{T}} x < 0 \end{cases}$$

Step 1: Set the initial weights **(-0.5, -1)**, and fix the learning rate as **1**.

Step 2: Make predicts based on current weights and update the weights.

Sample ID	Feature Vector (x_1, x_2)	True class y	Predict class $h_\theta(x)$
1	(-0.8,0.6)	0	
2	(-0.55,0.7)	0	
3	(-0.4,0.7)	0	
4	(-0.1,-0.2)	0	
5	(-0.75,0.95)	0	
6	(0.2,0.75)	1	
7	(0.9,0.9)	1	
8	(0.45,0.3)	1	
9	(0.4,-0.5)	1	
10	(0.6,-0.9)	1	

Seen from the table, we can find the samples _____ are misclassified. We randomly choose one sample, the 6th one (0.2, 0.75) for weight updating. According to the weight updating rule

$$
\begin{aligned}
w :=& w + \alpha(y - h_\theta(x))x \\
=& \begin{cases} w + \alpha x & \text{if } y = 1 \text{ and } h_\theta(x) = 0 \\ w - \alpha x & \text{if } y = 0 \text{ and } h_\theta(x) = 1 \\ w & \text{others} \end{cases}
\end{aligned}
$$

we can obtain the new weights _____.

Step 3: Repeat Step 2.

Sample ID	Feature Vector (x_1, x_2)	True class y	Predict class $h_\theta(x)$
1	(-0.8,0.6)	0	
2	(-0.55,0.7)	0	
3	(-0.4,0.7)	0	
4	(-0.1,-0.2)	0	
5	(-0.75,0.95)	0	
6	(0.2,0.75)	1	
7	(0.9,0.9)	1	
8	(0.45,0.3)	1	
9	(0.4,-0.5)	1	
10	(0.6,-0.9)	1	

Seen from the table, we can find the samples _____ are misclassified. We randomly choose one sample, the 8th one (0.45, 0.3) for weight updating. Finally, we can obtain the new weights _____.

Step 4: Repeat Step2.

Sample ID	Feature Vector (x_1, x_2)	True class y	Predict class $h_\theta(x)$
1	(-0.8,0.6)	0	
2	(-0.55,0.7)	0	
3	(-0.4,0.7)	0	
4	(-0.1,-0.2)	0	
5	(-0.75,0.95)	0	
6	(0.2,0.75)	1	
7	(0.9,0.9)	1	
8	(0.45,0.3)	1	
9	(0.4,-0.5)	1	
10	(0.6,-0.9)	1	

Question: Does the Perceptron algorithm converge now?