Shura Boz

4/7/21

1)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Default | x | 1 | 2 | 3 | 4 | 5 |  |
|  | y | -1 | -1 | 1 | 1 | -1 |  |
| Round 1 | x | 1 | 1 | 2 | 4 | 5 |  |
|  | y | -1 | -1 | -1 | 1 | -1 | X <=3 -> Y = -1  X>3 -> Y=1 |
| Round 2 | x | 3 | 3 | 4 | 4 | 5 |  |
|  | Y | 1 | 1 | 1 | 1 | -1 | X<=4.5 -> Y = 1  X>4.5 -> Y = -1 |
| Round 3 | x | 1 | 2 | 2 | 5 | 5 |  |
|  | Y | -1 | -1 | -1 | -1 | -1 | X<= .5-> Y =-1  X>.5 -> Y=-1 |
| Round 4 | x | 1 | 3 | 4 | 4 | 5 |  |
|  | Y | -1 | 1 | 1 | 1 | -1 | X<=4.5 ->Y = 1  X>4.5 -> Y = -1 |
| Round 5 | x | 1 | 2 | 3 | 3 | 4 |  |
|  | Y | -1 | -1 | 1 | 1 | 1 | X<= 2.5-> Y = -1  X>2.5 -> Y = 1 |

|  |  |  |  |
| --- | --- | --- | --- |
| Round | Split | Left | Right |
| 1 | 3 | -1 | 1 |
| 2 | 4.5 | 1 | -1 |
| 3 | .5 | -1 | -1 |
| 4 | 4.5 | 1 | -1 |
| 5 | 2.5 | -1 | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Round | 1 | 2 | 3 | 4 | 5 |
| 1 | -1 | -1 | -1 | 1 | 1 |
| 2 | 1 | 1 | 1 | 1 | -1 |
| 3 | -1 | -1 | -1 | -1 | -1 |
| 4 | 1 | 1 | 1 | 1 | -1 |
| 5 | -1 | -1 | 1 | 1 | 1 |
| Sum | -1 | -1 | 1 | 3 | -1 |
| Prediction | -1 | -1 | 1 | 1 | -1 |

2)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Default | x | 1 | 2 | 3 | 4 | 5 |  |
|  | y | 1 | 1 | -1 | -1 | 1 |  |
| Round 1 | x | 1 | 2 | 3 | 4 | 4 |  |
|  | y | 1 | 1 | -1 | -1 | -1 | X<=2.5-> Y =1  X>2.5 -> Y = -1 |
| Round 2 | x | 5 | 5 | 5 | 5 | 5 |  |
|  | y | 1 | 1 | 1 | 1 | 1 | X<=.5 ->Y = 1  X>.5 -> Y =1 |
| Round 3 | x | 3 | 3 | 4 | 4 | 5 |  |
|  | y | -1 | -1 | -1 | -1 | 1 | X<=4.5 -> Y = -1  X>4.5 -> Y = 1 |

Incorrect :  
Round 1 : X=5

Round 2: X=3, X=4

Round 3: X=1, X=2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Alpha | X=1 | X=2 | X=3 | X=4 | X=5 |
| Default |  | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Round 1 |  | .0357 | .0357 | .0357 | .0357 | .8572 |
| y |  | 1 | 1 | -1 | -1 | -1 |
| Round 2 |  | .0061 | .0061 | .4207 | .4207 | .1464 |
| Y |  | 1 | 1 | 1 | 1 | 1 |
| Round 3 |  | .0002 | .0002 | .4979 | .4979 | .0038 |
| Y |  | -1 | -1 | -1 | -1 | 1 |
| Sum |  | .69143 | .69143 | -2.48663 | -2.48663 | 3.54317 |
| Classification |  | 1 | 1 | -1 | -1 | 1 |

3)

![Chart, scatter chart

Description automatically generated]()

Support vectors

b. [2 points] If a black circle is added as a training sample in the position (7,5), does this affect the previously learned decision boundary? Explain why.

It would not affect the decision boundary because the point is just a little above the line so the margin would not move although if you position the line a little more sloped it could be considered a support vector

c. [2 points] If a yellow circle is added as a training sample in the position (4,2), does this affect the previously learned decision boundary? Explain why.

This would not affect a previously learned boundary because the hard margin would still be at the point (4,3) so it wouldn’t even be a support vector

d. [2 points] If a black circle is added as a test sample in the position (7,5), will this sample be classified correctly according to the previously learned decision boundary? Explain why.

A black circle at that point would be classified correctly because it would fall just about the boundary itself.

e. [2 points] If a black circle is added as a test sample in the position (6,4), will this sample be classified correctly according to the previously learned decision boundary? Explain why.

It would be classified correctly because it is on top of the decision boundary but under the hard margin.

f. [2 points] If a yellow circle is added as a test sample in the position (4,2), will this sample be classified correctly according to the previously learned decision boundary? Explain why.

It would be classified correctly because it would be under the deciding boundary as well as the hard margin

g. [2 points] If a yellow circle is added as a test sample in the position (5,3), will this sample be classified correctly according to the previously learned decision boundary? Explain why.

The point would correctly classified because it’s under the decision boundary even though it’s above the hard margin

h. [2 points] If a black circle is added as a test sample in the position (5,3), will this sample be classified correctly according to the previously learned decision boundary? Explain why.

The black circle would be incorrectly classified because it is on the wrong side of the decision boundary so it would be considered an outlier

i. [2 points] If a yellow circle is added as a test sample in the position (6,4), will this sample be classified correctly according to the previously learned decision boundary? Explain why.

The yellow circle would be incorrectly classified because it is on the wrong side of the decision boundary so it would be considered an outlier

j. [2 points] If a black circle is added as a training sample in the position (4,4), how this will affect the decision boundary if C = 1 and C = ∞? Consider the soft margin formulation.

If C=1 nothing would change because the margin would be the same but if C= ∞ there would be no margins and the decision boundary would have to be between (4,3) and (4,4)

5) 

a) The hard margin boundary is between 0 and 1. The support vectors are when X= 0 and X=1

b)+(w\*1+b)=1 -> w+b=1 -> 1-b=w -> 1-(-1)=w ->2=w

-(w\*0+b)=1 -> -(b)=1->b = -1

c) +(w\*2+b)=1 -> w=(1-b)/2 -> w=(1-(-1)/2 -> w= 1

-(w\*0+b)=1 -> b =-1 w = 1

6) 𝛷(𝑥) = (𝑥12 , 𝑥22 ,√2𝑥1𝑥2,√2𝑥1,√2𝑥2, 1)

K(X,Y) = (X\*Y+1)2

A(1,2)

B(2,4)

a) 𝛷(A)= (1, 4, 2√2, √2, 2√2, 1)

b)𝛷(B)= (4, 16, 8√2, 2√2, 4√2,1)

c)𝛷(A,B)=(1\*4)+(4\*16)+( 2√2\*8√2)+(√2\*2√2)+(2√2\*4√2)+(1\*1) = 121

d)K(A,B) = (1\*2+2\*4+1)2=121