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1)

Dataset	x	1	2	3	4	5		
	y	-1	-1	1	1	-1		
Round 1	x	1	1	2	4	5	x <= 3 --> y = -1	x > 3 --> y = 1
	y	-1	-1	-1	1	-1		
Round 2	x	3	3	4	4	5	x <= 4.5 --> y = 1	x > 4.5 --> y = -1
	y	1	1	1	1	-1		
Round 3	x	1	2	2	5	5	x <= 5 --> y = -1	x > 5 --> y = -1
	y	-1	-1	-1	-1	-1		
Round 4	x	1	3	4	4	5	x <= 2 --> y = -1	x > 2 --> y = 1
	y	-1	1	1	1	-1		
Round 5	x	1	2	3	3	4	x <= 2.5 --> y = -1	x > 2.5 --> y = 1
	y	-1	-1	1	1	1		
Sum		-3	-1	1	3	-3		
Predicted Class		-1	-1	1	1	-1		

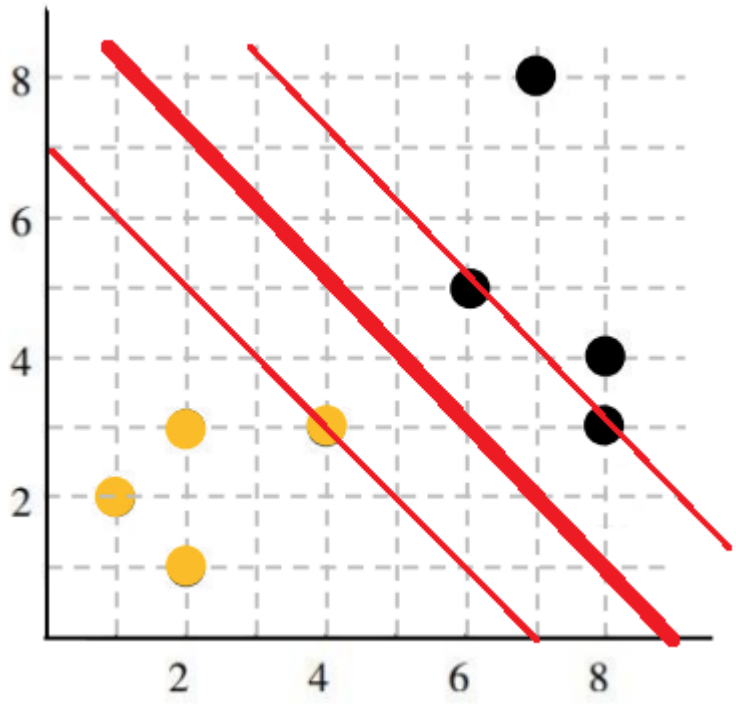
Summary			
Round	Split Point	Left Class	Right Class
1	3	-1	1
2	4.5	1	-1
3	5	-1	-1
4	2	-1	1
5	2.5	-1	1

2)

Dataset	x	1	2	3	4	5		
	y	1	1	-1	-1	1		
Round 1	x	1	2	3	4	4	x <= 2.5 --> y = 1	x > 2.5 --> y = -1
	y	1	1	-1	-1	-1		
Round 2	x	5	5	5	5	5	x <= 5 --> y = 1	x > 5 --> y = 1
	y	1	1	1	1	1		
Round 3	x	3	3	4	4	5	x <= 4.5 --> y = -1	x > 4.5 --> y = 1
	y	-1	-1	-1	-1	1		
Sum		1	1	-1	-1	1		
Predicted Class		1	1	-1	-1	1		

Summary			
Round	Split Point	Left Class	Right Class
1	2.5	1	-1
2	5	1	1
3	4.5	-1	1

3) https://github.com/garyjsk271/Machine-Learning/tree/main/assignment%203



4) a)

The support vectors are on (4,3) for the yellow dot and (6, 5) for the black dot.

b) No, it would not affect the previously learned decision boundary because (7, 5) would not be one of the points that are closest to the decision boundary. For the black dots, the one closest to the boundary would still be (8, 3) and (6, 5).

c) No, it would not affect the previously learned decision boundary because (4, 2) would not be one of the points that are closest to the decision boundary. For the yellow dots, the one closest to the boundary would still be (4, 3).

d) Since (7, 5) is above the decision boundary, it would be classified as a black dot. This is the correct classification so the sample will be classified correctly.

e) Since (6, 4) is above the decision boundary, it would be classified as a black dot. This is the correct classification so the sample will be classified correctly.

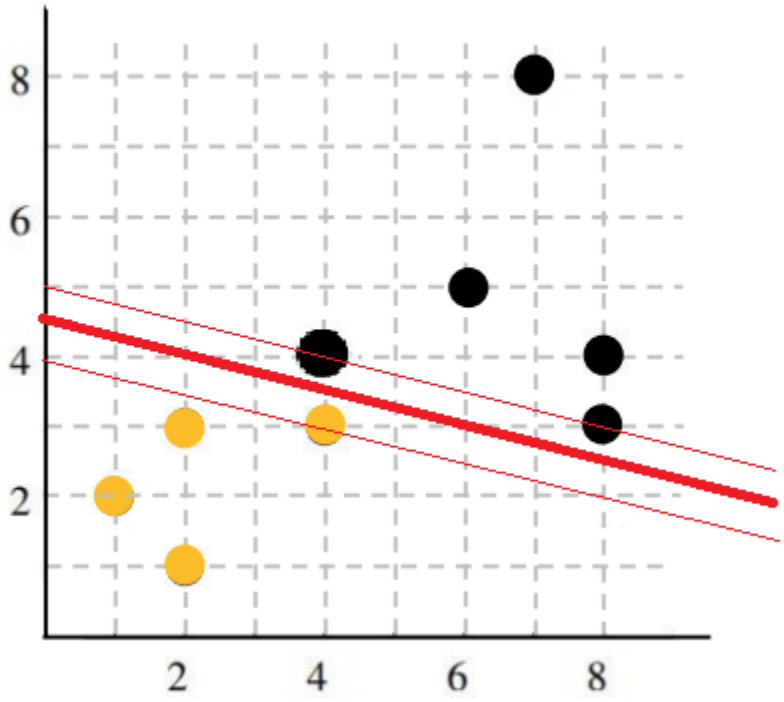
f) Since (4, 2) is below the decision boundary, it would be classified as a yellow dot. This is the correct classification so the sample will be classified correctly.

g) Since (5, 3) is below the decision boundary, it would be classified as a yellow dot. This is the correct classification so the sample will be classified correctly.

h) Since (5, 3) is below the decision boundary, it would be classified as a yellow dot. This is the incorrect classification so the sample will be classified incorrectly.

i) Since (6, 4) is above the decision boundary, it would be classified as a black dot. This is the incorrect classification so the sample will be classified incorrectly.

j) With C = 1, it would have a relatively big margin so the decision boundary would remain unchanged. However, with C = infinity, the model would be absolutely intolerable to margin violations. Thus, below is the margin with a black dot on (4, 4), C = infinity.



5) a)

x	-3	0	1	2	3	4	5
Class	−	−	+	+	+	+	+

x = 0.5 is the decision boundary.
x = 0 and x = 1 are the support vectors.

b) yi (w.xi + b) = 1
-1 (w.(0) + b) = 1 → b = -1

1 (w.(1) + b) = 1
w + b = 1
w - 1 = 1 → w = 2

d = 2/||w|| = 2/2 = 1

c) With (1, +) removed, x = 1 is the decision boundary, x = 0 and x = 2 are the support vectors.

$-1\ (w.(0) + b) = -1 \rightarrow b = -1$

$1(w.(2) + b) = 1$

$2w - 1 = 1 \rightarrow w = 1$

$d = 2/||1|| = 2$

6)

a) $\Phi(A) = (1^2, 2^2, \sqrt{2}\cdot 1\cdot 2, \sqrt{2}\cdot 1, \sqrt{2}\cdot 2, 1)$

$= (1, 4, 2\sqrt{2}, \sqrt{2}, 2\sqrt{2}, 1)$

b) $\Phi(B) = (2^2, 4^2, \sqrt{2}\cdot 2\cdot 4, \sqrt{2}\cdot 2, \sqrt{2}\cdot 4, 1)$

$= (4, 16, 8\sqrt{2}, 2\sqrt{2}, 4\sqrt{2}, 1)$

c) $\Phi(A)\ \Phi(B) = 1\cdot 4 + 4\cdot 16 + 2\sqrt{2}\cdot 8\sqrt{2} + \sqrt{2}\cdot 2\sqrt{2} + 2\sqrt{2}\cdot 4\sqrt{2} + 1\cdot 1$

$= 4 + 64 + 32 + 4 + 16 + 1$

$= 68 + 36 + 17$

$= 121$

d) $A\cdot B = 1\cdot 2 + 2\cdot 4 = 10$

$K(A,B) = (A\cdot B + 1)^2 = (10+1)^2 = 121$

7) https://github.com/garyjsk271/Machine-Learning/tree/main/assignment%203