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Exercise 1:

x_1	x_2	y	Lagrange Multiplier
0.3858	0.4687	1	65.5261
0.4871	0.611	–1	65.5261
0.9218	0.4103	–1	0
0.7382	0.8936	–1	0
0.1763	0.0579	1	0
0.4057	0.3529	1	0
0.9355	0.8132	–1	0
0.2146	0.0099	1	0

$$\mathbf{w} = \sum_{i=1}^{N} \lambda_i y_i \mathbf{x}_i,$$

Given: N =2; $x_{i=1,2} = x_1$ and x_2 which is a vector
$y_1 = 1$
$y_2 = -1$
$\lambda 1 = 65.5261$
$\lambda 2 = 65.5261$

Vector W computation

Vector **W = $\mathbf{w_1}$ & $\mathbf{w_2}$**
$w_1 = \lambda 1 * y1 * x1 + \lambda 2 * y2 * x2$
$w_2 = \lambda 1 * y1 * x1 + \lambda 2 * y2 * x2$

$w_1 = 65.5261 \times 1 \times 0.3858 + 65.5261 \times -1 \times 0.4871 = -6.64.$
$w_2 = 65.5261 \times 1 \times 0.4687 + 65.5261 \times -1 \times 0.611 = -9.32.$

Bias Computation

$y_i(\mathbf{w} \cdot x_i + b) = 1$
substituting $y_1 = 1$ to get b_1 that is i = 1
$b_1 = 1 - \mathbf{w}x_i$
substituting $y_2 = -1$ to get b_2 that is i = 2
$-wx_i - b_2 = 1$
$b_2 = -1 - wx_i$

$b_1 = 1 - \mathbf{w} \cdot x1 = 1 - (-6.64)(0.3858) - (-9.32)(0.4687) = 7.9300.$
$b_2 = -1 - \mathbf{w} \cdot x2 = -1 - (-6.64)(0.4871) - (-9.32)(0.611) = 7.9289$
Averaging these values to obtain b = 7.93.

Decision boundary $w1x1 + w2x2 + b \ = \ \mathbf{0}$

$$(-6.64)*x_1 + (-9.32)* x_2 + 7.93 = 0$$

<u>Exercise 2:</u>

Note: Refer Slide No.99 – 104 from Lecture 20 to 29_Rule Extraction_SVM_Univariate_Multivariate_Regression Trees

The decision boundary is $f(x_1, x_2) \ = \ x_1x_2.$

<u>Exercise 3:</u>

1. Consider the 1-dimensional data set with 10 data points {1, 2, 3, . . . 10}. Show three iterations of the k-means algorithms when k = 2, and the random seeds are initialized to {1,2}. Repeat the problem with random seeds {2,9}. How did the different choice of the seed set affect the quality of the results?

Use Manhattan

Solution:

dp	m1(1)	m2(2)	MANHATTAN		
1	0	1			
2	1	0			
3	2	1			
4	3	2			
5	4	3			
6	5	4			
7	6	5			
8	7	6			
9	8	7			
10	9	8			
INITIAL:	C1={1}	C2={2,3,4,5,6,7,8,9,10}		6	
dp	m1(1)	m2(6)			
1	0	5			
2	1	4			
3	2	3			

4	3	2			
5	4	1			
6	5	0			
7	6	1			
8	7	2			
9	8	3			
10	9	4			
ITERATION 1	C1={1,2,3}	C2={4,5,6,7,8,9,10}		7	
dp	m1(2)	m2(7)			
1	1	6			
2	0	5			
3	1	4			
4	2	3			
5	3	2			
6	4	1			
7	5	0			
8	6	1			
9	7	2			
10	8	3			
ITERATION 2:	C1={1,2,3,4}	2.5	C2={5,6,7,8,9,10}		7.5
dp	m1(2.5)	m2(7.5)			
1	1.5	6.5			
2	0.5	5.5			
3	0.5	4.5			
4	1.5	3.5			
5	2.5	2.5			
6	3.5	1.5			
7	4.5	0.5			
8	5.5	0.5			
9	6.5	1.5			
10	7.5	2.5			
ITERATION 3: c1={1,2,3,4,5}					
	c2=(6,7,8,9,10}				

- √ With the initial seed as {2,9}; the quality of the algorithm is improvised, and the algorithm converges in the first iteration itself.
- √ Initial:C1(m1=2) = {1,2,3,4,5}
  C2(m2=9) = {6,7,8,9,10}
- √ Iteration 1: C1(m1=3) = {1,2,3,4,5}
  C2(m2=8) = {6,7,8,9,10}