Machine Learning

Subaina Norab
22-NIU-CS-1374

KNN:-

Study Hour	Sleep Hour	Exam Result	Euclidean distance
6	7	Pass	2.8
3	8	Fail	3.16
8	8	Pass	5
9	10	Pass	7.07
2	9	Fail	4.4

Now:

4 5 ?

Here $k = 3$

⇒ First Calculate Euclidian distance

⇒ Ascending order: 2.8
3.16
4.4

⇒ So, according to voting its class is Fail

4 5 Fail

K-D Tree

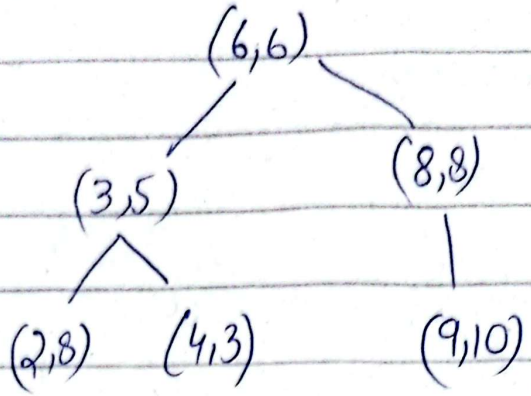
Data:

(2,8), (9,10), (3,5), (8,8), (4,3), (6,6)

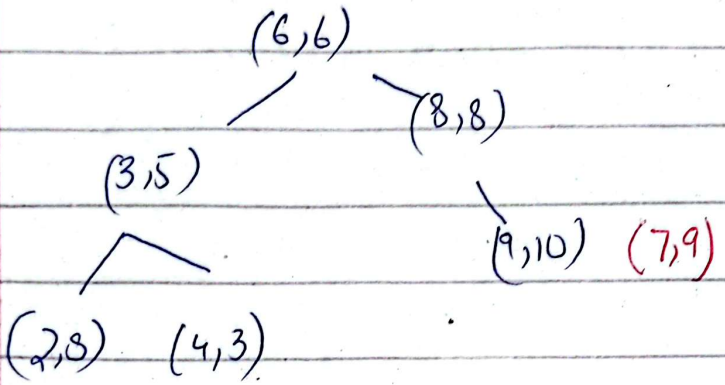
* Find median

∴ (2,8), (3,5), (4,3), (6,6), (8,8), (9,10)

KD Tree:



New Point : (7,9)



Closed Form Solution:

Finding value of w_1 and w_0

X	Y	X^2	Y^2	X·Y
2	7	4	49	14
4	9	16	81	36
5	11	25	121	55
8	20	64	400	160
$\Sigma X = 19$	$\Sigma Y = 47$	$\Sigma X^2 = 109$	$\Sigma Y^2 = 651$	$\Sigma XY = 265$

$$w_1 = \frac{N(\Sigma XY) - (\Sigma X)(\Sigma y)}{N(\Sigma x^2) - (\Sigma x)^2}$$

$$= \frac{4(265) - (19)(47)}{4(109) - (19)^2}$$

$$\boxed{w_1 = 2.22}$$

$$w_0 = \frac{\Sigma y - w_1(\Sigma x)}{N}$$

$$= \frac{47 - (2.2)(19)}{4}$$

$$\boxed{w_0 = 1.3}$$

$$\Rightarrow \quad y = 2.22 + 1.3X$$

Perceptron Learning:-

x_1	x_2	Output
5	6	1
8	9	-1
2	3	1
9	2	-1

$$h_w(x) = w_1 x_1 + w_2 x_2 + w_3 1$$

Iteration 1:

weight:

$w_1 = 0.5 \quad w_2 = 0.2 \quad w_3 = -0.1$

$h_w = w_1 x_1 + w_2 x_2 + w_3$

$= 0.5 \times 5 + 0.2 \times 6 + -0.1$

$= 3.6$

So, $h_w > 0 \rightarrow$ output = 1

Iteration 2:

$h_w = 8 \times 0.5 + 9 \times 0.2 - 0.1$

$5.7 > 0 \Rightarrow 1$

$\Rightarrow w^T = w_i + \alpha (y - h_w(x)) x_i$

$= \begin{bmatrix} 0.5 \\ 0.2 \\ -0.1 \end{bmatrix} + 0.2(-1-1) \begin{bmatrix} 8 \\ 9 \\ 1 \end{bmatrix}$

$= \begin{bmatrix} 0.5 \\ 0.2 \\ -0.1 \end{bmatrix} + -0.4 \begin{bmatrix} 8 \\ 9 \\ 1 \end{bmatrix}$

$w = \begin{bmatrix} -2.7 \\ -3.4 \\ -0.5 \end{bmatrix}$

$\Rightarrow h_w = -2.7 \times 8 + -3.4 \times 9 - 0.5$

$= -52.7 < 0$

$\Rightarrow$ output = -1

Iteration # 3.

$hw = (-2.7 \times 2) + (-3.4 \times 3) - 0.5$

$= -16.1 < 0$

output = -1

$$w = \begin{bmatrix} -2.7 \\ -3.4 \\ -0.5 \end{bmatrix} + 0.2(1+1) \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$$

$$w = \begin{bmatrix} -1.9 \\ -2.2 \\ -0.1 \end{bmatrix}$$

$hw = (-1.9 \times 2) + (-2.2 \times 3) - 0.1$

$= -10.5 < 0$

output = -1

Again

$$w = \begin{bmatrix} -1.9 \\ -2.2 \\ -0.1 \end{bmatrix} + 0.2(1+1) \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$$

$$w = \begin{bmatrix} -1.1 \\ -1 \\ -0.04 \end{bmatrix}$$

$h_w = -1.1 \times 2 + -1 \times 3 + -0.04$

$= -5.24 < 0 \quad = -1$

$$w = \begin{bmatrix} -1.1 \\ -1 \\ -0.04 \end{bmatrix} + 0.4 \begin{bmatrix} 2 \\ 3 \\ 1 \end{bmatrix}$$

$$w = \begin{bmatrix} -0.3 \\ 0.2 \\ 0.36 \end{bmatrix}$$

$h_w = -0.3 \times 2 + 0.2 \times 3 + 0.36$

$= 0.36 > 0$

output = 1

Iteration = 4:

$h_w = -0.3 \times 9 + 2 \times 0.2 + 0.36$

$= -1.94 < 0$

output = -1

GRADIENT:-

Salary	Experience	Salary
	5	10
	10	50
	2	5

Consider $w_1 = 1, w_0 = 1$

Experience	Salary	Predicted	Error	Gradient (w_0)	Gradient (w_1)
5	10	6	-4	-2.6	-13.3
20	20	11	-9	-6	-60
10					
2	5	3	-2	-1.3	-2.6

Total gradient w_0 = -9.9

Total gradient w_1 = -75.9

learning rate = 0.01

New weights:

$w_0 = 1 - 0.01(-9.9) = 1.099$

$w_1 = 1 - 0.01(-75.9) = 1.759$

2nd:

$w_0 = 1.099$

$w_1 = 1.759$

Experience	Salary	Predicted	Error	Gradient(w_0)	Gradient(w_1)
5	10	9.894	-0.106	-0.07	-0.353
10	20	18.689	-1.311	-0.874	-8.74
2	5	4.617	-0.383	-0.255	-0.510
				$\Sigma = -1.199$	$\Sigma = -9.60$

New weights:

$w_0 = 1 - 0.01(-1.199) = 1.01199$

$w_1 = 1 - 0.01(-9.603) = 1.09603$