Answer to the ques no 1

Naive Byes

	Positive	Negative
I	0.09	0.16
always	0.07	0.06
like	0.29	0.06
foreign	0.04	0.15
films	0.08	0.11

$P(S|Pos) = (0.09 \times 0.07 \times 0.29 \times 0.04 \times 0.08)$

$= 0.00000586$

$P(S|Neg) = (0.16 \times 0.06 \times 0.06 \times 0.15 \times 0.11)$

$= 0.0000009504$

$P(S|Pos) < P(S|Neg)$

Negative class will Naive Bayes assign to the sentence. "I like foreign films".

Answer to the ques no 2

Naive Byes

$|v| = |(20-13)|$

$= 7$

1. Prior from training:

$\hat{P}(c_j) = \frac{N_{cj}}{N_{total}}$

~~P(-)~~

$P(\text{comedy}) = \frac{2}{5}$

$P(\text{action}) = \frac{3}{5}$

2. Likelihoods from training:

$P(\text{"fast"} \mid \text{comedy}) = \frac{1+1}{9+7}$

$P(\text{"fast"} \mid \text{action}) = \frac{2+1}{11+7}$

$P(\text{"couple"} \mid \text{comedy}) = \frac{2+1}{9+7}$

$P(\text{"couple"} \mid \text{action}) = \frac{0+1}{11+7}$

$P(\text{"shoot"} \mid \text{comedy}) = \frac{0+1}{9+7}$

$P(\text{"shoot"} \mid \text{action}) = \frac{4+1}{11+7}$

$P(\text{"fly"} \mid \text{comedy}) = \frac{1+1}{9+7}$

$P(\text{"fly} \mid \text{action}) = \frac{1+1}{11+7}$

3. Scoring the test set:

$$P(\text{comedy})\ P(\text{s}|\text{comedy}) = \frac{2}{5} \times \frac{2\times3\times1\times2}{(16)^4}$$

$$= 4.39\times10^{-4}$$

$$= 7.32\times10^{-5}$$

$$P(\text{action})\ P(\text{s}|\text{action}) = \frac{3}{5} \times \frac{3\times1\times5\times2}{(18)^4}$$

$$= 1.71\times10^{-4}$$

∴ fast, couple, shoot, fly : action.

Because comedy < action.

Ans to the ques no 3 — Cross entropy Loss

$$x = [3 \quad 2 \quad 1 \quad 3 \quad 0 \quad 4.28]$$

$$w = [-2.5 \quad -5.0 \quad -1.2 \quad 1.5 \quad 2.0 \quad 1.7] \quad +0.1$$

As, we know—

$$w\cdot x + b = \{(3\times(-2.5)) + (2\times(-5.0)) + (1\times(-1.2)) + (3\times1.5) + (0\times2.0) + (4.28\times1.7)\} + 0.1$$

$$= -6.924 + 0.1$$

$$= -6.824$$

$$P(+|x) = P(Y=1|x) = \sigma(w \cdot x + b)$$

$$= \frac{1}{1 + e^{-(w \cdot x + b)}}$$

$$= \frac{1}{1 + e^{6.824}}$$

$$= 0.00109$$

$$P(-|x) = P(Y=0|x) = 1 - \sigma(w \cdot x + b)$$

$$= 1 - 0.00109$$

$$= 0.9989$$

$y = 1$

Cross-entropy loss for $y = 1$ [model was right]

$$L_{CE}(\hat{y}, y) = -[y \log \sigma(w \cdot x + b) + (1 - y) \log (1 - \sigma(w \cdot x + b))]$$

$$= -[\log \sigma(w \cdot x + b)]$$

$$= -\log (0.00109)$$

$$= 6.822$$

Cross-entropy loss for $y = 0$ [model was wrong]

$$L_{CE}(\hat{y}, y) = -[y \log \sigma(w \cdot x + b) + (1 - y) \log (1 - \sigma(w \cdot x + b))]$$

$$= -[\log (1 - \sigma(w \cdot x + b))]$$

$$= -\log (0.9989)$$

$$= 0.0011$$

Loss was bigger when model was right.

$|2-2|+|5-10|$

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Ans to the ques no 4

K- Means

	Point	$C_1(2,5)$	$C_2(5,8)$	$C_3(1,2)$	Cluster
A_1	(2, 10)	5	5	9	C_1
A_2	(2, 5)	0	6	4	C_1
A_3	(8, 4)	7	7	9	C_1
A_4	(5, 8)	6	0	10	C_2
A_5	(7, 5)	5	5	9	C_1
A_6	(6, 4)	5	5	7	C_1
A_7	(1, 2)	4	10	0	C_3
A_8	(4, 9)	6	2	10	C_2
A_9	(9, 5)	7	7	11	C_1
A_{10}	(1, 4)	2	8	2	C_1

Calculation:

Point	Mean 1	$C_1 = \lvert x_2-x_1\rvert + \lvert y_2-y_1\rvert$
(2, 10)	(2, 5) C_1	$\lvert 2-2\rvert + \lvert 5-10\rvert = 5$
(2, 5)		$\lvert 2-2\rvert + \lvert 5-5\rvert = 0$
(8, 4)		$\lvert 2-8\rvert + \lvert 5-4\rvert = 7$
(5, 8)		$\lvert 2-5\rvert + \lvert 5-8\rvert = 6$
(7, 5)		$\lvert 2-7\rvert + \lvert 5-5\rvert = 5$
(6, 4)		$\lvert 2-6\rvert + \lvert 5-4\rvert = 5$
(1, 2)		$\lvert 2-1\rvert + \lvert 5-2\rvert = 4$
(4, 9)		$\lvert 2-4\rvert + \lvert 5-9\rvert = 6$
(9, 5)		$\lvert 2-9\rvert + \lvert 5-5\rvert = 7$
(1, 4)		$\lvert 2-1\rvert + \lvert 5-4\rvert = 2$

Point	Mean 2	$c_2 = \|x_2 - x_1\| + \|y_2 - y_1\|$
(2,10)	(5,8) c_2	$\|5-2\| + \|8-10\| = 5$
(2,5)		$\|5-2\| + \|8-5\| = 6$
(8,4)		$\|5-8\| + \|8-4\| = 7$
(5,8)		$\|5-5\| + \|8-8\| = 0$
(7,5)		$\|5-7\| + \|8-5\| = 5$
(6,4)		$\|5-6\| + \|8-4\| = 5$
(1,2)		$\|5-1\| + \|8-2\| = 10$
(4,9)		$\|5-4\| + \|8-9\| = 2$
(9,5)		$\|5-9\| + \|8-5\| = 7$
(1,4)		$\|5-1\| + \|8-4\| = 8$

Point	Mean 3	$c_3 = \|x_2 - x_1\| + \|y_2 - y_1\|$
(2,10)	(1,2) c_3	$\|1-2\| + \|2-10\| = 9$
(2,5)		$\|1-2\| + \|2-5\| = 4$
(8,4)		$\|1-8\| + \|2-4\| = 9$
(5,8)		$\|1-5\| + \|2-8\| = 10$
(7,5)		$\|1-7\| + \|2-5\| = 9$
(6,4)		$\|1-6\| + \|2-4\| = 7$
(1,2)		$\|1-1\| + \|2-2\| = 0$
(4,9)		$\|1-4\| + \|2-9\| = 10$
(9,5)		$\|1-9\| + \|2-5\| = 11$
(1,4)		$\|1-1\| + \|2-4\| = 2$

C_1: (2,10) (2,5) (8,4) (7,5) (6,4) (9,5) (1,4)

$\Rightarrow (2+2+8+7+6+9+1)/7 = 5$ — x

$\Rightarrow (10+5+4+5+4+5+4)/7 = 5.29$ — y

$\therefore C_1 = \{5, 5.29)$

$C_2 = (5,8)\ (4,9)$

$\Rightarrow (5+4)/2 = 4.5$

$\Rightarrow (8+9)/2 = 8.5$

$\therefore C_2 = \{4.5, 8.5)$

$C_3 = (1,2)$

P.	Point	C_1 (5, 5.29)	C_2 (4.5, 8.5)	C_3 (1,2)	Cluster
A_1	(2,10)	7.71	4	9	C_2
A_2	(2,5)	3.29	6	4	C_1
A_3	(8,4)	4.29	8	9	C_1
A_4	(5,8)	2.71	1	10	C_2
A_5	(7,5)	2.29	6	9	C_1
A_6	(6,4)	2.29	6	7	C_1
A_7	(1,2)	7.29	10	0	C_3
A_8	(4,9)	4.71	1	10	C_2
A_9	(9,5)	4.29	8	11	C_1
A_{10}	(1,4)	5.29	8	2	C_3

Point	Mean 1	$C_1 = \lvert x_2 - x_1 \rvert + \lvert y_2 - y_1 \rvert$
(2, 10)	(5, 5.29) C_1	$\lvert 5 - 2 \rvert + \lvert 5.29 - 10 \rvert = 7.71$
(2, 5)		$\lvert 5 - 2 \rvert + \lvert 5.29 - 5 \rvert = 3.29$
(8, 4)		$\lvert 5 - 8 \rvert + \lvert 5.29 - 4 \rvert = 4.29$
(5, 8)		$\lvert 5 - 5 \rvert + \lvert 5.29 - 8 \rvert = 2.71$
(7, 5)		$\lvert 5 - 7 \rvert + \lvert 5.29 - 5 \rvert = 2.29$
(6, 4)		$\lvert 5 - 6 \rvert + \lvert 5.29 - 4 \rvert = 2.29$
(1, 2)		$\lvert 5 - 1 \rvert + \lvert 5.29 - 2 \rvert = 7.29$
(4, 9)		$\lvert 5 - 4 \rvert + \lvert 5.29 - 9 \rvert = 4.71$
(9, 5)		$\lvert 5 - 9 \rvert + \lvert 5.29 - 5 \rvert = 4.29$
(1, 4)		$\lvert 5 - 1 \rvert + \lvert 5.29 - 4 \rvert = 5.29$

Point	Mean 2	$C_2 = \lvert x_2 - x_1 \rvert + \lvert y_2 - y_1 \rvert$
(2, 10)	(4.5, 8.5)	$\lvert 4.5 - 2 \rvert + \lvert 8.5 - 10 \rvert = 4$
(2, 5)		$\lvert 4.5 - 2 \rvert + \lvert 8.5 - 5 \rvert = 6$
(8, 4)		$\lvert 4.5 - 8 \rvert + \lvert 8.5 - 4 \rvert = 8$
(5, 8)		$\lvert 4.5 - 5 \rvert + \lvert 8.5 - 8 \rvert = 1$
(7, 5)		$\lvert 4.5 - 7 \rvert + \lvert 8.5 - 5 \rvert = 6$
(6, 4)		$\lvert 4.5 - 6 \rvert + \lvert 8.5 - 4 \rvert = 6$
(1, 2)		$\lvert 4.5 - 1 \rvert + \lvert 8.5 - 2 \rvert = 10$
(4, 9)		$\lvert 4.5 - 4 \rvert + \lvert 8.5 - 9 \rvert = 1$
(9, 5)		$\lvert 4.5 - 9 \rvert + \lvert 8.5 - 5 \rvert = 8$
(1, 4)		$\lvert 4.5 - 1 \rvert + \lvert 8.5 - 4 \rvert = 8$

C_1: (2,5) (8,4) (7,5) (6,4) (9,5)

$\Rightarrow (2+8+7+6+9)/5 = 6.4$

$\Rightarrow (5+4+5+4+5)/5 = 4.6$

C_1: (6.4, 4.6)

C_2: (2,10) (5,8) (4,9)

$\Rightarrow (2+5+4)/3 = 3.67$

$\Rightarrow (10+8+9)/3 = 9$

C_3: (1,2) (1,4)

$= (1+1)/2 = 1$

$= (2+4)/2 = 3$

	Point	C_1 (6.4, 4.6)	C_2 (3.67, 9)	C_3 (1, 3)	Cluster
A_1	(2,10)	9.8	2.67	8	C_2
A_2	(2,5)	4.8	5.67	3	C_3
A_3	(8,4)	2.2	9.33	8	C_1
A_4	(5,8)	4.8	2.33	9	C_2
A_5	(7,5)	1	7.33	8	C_1
A_6	(6,4)	1	7.33	6	C_1
A_7	(1,2)	8	9.67	1	C_3
A_8	(4,9)	6.8	0.33	9	C_2
A_9	(9,5)	3	9.33	10	C_1
A_{10}	(1,4)	6	7.67	1	C_3

Point	Mean 1	$C_1 = \lvert x_2 - x_1 \rvert + \lvert y_2 - y_1 \rvert$
(2,10)	(6.4, 4.6) C1	$\lvert 6.4 - 2 \rvert + \lvert 4.6 - 10 \rvert = 9.8$
(2,5)		$\lvert 6.4 - 2 \rvert + \lvert 4.6 - 5 \rvert = 4.8$
(8,4)		$\lvert 6.4 - 8 \rvert + \lvert 4.6 - 4 \rvert = 2.2$
(5,8)		$\lvert 6.4 - 5 \rvert + \lvert 4.6 - 8 \rvert = 4.8$
(7,5)		$\lvert 6.4 - 7 \rvert + \lvert 4.6 - 5 \rvert = 1$
(6,4)		$\lvert 6.4 - 6 \rvert + \lvert 4.6 - 4 \rvert = 1$
(1,2)		$\lvert 6.4 - 1 \rvert + \lvert 4.6 - 2 \rvert = 8$
(4,9)		$\lvert 6.4 - 4 \rvert + \lvert 4.6 - 9 \rvert = 6.8$
(9,5)		$\lvert 6.4 - 9 \rvert + \lvert 4.6 - 5 \rvert = 3$
(1,4)		$\lvert 6.4 - 1 \rvert + \lvert 4.6 - 4 \rvert = 6$

Point	Mean 2	$C_2 = \lvert x_2 - x_1 \rvert + \lvert y_2 - y_1 \rvert$
(2,10)	(3.67, 9) C2	$\lvert 3.67 - 2 \rvert + \lvert 9 - 10 \rvert = 2.67$
(2,5)		$\lvert 3.67 - 2 \rvert + \lvert 9 - 5 \rvert = 5.67$
(8,4)		$\lvert 3.67 - 8 \rvert + \lvert 9 - 4 \rvert = 9.33$
(5,8)		$\lvert 3.67 - 5 \rvert + \lvert 9 - 8 \rvert = 2.33$
(7,5)		$\lvert 3.67 - 7 \rvert + \lvert 9 - 5 \rvert = 7.33$
(6,4)		$\lvert 3.67 - 6 \rvert + \lvert 9 - 4 \rvert = 7.33$
(1,2)		$\lvert 3.67 - 1 \rvert + \lvert 9 - 2 \rvert = 9.67$
(4,9)		$\lvert 3.67 - 4 \rvert + \lvert 9 - 9 \rvert = 0.33$
(9,5)		$\lvert 3.67 - 9 \rvert + \lvert 9 - 5 \rvert = 9.33$
(1,4)		$\lvert 3.67 - 1 \rvert + \lvert 9 - 4 \rvert = 7.67$

Point	Mean 3	$c_3 = \lvert x_2 - x_1 \rvert + \lvert y_2 - y_1 \rvert$
(2,10)	(1,3) c_3	$\lvert 1-2 \rvert + \lvert 3-10 \rvert = 8$
(2,5)		$\lvert 1-2 \rvert + \lvert 3-5 \rvert = 3$
(8,4)		$\lvert 1-8 \rvert + \lvert 3-4 \rvert = 8$
(5,8)		$\lvert 1-5 \rvert + \lvert 3-8 \rvert = 9$
(7,5)		$\lvert 1-7 \rvert + \lvert 3-5 \rvert = 8$
(6,4)		$\lvert 1-6 \rvert + \lvert 3-4 \rvert = 6$
(1,2)		$\lvert 1-1 \rvert + \lvert 3-2 \rvert = 1$
(4,9)		$\lvert 1-4 \rvert + \lvert 3-9 \rvert = 9$
(9,5)		$\lvert 1-9 \rvert + \lvert 3-5 \rvert = 10$
(1,4)		$\lvert 1-1 \rvert + \lvert 3-4 \rvert = 1$

c_1 : (8,4) (7,5) (6,4) (9,5)

$\Rightarrow (8+7+6+9)/4 = 7.5$

$\Rightarrow (4+5+4+5)/4 = 4.5$

$c_2 = (2,10)\ (5,8)\ (4,9)$

$\Rightarrow (2+5+4)/3 = 3.67$

$\Rightarrow (10+8+9)/3 = 9$

$c_3 = (2,5)\ (1,2)\ (1,4)$

$\Rightarrow (2+1+1)/3 = 1.33$

$\Rightarrow (5+2+4)/3 = 3.67$

	Point	c_1 (7.5, 4.5)	c_2 (3.67, 9)	c_3 (1.33, 3.67)	Cluster
A_1	(2, 10)	11	2.67	7	c_2
A_2	(2, 5)	6	5.67	2	c_3
A_3	(8, 4)	1	9.33	7	c_1
A_4	(5, 8)	6	2.33	8	c_2
A_5	(7, 5)	1	7.33	7	c_1
A_6	(6, 4)	2	7.33	5	c_1
A_7	(1, 2)	9	9.67	2	c_3
A_8	(4, 9)	8	0.33	8	c_2
A_9	(9, 5)	2	9.33	9	c_1
A_{10}	(1, 4)	7	7.67	3	c_3

Point	Mean	$c_1 = \lvert x_2 - x_1 \rvert + \lvert y_2 - y_1 \rvert$
(2, 10)	(7.5, 4.5) c_1	$\lvert 7.5 - 2 \rvert + \lvert 4.5 - 10 \rvert = 11$
(2, 5)		$\lvert 7.5 - 2 \rvert + \lvert 4.5 - 5 \rvert = 6$
(8, 4)		$\lvert 7.5 - 8 \rvert + \lvert 4.5 - 4 \rvert = 1$
(5, 8)		$\lvert 7.5 - 5 \rvert + \lvert 4.5 - 8 \rvert = 6$
(7, 5)		$\lvert 7.5 - 7 \rvert + \lvert 4.5 - 5 \rvert = 1$
(6, 4)		$\lvert 7.5 - 6 \rvert + \lvert 4.5 - 4 \rvert = 2$
(1, 2)		$\lvert 7.5 - 1 \rvert + \lvert 4.5 - 2 \rvert = 9$
(4, 9)		$\lvert 7.5 - 4 \rvert + \lvert 4.5 - 9 \rvert = 8$
(9, 5)		$\lvert 7.5 - 9 \rvert + \lvert 4.5 - 5 \rvert = 2$
(1, 4)		$\lvert 7.5 - 1 \rvert + \lvert 4.5 - 4 \rvert = 7$

	Mean 3	$C_3 = \lvert x_2 - x_1 \rvert + \lvert y_2 - y_1 \rvert$
$A_1(2,10)$		$\lvert 1.33 - 2 \rvert + \lvert 3.67 - 10 \rvert = 7$
$A_2(2,5)$		$\lvert 1.33 - 2 \rvert + \lvert 3.67 - 5 \rvert = 2$
$A_3(8,4)$	$(1.33, 3.67)$ C_3	$\lvert 1.33 - 8 \rvert + \lvert 3.67 - 4 \rvert = 7$
$A_4(5,8)$		$\lvert 1.33 - 5 \rvert + \lvert 3.67 - 8 \rvert = 8$
$A_5(7,5)$		$\lvert 1.33 - 7 \rvert + \lvert 3.67 - 5 \rvert = 7$
$A_6(6,4)$		$\lvert 1.33 - 6 \rvert + \lvert 3.67 - 4 \rvert = 5$
$A_7(1,2)$		$\lvert 1.33 - 1 \rvert + \lvert 3.67 - 2 \rvert = 2$
$A_8(4,9)$		$\lvert 1.33 - 4 \rvert + \lvert 3.67 - 9 \rvert = 8$
$A_9(9,5)$		$\lvert 1.33 - 9 \rvert + \lvert 3.67 - 5 \rvert = 9$
$A_{10}(1,4)$		$\lvert 1.33 - 4 \rvert + \lvert 3.67 - 4 \rvert = 3$

C_1 : (8,4) (7,5) (6,4) (9,5)

$\Rightarrow (8+7+6+9)/4 = 7.5$

$\Rightarrow (4+5+4+5)/4 = 4.5$

$C_1 = (7.5, 4.5)$

$C_2 = (2,10)\ (5,8)\ (4,9)$

$\Rightarrow (2+5+4)/3 = 3.67$

$\Rightarrow (10+8+9)/3 = 9$

$C_2 = (3.67, 9)$

$C_3 = (2,5)\ (1,2)\ (1,4)$

$\Rightarrow (2+1+1)/3 \doteq 1.33$

$\Rightarrow (5+2+4)/3 = 3.67$

$\therefore C_3 = (1.33, 3.67)$

Ans to the ques no 5

K-Nearest Neighbor

- $A_1 = \{2, 10\}$

$K_1 = \{A_1\}$

- $A_2 = \{2, 5\}$

$\therefore d\{A_1, A_2\} = \sqrt{(2-2)^2 + (10-5)^2} = \sqrt{5^2} = 5 > 4$

$\therefore K_2 = \{A_2\}$

- $A_3 = \{8, 4\}$

$\therefore d\{A_1, A_3\} = \sqrt{(8-2)^2 + (4-10)^2} = 8.48 > 4$

$\therefore d\{A_2, A_3\} = \sqrt{(8-2)^2 + (4-5)^2} = 6.08 > 4$

$\therefore K_3 = \{A_3\}$

- $A_4 = \{5, 8\}$

$\therefore d\{A_1, A_4\} = \sqrt{(5-2)^2 + (8-10)^2} = 3.61 < 4$ ✓

$\therefore d\{A_2, A_4\} = \sqrt{(5-2)^2 + (8-5)^2} = 4.24 > 4$

$\therefore d\{A_3, A_4\} = \sqrt{(5-8)^2 + (8-4)^2} = 5 > 4$

$\therefore K_1 = \{A_1, A_4\}$

- $A_5 = \{7, 5\}$

$\therefore d\{A_1, A_5\} = \sqrt{(7-2)^2 + (5-10)^2} = 7.02 > 4$

$\therefore d\{A_2, A_5\} = \sqrt{(7-2)^2 + (5-5)^2} = 5 > 4$

$\therefore d\{A_3, A_5\} = \sqrt{(7-8)^2+(5-4)^2} = 1.41 < 4$ ✓

$\therefore d\{A_4, A_5\} = \sqrt{(7-5)^2+(5-8)^2} = 3.6 < 4$ ✓

$K_3 = \{A_3, A_5\}$?

$A_6 = \{6, 4\}$

$\therefore d\{A_1, A_6\} = \sqrt{(6-2)^2+(4-10)^2} = 7.21 > 4$

$\therefore d(A_2, A_6) = \sqrt{(6-2)^2+(4-5)^2} = 4.12 > 4$

$\therefore d(A_3, A_6) = \sqrt{(6-8)^2+(4-4)^2} = 2 < 4$ ✓

$\therefore d(A_4, A_6) = \sqrt{(6-5)^2+(4-8)^2} = 4.12 > 4$

$\therefore d(A_5, A_6) = \sqrt{(6-7)^2+(4-5)^2} = 1.41 < 4$ ✓

$\therefore K_3 = \{A_3, A_5, A_6\}$

$A_7 = (1, 2)$

$\therefore d(A_1, A_7) = \sqrt{(1-2)^2+(2-10)^2} = 8.06 > 4$

$\therefore d(A_2, A_7) = \sqrt{(1-2)^2+(2-5)^2} = 3.16 < 4$ ✓

$\therefore d(A_3, A_7) = \sqrt{(1-8)^2+(2-4)^2} = 7.28 > 4$

$\therefore d(A_4, A_7) = \sqrt{(1-5)^2+(2-8)^2} = 7.21 > 4$

$\therefore d(A_5, A_7) = \sqrt{(1-7)^2+(2-5)^2} = 6.71 > 4$

$\therefore d(A_6, A_7) = \sqrt{(1-6)^2+(2-4)^2} = 5.39 > 1$

$\therefore K_2 = \{A_2, A_7\}$

• $A_8 = (4, 9)$

$\therefore d(A_1, A_8) = \sqrt{(2-4)^2 + (10-9)^2} = 2.236 < 4$ ✓

$\therefore d(A_2, A_8) = \sqrt{(2-4)^2 + (5-9)^2} = 4.472 > 4$

$\therefore d(A_3, A_8) = \sqrt{(8-4)^2 + (4-9)^2} = 6.403 > 4$

$\therefore d(A_4, A_8) = \sqrt{(5-4)^2 + (8-9)^2} = 1.414 < 4$ ✓

$\therefore d(A_5, A_8) = \sqrt{(7-4)^2 + (5-9)^2} = 5 > 4$

$\therefore d(A_6, A_8) = \sqrt{(6-4)^2 + (4-9)^2} = 5.385 > 4$

$\therefore d(A_7, A_8) = \sqrt{(1-4)^2 + (2-9)^2} = 7.615 > 4$

$K_1 = \{A_1, A_4, A_8\}$.

• $A_9 (9, 5)$

$\therefore d(A_1, A_9) = \sqrt{(2-9)^2 + (10-5)^2} = 8.60 > 4$

$\therefore d(A_2, A_9) = \sqrt{(2-9)^2 + (5-5)^2} = 7 > 4$

$\therefore d(A_3, A_9) = \sqrt{(8-9)^2 + (4-5)^2} = 1.414 < 4$ ✓

$\therefore d(A_4, A_9) = \sqrt{(5-9)^2 + (8-5)^2} = 5 > 4$

$\therefore d(A_5, A_9) = \sqrt{(7-9)^2 + (5-5)^2} = 2 < 4$ ✓

$\therefore d(A_6, A_9) = \sqrt{(6-9)^2 + (4-5)^2} = 3.16 < 4$ ✓

$\therefore d(A_7, A_9) = \sqrt{(1-9)^2 + (2-5)^2} = 8.54 > 4$

$\therefore d(A_8, A_9) = \sqrt{(4-9)^2 + (9-5)^2} = 6.403 > 4$

$\therefore K_3 = \{A_3, A_5, A_6, A_9\}$

• $A_{10} = (1, 4)$

$\therefore d(A_1, A_{10}) = \sqrt{(2-1)^2 + (10-4)^2} = 6.08 > 4$

$\therefore d(A_2, A_{10}) = \sqrt{(2-1)^2 + (5-4)^2} = 1.414 < 4$ ✓

$\therefore d(A_3, A_{10}) = \sqrt{(8-1)^2 + (4-4)^2} = 7 > 4$

$\therefore d(A_4, A_{10}) = \sqrt{(5-1)^2 + (8-4)^2} = 5.65 > 4$

$\therefore d(A_5, A_{10}) = \sqrt{(7-1)^2 + (5-4)^2} = 6.08 > 4$

$\therefore d(A_6, A_{10}) = \sqrt{(6-1)^2 + (4-4)^2} = 5 > 4$

$\therefore d(A_7, A_{10}) = \sqrt{(1-1)^2 + (2-4)^2} = 2 < 4$ ✓

$\therefore d(A_8, A_{10}) = \sqrt{(4-1)^2 + (9-4)^2} = 5.830 > 4$

$\therefore d(A_9, A_{10}) = \sqrt{(9-1)^2 + (5-4)^2} = 8.0622 > 4$

Here

$\therefore K_2 = \{A_2, A_7, A_{10}\}$

$\therefore K_1 = \{A_1, A_4, A_8\}$

$\therefore K_3 = \{A_3, A_5, A_6, A_9\}$

Ans to the ques no 6

* The initial cluster is A_1 (2, 10)

* Distance from A_1

	Point	Dist (2, 10)
A_1	(2, 10)	0
A_2	(2, 5)	5
A_3	(8, 4)	12 ⟶ [Max]
A_4	(5, 8)	5
A_5	(7, 5)	10
A_6	(6, 4)	10
A_7	(1, 2)	9
A_8	(4, 9)	3
A_9	(9, 5)	12
A_{10}	(1, 4)	7

• Cluster 2 center is A 3 and

$T = 12$.

	Point	(2,10) Dist 1	(8,4) Dist 2	MIN DIST
A1	(2,10)	0	12	0
A2	(2,5)	5	7	5
A3	(8,4)	12	0	0
A4	(5,8)	5	7	5
A5	(7,5)	10	2	2
A6	(6,4)	10	2	2
A7	(1,2)	9	9	9 _ Max
A8	(4,9)	3	9	3
A9	(9,5)	12	2	2
A10	(1,4)	7	7	7 ~~-> Max~~

Dmax = 9

T/2 = 12/2 = 6

∴ Dmax > T/2

For cluster 3 the center is A7 (1,2)

	Point	$A_1(2,10)$	$A_3(3,4)$	$A_7(1,2)$	Min.
A_1	(2,10)	0	12	9	0
A_2	(2,5)	5	7	4	4
A_3	(8,4)	12	0	9	0
A_4	(5,8)	5	7	10	5 [Max]
A_5	(7,5)	10	2	9	2
A_6	(6,4)	10	2	7	2
A_7	(1,2)	9	9	0	0
A_8	(4,9)	3	9	10	3
A_9	(9,5)	12	2	11	2
A_{10}	(1,4)	7	7	2	2

$$T = \frac{12+12+9}{1} \quad \left[\frac{k(k+1)}{2} = \frac{1+(1+1)}{2} = 1\right]$$

$= 33$

$T/2 = 33/2 = 16.5$

$d_{max} = 5$

$d_{max} < T/2$

∴ Thus the procedure is terminated.