AI&ML-Theory Exam on Unsupervised Learning

1. Perform K-Means clustering for the dataset X and Fill up the following table while estimating Labels L and Centroids M for each iteration. Iterate till convergence for the specified number of maximum iterations. Report the final labels and the cluster centroids.

Ans:

#	X										M_1	M_2	M_3
	-1	27	31	2	59	3	61	34	0	12			
L_0	1	1	1	2	2	2	3	3	3	1			
L_1	1	3	3	1	3	1	3	3	1	1	17	21.33	31.67
L_2	1	2	2	1	3	1	3	3	1	1	3.2	21.33	42.4
L_3	1	2	2	1	3	1	3	2	1	1	3.2	29	51.33
L_4	1	2	2	1	3	1	3	2	1	1	3.2	30.67	60
L_5													
L_6													
L_7													

Processing will stop after L(x) is same as L(x-1)

Values at L_4 is final labels and cluster centroids.

2. Consider the following dataset

1	27	31	2	59	3	61	34	0	12

Suggest a Threshold T for this dataset using Otsu's method. Start iterations with T0 = 3.

Ans:

(d) 22.8

3. Consider the problem of incremental mean and standard deviation update for streaming data problems. For a certain problem, the respective values of mean and standard deviation from the previous instant are m(t-1) = 10 and s(t-1) = 2. The data at present instant is x(t) = 7. Estimate the updated values of mean m(t) and standard deviation s(t). The update rate is r = 0.05.

Ans:

(c) m(t) = 9.85; s(t) = 2.06

4. A dataset containing 1,10,000 points is to be subjected to hierarchical K-Means clustering with K=2. We will construct a fully grown tree and terminate with at least 100 points at each leaf node. The root node depth is considered to be ZERO. What value of maximum depth (dmax) shall we set for this divisive clustering tree.

Ans:
(b) dmax = 10

5. Consider the following dataset D which is subjected to mean-shift clustering through mean-shift iterations using an Epanechnikov kernel of band-width $h = 1.73$. Let, the cluster mode value at the kth iteration be $\boldsymbol{x}^{(k)} = \begin{bmatrix} 3.7 \\ 2.5 \end{bmatrix}$. Evaluate the mode value $\boldsymbol{x}^{(k+1)}$ at the (k+1)th iteration.

$\boldsymbol{x}_1$	$\boldsymbol{x}_2$	$\boldsymbol{x}_3$	$\boldsymbol{x}_4$	$\boldsymbol{x}_5$	$\boldsymbol{x}_6$	$\boldsymbol{x}_7$	$\boldsymbol{x}_8$	$\boldsymbol{x}_9$	$\boldsymbol{x}_{10}$
4.2	2.5	4.7	3.4	2.9	4.3	6.0	2.6	3.1	1.9
1.7	0.4	2.0	4.6	1.5	0.9	2.8	2.2	4.8	3.9

Ans:

(d) $\boldsymbol{x}^{(k+1)} = \begin{bmatrix} 3.74 \\ 1.66 \end{bmatrix}$