[b] Show the mechanism of simulated annealing algorithm to avoids trapping in local optima. Give appropriate mathematical equations. [5]

[c] Describe the exploitation and exploration phenomenon in Particle Swarm Optimization (PSO) along with adequate mathematical expressions. [5]

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Total No. of Pages 04 *Roll No. .....*

SIXTH SEMESTER **B. Tech. [CSE]**

END SEMESTER EXAMINATION *May-2019*

CO324 PATTERN RECOGNITION

Time: 3:00 Hours *Max. Marks: 50*

Note: Answer ***ALL*** questions.
Assume suitable missing data, if any.
USE ONLY OPTIMAL NUMBER OF WORDS TO ANWER

1[a] A former requires an automated pattern recognition system to segregate apples into two categories: Good, and Average. Give (briefly) steps and model of such pattern recognition. [Use block diagram to explain] [2]

[b] A surveillance system is designed to detected intruders. The probability of occurrence of intrusion is 0.05. There may be two type of error is detection: surveillance system detects an intruder, and there is no intruder (Type-I error), it fails to detect and there is an intruder (Type-II error). Let the probability of surveillance system detecting an intruder given there is no intruder is 0.1, and probability of surveillance system does not detect any intruder given there is an intruder is 0.01. Find the probability of Type-I error, Type-II error, probability of surveillance system detects an intruder, and the probability of presence of an intruder given surveillance system has detected an intruder. [2+2+2+2]

2. Answer *any TWO* of the followings

[a] Consider two nonnegative numbers a and b, and show that, if $a \leq b$, then $a \leq (ab)^{1/2}$. Use this result to show that, if the decision regions of a two-class classification problem are chosen to minimize the probability of misclassification, this probability will satisfy [5]

$$p(mistake) \leq \int \{p(x, C_1)\, p(x, C_1)\}^{1/2} dx$$

[b] Data is collected from a restaurant for various cooks, customers, and cuisines and food is labelled as tasty or not tasty. The data shown in Table-I. Design a Naïve Bayes classifier to predict taste of food if Cook = Shyam, Mood = Bad and Cuisine = Continental. [5]

Table-I

Cook	Mood	Cuisine	Taste
Shyam	Bad	Indian	Tasty
Shyam	Good	Continental	Tasty
Anu	Bad	Indian	Not Tasty
Anu	Good	Indian	Tasty
Uma	Bad	Indian	Tasty
Uma	Bad	Continental	Not Tasty
Anu	Bad	Continental	Not Tasty
Uma	Good	Continental	Not Tasty
Uma	Good	Indian	Tasty
Anu	Good	Continental	Tasty

[c] A common issue in the design of pattern recognition systems is of noisy and missing feature. Briefly discus a strategy to deal with noisy and missing features. [5]

3. Answer *any TWO* of the followings

[a] Compute the principal axes of the distribution. The covariance matrix of the distribution is given as [5]

$$\Sigma = \begin{bmatrix} 2.0 & 0.8 \\ 0.8 & 0.6 \end{bmatrix}$$

[b] Let x have an exponential density [5]

$$p(x|a) = \begin{cases} ae^{-ax}, & x \geq 0 \\ 0, & otherwise \end{cases}$$

Suppose that m samples are drawn independently according to p(x|a). Derive the equation of maximum likelihood estimate for a.

[c] Values of feature x of 45 randomly selected samples are shown in Table-II for each class A, class B. Obtain probability density estimation for both classes using histogram method [Consider interval of 1]. Also, find decision boundary if both the classes are equiprobable. [5]

Table-II

Values of feature x for 45 randomly selected samples of class A														
0.27	0.31	1.40	1.61	1.64	1.64	2.67	2.85	2.96	2.97	2.17	2.17	3.38	3.67	3.73
3.83	3,99	3.06	3.10	3.12	4.18	4.20	4.23	4.27	4.27	4.39	4.40	4.46	4.47	4.61
4.64	4.89	4.96	5.12	5.15	5.33	5.33	5.47	5.64	6.85	6.99	6.29	6.42	7.53	7.70
Values of feature x for 45 randomly selected samples of class B														
3.54	3.88	4.24	4.30	4.30	4.70	4.75	4.97	5.21	5.42	5.60	5.77	5.87	6.94	6.95
6.04	6.05	6.15	6.19	6.21	6.33	6.41	6.43	6.49	6.52	6.58	7.60	7.63	7.65	7.75
7.90	7.92	7.03	7.08	7.28	7.29	7.33	8.42	8.43	8.46	8.62	8.67	8.68	9.68	9.78

4. Answer *any TWO* of the followings

[a] Explain the concept of soft clustering (*be crisp in your answer*). From the data given in Table-II cluster all data points with the help of k-means clustering algorithm. Use Euclidean distance as the similarity measure and point A and B as the initial centroids. Solve for maximum 3 iterations. [5]

Table-III

Label	X	Y
A	185	72
B	170	56
C	168	60
D	179	68
E	182	72

[b] Find the clusters using complete link technique for the data shown in Table-IV. Use Euclidean distance, and draw dendogram. [5]

Table-IV

Label	X	Y
A	0.40	0.53
B	0.22	0.38
C	0.35	0.32
D	0.26	0.19
E	0.08	0.41

[c] A perceptron can be used to classify linear separable data. Design a classifier using combination of such perceptron to classify a dataset with two classes, class A: $[0, 0]^T$, $[1, 1]^T$ and class B: $[0, 1]^T$, $[1, 0]^T$. Use sigmoid function as the activation function. [5]

5[a] Answer *any TWO* of the followings

Use perceptron learning rule to train the network. The input training vectors are as follows: $X_1 = [1 \ -2 \ 0 \ 1]^T$, $X_2 = [0 \ 1.5 \ -0.5 \ -1]^T$ and $X_3 = [-1 \ 1 \ 0.5 \ -1]^T$. The initial weight vector is $[1 \ -1 \ 0 \ 0.5]^T$, The learning rate is 0.1 and the desired outputs are $d_1 = -1$, $d_2 = -1$ and $d_3 = 1$. Calculate the weight after one complete cycle. The activation function is given by: [5]

$$s(t) = \begin{cases} 1, & t \geq 0 \\ -1, & otherwise \end{cases}$$