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SIXTH SEMESTER

B.Tech. (CSE)

SUPPLEMENTARY EXAMINATION **Sep-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] Discuss the design steps of a pattern recognition system using a block diagram. [consider a practical example] [2]

[b] Consider a tumor detection system using medical imaging. The probability of occurrence of tumor is 0.05. There may be two type of error is detection: the system detects a tumor, and there is no tumor in reality (Type-I error); it fails to detect and there is a tumor (Type-II error). Let the probability of the system detecting a tumor given there is no tumor is 0.1, and probability of the system does not detect any tumor given there is a tumor is 0.01. Find the probability of Type-I error, Type-II error, probability of the system detects a tumor, and the probability of presence of a tumor given the system has detected a tumor.

[2+2+2+2]

2. Answer *any TWO* of the followings

[a] What is meant by support vector? Explain, with an example in 2-D feature space. Consider a hyperplane $\mathbf{w}^T\mathbf{x} + w_0 = 0$. The hyperplane acts as decision surface between class i and class j. Calculate margin of an object $\mathbf{x}$ from the decision surface. [5]

[b] Consider a fictional dataset that describes the weather conditions for playing a game of golf. Given the weather conditions, each tuple classifies the conditions as fit("Yes") or unfit("No") for playing golf. Design a classifier based on Naïve Bayes approach and find if there is a play or no play for feature vector X=[Rainy, Cool, Normal, True]. [5]

Table-I

Day	Outlook	Temperature	Humidity	Windy	Play
0	Rainy	Hot	High	False	No
1	Rainy	Hot	High	True	No
2	Overcast	Hot	High	False	Yes
3	Sunny	Mild	High	False	Yes
4	Sunny	Cool	Normal	False	Yes
5	Sunny	Cool	Normal	True	No
6	Overcast	Cool	Normal	True	Yes
7	Rainy	Mild	High	False	No
8	Rainy	Cool	Normal	False	Yes
9	Sunny	Mild	Normal	False	Yes
10	Rainy	Mild	Normal	True	Yes
11	Overcast	Mild	High	True	Yes
12	Overcast	Hot	Normal	False	Yes
13	Sunny	Mild	High	True	No

[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] The five observations of two dimensional data are given in Table II. Reduce the dimensionality of data using PCA. [5]

Table II

x	10	12	13	14	16
y	16	18	20	22	24

Hint: the eigenvalues of covariance matrix of data are: 0.0670, 14.9330 and the eigenvectors are: $[-0.8174 \quad 0.5760]^T$, $[0.5760 \quad 0.8174]^T$.

[c] Consider the problem of binary classification using the Naive Bayes classifier. You are given two dimensional features (X_1, X_2) and the categorical class conditional distributions in the tables below. The entries

in Table III correspond to P ($X_1 = x_1|Ci$) and P ($X_2 = x_2|Ci$) respectively. Given a data point (−1, 1), calculate the following posterior probabilities: P ($C_1|X_1 = -1, X_2 = 1$). [5]

Table III

Class	X_1			X_2		
	-1	0	1	-1	0	1
C_1	0.2	0.4	0.4	0.4	0.5	0.1
C_2	0.3	0.6	0.1	0.1	0.3	0.6

4. Answer *any TWO* of the followings

[a] How would a sample with a feature vector (1, 1) be classified if samples from class A are at (3, 0) (4, 1) and (3, 2) and sample from class B are at (1, -1) and (1, -1.5) using the K means. [5]

[b] Use KNN algorithm and predict the type of fruit or food type to which Tomato (Sweet = 6, Crunch = 4) belongs

Table IV

Ingredient	Sweet	Crunch	Food Type
Grape	8	5	Fruit
Greenbean	3	7	Vegetable
Nuts	3	6	Protein
Orange	7	3	Fruit

[c] Explain working of a perception (in ANN) using a block diagram. Also, design XOR gate using ANN. [5]

5[a] Consider a neural network with following set of input and desired output training vectors: [5]

$$\mathbf{X}^{(1)} = [-1, 2, 0, 1]^T; \quad t^{(1)} = 1,$$
$$\mathbf{X}^{(2)} = [0.5, -0.5, 2, -1]^T; \quad t^{(2)} = -1,$$
$$\mathbf{X}^{(3)} = [-1.5, 0, 0.5, -1]^T; \quad t^{(3)} = +1,$$

With initial weight vector $\mathbf{W}^{(1)} = [0.1, 0.4, 0, 0.3]^T$, and the learning rate $\eta = 0.1$. Activation function of neuron is Signam function and learning rule is $\mathbf{W}^{(n+1)} = \mathbf{W}^{(n+1)} + \eta[t^{(n)} - o^{(n)}]\mathbf{X}^{(n)}$, . Find out whether ANN will give produce target outputs in two iterations or not. Show each step clearly.

[b] Explain the working of simulated annealing algorithm and compare it with steepest descent algorithm in terms of global vs local search. [5]

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

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