Code No: 07A81205 **R07** **Set No. 2**

IV B.Tech II Semester Examinations,April/May 2012
PATTERN RECOGNITION
Information Technology

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. For each of the following datasets, construct a normal plot, and decide if the data appear to be approximately normally distributed.
   (a) 35, 43, 46, 48, 51, 55, 58, 65
   (b) 2.0, 3.0, 3.2, 3.5, 3.7, 3.9, 4.0, 4.2, 4.4, 4.4, 4.5, 4.8, 5.0, 5.1, 5.4, 5.8, 6.1 [8+8]
2. Explain the Bayesian estimation or Bayesian learning approach to pattern classification problems. [16]
3. Discuss the state transition matrix and state-transition coefficients for 4-state left-right Model. [16]
4. Class A has a symmetric triangular density ranging from 0 to 4, and class B has a uniform density ranging from 2 to 6. The prior probabilities and costs are the same for both classes.
   (a) Where are the optimal decision regions?
   (b) What are the probabilities of error for class A and for class B if these decision regions are used. [16]
5. Write short notes on the following:
   (a) Applications of normal mixtures in unsupervised learning
   (b) Mixture density
   (c) Component densities
   (d) Mixing parameters. [16]
6. (a) Given the observation sequence O=(o_1,o_2, ... o_T) and the model λ = (A,B,π) how do we choose a corresponding state sequence q=(q_1,q_2,.......... q_T) that is optimal in some sense (i.e. best explains the observations)?
   (b) Explain N-state urn-and-ball model. [8+8]
7. Consider the use of multidimensional scaling for representing the points $x_1 = (1, 0)^t$, $x_2 = (0, 0)^t$, and $x_3 = (0, 0)^t$, in one dimensions. To obtain a unique solution, assume that the image points satisfy $0 = y_1 < y_2 < y_3$.
   Show that the criterion function $J_e e$ is minimized by the configuration with $y_2 = (1 + \sqrt{2})/3$ and $y_3 = 2y_2$. [16]

8. Distinguish between the preprocessing, feature extraction and classification operations of pattern recognition system. [16]

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Code No: 07A81205 **R07** **Set No. 4**

IV B.Tech II Semester Examinations,April/May 2012
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Information Technology

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Explain the class- conditional densities in Bayesian estimation. [16]
2. (a) How do we adjust the model parameters λ=(A, B, π) to maximize P(O/λ)?
   (b) Explain the discrete-time Markov process. [8+8]
3. Explain the related minimum variance criteria in clustering with examples. [16]
4. Explain the functional structure of a general statistical Pattern classifier with neat diagram. [16]
5. (a) Find the mean and variance of a standard normal distribution.
   (b) Explain decision regions for two-dimensional Gaussian data. [8+8]
6. Explain non-linear component analysis with neat diagram. [16]
7. Explain about error rate, risk multiplier classifiers of Post processing in pattern recognition system. [16]
8. (a) In which case Hidden Markov model parameter set to zero initially will remain at zero throughout the re-estimation procedure.
   (b) Constraints of the left-right model have no effect on the re-estimation procedure. Justify. [8+8]

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Code No: 07A81205 **R07** **Set No. 1**

IV B.Tech II Semester Examinations,April/May 2012
PATTERN RECOGNITION
Information Technology

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. Classes A and B are bivariate normally distributed with μ_x, μ_y, σ_x, σ_y, and ρ_{xy} of 0, 0, 1, 2, 0 for class A and 2, 0, 1, 1, 0 for class B. P(A) = 2/5, P(B) = 3/5, and the cost of misclassifying an A is three times that for a B.
   (a) What is the equation of the optimal decision boundary?
   (b) Sketch the optimal decision boundary and a contour of constant probability density for each class. [8+8]

2. (a) In a poll of 500 people, 300 were in favor of proposition. Find a 95 percent confidence Interval for the true fraction of people in favor of the proposition?
   (b) Explain the terms prior probability and posterior probability in Bayes decision theory. [8+8]

3. Explain the three basic problems for Hidden Markov Model. [16]

4. Show that if our model is poor, the maximum-likelehood classifier we derive is not the best-even among our (poor) model set-by exploring the following example. Suppose we have two equally probable categories (i.e., P(ω_1)=P(ω_2)=0.5). Furthermore, we know that p(x/ ω_1) $\sim$ N(0,1) but assume that p(x/ ω_2) $\sim$ N(μ ,1). (That is, that parameter θ we seek by maximum-likelihood techniques is the mean of the second distribution.) Imagine, however, that the true underlying distribution is p(x/ ω_2) $\sim$ N(1,10^6).
   (a) What is the value of our maximum-likelihood estimate μ in our poor model, given a large amount of data?
   (b) What is the decision boundary arising from this maximum-likelihood estimate in the poor model? [8+8]

5. How do you justify that a thre-layer network cannot be used for non-linear principal component analysis, even if the middle layer consists of nonlinear units. [16]

6. Let $x_1 = \begin{pmatrix} 0 \\ 0 \end{pmatrix}$, $x_2 = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$, $x_3 = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$, and $x_4 = \begin{pmatrix} 2 \\ 0.5 \end{pmatrix}$, and consider the following three partitions:

   $D_1 = \{x_1, x_2\}, D_2 = \{x_3, x_4\}$

   $D_1 = \{x_1, x_4\}, D_2 = \{x_2, x_3\}$

   $D_1 = \{x_1, x_2, x_3\}, D_2 = \{x_4\}$

(a) Find the clustering that minimizes the sum-of-squared error criterion,

$$\mathrm{J_e} = \sum_{i=1}^{c} \sum_{x \in Di} ||x - m_i||^2$$

(b) Find the clustering that minimizes the trace criterion,

$$J_e = |SW| = |\sum_{i=1}^{c} s\, i|$$ [16]

7. (a) Explain the concept of decision boundary in design of simple classifiers.

   (b) Explain the design cycle of patern recognition system and also explain the computational complexity in the design. [8+8]

8. What are the restrictions placed on the form of the probability density function to ensure that the parameters of the pdf can be re-estimated in a consistent way? [16]

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Code No: 07A81205 **R07** **Set No. 3**

IV B.Tech II Semester Examinations,April/May 2012
PATTERN RECOGNITION
Information Technology

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Write sum-of sqared functions for multidimensional scaling.
   (b) How do you compute the gradients of criterion function of multidimensional scaling? [8+8]

2. (a) Explain the concept of classification in pattern recognition system with examples.
   (b) Explain the concept of post processing in pattern recognition system with examples. [8+8]

3. (a) Explain the marginal density functions.
   (b) Use a Z-transformation and the normal tables to calculate P $(-1 \leq x \leq 2)$ where x has the density $P(x) = \frac{1}{3\sqrt{2\pi}}\, e^{-}(x-2)^2/18$ [8+8]

4. (a) Explain the general principle of maximum likelihood estimation.
   (b) Find the maximum likelihood estimate for μ in a normal distribution. [8+8]

5. (a) Write the re-estimation formulas for the coefficients of the mixture density.
   (b) Discuss the state transition matrix for 4-state ergodic model and 6-state parallel path left- right model with examples. [8+8]

6. Some data with features x and y (see the following table) were randomly selected from a population that consists of classes A and B. What is the probability that a new sample with x = 0, y = 1 belongs to class A? Make only necessary assumptions and list them. [16]

Class	Samples	X=0	X=1	Y=0	Y=1
A	6	4	2	5	1
B	4	2	2	3	1

7. If a set of n samples D is partitioned into c disjoint subsets D_1,- - - , D_c, the sample mean m_i for samples in D_i is undefined if D_i is empty. In such a case, the sum-of-squared errors involves only the nonempty subsets:
$$J_e = \sum_{Di \neq \phi} \sum_{x=Di} ||x - m_i||^2$$
Assuming that $n \geq c$, show there are no empty subsets in a partition that minimizes J_e. Explain your answer in words. [16]

8. Consider an HMM representation (Parameterized by λ') of a coin-tossing experiment. Assume a three-state model (Corresponding to three different coins with probabilities)

	State1	State2	State3
P(H)	0.5	0.75	0.25
P(T)	0.5	0.25	0.75

The state - transition probabilities were
$a_{11} = 0.9$, $a_{21} = 0.45$, $a_{31} = 0.45$
$a_{12} = 0.05$, $a_{22} = 0.1$, $a_{32} = 0.45$
$a_{13} = 0.05$, $a_{23} = 0.45$, $a_{33} = 0.1$
In this new model λ', consider the observation sequence O = (H H H H T H T T T T). What state sequence is most likely? What is the Probability of the observation sequence most likely state sequence? [16]

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