



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH (CSE)/SEM-8/CS-801F/2013

2013

PATTERN RECOGNITION

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

10 × 1 = 10

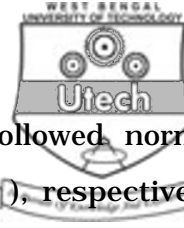
i) Clustering algorithm usually employ

a) supervised learning

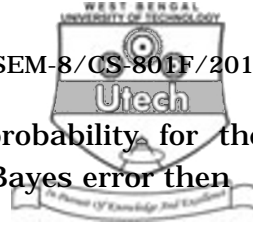
b) unsupervised learning

c) reinforcement learning

d) competitive learning.



- ii) The likelihood of class w_1 and w_2 followed normal distribution $N(-0.5, 2)$ and $N(0.5, 2)$, respectively. For equal prior, a pattern $X = 1.0$ belongs to
- a) class w_1
 - b) class w_2
 - c) either class w_1 or class w_2
 - d) both the classes.
- iii) If the covariance matrices for all of the classes are identical, then the discriminant functions will be
- a) Linear
 - b) Quadratic
 - c) Polynomial
 - d) None of these.
- iv) For uniform prior we can estimate the parameter of a density function by using
- a) maximum likelihood (*ML*)
 - b) maximum a posteriority (*MAP*)
 - c) either *ML* or *MAP*
 - d) none of these.
- v) *K*-Nearest Neighbor based classifier is
- a) linear and optimal
 - b) linear and suboptimal
 - c) nonlinear and optimal
 - d) nonlinear and suboptimal.



- vi) If P_{NN} is the classification error probability for the Nearest Neighbor rule and P_B is the Bayes error then
- a) $P_B \leq P_{NN} \leq 2P_B$ b) $P_{NN} \geq P_{2B}$
c) $P_{NN} \leq P_{2B}$ d) $P_{NN} \leq P_{B..}$
- vii) Gradient descent search is not applicable to find optima on a
- a) rough surface
b) smooth surface
c) surface with single optima
d) surface with multiple optima.
- viii) Perceptron is not able to implement
- a) OR gate b) AND gate
c) XOR gate d) NOT gate.
- ix) Given two fuzzy clusters A_1 and A_2 . A data point X in two-class (fuzzy C-means clustering) then satisfies
- a) $\mu_{A_1}(x) + \mu_{A_2}(x) = 1$
b) $\mu_{A_1}(x) + \mu_{A_2}(x) < 1$
c) $\mu_{A_1}(x) + \mu_{A_2}(x) > 1$
d) $\mu_{A_1}(x) + \mu_{A_2}(x) \leq 1$.
- x) Principal component analysis is one important step in
- a) Data dimension reduction
b) Data encryption
c) Noise filtering
d) Data communication.



GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following.

$3 \times 5 = 15$

2. Compare and contrast supervised and unsupervised learning.
3. Design a Bayes classifier in terms of a set of discriminant functions.
4. A sample from class-A is located at $(X, Y, Z) = (1, 2, 3)$, a sample from class-B is at $(7, 4, 5)$ and a sample from class-C is at $(6, 2, 1)$. How would a sample at $(3, 4, 5)$ be classified using the Nearest Neighbor technique and Euclidean distance ?
5. Write a short note on generalized linear discriminant function.
6. Consider the following proximity matrix :

$$P = \begin{matrix} & \begin{matrix} x_1 & x_2 & x_3 & x_4 & x_5 \end{matrix} \\ \begin{matrix} x_1 \\ x_2 \\ x_3 \\ x_4 \\ x_5 \end{matrix} & \begin{bmatrix} 0 & 6 & 8 & 2 & 7 \\ & 0 & 1 & 5 & 3 \\ & & 0 & 10 & 9 \\ & & & 0 & 4 \\ & & & & 0 \end{bmatrix} \end{matrix}$$

Draw the resulting dendrogram by applying single link clustering algorithm.



GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Describe the basic steps involved in the design of pattern recognition system.

b) What is maximum likelihood (ML) estimation ? Show that if the likelihood function is univariate Gaussian with unknowns the mean μ as well as variance σ^2 , then ML estimate are given by

$$\mu = \frac{1}{N} \sum_{k=1}^N X_k, \text{ and } \sigma^2 = \frac{1}{N} (X_k - \mu)^2,$$

where X_k is the k^{th} pattern and N is the total number of training patterns.

c) Compare parametric and non-parametric technique.

6 + 5 + 4



8. a) What is Bayesian classifier ? Prove that it is an optimal classifier.
- b) In a two class problem with single feature X the *pdf*s are Gaussians with variance $\sigma^2 = \frac{1}{2}$ for both classes and mean value 0 and 1 respectively. If $P(w_1) = P(w_2) = \frac{1}{2}$, compute the threshold value X_0 for minimum error probability. 4 + 5 + 6
9. a) What is density estimation ? What are the necessary conditions for its convergence ?
- b) Compare Parzen Windows and k -Nearest Neighbor density estimation technique.
- c) What is perceptron ? Discuss briefly the perceptron based learning algorithm. 4 + 4 + 7
10. a) What is clustering ? Categorize the different clustering algorithms of the pattern recognition domain.
- b) Explain Fuzzy-C-means clustering algorithm. Write a short note about its criterion function. 6 + 9



11. a) What is feature selection ? What is optimal and suboptimal feature subset selection ?
- b) Explain one suboptimal feature subset selection technique.
- c) What is feature generation ? Write a short note on principal component analysis.
- 4 + 5 + 6

=====