

B.TECH/IT/6TH SEM/INFO 3243/2019
PATTERN RECOGNITION
(INFO 3243)

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

*Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.*

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) The covariance matrix in Bayes classifier employs a distance metric called____
(a) Mahalanobish distance (b) Euclidean distance
(c) City block distance (d) Hausdor distance.
- (ii) Clustering algorithm usually employs
(a) supervised learning
(b) unsupervised learning
(c) reinforcement learning
(d) competitive learning.
- (iii) The collection of patterns in a class is {1, 2, 3, 4, 5}. If the class is normally distributed then estimates of the parameters are____
(a) $\mu = 3$ and $\sigma^2 = 10$ (b) $\mu = 2$ and $\sigma^2 = 2$
(c) $\mu = 15$ and $\sigma^2 = 10$ (d) $\mu = 3$ and $\sigma^2 = 2$.
- (iv) Let the number of patterns belong to C1, C2 and C3 are 14, 25 and 11 respectively then the gini impurity will be____
(a) 0.40 (b) 0.35 (c) 0.31 (d) 0.49.
- (v) If probability of heads is 0.9 then what is the probability of generating the sequence “hhhhth” using six independent tosses?
(a) $P(\text{hhhhth}) = 0.04$ (b) $P(\text{hhhhth}) = 0.50$
(c) $P(\text{hhhhth}) = 0.06$ (d) $P(\text{hhhhth}) = 0.60$.
- (vi) A patient has been tested positive for a disease. Consider the following information and find the probability that the patient actually has the disease?
 $P(\text{Test} = +ve \mid \text{Disease} = \text{True}) = 0.95$, $P(\text{Test} = +ve \mid \text{Disease} = \text{False}) = 0.05$
and $P(\text{Disease} = \text{True}) = 0.01$
(a) 0.116 (b) 0.516 (c) 0.95 (d) 0.161.

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- (vii) If the variance covariance matrix is diagonal matrix then the features are____
(a) independent (b) dependent
(c) zero mean value (d) uniformly distributed.
- (viii) Fisher’s linear discriminant analysis is used in____
(a) unsupervised classification (b) supervised classification
(c) reinforcement classification (d) competitive classification.
- (ix) When two classes can be separated by a separate line, they are known as____
(a) linearly separable (b) linearly inseparable classes
(c) may be separable or inseparable, it depends on system
(d) none of the mentioned.
- (x) Impurity of an attribute is high means
(a) this attribute makes the maximum difference to the classification.
(b) this attribute makes little difference to the classification.
(c) this attribute can be used for verification of unknown patterns.
(d) this attribute makes not so much difference to the classification.

Group – B

2. Consider two-dimensional Gaussian distribution with prior probability of the classes $P(C1) = P(C2) = 1/4$ and $P(C3) = 1/2$. Find the decision boundary with the help of given information:
 $\mu_1 = \begin{bmatrix} -1 \\ 3 \end{bmatrix}$ $\mu_2 = \begin{bmatrix} 0 \\ 6 \end{bmatrix}$ $\mu_3 = \begin{bmatrix} -2 \\ 4 \end{bmatrix}$ $\Sigma_1 = \begin{bmatrix} 1 & -0.5 \\ 0.5 & 2 \end{bmatrix}$ $\Sigma_2 = \begin{bmatrix} 2 & -2 \\ -2 & 7 \end{bmatrix}$ $\Sigma_3 = \begin{bmatrix} 1 & 1.5 \\ 1.5 & 3 \end{bmatrix}$ **12**
3. (a) Explain Bayes’ theorem to classify objects.
(b) Consider the prior probabilities of three classes are given below.
 $P(\text{Small}) = 1/3$, $P(\text{Medium}) = 1/3$ and $P(\text{Large}) = 1/3$
We have a set of nails, bolts and rivets in a box. The class-conditional probabilities of these objects are given below.
 $P(\text{Nail} \mid \text{Small}) = 1/4$, $P(\text{Nail} \mid \text{Medium}) = 1/2$, $P(\text{Nail} \mid \text{Large}) = 1/3$
 $P(\text{Bolt} \mid \text{Small}) = 1/2$, $P(\text{Bolt} \mid \text{Medium}) = 1/6$, $P(\text{Bolt} \mid \text{Large}) = 1/3$
 $P(\text{Rivet} \mid \text{Small}) = 1/4$, $P(\text{Rivet} \mid \text{Medium}) = 1/3$, $P(\text{Rivet} \mid \text{Large}) = 1/3$
Find the probability of the class labels given that it is a nail, bolt or rivet.

4 + 8 = 12

Group – C

4. (a) Write the steps of K-NN classifier.
(b) Let the patterns (0, 3), (0, 2), (0, 1), (0, 0), (- 1, 0), (- 2, 0) belong to C1 and (1, 3), (1, 1), (1, 0), (0, - 1) belong to C2. Classify the pattern (1, 4) using k-NN algorithm where value of k is 1 and 3.

4 + 8 = 12

5. (a) Write the forward algorithm of hidden Markov model.
- (b) Write the decoding algorithm of hidden Markov model.

6 + 6 = 12**Group – D**

6. Based on the samples of data design a decision tree and classify the new pattern
Wakeup = Late, Have Talk = No and Weather = Rainy.

Wakeup	Have Talk	Weather	Go to School
Normal	No	Sunny	No
Normal	No	Rainy	No
Early	No	Sunny	Yes
Late	No	Sunny	Yes
Late	Yes	Sunny	Yes
Late	Yes	Rainy	No
Early	Yes	Rainy	Yes
Normal	No	Sunny	No
Normal	Yes	Sunny	Yes
Late	Yes	Sunny	Yes
Normal	Yes	Rainy	Yes
Early	No	Rainy	Yes
Early	Yes	Sunny	Yes

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7. (a) Compare the clustering and classification methods.
- (b) Consider the set of 2D patterns: (1, 1), (1, 2), (2, 1), (2, 1.5), (3, 2) (4, 1.5), (4, 2), (5, 1.5), (4.5, 2), (4, 4) (4.5, 4), (4.5, 5), (4, 5), (5, 5). Use K-means algorithm where K = 3.

2 + 10 = 12**Group – E**

8. (a) What do you mean by dimension reduction?
- (b) Let the patterns (1, 2), (2, 3), (3, 3), (4, 5), (5, 5) belong to C1 and (1, 0), (2, 1), (3, 1), (3, 2), (5, 3), (6, 5) belong to C2. Now reduce the dimension using Fisher's linear discriminant analysis.
9. (a) What do you mean by feature selection? Why is feature selection algorithm required for pattern classification?
- (b) Write the branch and bound algorithm for feature selection.

2 + 10 = 12**(2+3) + 7 = 12**