

B.E. COMPUTER SCIENCE AND ENGINEERING
FOURTH YEAR FIRST SEMESTER - 2025

SUBJECT
PATTERN RECOGNITION

Time : 3 hours

Full marks : 100

Answer question no.1 and any four from the rest

All questions carry equal marks

1. Answer true or false stating reasons

2x10 = 20

- (a) A Naïve Bayes Classifier can only work on continuous-valued data.
- (b) The success of a pattern classification scheme using decision function depends only on finding the appropriate form of $d(x)$.
- (c) In a typical PR problem, the dimensionality of measurement space is always less than that of feature space.
- (d) In case of pattern classification method using decision function, once a certain function or functions have been selected the only way to establish the effectiveness of the chosen decision functions is by direct trial.
- (e) A single-layer-perceptron cannot solve Exclusive-OR problem.
- (f) In Bayesian Network, the nodes represent events and the edges represent conditional dependencies.
- (g) For a supervised pattern classification problem having M classes, where the patterns are pair-wise separable, the classifier needs to compute $M/2$ number of decision surfaces to perform classification.
- (h) Partitional clustering methods help in exploring data at different levels of granularity.
- (i) The merit of a NB classifier is that, the assumption of class conditional independence is always valid for real life problems.
- (j) Syntactic Pattern Recognition attempts to classify patterns based on a set of extracted features and an underlying statistical model for the generation of these patterns.

2. (a) Explain briefly with an example the necessary steps involved in a typical PR system. 10

- (b) Assume any three disjoint pattern classes ω_1, ω_2 and ω_3 in $\mathbb{R}^2$. Compute the decision boundaries and decision rules that are needed to successfully classify all the patterns from the said three classes for the following two cases:

[Turn over

1. Each class is separable from all other classes
2. Classes are pair-wise separable

10

3. What is partitional clustering? State and explain one such method which is based on the principle of minimization of intra-class distances. Discuss the merits and demerits of the method. 2 + 12 + 6

4. (a) Explain briefly a typical Naïve Bayes Classifier. What are the advantages of such a classifier over KNN and Decision Tree? 6+4

(b) Consider the following hypothetical data for possible buyers of laptops.

Age Group	Income	Student	Credit_rating	Class: buys_laptop
Youth	High	No	Fair	No
Youth	High	No	Excellent	No
Middle_aged	High	No	Fair	Yes
Senior	Medium	No	Fair	Yes
Senior	Low	Yes	Fair	Yes
Senior	Low	Yes	Excellent	No
Middle_aged	Low	Yes	Excellent	yes
Youth	Medium	No	Fair	No
Youth	Low	Yes	Fair	Yes
Senior	Medium	Yes	Fair	Yes
Youth	Medium	Yes	Excellent	Yes
Middle_aged	Medium	No	Excellent	Yes
Middle_aged	High	Yes	Fair	Yes
Senior	Medium	No	Excellent	No

Use a Naïve Bayes Classifier to determine whether a person represented by the following tuple (X) will purchase a laptop.

X = (Age_group = Youth, Income = Medium, Student = Yes, Credit_rating = Fair) 10

5. (a) What is the importance of Syntactic PR? How the Syntactic patterns are described? Describe with a neat diagram the working of a typical Syntactic PR system. 4 + 6 + 10

6. (a) How are the features of a biological neurone imitated in an artificial neurone? 6

- (b) Describe how can a single layer perceptron classify two linearly separable classes? Can such an ANN learn an XOR function? Justify your answer.

10 + 4

7. Write short notes on any two of the following.

2 X 10

- (a) Bayesian Belief Network
- (b) Features of a typical ANN
- (c) Importance of non-metric similarity measure in clustering.