

BE in Information Technology
Fourth Year Second Semester Examination 2019
Sub: Pattern Recognition

Time : Three hours

Full Marks : 100

Answer any 5

20x5=100

1. a. Compare the clustering and classification methods.
 b. Given dataset $X = \{4, 5, 6, 7, 9, 10, 12, 14, 15, 16, 17\}$ use Parzen Window to estimate the density $p(x)$ at $x = 3$ and 15 where height is 2 and 4 . 5 + 15 = 20
2. a. Write the steps of K-NN classifier.
 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 $K = 3$. 6 + 14 = 20
3. a. What do you mean by dimension reduction?
 b. Let the patterns $(1, 2), (2, 3), (3, 3), (4, 5), (5, 5)$ belong to C_1 and $(1, 0), (2, 1), (3, 1), (3, 2), (5, 3), (6, 5)$ belong to C_2 . Now reduce the dimension using Fisher's Linear Discriminant Analysis. 5 + 15 = 20
4. What do you mean by parameter estimation? Why non-parametric parameter estimation is required? Estimate the mean and variance of a Gaussian distribution using MLE. 3+4+13=20
5. Consider two-dimensional Gaussian Distribution with Prior Probability of the classes $P(C_1) = P(C_2) = 1/4$ and $P(C_3) = 1/2$. Find the decision boundary with the help of given information: 20

$$\mu_1 = \begin{bmatrix} -1 \\ 3 \end{bmatrix} \quad \mu_2 = \begin{bmatrix} 0 \\ 6 \end{bmatrix} \quad \mu_3 = \begin{bmatrix} -2 \\ 4 \end{bmatrix}$$

$$\Sigma_1 = \begin{bmatrix} 1 & -0.5 \\ -0.5 & 2 \end{bmatrix} \quad \Sigma_2 = \begin{bmatrix} 2 & -2 \\ -2 & 7 \end{bmatrix} \quad \Sigma_3 = \begin{bmatrix} 1 & 1.5 \\ 1.5 & 3 \end{bmatrix}$$
6. Write the training algorithm for single output perceptron. Realize the Bipolar AND Gate using Perceptron. 20
7. a. Training dataset given below:

Cook	Mood	Cuisine	Tasty
Sita	Bad	Indian	Yes
Sita	Good	Continental	Yes
Asha	Bad	Indian	No
Asha	Good	Indian	Yes
Usha	Bad	Continental	No
Usha	Bad	Indian	Yes
Asha	Bad	Continental	No
Asha	Good	Continental	Yes
Usha	Good	Indian	Yes
Usha	Good	Continental	No

Now, classify the new pattern Cook = Usha, Mood = Bad, Cuisine = Continental using Naïve Bayes Classifier.

- b. Define Bayes' Theorem to classify objects. 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.

$$P(\text{Nail} \mid \text{Small}) = 1/4, \quad P(\text{Nail} \mid \text{Medium}) = 1/2, \quad P(\text{Nail} \mid \text{Large}) = 1/3$$

$$P(\text{Bolt} \mid \text{Small}) = 1/2, \quad P(\text{Bolt} \mid \text{Medium}) = 1/6, \quad P(\text{Bolt} \mid \text{Large}) = 1/3$$

$$P(\text{Rivet} \mid \text{Small}) = 1/4, \quad P(\text{Rivet} \mid \text{Medium}) = 1/3, \quad P(\text{Rivet} \mid \text{Large}) = 1/3$$

Find the probability of the class labels given that it is a nail, bolt or rivet.

$$10 + 3 + 7 = 20$$