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
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> 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)   When two classes can be separated by a straight line, they are known as -
    (a) Linearly separable classes
    (b) Linearly inseparable classes
    (c) May depend on system, can be separable/inseparable
    (d) All of the above

    (ii)   Given patterns: $P_1 = \langle 5,4,3 \rangle$, $P_2 = \langle 5,4,2 \rangle$, $P_3 = \langle 101,202,303 \rangle$. Which of the following statement/s is/are correct?
    (a) P_1 and P_2 are dis-similar   (b) P_1 and P_3 are similar
    (c) P_2 and P_3 are similar   (d) P_1 and P_2 are similar

    (iii)   What is the objective of perceptron learning?
    (a) Class identification
    (b) Weight adjustment
    (c) Weight adjustment along with classification
    (d) None of the above

    (iv)   Incase of Bayes' decision rule, the probability of error is defined as
    (a) $p\left(\frac{\text{error}}{x}\right) = \begin{cases} p(\omega_1/x) \text{ if we decide } \omega_1 \\ p(\omega_2/x) \text{ if we decide } \omega_2 \end{cases}$
    (b) $p\left(\frac{\text{error}}{x}\right) = \begin{cases} p(\omega_1/x) \text{ if we decide } \omega_2 \\ p(\omega_2/x) \text{ if we decide } \omega_1 \end{cases}$
    (c) $p(\text{error}/x) = p(\omega_1/x)$ whether we decide ω_1 or ω_2
    (d) $p(\text{error}/x) = p(\omega_2/x)$ whether we decide ω_1 or ω_2
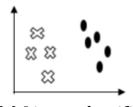
    (v)   Line perpendicular to the major axis is known as
    (a) Median axis   (b) Equilateral axis
    (c) Equidistant axis   (d) Minor axis

(vi) Which of the following is the best suited classifier for classifying the following pattern?

(a) Linear classifier　　　　　　　　　(b) Cubic classifier
(c) Quadratic classifier　　　　　　　　(d) None of these

(vii) Parametric representation of Gaussian probability density function is given by?
(a) radius and center　　　　　　　　　(b) mean and variance
(c) standard deviation　　　　　　　　　(d) centroid and height

(viii) What is unsupervised learning?
(a) features of group explicitly stated
(b) number of groups may be known
(c) neither feature nor number of groups is known
(d) none of the mentioned

(ix) Which of the following could be possible stopping criteria in K-means clustering?
(a) Convergence. (No further change in centroids).
(b) Maximum number of iterations.
(c) Both a and b
(d) None of these

(x)   Why is the XOR problem exceptionally interesting to neural network researchers?
(a) Because it can be expressed in a way that allows you to use a neural network
(b) Because it is complex binary operation that cannot be solved using neural networks
(c) Because it can be solved by a single layer perceptron
(d) Because it is the simplest linearly inseparable problem that exists.

Group – B

2. Suppose we have points belonging to two classes ω_1 and ω_2. The training samples which are provided for these two classes are $\omega_1 \rightarrow \begin{pmatrix} 2 \\ 6 \end{pmatrix} \begin{pmatrix} 3 \\ 4 \end{pmatrix} \begin{pmatrix} 3 \\ 8 \end{pmatrix} \begin{pmatrix} 4 \\ 6 \end{pmatrix}$, $\omega_2 \rightarrow \begin{pmatrix} 3 \\ 0 \end{pmatrix} \begin{pmatrix} 1 \\ -2 \end{pmatrix} \begin{pmatrix} 3 \\ -4 \end{pmatrix} \begin{pmatrix} 5 \\ -2 \end{pmatrix}$. $P(\omega_1)=P(\omega_2)=0.5$. Find the decision boundary between ω_1 and ω_2?

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3.   Training dataset given in table 1, classify the new pattern Weather = Sunny, Humidity = Normal, Windy = True using Naïve Bayes Classifier.

Table 1

Weather	Humidity	Windy	Play Golf
Rainy	High	False	No
Rainy	High	True	No
Overcast	High	False	Yes
Sunny	High	False	Yes
Sunny	Normal	False	Yes
Overcast	Normal	True	Yes
Rainy	Normal	False	Yes
Overcast	High	True	Yes
Rainy	Normal	True	Yes
Sunny	High	True	No

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Group – C

4.   Estimate the variance of a multivariate Gaussian distribution using MLE.

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5.   Given is the 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.

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Group – D

6.   Given the following points, A(1,1), B(1,2), C(2,2), D(3,2), E(4,1), F(4,2), G(6,1), H(6,2), and I(9,3); hierarchal clustering with single linkage is to be used to cluster the data points into three clusters. Find out the correct clusters.

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7.   Based on the samples of data in table 1, design a decision tree and classify the new pattern Weather = Sunny, Humidity = Normal, Windy = True.

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Group – E

8.   For a two class problem,
$\binom{1}{6}, \binom{2}{7}, \binom{3}{8}, \binom{4}{9}$ and $\binom{5}{10} \in \omega_1$ and $\binom{7}{1}, \binom{8}{1}, \binom{9}{1}, \binom{10}{1}$ and $\binom{11}{1} \in \omega_2$, find the total within class scatter, S_w.

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9. For the following vectors,
$\binom{1}{6}, \binom{2}{7}, \binom{3}{8}, \binom{4}{9}$ *and* $\binom{5}{10}$, find out the projection of the vector $\binom{2}{7}$ onto a lower dimension using PCA.

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Department & Section	Submission Link
IT	https://classroom.google.com/c/MzY5MTE4OTI3NjAz/a/MzY5MTEzMDczNTU2/details

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