Exam Date & Time: 30-Nov-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

Department of Electronics and Communication Engineering
Machine Learning [ECE 4052]

Marks: 50   **Duration: 180 mins.**

Descriptive

Answer all the questions.

Data missing if any, may be suitably assumed.

1A)   Explain supervised, unsupervised and reinforcement learning techniques with suitable
           examples.   (4)

1B)   Consider a 0-1 loss function for a 3-classs problem. Assume $Pr(g_1/x)=0.6$, $Pr(g_2/x)=0.2$,
           and $Pr(g_3/x)=0.2$, where g_1, g_2 and g_3 are 3-class labels. Construct the loss function and
           find the error scores for each class.   (3)

1C)   In a linear regression learning, show that the model parameters are given by,

$$\vec{\hat{\beta}} = (X^T X)^{-1} X^T Y$$
           . Here X denotes the input data matrix and Y is the output   (3)
           vector.

2A)   Consider the following four training examples.

x	y
2	9
3	12
4	16
5	19

                                                                                                                            (4)

           Regression function f(x) of the form f(x) = ax + b which is parameterized by (a, b) is
           learnt by using squared error as the loss function. Calculate the squared error loss for the
           given input training data set when (i) (a, b)=(4, 3) and (ii) (a, b)=(3, 4) . Which
           parameter pair gives minimum loss?

2B)   Obtain the expressions for bias and variance of classifier or regressor. Using an
           example, describe the importance of these terms while modeling a mapping function.   (3)

2C)   What do you mean by "Masking problem" in classifiers? Explain the Masking problem
           with the help of example. How can it be addressed?   (3)

3A)   Illustrate logistic regression-based classifier and show that it is a linear classifier. Obtain
           the log-likelihood function for the same.   (4)

3B)   Consider an SVM classifier with a polynomial kernel of degree 2. If the input feature   (3)
           space is of two dimensions, obtain basis functions in the transform space.

3C) Consider a newly released phone X1 with 1269 reviews. It is found that only 172 of them were bad reviews. It has been analysed that good reviews mean that product is good 90% of the time and bad reviews mean that product is bad 70% of the time. What is the probability that if you order X1, it is a bad phone? (3)

4A) How the Boolean functions AND and OR can be learned using perceptron? Give their structures, geometric interpretations and limitations. (4)

4B) Explain the Maximum A Posteriori (MAP) parametric estimation method with the help of necessary expressions. (3)

4C) With the help of structures, describe how linear regression can be visualized using graphical models. (3)

5A) Describe the classifier performance measures namely, receiver operating characteristics (ROC), Precision, Recall, Sensitivity and Specificity as applicable to two-class problem. (4)

5B) With the help of suitable example, explain the k-Means clustering algorithm. (3)

5C) Describe the concept of 'Bagging' and 'Boosting' in details as applicable to combining multiple learning techniques. (3)

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