

Program : Computer
Level : Bachelor
Year/Part : III / II

Subject: Machine Learning

FM: 100
PM: 45
Time: 3 hrs

Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks. Neat and clean writing are extra credited.

Attempt all the questions.

1. a) Define Machine Learning. Discuss the major types of Machine Learning with one example for each. 7
- b) You are given the following data. Fit a simple linear regression line $Y = a + bX$ using the least squares method and find the best values of a and b. Also, predict the score of the student who studied for 9.5 hours. 8

X (Hours Studied)	Y (Test Score)
2	45
4	55
6	65
8	75

2. a) -Explain Ridge and Lasso Regression. How do they address overfitting? 7
- b) Explain Support Vector Machines (SVM) for classification. What is the role of kernel functions in handling non-linearly separable data? 8

OR

Explain the KNN classifier algorithm with a suitable example.

3. a) What is clustering? Why clustering is required in ML? Compare K-Means and DBSCAN clustering methods. 7
- b) Explain Association Rule Mining with a sample transaction dataset. Use Apriori algorithm to find the frequent itemsets from below dataset. Assume minimum support count = 2. 8

TID	Items
101	3,4,5
102	2, 3,5
103	1,2,3,4
104	1,2,3

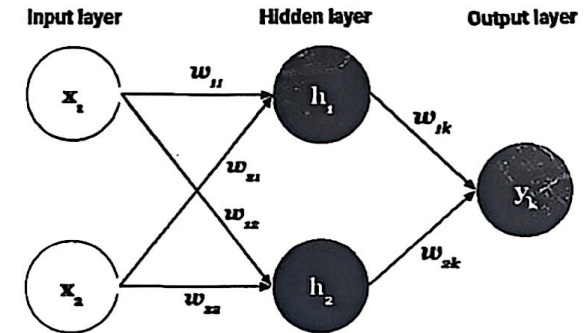
4. a) Explain the concept of dimensionality reduction. Differentiate PCA and LDA. Mention the steps for computing Principal components. 7
- b) Given a neural network structure as below with sigmoid activation function and parameters as below. Compute the predicted output. If the actual output is 1, will it make back propagation? If so, why this is required? 8

Given:

$$x_1 = 1.0, x_2 = 2.0,$$

$$w_{11} = 0.1, w_{12} = 0.3, b_1 = 0.1, w_{21} = 0.2, w_{22} = 0.4,$$

$$b_2 = 0.2, w_{31} = 0.5, w_{32} = 0.6, b_3 = 0.3$$



5. a) Describe the role of activation functions in neural networks. Compare ReLU, Sigmoid, and Tanh with sketches. 7
- b) Explain how LSTM solves the problem of vanishing gradient problem. 8

OR

Describe CNNs. Explain the roles of convolution, pooling, and fully connected layers in image processing.

6. a) A binary classification model produced the following confusion matrix on a test dataset of 100 samples. Calculate the accuracy, precision, recall and F1-Score of the model. 7

	Predicted Positive	Predicted Negative
Actual Positive	40	10
Actual Negative	20	30

- b) What is Hyper-parameter Tuning? Describe the process and importance of cross-validation. Compare K-fold cross-validation and Leave-One-Out Cross Validation (LOOCV). 8
7. Write short notes on: (any two) 10
 - a) Machine Learning workflow
 - b) Loss functions
 - c) Regression metrics
