

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Bachelor of Technology (Computer Engineering) SEMESTER - 6 Summer 2025 (Regular)

Course :Bachelor of Technology (Computer Engineering) Branch : Engineering and Technology

Semester : SEMESTER - 6

Subject Code & Name: BTCOC603 - MACHINE LEARNING

Time : 3 Hours]

[Total Marks : 60

Instructions to the Students:

1. Each question carries 12 marks.
2. Question No. 1 will be compulsory and include objective-type questions.
3. Candidates are required to attempt any four questions from Question No. 2 to Question No.6
4. Use of non-programmable scientific calculators is allowed.
5. Assume suitable data wherever necessary and mention it clearly.

Q1. Objective type questions. (Compulsory Question)

12

- 1 What is inductive bias in machine learning?
 - a) An assumption that helps generalize beyond training data
 - b) The amount of data needed for training
 - c) A technique for model evaluation
 - d) A type of feature scaling
- 2 Which of the following is a feature reduction technique?
 - a) Decision Trees
 - b) Linear Regression
 - c) Principal Component Analysis (PCA)
 - d) k-Means
- 3 In Bayes learning, what does the posterior probability represent?
 - a) Prior knowledge of the data
 - b) The likelihood of the data given the model
 - c) The updated belief after seeing the data
 - d) The variance in the hypothesis
- 4 What is the purpose of a kernel in SVM?
 - a) To reduce dimensionality
 - b) To convert linear problems to non-linear
 - c) To calculate accuracy
 - d) To regularize the model
- 5 Which activation function is most commonly used in hidden layers of deep neural networks?
 - a) Sigmoid
 - b) ReLU
 - c) Linear
 - d) Softmax
- 6 What does backpropagation primarily update?
 - a) Data inputs
 - b) Output layer nodes
 - c) Weights in the neural network
 - d) Learning rate
- 7 What is VC Dimension?
 - a) The number of training examples
 - b) capacity of model to shatter data points
 - c). The error in a model
 - d) The number of clusters in the dataset
- 8 In Gaussian Mixture Models (GMM), what does each component represent?
 - a) A cluster with hard boundaries
 - b) A fixed decision tree
 - c) A probability distribution
 - d) A binary classifier
- 9 Ensemble learning combines
 - a) Clusters of the same model
 - b) Several models to improve performance
 - c) Feature selection methods
 - d) Hyperparameters

- 10 Which of the following methods is commonly used in collaborative filtering?
- Supervised learning
 - Content-based filtering
 - User-item matrix
 - Logistic regression
- 11 Perceptron can solve which type of problems?
- Non-linearly separable
 - Multi-class
 - Linearly separable
 - Regression
- 12 Adaptive hierarchical clustering is different from standard hierarchical clustering because it:
- Uses a fixed number of clusters
 - Requires more data
 - Adjusts its structure based on data characteristics
 - Cannot be visualized

Q2. Solve the following.

- A) Explain the concept of inductive bias in machine learning. Why is it necessary? Illustrate with an example.
- B) You have given the data: $x = 1, 2$ and $y = 2, 4$. Apply a single step of linear regression on the data.

Q3. Solve the following.

- A) Using the following weather dataset, estimate the probability of playing the game if the weather is "Rainy" using the Naive Bayes algorithm. Clearly state all assumptions and steps involved.

Weather	Play
Sunny	No
Overcast	Yes
Rainy	Yes
Sunny	Yes
Sunny	Yes
Overcast	Yes
Rainy	No
Rainy	Yes
Sunny	No
Rainy	Yes
Sunny	Yes
Overcast	Yes
Overcast	Yes
Rainy	No

- B) Compare Logistic Regression and Support Vector Machines (SVM) in terms of their practical applicability across various machine learning tasks, considering the following aspects:
- Assumptions about the data
 - Interpretability of the model
 - handling outliers
 - Computational complexity
 - Suitability for high-dimensional data
 - Performance on linearly and non-linearly separable problems

Q4. Solve Any Two of the following.

- A) Given the following network: 1 input node with value $x = 11$ weight $w = 0.5$, Bias $b = 0.1$, and activation function sigmoid. Compute the output of the neuron.

- B) Explain the working of the Backpropagation algorithm in multilayer neural networks and discuss its practical role in training deep neural networks (DNNs). How does Backpropagation help in minimizing prediction errors during model training?
- C) Explain the concept of Probably Approximately Correct (PAC) learning and discuss how it applies to evaluating machine learning models. Clearly define the terms: hypothesis class, ϵ (error), and δ (confidence) in this context.

Q5. Solve Any Two of the following.

- A) Explain in detail the architecture and working mechanism of a Multilayer Neural Network. 6
- B) Calculate the information gain for the following dataset:

Day	Weather	Temperature	Humidity	Wind	Play Cricket
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cool	Normal	Weak	Yes
6	Rain	Cool	Normal	Strong	No
7	Overcast	Cool	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cool	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

- C) Explain in detail the bagging and boosting techniques in ensemble learning. 6

Q6. Solve Any Two of the following.

- A) What is ensemble learning? Explain in detail the working of the Random Forest Algorithm. 6
- B) Given the points: (1, 1), (2, 1), (4, 3), and (5, 4). Run two iterations of k-means clustering with $k = 2$ and initial centroids at (1, 1) and (5, 4). Show cluster assignment and new centroids. 6
- C) Explain hierarchical clustering. How does it differ from regular hierarchical clustering in terms of structure and computational efficiency? 6

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