

Atal Bihari Vajpayee Indian Institute of Information Technology & Management, Gwalior

IT306: Machine Learning

Major Examination (Session 2024–25)

Maximum Time: 3 Hours

Max Marks: 55

Note: Attempt any five questions. Clearly justify your answers with proper reasoning.

1. (a) Explain gradient boosting in detail. (b) Compare AdaBoost, Gradient Boosting, and XGBoost. (10 Marks)
2. (a) Derive the backpropagation algorithm for training a multi-layer perceptron. (b) Apply one epoch of backpropagation for a simple 2–2–1 neural network. (12 Marks)
3. (a) Discuss clustering evaluation metrics such as Silhouette score and Davies–Bouldin index. (b) Cluster the points $(1, 2), (2, 2), (8, 8), (9, 9)$ using k -means with $k = 2$ (first iteration). (9 Marks)
4. (a) Explain Hidden Markov Models (HMMs). (b) Apply the forward algorithm to compute the probability of an observed sequence. (8 Marks)
5. (a) Discuss Bayesian learning. (b) Show how MAP estimation differs from MLE with a practical example. (8 Marks)
6. Write short notes on any two: (i) Dimensionality reduction techniques beyond PCA (ii) Reinforcement learning applications (iii) Ethical challenges in machine learning (8 Marks)