

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-7 SEMESTER – OLD PAPER – S22 TO S25 – QUESTION BANK

Subject Name & Code:

AI and Machine Learning- 3170924

Unit 1: Introduction to AI and Machine Learning Fundamentals

Repeated Questions:

1. **Compare/Distinguish between supervised and unsupervised learning.**
 - Appeared in: W22 (Q1b, 04 marks), S23 (Q1b, 04 marks), W23 (Q2b, 04 marks), S24 (Q1b, 04 marks), W24 (Q1c, 07 marks), SUM25 (Q4a, 03 marks)
2. **Give a brief review/history of Artificial Intelligence.**
 - Appeared in: W22 (Q1c, 07 marks), S24 (Q1c, 07 marks), SUM25 (Q1b, 04 marks)
3. **Define and explain the concept of Artificial Intelligence.**
 - Appeared in: W23 (Q1b, 04 marks), S24 (Q1a, 03 marks)
4. **Explain the term 'Hypothesis Space'.**
 - Appeared in: S22 (Q1b, 04 marks), W24 (Q3a, 03 marks)
5. **Explain the term 'Inductive Bias'.**
 - Appeared in: W22 (Q1a, 03 marks), W24 (Q3a, 03 marks)

Other Important Questions:

- Explain the significance/importance of AI in various sectors/human life. (S23 - Q1a, 03 marks), (W24 - Q1a, 03 marks), (S24 - Q1a, 03 marks)
- Compare Artificial intelligence and human intelligence. (S22 - Q1a, 03 marks), (SUM25 - Q1c, 07 marks)
- Describe the key goals and objectives of Artificial Intelligence. How is AI shaping the future? (SUM25 - Q1a, 03 marks)
- What is Machine Learning? Explain the steps to develop a machine learning application. (W23 - Q3b, 04 marks)
- Briefly describe characteristics of Artificial Intelligence. (W23 - Q1a, 03 marks)
- Explain classification of Machine learning in details. (S22 - Q1c, 07 marks)
- Define the following: (i) Reinforcement Learning (ii) Deep Learning (iii) Semi-supervised Learning. (W24 - Q2a, 03 marks), (W23 - Q3a, 03 marks)
- What is cross validation? Explain k-fold cross validation. (W22 - Q2b, 04 marks)
- Explain the concept of Cross-validation (CV) in machine learning. (S23 - Q5c, 07 marks)

- Define the following terms: (i) Accuracy in ML (ii) Attribute in ML (iii) Decision boundary for SVM. (S23 - Q5a, 03 marks)
- Define the following in context of Machine Learning: (i) Accuracy (ii) Precision (iii) Over-fitting. (W24 - Q3a, 03 marks)
- List the methods to avoid over-fitting. (W23 - Q3a, 03 marks)
- Explain the concept of Bias-Variance tradeoff in machine learning. (S23 - Q4b, 04 marks)

Unit 2: Artificial Neural Networks

Repeated Questions:

1. **Explain Biological neurons and artificial neural networks.**
 - Appeared in: S22 (Q2a, 03 marks), W24 (Q4a, 03 marks), S24 (Q2b, 04 marks)
2. **What is the importance of activation function? Explain different types of activation functions.**
 - Appeared in: S22 (Q2c, 07 marks), W22 (Q2c, 07 marks), S24 (Q2c, 07 marks), W24 (Q5c, 07 marks), SUM25 (Q2c, 07 marks)
3. **Explain Back Propagation Neural Networks.**
 - Appeared in: S22 (Q3c, 07 marks), W22 (Q2c OR, 07 marks), S23 (Q3c, 07 marks), W24 (Q5c, 07 marks), S24 (Q3b, 04 marks)
4. **Explain Perceptron NN and Multi-layer Perceptron NN.**
 - Appeared in: S22 (Q3c, 07 marks), S24 (Q3c, 07 marks)

Other Important Questions:

- With the help of a schematic diagram, explain the concept of multi-layer perceptron neural network. (S23 - Q1c, 07 marks)
- Explain the fundamental structure of an Artificial Neural Network (ANN) and provide a clear diagram. (SUM25 - Q2b, 04 marks)
- How learning rate of ANN affect the convergence? (W23 - Q2a, 03 marks)
- Express various structures of ANN. (W23 - Q2c, 07 marks)
- Explain the concept of forward-phase and backward-phase in the weight-update algorithm. (W24 - Q5c, 07 marks), (S23 - Q3c, 07 marks)
- Demonstrate the different types of learning methods used in neural networks. (SUM25 - Q2c OR, 07 marks)
- Evaluate application of neural network and justify the need of using neural network in the applications. (S24 - Q3c OR, 07 marks)
- Explain any one neural network-based application. (S22 - Q3c OR, 07 marks)

Unit 3: Core Machine Learning Algorithms - I

Repeated Questions:

1. **Explain the concept of Decision Trees.**
 - Appeared in: S22 (Q3a OR, 03 marks), S23 (Q2b, 04 marks), W24 (Q5a, 03 marks), S24 (Q3a OR, 03 marks)
2. **Explain Entropy and Information Gain w.r.t. a Decision Tree.**
 - Appeared in: S23 (Q2b, 04 marks), W24 (Q2c OR, 07 marks)
3. **Explain Linear Regression.**
 - Appeared in: W22 (Q3b, 04 marks), S23 (Q4c, 07 marks), SUM25 (Q3c, 07 marks)
4. **Explain Logistic Regression.**
 - Appeared in: S22 (Q4a OR, 03 marks), W22 (Q3b, 04 marks), S24 (Q2c OR, 07 marks), SUM25 (Q5c, 07 marks)
5. **Explain/Differentiate between Linear and Logistic Regression.**
 - Appeared in: W24 (Q3b, 04 marks), S23 (Q4a, 03 marks), W23 (Q4b, 04 marks)

Other Important Questions:

- What are the main distinctions between the methodologies of Classification and Regression? (W24 - Q2b, 04 marks)
- Explain the concept of Support Vector Machines (SVM) with a diagram. (S23 - Q2c, 07 marks), (W23 - Q3c, 07 marks), (W24 - Q3c, 07 marks)
- Explain the concept of hyperplanes, support vectors, and the kernel trick in SVM. (W24 - Q5c, 07 marks), (SUM25 - Q5a, 03 marks)
- Explain the basic concept of Support Vector Machines (SVM). (SUM25 - Q5b, 04 marks)
- Explain the concept of decision boundary and Kernel trick w.r.t SVM. (S24 - Q4a OR, 03 marks)
- Explain K-Nearest Neighbors (KNN) algorithm. (SUM25 - Q3c OR, 07 marks)
- What is K-means clustering? Explain with a diagram. (S23 - Q2c OR, 07 marks), (W24 - Q5c, 07 marks), (S24 - Q5a OR, 03 marks)
- How KNN is different from K-means clustering? (S23 - Q2c OR, 07 marks), (W24 - Q3c, 07 marks)
- Explain collaborative filtering. (S22 - Q3a, 03 marks), (SUM25 - Q3b OR, 04 marks), (W22 - Q4a, 03 marks)
- What do you mean by Recommendation system(s)? State key differences between content-based filtering and collaborative filtering. (S23 - Q4c, 07 marks)
- What are the issues in Decision tree learning? How to overcome them? (W23 - Q4c, 07 marks)

Unit 4: Core Machine Learning Algorithms - II & Advanced Topics

Repeated Questions:

1. **What is dimensionality reduction? Explain feature selection and feature extraction.**
 - Appeared in: S22 (Q3b OR, 04 marks), W22 (Q3a, 03 marks), W24 (Q3b, 04 marks), SUM25 (Q3a, 03 marks)
2. **Explain Agglomerative Hierarchical Clustering.**
 - Appeared in: S22 (Q2c OR, 07 marks), W24 (Q4c, 07 marks), S24 (Q5b OR, 04 marks), SUM25 (Q4c, 07 marks)
3. **Explain K-means clustering.**
 - Appeared in: W24 (Q3c, 07 marks), W24 (Q5c, 07 marks), S24 (Q5a OR, 03 marks)
4. **Is clustering a supervised or unsupervised learning method? Explain with an example.**
 - Appeared in: SUM25 (Q4a, 03 marks), W24 (Q5a, 03 marks)

Other Important Questions:

- Enlist the steps involved in feature selection. (S24 - Q3a, 03 marks), (W22 - Q3a, 03 marks)
- Describe how principal component analysis (PCA) is carried out. (W23 - Q3b, 04 marks)
- Explain the Classification of Regression with its real time applications. (W23 - Q3c OR, 07 marks)
- Define the following terms with respect to K-Nearest neighbor learning: a) Regression b) Residual c) Kernel Function. (W23 - Q4a, 03 marks)
- What is semi-supervised learning? How is it different from supervised and unsupervised learning? (S23 - Q2a, 03 marks)
- What is Reinforcement learning? How it is different from Supervised learning? (S23 - Q3b, 04 marks)
- Brief reinforcement learning. (W23 - Q5a, 03 marks)
- Differentiate between Semi supervised learning and Active learning. (W23 - Q5a OR, 03 marks)
- What is deep learning? How it is different from Machine learning? (W23 - Q2c OR, 07 marks), (SUM25 - Q4b, 04 marks)
- Differentiate between machine learning and deep learning. (SUM25 - Q4b, 04 marks)
- Compare and contrast simple linear regression and multiple linear regression. (SUM25 - Q3c, 07 marks)
- Explain the concept of linear regression. State key differences between univariate and multivariate linear regression. (S23 - Q4c, 07 marks)

Unit 5: Fuzzy Logic Systems

Repeated Questions:

1. **Compare conventional sets vs fuzzy sets / Difference between fuzzy and crisp logic.**
 - Appeared in: S22 (Q4a, 03 marks), W24 (Q1b, 04 marks), S24 (Q2a, 03 marks)
2. **Explain the Membership Function of fuzzy logic. / Discuss different types of membership functions.**
 - Appeared in: S22 (Q4b, 04 marks), W22 (Q3c, 07 marks), S24 (Q3b OR, 04 marks)
3. **Explain operations of fuzzy sets (Compliment, Union, Intersection).**
 - Appeared in: S22 (Q4c, 07 marks), W24 (Q4c, 07 marks), W23 (Q5c, 07 marks)
4. **Explain Methods of Defuzzification.**
 - Appeared in: S22 (Q5c, 07 marks), W23 (Q4c, 07 marks), S24 (Q5c OR, 07 marks)
5. **Explain Fuzzy Inference System (FIS) / Fuzzy IF-THEN rule.**
 - Appeared in: W24 (Q4a, 03 marks), W23 (Q4b, 04 marks), S24 (Q4a, 03 marks)

Other Important Questions:

- What are the benefits and limitations of a fuzzy logic system? (SUM25 - Q5a OR, 03 marks)
- What is fuzzification and defuzzification? Explain the meaning of universe of discourse. (W24 - Q4b, 04 marks), (S23 - Q5b, 04 marks)
- Define the following terms w.r.t. fuzzy logic: (i) Membership function (ii) Core (iii) Crossover point. (S23 - Q3a, 03 marks)
- Explain the concept of Fuzzy Logic Control with an example. (S23 - Q4b, 04 marks)
- Explain any one fuzzy logic-based application. (S22 - Q4c OR, 07 marks)
- **Numerical:** Using the Centre of Area Defuzzification method, find the crisp outputs Y1 and Y2 for the given membership functions, assuming $X1 = X2 = 4$. (SUM25 - Q5b OR, 04 marks)
- **Numerical:** In Mamdani approach, assume that two rules are going to be fired for a set of inputs. The fuzzified outputs of two fired rules are shown in Fig. A and Fig. B. Find the defuzzified output using Centre of Sums method. (W22 - Q3c, 07 marks)

Unit 6: Genetic Algorithms

Repeated Questions:

1. **Explain Genetic Algorithm with the help of a flowchart/block diagram.**
 - Appeared in: W24 (Q2c, 07 marks), W23 (Q1c, 07 marks), S24 (Q4b, 04 marks)
2. **Explain Genetic Algorithm operators: Crossover.**
 - Appeared in: S22 (Q5b, 04 marks), W23 (Q5b OR, 04 marks), S24 (Q5b OR, 04 marks)
3. **Explain Genetic Algorithm operators: Selection/Reproduction.**
 - Appeared in: S22 (Q5b, 04 marks), W24 (Q4b, 04 marks), S24 (Q5a, 03 marks)
4. **Compare Genetic algorithm with traditional optimization Technique.**
 - Appeared in: S22 (Q5a, 03 marks)
5. **Explain any one Genetic Algorithm based application.**
 - Appeared in: S22 (Q5c OR, 07 marks), W22 (Q4c, 04 marks), S24 (Q4c, 07 marks)

Other Important Questions:

- Explain genetic algorithm operator: Reproduction. (S22 - Q5a OR, 03 marks)
- Elaborate roulette wheel selection method. (S24 - Q5a, 03 marks)
- Explain any one crossover technique with an example. (W23 - Q5b OR, 04 marks), (SUM25 - Q4b OR, 04 marks)
- Explain why Genetic Algorithms are less likely to get stuck in local optimum? (W22 - Q4a, 03 marks)
- Discuss economic generation scheduling using a genetic algorithm. (W23 - Q5c OR, 07 marks)
- **Numerical:** The decision variables x_1 and x_2 in Genetic Algorithms are represented by $x_1 = 110011$ and $x_2 = 001101$. Find the value of x_1 and x_2 if the limits on decision variables for x_1 is between 0 to 5 and for x_2 is between 2 to 7.5. (W22 - Q4b, 04 marks)
