# SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

## DEPARTMENT OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE
## &
## DEPARTMENT OF INFORMATION TECHNOLOGY

**QUESTION BANK**

**V SEMESTER**
**AD3563-MACHINE LEARNING**
**Regulation – 2023**

**Academic Year 2025-2026 (Odd Semester)**

*Prepared by*

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**DEPARTMENT OF INFORMATION TECHNOLOGY**

**QUESTION BANK**

**SUBJECT : AD3563-MACHINE LEARNING**

**SEM / YEAR: V / III**

| UNIT I – INTRODUCTION TO MACHINE LEARNING | | | |
|---|---|---|---|
| Review of Linear Algebra for machine learning; Introduction and motivation for machine learning; Examples of machine learning applications, Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off. | | | |
| | **PART-A** | | |
| **Q.No** | **Questions** | **BT Level** | **Competence** |
| 1 | **List** the role of eigenvalues and eigenvectors in machine learning. | BTL1 | Remembering |
| 2 | **Define** the dot product and **state** its significance in machine learning. | BTL1 | Remembering |
| 3 | **Identify** the rank of a matrix and **state** its importance. | BTL1 | Remembering |
| 4 | **Name** how matrix inversion is used in linear regression. | BTL1 | Remembering |
| 5 | **Define** the difference between scalar, vector, and matrix. | BTL1 | Remembering |
| 6 | **Summarize** supervised learning with an example. | BTL2 | Understanding |
| 7 | **Classify** the key differences between AI, machine learning, and deep learning. | BTL2 | Understanding |
| 8 | **State** why machine learning is preferred over rule-based systems. | BTL1 | Remembering |
| 9 | **Outline** two real-world applications of machine learning. | BTL2 | Understanding |
| 10 | **Differentiate** between training and testing data. | BTL2 | Understanding |
| 11 | **Outline** two machine learning applications in healthcare. | BTL2 | Understanding |
| 12 | **Show** how machine learning is used in recommendation systems. | BTL2 | Understanding |
| 13 | **List** the type of learning used in spam detection and **state** why it is suitable. | BTL1 | Remembering |
| 14 | **Give** an example of a machine learning application in finance. | BTL2 | Understanding |
| 15 | **Illustrate** one use case of machine learning in autonomous vehicles. | BTL2 | Understanding |
| 16 | **Define** VC dimension in the context of hypothesis spaces. | BTL2 | Understanding |
| 17 | **Outline** what a high VC dimension indicates about a model. | BTL2 | Understanding |
| 18 | **Interpret** how VC dimension relates to model complexity. | BTL2 | Understanding |
| 19 | **List** what PAC stands for in machine learning. | BTL2 | Understanding |
| 20 | **Name** the term "probably approximately correct" in one sentence. | BTL1 | Remembering |
| 21 | **Define** how PAC learning formalizes the learning process. | BTL1 | Remembering |
| 22 | **Identify** a hypothesis space in machine learning. | BTL1 | Remembering |

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| 23 | **State** inductive bias with an example. | BTL1 | Remembering | |
| 24 | **List** why inductive bias is necessary for generalization. | BTL1 | Remembering | |
| | **PART-B** | | | |
| 1 | Explain the importance of Eigen values and Eigen vectors in machine learning with an example application such as Principal Component Analysis (PCA) | (16) | BTL3 | Applying |
| 2 | Discuss how linear algebra concepts such as matrix multiplication, inversion, and transposition are used in linear regression. | (16) | BTL3 | Applying |
| 3 | Determine how vector spaces and subspaces are relevant in understanding the feature space of machine learning models. | (16) | BTL5 | Evaluating |
| 4 | What is machine learning? Discuss its motivation, and differentiate it from traditional programming with suitable examples. | (16) | BTL5 | Evaluating |
| 5 | Describe the different types of machine learning (supervised, unsupervised, reinforcement learning) and provide one real-world example of each. | (16) | BTL3 | Applying |
| 6 | What are the major challenges in machine learning today, and how do they influence model development? | (16) | BTL3 | Applying |
| 7 | Discuss at least three real-world applications of machine learning and explain how machine learning is used in each. | (16) | BTL3 | Applying |
| 8 | Explain how machine learning is applied in healthcare, focusing on predictive diagnostics or personalized medicine. | (16) | BTL5 | Evaluating |
| 9 | Illustrate the use of machine learning in natural language processing (NLP) with examples. | (16) | BTL3 | Applying |
| 10 | Define VC dimension and explain its significance in understanding the capacity of a learning algorithm. | (16) | BTL4 | Analyzing |
| 11 | Derive and interpret the VC dimension for simple hypothesis spaces such as intervals on the real line or linear classifiers in 2D. | (16) | BTL6 | Creating |
| 12 | How does the VC dimension affect overfitting and underfitting in a learning model? | (16) | BTL3 | Applying |
| 13 | (i) Explain the PAC learning framework. Discuss its assumptions and how it quantifies learnability.<br>(ii) Derive the PAC learning bound and explain the significance of sample complexity in terms of error and confidence. | (8)<br>(8) | BTL3 | Applying |
| 14 | How does PAC learning help in understanding the feasibility of learning a concept? | (16) | BTL3 | Applying |
| 15 | How can you apply the concepts of hypothesis spaces, inductive bias, and generalization to design a machine learning model? | (16) | BTL3 | Applying |
| 16 | What is a hypothesis space? How does its size and complexity impact model generalization? | (16) | BTL3 | Applying |
| 17 | Define inductive bias and explain its role in generalization. Use an example to show how different biases lead to different learned hypotheses. | (16) | BTL3 | Applying |

## UNIT II- SUPERVISED LEARNING

Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Perceptron algorithm, Probabilistic discriminative model - Logistic regression, Probabilistic generative model – Naive Bayes, Maximum margin classifier – Support vector machine, Decision Tree, Random Forests.

### PART-A

| Q.No | Questions | BT Level | Competence |
|---|---|---|---|
| 1 | **Identify** the objective of least squares in linear regression. | BTL1 | Remembering |
| 2 | **Summarize** the assumption behind linear regression. | BTL2 | Understanding |
| 3 | **Define** the cost function used in simple linear regression. | BTL2 | Understanding |
| 4 | **State** what is meant by multicollinearity in multiple linear regression. | BTL1 | Remembering |
| 5 | **Mention** one advantage and one limitation of Bayesian linear regression. | BTL2 | Understanding |
| 6 | **How** does a decision tree classify data? | BTL1 | Remembering |
| 7 | **Compare** the difference between batch and stochastic gradient descent. | BTL2 | Understanding |
| 8 | **Identify** the role of the learning rate in gradient descent. | BTL1 | Remembering |
| 9 | **Illustrate** how gradient descent minimizes the cost function in linear regression. | BTL2 | Understanding |
| 10 | **Define** a discriminant function with an example. | BTL1 | Remembering |
| 11 | **Outline** the basic idea behind the perceptron algorithm. | BTL2 | Understanding |
| 12 | **Name** the type of data the perceptron algorithm can classify correctly. | BTL1 | Remembering |
| 13 | **Summarize** one limitation of the perceptron learning algorithm. | BTL2 | Understanding |
| 14 | **State** the decision boundary for logistic regression. | BTL2 | Understanding |
| 15 | **Compare** why logistic regression is preferred over linear regression for classification. | BTL2 | Understanding |
| 16 | **Identify** the main objective of the Maximum Margin Classifier. | BTL1 | Remembering |
| 17 | **Define** the sigmoid function and its role in logistic regression. | BTL1 | Remembering |
| 18 | **Summarize** the assumption made by the Naive Bayes classifier about features. | BTL2 | Understanding |
| 19 | **What** is a random forest?. | BTL1 | Remembering |
| 20 | **Identify** one use case of Naive Bayes in real-world applications. | BTL1 | Remembering |
| 21 | **Illustrate** how Naive Bayes handles categorical data. | BTL2 | Understanding |
| 22 | **State** what is meant by the margin and support vectors in SVM. | BTL1 | Remembering |
| 23 | **Define** Gini index, and how is it used in decision trees? | BTL1 | Remembering |
| 24 | **Identify** why SVM is called a maximum margin classifier. | BTL1 | Remembering |

| | PART-B | | | |
|---|---|---|---|---|
| 1 | Discover the least squares solution for linear regression with a single variable. Explain the assumptions made and interpret the regression coefficients. | (16) | BTL3 | Applying |
| 2 | Examine the least squares method to multiple linear regression. Derive the normal equation and discuss the geometric interpretation of the solution. | (16) | BTL4 | Analyzing |
| 3 | Identify the concept of overfitting in linear regression. How can regularization (Ridge or Lasso) help in preventing it? | (16) | BTL3 | Applying |
| 4 | Explain Bayesian linear regression in detail. Derive the posterior distribution and compare it with traditional linear regression. | (16) | BTL5 | Evaluating |
| 5 | Explain the working of gradient descent in linear regression. Discuss batch, stochastic, and mini-batch variants, along with their pros and cons. | (16) | BTL5 | Evaluating |
| 6 | Construct gradient descent for linear regression with one variable and show convergence using a sample dataset | (16) | BTL6 | Creating |
| 7 | Evaluate the perceptron learning algorithm. Derive the update rule, explain its convergence for linearly separable data, and discuss its limitations. | (16) | BTL5 | Evaluating |
| 8 | Identify the discriminant function used in linear classification. How does it help in decision boundary formation? | (16) | BTL3 | Applying |
| 9 | Discover the logistic regression model from the sigmoid function. Explain how maximum likelihood estimation is used to find model parameters. | (8)<br>(8) | BTL4 | Analyzing |
| 10 | Compare linear regression and logistic regression. Discuss their differences in terms of output, loss function, and use cases. | (16) | BTL5 | Evaluating |
| 11 | Analyze the Naive Bayes classification algorithm in detail. Derive the decision rule and discuss the effect of the independence assumption. | (8)<br>(8) | BTL4 | Analyzing |
| 12 | Apply Naive Bayes to a binary classification problem. Use a small dataset and show the full step-by-step computation. | (8)<br>(8) | BTL3 | Applying |
| 13 | Compose the concept of maximum margin classification. Derive the hard margin SVM optimization problem and interpret the role of support vectors. | (8)<br>(8) | BTL6 | Creating |
| 14 | Explain the kernel trick in SVM. Provide examples of common kernels and explain how they help in non-linear classification. | (16) | BTL5 | Evaluating |
| 15 | Model how a decision tree is constructed? Discuss entropy, information gain, and the splitting criteria used in ID3 or CART. | (16) | BTL3 | Applying |
| 16 | Estimate overfitting in decision trees. How does pruning help? Explain pre-pruning and post-pruning strategies. | (16) | BTL6 | Creating |
| 17 | Analyze the working of Random Forests. Explain how ensemble learning and bagging help improve accuracy and reduce overfitting in classification problems. | (16) | BTL4 | Analyzing |

| UNIT III- ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING | | | | |
|---|---|---|---|---|
| Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization. | | | | |
| | **PART-A** | | | |
| **Q.No** | **Questions** | | **BT Level** | **Competence** |
| 1 | **What** is ensemble learning? | | BTL1 | Remembering |
| 2 | **List** one benefit of using ensemble methods. | | BTL1 | Remembering |
| 3 | **Compare** hard voting and soft voting. | | BTL2 | Understanding |
| 4 | **State** the definition of bagging in the context of ensemble learning. | | BTL1 | Remembering |
| 5 | **Summarize** the concept of bootstrapping in bagging. | | BTL2 | Understanding |
| 6 | **Mention** one algorithm that uses bagging. | | BTL2 | Understanding |
| 7 | **What** is boosting, and how does it improve model performance? | | BTL1 | Remembering |
| 8 | **Differentiate** boosting from bagging. | | BTL2 | Understanding |
| 9 | **What** are two popular boosting algorithms? | | BTL1 | Remembering |
| 10 | **Outline** the concept of stacking in ensemble learning. | | BTL2 | Understanding |
| 11 | **What** is the role of the meta-learner in stacking? | | BTL2 | Understanding |
| 12 | **Why** does ensemble learning often improve model performance? | | BTL2 | Understanding |
| 13 | **What** is the purpose of model combination? | | BTL1 | Remembering |
| 14 | **List** two common strategies for model combination. | | BTL1 | Remembering |
| 15 | **Summarize** the role of weighting in model averaging. | | BTL2 | Understanding |
| 16 | **Define** majority voting in ensemble methods. | | BTL2 | Understanding |
| 17 | **Why** does model diversity affect ensemble performance? | | BTL2 | Understanding |
| 18 | **What** is unsupervised learning, and provide one example. | | BTL2 | Understanding |
| 19 | **What** is the main objective of clustering? | | BTL2 | Understanding |
| 20 | **What** is the importance of instance based learning in machine learning and give an example algorithm. | | BTL2 | Understanding |
| 21 | **State** the objective function of K-means clustering. | | BTL1 | Remembering |
| 22 | **What** is the role of centroids in K-means? | | BTL1 | Remembering |
| 23 | **Mention** one limitation of K-means clustering. | | BTL2 | Understanding |
| 24 | **What** is the Expectation-Maximization (EM) algorithm and how is it used in GMMs? | | BTL1 | Remembering |
| | **PART-B** | | | |
| 1 | Identify the concept of ensemble learning. Discuss its advantages with examples of where it outperforms individual models. | (16) | BTL3 | Applying |

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| 2 | Analyze bagging technique in ensemble learning. Explain its advantages and limitations. | (16) | BTL4 | Analyzing |
| 3 | What is boosting? Explain the bootstrapping process, and how it helps in reducing variance using an example like Random Forests. | (16) | BTL3 | Applying |
| 4 | Compare and contrast bagging and boosting. Discuss their objectives, mechanisms, and impact on bias and variance. | (16) | BTL4 | Analyzing |
| 5 | Assess the stacking ensemble technique. Explain the role of base learners and meta-learners with an appropriate example. | (16) | BTL4 | Analyzing |
| 6 | What are voting-based ensemble methods? Differentiate between hard voting and soft voting with examples. | (16) | BTL5 | Evaluating |
| 7 | Explain model combination schemes. Describe model averaging, majority voting, and weighted combination strategies with examples. | (16) | BTL5 | Evaluating |
| 8 | Apply the importance of diversity in ensemble methods. How does it contribute to better generalization? | (16) | BTL3 | Applying |
| 9 | Define unsupervised learning. Explain how it differs from supervised learning and provide examples of tasks and algorithms. | (16) | BTL5 | Evaluating |
| 10 | Describe the K-means clustering algorithm. Explain the steps with mathematical formulation and give a real-world example. | (16) | BTL3 | Applying |
| 11 | Determine the limitations of K-means clustering? How can they be addressed (e.g., by using K-medoids or DBSCAN)? | (16) | BTL5 | Evaluating |
| 12 | Explain the working of the K-Nearest Neighbors (KNN) algorithm. How is it used for both classification and regression? | (8)<br>(8) | BTL5 | Evaluating |
| 13 | Compare KNN and K-means. Explain their differences in learning type, working mechanism, and use cases. | (16) | BTL4 | Analyzing |
| 14 | Compile the working of Gaussian Mixture Model (GMM). How does it differ from K-means in terms of cluster assignment? | (16) | BTL6 | Creating |
| 15 | Make use of the Expectation-Maximization (EM) algorithm. Derive its steps and show how it is used in training GMMs. | (16) | BTL3 | Applying |
| 16 | Compose the application of EM in unsupervised learning. Provide an example of clustering using EM and GMM. | (16) | BTL6 | Creating |
| 17 | Analyze elbow method and silhouette analysis for determining the optimal number of clusters in K means clustering. | (16) | BTL4 | Analyzing |

## UNIT IV- NEURAL NETWORKS

Multilayer perceptron, activation functions, network training – gradient descent optimization – stochastic gradient descent, error backpropagation, from shallow networks to deep networks –Unit saturation (aka the vanishing gradient problem) – ReLU, hyperparameter tuning, batch normalization, regularization, dropout.

### PART-A

| Q.No | Questions | BT Level | Competence |
|---|---|---|---|
| 1 | **Define** a multilayer perceptron (MLP). | BTL1 | Remembering |
| 2 | **List** how MLP differs from a single-layer perceptron. | BTL1 | Remembering |
| 3 | **What** is the role of hidden layers in an MLP? | BTL1 | Remembering |
| 4 | **Interpret** the purpose of an activation function in neural networks. | BTL2 | Understanding |
| 5 | **Write** the mathematical form of the sigmoid function. | BTL2 | Understanding |
| 6 | **State** one limitation of the sigmoid activation function. | BTL2 | Understanding |
| 7 | **Compare** the advantage of using ReLU over sigmoid or tanh. | BTL2 | Understanding |
| 8 | **Define** the ReLU activation function. | BTL2 | Understanding |
| 9 | **What** is the objective of gradient descent in training neural networks? | BTL2 | Understanding |
| 10 | **Compare** batch and stochastic gradient descent. | BTL2 | Understanding |
| 11 | **State** one advantage and one disadvantage of stochastic gradient descent. | BTL1 | Remembering |
| 12 | **Demonstrate** what the learning rate controls in gradient descent. | BTL2 | Understanding |
| 13 | **Summarize** the concept of backpropagation. | BTL2 | Understanding |
| 14 | **Why** is the chain rule important in backpropagation? | BTL2 | Understanding |
| 15 | **What** kind of loss function is typically used in classification tasks? | BTL1 | Remembering |
| 16 | **Summarize** the vanishing gradient problem. | BTL2 | Understanding |
| 17 | **Outline** how ReLU helps mitigate the vanishing gradient problem. | BTL2 | Understanding |
| 18 | **Classify** the two common regularization techniques. | BTL2 | Understanding |
| 19 | **Give** two examples of hyperparameters in neural network training. | BTL2 | Understanding |
| 20 | **Outline** the role of cross-validation in hyperparameter tuning. | BTL2 | Understanding |
| 21 | **What** is batch normalization, and why is it used? | BTL2 | Understanding |
| 22 | **Mention** one benefit of using batch normalization during training. | BTL1 | Remembering |
| 23 | **State** the purpose of regularization in neural networks. | BTL1 | Remembering |
| 24 | **Illustrate** what dropout does in a neural network during training. | BTL1 | Remembering |

### PART-B

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|---|---|---|---|---|
| 1 | Elaborate the architecture of a multilayer perceptron (MLP). Describe how inputs are transformed through layers using weights and activation functions. | (16) | BTL6 | Creating |
| 2 | Compare single-layer and multilayer perceptrons. Explain why multilayer perceptrons are more powerful in modeling complex data. | (16) | BTL5 | Evaluating |
| 3 | Describe different activation functions such as sigmoid, tanh, and ReLU. Compare their properties and impact on training deep networks. | (16) | BTL4 | Analyzing |
| 4 | Explain the limitations of sigmoid and tanh functions. How does the ReLU activation function help overcome these limitations? | (16) | BTL5 | Evaluating |
| 5 | Formulate the gradient descent algorithm and its role in training neural networks. Include mathematical derivation for weight updates. | (16) | BTL6 | Creating |
| 6 | Explain stochastic gradient descent (SGD). Compare it with batch and mini-batch gradient descent in terms of convergence and computation. | (16) | BTL5 | Evaluating |
| 7 | Analyze the importance of the learning rate in gradient descent optimization. What happens when it is too small or too large? | (16) | BTL4 | Analyzing |
| 8 | Explain the backpropagation algorithm in detail. Derive the equations used to compute the gradients of the loss function. | (16) | BTL5 | Evaluating |
| 9 | Illustrate backpropagation with an example for a simple neural network with one hidden layer. | (8)<br>(8) | BTL3 | Applying |
| 10 | What is the vanishing gradient problem? Identify why it occurs in deep networks and its impact on learning. | (8)<br>(8) | BTL3 | Applying |
| 11 | Choose the strategies to address the vanishing gradient problem. Include the role of ReLU and proper weight initialization. | (16) | BTL3 | Applying |
| 12 | What are hyperparameters in neural networks? Discuss strategies for tuning them and the effect on model performance. | (16) | BTL6 | Creating |
| 13 | Compare grid search and random search for hyperparameter tuning. Mention their pros and cons. | (16) | BTL4 | Analyzing |
| 14 | Explain batch normalization. Describe how it works and its benefits during training of deep neural networks. | (16) | BTL5 | Evaluating |
| 15 | Discuss how batch normalization affects learning rate, convergence speed, and regularization. | (16) | BTL5 | Evaluating |
| 16 | Discover the concept of regularization in neural networks. Describe L1 and L2 regularization and how they prevent overfitting. | (16) | BTL4 | Analyzing |
| 17 | Make use of dropout as a regularization technique. How does it work, and why is it effective in deep learning? | (16) | BTL3 | Applying |

| UNIT V- : DESIGN AND ANALYSIS OF MACHINE LEARNING EXPERIMENTS | | | |
|---|---|---|---|
| Guidelines for machine learning experiments, Cross Validation (CV) and resampling – K-fold CV, bootstrapping, measuring classifier performance, assessing a single classification algorithm and comparing two classification algorithms – t test, McNemar's test, K-fold CV paired t test. | | | |
| | **PART-A** | | |
| **Q.No** | **Questions** | **BT Level** | **Competence** |
| 1 | **What** is the purpose of conducting machine learning experiments? | BTL1 | Remembering |
| 2 | **Mention** two good practices when designing a machine learning experiment. | BTL2 | Understanding |
| 3 | **Classify** and name two common resampling techniques used in cross-validation. | BTL2 | Understanding |
| 4 | **Why** is it important to separate training and testing datasets? | BTL2 | Understanding |
| 5 | **Define** model evaluation in the context of machine learning. | BTL2 | Understanding |
| 6 | **What** is cross-validation? | BTL2 | Understanding |
| 7 | **Summarize** the main idea behind K-fold cross-validation. | BTL2 | Understanding |
| 8 | **Differentiate** stratified K-fold cross-validation from regular K-fold. | BTL2 | Understanding |
| 9 | **Define** leave-one-out cross-validation (LOOCV). | BTL1 | Remembering |
| 10 | **State** the purpose of using cross-validation. | BTL2 | Understanding |
| 11 | **Illustrate** resampling in machine learning experiments. | BTL2 | Understanding |
| 12 | **What** is bootstrapping in the context of model evaluation? | BTL2 | Understanding |
| 13 | **List** how bootstrapping differs from K-fold cross-validation. | BTL1 | Remembering |
| 14 | **Summarize** the key advantage of bootstrapping over traditional train-test splits. | BTL2 | Understanding |
| 15 | **What** is a confusion matrix? | BTL2 | Understanding |
| 16 | **Define** precision and recall. | BTL1 | Remembering |
| 17 | **State** what the F1-score represents. | BTL1 | Remembering |
| 18 | **What** does ROC stand for in machine learning? | BTL2 | Understanding |
| 19 | **Interpret** in what scenario is McNemar's test most appropriate. | BTL2 | Understanding |
| 20 | **State** the purpose of assessing a single classification algorithm's performance. | BTL2 | Understanding |
| 21 | **List** why repeated evaluation is important for a classification algorithm. | BTL1 | Remembering |
| 22 | **What** is the purpose of using a t-test in comparing classifiers? | BTL1 | Remembering |
| 23 | **Interpret** the use of McNemar's test in machine learning. | BTL2 | Understanding |
| 24 | **Summarize** how K-fold CV paired t-test differs from a standard t-test in classifier comparison. | BTL1 | Remembering |
| | **PART-B** | | |

| | | | | |
|---|---|---|---|---|
| 1 | Explain the importance of designing proper machine learning experiments. Discuss common pitfalls and best practices. | (16) | BTL3 | Applying |
| 2 | Describe K-fold cross-validation in detail. Explain how it helps in estimating the generalization error of a model. | (16) | BTL3 | Applying |
| 3 | What is bootstrapping? Explain the bootstrapping procedure for model evaluation and compare it with cross-validation. | (16) | BTL3 | Applying |
| 4 | Explain the difference between hold-out validation and cross-validation. Discuss the advantages and disadvantages of each. | (16) | BTL3 | Applying |
| 5 | Define the confusion matrix and explain its components. How is it used to measure classifier performance? | (16) | BTL4 | Analyzing |
| 6 | Discuss various metrics used to measure classifier performance, such as accuracy, precision, recall, F1-score, and ROC-AUC and explain their significance. | (16) | BTL3 | Applying |
| 7 | Examine the ROC curve and AUC metric. How do they help in evaluating classifiers? | (16) | BTL4 | Analyzing |
| 8 | Discuss the need for statistical testing when comparing two classification algorithms. | (16) | BTL4 | Analyzing |
| 9 | Explain the paired t-test used for comparing two classifiers. Describe its assumptions, procedure, and interpretation. | (16) | BTL5 | Evaluating |
| 10 | What is McNemar's test? Explain how it is used to compare two classification models. | (16) | BTL4 | Analyzing |
| 11 | Describe the K-fold cross-validation paired t-test. How does it differ from the standard paired t-test? | (16) | BTL5 | Evaluating |
| 12 | Estimate how to assess the performance of a single classification algorithm using cross-validation. | (16) | BTL6 | Creating |
| 13 | Formulate the importance of resampling techniques in machine learning experiments. Give examples where they are useful. | (16) | BTL6 | Creating |
| 14 | Compare and contrast different resampling methods used in machine learning evaluation. | (16) | BTL5 | Evaluating |
| 15 | What is overfitting in machine learning experiments? How can cross-validation help detect overfitting? | (16) | BTL5 | Evaluating |
| 16 | Elaborate the concept of bias-variance trade-off in the context of model evaluation. | (16) | BTL6 | Creating |
| 17 | Develop an experiment to compare two classification algorithms on a given dataset. Outline the steps, evaluation metrics, and statistical tests you would use. | (16) | BTL4 | Analyzing |

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