SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF INFORMATION TECHNOLOGY

QUESTION BANK

I SEMESTER

DS3162 - MACHINE LEARNING

Regulation – 2023

Academic Year 2026 – 2027 (ODD)

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

QUESTION BANK

SUBJECT : DS3162 - Machine Learning
SEM / YEAR: I Sem/ I Year

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS			
What is Machine Learning? Need -History - Definitions - Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems - Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics Bayesian Conditional Probability -Vector Calculus& Optimization - Decision Theory - Information theory			
PART – A			
Q.No.	**Questions**	**BT Level**	**Competence**
1	What is machine learning? Give some examples.	**BTL1**	**Remembering**
2	Distinguish between Information theory and Decision theory	**BTL2**	**Understanding**
3	Point out few examples of machine learning applications.	**BTL4**	**Analyzing**
4	Enlist the types of machine learning techniques.	**BTL1**	**Remembering**
5	Describe the steps involved in machine learning process.	**BTL2**	**Understanding**
6	List the algorithms of concept learning.	**BTL1**	**Remembering**
7	Distinguish between supervised and unsupervised learning.	**BTL2**	**Understanding**
8	Define Activation Function.	**BTL1**	**Remembering**
9	Compare traditional programming and machine learning.	**BTL2**	**Understanding**
10	Mention the issues in machine learning.	**BTL2**	**Understanding**
11	Define Confusion Matrix.	**BTL1**	**Remembering**
12	State the difference between classification and regression.	**BTL2**	**Understanding**
13	Explain the useful perspective on machine learning.	**BTL1**	**Remembering**
14	Discuss about Bias Variance Trade off	**BTL2**	**Understanding**
15	Sketch a decision tree for playing tennis game.	**BTL2**	**Understanding**
16	What is a Linear Algebra?	**BTL2**	**Understanding**
17	List the applications of machine learning.	**BTL1**	**Remembering**
18	Elucidate about the Decision tree learning.	**BTL1**	**Remembering**
19	Mention the five popular algorithms of Machine Learning?	**BTL1**	**Remembering**
20	Define Vector Calculus and optimization.	**BTL2**	**Understanding**
21	Evaluate the relationship between AI and Machine learning.	**BTL2**	**Understanding**
22	Assess the role of Information gain in Decision trees.	**BTL2**	**Understanding**
23	Define Analytical Geometry	**BTL1**	**Remembering**
24	What is ‘Training set’ and ‘Test set’?	**BTL2**	**Understanding**

PART – B			
1	(i) What is machine learning? Discuss about learning and machine learning. (8) (ii) Discuss the various types of machine learning.(8)	**BTL4**	**Analyzing**
2	Explain Supervised Learning with example. (16)	**BTL2**	**Understanding**
3	Explain the types of Machine Learning (16)	**BTL5**	**Evaluating**
4	(i)Describe in detail the rule for estimating training values. (8) (ii)State the final design of checkers learning system. (8)	**BTL4**	**Analyzing**
5	Write about the different issues in Machine Learning. (16)	**BTL4**	**Analyzing**
6	Write Short notes on (i) Attribute Selection (8) (ii) Entropy (4) (iii) Information gain (4)	**BTL3**	**Applying**
7	Illustrate the concept of Linear Algebra & Analytical Geometry (16)	**BTL3**	**Applying**
8	Explain in detail about Information theory (16)	**BTL3**	**Applying**
9	Explain in detail about Machine Learning Process with an example. (16)	**BTL3**	**Applying**
10	Explain the useful perspectives of machine learning in different Applications. (16)	**BTL3**	**Applying**
11	Illustrate the basic decision tree algorithm with an example. (16)	**BTL3**	**Applying**
12	Generalize the concept of Vector Calculus& Optimization with an example (16)	**BTL4**	**Analyzing**
13	Describe Training, Testing and Validation sets with examples (16)	**BTL4**	**Analyzing**
14	Explain confusion Matrix with an example.(16)	**BTL3**	**Applying**
15	Marie's marriage is tomorrow. In recent years, each year it has rained only 5 days. The weatherman has predicted rain for tomorrow. When it actually rains, the weatherman correctly forecasts rain 90% of the time. When it doesn't rain, the weatherman incorrectly forecasts rain 10% of the time. The question: What is the probability that it will rain on the day of Marie's wedding? (16)	**BTL3**	**Applying**
16	Summarize in detail about types of Regression and Classification in Supervised Learning (16)	**BTL5**	**Evaluating**
17	Explain the following (i) Statistics Bayesian Conditional Probability (8) (ii) Decision Theory (8)	**BTL4**	**Analyzing**

UNIT II SUPERVISED LEARNING			
Introduction-Discriminative and Generative Models -Linear Regression - Least Squares - Under-fitting / Over fitting -Cross-Validation - Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines -Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods -Decision Trees -ID3 - CART - Ensemble Methods - Random Forest - Evaluation of Classification Algorithms			
PART – A			
Q.No.	**Questions**	**BT Level**	**Competence**
1	Outline the difference between supervised learning and unsupervised learning.	**BTL1**	**Remembering**
2	State the k-nearest neighbor learning algorithm.	**BTL1**	**Remembering**
3	State the objective of the Least Squares method in linear regression?	**BTL1**	**Remembering**
4	What is a random forest?	**BTL1**	**Remembering**
5	State the standard approach to supervised learning.	**BTL1**	**Remembering**
6	How does a decision tree classify the data?	**BTL1**	**Remembering**
7	How can over fitting be avoided?	**BTL2**	**Understanding**
8	Brief what is 'Over fitting' in Machine learning?	**BTL2**	**Understanding**
9	What is a Linear Regression?	**BTL2**	**Understanding**
10	Give the disadvantages of the linear regression model.	**BTL2**	**Understanding**
11	State the difference between classification and regression.	**BTL2**	**Understanding**
12	Define Ensemble Methods	**BTL1**	**Remembering**
13	What are tree-based methods?	**BTL1**	**Remembering**
14	Give the difference between stochastic gradient descent (SGD) and gradient descent (GD)?	**BTL2**	**Understanding**
15	What are the different types of least squares?	**BTL2**	**Understanding**
16	List the difference between least squares regression and multiple regression?	**BTL1**	**Remembering**
17	Give the difference between K-means and KNN?	**BTL2**	**Understanding**
18	What are types of classification models?	**BTL1**	**Remembering**
19	Define the cost function used in simple linear regression	**BTL2**	**Understanding**
20	Express the basic concept involved in CART.	**BTL2**	**Understanding**
21	Explain the Limitation of Genetic Algorithm.	**BTL2**	**Understanding**
22	Define the concept of margin in a Support Vector Machine.	**BTL1**	**Remembering**
23	Define the concept of ID3.	**BTL1**	**Remembering**
24	Define Genetic Programming.	**BTL1**	**Remembering**
PART – B			
1	Explain the principle of the gradient descent algorithm. Accompany your explanation with a diagram (16)	**BTL4**	**Analyzing**
2	Elaborate on logistics regression with an example. Explain the process of computing coefficients. (16)	**BTL4**	**Analyzing**
3	What is a classification tree? Illustrate the steps to construct a classification tree. List and explain about the different procedures used. (16)	**BTL3**	**Applying**
4	(i) Write in detail about Decision Tree. (8) (ii) Write in detail Classification and Regression Tree (CART) (8)	**BTL4**	**Analyzing**
5	Illustrate the concept of Support Vector Machine with necessary examples.	**BTL4**	**Analyzing**

6	Illustrate Logistic Regression as a Probabilistic Discriminative Model and explain in detail (16)	**BTL3**	**Applying**
7	Explain in detail about Reinforcement Learning with example. (16)	**BTL3**	**Applying**
8	Show when and why you would use random forests vs SVM? (16)	**BTL6**	**Creating**
9	Explain in detail about Gaussian mixture models and expectation maximization? (16)	**BTL4**	**Analyzing**
10	List non-parametric techniques and Explain K-nearest neighbor estimation.(16)	**BTL5**	**Evaluating**
11	Explain the various ensemble learning techniques?(16)	**BTL4**	**Analyzing**
12	Explain the following (i) Linear regression (8) (ii) Logistic Regression (8)	**BTL4**	**Analyzing**
13	(i) Describe ensemble methods. (8) (ii) Explain random forest algorithm in detail. (8)	**BTL3**	**Applying**
14	Explain details about KNN algorithm? (16)	**BTL4**	**Analyzing**
15	Describe the general procedure of random forest algorithm (16)	**BTL5**	**Evaluating**
16	Design a random forest model for a classification problem and analyze its performance.	**BTL5**	**Evaluating**
17	(i) Write about the ID3.(8) (ii) Generalize how Classification is done with an Example.(8)	**BTL6**	**Creating**

UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING			
Introduction - Clustering Algorithms - K - Means - Hierarchical Clustering - Cluster Validity – Dimensionality Reduction - Principal Component Analysis - Recommendation Systems - EM algorithm. Reinforcement Learning - Elements - Model based Learning - Temporal Difference Learning.			
PART – A			
Q.No.	**Questions**	**BT Level**	**Competence**
1	What is the purpose of the Expectation-Maximization (EM) algorithm in GMM?	**BTL1**	**Remembering**
2	What is Reinforcement learning model?	**BTL1**	**Remembering**
3	What is expectation maximization algorithm used for?	**BTL1**	**Remembering**
4	What is the role of centroids in the K-means algorithm?	**BTL1**	**Remembering**
5	What is Principal Component Analysis?	**BTL1**	**Remembering**
6	What is the main objective of clustering?	**BTL2**	**Understanding**
7	What is meant by Nearest Neighbour methods.	**BTL2**	**Understanding**
8	State one major limitation of K-means clustering.	**BTL2**	**Understanding**
9	Give the examples of unsupervised learning?	**BTL2**	**Understanding**
10	How do you implement expectation maximization algorithm?	**BTL2**	**Understanding**
11	What is the Expectation-Maximization (EM) algorithm and how is it used in GMMs?	**BTL1**	**Remembering**
12	State the objective function of K-means clustering.	**BTL1**	**Remembering**
13	What is the role of centroids in K-means?	**BTL1**	**Remembering**
14	What is a Gaussian Mixture Model (GMM)?	**BTL2**	**Understanding**
15	How is perceptron learning algorithm used?	**BTL2**	**Understanding**
16	State the significance of Gaussian mixture model?	**BTL2**	**Understanding**
17	Define EM algorithm.	**BTL1**	**Remembering**
18	How K-Means Algorithm is used in Unsupervised Learning?	**BTL2**	**Understanding**
19	How Expectation maximization is used in Gaussian mixture models?	**BTL2**	**Understanding**
20	What is difference between K means and Gaussian mixture?	**BTL1**	**Remembering**
21	What is k-means unsupervised learning?	**BTL1**	**Remembering**
22	What is the principle of maximum likelihood?	**BTL1**	**Remembering**
23	Why is the smoothing parameter h need to be optimal?	**BTL2**	**Understanding**
24	Give the basic idea behind the K-Nearest Neighbors (KNN) algorithm?	**BTL2**	**Understanding**
PART – B			
1	Explain the Principle Component Analysis with Analysis.	**BTL4**	**Analyzing**
2	Explain various learning techniques involved in unsupervised learning.(16)	**BTL4**	**Analyzing**
3	Analyze the applications of clustering and identify advantages and disadvantages of clustering algorithms. (16)	**BTL3**	**Applying**
4	Illustrate in detail the different ensemble learning techniques. (16)	**BTL3**	**Applying**
5	Elaborate on the steps in expectation-maximization algorithm. (16)	**BTL5**	**Evaluating**
6	Explain about EM algorithm. (16)	**BTL4**	**Analyzing**
7	(i)Describe the PCA relation with MLP. (8) (ii)Explain Kernel PCA Algorithm.(8)	**BTL3**	**Applying**

8	Discuss the Probabilistic Learning methods involved in Machine Learning.(16)	**BTL3**	**Applying**
9	Explain the concept and algorithm involved in Unsupervised Learning Environment. (16)	**BTL6**	**Creating**
10	Explain the importance of Eigen values and Eigen vectors in machine learning with an example application such as Principal Component Analysis (PCA)	**BTL3**	**Applying**
11	Compose the application of EM in unsupervised learning. Provide an example of clustering using EM and GMM.	**BTL6**	**Creating**
12	Explain briefly about unsupervised learning structure? (16)	**BTL4**	**Analyzing**
13	Explain the working of the K-Nearest Neighbors (KNN) algorithm. How is it used for both classification and regression?	**BTL5**	**Evaluating**
14	(i)Explain the concepts of clustering approaches. (8) (ii)How it differ from classification (8)	**BTL4**	**Analyzing**
15	Describe the K-means clustering algorithm. Explain the steps with mathematical formulation and give a real-world example.	**BTL3**	**Applying**
16	Discuss challenges in reinforcement learning and solutions.	**BTL5**	**Evaluating**
17	Explain the Gaussian Expectation-Maximization Algorithm with necessary example.	**BTL5**	**Evaluating**

UNIT IV PROBABILISTIC METHODS FOR LEARNING			
Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks - Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks - Probability Density Estimation - Sequence Models - Markov Models - Hidden Markov Models			
PART – A			
Q.No.	**Questions**	**BT Level**	**Competence**
1	What is Maximum Likelihood Estimation (MLE)?	**BTL1**	**Remembering**
2	Give the formula for Maximum A Priori (MAP) estimation.	**BTL2**	**Understanding**
3	Define Bayesian Belief Network (BBN).	**BTL1**	**Remembering**
4	What is probabilistic modelling of problems?	**BTL1**	**Remembering**
5	State the purpose of inference in Bayesian Belief Networks.	**BTL1**	**Remembering**
6	What is Probability Density Estimation?	**BTL1**	**Remembering**
7	Describe sequence models in probabilistic learning.	**BTL2**	**Understanding**
8	Define Markov Model.	**BTL1**	**Remembering**
9	What is a Hidden Markov Model (HMM)?	**BTL1**	**Remembering**
10	List the components of a Hidden Markov Model.	**BTL1**	**Remembering**
11	What is the independence assumption in Naïve Bayes?	**BTL1**	**Remembering**
12	Give an example of where Naïve Bayes is used.	**BTL2**	**Understanding**
13	What is the difference between MLE and MAP?	**BTL2**	**Understanding**
14	Define conditional independence in BBN.	**BTL1**	**Remembering**
15	What is d-separation in Bayesian networks?	**BTL1**	**Remembering**
16	Describe kernel density estimation for PDE.	**BTL2**	**Understanding**
17	What are transition probabilities in Markov models?	**BTL1**	**Remembering**
18	Give the applications of Hidden Markov Models.	**BTL2**	**Understanding**
19	What is the Viterbi algorithm used for in HMM?	**BTL1**	**Remembering**
20	Define emission probabilities in HMM.	**BTL1**	**Remembering**

21	What is the role of prior probability in MAP?	**BTL2**	**Understanding**
22	List types of inference in BBN.	**BTL1**	**Remembering**
23	Describe the forward algorithm in HMM.	**BTL2**	**Understanding**
24	What is the Baum-Welch algorithm?	**BTL1**	**Remembering**
	PART – B		
1	Explain the variants of Naïve Bayes algorithm like Gaussian and Multinomial with examples.	**BTL4**	**Analyzing**
2	Discuss Maximum Likelihood estimation and derive it for a binomial distribution.	**BTL5**	**Evaluating**
3	Illustrate Maximum A Priori estimation with a coin toss example.	**BTL3**	**Applying**
4	Illustrate Bayesian Belief Networks with a diagram and example.	**BTL3**	**Applying**
5	Explain probabilistic modelling for weather prediction with an example.	**BTL4**	**Analyzing**
6	Discuss exact inference methods in Bayesian Belief Networks like enumeration.	**BTL6**	**Creating**
7	Explain approximate inference in BBN using sampling techniques.	**BTL4**	**Analyzing**
8	(i) Describe sequence models. (8) (ii) Give their applications. (8)	**BTL3**	**Applying**
9	Explain non-parametric methods for PDE like histograms.	**BTL4**	**Analyzing**
10	Explain Hidden Markov Models (HMM) in detail.	**BTL4**	**Analyzing**
11	Explain first-order Markov Models with a state transition example.	**BTL3**	**Applying**
12	Discuss the evaluation problem in Hidden Markov Models using forward algorithm.	**BTL5**	**Evaluating**
13	Explain the decoding problem in HMM using Viterbi algorithm with example.	**BTL3**	**Applying**
14	Discuss the learning problem in HMM using Baum-Welch algorithm.	**BTL4**	**Analyzing**
15	Compare Naïve Bayes with logistic regression for classification tasks.	**BTL5**	**Evaluating**
16	Explain variable elimination for inference in BBN with a small network example.	**BTL4**	**Analyzing**
17	Illustrate Kernel Density Estimation for PDE using a dataset.	**BTL3**	**Applying**

UNIT V NEURAL NETWORKS AND DEEP LEARNING			
Neural Networks - Biological Motivation- Perceptron - Multi-layer Perceptron - Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning - Deep Learning-Convolution Neural Networks - Recurrent Neural Networks - Use cases			
PART – A			
Q.No.	**Questions**	**BT Level**	**Competence**
1	Name any two activation functions	**BTL1**	**Remembering**
2	Which activation function is used in multilayer perceptron?	**BTL1**	**Remembering**
3	Does MLP have activation function?	**BTL1**	**Remembering**
4	What is the role of an activation function in a neural network?	**BTL1**	**Remembering**
5	What is the problem with ReLU?	**BTL1**	**Remembering**
6	What is perceptron and its types?	**BTL1**	**Remembering**
7	Why is ReLU better than softmax?	**BTL2**	**Understanding**
8	Draw the architecture of multilayer perceptron	**BTL2**	**Understanding**
9	Why do you require Multilayer Perceptron?	**BTL2**	**Understanding**
10	What are the activation functions of MLP?	**BTL2**	**Understanding**
11	What are the types of activation function?	**BTL2**	**Understanding**
12	What is Convolutional Neural Network?	**BTL1**	**Remembering**
13	What is Recurrent Neural Network?	**BTL1**	**Remembering**
14	Give some Limitations of machine learning	**BTL1**	**Remembering**
15	What is Deep Learning?	**BTL1**	**Remembering**
16	Give the advantages of Multilayer Perceptron?	**BTL2**	**Understanding**
17	What do you mean by activation function?	**BTL2**	**Understanding**
18	Name the two parts of MLP.	**BTL1**	**Remembering**
19	How many layers are there in perceptron?	**BTL1**	**Remembering**
20	Explain the structure of CNN Architecture	**BTL1**	**Remembering**
21	List the Components of CNN	**BTL1**	**Remembering**
22	List the Components of RNN	**BTL1**	**Remembering**
23	State one key limitation of the Perceptron model.	**BTL2**	**Understanding**
24	Give the difference between a perceptron and a MLP?	**BTL2**	**Understanding**
PART – B			
1	Explain a deep feed forward network with a neat sketch. (16)	**BTL4**	**Analyzing**
2	Explain in detail about gradient descent optimization? (16)	**BTL4**	**Analyzing**
3	Draw the architecture of a single layer perceptron (SLP) and explain its operation. Mention its advantages and disadvantages. (16)	**BTL5**	**Evaluating**
4	How do you tune hyper parameters for better neural network performance? Explain in detail. (16)	**BTL3**	**Applying**
5	Explain in detail about Perceptron and its types? (16)	**BTL4**	**Analyzing**
6	(i) Explain the steps in the back propagation learning algorithm.(8) (ii)What is the importance of it in designing neural networks? (8)	**BTL4**	**Analyzing**
7	(i) Draw the architecture of a Multilayer perceptron (MLP) and explain its operation. (8) (ii)Mention its advantages and disadvantages. (8)	**BTL3**	**Applying**

8	Illustrate deep learning concepts and its evolution.(16)	**BTL3**	**Applying**
9	With a neat illustration, Explain in detail the Neural Network Process with an example.	**BTL4**	**Analyzing**
10	Design a simple MLP for a classification task and explain training.	**BTL6**	**Creating**
11	Illustrate the factors that affect the performance of multilayer feed-forward neural network. (16)	**BTL3**	**Applying**
12	Explain detail about activation functions? (16)	**BTL4**	**Analyzing**
13	Elaborate the process of training hidden layers by ReLU in deep networks(16)	**BTL4**	**Analyzing**
14	Explain about ReLu, Hyper parameter tuning, Normalization, Regularization, Dropout? (16)	**BTL4**	**Analyzing**
15	Describe back propagation and features of back propagation. (16)	**BTL5**	**Evaluating**
16	Develop a Back propagation algorithm for Multilayer Feed forward neural network consisting of one input layer, one hidden layer and output layer from first principles. (16)	**BTL5**	**Evaluating**
17	Explain in detail the back propagation algorithm in neural network(16)	**BTL5**	**Evaluating**