SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF CYBER SECURITY

QUESTION BANK

1923705 - INTRODUCTION TO MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

Regulation – 2019

VII SEMESTER

Academic Year 2025-2026 (ODD Semester)

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SUBJECT : 1923705 INTRODUCTION TO MACHINE LEARNING AND ARTIFICIAL INTELLIGENCE

SEM / YEAR : VII Sem / IV Year

UNIT I - INTRODUCTION			
Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.			
PART-A			
Q.No.	**Question**	**Level**	**Competence**
1	What is a learning problem in the context of machine learning?	BTL1	Remember
2	Define the term "hypothesis space" in machine learning.	BTL2	Understand
3	What are the three main components of a machine learning task?	BTL1	Remember
4	Mention two types of learning from data.	BTL1	Remember
5	What is the difference between training data and test data?	BTL2	Understand
6	Define concept learning.	BTL1	Remember
7	What is the role of a hypothesis in concept learning?	BTL2	Understand
8	What is a positive example and a negative example in concept learning?	BTL2	Understand
9	What do you mean by a general-to-specific ordering of hypotheses?	BTL1	Remember
10	Give an example of a real-world concept learning problem.	BTL2	Understand
11	What is a version space in concept learning?	BTL1	Remember
12	What is the Candidate Elimination algorithm?	BTL2	Understand
13	Name the two boundary sets in version space representation.	BTL1	Remember
14	What happens to the version space when a contradictory example is given?	BTL1	Remember
15	How does the Candidate Elimination algorithm use positive and negative examples?	BTL2	Understand
16	Define inductive bias in machine learning.	BTL1	Remember
17	Why is inductive bias necessary in machine learning?	BTL1	Remember
18	Give an example of an inductive bias in decision tree learning.	BTL1	Remember
19	Differentiate between language bias and search bias.	BTL2	Understand
20	What is a decision tree?	BTL1	Remember

21	Mention any two advantages of using decision tree algorithms.	BTL1	Remember
22	What is entropy in decision tree learning?	BTL2	Understand
23	What is the purpose of heuristic space search in decision tree construction?	BTL1	Remember
24	What is a decision tree?	BTL1	Remember

PART-B

Q.No.	Question	Marks	Level	Competence
1	Explain the various perspectives and issues involved in machine learning problems with suitable examples.	16	BTL3	Apply
2	Discuss the different types of learning (supervised, unsupervised, reinforcement) with examples and their applications.	16	BTL4	Analyze
3	Describe in detail the components of a machine learning system. How do these components interact during the learning process?	16	BTL4	Analyze
4	Define concept learning. Explain the general-to-specific ordering of hypotheses with suitable illustrations.	16	BTL3	Apply
5	With the help of an example, explain how concept learning can be formulated as a search problem.	16	BTL6	Create
6	Describe the hypothesis space and explain how it is used in concept learning.	16	BTL4	Analyze
7	What is version space? Explain how the Candidate Elimination algorithm finds the version space using examples.	16	BTL3	Apply
8	Illustrate with a suitable example the working of Candidate Elimination algorithm. Discuss how general and specific boundaries are updated.	16	BTL3	Apply
9	Compare and contrast Candidate Elimination algorithm with Find-S algorithm.	16	BTL4	Analyze
10	What is inductive bias? Explain the role and importance of inductive bias in learning algorithms.	16	BTL6	Create
11	Discuss the types of inductive biases. How does bias affect the hypothesis chosen by a learner?	16	BTL3	Apply
12	Explain why inductive bias is necessary in machine learning. Use examples to support your explanation.	16	BTL5	Evaluate
13	Explain how decision trees are constructed using the ID3 algorithm. Use a suitable example to demonstrate the steps.	16	BTL3	Apply
14	Discuss entropy and information gain in decision tree learning. How are these used to build optimal trees?	16	BTL3	Apply
15	Explain the advantages and limitations of decision tree learning. Also discuss overfitting and pruning methods.	16	BTL6	Create
16	Explain how decision tree learning can be treated as a heuristic search through the space of possible hypotheses.	16	BTL6	Create
17	Describe different search strategies used in hypothesis space search. Explain their relevance in machine learning.	16	BTL4	Analyze

UNIT II - NEURAL NETWORKS AND GENETIC ALGORITHMS

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

PART-A

Q.No.	Question	Level	Competence
1	What is an artificial neural network (ANN)?	BTL1	Remember
2	What is the role of weights in a neural network?	BTL1	Remember
3	Define an activation function.	BTL1	Remember
4	What is the difference between input and output layers in a neural network?	BTL1	Remember
5	What is an artificial neural network (ANN)?	BTL1	Remember
6	Mention any two applications of neural networks.	BTL2	Understand
7	What is overfitting in neural networks?	BTL2	Understand
8	What is the vanishing gradient problem?	BTL2	Understand
9	State any two limitations of neural networks.	BTL2	Understand
10	What is a perceptron?	BTL2	Understand
11	Define the learning rule used in a perceptron.	BTL2	Understand
12	What type of problems can be solved using a single-layer perceptron?	BTL1	Remember
13	What is the limitation of a single-layer perceptron?	BTL2	Understand
14	What is a multilayer perceptron (MLP)?	BTL2	Understand
15	What is the function of the hidden layer in a neural network?	BTL2	Understand
16	Define backpropagation.	BTL1	Remember
17	What is the main purpose of the backpropagation algorithm?	BTL1	Remember
18	What is a convolutional neural network (CNN)?	BTL1	Remember
19	What is a recurrent neural network (RNN)?	BTL1	Remember
20	State any two differences between CNN and MLP.	BTL1	Remember
21	What is dropout in neural networks?	BTL2	Understand
22	What is a genetic algorithm?	BTL1	Remember
23	Mention two key operations in genetic algorithms.	BTL2	Understand
24	What is a chromosome in the context of genetic algorithms?	BTL1	Remember

PART-B

Q.No.	Question	Marks	Level	Competence

1	Explain the architecture of artificial neural networks. Describe how information is processed through layers with suitable diagrams.	16	BTL4	Analyze
2	Discuss the types of activation functions used in neural networks. Highlight their advantages and drawbacks.	16	BTL4	Analyze
3	Describe how weights and biases influence the functioning of a neural network. Provide an example.	16	BTL3	Apply
4	What are the major issues and challenges faced when training neural networks? Discuss overfitting, vanishing gradient, and convergence.	16	BTL4	Analyze
5	Explain the learning process in neural networks with a focus on error minimization. How does learning rate affect training?	16	BTL6	Create
6	Compare and contrast shallow neural networks with deep neural networks. Explain their trade-offs and use cases.	16	BTL3	Apply
7	Explain the architecture and learning rule of a single-layer perceptron. Use an example to show linearly separable problem solving.	16	BTL3	Apply
8	Describe the limitations of single-layer perceptrons. How were they addressed in multilayer networks?	16	BTL3	Apply
9	Discuss how a perceptron can be trained using the perceptron learning algorithm with a suitable numerical example.	16	BTL4	Analyze
10	Describe the architecture of a multilayer perceptron (MLP). How is it different from a single-layer perceptron?	16	BTL3	Apply
11	Explain the backpropagation algorithm used for training MLPs. Provide a step-by-step example.	16	BTL3	Apply
12	Discuss the role of hidden layers and how they help in learning complex functions in a neural network.	16	BTL6	Create
13	Explain the concept of dropout, batch normalization, and learning rate scheduling in training deep neural networks.	16	BTL6	Create
14	Compare Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) with applications.	16	BTL5	Evaluate
15	What are the common techniques used to prevent overfitting in deep learning models? Explain with examples.	16	BTL5	Evaluate
16	Explain the working of genetic algorithms. Discuss selection, crossover, and mutation with examples.	16	BTL4	Analyze
17	What is genetic programming? Compare it with genetic algorithms. Explain how hypothesis space search is performed using genetic programming.	16	BTL4	Analyze

UNIT III - BAYESIAN AND COMPUTATIONAL LEARNING
Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.
PART-A

Q.No.	Question	Level	Competence
1	What is Bayes' Theorem?	BTL1	Remember
2	Write the formula of Bayes' Theorem.	BTL2	Understand
3	What is prior probability in Bayes' Theorem?	BTL1	Remember
4	What is the difference between prior and posterior probability?	BTL1	Remember
5	What is the goal of concept learning in probabilistic models?	BTL2	Understand
6	Define Maximum Likelihood Estimation (MLE).	BTL2	Understand
7	What assumption is made in maximum likelihood estimation?	BTL1	Remember
8	How does MLE help in selecting hypotheses?	BTL1	Remember
9	What is the Minimum Description Length (MDL) principle?	BTL2	Understand
10	What is the intuition behind MDL in model selection?	BTL1	Remember
11	Mention one advantage of using the MDL principle.	BTL2	Understand
12	How is MDL different from MLE?	BTL2	Understand
13	What is a Bayes Optimal Classifier?	BTL2	Understand
14	Why is the Bayes Optimal Classifier considered ideal?	BTL2	Understand
15	What is the main challenge in using the Bayes Optimal Classifier?	BTL2	Understand
16	What does the Bayes Optimal Classifier aim to minimize?	BTL2	Understand
17	What is the Gibbs algorithm used for in probabilistic learning?	BTL1	Remember
18	Define the Naïve Bayes Classifier.	BTL1	Remember
19	What is the main assumption made in Naïve Bayes Classifier?	BTL2	Understand
20	Mention one strength and one weakness of Naïve Bayes.	BTL2	Understand
21	What is a Bayesian Belief Network?	BTL2	Understand
22	What is the Expectation-Maximization (EM) algorithm used for?	BTL1	Remember
23	In what situation is EM algorithm commonly used?	BTL1	Remember
24	What is the difference between the E-step and M-step in EM?	BTL1	Remember

PART-B

Q.No.	Question	Marks	Level	Competence
1	State and explain Bayes' Theorem with a suitable example. How is it applied in machine learning?	16	BTL4	Analyze
2	Explain the concept of probabilistic concept learning. How does it differ from deterministic concept learning?	16	BTL6	Create
3	Discuss how Bayes' Theorem is used in concept learning. Illustrate your answer with a real-world application.	16	BTL6	Create

4	Explain Maximum Likelihood Estimation (MLE). Derive the MLE formula and apply it to a simple example.	16	BTL3	Apply
5	What is the Minimum Description Length (MDL) principle? Explain how it is used to choose between competing hypotheses.	16	BTL3	Apply
6	Compare and contrast Maximum Likelihood Estimation and Minimum Description Length principle. Provide examples.	16	BTL4	Analyze
7	Define and explain the Bayes Optimal Classifier. Why is it considered ideal and what are its limitations in practice?	16	BTL4	Analyze
8	Explain the Gibbs algorithm and its role in probabilistic learning. How does it compare to the Bayes Optimal Classifier?	16	BTL3	Apply
9	Explain the working of the Naïve Bayes Classifier with a step-by-step example. What assumptions are made?	16	BTL4	Analyze
10	What are the strengths and limitations of Naïve Bayes Classifier? In what types of problems is it most effective?	16	BTL4	Analyze
11	What is a Bayesian Belief Network? Describe its structure, representation, and applications in machine learning.	16	BTL5	Evaluate
12	Explain how inference is performed in a Bayesian Belief Network. Give an example with conditional probabilities.	16	BTL6	Create
13	Describe the Expectation-Maximization (EM) algorithm. Explain the E-step and M-step with a numerical example.	16	BTL5	Evaluate
14	Explain probability-based learning. How does it differ from rule-based or decision tree learning methods?	16	BTL3	Apply
15	Define sample complexity. How does it relate to Probably Approximately Correct (PAC) learning? Explain with a diagram.	16	BTL5	Evaluate
16	Discuss the differences between finite and infinite hypothesis spaces. How does this affect learning algorithms?	16	BTL4	Analyze
17	What is the Mistake Bound Model of learning? Explain with an example how mistake bounds are used to evaluate algorithms.	16	BTL5	Evaluate

UNIT IV - INSTANT BASED LEARNING

K– Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

PART-A

Q.No.	Question	Level	Competence
1	What is the main idea behind the K-Nearest Neighbour algorithm?	BTL 2	Understand
2	Mention two common distance metrics used in KNN.	BTL 2	Understand
3	What does the ‘K’ represent in KNN, and how does it affect the model?	BTL 1	Remember
4	How does KNN handle classification problems?	BTL 2	Understand
5	Is KNN a lazy learner or an eager learner? Justify.	BTL 1	Remember
6	What is the time complexity of classifying a single instance using KNN?	BTL 1	Remember
7	Define Locally Weighted Regression.	BTL 2	Understand
8	How does LWR differ from global linear regression?	BTL 1	Remember
9	What is the role of the kernel (weighting) function in LWR?	BTL 1	Remember
10	Why is LWR considered a non-parametric learning method?	BTL 2	Understand

11	Mention one advantage and one limitation of LWR.	BTL 1	Remember
12	What happens if the bandwidth in LWR is very large?	BTL 1	Remember
13	What is a radial basis function in the context of neural networks?	BTL 1	Remember
14	What is the general formula of a Gaussian RBF?	BTL2	Understand
15	What are the key components of an RBF network?	BTL2	Understand
16	Compare RBF networks with multilayer perceptrons.	BTL 1	Remember
17	What is the role of centers in an RBF network?	BTL 1	Remember
18	How does an RBF network perform classification?	BTL1	Remember
19	What is Case-Based Learning?	BTL2	Understand
20	What do you mean by a "case" in Case-Based Reasoning (CBR)?	BTL1	Remember
21	List the four main steps in Case-Based Reasoning.	BTL2	Understand
22	Mention two application areas of Case-Based Learning.	BTL1	Remember
23	How is similarity measured in Case-Based Learning?	BTL2	Understand
24	What is the main difference between Case-Based Learning and instance-based learning like KNN?	BTL1	Remember

PART-B

Q.No.	Questions	Marks	Level	Competence
1	Explain the K-Nearest Neighbour (KNN) algorithm in detail. Discuss how it works for classification and regression with examples.	16	BTL3	Apply
2	Describe various distance metrics used in KNN. How does the choice of 'K' affect the performance of the algorithm?	16	BTL3	Apply
3	Discuss the advantages and disadvantages of the KNN algorithm. How can its performance be improved?	16	BTL3	Apply
4	Compare KNN with other supervised learning techniques such as decision trees and Naïve Bayes.	16	BTL3	Apply
5	Explain Locally Weighted Regression (LWR) with a neat diagram. How is it different from ordinary linear regression?	16	BTL4	Analyze
6	Discuss the working of LWR and the role of kernel functions and bandwidth in weighting the data points.	16	BTL5	Evaluate
7	Compare and contrast global and local models in the context of regression. Provide examples.	16	BTL5	Evaluate
8	Explain how Locally Weighted Regression can be implemented. Mention its practical applications.	16	BTL6	Create
9	What is a Radial Basis Function Network? Explain its architecture, training process, and working with a suitable diagram.	16	BTL5	Evaluate
10	Discuss the mathematical formulation of radial basis functions. Explain the Gaussian RBF in detail.	16	BTL4	Analyze
11	Compare RBF networks with Multilayer Perceptrons. Highlight their differences in architecture and training.	16	BTL3	Apply

12	Explain the use of RBF networks in pattern classification. Provide a real-world application.	16	BTL4	Analyze
13	What is Case-Based Learning? Explain the steps involved in Case-Based Reasoning (CBR) with suitable examples.	16	BTL3	Apply
14	Describe the four major steps in the CBR cycle: retrieve, reuse, revise, and retain. Provide an illustrative case.	16	BTL3	Apply
15	Compare Case-Based Learning with rule-based and instance-based learning. Highlight strengths and weaknesses.	16	BTL3	Apply
16	Discuss the importance of similarity measures in Case-Based Reasoning. How is similarity calculated and used?	16	BTL3	Apply
17	Explain how Case-Based Learning is applied in real-time decision-making systems. Mention at least two applications.	16	BTL6	Create

UNIT V - ADVANCED LEARNING

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q–Learning – Temporal Difference Learning.

PART-A

Q.No.	Question	Level	Competence
1	What is meant by learning sets of rules in machine learning?	BTL 1	Remember
2	How does rule learning differ from decision tree learning?	BTL 2	Understand
3	What is a rule in the context of machine learning?	BTL 2	Understand
4	What is the main advantage of rule-based learning?	BTL 2	Understand
5	What is the sequential covering algorithm?	BTL 2	Understand
6	Mention one strength and one limitation of the sequential covering method.	BTL 1	Remember
7	How does sequential covering build a rule set?	BTL 2	Understand
8	What type of problems is the sequential covering algorithm best suited for?	BTL 1	Remember
9	What is the difference between propositional and first-order rules?	BTL 1	Remember
10	What is a first-order rule? Give an example.	BTL 1	Remember
11	What is meant by learning a rule set?	BTL 1	Remember
12	How are rule sets evaluated during training?	BTL 1	Remember
13	What is inverted deduction in the context of rule learning?	BTL 1	Remember
14	Define inverting resolution.	BTL 2	Understand
15	How does inverting resolution help in hypothesis generation?	BTL 2	Understand
16	What is the difference between deduction and induction?	BTL 2	Understand

17	What is analytical learning in machine learning?	BTL 2	Understand
18	What is a perfect domain theory?	BTL 2	Understand
19	How does a perfect domain theory aid in analytical learning?	BTL 1	Remember
20	What is the major assumption in analytical learning?	BTL 2	Understand
21	What is Explanation-Based Learning (EBL)?	BTL 1	Remember
22	What is the main goal of EBL?	BTL 2	Understand
23	Expand FOCL and mention its components.	BTL 1	Remember
24	What is the purpose of the FOCL algorithm?	BTL2	Understand

PART-B

Q.No.	Question	Marks	Level	Competence
1	Explain the concept of learning sets of rules. How is it used for classification tasks? Illustrate with examples.	16	BTL5	Evaluate
2	Describe the Sequential Covering Algorithm. How does it build rule sets incrementally? Provide a working example.	16	BTL6	Create
3	Compare and contrast the Sequential Covering Algorithm with Decision Tree Learning. Discuss their strengths and limitations.	16	BTL4	Analyze
4	What are rule sets in machine learning? How are they generated and evaluated?	16	BTL3	Apply
5	Explain the difference between propositional rules and first-order rules with suitable examples.	16	BTL3	Apply
6	What are sets of first-order rules? Discuss their representation, generalization, and role in complex learning tasks.	16	BTL4	Analyze
7	What is induction on inverted deduction? Explain how it is used in the context of hypothesis generation.	16	BTL4	Analyze
8	Explain the concept of inverting resolution. How does it contribute to learning first-order logic rules?	16	BTL4	Analyze
9	Compare deductive learning with inductive learning. Where does inverting resolution fit in this context?	16	BTL6	Create
10	What is analytical learning? Describe how it uses a domain theory to improve learning efficiency.	16	BTL6	Create
11	Define perfect domain theory. How does it enhance the performance of explanation-based learning?	16	BTL3	Apply
12	Discuss the assumptions and limitations of analytical learning. Provide real-world applications.	16	BTL3	Apply
13	Explain the working of Explanation-Based Learning (EBL) with a step-by-step example.	16	BTL4	Analyze
14	What is the FOCL algorithm? Describe its architecture and how it combines empirical and analytical learning.	16	BTL3	Apply
15	Compare FOIL and FOCL algorithms. How does FOCL improve upon FOIL in rule learning?	16	BTL5	Evaluate
16	What is Reinforcement Learning? Describe the key components: agent, environment, policy, reward, and value function.	16	BTL 6	Create
17	Explain the Q-learning algorithm. How does it work and differ from Temporal Difference Learning? Provide a numerical example.	16	BTL 6	Create

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