

B.TECH DEGREE EXAMINATIONS: NOV/DEC 2024

(Regulation 2018)

Seventh Semester

INFORMATION TECCHNOLOGY

U18ITI7203: Machine Learning

COURSE OUTCOMES**CO1:** Differentiate between supervised, unsupervised, and semi-supervised machine learning approaches**CO2:** Discuss the decision tree algorithm and identify and overcome the problem of overfitting**CO3:** Discuss and apply the back-propagation algorithm and genetic algorithms to various problems**CO4:** Apply the Bayesian concepts to machine learning**CO5:** Analyse and suggest appropriate machine learning approaches for various types of problems**Time: Three Hours****Maximum Marks: 100****Answer all the Questions:-****PART A (10 x 2 = 20 Marks)****(Answer not more than 40 words)**

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|---------------------------------------------------------------------------------------|-----|-------------------|
| 1. Explain how the Candidate Elimination algorithm is different from Find-S Algorithm | CO1 | [K ₂] |
| 2. Outline the capabilities and limitations of ID3 | CO3 | [K ₂] |
| 3. What is the role of version spaces in concept learning? | CO1 | [K ₂] |
| 4. What is a perceptron, and what type of problem can it solve? | CO2 | [K ₂] |
| 5. What is the Naive Bayes classifier, and why is it called "naive"? | CO3 | [K ₂] |
| 6. How does locally weighted regression differ from ordinary linear regression? | CO4 | [K ₂] |
| 7. What is Q-Learning, and how is it applied in reinforcement learning? | CO5 | [K ₂] |
| 8. List the key properties of Instance-based learning methods. | CO4 | [K ₂] |
| 9. What is the purpose of an activation function in neural networks? | CO2 | [K ₂] |
| 10. Discuss the idea of case based learning. | CO5 | [K ₂] |

Answer any FIVE Questions:-**PART B (5 x 16 = 80 Marks)****(Answer not more than 400 words)**

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|--------------------------------------------------------------------------------------------------------------------------------|---|-----|-------------------|
| 11. a) Trace the Candidate Elimination Algorithm for the hypothesis space H' given thesequence of training examples from Table | 8 | CO1 | [K ₃] |
| H' = < ?, Cold, High, ?,?,?>v<Sunny, ?, High, ?,?,Same> | | | |

Example	Sky	AirTemp	Humidity	Wind	Water	Forecast	Enjoy Sport
1	Sunny	Warm	Normal	Strong	Warm	Same	Yes
2	Sunny	Warm	High	Strong	Warm	Same	Yes
3	Rainy	Cold	High	Strong	Warm	Change	No
4	Sunny	Warm	High	Strong	Cool	Change	Yes

- b) Discuss the challenges associated with inductive bias in machine learning. Why is inductive bias necessary, and how does it impact learning outcomes? 8 CO1 [K₂]
12. a) Describe the back-propagation algorithm used in training multilayer neural networks. How does the algorithm adjust the weights to minimize error? 8 CO2 [K₂]
- b) Explain the process of hypothesis space search in genetic algorithms. Discuss the role of selection, crossover, and mutation in exploring the hypothesis space. 8 CO2 [K₂]
13. a) You are tasked with building a Naive Bayes classifier to classify movie reviews as either "Positive" or "Negative" based on the presence of certain words in the reviews. The training dataset contains the following: 16 CO3 [K₃]
- **Vocabulary:** {great, boring, good, bad, amazing, dull, entertaining, disappointing}
 - **Movie Reviews (Training Data):**
 - Review 1: ["great", "amazing", "entertaining"] → Positive
 - Review 2: ["boring", "dull", "disappointing"] → Negative
 - Review 3: ["good", "entertaining", "great"] → Positive
 - Review 4: ["boring", "bad", "dull"] → Negative
 - Review 5: ["good", "amazing", "great"] → Positive
- You need to classify the following **test review**:
- **Test Review:** ["boring", "dull", "great"]
- Tasks:*
1. **Calculate the prior probabilities** of the classes "Positive" and "Negative" using the training data.
 2. **Calculate the likelihood** of each word in the test review ("boring", "dull", "great") for both the "Positive" and "Negative" classes, using the Naive Bayes assumption that the words are conditionally independent. Apply **Laplace smoothing** to handle zero probabilities.

3. Use **Bayes' Theorem** to calculate the posterior probabilities of the test review being "Positive" or "Negative."
4. Based on the calculated probabilities, classify the test review as either "Positive" or "Negative."

14. a) Discuss Locally Weighted Regression (LWR) and how it differs from global linear regression. Illustrate its use in a regression problem. 8 CO4 [K₂]
- b) Apply K-Nearest Neighbors (K-NN) algorithm to predict the price category of a house based on its size (in square feet) and the number of bedrooms. The dataset is provided below: 8 CO4 [K₃]

House ID	Size (sq ft)	Bedrooms	Price Category
1	2100	3	High
2	1600	2	Medium
3	2400	4	High
4	1416	2	Low
5	3000	4	High
6	1200	2	Low

You are given the following **new house** for which you need to predict the price category:

New House: Size = 1800 sq ft, Bedrooms = 3

15. a) Discuss various tasks in Reinforcement Learning. What are the differences between episodic and continuous tasks, and how does the reward system work in each case? 8 CO5 [K₂]
- b) Describe the FOCL (First Order Combined Learner) algorithm. How does it extend the basic methods of inductive logic programming? 8 CO5 [K₂]
16. a) Consider the following set of training examples: 8 CO2 [K₃]

Instance	A1	A2	Classification
1	T	T	Positive
2	T	T	Positive
3	T	F	Negative
4	F	F	Positive
5	F	T	Negative
6	F	T	Negative

(a) What is the entropy of this collection of training examples with respect to the target function classification?

(b) What is the information gain of A2 relative to these training examples?

- b) Explain the role of the learning rate in gradient descent. How does it affect the convergence of the algorithm and discuss how to choose the number of iterations 8 CO2 [K₂]

or stopping criteria for gradient descent to ensure that the cost function is minimized effectively.
