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Question Paper Code : 81170

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fourth Semester

Computer Science and Engineering

CS 3491 — ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

(Common to : Computer Science and Design/Computer Science and Engineering
(Cyber Security)/Computer and Communication Engineering/Information
Technology)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

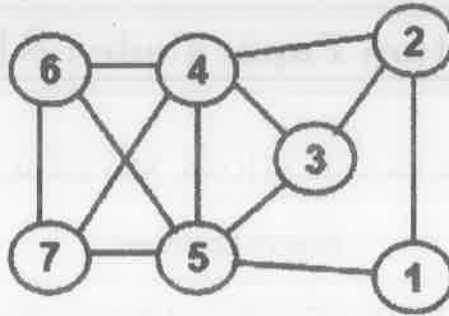
Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is value alignment problem?
2. What is meant by uniformed search strategy?
3. What is the fundamental idea about decision theory?
4. How rejection sampling is applied to real time applications?
5. What is the least squares method in linear regression, and how is it applied in single and multiple variable models?
6. What is Maximum margin classifier?
7. How can we make k-means robust to outliers?
8. Differentiate voting from stacking using a linear perceptron as the combiner function.
9. Give some of the activation functions.
10. What is gradient descent optimization?

PART B — (5 × 13 = 65 marks)

11. (a) Write the BFS algorithm and trace the same on the graph given below



Or

- (b) Imagine you are developing a scheduling system for a university. The university has allocate time slots for several classes in such a way that:

- No two classes are scheduled in the same room at the same time.
- No instructor is assigned to more than one class at a time.
- Certain courses require specific rooms (e.g., labs or lecture halls).

Frame this as a Constraint Satisfaction Problem (CSP) by identifying the variables, domains, and constraints. Then, explain how a CSP approach can be used to find a feasible schedule.

12. (a) Explain how Bayesian inference can be used to classify stock price movement based on non-linear patterns in historical data.

Or

- (b) Discuss in detail about exact inference and approximate inference in Bayesian networks.

13. (a) Discuss how Bayesian Linear Regression differs from standard Linear Regression in terms of interpretation, uncertainty estimation, and prediction. Provide illustrative diagrams or example to support your explanation.

Or

- (b) A healthcare startup is developing a predictive model to identify whether a patient is at risk of developing Type 2 diabetes based on various health indicators such as age, BMI, glucose levels, physical activity, and family history. The data collected includes thousands of patient records labeled as either diabetic (1) or non-diabetic (2). As the data scientist in the team, you are tasked with building a binary classification model using Logistic Regression.

Discuss why logistic regression is an appropriate choice for this problem. What steps would you take if the model shows bias toward predicting one class more often than the other?

14. (a) An e-commerce company is facing a rise in fraudulent transactions. Despite using traditional machine learning models like Decision Trees and Logistic Regression, the detection rate remains suboptimal, leading to financial losses and customer dissatisfaction. To enhance the detection accuracy, the company decides to explore Ensemble Learning techniques. As a data scientist at the company, you are tasked with implementing an ensemble learning solution to improve fraud detection accuracy.

Describe how ensemble learning can be applied in this scenario in terms of model performance, error reduction, and overfitting handling. Support your explanation with justification for selecting a specific ensemble method.

Or

- (b) Discuss working principles and applications of Expectation-Maximization (EM) Algorithm. Why is it used, and in what contexts is it particularly beneficial?
15. (a) Explain the architecture of a Multilayer Perceptron (MLP), and describe how forward propagation and back propagation work together during the training process.

Or

- (b) Discuss the evolution from shallow neural networks to deep neural networks. What are the limitations of shallow networks that deep architectures overcome?

PART C — (1 × 15 = 15 marks)

16. (a) The Botanical research center wants to group the flowers into 2 clusters based on sepal length, sepal width, petal length and petal width (in cm). Explain about k-means and use it for clustering by considering the minkowski distance measure with $q=1$. The following are the data about the flowers,

Sepal Length	Sepal Width	Petal Length	Petal Width
5.1	3.5	1.4	0.2
4.9	3.0	1.4	0.2
4.7	3.2	1.3	0.2
4.6	3.1	1.5	0.2
7.0	3.2	4.7	1.4
6.4	3.2	4.5	1.5
6.9	3.1	4.9	1.5
6.5	2.8	4.6	1.5
7.6	3.0	6.6	2.1

Sepal Length	Sepal Width	Petal Length	Petal Width
4.9	2.5	4.5	1.7
7.3	2.9	6.3	1.8
6.7	2.5	5.8	1.8

Apply the same for 2 iterations. Trace the following intermediate results, at the end of each iteration:

- (i) Find the new clusters formed.
- (ii) Calculate the Centroid of the new clusters
- (iii) Draw a Scatter plot.

Or

- (b) Why naïve Bayesian classification is called “naïve”? Briefly outline the major ideas of naïve Bayesian classification. Predict the class label using naïve Bayesian classification. The training data set or for the up gradation of an employee is given below. The data tuples are described by the attributes department, status, age, experience and salary. The class label attribute has two distinct values (E- Eligible, NE —Not Eligible).

Department	Status	Age	Experience	Salary	Class Label
Sales	Senior	31-35	Yes	46K-50K	E
Sales	Junior	26-30	No	36K-40K	NE
Sales	Junior	31-35	No	41K-45K	E
Systems	Junior	26-30	No	46K-40K	E
Systems	Senior	31-35	Yes	36K-40K	NE
Systems	Junior	26-30	No	46K-40K	E
Systems	Senior	36-40	Yes	36K-41K	E
Marketing	Senior	36-40	Yes	46K-50K	E
Marketing	Junior	31-35	No	41K-45K	NE
Secretary	Senior	36-40	Yes	36K-40K	E
Secretary	Junior	26-30	No	41K-45K	E

Classify the tuple

X = (Department = “Systems”, Status = “Junior”, Aged = “31-35”, Experience = “Yes”, Salary = “36K-40K”).