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Question Paper Code:U6B03

B.E./B.Tech. DEGREE EXAMINATION, APRIL / MAY 2025

Sixth Semester

Biomedical Engineering

21UBM603 - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TECHNIQUES

(Regulations 2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. List the characteristics of AI. CO1- U
2. What is adversarial search? CO1- U
3. Define uncertainty. CO1- U
4. Mention the needs of probabilistic reasoning in AI. CO1- U
5. Outline the difference between supervised learning and unsupervised learning. CO1- U
6. How can overfitting be avoided? CO1- U
7. Define ensemble learning. CO1- U
8. How expectation maximization is used in Gaussian mixture models? CO1- U
9. Name any two activation functions. CO1- U
10. What is stochastic gradient descent and why is it used in the training of neural networks? CO1- U

PART – B (5 x 16= 80 Marks)

11. (a) i) Differentiate Blind Search and Heuristic Search. CO1-U (10)
ii) Explain in brief the characteristics of intelligent agent. CO1-U (6)
Or
(b) i) Explain in detail the iterative deepening search algorithm with an example. CO1-U (10)
ii) Briefly discuss the Adversarial search. Name the techniques used for adversarial search. CO1-U (6)

12. (a) i) State the Bayes' theorem. How it is useful for decision making under uncertainty? CO1-U (6)
- ii) Consider the following set of propositions: CO2-App (10)
- Patient has spots
 - Patient has measles
 - Patient has high fever
 - Patient has Rocky mountain spotted fever.
 - Patient has previously been inoculated against measles.
 - Patient was recently bitten by a tick
 - Patient has an allergy.
- (a) Create a network that defines the casual connections among these nodes.
- (b) Make it a Bayesian network by constructing the necessary conditionalprobability matrix.

Or

- (b) i) Briefly explain the joint tree algorithm in Bayesian networks. CO1-U (6)
- ii) A patient has a disease N. Physicians measure the value of a parameter P to see the disease development. The parameter can take one of the following values {low, medium, high}. The value of P is a result of patient's unobservable condition/state S, which can be {good, poor}. The state changes between two consecutive days in one fifth of cases. CO2-App (10)
- If thepatient is in good condition:
- 10 measurement $\rightarrow$ 5 low, 3 medium and 2 high
- If the patient is in poor condition,
- 10 measurements $\rightarrow$ 3 low, 3 medium and 4 high
- On arrival to the hospital on day 0, the patient's condition was unknown, i.e., $P(S_0 = \text{good}) = 0.5$.
- Using Bayesian network modeling, calculate probability that the patient is in good condition on day 2, given low P values on days 1 and 2.

13. (a) i) Explain the principle of the gradient descent algorithm. CO1-U (6)
- ii) The values of x and their corresponding values of y are shown in the table below. CO3-App (10)

x	1	2	3	4	5	6	7
y	3	4	5	5	6	8	10

Find the least square regression line $y = ax + b$. Also estimate the value of y when $x = 10$.

Or

- (b) i) Describe the general procedure of random forest algorithm. CO1-U (6)
ii) Construct a linear decision boundary using Support Vector Machine classifier for the following set of data points (X) and their corresponding class label (Y):

$$X = \begin{bmatrix} 1 & 1 \\ 2 & -2 \\ 2 & 1 \end{bmatrix} Y = \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix}$$

14. (a) i) What is bagging and boosting? Give examples. CO1-U (6)
ii) Construct a small training dataset and demonstrate how the AdaBoost algorithm builds an ensemble classifier. Clearly show each step of the boosting process and final combined hypothesis. CO3-App (10)

Or

- (b) i) List the applications of clustering and identify advantages and disadvantages of clustering algorithms. CO1-U (6)
ii) Use the k-means algorithm and Euclidean distance to cluster the following 5 data points into 2 clusters: CO3-App (10)

Data points	C1: (4, 0.33, 3)	C2: (0.5, 1.5, 2.5)	Cluster
P1: (1, 2, 3)	4.67	1.5	C2
P2: (0, 1, 2)	5.67	1.5	C2
P3: (3, 0, 5)	3.33	6.5	C1
P4: (4, 1, 3)	0.67	4.5	C1
P5: (5, 0, 1)	3.33	7.5	C1

Run the algorithm to find the clusters and cluster centers after second iteration.

15. (a) Analyze the role of the backpropagation algorithm in training deep neural networks. How does it facilitate gradient computation and weight updates across multiple layers? CO4-Ana (16)

Or

- (b) Analyze how hyperparameter tuning affects the performance of a neural network model. Discuss different approaches for hyperparameter optimization. CO4-Ana (16)

