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RV College of Engineering®
Mysore Road, RV Vidyaniketan Post,
Bengaluru - 560059, Karnataka, India

R V College of Engineering

R V Vidyanikethan Post
Mysuru Road Bengaluru - 560 059

IV Semester BE Regular/Supplementary Examinations June/July-2025.
Artificial Intelligence and Machine Learning
Course : Artificial Intelligence and Machine Learning-AI244AI

Time : 3 Hours **Maximum Marks : 100**

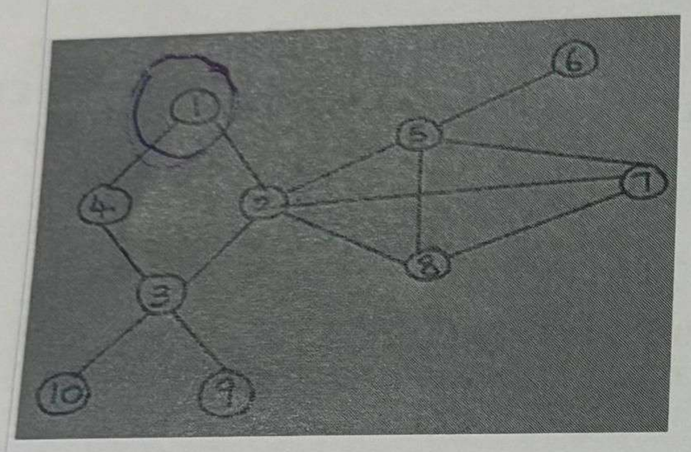
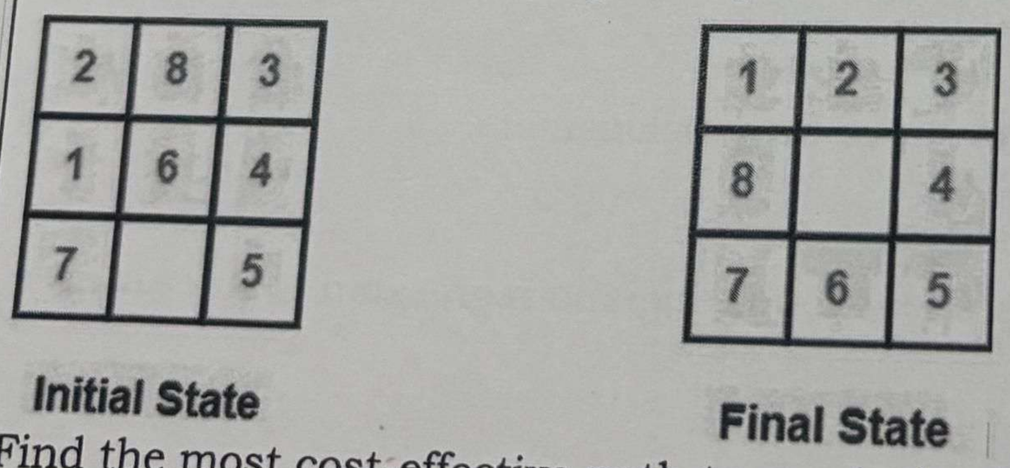
Instructions to the students

1.Answer all questions from Part A. Part A questions should be answered in first three pages of the answer book only.
2.Answer FIVE full questions from Part B. In Part B question number 2 is compulsory. Answer any one full question from 3 and 4, 5 and 6, 7 and 8, and 9 and 10.

Part A

Question No	Question	M	CO	BT
1.1	List two differences between model-based and simple reflex agents.	02	1	1
1.2	List two key challenges that a robot vacuum cleaner faces in a home environment, specifically in terms of perception and action execution.	02	2	1
1.3	What does the term "**search space**" refer to in heuristic search?	01	1	2
1.4	Which search strategy is used in two-player games like chess?	01	1	2
1.5	Identify the key difference between hill-climbing and local-beam search.	02	1	2
1.6	What is model overfitting?Mention its Cause	02	1	1
1.7	Differentiate between precision and recall.	02	2	1
1.8	Give one real-world application of the Naive Bayes classifier.	01	2	1
1.9	Identify the various model parameters learned in logistic regression to finetune the model?	02	2	1
1.10	What is the key assumption of the Naïve Bayes classifier?	01	1	2
1.11	What is cluster analysis in unsupervised learning?	02	1	1
1.12	What is the role of the silhouette score in K-means clustering?	02	1	2

Part B

Question No	Question	M	CO	BT
2a	A ride-sharing app (e.g., Uber) utilizes AI to determine the optimal route for drivers, taking into account traffic conditions, fuel consumption, and estimated arrival times. 1. Discuss how a utility-based agent can be used in this scenario. A smart thermostat adjusts room temperature based on past temperature readings and current sensor inputs. 2. Describe how a model-based reflex agent can function in this application.	08	3	3
2b	Apply the Depth first search algorithm for the following graph shown in figure 2b  Figure 2b: Graph *i)* Display the output visiting each node, starting node: 1and *ii)* Develop the DFS spanning tree *iii)* Mention the advantages, disadvantages, and time and space complexities of DFS	08	3	4
3a	Discuss how Hill-Climbing can get stuck in local maxima, and how simulated annealing overcomes this.	06	1	1
3b	Given an initial state of 8-puzzle problem and final state to be reached-  **Initial State** **Final State** Find the most cost-effective path to reach the final state from initial state using A* Algorithm for the figure shown	10	3	5
	OR			
4a	For the following two-ply game tree shown in figure the terminal nodes show the utility values computed by the utility function. Use the Min-Max algorithm to compute the utility values for other nodes in the given game tree.	08	3	4

M	CO	BT
08	3	3
08	3	4
5	1	1
3	5	

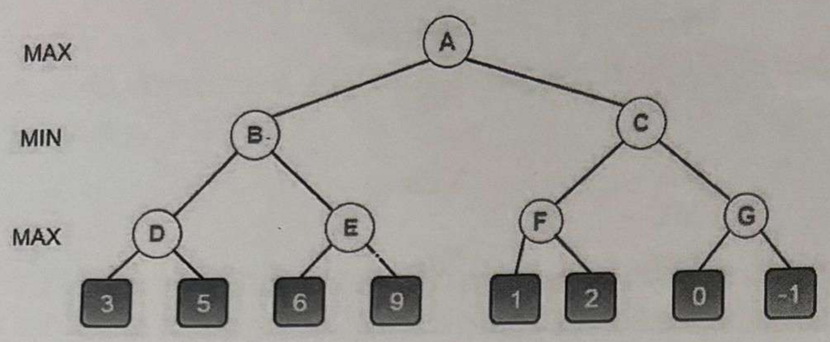


Figure.: Game tree

4b	What is **Local Beam Search**? Describe with a function given: f(x) = -(x-7)^2+49 example how multiple states are maintained and updated at each step.	08	2	3
5a	Illustrate the concept of overfitting and underfitting using bias-variance decomposition. Provide graphs to support your answer.	08	2	1
5b	Analyze and identify issues in the following machine learning scenarios and propose solutions a. A weather prediction dataset contains a value of temperature = -200°C. What type of issue is this? What should be done to handle such data b. A sentiment analysis model has training accuracy = 30% and test accuracy = 85%. What could explain such a pattern? How can the training process be improved? c. A credit risk prediction model shows training error = 10% and test error = 55%. What does this suggest about the model's behavior? What techniques can be used to improve generalization?	08	3	4

OR

6a — You are given the following dataset for classifying whether a customer will purchase travel insurance based on demographic and behavioral attributes. Use the information to construct a decision tree using the ID3 algorithm. (08 | 2 | 4)

Age	Employment	Travel Frequency	Owns Vehicle	Bought Insurance (Yes/ No)
Young	Employed	Often	No	Yes
Young	Student	Rarely	No	No
Middle-Aged	Employed	Often	Yes	Yes
Senior	Retired	Rarely	Yes	No
Middle-Aged	Student	Often	No	Yes
Young	Employed	Rarely	Yes	No

Senior	Employed	Often	No	Yes
Young	Retired	Rarely	Yes	No
Middle-Aged	Employed	Rarely	No	Yes
Senior	Student	Often	Yes	No

Calculate the Entropy for the entire dataset.

Compute the Information Gain for each attribute (Age, Employment, Travel Frequency, Owns Vehicle).

Identify the best attribute to split at the root node.

Repeat the process until the decision tree is fully constructed

Analyze and identify issues in the following machine learning scenarios and propose solutions

I . In a retail dataset, the attribute "number of items purchased" has a negative value of -4

a. Why is this a concern?

b. How can such anomalies be detected and corrected?

II. A deep learning model for image classification reports a training error of 99% and test error of 98%.

6b

a. What are the potential causes of this issue?

b. Suggest modifications to improve model performance.

III. A spam detection model has training error = 8% and test error = 10%, but precision is very low.

a. What does this indicate about the predictions?

b. What metrics and adjustments should be considered for improvement?

Consider the given dataset, apply the naïve Bayes algorithm, and predict that if a fruit has the following properties then which type of the fruit it is Fruit = {Yellow, sweet, long}

Frequency table:

7a

Fruit	Yellow	Sweet	Long	Total
Mango	350	450	0	650
Banana	400	300	350	400
Others	50	100	50	150
Total	800	850	400	1200

7b With neat sketch techniques.

For the given data Red or Blue using

Table 3a

Brightness	Satur
40	20
50	50
60	90
10	25
70	70
60	10
25	80
20	35

8a

8b

08 3

10 3

Qb What are interna

7b	With neat sketches, explain Bagging and Boosting ensemble learning techniques.	06	2	2

OR

For the given data set shown in Table 3a., find whether (20,35) belongs to class Red or Blue using the KNN neighbor. Assume K = 5.

Table 3a

Brightness	Saturation	Class
40	20	Red
50	50	Blue
60	90	Blue
10	25	Red
70	70	Blue
60	10	Red
25	80	Blue
20	35	????

8a		08	3	5
8b	Discuss the strengths and limitations of Logistic Regression, KNN, and Ensemble Models in classification tasks.	08	3	3
9a	What are the different types of clusters? Illustrate with examples.	08	3	1
9b	What are the limitations of K-means clustering? Suggest methods to overcome them.	08	2	1

OR

10a	A retail store wants to segment customers based on their purchases. Propose how K-means can be applied. Include preprocessing and evaluation steps.	10	3	6
10b	What are internal and external cluster validity indices? Give examples.	06	2	1