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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: VII**
Branch: Aerospace Engineering **Duration: 3 hrs.**
Course Code:22AS7PEMLA **Max Marks: 100**
Course: Machine Learning in Aerospace Engineering

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Define Machine Learning (ML) and illustrate its distinction from traditional programming using block diagram.	CO1	PO1	6
	b)	Infer the characteristics of different types of ML techniques with a neat diagram for each.	CO1	PO1	10
	c)	What is Q-Learning? Under what class it comes? Explain briefly.	CO1	PO1	4
		OR			
2	a)	Identify the type of machine learning problem for each of the following scenarios. Justify your answers. i) Predicting if a new image has cat or dog based on the historical data of other images of cats and dogs, where you are supplied the information about which image is cat or dog. ii) Predict which team will win a tournament. iii) Predicting the monthly sales of a cloth store in rupees. iv) Learning to drive a cycle. v) Group audio files based on language of the speakers.	CO1	PO2	5
	b)	Summarize any five the challenges and applications of ML algorithms in various domains.	CO1	PO1	10
	c)	A robot is navigating a grid environment. The robot is currently at state S1 and chooses an action a1, moving to state S2. It receives a reward r =2. The current Q (S1, a1) =1.5 and the maximum Q-value of the next state maxa′ Q (S2, a′) = 3 The learning rate is α=0.2, and the discount factor is γ=0.8. Calculate the updated Q (S1, a1).	CO1	PO2	5
		UNIT - II			
3	a)	Explain Linear regression with the help of equations.	CO1	PO1	6

Q.No.		Question	CO	PO	Marks
	b)	Apply SVM to classify the data into two classes. Plot the resultant graph with best hyperplane. Class A: (2,3), (3,3), (3,4) Class B: (6,5), (7,6), (8,7)	CO1	PO2	**8**
	c)	Explain how Principal Component Analysis (PCA) can be applied in fluid mechanics for reducing the dimensionality of complex flow data. Illustrate with a case study involving turbulence analysis in a fluid flow system.	CO1	PO2	**6**
		OR			
4	a)	Researchers in a lab are studying a chemical reaction for a new compound. The data records the mass of the compound over time and it is as follows.	CO1	PO2	**8**

Time Unit (x)	5	7	12	16	20
Mass (y)	40	120	180	210	240

Apply the Simple Linear Regression and predict the mass of compound at time unit 10 and 15 respectively.

Q.No.		Question	CO	PO	Marks
	b)	Compare and contrast different types of support vector machines with a neat diagram for each.	CO1	PO1	**12**
		UNIT - III			
5	a)	Explain how decision trees can be represented for a classification task. Use an example to illustrate how decision nodes and leaf nodes are structured in a decision tree.	CO2	PO1	**5**
	b)	Explain the role of inductive bias in decision tree learning. How does the bias influence the construction of the decision tree?	CO2	PO1	**5**
	c)	Design a decision tree for the given dataset using the ID3 algorithm.	CO2	PO2	**10**

Instance	A1	A2	Classification
1	False	True	$
2	False	True	$
3	False	False	+
4	True	False	$
5	True	True	+
6	True	True	+

Q.No.		Question	CO	PO	Marks
		OR			
6	a)	Identify and explain two major issues in Decision Tree learning.	CO2	PO1	**5**
	b)	A retail company wants to develop a predictive model to recommend whether a customer is likely to purchase a product based on the following features: • **Age** (categorical: "Young", "Middle-aged", "Old")	CO2	PO3	**10**

			• **Income** (categorical: "Low", "Medium", "High") • **Product Category** (categorical: "Electronics", "Clothing", "Furniture") • **Previous Purchases** (categorical: "Yes", "No") • **Location** (categorical: "Urban", "Suburban", "Rural") The company has historical data of 1,000 customers, with the target variable being **Purchase Decision** (categorical: "Yes", "No"). The ID3 algorithm will be used to construct a decision tree to predict the likelihood of a customer purchasing a product based on the given features. **Answer the given questions:** i) How does ID3 select the best feature to split on in the decision tree? ii) What is Information Gain, and how is it calculated in the ID3 algorithm? iii) How would you handle missing values in the dataset while applying the ID3 algorithm? iv) What is overfitting in decision trees, and how can it be prevented in ID3? v) Explain how the "Product Category" feature with many values might affect the decision tree in ID3 and how you would mitigate this issue.			
		c)	Discuss the concept of hypothesis space search in Decision Tree learning. How does the algorithm navigate this space to find the optimal tree?	*CO2*	*PO1*	**5**
			UNIT - IV			
	7	a)	Justify the need of activation functions. Illustrate any three activation functions with relevant graphs.	*CO2*	*PO1*	**10**
		b)	A neuron j received inputs from four other neurons whose activity levels are 10, -20, 4 and -2. The respective synaptic weights of neuron j are 0.8,0.2,1 and 0.9. Calculate the output of neuron j which has a linear activation function.	*CO2*	*PO2*	**5**
		c)	Explain how a single-layer perceptron can be used to classify emails as either "spam" or "not spam." Discuss how the perceptron algorithm works	*CO2*	*PO1*	**5**
			OR			
	8	a)	Differentiate artificial neuron and biological neuron with a neat diagram.	*CO2*	*PO1*	**5**
		b)	Justify the need of back propagation in a multilayer perceptron learning. Highlight the working of back propagation algorithm with an algorithm and network diagram.	*CO2*	*PO1*	**15**

UNIT - V

Q. No.		Question	CO	PO	Marks
9	a)	Explain the Minimum Description Length (MDL) principle in model selection. How does MDL balance between model complexity and fit to the data?	*CO3*	*PO1*	**5**
	b)	Explain how Bayes' Theorem can be applied in concept learning to improve the accuracy of classification models.	*CO3*	*PO1*	**5**
	c)	Find out whether the object with attribute Confident = Yes, Sick = No will Fail or Pass using Bayesian classification.	*CO3*	*PO2*	**10**

Confident	**Studied**	**Sick**	**Result**
Yes	No	No	Fail
Yes	No	Yes	Pass
No	Yes	Yes	Fail
No	Yes	No	Pass
Yes	Yes	Yes	Pass

OR

Q. No.		Question	CO	PO	Marks
10	a)	Apply the Naive Bayes classifier to below data and classify the new instance: (Weather condition = rain, Road Condition = good, Traffic condition = normal, Engine problem = no) to the suitable target class.	*CO3*	*PO3*	**10**

SNo.	Weather condition	Road condition	Traffic condition	Engine problem	Accident
1	Rain	bad	high	no	yes
2	snow	average	normal	yes	yes
3	clear	bad	light	no	no
4	clear	good	light	yes	yes
5	snow	good	normal	no	no
6	rain	average	light	no	no
7	rain	good	normal	no	no
8	snow	bad	high	no	yes
9	clear	good	high	yes	no
10	clear	bad	high	yes	yes

Q. No.		Question	CO	PO	Marks
	b)	How does Maximum Likelihood Estimation (MLE) help in predicting probabilities for a given dataset?	*CO3*	*PO1*	**5**
	c)	Describe the Naïve Bayes classifier and explain why it is referred to as "naïve". How can it be applied to a text classification problem, such as spam email detection?	*CO3*	*PO1*	**5**

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