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RCSE–002

Ph. D. IN COMPUTER SCIENCE

(PHDCS)

Term-End Examination

December, 2023

RCSE-002 : MACHINE LEARNING

Time : 3 Hours *Maximum Marks : 100*

Weightage : 50%

Note : *(i) Question No. **1** is compulsory.*

*(ii) Answer any **three** questions from the rest.*

(iii) Use of scientific calculator is allowed.

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1. (a) What is Machine Learning ? Explain the type of problems that can be solved using machine learning. Also, differentiate between supervised and unsupervised learning. 10

(b) Explain central limit theorem. Also explain how central limit theorem can be useful in hypothesis testing ? 10

(c) Write candidate elimination algorithm and explain with the help of a suitable example how it can be applied to find version space of hypotheses. 10

(d) Explain with the help of a suitable example, how can partially learned concepts be used ? 10

2. (a) NASA wants to discriminate between Martians (M) and Humans (H) based on the following attributes : 15

Green $\in$ {N, Y}, Legs $\in$ (2, 3), Height $\in$ (S, T), Smelly $\in$ (N, Y).

The available training data is as follows :

S. N.	Green	Legs	Height	Smelly	Species
1	N	3	S	Y	M
2	Y	2	T	N	M
3	Y	3	T	N	M
4	N	2	S	Y	M
5	Y	3	T	N	M

6	N	2	T	Y	H
7	N	2	S	N	H
8	N	2	T	N	H
9	Y	2	S	N	H
10	N	2	T	Y	H

(i) Greedily learn a decision tree using the ID3-algorithm and draw the tree.

(ii) Write the learned concept for Martian as a set of conjunctive rules.

(b) List the issues and challenges faced in Decision tree learning. 5

3. (a) Explain Hierarchical clustering method with the help of a suitable example. 10

(b) Using Naive-Bayes' classifier and following training examples, find the class of unseen sample X = {rain, hot, high, false} : 10

Outlook	Temp	Humidity	Wind	Class
Sunny	hot	high	False	N
Sunny	hot	high	True	N
Overcast	hot	high	False	P
Rain	mild	high	False	P
Rain	cool	normal	False	P

Rain	cool	normal	True	N
Overcast	cool	normal	True	P
Sunny	mild	high	False	N
Sunny	cool	normal	False	P
Overcast	mild	high	True	P
Overcast	hot	normal	False	P
Rain	mild	high	True	N

4. (a) Explain the process of designing a learning system with the help of an example. 10

   (b) What is need for comparison of learning algorithms ? Explain how you will compare two learning algorithms L_A and L_B. 10

5. Write short notes on the following : 4×5=20

   (a) PAC-Learnability

   (b) Type-I Error, Type-II Error and True Error

   (c) Mistake bound for the FIND-S algorithm

   (d) Paired t-Test