



# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

## DEPARTMENT OF MECHATRONICS

### II SEMESTER M.TECH. (INDUSTRIAL AUTOMATION & ROBOTICS)

### END SEMESTER EXAMINATIONS, JULY 2022

### SUBJECT: ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS [MTE 5002]

Date: 1 July 2022

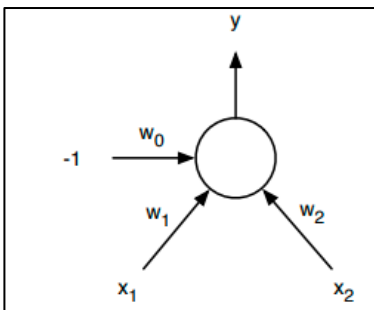
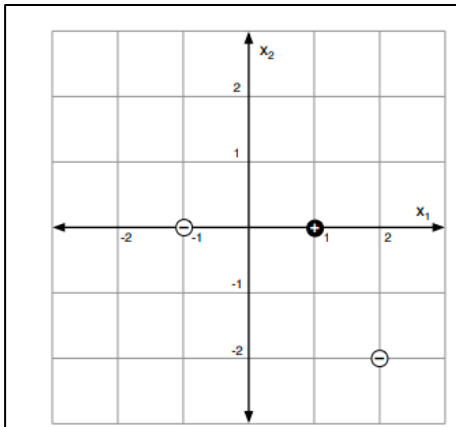
Time: 3 Hours

MAX. MARKS: 50

#### Instructions to Candidates:

- ❖ Answer **ALL** the questions.
- ❖ Missing data can be assumed and suitably justified.

Q. No	Question	M	CO	PO	LO	BL
1A.	If the probability mass function of a random variable is given by $P(X=r) = kr^3$ , where $r = 1, 2, 3, 4$ . Find the value of k.	2	1	1,2	M1	3
1B.	Define and Explain any three moments of statistics with their significances.	3	1	1,2	M1	2
1C.	Explain in detail the Logistics Regression Classifier and derive its cost function.	5	1	1,2	M2	3
2A	Explain the Basic fuzzy set operation i. Union ii. Intersection iii. Complement iv. Product	2	2	2, 3	M1	3
2B	Discuss Mamdani and Sugeno fuzzy inference systems (fuzzy models). Explains the steps involved, and How to Decide Whether to Apply- Mamdani or Sugeno Fuzzy Inference System?	3	2	3,4	M4	3
2C	Explain the assumption made by the Pearson correlation techniques and how Spearman correlation technique is different from it	5	1	1,3	M3	3
3A	Explain the following with an example for GA's i. Population ii. Reproduction iii. Crossover iv. Deletion	2	2	2,3	M1	3
3B	Justify and explain the need of Cross-Fold Validation in Machine Learning.	3	3	1, 2	M4	3
3C	Explain the working philosophy of following Optimizers • Nesterov Accelerated Gradient Descent • RMS-Prop • ADAM	5	3	3, 4	M4	3
4A	Define and explain Comprehensive learning PSO and clonal PSO.	2	2	3,4	M4	2
4B	Define Genetic Algorithms, Enlist and describe two applications of Genetic Algorithms (GAs).	3	2	3,4	M4	2
4C	With reference to Ant Colony Optimization (ACO), explain following algorithmic elements. i. Evaporation ii. Visibility	5	2	3,4	M3	3

	iii. Transition Probability																										
5A	Distinguish between Type 1 and 2 Errors in the perspective of hypothesis testing.	2	3	1,2,3	M3	3																					
5B	<div>Consider Table 5. B which has a sample dataset to learn a decision tree that predicts if people pass or fail (Yes or No), based on their previous GPA (High, Medium, or Low) and whether or not they studied.</div> <table border="1"><thead><tr><th>GPA</th><th>Studied</th><th>Passed</th></tr></thead><tbody><tr><td>L</td><td>F</td><td>F</td></tr><tr><td>L</td><td>T</td><td>T</td></tr><tr><td>M</td><td>F</td><td>F</td></tr><tr><td>M</td><td>T</td><td>T</td></tr><tr><td>H</td><td>F</td><td>T</td></tr><tr><td>H</td><td>T</td><td>T</td></tr></tbody></table> <div>Table 5. B</div> <div>Estimate:</div> <div><div>1. Draw the full decision tree that would be learned for this dataset (you do not need to show any calculations) and calculate the entropy of Passed (Entire Dataset)?</div><div>2. The entropy (Passed   GPA)?</div><div>3. The entropy (Passed   Studied)?</div></div>	GPA	Studied	Passed	L	F	F	L	T	T	M	F	F	M	T	T	H	F	T	H	T	T	3	3	3,5	M5	4
GPA	Studied	Passed																									
L	F	F																									
L	T	T																									
M	F	F																									
M	T	T																									
H	F	T																									
H	T	T																									
5C	<div>Fig 5.C.2 shows four data points for Binary Classification and a Neural Net is to be trained on these.</div> <div>Data points are: Negative: (-1, 0) (2, -2) Positive: (1, 0)</div> <div>Assume:</div> <div><div>1. We have a single sigmoid unit (Fig 5.C.1)</div><div>2. The negative class is represented by the desired output of 0 and the positive class by the desired output of 1.</div><div>3. Weights are <math>w_0 = 0</math>, <math>w_1 = 1</math>, <math>w_2 = 1</math>.</div></div> <div><div></div><div></div></div> <div>Fig 5.C.1</div> <div>Fig 5.C.2</div> <div>Estimate</div> <div><div>1. The computed y value for each of the points on the diagram above?</div><div>2. The change in <math>w_2</math> as determined by backpropagation using a step size (<math>\eta</math>) of 1.0? Assume that the input is <math>x = (2, -2)</math> and the initial weights are as specified above. Show the formula you are using as well as the numerical result.</div></div>	5	3	3,5	M5	4																					