2023

COMPUTER SCIENCE

Paper : CSMC-304

(Artificial Intelligence)

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***question nos.*** **1** and **2**, and ***any four*** questions from the rest.

1. Answer ***any five*** questions : 2×5

(a) Consider a fuzzy set A defined on the interval $x = [0, 10]$ of integers by the membership function. $\mu A(x) = x/(x + 2)$; α cut corresponding to $\alpha = 0.5$ will be _____.

(b) Two fuzzy sets A and B are given with membership functions

$$\mu A(x) = \{0.2, 0.4, 0.8, 0.5, 0.1\} \mu B(x) = \{0.1, 0.3, 0.6, 0.3, 0.2\}.$$

The value of μ _____ will be $(A \cap B)$.

(c) Let us consider the fuzzy set M on the set $U = \{a, b, c, d, e, f, g\}$ described as

$$M = 0.3175/a + 0.1524/c + 1.234/d + 0.3275/e + 0.7234/f + 0.6298/g;$$

Find out support (M) and core(M).

(d) Can fuzzy membership be True and False simultaneously?

(e) Define convex and normal fuzzy sets with the help of an example.

(f) How many learnable parameters are there for a 3-4-3-3 neural network?

(g) Assume, you want to cluster 7 observations into 3 clusters using the K-Means clustering Algorithm. After first iteration, the clusters C1, C2, C3 have the following observations :

C1 : {(2,2), (4,4), (6,6)}; C2 : {(0,4), (4,0)}; C3 : {(5,5), (9,9)}.

What will be the cluster centroids if you want to proceed with the second iteration?

(h) State modus ponen with the help of an example.

2. Answer ***any five*** questions : 4×5

(a) State the different types of intelligence with the help of examples. State the differences between Depth-Limited Search Algorithm and Bidirectional Search Algorithm.

(b) Consider the following problem. A Water Jug Problem: You are given two jugs, a 4-gallon one and a 3-gallon one, a pump that has unlimited water that you can use to fill the jug, and the ground on which water may be poured. Neither jug has any measuring markings on it. You have to get

exactly 2 gallons of water in the 4-gallon jug. Explain the rule set, to solve this problem.

(c) Explain the organization of the Expert System with the help of a block diagram.

(d) Define pareto-optimal front. State NSGA-II algorithm with Pareto-ranking.

(e) The fuzzy if-then-else rule under consideration is R : if 'distance is long' then 'drive at high speed' else 'drive at moderate speed'. The relevant sets are Distance ={100, 500, 1000, 5000} is the universe of the fuzzy set long-distance, speed = {30, 50, 70, 90, 120} is the universe of the fuzzy sets.

long-distance = 0.1/100 + 0.3/500 + 0.7/1000 + 1.0/5000

high-speed = 0.1/30 + 0.3/50 + 0.5/70 + 0.7/90 + 0.9/120

moderate-speed = 0.3/30 + 0.8/50 + 0.6/70 + 0.4/90 + 0.1/120

Compute the relation matrix of R using Zadeh's interpretation.

(f) The values of y and their corresponding values of y are shown in the table below :

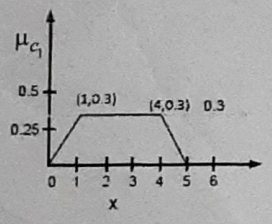
X	0	1	2	3	4
Y	2	3	5	4	6

Find the least square regression line $y = ax + b$ and plot it.

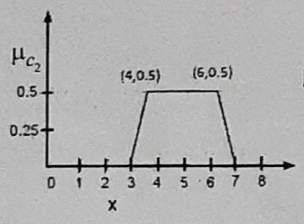
Estimate the value of y when $x = 10$.

(g) State MADALINE MR-I algorithm for 4-2-1 topology.

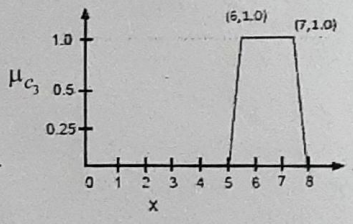
3. There are three fuzzy sets A1, A2, A3 in the following figures. Find out the defuzzified value of the aggregated fuzzy set (A1, A2, A3) using the Centre of Gravity method. 10



A1



A2



A3

4. Consider the following set of axioms :

(a) Marcus was a man.

(b) Marcus was a Roman.

(c) All men are people.

(d) Caesar was a ruler.

(e) All Romans were either loyal to Caesar or hated him or both.

(f) Everyone is loyal to someone.

(g) People only try to assassinate rulers they are not loyal to.

(h) Marcus tried to assassinate Caesar.

Using resolution answer the query "Who hated Caesar?" 10

5. (a) Refer to Table 1, draw the decision tree using the CART algorithm :

Table 1

Day	Outlook	Temperature	Humidity	Wind	Decision: (Golf Play possible)
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cool	Normal	Weak	Yes
6	Rain	Cool	Normal	Strong	No
7	Overcast	Cool	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cool	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No

(b) Find out the class label of the following sample (X) (refer to Table 1) using a naïve Bayesian classifier :

X = {Outlook = Rain, Temperature = Hot, Humidity = High, Wind = Weak}. 7+3

6. (a) Compute A (+) B; where A = {(2, 1), (3, 0.5)} and B = {(3, 1), (4, 0.5)} are fuzzy sets.

(b) Given Table 2, regarding the information system presented in Table-2, let W = {y| Can Walk (y) = Yes} = {2, 3, 4, 5, 8}; and B = {Age}; Prove that W is Rough Set. 6+4

Table 2

#	Age (in months)	Can Walk
1	12	No
2	14	Yes
3	14	Yes
4	13	Yes
5	12	Yes
6	10	No
7	10	No
8	13	Yes

7. (a) Refer to Figure 1, find the most cost-effective path to reach from start state A to final state J using A* Algorithm.

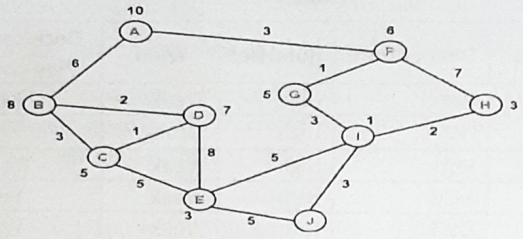


Figure 1

(b) Make a comparative study between A* and AO* algorithm. 7+3

8. Compute set of weight values after 1st iteration of the multilayer feed-forward network using back-propagation learning. Consider the model (3-2-2) as a multilayer feed-forward neural network with the following initialization (Table 3) : 10

Table 3

X_1	1	Input
X_2	0	Input
X_3	1	Input
W_{14}	0.2	Weight
W_{15}	–0.3	Weight
W_{24}	0.4	Weight
W_{25}	0.1	Weight
W_{34}	–0.5	Weight
W_{35}	0.2	Weight
W_{46}	–0.3	Weight
W_{56}	–0.2	Weight
W_{47}	0.3	Weight
W_{57}	0.2	Weight
θ_4	–0.4	Bias
θ_5	0.2	Bias
θ_6	0.1	Bias
θ_7	–0.2	Bias
H	0.9	Leaning rate
Class label	1	At node 6
	0	At node 7