

2022

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 no. 1 and 2 and *any four* from the rest.

2×5

1. Answer *any five* questions :

(a) Prove that height (F) = 1 where F is normal fuzzy set.

(b) If A and B are two fuzzy sets with membership functions $\mu_A(x) = \{0.2, 0.5, 0.6, 0.1, 0.9\}$
 $\mu_B(x) = \{0.1, 0.5, 0.2, 0.7, 0.8\}$. What will be the value of $\mu(A \cap B)$?(c) Let us consider the fuzzy set M on the set $U = \{a, b, c, d, e, f, g\}$ described as $M = 0.3175/a + 0.1524/c + 0.1234/d + 0.3275/e + 0.7234/f + 0.6298/g$. Find out support (M), core (M).

(d) Consider two fuzzy sets :

 $P = \text{Beautiful flowers} = 0.3/\text{jasmine} + 0.9/\text{rose} + 1.0/\text{lotus} + 0.7/\text{daffodil}$ $Q = \text{Fragrant flowers} = 1.0/\text{jasmine} + 1.0/\text{rose} + 0.5/\text{lotus} + 0.2/\text{daffodil}$ Compute fuzzy sets R, where $R = \text{XOR}(P, Q)$.

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

(f) Let, age 0 to 35 young aged; 20 to 60 middle aged; and 45 to 80 old aged persons. Draw the membership curve and define the membership functions of 'Age'.

(g) Consider a dataset with five objects $a = \{1,2\}$, $b = \{2,5\}$, $c = \{7,4\}$, $d = \{9,2\}$, $e = \{6,6\}$; There are two clusters $C1 : \{a,b\}$ and $C2 : \{c,d,e\}$; Compute the distances between $C1$ and $C2$ using single linkage, complete linkage.

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

(i) Prove that the statement $((\sim P + Q) \equiv (P \rightarrow Q))$ is invalid.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) State k-means algorithm with proper mathematical notations. How one can set the value of k?

(c) Realize Bipolar OR (2 inputs) using perceptron learning. Assume that weights are initialized to 0, Bias input = 1 and learning rate is 0.5.

(d) State the difference between fuzzyfication and defuzzyfication with the help of an example.

Please Turn Over

- ✓(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 high-speed as well as moderate speed;

$$\text{long-distance} = 0.1/100 + 0.3/500 + 0.7/1000 + 1.0/5000$$

$$\text{high-speed} = 0.1/30 + 0.3/50 + 0.5/70 + 0.7/90 + 0.9/120$$

$$\text{moderate-speed} = 0.3/30 + 0.8/50 + 0.6/70 + 0.4/90 + 0.1/120$$

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

- (f) Prove that

$$\text{Err}_j = \text{O}_j(1 - \text{O}_j)(\text{T}_j - \text{O}_j); \text{ where,}$$

T_j = True output of the neural network (jth neuron)

O_j = Obtained Output of the neural network (jth neuron)

Err_j = Error at jth Neuron

The network is trained through backpropagation learning

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

3. Consider the following set of axioms

John likes all kind of food.

Apple and vegetable are food.

Anything anyone eats and not killed is food.

Anil eats peanuts and still alive.

John eats everything that Anil eats.

Using resolution prove that 'John likes peanuts'.

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- ✗ Let there are two functions $\text{Cost}(x) = \{9, 9, 8, 6, 4, 3, 4, 3, 2, 3\}$ and $\text{Time}(x) = \{5, 3, 2, 2, 1, 2, 3, 3, 5, 6\}$ for the values of $x = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$ respectively. Both the functions need to be minimized. Compute pareto optimal front and rank them.

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- ✓5. Consider the following dataset and find frequent item-sets and generate association rules for them (TID is the transaction id and 11, 12...are items).

| TID | Items |
|-----|----------------|
| T1 | 11, 12, 15 |
| T2 | 12, 14 |
| T3 | 12, 13 |
| T4 | 11, 12, 14 |
| T5 | 11, 13 |
| T6 | 12, 13 |
| T7 | 11, 13 |
| T8 | 11, 12, 13, 15 |
| T9 | 11, 12, 13 |

Find out the significant rule set if confidence threshold is 60% and support count is 2.

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(3)

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

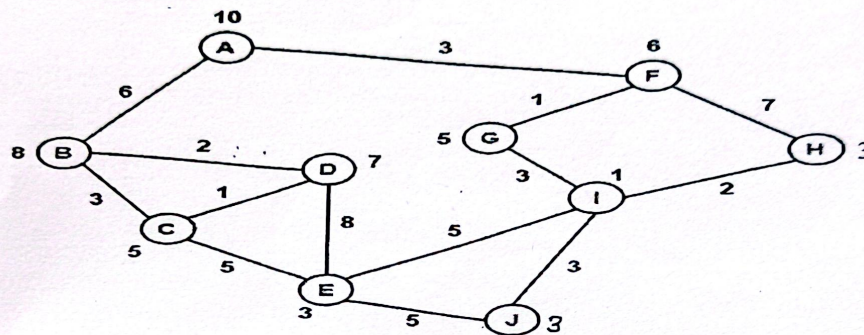


Figure 1

- (b) Make a comparative study between A* and AO* algorithm. 7+3
7. (a) Consider the following problem: A Water Jug Problem: You are given two jugs, a 4 gallon one and a 3 gallon one, a pump which has unlimited water which you can use to fill the jug, and the ground on which water may be poured. Neither jug has any measuring markings on it. How can you get exactly 2 gallons of water in the 4 gallon jug? Explain with the rule set. 4+6
- (b) Explain Expert System development environment with the help of a block diagram.
8. Compute set of weight values and bias values after 1st iteration of multilayer feed forward network using the back propagation learning. Consider the model (4-3-2-2) as a multilayer feed forward neural network with following initialization.

Training Pattern = {1,0,1,1} with class label {1,1}; all weight and bias values are initialized to 0; learning rate 0.5.

$$\begin{array}{r} 3 \quad 4 \quad 3 \\ \hline 0, 4 \\ 3, 1 \\ 0, 1 \\ 3, 1 \end{array}$$

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