Paper Name: Artificial Intelligence
MSc CS 3rd Semester 2nd UT FM=30

## PART-A

Q1. Answer any five questions 5 X 2 =10

i) If A and B are two fuzzy sets with membership functions μA(x) = {0.2, 0.5, 0.6, 0.1, 0.9} μB(x)= {0.1, 0.5, 0.2, 0.7, 0.8} Then the value of μA ∩B will be

ii) Consider two fuzzy sets:
P=Beautiful flowers=0.3/jasmine + 0.9/rose + 1.0/lotus + 0.7/daffodil
Q=Fragrant flowers= 1.0/jasmine + 1.0/rose + 0.5/lotus + 0.2/daffodil
Compute fuzzy sets R
Where R=XOR (P,Q)

iii) Consider a dataset with six objects a={1,2}, b={2,5}, c={7,4}, d={9,2}, e={6,6},f={9,10}, There are three clusters C1: {a,b}, C2: {c, d}, C3: {e,f} ; Compute highest distance among the cluster centers using single linkage

iv) State modus tollen with the help of an example

v) Prove that the statement ((P + Q) ≡ (~P→Q)) is invalid

vi) How many learnable parameters in 4-3-6-4-3 ANN?

## PART-B

**Answer any four questions** 4 X 5=20

1. State the different types of intelligence with the help of examples. State the differences between Depth-Limited Search Algorithm
2. Consider the following set of axioms

   a) If it rains, Joe brings his umbrella
   b) If Joe has an umbrella, he doesn't get wet
   c) If it doesn't rain, Joe doesn't get wet
   d) It is raining

   prove that Joes doesn't get wet

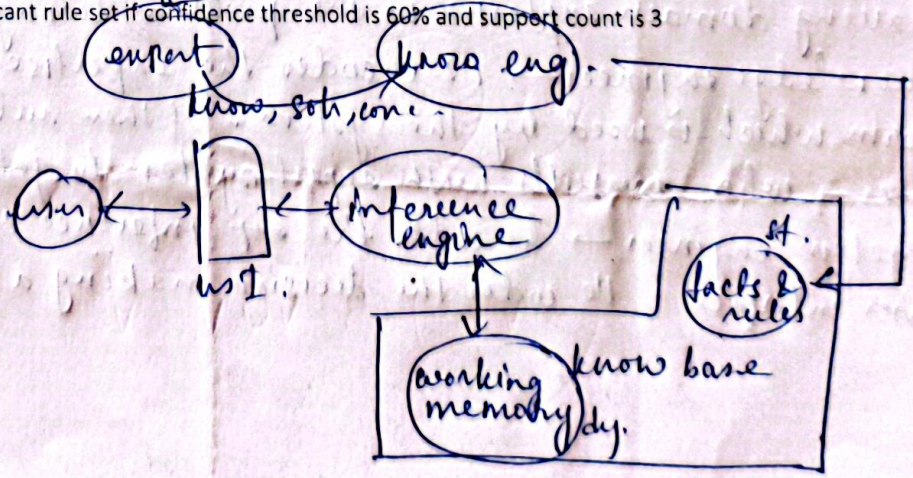
3. State fuzzy c-means algorithm with proper mathematical notations. How one can set the value of k of k-means algorithm?
4. Let Table 1 is an information table where "Flu" is a decision attribute. Find out the REDUCT/s and CORE.

Table-1

| Patient_id | Headache | Temp | Flu |
|---|---|---|---|
| U1 | Yes | Normal | No |
| U2 | Yes | High | Yes |
| U3 | Yes | Very High | Yes |
| U4 | No | Normal | No |
| U5 | No | High | No |
| U6 | No | Very High | Yes |

5. Compute A (-) B; where A={(2,1), (3,0.5)} and B={(3,0.4), (4,0.9)} are fuzzy sets.
6. Consider the following dataset and we will find frequent item sets and generate association rules for them (Here TID is the transaction and I1,I2...are items). Find out the significant rule set if confidence threshold is 60% and support count is 3

| TID | items |
|---|---|
| T1 | I1, I2 , I5 |
| T2 | I2,I4 |
| T3 | I2,I3 |
| T4 | I1,I2,I4 |
| T5 | I1,I3 |
| T6 | I2,I3 |
| T7 | I1,I3 |
| T8 | I1,I2,I3,I5 |
| T9 | I1,I2,I3 |



M.Sc. 3rd Sem (Mid-Sem) Exam 2022

Paper Name: Artificial Intelligence (CSME304)

Full Marks=30 Time=1 Hour

Q1. Answer any **five** questions 5 X 2 =10

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

ii) Let us consider the fuzzy set M on the set U={a,b,c,d,e} described as

M=0.375/a +0.5/c + 1.0/d + 0.875/e;

Find out support(M), core(M)?

iii) Consider two fuzzy sets:

P=Beautiful flowers=0.3/jasmine + 0.9/rose + 1.0/lotus + 0.7/daffodil

Q=Fragrant flowers= 1.0/jasmine + 1.0/rose + 0.5/lotus + 0.2/daffodil

Compute fuzzy sets R

Where R=OR (P,Q)

iv) Define convex fuzzy set with the help of an example

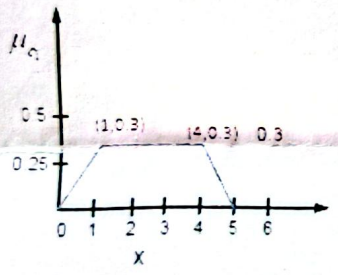
v) Let, age 0 to 35 young aged; 20 to 60 middle aged; and 45 to 80 old aged persons. Draw the membership curve and define the membership functions of "Age"

vi) Consider a dataset with five objects a=1, b=2, c=4, d=5, e=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 and avg, linkage

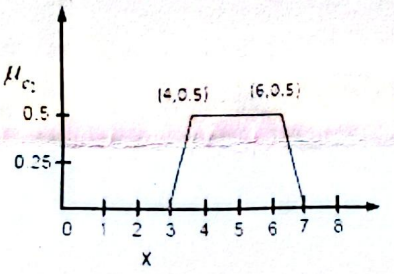
Q2. Answer any **five** questions

a) Define the agents in artificial intelligence. State the differences between Uniform-cost Search Algorithm and Iterative deepening depth-first Search (1+3)=4

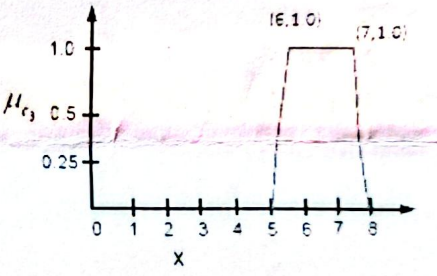
b) There are three fuzzy sets A1, A2, A3 in the following figure. Find out the defuzzified value of the aggregated fuzzy set (A1,A2,A3) using centre of gravity method.




A1




A2




A3

c) Let A = {mimi, bob, kitty, jina} be a set of four children and B={tintin, asterix, phantom, mickey} be a set of four comic characters; and C={funny,cute,dreamy} be a set of three nature attributes. The fuzzy relations R=x likes y is defined on A X B and S=x IS y is defined on B X C as shown in Table 1A and Table 1B. Find out the fuzzy relation T= x IS y defined on A X C.

**Table: 1A:-- R= x likes y on AXB**

| | Tintin | asterix | phantom | mickey |
|---|---|---|---|---|
| mimi | 0.8 | 0.5 | 0.7 | 0.8 |
| bob | 0.4 | 0.9 | 0.3 | 0.3 |
| kitty | 0.6 | 0.7 | 0.4 | 0.9 |
| jina | 0.3 | 0.8 | 0.2 | 0.5 |

**Table: 1B:-- S= x IS y on BXC**

| | funny | cute | dreamy |
|---|---|---|---|
| tintin | 0.6 | 0.7 | 0.3 |
| asterix | 0.8 | 0.4 | 0.2 |
| phantom | 0.1 | 0.2 | 0.1 |
| mickey | 0.9 | 0.8 | 0.3 |

P.T.O

# 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.

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

(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 + 1234/d + 0.3275/e + 0.7234/f + 0.6298/g. Find out support (M), core (M).

(d) Consider two fuzzy sets :

*P = Beautiful flowers = 0.3/jasmine + 0.9/rose + 1.0/lotus + 0.7/daffodil*

*Q = Fragrant flowers = 1.0/jasmine + 1.0/rose + 0.5/lotus + 0.2/daffodil*

Compute fuzzy sets R, where R = 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 ponen 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.

(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;
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) Prove that
$Err_j = Oj(1 - Oj)(Tj - Oj)$; where,
Tj = True output of the neural network (jth neuron)
Oj = 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 'Jhon likes peanuts'. 10

4. Let there are two functions Cost(x) = {9,9,8,6,4,3,4,3,2,3} and 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. 10

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).

| T1D | Items |
|---|---|
| Tl | 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. 10

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

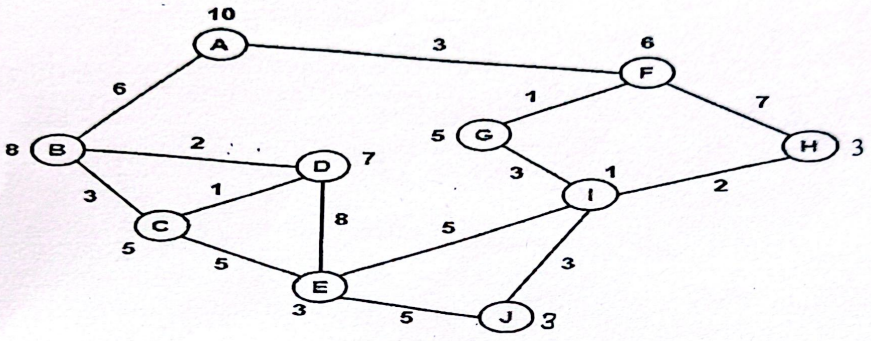



Figure 1

(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.

(b) Explain Expert System development environment with the help of a block diagram. 4+6

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. 10

3 4 3

3

0, 4

3, 1

0, 1

3, 1