Mode of Examination: Online

M.Sc. (Computer Science) Semester – III Examination, 2020

2020

Subject: Computer Science

Paper Code & Name: CSM301 (Introduction to Soft Computing)

Full Marks: 70

Date: 10.03.2021 **Time and Duration: 12 noon to 3 pm**

Please note the following instructions carefully:

Promise not to commit any academic dishonesty.
Marks will be deducted if the same/similar answers are found in different answer-scripts.
Candidates are required to answer in their own words as far as applicable.
Each page of the answer scripts should have your University Roll # on the right-top corner.

The name of the scanned copy of the answer script will be of the following format:
(Example: CSM-301-ISC-My Roll Number.pdf)
The subject of the mail should be the file name only.

The name of the scanned answer-script is to be sent to cucse2020@gmail.com
The report should have the top page (Page #1) as an index page; mention page number(s) against the answer of each question number.
The answer-script may not be accepted after the scheduled time.

Answer Question No. **1, 2**, and **any Four** from the rest.

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

a) If F is a normal fuzzy set, then prove that height (F) =1

b) 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), and |M|.

c) Prove that the statement ((~P ∨ Q) ≡ (P→Q)) is valid

d) A 4-input neuron has weights 1, 2, 3, and 4. The transfer function is linear, with the constant of proportionality being equal to 2. The inputs are 4, 10, 5, and 20, respectively. What will be the output?

e) Consider a fuzzy set A defined on the interval X = [0, 10] of integers by the membership function $\mu A(x) = x / (x+2)$
Then find out the α cut corresponding to α = 0.5

f) For interval A = [3, 5] and B = [−2, 7] find A ⋄ B, (where ⋄ is the multiplication for intervals.
g) Design an ANN to simulate a three input AND gate.

2. Answer any **five** questions 5 X 4 =20

a) Consider the following definition:
"Persons of age 0 to 35, 20 to 60, 45 to 80 are known as young, middle-aged, old respectively." Now construct the membership functions for linguistic variables young, middle-aged and old.

b) 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=disjunctive sum(P, Q)

(b) State the difference between Supervised and Unsupervised Learning. State the influence of the learning rate.

c) Define the truth value of a fuzzy rule. Explain how the following composite fuzzy rule can be stored in the fuzzy rule base:
IF x1 is NOT A1 AND x2 is A2 OR x3 is A3, THEN y is B

d) State the working principle of k-SOM.

d) Find the membership function for the triangular fuzzy number T = (−6, −1, 11). Also, find the 0.4 cut of this fuzzy number.

f) Consider the following axioms--

i. Every child loves Santa
ii. Everyone who loves Santa, loves any reindeer
iii. Rudolph is a reindeer and Rudolph has a red nose
iv. Anything which has a red nose is weird or is a clown
v. No reindeer is a clown
vi. Scrooge does not love anything which is weird

Using resolution proves that "Scrooge is not a child".

g) State Fuzzy c-means algorithm with proper mathematical notations

3. 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

4. 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 A and Table B. Find out the fuzzy relation T= x likes y defined on A X C.

Table: A:-- 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: B:-- S= x IS y on BXC

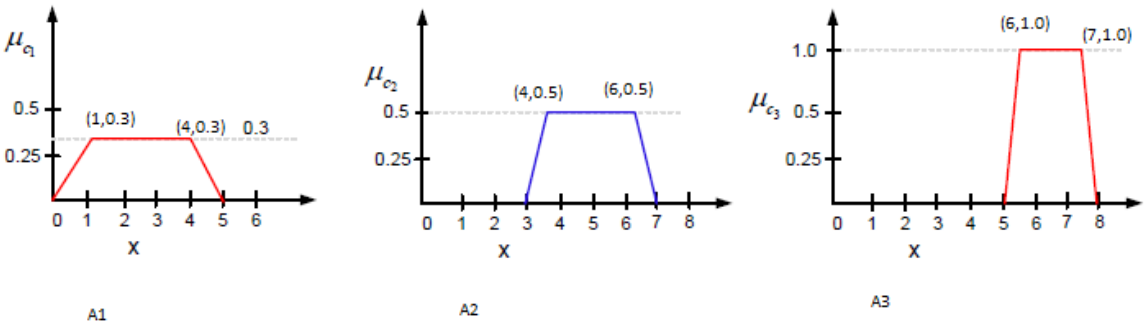
	funny	cute	dreamy
tintin	0.6	0.7	0.3
asterix	0.8	0.4	0.2
phantom	0.1	0.2	0.1
mickey	0.9	0.8	0.3

(4+6)=10

5. a) Realize a two-input bipolar AND gate (including bias input =1) using perceptron learning. Assume that weights are initialized to 0 and the learning rate is 0.5.

b) Explain Kosko's Bidirectional Association Memory with an example (5+5)

6. a) There are three fuzzy sets A1, A2, A3 in the following figure. Find out the de-fuzzified value of the aggregated fuzzy set (A1, A2, A3) using the centre of gravity method.



b) State MADALINE MR-I learning based on 3-2-1 topology of a feed forward neural network.

6+4=10

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

Table-1

X1	1	input
X2	0	input
X3	1	Input
W14	0.2	weight
W15	-0.3	weight
W24	0.4	weight
W25	0.1	weight
W34	-0.5	weight
W35	0.2	weight
W46	-0.3	weight
W56	-0.2	weight
W47	0.3	Weight
W57	0.2	Weight
Θ4	-0.4	Bias
Θ5	0.2	Bias
Θ6	0.1	Bias
Θ7	-0.2	Bias
H	0.9	Leaning rate
Class label	1	At node 6
	0	At node 7

8. a) State stability and plasticity dilemma.
   b) Draw and explain the simplified architecture of Adaptive Resonance Theory (ART1)
   c) Write the learning algorithm of Adaptive Resonance Theory (ART1)

   2+(1+3) +4=10

9. Define Self-Organization Map. Design a SOM to cluster the patterns s1 = {0, 1, 0, 0}, s2 = {0, 0, 1, 0}, s3 = {1, 1, 0, 0} and s4 = {0, 0, 1, 1} into two clusters. Apply the resultant SOM to the pattern {0, 1, 1, 1} to determine the cluster to which it belongs. 2+6+2=10

10. State all four axioms for t−norm and check the validity for intersection operator (∩). Mention the importance of fuzzy extension principle. Define intersection and set difference of two fuzzy sets. Find the intersection and set difference for the following two fuzzy sets:
    A={0.8/2 + 0.7/3 + 0.6/4 + 0.2/5 + 0.1/6 } B = {0.5/2 + 0.4/3 + 0.4/4 + 0.6/5 + 0.3/6 }

    2+2+2+2+2=10