UNIVERSITY OF CALCUTTA
Mode of Examination: Online
MSc. Semester –III Examination, 2021

2020

Subject: Computer Science

Paper Code & Name: CSM 301 & Introduction to Soft Computing

Full Marks: 70

Date: 17.01.2022 **Time and Duration: 12:00 pm to 3:00 pm (3 hours)**

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: CSM301-ISC-My Roll Number.pdf)
The subject of the mail should be the file name only.

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.
Extra 30 minutes is allowed for uploading the answer script.
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 A and B are two fuzzy sets with membership functions:
μa(χ) ={0.2,0.5.,0.6,0.1,0.9}
μb (χ)= {0.1,0.5,0.2,0.7,0.8}
then what will be the value of μa ∩ μb

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 height (F) =1 where F is normal fuzzy set

d) The height h(A) of a fuzzy set A is defined as h(A) =sup A(x) where x belongs to A.
Based on which criteria fuzzy set A is called normal?

e) State the difference between fuzziness and probability with the help of an example

f) Let R and S be two fuzzy relations defined as follows. Then, compute the resulting relation, T, which relates elements of universe of X to elements of universe of Z using max-product composition. Here, X={x1,x2}; Y={y1,y2}; Z={z1,z2,z3}

$$R(X,Y)=\begin{matrix}0.7 & 0.5\\ 0.8 & 0.4\end{matrix} \qquad S(Y,Z)=\begin{matrix}0.9 & 0.6 & 0.2\\ 0.1 & 0.7 & 0.5\end{matrix}$$

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

a) 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

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

c) Assume there are two fuzzy sets A = {(2,1), (3, 0.5)} and B= {(3,1),(4,0.5)}; Compute and draw fuzzy set A(+)B

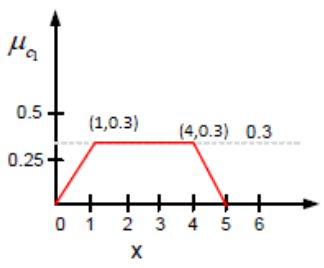
d) Prove that
$Err_j = O_j(1 - O_j)(T_j - O_j)$;
Where T_j= True output of the neural network (jth neuron)
O_j= Obtained Output of the neural network (jth neuron)
Err_j= Error at jth Neuron
The network is trained through backpropagation learning

e) State the working principle of K-SOM. What is the stability and plasticity dilemma in ART.

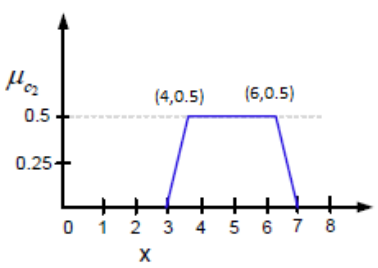
f) State the comparison of various Hybrid systems (sequential, auxiliary and embedded hybrid systems)

3. Realize Bipolar AND (2 inputs) through perceptron learning. Use bipolar step function as activation function. Assume that learning rate is 1 and all the weights are initialized to zero.

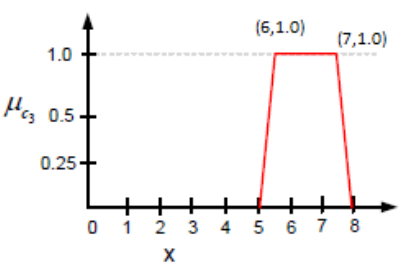
4. i) There are three fuzzy sets A1, A2, A3 in the following figure. Find out the defuzzified value of the aggregated fuzzy set (A1,A2,A3) using centre of gravity method.



A1



A2



A3

ii) Consider the following set of axioms

a. Every child loves Santa
b. Everyone who loves Santa, loves any reindeer
c. Rudolph is a reindeer and Rudolph has a red nose
d. Anything which has a red nose is weird or is a clown
e. No reindeer is a clown
f. Scrooge does not love anything which is weird

Using resolution prove that "Scrooge is not a child". (4+6)=10

5. i) State crossover process of genetic algorithm with the help of examples
ii) What do you mean by multi-objective optimization? Explain with an example
iii)Define pareto optimal front. Explain Goldberg's pareto ranking with the help of an example.

2+2+(1+5)=10

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

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

7. i) State the difference between Hetero-associative and Auto-associative memory.
   ii) Suppose there 3 pattern pairs given by
   A1=100001 B1=11000
   A2=011000 B2=10100
   A3=001011 B3=01110
   Retrieve pattern B3 after knowing the associated pattern A3=001011 using Kosko's Bi-directional associative memory
   iii) How weights of a Neural Network will be determined using Genetic algorithm? Explain it with the help of an example. 1+4+5=10