2019

COMPUTER SCIENCE

Paper : CSM-301

(Introduction to Soft Computing)

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, 2** and ***any four*** from the rest.

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

(a) State the difference between fuzziness and probability with the help of an example.

(b) What do you mean by perceptron?

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

(d) Explain why mutation operator for GA is used to exit from stuck at local optima problem.

(e) State the basic objective of a fuzzy cruise controller.

(f) Let us consider the fuzzy set M on the 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|?

(g) The height h(A) of a fuzzy set A is defined as h(A) = sup A(x) where x belongs to A. What is the condition for a fuzzy set A to be normal?

(h) 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)

(i) Write the formula for the interpretation of fuzzy rule using Mamdabi's interpretation.

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

(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 graph and membership functions for linguistic variables young, middle-aged and old. 4

(b) 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;

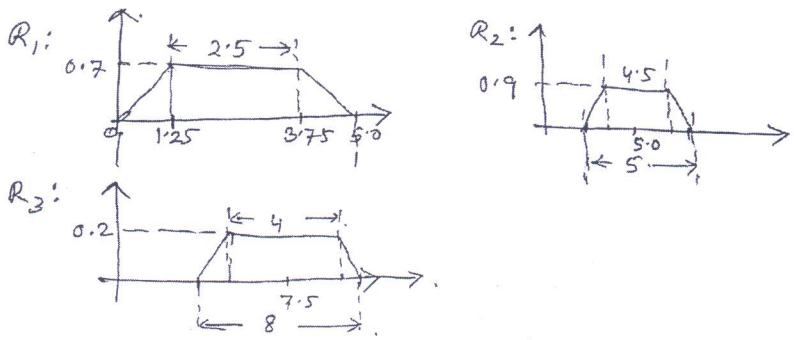
long-distance = 0.1/100 + 0.3/500 + 0.7/1000 + 1.0/5000

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

(c) Explain the use of defuzzification in the Fuzzy Inference System. Use CoS method for the following output fuzzy rules to get the crisp output. 2+2



(d) 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 1 and Table 2. Find out the fuzzy relation T = x IS y defined on A X C. 4

Table : 1 :- 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 : 2 :- 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

(e) What do you mean by learning rule for ANN? State the working procedure of 'Delta learning rule'. 2+2

(f) State Modus Ponens, Modus Tollens, Universal Specialization and Chain Rule with the help of examples. 4

(g) (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. 2+2

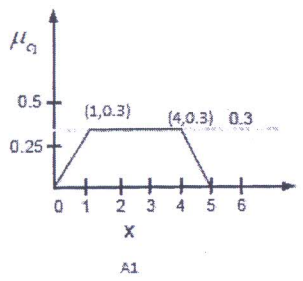
(h) Find the max-product composition of following given two fuzzy relations. Also find the total projection of this resultant relation. 2+2

$$R_1 = \begin{bmatrix} 0.1 & 0.2 & 0.0 & 1.0 & 0.7 \\ 0.3 & 0.5 & 0.0 & 0.2 & 1.0 \\ 0.8 & 0.0 & 1.0 & 0.4 & 0.3 \end{bmatrix}$$

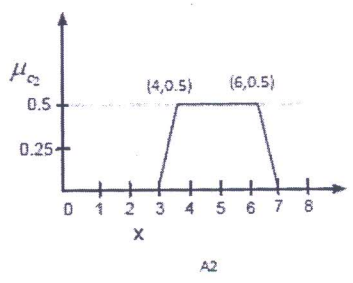
$$R_2 = \begin{bmatrix} 0.9 & 0.0 & 0.3 & 0.4 \\ 0.2 & 1.0 & 0.8 & 0.0 \\ 0.8 & 0.0 & 0.7 & 1.0 \\ 0.4 & 0.2 & 0.3 & 0.0 \\ 0.0 & 1.0 & 0.0 & 0.8 \end{bmatrix}$$

3. Define linear separability. Show that XDR-Gate is not Linearly separable. State the features of McCulloch-Pitts Neural net. Implement OR-Gate using this net. 2+3+2+3

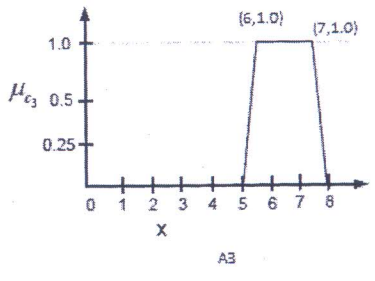
4. (a) There are three fuzzy sets A1, A2, A3 in the following figures. Find out the defuzzified value of the aggregated fuzzy set (A1, A2, A3) using centre of gravity method.



A1



A2



A3

(b) Compute error values after 1st iteration of multilayer feed forward network (3-2-1) using the back propagation leaning. Consider **Table 1** with following initialization :

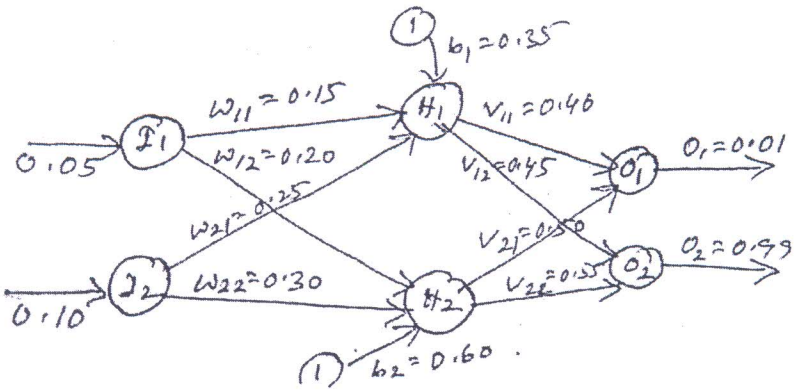
Table-1

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
Θ4	–0.4	Bias
Θ5	0.2	Bias
Θ6	0.1	Bias
1	0.9	Leaning rate
Class label	1	

(c) (i) Define L-R type fuzzy numbers with various operations.

(ii) Draw the l-m-n fuzzy back-propagation architecture and state the learning and inference algorithm of the network. 3+2+(3+2)

5. Draw and explain the operations of back propagation neural network. Established a matrix based mathematical relation formula to calculate the output of such network. Demonstrate the working of following back-propagation neural network (Show weight updation for only one iteration). 3+2+5



6. Define λ-cut. Apply λ-cut for the following fuzzy set operations :

$$A = \left\{ \frac{0.2}{x_1} + \frac{0.3}{x_2} + \frac{0.4}{x_3} + \frac{0.7}{x_4} + \frac{0.1}{x_5} \right\}$$

$$B = \left\{ \frac{0.4}{x_1} + \frac{0.5}{x_2} + \frac{0.6}{x_3} + \frac{0.8}{x_4} + \frac{0.9}{x_5} \right\}$$

(i) $(\bar{A})_{\lambda=0.7}$

(ii) $(A \cap B)_{\lambda=0.6}$

(iii) $(\bar{A} \cup B)_{\lambda=0.7}$

State the importance of fuzzy extension principle. 2+(2×3)+2

7. Illustrate how GA can be used to solve the following optimization problem :

max $f(x_1 x_2) = f(x_1 - 5)^2 + (x_1 - 6)^2 : 1 \le x_1 \le 8^2 \le x_2 \le 5.$

x_1, x_2

Assume the followings :

(a) for selection roulette wheel is used

(b) Single point cross over

(c) Real encoding GA

(d) Cross over and mulation probabilities respectively 0.3^{ad}, 0.2.

(e) Population size = 3.

Show 2-iterations.

Mention how GA is different from traditional algorithm. 7+3

8. (a) State stability and plasticity dilemma.

(b) Draw and illustrate the simplified architecture of Adaptive Resonance Theory (ART1)

(c) State the learning algorithm of Adaptive Resonance Theory (ART1) 2+(1+3)+4

9. (a) State the difference between Hetero-associative and Auto-associative memory.

(b) Suppose here 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

(c) State the K-SOM architecture and learning algorithm. 2+4+4