National Institute of Technology, Hamirpur (HP)

B. Tech. End-semester Examination

Branch :Open Elective (Offered by DoEE) Semester:5th

Title of the Course: Neural Networks and Fuzzy Logic Systems

Course Code: EE-370

Time: 2 Hours **Maximum Marks: 50**

Q.1 (a) Draw architecture of self-organizing feature map (SOFM). List the procedural steps being executed while training and testing the network. (5)

(b) Consider Fig. 1 given below.

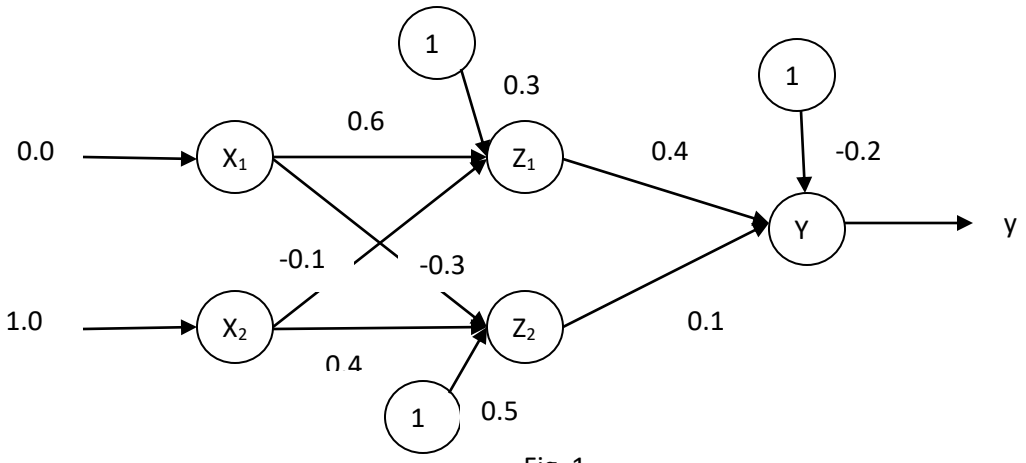


Fig. 1

Using error back-propagation learning technique, find new connection-weights and biases when nodes Y, Z_1 and Z_2 are equipped with bipolar sigmoidal function. Take learning rate, η as 0.25. Target output y_t is 1.0. (5)

Q.2(a) Through a schematic diagram, explain how information is processed in radial function network(RBFN). Explain methods used to estimate class centers, RBF spread and weight matrix. (5)

(b) It is required to store (below listed) four pairs of patterns in the Bidirectional Associative Memory (BAM).

$X_1 = [1, 1, 1, 1, 1, 1]^T$, $Y_1 = [1, 1, 1]^T$; $X_2 = [-1, -1, -1, -1, -1, -1]^T$, $Y_2 = [-1, -1, -1]^T$; $X_3 = [1, 1, -1, -1, 1, 1]^T$; $Y_3 = [1, -1, 1]^T$; and $X_4 = [-1, -1, 1, 1, -1, -1]^T$, $Y_4 = [-1, 1, -1]^T$.

Design BAM for storing above pairs and test the network by applying probe vector, $X = [-1, 1, 1, 1, 1, 1]^T$ and prove that network can be used as an error corrector. (5)

Q.3 (a) Derive a metric using Euclidian distance of order *p* to measure the fuzziness of a fuzzy set for finite and infinite universe of discourse, X. (5)

(b) Consider following fuzzy sets defined over common universe of discourse, $X = \{x_1, x_2, x_3, x_4, x_5\}$.

$A = \{1/x_1, 0.5/x_2, 0.3/x_3, 0.8/x_4, 0.9/x_5\}$; $B = \{1/x_1, 0.5/x_2, 0.3/x_3, 0.8/x_4, 0.9/x_5\}$. Find

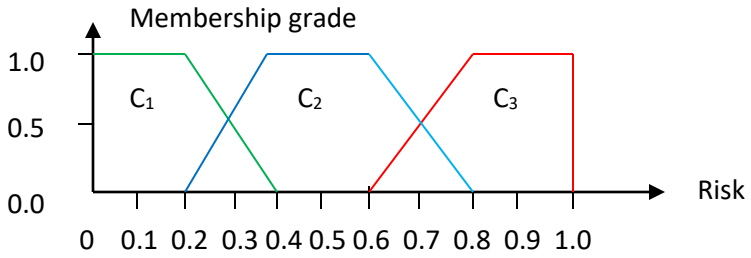
(i) CORE(A) (ii) FUZ(B) (iii) DIL(B) (iv) A $\oplus$ B (v) Prove that $\overline{A \cup B} = \overline{A} \cap \overline{B}$. (5)

Q.4(a) Give step-by-step procedure for implementing PI-like FLC starting from its control law and associated rule base. (5)

(b) Design a fuzzy system to calculate the extent of risk involved in management of the project whose details are as under:

Type	Fuzzy Variables	Fuzzy values	Rule base
Inputs	1.Project_funding (x)	Inadequate (A_1) Marginal (A_2) Adequate (A_3)	Rule 1: IF x is A_3 (0.0) OR y is B_1 (0.1) THEN z is C_1. Rule 2: IF x is A_2 (0.2) AND y is B_2 (0.7) THEN z is C_2. Rule 3: IF x is A_1 (0.5) THEN z is C_3.
	2. Project_staffing (y)	Small (B_1) Large (B_2)	
Output	1. Risk (z)	Low (C_1) Normal (C_2) High (C_3)	

For the given set of inputs their membership grades to respective fuzzy sets are given in brackets under Rule base. Calculate the extent of risk if fuzzy sets of output are positioned as under:



(5)

Q.5 How fuzzy system can be applied to classification problem? Highlight the scope of evolutionary computation (GA) in the process to optimize the partition of fuzzy space so as to have optimum rule base. (5+5 =10)

Q.6 (a) List and explain procedural steps for implementing Genetic Algorithm. (5)

(b) Through Schema theorem prove that weak solutions get eliminated and strong solutions swell in number as genetic search move from generation to next. (5)

Q.7 (a) With suitable example explain most commonly used methods for defuzzification. (5)

(b) With suitable block diagram explain Mamdani SISO fuzzy inference system. (5)

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