BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI

Neural Networks & Fuzzy Logic (BITS F312) [2nd Semester, 2018-2019]

Comprehensive Exam - Part B (open book)

Max. Time: 2 hrs. 15 min. Max. Marks: 75 Date: 10.05.2019

Q1. An RBFN used for function approximation y = f(x_1 ,x_2 ,x_3) has been trained with Center1= (0.2,0.7,0.1), Centre 2= (0.5,0.1,0.4), weight vector (w_1 , w_2 ,b) = (0.3,-0.7,0.1).

(a) Draw the network

(b) Calculate the output of RBFN (Gaussian activation function) for Input= (0.4,0.6,0.1)

(c) Suppose weight matrix is not given and target outputs are given. How many minimum numbers of inputs are needed to find (w_1, w_2, b)? [12]

Q2. Hundred 3-D data are to be clustered among three clusters A,B,C using Kohenon learning.

(a) Draw the network

(b) Find the winner node by calculating all relevant distances

(c) Find new weight matrix after first sample[1.0, 1.5, 1.6] is presented, learning rate is 0.6

(d) Comment upon the weight changes

W(0) = W_A : 0.2 0.7 0.3; W_B : 0.1 0.1 0.5 ; W_C : 0.9 0.9 0.9 [2+4+3+1=10]

Q3. 3-D data (X_t) at time instants X_0 to X_{50} is inputted to LSTM. X_0 = [0.1 0.2 0.3] and X_1= [0.1 0.3 0.4]. Hidden and cell state are of size 2. All weight matrices have their initial element values as 0.1.

Calculate outputs of LSTM at t=0 and t=1. Truncate calculations to three places after decimal. [14]

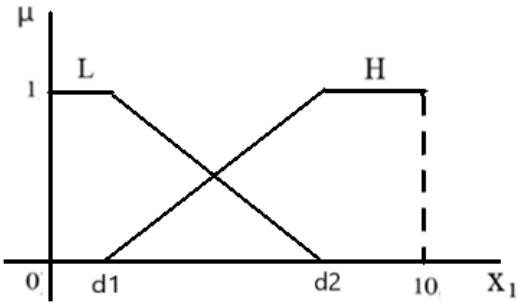
Q4. Pattern X= [1,1,1,-1] is to be stored in Binary Bipolar Hopfield network. Assume threshold for activation to be zero.

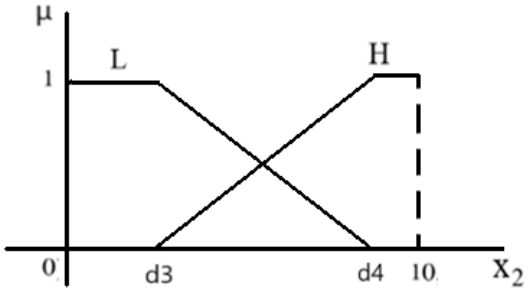
(a) Write the weight matrix to store pattern X

(b) Calculate energy of stable state X

(c) Calculate energy of state [1 1 1 1] and update the nodes in order of 3,2,4,1. [3+2+5=10]

Q5. The inputs of a two input, single output fuzzy model are described by the following membership functions (L≡Low, H≡High) where $d_1, d_3 \in [1,3]$ and $d_2, d_4 \in [7,9]$:





The output is given by a zero order Sugeno model. The output corresponding to the i^{th} rule is given by:

$$y^{(i)} = c_i \text{ , (i=1,2,3,4) where } c_i \in [5,10].$$

All the parameters d_i, c_i (i=1,2,3,4) are to be optimized using GA to match the following data:

S. No.	X_1	X_2	Y
1.	3.5	6.5	9.0

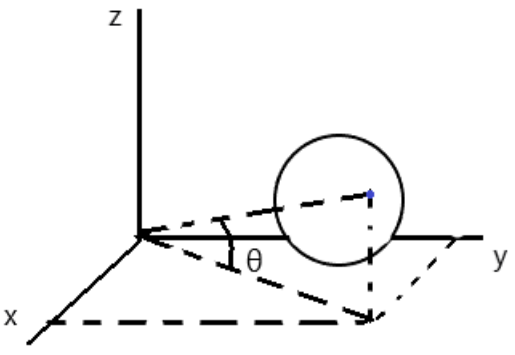
Assuming all the parameters to be represented by 4-bit binary strings, define a suitable objective function and calculate the fitness of the following member present in the population:

1011 1101 0101 0011 0001 0100 0111 1000

d1 . . . d4 c1 . . . c4

[20]

Q6. The standard PSO algorithm is used to find the point in the 3-D space which has the maximum elevation angle from the x-y plane (i.e. θ) among all the points contained within a sphere of unity radius centered at (5,5,5). The initial population of size two is randomly chosen as (4,4,6) and (5,5,5). If the initial velocities of the particles are zero and w=0.8, $c_1=c_2=2.0$, $r_1=0.6$, $r_2=0.4$, show one iteration to update the population.



[9]

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