BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
Neural Networks & Fuzzy Logic (BITS F312) [1st Semester, 2018-2019]
Mid-Semester Exam - Part B (open book)

Max Time- 1 hr 15 min | Max Marks - 60 | Date: 12.10.2018

Q1. A single input feedforward neural network is to be trained to learn the unit step response of first order system in time domain described by equation [$1-e^{-t/\tau}$] for different time constants from time t = 0 to 10 sec. There is one hidden layer having two nodes.

i) Draw the network architecture to train the network to learn unit step response for three time constants.

ii) Perform One forward and One backward pass for training the network at t=1sec for three time constants (τ = 0.5s, 1s, and 2s), and calculate change in weights.

[Learning rate is 0.2, weights between input and hidden layer is 0.4, between hidden and output layer is 0.2, no bias input. Activation function at the hidden layer is logsigmoid with slope of 2, and at the output layer is ReLu].

Truncate all values to 4 places after decimal. [20]

Q2. Hebb learning is used to Associate square represented in 4x4 matrix with square represented in 3x3 matrix. Pixels used to represent square is represented by 1 and pixels not used by zero.

i) Find the weight matrix for this Association.

ii) If 4x4 representation of square has two mixing pixels at second and third position in last row, show the output. Will it still represent correct association?

Assume hard threshold function [net > 0, f(net) =1, zero otherwise] [10]

Q3. Let the four patterns to be clustered in two clusters using Kohonen mapping are (0 0 1 1), (0 1 1 1), (1 0 0 0), (1 1 0 0). Weights from inputs to node 1 are 0.1, and to node 2 are 0.3. Calculate the weight matrix after presenting first two patterns. Learning rate is 0.6. Comment upon the intuitive understanding of resultant increase/decrease in weights.

Truncate all values to 3 places after decimal. [10]

P.T.O.

Q4. A thermal power plant has two power generating units. The per hour cost of power generation for the generating units are given by

$C_1 = 0.2\,P_1^2 + 8\,P_1 + 50$ and $C_2 = 0.1\,P_2^2 + 10\,P_2 + 40$

where C is in Rs. and P is in MW. What will be the optimal sharing of generation between the two units if the total power requirement is 500MW?

Neglect losses and assume that both the units have a maximum and minimum generation limits of 350MW and 100MW respectively. [5]

Q5. Consider the following optimization problem being solved using binary coded GA.

maximize $f(x_1, x_2) = x_1^2 + x_2^2 + x_1 x_2$; $0 \le x_1, x_2 \le 15$

Assume:

i) Binary string length for each variable = 4

ii) Initial population in the phenotype space as (15,10); (5,15); (9,8); (3,2); (12,2); (4,4)

iii) EC (Elite Count) = 2; P_c = 1.0; P_m = 0.0.

iv) Roulette wheel selection with random numbers generated are: 0.72, 0.27, 0.50, 0.11, 0.68, 0.91

v) Single point crossover with crossover site 5 and 3 alternately. Form mating pairs as (first and last candidates), (second and second last candidates) and so on.

Obtain the next generation in the phenotype space along with the fitness value of each member. Clearly show all the steps in a tabular form.

Truncate all values to 3 places after decimal. [15]