National Institute of Technology, Rourkela

CS6475: Soft Computing Laboratory

ASSIGNMENT: 05

Your task is to train a 3-layer multilayer perceptron using the following steps of an evolutionary algorithm for learning parity-3 problem (Ex-Or problem with 3 number of bits).

Use a real-encoded evolutionary algorithm to find the near-optimal weights of the 3-layer multilayer perceptron by keeping the range of weights of neural network between -1 to 1 and following conditions.

Use the following Algorithm:

Input: Number of inputs (k), Number of neurons in the hidden layer (q), Input (X), Target (Y).

Output: Training error of each generation using the best chromosome

Step 1 Initialization Step

1.1: Initialize the generation counter g=0, $Cr = 0.7$, population size $P_{size} = 20$, maximum generations max_gen=200.

1.2: Randomly Initialize the population of P_{size} individuals: $p_g = (C_g^1, \dots, C_g^{P_{size}})$, with $C_g^i = (W_g^{i,1}, \dots, W_g^{i,L})$ for i=1,..... P_{size}, L=number of genes in each chromosome, $W_g^{i,j}$= jth gene of ith chromosome in gth generation representing a weight of ANN.

1.3: Calculate the fitness of each chromosome by feed forwarding the inputs and computing the mean square error between actual and predicted values.

Step 2 Iteration Step

2.1: While (max_gen is not reached) do begin

2.2: for i=1 to P_{size}

2.3: Perform mutation to generate the mutant vector M_i

2.4: Perform crossover between mutant vector M_i and C_g^i to generate the trial vector.

2.5: Perform selection between the trial vector and C_g^i. If the fitness of the trial vector is better then it will go to the next generation otherwise C_g^i will go to next generation.

2.6: end of for

2.7: Set g=g+1

2.8: end of while

Step 3 Final Step

Use the chromosome having the best fitness as the optimal weight set of ANN. Print the fitness (mean square error) of the best chromosome of each generation as the fitness curve.

• Scale Factor: F= rand (0,1)

• Crossover Rate: 0.7

• Crossover Scheme:

Single point crossover (If the first character of your name lies between A and H)

Two-Point crossover (If the first character of your name lies between I and R)

Uniform crossover (If the first character of your name lies between S and Z)

• Mutation Scheme: $M_g^i = C_g^{best} + F \times (C_g^{r1} - C_g^{r2})$ (If the last digit of your roll number is Odd)

$M_g^i = C_g^{r1} + F \times (C_g^{r2} - C_g^{r3})$ (If the last digit of your roll number is .even)

F= rand(0,1)

Note: C_g^{best} denotes the best chromosome of the g th population.

C_g^{r1}, C_g^{r2}, C_g^{r3} are randomly selected chromosomes of the g th population.

All the vectors (chromosomes) should be distinct to one another.

• Number of Inputs: 3

• Number of hidden layers: 1

• Number of neurons in the hidden layer: 6

• Number of output neurons: 1

• Activation function of the hidden layer: Sigmoid

Activation function of output layer: Linear

Plot the convergence graph denoting the fitness of the best solution of every generation.