2018

COMPUTER AND INFORMATION SCIENCE

Paper : CISM-401

Soft Computing

Full Marks: 70

Answer ***questions* 1, 2** and ***any four*** of the remaining questions.

1. Answer ***any five*** 2×5

(a) A neuron with 4 inputs has the weight vector w = $[1, 2, 3, 4]^T$ and a bias b = 0 (zero). The activation function is linear and is given by f(net) = 2* net. If the input vector is x = $[4, 8, 5, 6]^T$ then find the output of the neuron.

(b) Why is it impossible for a single binary perceptron to solve the XOR problem?

(c) Evolutionary computation algorithms are very unlikely to get stuck in local minima. Justify the statement.

(d) Define α–cut of a fuzzy set with an example.

(e) Let A and B are two fuzzy sets. Prove that $\overline{A \cup B} = \bar{A} \cap \bar{B}$.

(f) Explain one crossover operation performed in real coded genetic algorithm (RCGA).

2. Answer ***any four*** 5×4

(a) Suppose that a credit card company decided to deploy a new system for assessing credit worthiness of its customers. The new system is using a feed-forward neural network with a supervised learning algorithm. Suggest in a form of essay what should be the bank have before the system can be used. Discuss issues associated with this requirement.

(b) Consider the following statement – "Classification can be considered as a special case of estimation" –Justify in favour or against this statement.

(c) Show that the 4 variable boolean function "(a AND b AND c) OR d" can be implemented by a single layer ANN (perceptron).

(d) "Mutation and maintaining best solution obtained are very important in the convergence of genetic algorithms". –Justify the statement.

(e) Write the Roulette Wheel selection method in the implementation of genetic algorithm.

(f) Explain the difference between randomness and fuzziness with examples.

3. Derive the gradient descent training rule assuming that the largest function representation is:

$o_d = w_o + w_1 x_1 + \ldots + w_n x_n$ 10

4. Assume we have a set of data from patients who have visited Heritage hospital during the year 2017. A set of features (e.g., temperature, height) have been also extracted for each patient. Our goal is to decide whether a new visiting patient has any of diabetes, heart disease, or alzheimer (a patient can have one or more of these diseases). We have decided to use a neural network to solve this problem. We have two

choices: (i) either to train a separate neural network for each of the diseases or (ii) to train a single neural network with one output neuron for each disease , but with a shared hidden layer. Which method do you prefer? Justify your answer. [10]

5. Define explicitly the cost/error function E, assuming that a set of training examples D is provided, where each training example $d \in D$ is associated with the target output t_d. 10

6. Define Max-Min fuzzy composition. Consider R_1 and R_2 as given below. Find the new relation $R = R_1 \circ R_2$ where $\circ$ represents max-min composition. 10

R_1	Y_1	Y_2	Y_3	Y_4	Y_5
X_1	0·1	0·2	0	1	0·7
X_2	0·3	0·5	0	0·2	1
X_3	0·8	0	1	0·4	0·3

R_2	Z_1	Z_2	Z_3
Y_1	0·2	1	0·2
Y_2	0·7	0·9	0·3
Y_3	0·1	0·6	0
Y_4	0·8	0·1	0·4
Y_5	0·5	0	0·1

7. Consider the problem of finding the shortest route through several cities, such that each city is visited only once and in the end return to the starting city (the Travelling Salesman problem). Suppose that in order to solve this problem we use a genetic algorithm. Describe the methods you will adapt for (i) encoding, (ii) selection of fitness function, (iii) performing Crossover and (iv) performing mutation. 10

8. (a) Define the terms chromosome, fitness function, crossover and mutation as used in genetic algorithms. Explain how genetic algorithms work, in English or in pseudocode. 6+2+2

   (b) A genetic algorithm is to be used to evolve a binary string of length n containing only 1s. The initial population is a randomly generated set of binary strings of length n.

   (i) Give a suitable fitness function for this problem.

   (ii) Will the off-spring of parents with a high fitness value generally also have a high fitness value, given your fitness function? Explain your answer. 6+2+2