20.5.14

Indian Institute of Engineering Science and Technology, Shibpur

B. E. (CST) 8th Semester Final-Semester Examination, May 2014

Introduction to Soft Computing

Elective IV (CS-804/II)

Time: 3 Hours **Full Marks: 70**

Answer question number 1 and any four from the rest.

1) Answer any ten questions by choosing the correct alternatives: 1×10=10

i) Degree of subsethood of a non-null fuzzy set A in another fuzzy set B is defined as
   a) $|A \cup B| / |A|$. b) $|A \cup B| / |B|$.
   c) $|A \cap B| / |A|$. d) $|A \cap B| / |B|$.

ii) Hebbian learning is an example of
   a) supervised learning. b) unsupervised learning.
   c) reinforcement learning. d) none of the above.

iii) A linguistic variable enables its value to be described
   a) only qualitatively by a linguistic term.
   b) only quantitatively by a corresponding membership function.
   c) both qualitatively by a linguistic term and quantitatively by a corresponding membership function.
   d) by a crisp set.

iv) Support of a fuzzy set $A \in X$, the universal set, can be defined as
   a) $S(A) = {}^{0+}A$. b) $S(A) = {}^{1}A$.
   c) $S(A) = \text{Sup}\{\mu_A(x)\} \ \forall x \in X$. d) $S(A) = \sum \mu_A(x) \ \forall x \in X$.

v) A fuzzy set is said to be sub-normal fuzzy set when its height is
   a) equal to one. b) less than one.
   c) greater than one. d) less than or equal to one.

vi) Genetic algorithm was introduced by
   a) L. A. Zadeh. b) Donald Rosenblatt.
   c) P. Goldberg. d) John Holland.

vii) A ..... network is created by combining a number of ADALINE networks.
   a) Recurrent b) MADALINE
   c) Competitive d) Auto-associative memory

viii) The size of each chromosome for the problem of maximizing a function $f(x) = x^2$ in the interval $0<=x<=31$ is

a) six. b) five.

c) four. d) three.

ix) The activation function which is used to train the ANN is continuous and varies gradually between -1 and +1 is known as

a) Hard limiter function. b) Ramp function.

c) Bipolar sigmoid function. d) Hyperbolic tangent function.

x) From the view point of learning in ANN, weights encode .....

a) Associative memory. b) Short-term memory.

c) Long-term-memory. d) None of the above.

xi) The order and defining length of the schema 011*1** are respectively

a) 4 and 2. b) 2 and 4.

c) 4 and 4. d) 3 and 4.

xii) In Genetic Algorithm the term 'Gene' is termed as

a) coded design vector. b) coded design variable.

c) every bit. d) none of these.

2) a) Consider the fuzzy sets A and B defined on the interval X=[0,5] of real numbers, by the membership grade functions –

$\mu_A(x) = x / (x+1)$ and $\mu_B(x) = 2^{-x}$

Determine the mathematical formulae and graphs of the membership grade functions of each of the following sets:

i) $\overline{A}$ ii) $\overline{B}$ iii) $A \cup B$ iv) $A \cap B$

b) Prove that the union of two fuzzy subsets A, B $\in$ X, the universal set, is the smallest fuzzy subset containing A as well as B.

(2+2+3+3)+5

3) a) Consider the linguistic variable "Age". Let the term "old" be defined by

$$\mu_{old}(x) = \begin{cases} 0 & \text{if } x \in [0,40] \\ \left(1+\left(\left(x-40\right)/5\right)^{-2}\right)^{-1} & \text{if } x \in (40,100] \end{cases}$$

Determine the membership function of the term "very old", "not very old" and "more or less old".

b) How membership functions of fuzzy sets are designed?

c) Define α – cut and strong α – cut in fuzzy set theory with suitable examples.

d) Define convexity of fuzzy sets.

e) What do you mean by cut worthy and strong cut worthy properties in fuzzy set theory?

5+3+3+2+2

4) a) Briefly explain any two applications of ANN?

b) State the Delta Learning rule.

c) Explain the working principle of Kohonen self organizing feature map.

d) Design a single LTU perceptron that can classify the following six patterns –

$\{ [-1,0]^T, [-1.5,-1]^T, [-1,-2]^T \}$: Class 1

$\{ [2,0]^T, [2.5,-1]^T, [1,-2]^T \}$: Class 2

2+3+5+5

5) a) Discuss the advantages of a multi-layer perceptron over single layer perceptron.

b) Design a two-layer network of perceptrons that implements A XOR B.

c) What are the main differences between perceptron learning rule and Widro-Hoff learning rule?

d) State and explain perceptron convergence theorem.

3+6+3+3

6) a) What is the difference between traditional search method and search using genetic algorithm?

c) What type of problems are solved using genetic algorithm?

b) How can you solve the travelling salesman problem using genetic algorithm.

c) Compare rank selection and Roulett-wheel selection method.

3+2+7+3

7) a) State and prove the schema theorem on genetic algorithm.

b) A population contains the following strings and fitness values at generation 0.

#	String	Fitness
1	10001	20
2	11100	10
3	00011	5
4	01110	15

The probability of mutation is p_m=0.01 and the probability of crossover is p_c=1.0. Calculate the expected number of schemata of the form 1**** and 0**1* in generation 1.

10+5