CN/B.Tech/IT/Odd/Sem-7th/IT-703B/2015-16

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IT – 703B

SOFT COMPUTING

Time Allotted: 3 Hours   Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer *all* questions. $10 \times 1 = 10$

(i) The AND function with bipolar inputs and targets is realized by Hebb net, because

(A) the problem is not linearly separable

(B) the problem is linearly separable

(C) the Hebb learning rule has the co relational mechanism

(D) none of these

(ii) The competitive learning rule is suited for

(A) unsupervised network training

(B) supervised network training

(C) reinforced network training

(D) none of these

(iii) Discrete Hopfield net is a

(A) feed forward network   (B) feedback network

(C) recurrent network   (D) none of these

(iv) The predicate logic statement of "A likes some of which B likes" is

(A) $\forall x$ (likes (B, x) $\Rightarrow$ likes(A, x)   (B) $\forall x$ (B, x) $\Rightarrow$ likes(A, x)

(C) $\exists x$ (likes (B, x) = likes(A, x)   (D) $\exists x$ (likes (B, x) $\wedge$ likes(A, x)

(v) When the fitness values of chromosomes in GA differ very much the best reproduction operator is

(A) Roulette-wheel selection   (B) Tournament selection

(C) Rank selection   (D) None of these

(vi) The Genetic algorithm does not need any auxiliary information and provides the

(A) the set of feasible solutions   (B) local optimal solution

(C) global optimal solution   (D) none of these

(vii) The backpropagation network is based on

(A) Hebbian learning rule   (B) Perceptron learning rule

(C) Delta learning rule   (D) None of these

(viii) The proposition logic lacks the ability to symbolize

(A) quantification   (B) connectivity

(C) equivalence   (D) negation

(ix) In fuzzy logic if X is A then Y is B equivalent to

(A) $(A \times B) \cup (A^c \times Y)$ (B) $(A \times B) \cup (A \times Y)$

(C) $(A \times B^c) \cup (A \times Y)$ (D) $(A \times B) \cup (A^c \times Y^c)$

(x) The size of the each chromosome for the problem maximizing a function $f(x) = x^2$ in the interval $0 \le x \le 31$, for integer x

(A) six   (B) five   (C) four   (D) three

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. $3 \times 5 = 15$

2. Find the weights required to perform the following classification using perceptron network.
The vector $(1, 1, 1, 1)$ and $(-1, 1, -1, -1)$ are belonging to the class (so have target value 1), vectors $(1, 1, 1, -1)$ and $(1, -1, -1, 1)$ are not belonging to class (so have target value -1). Assume learning rate as 1 and initial weights 0.

3. Consider a set $P = (P_1, P_2, P_3, P_4)$ of four variables of paddy plants, set $D = (D_1, D_2, D_3, D_4)$ of the various disease affecting the plants and $S = (S_1, S_2, S_3, S_4)$ be the common symptoms of the disease.
Let $\tilde{R}$ be a relation on $P \times D$ and $\tilde{S}$ be a relation on $D \times S$

For, $\tilde{R} = \begin{bmatrix} 0.6 & 0.6 & 0.9 & 0.8 \\ 0.1 & 0.2 & 0.9 & 0.8 \\ 0.9 & 0.3 & 0.4 & 0.8 \\ 0.9 & 0.8 & 0.1 & 0.2 \end{bmatrix}, \tilde{S} = \begin{bmatrix} 0.1 & 0.2 & 0.7 & 0.9 \\ 1.0 & 1.0 & 0.4 & 0.6 \\ 0.0 & 0.0 & 0.5 & 0.9 \\ 0.9 & 1.0 & 0.8 & 0.2 \end{bmatrix}$

Obtain the association of the plants with different symptoms of the disease using max-min composition.

4. (a) How can you realize crossover probability = 0.6 (say) in a Genetic Algorithm program?
   (b) Average fitness of a scheme H and the entire population in an iteration of Genetic Algorithm are 20 and 10 respectively. If the population of schema H at the current iteration is 100, what is its population in the next iteration due to selection only?

5. Differentiate between Perceptron rule of training and Delta rule of training.

6. Let $X = \{a, b, c, d\}$, $Y = \{1, 2, 3, 4\}$
$\tilde{A} = \{(a,0)(b,0.8)(c,0.6)(d,1)\}$
$\tilde{B} = \{(1,0.2)(2,1)(3,0.8)(4,0)\}$
$\tilde{C} = \{(1,0)(2,0.4)(3,1)(4,0.8)\}$
Determine the implication relations
If x is $\tilde{A}$ THEN y is $\tilde{B}$
If x is $\tilde{A}$ THEN y is $\tilde{B}$ ELSE y is $\tilde{C}$

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. $3 \times 15 = 45$

7. (a) Write down the training algorithm of BPN based on delta learning rule.   6
   (b) Using the back-propagation network, find the new weights after one epoch for the net shown in the following figure. It is presented with the input pattern $[-1, +1]$ and the target output is $+1$. Use a learning rate $\alpha = 0.25$ and bipolar sigmoidal activation function.   9
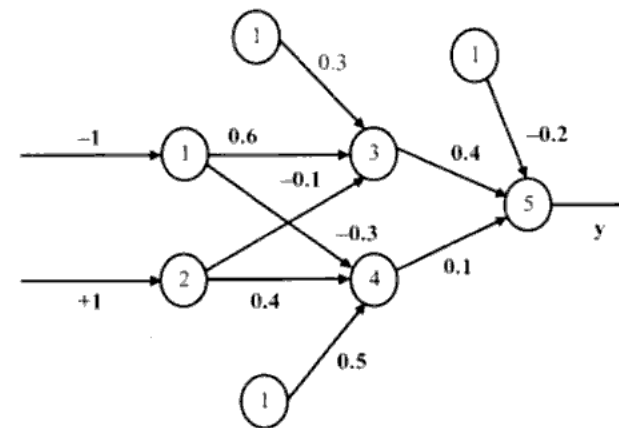
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8. (a) What is fuzzy inference system (FIS)? 2

(b) With suitable diagram, explain the working principle of a FIS. 5

(c) Discuss the different methods of FIS. 8

9. (a) What is the difference between Fuzzy equivalence relation and Fuzzy tolerance relation? 2

(b) The two fuzzy sets are as follows 6

A = [0.5, 0.7, 0.2, 0.3, 1.0, 0.8]

B = [0.0, 0.2, 0.1, 0.4, 0.6, 1.0]

Find the inner product and outer product of two vectors.

(c) Perform fuzzy arithmetic operations (subtraction, multiplication) on the following membership grade functions using α-cut method. 7

$$A(x) = 0, \text{ for } x \le 7$$
$$= (x - 7), \text{ for } 7 < x \le 8$$
$$= (-x + 9), \text{ for } 8 < x \le 9$$
$$= 0, \text{ for } x > 9$$
$$B(x) = 0, \text{ for } x \le 4$$
$$= (x - 4), \text{ for } 4 < x \le 5$$
$$= (-x + 6), \text{ for } 5 < x \le 6$$
$$= 0, x > 6$$

10. (a) What is the difference between centroid method and center of largest area method for defuzzification? 6

(b) How is a fuzzy relation converted into crisp relation using λ-cut process? 3

(c) Show that λ-cut relation of the following $\lambda = 0.1, 0'$ 3

$$R = \begin{bmatrix} 1.0 & 0.0 & 0.2 & 0.1 & 0.4 \\ 0.6 & 0.7 & 0.3 & 0.5 & 0.0 \\ 0.8 & 0.9 & 0.6 & 0.3 & 0.2 \\ 0.1 & 0.0 & 1.0 & 0.9 & 0.7 \end{bmatrix}$$

(d) For a speed control of DC motor, the membership function of series resistance, armature current and speed are given as follows. 3
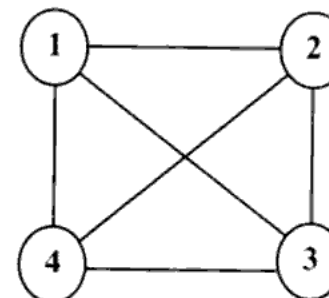
$$R_w = \left\{ \frac{0.4}{30} + \frac{0.6}{60} + \frac{1.0}{100} + \frac{0.1}{120} \right\}$$

$$I_a = \left\{ \frac{0.2}{20} + \frac{0.3}{40} + \frac{0.6}{60} + \frac{0.8}{80} + \frac{1.0}{100} + \frac{0.2}{120} \right\}$$

$$N = \left\{ \frac{0.35}{500} + \frac{0.67}{1000} + \frac{0.97}{1500} + \frac{0.25}{1800} \right\}$$

Compute relation T for relating series resistance to motor speed, i.e., R_{se} to N.

11. (a) Explain the cycle of genetic algorithm. 3

(b) What is crossover rate and mutation rate? 5

(c) Solve the following Traveling Salesman Problem for 4 cities by Using Genetic Algorithm. 7

The distance matrix for four cities is

1	0			
2	5	0		
3	6	13	0	
4	8	8	9	0
	1	2	3	4