Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS / B.TECH (IT) / SEM-7 / IT-703C / 2010-11

2010-11

SOFT COMPUTING

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : $10 \times 1 = 10$

   i) Which of the following explains the support of a fuzzy set A ?

   a) Support $(A) = \{X | \mu_A(x) > 0\}$

   b) Support $(A) = \{X | \mu_A(x) \geq 0\}$

   c) Support $(A) = \{X | \mu_A(x) < 0\}$

   d) Support $(A) = \{X | \mu_A(x) \leq 0\}$

   Where A is the set of all points x in X.

ii) What are the 3 basic operators of Genetic Algorithm ?

a) Selection, inverse selection, mutation

b) Selection, crossover, mutation

c) Selection, crossover, double mutation

d) Selection, Roulette wheel selection, mutation.

iii) The disadvantage of *k*-means algorithm is overcome by

a) $k - k$ means algorithm

b) Back propagation algorithm

c) k –medoid algorithm

d) A^* algorithm.

iv) Lukasiewicz Implication relation states

a) $\mu_R(x,y) = \max\left[\mu_A(x)\, n\, \mu_B(y), 1 - \mu_A(x)\right]$

b) $\mu_R(x,y) = \min\left[1, \frac{\mu_B(y)}{\mu_A(x)}\right]$

c) $\mu_R(x,y) = \min\{1, \mu_A(x) + \mu_B(y)\}$

d) $\mu_R(x,y) = \min\{1, [1 - \mu_A(x) + \mu_B(y)]\}$.

v) Signum function is used in

a) ADALINE neuron

b) Perceptron

c) Self-organizing neural network

d) Neurons in Back-propagation algorithm.

vi) The order of schema H = ? 0 0 1 ? 1 ? in the genetic algorithm is

a) 7 b) 4

c) 3 d) 2.

vii) When the input of a Sigmoid type non-linearity is zero, its output is

a) 1 b) $-\alpha$

c) $1/2$ d) $+\alpha$.

viii) Who is the designer of the ADALINE neural network ?

a) John Hopfield and Tank

b) McCulloch Pitts

c) Rosenblatt

d) Widrow and Holf.

ix) Clustering algorithm usually employ

a) unsupervised learning

b) reinforcement learning

c) supervised learning

d) competitive learning.

x) Intersection of two fuzzy sets R and S means

a) $\text{Max}\,[X_R(x, y), X_S(x, y)]$

b) $\text{Min}\,[X_R(x, y), X_S(x, y)]$

c) $X_R(x, y) = X_S(x, y)$

d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. Implement AND function using McCulloch Pitts neuron (take binary data)

3. The discretized membership functions for a transistor and a resistor are given below : 2½ + 2½

$$\mu_{\underset{\sim}{T}} = \left\{\frac{0}{0} + \frac{0\cdot 2}{1} + \frac{0\cdot 7}{2} + \frac{0\cdot 8}{3} + \frac{0\cdot 9}{4} + \frac{1}{5}\right\}$$

$$\mu_{\underset{\sim}{R}} = \left\{\frac{0}{0} + \frac{0\cdot 1}{1} + \frac{0\cdot 3}{2} + \frac{0\cdot 2}{3} + \frac{0\cdot 4}{4} + \frac{0\cdot 5}{5}\right\}$$

Find the algebraic sum and the bounded sum.

4. What is schema theorem ? If defining length of schema H, $d(h) = 4$ bits and length of the schema $L = 9$ bits. What is the probability of distribution of schema H by crossover ? Assume crossover probability $P_C = 0\cdot 6$. 2 + 3

5. Apply center of gravity type defuzzification to the following membership function to evaluate control signal 'U' of a plant:

$$\mu_A(U) = \left\{0\cdot 1/10, 0\cdot 6/20, 0\cdot 8/40\right\}$$

6. What is a pattern ? Define pattern clustering and classification. 1 + 4

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Consider the sets $\tilde{A} = \left\{\frac{0 \cdot 5}{2} + \frac{0 \cdot 3}{3} + \frac{1}{4} + \frac{0 \cdot 7}{5}\right\}$ and $\tilde{B} = \left\{\frac{0 \cdot 2}{2} + \frac{0 \cdot 4}{3} + \frac{0 \cdot 7}{4} + \frac{0 \cdot 5}{5}\right\}$. Prove De Morgan's Law.

b) Two fuzzy relations are given by

$$R = \begin{matrix} \\ x_1 \\ x_2 \end{matrix} \begin{matrix} \overset{Y_1}{} \\ \end{matrix} \begin{bmatrix} 0 \cdot 6 & 0 \cdot 3 \\ 0 \cdot 2 & 0 \cdot 9 \end{bmatrix} \begin{matrix} \overset{Y_2}{} \\ \end{matrix}$$

$$S = \begin{matrix} \\ Y_1 \\ Y_2 \end{matrix} \begin{matrix} \overset{Z_1}{} \\ \end{matrix} \begin{bmatrix} 1 \cdot 0 & 0 \cdot 5 & 0 \cdot 3 \\ 0 \cdot 8 & 0 \cdot 4 & 0 \cdot 7 \end{bmatrix} \begin{matrix} \overset{Z_2}{} & \overset{Z_3}{} \\ \end{matrix}$$

Obtain fuzzy relation $\underset{\sim}{T}$ as a composition between the fuzzy relations.

c) For the given rule : IF x is A, THEN y is B, and the observed fact x is A', we infer y is B' by using Generalized Modus Ponens. Given the membership distribution of x is A', $\mu_{A'}(x)$ and the membership of the fuzzy relation for the given IF-THEN rule, $\mu_R(x, y)$, what is the membership distribution of $\mu_{B'}(y)$?

$$\mu_{A'}(x) = \begin{bmatrix} 0 \cdot 8 & 0 \cdot 9 & 0 \cdot 2 \end{bmatrix}$$

$$\mu_{R'}(x) = \begin{bmatrix} 0 \cdot 8 & 0 \cdot 6 & 0 \cdot 5 \\ 0 \cdot 6 & 0 \cdot 5 & 0 \cdot 9 \\ 0 \cdot 7 & 0 \cdot 6 & 0 \cdot 5 \end{bmatrix}$$

5 + 5 + 5

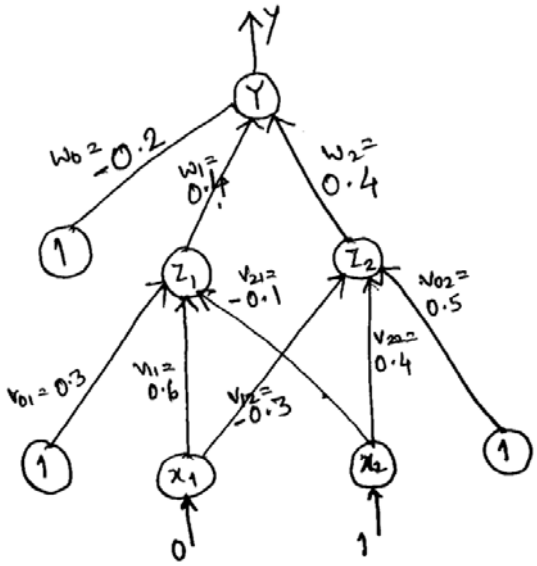
8. a) What is a hybrid system ?

   b) Given the training instances of a neural network, we need to determine the weights by Genetic Algorithm. Draw and explain the schematic diagram that considers hybridization of Neural net and Genetic algorithm.

   c) Mention two applications for Genetic Algorithm in real life. 3 + 10 + 2

9. a) What is Steepest Decent Learning ?

   b) Using back propagation network, find the new weights for the net shown in Fig. below. It is presented with the input pattern [0 , 1] and the target output is 1. Use a learning rate α =0·25 and binary sigmoidal activation function.



2 + 13

10. a) Consider the following set of data points :
$(x_1, x_2) \varepsilon \{(1,1), (2,2), (2,1), (5,1), (6,2), (7,1)\}$

Initialize = $C_1 \equiv (x_1, x_2) = (1, 2)$ and

$C_2 \equiv (x_1, x_2) = (7, 2)$ as two random cluster centres.

Show one step of execution of the *k*-means clustering algorithm, and hence determine the updated cluster centre.

b) What condition do you set to check convergence of the algorithm ?

c) What are the disadvantages of this algorithm ? How can it be overcome ?

d) Explain the basic difference between supervised and unsupervised learning in context to Machine learning.

6 + 2 + 4 + 3

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

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

c) Show that λ-cut relation of the following fuzzy equivalence relation results in a crisp equivalence relation :

$$R = \begin{bmatrix} 1 & 0{\cdot}8 & 0{\cdot}4 & 0{\cdot}5 & 0{\cdot}8 \\ 0{\cdot}8 & 1 & 0{\cdot}4 & 0{\cdot}5 & 0{\cdot}9 \\ 0{\cdot}4 & 0{\cdot}4 & 1 & 0{\cdot}4 & 0{\cdot}4 \\ 0{\cdot}5 & 0{\cdot}5 & 0{\cdot}4 & 1 & 0{\cdot}5 \\ 0{\cdot}8 & 0{\cdot}9 & 0{\cdot}4 & 0{\cdot}5 & 1 \end{bmatrix}$$

6 + 3 + 6

==========