BENGAL ENGINEERING AND SCIENCE UNIVERISTY, SHIBPUR
M. E (ICE) 2nd SEMESTER SUPPLEMENTARY EXAMINATIONS 2011
Soft Computing Techniques (ICE - 1004)
Full Marks: 100 **Duration: 3 Hours**
Answer any five questions by taking at least one from each group

Group - A

Q.1 **(6+4+10)**

a) Describe the McCulloh-Pitts model of an artificial neuron.

b) Explain the competitive learning mechanism using artificial neural network model.

c) A neuron *j* receives inputs from four other neurons whose activity levels are 20, -10, 2 and 4. The respective synaptic weights of neuron *j* are 0.8, 0.2, -1.0 and -0.9. Calculate the output of neuron *j* for the following two situations:

i) The activation function of the neuron is piecewise linear function.

ii) The Neuron using the Sigmoid function as an activation function. Consider slope parameter a=1.

Assume that the bias applied to the neuron is zero.

Q.2 **(6+9+5)**

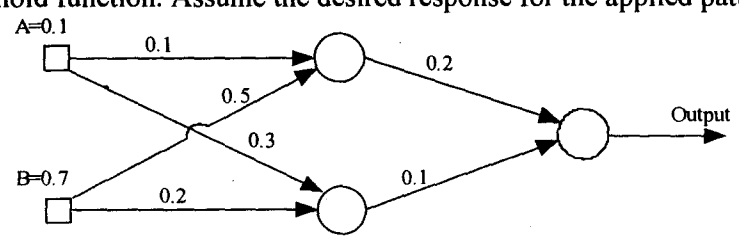
a) Describe memory-based learning mechanism for artificial neural network model.

b) Briefly explain about the different learning paradigms: Supervised, unsupervised and Reinforcement

c) Use least mean square (LMS) algorithm to obtain the formula for updating the weights of the neuron using gradient descent method.

Q.3 **(10+4+6)**

a) Try a training pass for the following multi-layer feedforward network using back-propagation learning algorithm. Learning rate parameter η=1. Also assume the activation function for each neuron is the sigmoid function. Assume the desired response for the applied pattern is 0.5.



b) Obtain an associative memory model using artificial neuron.

c) How is the memory matrix estimated in terms of the correlation matrix memory in an associative memory model?

Group - B

Q.4 **(4+3+8+5)**

a) Write the basic steps of Genetic Algorithm.

b) For which types of problem, value encoding technique is the best method to use. Explain with example.

c) Consider seven chromosomes with the following fitness values:5, 15, 30, 45, 55, 70 and 100.

i) Use the roulette wheel selection method to calculate the expected number of copies of each chromosome in the mating pool if a constant population size, n=7, is maintained.

ii) Repeat part (i) but use the selection method as rank selection procedure.

d) Which of the above two selection methods is better and why?

Q.5 **(8+5+5+2)**

a) Describe with examples the different types of crossover operations during reproduction process?

b) Is it possible to get a solution using GA for multi-objective optimization problems? If yes then show how it is possible and if it is not then why? Explain.

c) Suppose we are encoding a solution in GA using binary encoding mechanism and the objective function is a two variable function $f(x_1, x_2)$. For each of the variable four bits are used during encoding. Suppose after encoding the chromosome is 11010010 and the range of the variables are as follows: $x_1 \in [3,18]$ and $x_2 \in [-5, 10]$. If the objective function is $f(x_1, x_2) = x_1^2 + 4x_2$ then calculate the value of the objective function.

d) Define generation gap.

Group - C

Q.6 **(5+5+5+5)**

a) Write the resolution principle of a fuzzy set. Show with example how a fuzzy set can be represented using its α-cuts.

b) Suppose we have a fuzzy set A. Then define the resolution principle of the set A. Give one example.

c) Let A={(3,0.5), (5,1), (7,0.6)} and B={(3,1), (5, 0.6)}, Then obtain

i) E(A,B) , equality of fuzzy set A and B.

ii) S(A,B), subset hood of fuzzy set A and B.

e) Suppose f is a function mapping from universe of discourse U={-2, -1, 0, 1, 2} and $y=f(x)=x^2$. Let A be the fuzzy set defined on U, such that A=0.5/-1 + 0.8/0 + 1.0/1+ 0.4/2. Use extension principle to derive the fuzzy set B having membership function $y=f(x)$.

Q.7 **(6+6+8)**

a) What is the necessity of composition of a relation? What are the various types of fuzzy composition techniques you know?

b) Consider a universe of aircraft speed near the speed of sound as X={0.72, 0.725, 0.75, 0.775, 0.78} and a fuzzy set on this universe for the speed "*near mach 0.75*" = M where M={0/0.72 + 0.8/0.725 + 1/0.75 + 0.8/0.775 + 0/0.78}. Define a universe of altitudes as Y={21, 22, 23, 24, 25, 26, 27} in k-feet and a fuzzy set on this universe for the altitude fuzzy set "*approximately 24000 feet*" = N where N={0/21k + 0.2/22k + 0.7/23k + 1/24k + 0.7/25k + 0.2/26k + 0/27k}.

i) Determine R between M and N.

ii) For another aircraft speed say M_1 in the region of mach 0.75 where M_1={0/0.72 + 0.8/0.725+ 1/0.75+ 0.6/0.775 + 0/0.78}, find the $S = M_1 \circ R$. Symbols are in usual meaning.

c) Define α-composition of two fuzzy sets and α-composition of a fuzzy relation and a fuzzy set.

Consider a fuzzy system whose input is the fuzzy set A and the output is the fuzzy set B. Fuzzy sets A and B as follows

$$A = 0.2/x_1 + 0.8/x_2 + 1/x_3$$

And $B = 0.5/y_1 + 0.8/y_2 + 0.6/y_3$

Determine R such that $A \circ R = B$.

Q.8 **(5+5+10)**

a) Describe the basic components of a fuzzy logic system?

b) Write two different fuzzy implication rules which are used mostly for the fuzzy logic system implementation.

c) Use Center of gravity (COG) method to obtain defuzzified value for the two overlapped fuzzy sets A and B represented in graphical form.