

C9-R4: SOFT COMPUTING

NOTE:

1. Answer question 1 and any FOUR from questions 2 to 7.
2. Parts of the same question should be answered together and in the same sequence.

Time: 3 Hours

Total Marks: 100

1.
 - a) What are the applications of soft computing techniques in pure and applied mathematics?
 - b) Compare soft computing and hard computing techniques.
 - c) Explain Mc-Culloch-Pitt model of Artificial Neuron.
 - d) What is meant by transfer function of a ANN. Explain the sigmoid function.
 - e) Write and explain the perceptron learning algorithm.
 - f) Make block diagram of general image storage system.
 - g) The nodes in a multilayer neural network often contains sigmoid units which perform the following calculation for a given weighted sum
$$\mu(s) = 1/1 + e^{-s}$$
Calculate the output from sigmoid unit, which takes the set {0.1, 0.8, 0.8, 0.3} as input. (7x4)

2.
 - a) Suppose we have a multilayer network with two output nodes and the target output (say E) from output unit 1 is 1 and from output unit 2 is 0, still the output value produced from E was 0.3 for output unit 1 and 0.7 for output unit 2. The error term for output unit O(k) is calculated as
$$\mu(o(k)) = o(k) (E) (1 - o(k) (E)) (tk(E)) - o(k)(E)$$
Calculate the error term for O1 and O2.
 - b) Explain the following:
 - i) Recurrent Network
 - ii) Hopfield Network
 - iii) Boltzmann Machine(9+9)

3.
 - a) Explain the concept of uniform crossover in the theory of genetic algorithm. For two parents specified as follows, mention the children generated by uniform crossover.
$$\text{Parent 1: } 7^*3^*76^*13$$
$$\text{Parent 2: } 1^*7^*45^*22$$
 - b) How genetic methods differ from the conventional search methods.
 - c) Show that if the activation function $f(x) = x + \frac{1}{2}$ is used in delta rule, is identical to the perceptron training rule.
 - d) For the target value 0.7, calculate a single weight update using a generalized Delta rule for each weight in the network. (4+4+6+4)

4.
 - a) With the help of block diagram explain the concept of supervised learning.
 - b) Explain WIDROW-HOFF learning rule.
 - c) Differentiate between inverse learning and simple learning.
 - d) Define the following terms in brief: Epistemology, Metaknowledge (6+4+4+4)

5.

- a) Suppose we have a search problem where the solution space is three dimensional with each dimension being integer valued and ranging from 1 to 100. That is, solution to the problem are triples of integers (a,b,c) such that $1 \leq a, b, c \leq 100$. In this context calculate the following:
- i) How big is the search space for this problem?
 - ii) Represent the number 17 as a bit string?
 - iii) How many bits will solution to the problem require?
- b) Give a comparison between Neural Network and Von Neumann Computer.
- c) Define the terms: Adaptive learning, Self organization

(9+5+4)

6.

- a) List and explain five prominent features of Boltzman Machines.
- b) With the help of block diagram explain the concept of associative memory.
- c) For a 2-1 neural network using a sigmoid activation function and with weights $w_{11} = 0.5$, $w_{21} = 0.75$ and $n(\eta) = 0.2$.
- i) Draw a carefully labelled network diagram.
 - ii) Calculate the output value of the network for the input $INPUT1 = 0.65$, and $INPUT2 = 0.85$.

(10+4+4)

7.

- a) Genetic algorithm always performs better. Justify.
- b) Explain the concept of objective function and fitness function related to genetic algorithm.
- c) List various methods to generate offspring, while using genetic algorithm.
- d) Enumerate advantages and disadvantages of three major optimization algorithms.

(4+4+5+5)