# Bio-Inspired Intelligence: Algorithms and Applications

Mid-Semester Examination

October 31, 2022

(Total Marks - 40)

1. (a) Define Genotype and Phenotype in Genetic Algorithm.

   (b) Name any four selection techniques used in Genetic Algorithm.

   (c) Let 10110111 and 11001010 be two parents. How many different offsprings can be generated from them using Half Uniform Crossover Technique?

   (d) Let the adjacency list of a permutation encoded GA with 8 vertices are give as follows: $N_1$=$\{2, 6, 7\}$, $N_2$=$\{1, 3, 4, 5, 8\}$, $N_3$=$\{2, 4, 7\}$, $N_4$=$\{2, 3, 6, 7\}$, $N_5$=$\{2, 6, 8\}$, $N_6$=$\{1, 4, 5, 7\}$, $N_7$=$\{1, 3, 4, 6\}$, $N_8$=$\{2, 5\}$. Where $N_i$ is the set of neighboring vertices of vertex $i$. Find an offspring using Edge Recombination Crossover Technique.

   (e) Why fitness scaling is done in Genetic Algorithm?

   (f) Name one proportion based selection technique used in Genetic Algorithm.

   (2+2+2+3+2+1)

2. (a) How the learning in Artificial Neuron Network is classified? Name the classes?

   (b) Derive the learning equation of Error Correcting Learning using Gradient Descent method. Consider linear neuron model and Mean Square Error.

(c) Define VC dimension in Binary Classification? What will be its value for 4 dimensional input space?

(d) What are the advantages of Sequential Learning in ANN?

(e) State Cover's Theorem for classification. For $N$ input vectors in $m$ dimensional space what is the probability that a randomly chosen dichotomy is linearly separable?

(f) Design a 2-input X-NOR logic gate using Multi Layer Perceptron Model with 1 hidden layer. Use Unit Step Activation Function for all neurons. Mention the separating lines in the design.

(2+3+3+3+2+5)

3. (a) Mention the class of optimization problems suited for application of Particle Swarm Optimization?

(b) Write down the governing update equations used in PSO.

(c) State four advantages of PSO over other optimization techniques.

(d) What is Inertia Weight in PSO? What is its function? How is it varied with iteration?

(e) What is Restricted Reflecting Boundary Condition in PSO? Write down its update equations for a 2-D search space.

(1+2+2+3+2)