BITS F454: Bio-Inspired Intelligence: Algorithms and Applications

Comprehensive Examination

December 17, 2022

Total Marks - 80 Time: 3 Hrs.

1. (a) Describe the working of Genetic Algorithm using a Flowchart.

   (b) Name four encoding techniques used in Genetic Algorithm.

   (c) Mention two drawbacks of proportion based selection techniques. How can we overcome them? When do we use proportion based selection techniques?

   (d) Let the parents of a permutation encoded **GA** be **ABCDEFGH** and **FHDCGABE**. Generate a 8-bit random binary string and perform Precedence Preservation Crossover.

   (e) State three termination conditions of **GA**.

   (f) What is the disadvantage of Linear Scaling in **GA**? How to overcome that using Sigma Scaling? State a disadvantage of Sigma Scaling.

   (3+2+4+2+3+3)

2. (a) Name three learning techniques of Artificial Neural Network.

   (b) What is positive, negative and no correlation in Hebbian Learning? Derive the learning rule of Hebbian Learning.

   (c) Define local gradient in Back Propagation method of **ANN**. Derive the mathematical form of local gradient for an output layer neuron in linear neuron model.

   (d) State three advantages of Batch Based Learning in **ANN**.

   (e) What is Radial Basis Function?

   (f) Describe three differences between Multi Layer Perceptron Model and Radial Basis Function Model.

   (2+4+4+3+2+3)

3. (a) What is **Gbest**, **Pbest** and **Lbest** in Particle Swarm Optimization?

   (b) State a disadvantage of **PSO**. What are the measures to improve rate of convergence in **PSO**?

   (c) What is unrestricted or Invisible Damping Boundary Condition in **PSO**? Describe with a diagram for 2-D search space.

   (d) What is Guaranteed Convergence **PSO**? Briefly discuss the working principle.

   (e) Why boundary condition is not required in Binary **PSO**?

   (3+4+3+4+1)

4. (a) What is pheromone in Ant Colony Optimization. How transition probability is quantified in Simple Ant Colony Optimization (**SACO**)?

   (b) State and explain the pheromone update equations in **SACO**.

   (c) State and explain the pheromone update equation in Ant-quantity based Ant System with elitism.

   (3+3+4)

5. (a) What is waggle dance by bees? What are the different phases of Artificial Bee Colony (**ABC**) Algorithm?

   (b) State the relation of Fitness with Objective Function in **ABC** algorithm.

   (c) How probabilities of the solutions are fixed in **ABC** algorithm and why?

   (d) What is the function of the variable '**limit**' in **ABC** algorithm? Write the governing equation of Scout Phase in **ABC** algorithm.

   (4+2+2+2)

6. (a) Match the items of column A with the items of column B in the following table:

A	B
Bat	light
Firefly	Encircle
Butterfly	Sound
Grey Wolf	Fragrance

   (b) What is **Metropolis Rule** in Simulated Annealing Algorithm?

   (c) What are the four main stages of the Grey Wolf prey technique?

   (d) Give an example of real life application of the Bat Algorithm.

   (e) When do we see exploration activity in Firefly Algorithm?

   (4+2+2+1+1)