BIO-INSPIRED SYSTEMS LAB 1

1. Genetic Algorithm (GA)

Genetic Algorithms is a technique inspired by the natural mechanism of selection. They are, in effect, the use of techniques including selection, crossover, and mutation to evolve optimum solutions toward solving optimization problems.

Usages: Optimization, machine learning, artificial intelligence.

Application Domains: Engineering design, scheduling, robotics, bioinformatics.

Optimization Techniques: Selection techniques like roulette wheel and tournament, crossover techniques like single-point and multi-point and mutation techniques like bit-flip and swap.

2. Particle Swarm Optimization (PSO)

Overview: PSO is inspired from the social behavior of bird flocking or fish schooling. It solves an optimization problem iteratively by improvement of candidate solutions along some measure of quality.

Application Areas: Optimizing functions, training neural networks, control systems

Domains Applied: Robotics, Telecommunications, Power systems.

Optimization Techniques: Inertia weight update, Constriction factor, Velocity Clamping.

3. Ant Colony Optimization (ACO)
Summary: Inspired by the foraging behavior of ants that exploit pheromone trails to find the best paths of graphs.

Usages: Combinatorial optimization, routing and scheduling.

Application Fields: Network routing, logistics, vehicle routing.

Optimization Techniques: Pheromone updating rules, local search techniques and evaporation rate adjustment.

4. Cuckoo Search (CS)

Summary: CS is borrowed from a number of cuckoo birds' species, who lay eggs in other birds' nests and whose chicks, when hatched, are cared for by those host birds. They could grow up and reproduce in their turn, laying eggs in the nests of other birds, which get cared for by their new foster-parents, while its own eggs are either thrown out or deserted. Motivated by this

specific kind of brood parasitism, CS employs Lévy flights to scan the search space and updates the worst solutions.

Applications: Optimization problems, machine learning, engineering design.

Application Fields: Structural design, feature selection, scheduling.

Optimization Techniques: Lévy flights, discovery probability, elitism.

5. Grey Wolf Optimizer (GWO)

Abstract: GWO is an optimization algorithm inspired by the hunting behavior of grey wolves and the hierarchy of their leadership. Alpha, beta, delta, and omega guide search.

Applications: Optimization problems, machine learning.

Application Fields: Engineering design, image processing, feature selection.

Optimization Techniques: Encircling prey, hunting, attacking prey.

6. Parallel Cellular Algorithms

Summary: This family of algorithms represents solutions as a cellular structure, whereby each cell encodes a potential solution. Solutions evolve in parallel and often are local interactions.

Uses: Optimization, Parallel Computing.

Application Fields: Image processing, computational biology, scheduling.

Optimization Techniques: Local search, neighborhood structures, parallel processing.

7. Gene Expression Programming (GEP)

Summary GEP is an evolutionary algorithm that evolves computer programs or models. It makes use of chromosomes for encodings of solutions and applies genetic operators to evolve them.
Application Fields: Data mining, bioinformatics and finance modeling.
Optimization Techniques: Selection, crossover, mutation, transposition.