

BIO INSPIRED SYSTEMS

1. Genetic Algorithm (GA)

Genetic Algorithms is a method inspired by the natural mechanism of selection. They are, in essence, the use of techniques such as selection, crossover, and mutation to evolve optimum solutions towards solving optimization problems.

Usages: Optimization, machine learning, artificial intelligence.

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

Optimization Strategies: Selection strategies such as roulette wheel and tournament, crossover strategies such as single-point and multi-point, and mutation strategies such as bit-flip and swap.

2. Particle Swarm Optimization (PSO)

Summary: PSO simulates social behavior of bird flocking or fish schooling. It tackles an optimization problem iteratively through improvement of candidate solutions along some measure of quality.

Areas of application: 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: It is inspired by the foraging behavior of ants, which uses pheromone trails to find the best paths in 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 inspired from some species of cuckoo birds whose chicks are hatched in other birds' nests and are fed by those host birds. They can grow up and reproduce in their turn by

laying eggs in other birds' nests, which are looked after by their new foster-parents while the original eggs are either thrown out or abandoned. Inspired by this specialistic brood parasitism, CS uses Lévy flights to explore the search space and replace 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 created based on the hunting behavior of grey wolves and 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 uses chromosomes to encode solutions and applies genetic operators to evolve them.

Applications Fields: Data mining, bioinformatics and finance modeling.

Optimization Techniques: Selection, crossover, mutation, transposition.

References

1. <https://www.geeksforgeeks.org/introduction-to-optimization-with-genetic-algorithm/>
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