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Assignment No.: 03 (SCOA)

Problem Statement :

Implement Particle swarm optimization for benchmark function (eg. Square, Rosenbrock function). Initialize the population from the Standard Normal Distribution. Evaluate fitness of all particles.
Use :

c1=c2 = 2
Inertia weight is linearly varied between 0.9 to 0.4.
Global best variation

Objective :

- To familiarize with Particle swarm optimization.
- To learn about optimization algorithm.

Software and Hardware Requirement :

32/64 bit PC

Python

Theory :

Particle swarm optimization :

Particle swarm optimization (PSO) is a population based stochastic optimization technique developed by Dr. Eberhart and Dr. Kennedy in 1995, inspired by social behavior of bird flocking or fish schooling. PSO shares many similarities with evolutionary computation techniques such as Genetic Algorithms (GA). The system is initialized with a population of random solutions and searches for optima by updating generations. However, unlike GA, PSO has no evolution operators such as crossover and mutation. In PSO, the potential solutions, called particles, fly through the problem space by following the current optimum particles. Compared to GA, the advantages of PSO are that PSO is easy to implement and there are few parameters to adjust. PSO has been successfully applied in many areas: function optimization, artificial neural network training, fuzzy

system control, and other areas where GA can be applied. PSO uses a bunch of particles called the swarm. These particles are allowed to move around & explore the search-space. These particles move in a direction which is guided by —1.The particle's own previous velocity(Inertia)2.Distance from the individual particles' best known position (Cognitive Force)3.Distance from the swarms best known position (Social Force)The particle swarm optimization (PSO) algorithm is a population-based search algorithm based on the simulation of the social behavior of birds within a flock. The initial intent of the particle swarm concept was to graphically simulate the graceful and unpredictable choreography of a bird flock [449], with the aim of discovering patterns that govern the ability of birds to fly synchronously, and to suddenly change direction with a regrouping in an optimal formation. From this initial objective, the concept evolved into a simple and efficient optimization algorithm. In PSO, individuals, referred to as particles, are "flown" through hyperdimensional search space. Changes to the position of particles within the search space are based on the social-psychological tendency of individuals to emulate the success of other individuals. The changes to a particle within the swarm are therefore influenced by the experience, or knowledge, of its neighbors. The search behavior of a particle is thus affected by that of other particles within the swarm (PSO is therefore a kind of symbiotic cooperative algorithm). The consequence of modeling this social behavior is that the search process is such that particles stochastically return toward previously successful regions in the search space.

Essentially the particles collectively communicate with each other to converge faster. The swarm doesn't fully explore the search space but potentially finds a better solution.Interestingly the overall direction of the swarm movement can be changed at any point of time when a particle's individual best is better than the swarm best. This allows a lot of disorder and more chances of getting close to the global minima of the cost function Algorithm PSO is initialized with a group of random particles (solutions) and then searches for optima by updating generations. In every iteration, each particle is updated by following two "best" values. The first one is the best solution (fitness) it has achieved so far. (The fitness value is also stored.) This value is called pbest. Another "best" value that is tracked by the particle swarm optimizer is the best value, obtained so far by any particle in the population. This best value is a global best and called gbest. When a particle takes part of the population as its topological neighbors,

the best value is a local best and is called lbest. After finding the two best values, the particle updates its velocity and positions with following equation.

Conclusion :

In this assignment we learn the use of Partial swarn optimixation and various optimiation techniques. And their advantages over one another.