

Evolutionary Algorithms

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Tutorial Assignment n°3: Selection Methods

Selection is a critical step in Genetic Algorithms, as it determines which individuals from the current population will be chosen as parents for the next generation. There are several selection methods to choose from, each with its own characteristics and advantages. Here are some common selection methods in Genetic Algorithms:

1. **Roulette Wheel Selection (Fitness-Proportional Selection):** In this method, individuals are selected with a probability proportional to their fitness. Higher-fitness individuals have a higher chance of being selected. It mimics the idea of a roulette wheel, where each individual's slice of the wheel is proportional to their fitness.
2. **Tournament Selection:** In tournament selection, a fixed number of individuals are randomly selected from the population, and the one with the highest fitness among them is chosen as a parent. This process is repeated to select multiple parents for reproduction.
3. **Rank-Based Selection:** Rank-based selection assigns a rank to each individual based on their fitness. Instead of considering the absolute fitness values, it considers the relative ranking of individuals. Individuals with higher ranks have a higher probability of being selected.
4. **Stochastic Universal Sampling:** Stochastic universal sampling is a variation of roulette wheel selection that reduces selection bias. It selects multiple individuals at once, allowing for a more diverse parent population. It avoids the risk of prematurely converging to a suboptimal solution.
5. **Boltzmann Selection:** Boltzmann selection applies a temperature parameter to control the degree of randomness in selection. Initially, it explores the search space more widely (higher temperature) and gradually narrows down the selection process (lower temperature).
6. **Deterministic Crowding:** Deterministic crowding is a niche-preserving selection method where new individuals replace less fit parents if they are closer to the parents in the solution space. This encourages diversity by preserving niches.

7. **Elitist Selection:** Elitist selection involves selecting the best individuals (usually a fixed number or a percentage) from the current population to be carried over to the next generation. This ensures that the best solutions are retained.
8. **Random Selection:** Random selection assigns an equal probability to each individual in the population, regardless of their fitness. It introduces randomness into the selection process and may be used for exploration in certain scenarios.

The choice of the selection method depends on the problem at hand, the desired balance between exploration and exploitation, and the specific characteristics of the Genetic Algorithm. Different selection methods have their advantages and limitations, and they can be combined or customized to suit the needs of the optimization problem.

Question:

Apply the different selection methods on the well-known mono-objective optimization problems.