5.2 Evolutionary Programming

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Evolutionary Programming

Evolutionary programming (EP) was firstly proposed to simulate the evolution process and generate artificial intelligence and then applied in optimization domains.

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There is a consistent pursuing for our human to obtain the artificial intelligence.

About sixty years ago

Researchers attempted to build the model of natural evolution to realize the automatic programming, sequence prediction and so on. For example, Friedberg aimed to design the algorithm to find the program with certain inputs and outputs.

Friedberg

The pioneer of automatic programming

The performance of the method

Unfortunately, the mechanism proved worse even than a pure random search, resulted mainly by:

- The absence of effective selection pressure
- The extreme disassociation(Small changes in program syntax usually cause large changes in the input-output behaviour of the program)

In the 1960s

Having the knowledge of Friedberg' s disappointing results, Bremermann focused on the work of relatively simple optimization problems, especially for the linear programming and convex programming.

The performance of the method

It is too limited for real optimization applications.

Evolutionary Programming-The Emerging of Evolutionary Programming

In 1964

L. J.Fogel formally proposed a kind of evolutionary algorithms, called evolutionary programming (EP).

The mechanism of EP

The individual, on behalf of a transition table of finite-state-machine (FSM), mutates to reproduce new FSMs, meanwhile, whether the individual was able to mutate in the next generation depended on the performance in the evaluation testing.

The performance of the method

Compared with Friedberg' s and Bremermann' s algorithms:

- Applying EP algorithm to more sophisticated optimization problems
- Withith appropriate selective pressure provided

In 1970s

Nevertheless, the refined work did not receive the remarkable attention in the field, until the genetic algorithm and evolution strategies were fully accepted in 1970s.

The limitation in Friedberg and Bremermann' s experiments caused the ignorance of Fogel' s works in almost thirty years.

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The characteristic of the initial EP

- Fixed chromosome structure
- Changing numerical parameters evolving along with decision variables

The specific mechanism was brought by many other EAs and obtained a formal term, self-adaptation.

The categories of initial EP algorithms

- Standard EP, which has no self-adaptation specialities.
- Continuous standard EP, different from the generation-based algorithms, in which, the individual is evaluated and added into the population.
- Meta-EP, into which, the variance of mutation step size is cooperated.
- Continuous meta-EP, in which, the individual is evaluated and added into the population due to the variance of the mutation operator.
- Rmeta-EP, which cooperates covariances and standard deviations for self-adaptation.

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