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The Research of Genetic Ant Colony Algorithm and Its Application

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Abstract

This paper proposes genetic ant algorithm through the research of the traditional genetic algorithm and ant colony optimization. This algorithm use the results of the genetic algorithm to initialize the pheromone distribution ,use its strong adaptability and rapid global convergence and then get the optimal solution through the colony algorithm that has parallelism、positive feedback system and good solution efficiency. The simulation results of 0-1 knapsack and QoS demonstrate that this algorithm has higher converging speed, stability and global optimization ability.

Keywards: genetic algorithm (GA); ant colony optimization (ACO);optimization problem; 0-1 knapsack Problems； QoS

1. Introduction

Genetic Algorithm (GA) is first proposed by professor John Holland from the United States University of Michigan in 1960s, and Ant Colony Optimization (ACO) is proposed by Italian scholar M.Dorigo etc. GA and ACO both are searching algorithm that is simulating biological group evolution, and they were used extensively in function optimization, vehicle scheduling, image processing .

Both GA and ACO are iterative optimization process that is the foundation of the combination of these two algorithms. GA has the ability of rapid global convergence, but for the feedback information system it is helpless, it will do a lot of redundancy iteration when the solution get in a certain range, so it will reduce the efficiency of the exact solution. ACO will converge on the optimum solution through the

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accumulation and update of information pheromone.Because it has the ability of parallel processing and global searching. But due to the lack of early pheromone, the solution speed is low.

In order to overcome the defects of the two algorithms, on the basis of complementary advantages to propose a kind of genetic ant colony algorithm. First, use the results of GA to initialize the pheromone distribution of the relevant issues. Then, according to the parallel processing and global searching of ACO to get the optimal solution. So form a heuristic method genetic ant algorithm that has higher efficiency of time and solution than ACO and GA.

2. The Determination of Fusion Time of GA and ACO

In order to combine GA and ACO better, genetic ant algorithm need to set up a control function of GA, through calculate the evolution rate of the offspring groups, to control the iterations of GA ,that can ensure GA and ACO fusion at the right time.

Define a control function of GA $c_G^{l+1}=\frac{\overline{C(T)_{l+1}}}{(C(T)_l)^3}$,where $\overline{C(T)_l}$ is the average value of the group after l iteration of GA, $1\le l\le N_G$, N_G is the maximum iterations of GA.Statistics the value of c_G^{l+1} in the iterative process of GA , if c_G^{l+1} are less than 3% for three generations , it will show the optimizing speed of GA is low, so we can terminate GA and get into ACO. Figure 1 is the flow chart of the genetic ant colony algorithm.

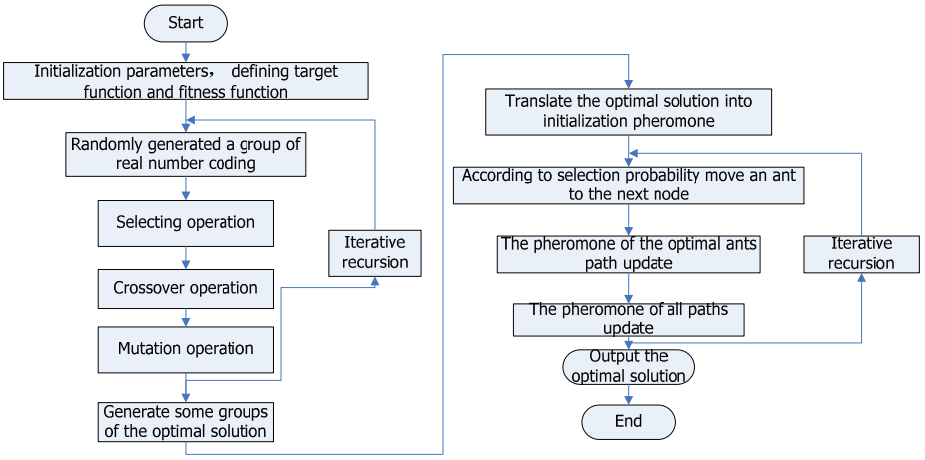

Fig. 1.The flow chart of the genetic ant colony algorithm.

3. Optimization Testing of the Genetic Ant Colony Algorithm

3.1. Description of 0-1 knapsack Problems(KPs)

We are given a set of n items, each item i having an integer profit p_i and an integer weight w_i $(i=1,2,\cdots,n)$ .The problem is to choose a subset of the items such that their overall profit is