

Title	遺伝的アルゴリズムに基づく電子商取引における問題 解決システムの構築
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Construction of the Problem Solution System in the Electronic Commerce based on Genetic Algorithm

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Group buying has become a popular type of Electronic Commerce. In group buying, the unit price of goods is decided based on the number of buyers, and a buyer can purchase goods at a low price if a sufficient number of buyers participate in group buying. There are many group buying sites on the Internet, and they have different discount rates for each others. Also, they have limitations of the number of goods to sell. Therefore, there can be a huge number of possible allocations of buyers. Thus, for buyers, it is important to find an optimal allocation of buyers in group buying sites. We call this the optimal buyer allocation problem. The optimal buyer allocation problem in group buying is an NP-hard problem. Therefore, searching for an optimal distribution by an exhaustive search is not practical because it takes too much time. It is necessary to instantaneously present a solution by a deadline. A genetic algorithm (GA) can calculate optimal solutions or semi-optimal solutions in real time.

In group buying, sellers prepare a range and quantity of goods to deal in, and buyers purchase goods at a low price by cooperating with each other. Sellers have the opportunity to dispose of a large stock, and buyers benefit since they can purchase goods at a discount price. Many group buying sites have been selling similar or the same goods. It is important for buyers to decide when and when to purchase the desired good. Also, it is often difficult for buyers to gather for purchasing a good since they are distributed on the Internet. If buyers are gathered in a group and then they are allocated

optimally to distributed group-buying sites, they can purchase goods at an optimal price, i.e., the lowest price. We focus on a situation in which several sellers are selling substitute goods. Since buyers can purchase whichever goods they want, they can purchase at a low price by being integrated into any other group. There is no difference among these goods for participants. Sellers submit a discount rate for each good to the host (system administrator). Buyers show the reservation price to the host. The reservation price is the highest amount of money that a buyer can pay.

A coalition in which the unit price of a good is higher than the reservation price for one buyer is called an invalid solution. On the other hand, a coalition in which a reservation price is higher than the unit prices of goods for all buyers is called a possible solution. A coalition in which the utility is the largest in the group of possible answers is called an optimal solution.

We describe a problem representation based on GA. By representing the problem with genes, we can express the allocated goods for buyers, the unit price of goods, and the buyer's utilities at once. The value of a coalition can be evaluated when all buyers are assigned goods. In this problem, we describe fatal genes. An optimal allocation has the two following constraints.

- 1) The number of goods is finite. Thus, a buyer cannot purchase a good if a certain seller does not have enough goods.
- 2) A Buyer cannot purchase the good if the unit price is higher than his reservation price.

A coalition that satisfies those constraints is called a possible solution. Also the genes are called possible genes. A coalition that does not satisfy those constraints is called an invalid solution, and the genes that do not satisfy the constraints are called invalid genes. In this problem, fatal genes may occupy most of the answer space according to. However, generally, the evaluation value of the fatal genes is zero in a GA. Thus, if there are many fatal genes in the group, it is quite difficult to obtain an optimal solution. In GA, we first assign numerical values to each element (gene locus) in a gene at random, and we call this operation of assigning "first selection." Therefore, in our algorithm, we first select genes that satisfy constraint (1). While constraint (1) can be satisfied relatively easily, it is hard to satisfy constraint (2) at the first stage. By evaluating a gene based on its total price, even if the gene violates the strong constraint (2), the gene can survive to the next generation. We call coalition (1) a superior solution. Also, a

gene that represents a superior solution is called a superior gene. Crossover is a very characteristic operation. However, if one-point crossover is carried out, this operation produces many fatal genes and decreases the efficiency of searching. Thus, we propose a crossover method (1). In the first place, this method determines whether to carry out crossover based on probability. When it determines that crossover should be carried out, two genes are operated by one-point crossover at all crossover points and then pooled with parents. The two superior genes are selected from the pooled genes at random and survive to the next generation. The advantage of this method is that fatal gene does not survive to the next generation.

In this paper, we focus on dynamic electronic group-buying in which sellers and buyers dynamically participate in and drop out from our market. Whenever the number of participants changes, buyers form coalitions again to get higher utility. In the electronic commerce in which many and unspecified people participate, the number of the seller and the buyer become large and the number of the combination becomes exponentially huge. Consequently, optimal coalition formation is difficult. Then, in this paper, a system that supports coalition formation in real-time based on GA we propose. Since a genetic algorithm computes a lot of solution candidates in real-time, it can be adapted for real-time combinatorial optimization problem to find semi-optimal solutions.

The aim of this paper is to solve this optimal allocation problem by a Genetic Algorithm. Our method can effectively avoid the growth of fatal genes.