University Timetabling in Minimum Area of Classroom Using Virus Evolutionary Theory

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Abstract

A genetic algorithm is a method used for combinatorial problems, and it is based on the theory of evolution by Darwin. Some suggestions have been made for the theory of evolution currently, and the virus evolutionary theory is one of them. This laboratory has so far developed a genetic algorithm using the virus evolutionary theory, and applied it to a variety of combinatorial problems. The standard genetic algorithm has used a number of chromosomes (individual), and an individual with high evaluation value is sought by selection, crossover and mutation. In the meanwhile, the genetic algorithm using the virus evolutionary theory (GAV) developed in this study is a method where improvement for an individual is carried out by attacking and infecting with a number of viruses.

University timetabling attracts researchers as interesting combinatorial problem. But the scheduling under the condition of the minimum number and area of classrooms for classes has not been seen.

Currently, in this university, a plan of turning an old building into a new one is being advanced. In this case, it is beneficial to design classrooms as small as possible. Here, the minimum number and area of classrooms for classes conducted in the six undergraduate school departments and the three graduate school departments in the faculty of science were sought, and it was tried to obtain the efficient class schedule for them. The maximum number of subjects was 640 in this case. The main object of this study is to carry out the scheduling in the minimum number and area of classrooms. If the constraint of the classrooms does not exist, the problem will become much easier.

The class schedule was created by GAV under the condition of the minimum number and area of classroom and the subjects of well balanced required subjects, simultaneously conducted subjects and day and time fixed subjects.

At first, the minimum number of classrooms and their area were obtained as follows. The subjects in all departments from Monday through Friday are listed in a line starting from the subject which has the largest number of students and they are totaled by the top twenty subjects because there are four sessions a day for five days from Monday through Friday. The number of

students for the top subject or the subject with the largest number of students among this twenty is the number to be accommodated in the classroom of the group. This method determines the minimum number and area of classrooms required.

GAV was carried out by attacking a chromosome by a number of viruses. The genes of the chromosome were recombined by the attack. The infection was recognized when the evaluation value goes up, but it fell into local minima easily.

In order to escape from these local minima, an infection which made the evaluation value worse in a small allowance rate (AR) under small permission rate (PR) was recognized as well. It was effective that AR and PR were decreased as the value of the objective function approach to the optimum value.

The authors already reported studies with the above contents (Saito, Tanifuji 2007). However, in order to obtain the optimum value of parameters related with the escapement from the local minima, that of each parameter related with AR and PR was obtained on trial and error basis up to the present. In this study for improvement, Design of Experiments (DOE) and Design Navigation Method (DNM) (Nakazawa 2001) were used in order to obtain the optimum values of the parameters related with the escapement from the local minima with fewer number of trial and error. DOE has the advantage in which various evaluation items are examined from fewer experiments. On the other hand, DNM is based on the concept of the information theory proposed by Shannon C. E, and this method is based on the principle "the system with the minimum value of integrated information is the best system."

In this study, procedures are advanced as follows. According to the orthogonal arrays of DOE, the various parameters required for the problem to be solved (four parameters in this study) and three-levels for these parameters are set. In addition, according to the combinations determined from the orthogonal arrays, value of integrated information at each level is calculated by DNM using the concept of the information theory. In this case, since the optimum value of the parameters is estimated within the region of the three levels, the level should be set within the region that is estimated including the optimum value. The value of the parameter showing the minimum value of integrated information among the obtained value is the optimum value of the parameter.

According to the above method, the estimated optimum value of four parameters related with AR and PR has successfully been obtained.

Reference

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