

THE COMPARATIVE CHARACTERISTICS OF METHODS FOR SOLVING LINEAR PROGRAMMING TASKS WITH BOOLEAN VARIABLES

In practice, there are a lot of tasks to be presented as a form of linear programming task with Boolean variables for their mathematical models. There is the mathematical model of such tasks as follows:

$$\chi(y) = \sum_{i=1}^n c_i y_i \rightarrow \min ,$$

at the following conditions:

$$\begin{cases} \sum_{j=1}^n a_{ij} y_j = b_j, i = 1, \dots, p \\ \sum_{j=1}^n a_{ij} y_j \leq b_j, i = p + 1, \dots, m \\ y_j \begin{cases} 0, \\ 1, \end{cases} j = 1, \dots, n. \end{cases}$$

There are many practical tasks, which are reduced to linear programming tasks with Boolean variables. For example, the task of job assignment of employees: there are N workers for N working places. The expenses for the assignment of I-employee to J-working place are known. Each worker is responsible for the one working process, so one process is performed by one employee. One needs to find some assignment of employees to jobs in order to minimize the total expenses on the appointment. The value of the variable is one, if the I-worker is assigned to the J-working place and equals zero otherwise.

There is one more task for the sources distribution for the fixed locations. It is as follows: there are N sources of physical fields and M fixed working places. We have to distribute the sources of physical field for the working places so that the value of the field at the point of measurement is minimum. There are following restrictions on source location:

- every working place is supported by only one source;
- every source supports no more than one working place;
- the number of distributed sources has to be maximum.

If the I-source is appointed to the J-place, the value of variable is one, otherwise it is zero. The set of feasible solutions in mathematical model of this task is defined by the system of linear equations with Boolean variables, and the objective function is linear at certain conditions. So, we have the task of linear programming with Boolean variables.

At resolving such solution each of these tasks can have different goals. If it is essential to achieve the most precise solution, so precise methods are used. However, the specifics of the actual conditions in which it is necessary to solve practical tasks, often does not allow to apply the precise methods. It is due to the fact that these tasks are huge and demand much time and computer memory. We had better get the fast and guaranteed solution if it has the current operational nature. Therefore, the research and development of approximate methods are becoming popular. In its turn, the results obtained by approximate methods can significantly deviate from the exact solution. Thus, it is reasonable to conduct the comparative characteristics of methods for solving linear programming problems with Boolean variables and for obtaining the particular opinion about the choice of the particular task.

The authors have developed the software, which includes the following methods for solving linear programming tasks with Boolean variables:

- the additive algorithm, which refers to the exact combinatorial methods. The algorithm contains a method based on branches and bounds. It is called additive because its computing operations include only addition and subtraction;
- the method of random search. The feature of this method is application of the iterative process of task solving, which is based on the replacement of the optimization task solving by systems of inequalities;
- the recession vector method, which is a local optimization method. This method uses the same conditions, which are common for all methods of local optimization(finding the value of the initial approximation and the radius of the circle of the point). But the rule of busting points based on the properties of the vector function, which is called the vector of recession and indicates the reduction the value function goals.

Microsoft OS family Windows is chosen as the target operating system, programming language Microsoft Visual C# is used for compatible platform. NET and the integrated development environment Microsoft Visual Studio 2012 is used to develop the software. The software finds the comparative characteristics for the mention above methods. The comparison is performed according to the following categories:

- the accuracy of the solution;
- the duration of solving the task depending on the dimension.

The conclusion. The software product is developed. It allows you to solve tasks of linear programming with Boolean variables using the additive algorithm, the random search and the method of vector recession. It also allows to find the comparative characteristics of these methods for the accuracy and time of solving depending on the dimension. The most optimal method for solving the such tasks was found.