SECTION 1

MATHEMATICAL PROBLEMS OF MANAGEMENT, OPTIMIZATION AND THEORY OF THE GAME

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ABOUT THE NATURE OF UNIVERSALITY OF METHODS OF COMBINATORIAL OPTIMIZATION

Annotation. It is shown that the universality of combinatorial optimization methods is related to the fact that the problems of this class are characterized by similarity, due to which they are solved by one method or modification of the same algorithm.

Keywords Similarity of problems of combinatorial optimization, combinatorial configuration, objective function, structure-alphabetical search method.

Introduction. In combinatorial optimization, you can cite many examples when problems from different classes are solved according to the same computational scheme. This is due to the fact that combinatorial optimization problems are similar on certain signs, in particular, according to the type of problem, the objective function argument, etc [1].

Formulation of the problem. The property of similarity is characteristic for many problems with combinatorics and combinatorial optimization. The development of universal algorithms is carried out with implicit account of this property. Therefore, one of the problems in the theory of combinatorial optimization is the identification of signs of similarity of these problems with the aim of generalizing and using for their solution effective universal approaches, which make it possible to find global or close to the global result.

The approach proposed. To solve this problem, it is necessary to establish, by certain criteria, the similarity of problems of combinatorics and combinatorial optimization problems of different classes. The use of the modeling method of the applied problems, which is developed within the theory of combinatorial optimization shows, that one of the main similarities is the type of the argument of the objective function and the type of the problem (static or dynamic). Combinatorial configurations of various types are similar in a way created and arranged, so they are generated by modifying the same algorithm.

Basic part. The theory of similarity establishes the criteria for the similarity of various physical phenomena, which allows them to study the properties of the phenomena themselves. Physical similarity is a generalization of the elementary notion of geometric similarity, in which the proportionality of the corresponding geometric elements of figures or bodies is ensured. Combinatorial optimization also has a similarity, which is due to the fact that universal methods and algorithms are usually used to solve combinatorial optimization problems of different classes. That is, it suggests that problems that are solved by universal approaches are similar in certain ways. This property differs from the geometric and described in the theory of similarity. Despite the huge number of publications on this theory, the similarity property in combinatorial optimization is not sufficiently highlighted. Also, there is no analysis of problems in order to identify the features by which they are solved by the same computational scheme.

In the modeling of applied problems within the framework of the theory of combinatorial optimization, it is necessary to highlight common features that are characteristic of the problems of this class. By way of calculating the objective function we have problems in which for a particular solution its value is calculated simultaneously. We call such problems static. The problems in which, in the process of

their solution, the current information generated by which the result is estimated is generated, and the search for the optimal solution is carried out in stages with the calculation of partial amounts of the objective function, we call the dynamic ones.

For simulation of applied problems within the framework of combinatorial optimization theory it is necessary:

- define the type of the problem (static or dynamic) by the way of calculating the target function;
- identify base sets which is given a certain problem;
- determine the type of problem for the input data;
- define the argument of the objective function (combinatorial configuration);
- modelling the objective function.

If we analyze the problems of combinatorial optimization for similarity, we can see that the main feature of their similarity is the type of the argument of the objective function, which are combinatorial configurations. Generation of the same combinatorial configurations of different types is also carried out according to the same scheme or modification of the same algorithm. In this case, similarity is determined by the way of their formation and ordering. Also, the static and dynamic combinatorial optimization problems are characterized by their characteristic, similarity signs.

Definition. We call similar problems of combinatorials or combinatorial optimization problems of different classes, which are solved by the same computational scheme or modification of the same algorithm.

The applied problems are complex in nature and the main the problem is usually divided into subtasks and the objective function, which evaluates the optimal solution, depends on several variables, which are combinatorial configurations of different types. To solve each of these subtasks, different procedures are used that work in the iterative mode. Recognition of speech signals and the problem of clinical diagnosis, which relate to different classes, are divided into similar types of subtasks, whose objective function depends on combinatorial configurations of the same type. According to the argument of the objective function, these problems are similar and solved according to the same computational scheme. The problems of combinatorial optimization, the argument of the objective function in which there are permutations (of traveling salesman problem, the problem of placement of one dimensional objects, the assignment problem) are solved by universal methods, in particular by structure-alphabetical search method [2]. This method is based on the recognition of the structure of the input data. It used a well-known solvable case consisting of the fact that for two sets of permutations, which are given by systems (a) and (b), the objective function $\sum ab$ is introduced. For these systems, permutations are defined, for which $\sum ab$ the largest or smallest values acquire.

The work of the method of structural-alphabetical search requires the modeling the basic problem by an ordered. The search for the optimal solution for the basic problem is carried out using by an ordered by one of the same computational scheme for different problems classes. When constructing an argument for which the target function acquires an optimal value, the nature of a particular problem is taken into account. Similarly, this method solves problems whose objective function is introduced in a subset of isomorphic combinatorial configurations.

Conclusion. Consequently, the universality of methods and algorithms is determined by the similarity of problems of combinatorial optimization. To establish it in the modeling of applied problems, it is necessary to identify common signs for them. This allows you to solve problems of different classes by the same method or modification of the same algorithm. Detection of signs, which sets the similarity of the problems of combinatorial optimization of different classes, will allow a large part of them to be reduced to a small number of standard schemes, possibly canonical forms. This will enable the development of adequate mathematical models and the choice or development of effective universal methods and algorithms for their solution.

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