COMPUTER NETWORK TOPOLOGICAL DESIGN AND K-GEODETIC GRAPHS

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INTRODUCTION

Constantly growing demands of high productivity and security of computer systems and computer networks call the interest of specialists in the environment of construction of optimum topologies of computer mediums. In earliest phases of design, the study of the topological influence of the processes that happen in computer systems and computer networks allows to obtain useful information which possesses a significant value in the subsequent design. In this monograph, author tries in summarized way, to expose the fundamental problems of topological design in computer technology. The problems of topological analysis and topological synthesis of the computer systems of multiprocessing and computer systems have been formulated, and these problems have been resolved in form of classes of geodetic and bigeodetic graphs with extreme topological parameters that correspond to the parameters of speed of information transmission, productivity, and security with limitations in costs. In the phase of topological design, the computer network is represented in graph form whose vertices correspond to the nodes of information processing, and edges correspond to the communication lines. Solution of the problems proposed in this monograph conduct to the construction of geodetic and bigeodetic graphs, which represent topologies of computer systems and computer networks that possess maximum homogeneity. This determines a concrete class of structures whose study is based on numerical introduction of indices of homogeneity. Elaboration of the network topology with extreme properties, such as maximum security or minimum diameter for a number given of nodes (machines) and edges (communication lines), is carried out enlarging gradually the number of nodes in the original k-geodetic graph. Such procedures of construction are related to the transformation, extensively utilized in graph theory, called homeomorphism. A condition is that once executed said transformation upon the graph, it follows conserving the property of geodesity, which reflects the fact that among each pair of vertices, a unique path of minimum length there exists. When the number of nodes and communication lines is not large, the choice problem of the network's optimum topology is resolved for different heuristic methods of local optimization. However, tendency to develop the computer systems of multiprocessing and computer networks conducts to a formation of topologies that in themselves include thousands of nodes and communication lines. The optimization of such topologies only with the help of heuristic methods can have multiple difficulties of calculation. Therefore, the regular and biregular methods of topological construction of k-geodetic networks developed in this monograph represent interest. This author has presented some existing methods of topological construction of k-geodetic networks, has elaborated new methods of construction of said networks and has built generalized algorithms of these methods. Geodetic graphs possess magnificent structural properties since their construction is based on levels of hierarchy that is to say, the same principle of construction in which the computer networks are based. Therefore, the

structural methods and algorithms here proposed can be used not only in the design of computer systems and computer networks, but also in the design of other systems.

This job includes the following topics. In chapter 1, the principles of organization of computer systems as base of construction of information processing systems have been described. This section has been designed based on the results obtained in [33]. In chapter 2, the structural bases of network design, and the general methodology of topological analysis and synthesis of systems have been described. In chapter 3, a detailed description about the advantages of the practical utilization of k-geodetic graphs in the topological design of computer networks has been described. Some results related to characterization, construction, and enumeration of such classes of graphs have been examined, and a new orientation to the approach of these three fundamental problems in the general geodetic graph theory have been presented. In chapter 4, the structural description of geodetic graphs in terms of their minimal even cycles has been studied. In transit, a type of characterization that allows determining by means of a quick inspection, if a given connected graph G is not geodetic, has been formulated. In the remaining part of this section, two types of BIB-Designs have been constructed, that at the same time, allowed to construct two large classes of bigeodetic graphs. In chapter 5, for the first time, the problem of constructing all geodetic graphs, homeomorphic to a given geodetic one, has been examined, and utilizing tools of combinatorial theory, the general number of some classes of these graphs has been found. Finally, in chapter 6, the exam of topological analysis and synthesis of the constructed k-geodetic networks has been carried out and it has been shown, that from the point of view of the quality of their operation, they are optimum according to the criteria of cost, security, maximum speed of information transmission, and productivity.