REPORTS OF THE NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
ISSN 2224-5227 **https://doi.org/10.32014/2019.2518-1483.18**
Volume 1, Number 323 (2019), 117 – 121

УДК 004.383.3

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MATHEMATICAL AND ALGORITHMIC MODELS OF INFORMATION PROCESSING AND MANAGEMENT SYSTEMS

Abstract. The article presents mathematical and algorithmic models of information processing and control systems. The algorithm should be standardized for all permissible input data, since the development of an algorithm is a process that is quite creative, therefore it requires significant costs and time and mental effort, and therefore, it is preferable that it provides a solution to unique tasks and developed to solve one problem. Regarding the purpose of information models, it is often in obtaining data to achieve the best performance indicators of a modeling object that can be used to prepare and make decisions of an economic, social, organizational or technical nature. Mathematical models consider many different functional dependencies, however, the main problem of modern systems for constructing mathematical models is still obtaining analytical equations describing the dynamics of the system under study.
Keywords: computer science, information, algorithmic model, computer system, logical design.

INTRODUCTION

With the development of information theory, cybernetics, information science as a science, the concept of “information” (from the Latin infor-matio - information, clarification), along with the concepts of “material”, “energy”, “space” and “time” lay The basis of the modern scientific picture of the world. At the same time, the unambiguous definition of this concept does not yet exist.

All approaches to the phenomenon of information have the right to exist and are explored in the relevant areas of science. "In computer science, information can be viewed as a product of the interaction of data and methods for their processing that are adequate to the problem being solved."

The word "algorithm", "algorithm" comes from the name of the outstanding scientist of the ninth century, Muhammad ibn Musa al-Khorez (translated from Arabic, Muhammad, son of Musa from Khorez ¬). According to the Latin translation of his work (XII century), Western Europe became acquainted with the decimal positional number system and the rules (algorism) of performing arithmetic operations in it.

MAIN PART

Formalization of the concept of algorithm. In all areas of its activities, in particular, in the field of information processing, a person is faced with various methods of solving problems. They determine the order of actions to obtain the desired result - we can interpret this as the initial or intuitive definition of the algorithm.

An algorithm is a finite prescription given in a language, defining a finite sequence of executable elementary operations for solving a problem, common to a class of possible input data.

Variants of the verbal definition of the algorithm belonging to Russian scientists and mathematicians A. N. Kolmogorov and A. A. Markov:

An algorithm is any system of computations performed according to strictly defined rules, which after some number of steps deliberately leads to the solution of the problem (Kolmogorov) .

The algorithm is an exact prescription that defines the computational process, going from variable input data to the desired result (Markov).

Algorithm Properties:

• Discretion. The algorithm consists of consecutive commands, only by executing one command, the performer can proceed to the next one. That is, the structure of the algorithm is discrete (interrupted).

• Extremity. The algorithm contains a finite number of elementary executable prescriptions, i.e., it satisfies the requirement of finite notation. The executor of the algorithm must perform a finite number of steps in solving the problem, that is, the algorithm satisfies the requirement of finiteness of actions.

• Accuracy (certainty). Each instruction of the algorithm must determine the unique action of the executor. This property often does not have prescriptions and instructions that are drawn up for people.

• Understandable. Each command of the algorithm should be clear to the performer. The algorithm is not designed to make independent decisions by the performer, not specified by the compiler of the algorithm.

• Universality (mass). The algorithm should be the same for all valid source data. The development of an algorithm is a creative process, but requiring a considerable amount of time and mental effort, so it is desirable that it provide a solution to the problems of this type. This property is optional; equally important are unique algorithms designed to solve one problem.

The algorithm presupposes the presence of an executor - a human or technical device (automatic, robot, computer) with a strictly defined set of possible commands. The set of commands that can be executed by the executor is called an executive command system (SKI). The performer can execute commands from SKI and nothing more.

The algorithm allows you to formalize the execution of the processing of the source data and obtaining the result. This is the basis of the work of software-controlled executive automata, such as industrial robots. The operator is not required to understand the essence of the algorithm, he must accurately execute commands in a given sequence.

An example of a performer who automatically performs various algorithms is a computer. Consider recording a television program onto a hard disk of a television program using a TV tuner. By specifying the start and end time in the schedule, by checking the "check box" next to "Turn off computer after recording", the user can be sure that the program will be recorded and the computer will be turned off. All the assigned work will be performed by the computer according to the algorithm developed earlier, without making any changes (other transfer, other time, not turning off the computer).

Verbal description is applicable only for the simplest algorithms. In the case when the links between the actions are complicated, a high degree of detail leads to a cumbersome description.

The description in the algorithmic language (pseudocode) is realized with the help of natural language words, but in a special form that reflects the structure of the algorithm. Increasingly, verbal description and writing on algorithmic language is reduced to one method - verbal.

Mathematical processing of statistical data, the results of the experiment. The use of dynamic (electronic) tables for processing and presenting the results of natural science and mathematical experimentation, economic and environmental observations, social surveys.

Mathematical processing of statistical data, experimental results.

The dependencies between the parameters of a certain object, process, phenomenon can be expressed using mathematical formulas. But in some cases the coefficients in these formulas can be obtained as a result of statistical processing of experimental data. Statistics is the science of collecting, measuring and analyzing large amounts of quantitative data. Statistics are approximate, averaged, obtained by repeated measurements. The mathematical apparatus of statistics develops a section of science called "Mathematical Statistics". Statistical data are used, in particular, to obtain a simplified mathematical description of a complex or unknown relationship between the data of a certain system (regression models). The statistical functions of spreadsheets make it possible to process statistical data, for example, to calculate the arithmetic mean of numerical data (AVERAGE), the geometric mean of the positive number of data, the minimum and maximum values from the data set, perform calculations (COUNT, COUNTDOWS, COUNT, COURT READINGS, etc.).

Models can be material and informational. Material models reproduce the physical, geo- metric and other properties of the object. Examples: a globe, a skeleton, models of buildings and bridges, models of airplanes, ships, automobiles.

The subject of study of computer science are informational models. Information models represent objects in a figurative or symbolic form. The object of information modeling can be physical (body fall), chemical (combustion reactions), biological (photo synthesis in plant leaves) processes, meteorological phenomena (thunderstorm, tornado), economic (currency devaluation), social (migration, population growth) processes, etc. A sign information model can be presented in the form of text (a program in a programming language), formulas (Newton's second law F = ma), tables (periodic law D. I. Mendeleev), maps, diagrams, drawings (language is used graphically x elements). Natural languages are used to create descriptive information models (the heliocentric model of the world of Copernicus). With the help of formal languages, formal informational models (mathematical, logical) are built. Models built using mathematical concepts and formulas are called mathematical models. In physics, many different functional dependencies are considered, expressed in the language of algebra, which are mathematical models of the phenomena or processes under study.

The subject of study of computer science are the general principles of building information models. The computer allows scientists to work with such information models that require large amounts of computation that are not possible in the "pre-computer" era. Only with the help of a computer, it became possible to calculate the forecast for the day before tomorrow.

The same object can have many different models, and the same model can describe different objects.

The purpose of information models is often to obtain data that can be used to prepare and make decisions of an economic, social, organizational or technical nature, in order to achieve the best performance indicators of an object of modeling. The object of modeling can be considered as a system. A system is a complex object consisting of interconnected parts (elements) and existing as a whole. Every system has a specific purpose (function, goal). A structure is a set of connections between elements of a system, i.e., the internal organization of a system.

To reflect the state of the systems, static and dynamic models are used.

Models that describe the state of a system at a specific point in time are called static information models (the structure of molecules, the structure of the solar system, the “System of Nature” by C. Linnaeus).

Models describing the processes of change and development of systems are called dynamic information models (the process of a chemical reaction, nuclear reaction, body movement, the development of organisms and populations).

To reflect systems with different structures, various types of information models are used:

- Tabular models are used to describe objects with the same property sets. Can be dynamic and static. The properties of an object are presented in the form of a list, and their values are placed in the cells of a rectangular table (the law and the Periodic Table of Chemical Elements of DI Mendeleev).

In hierarchical models, objects are distributed in levels. Each element of a higher level can consist of elements of the lower level, and an element of the lower level can be part of only one element of a higher level (genealogical tree, classification of objects).

- Network models are used to reflect such systems in which the connections between the elements have a complex structure (the Internet, a telephone network, a ball transfer process in a collective game, for example, in football). Can be static and dynamic.

For computing systems, called real-time systems [10], time is the most important parameter that determines the results and allows calculating the derivatives of parameters over time — speed and acceleration of the calculated values. Termination of the time measurement in this case is equivalent to a complete system failure, since the time connection of the computing process is lost with the state of sources of external information and consumers of the data generated. In addition to direct participation as a parameter when changing the values of variables and generating output values, the real time in such systems is used to regulate the sequence of solving various kinds of periodic tasks, which is also directly related to the operation of external subscribers.

The volume of tasks and the rate of their solution in control systems determine not only the required performance of the control aircraft, but also the amount of long-term memory of programs and constants. The average time of a task solving cycle depends mainly on the performance of the control aircraft and the program complexity of the tasks to be solved. The delay of messages before processing, apart from these parameters, is greatly influenced by the type and method of using long-term memory for storing programs, which determines the minimum time for searching and accessing any program. In addition, as the time for a complete solution cycle decreases, the certainty of the list of tasks to be solved increases and the degree of specialization of the structure of devices and memory of the control aircraft increases. However, it is assumed below that the main factor determining the effectiveness of the methods of organizing the computational process is the use of VS performance, and the efficiency of using program memory is not analyzed.

CONCLUSION

Depending on the types of functional tasks to be solved and the purpose of the control system, the requirements for the characteristics of the means of organizing the computational process in real time are significantly changed. This circumstance can be used to classify control and information systems and the aircraft used in them. As parameters that allow classification of control and information systems by type, it is advisable to take the allowable waiting time for the results of solving a certain problem (system reactivity) and the average time interval between a complete repetition of solving single-type tasks (system cyclicality) [9]. The classification of this type takes into account the main feature of the control aircraft associated with solving problems in real time and with the efficiency of management processes and the distribution of computing resources. These indicators are determined mainly by the inertia of objects and systems under control actions, and the necessary periodicity of the adjustment of their states on the part of the control system. In this case, as a rule, the allowable waiting time for the results of processing a message or solving a certain problem is one-two orders of magnitude less than the average repetition interval for solving single-type tasks.

УДК 004.383.3

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АҚПАРАТТЫҚ ЖҰМЫС ЖӘНЕ БАСҚАРУ ЖҮЙЕСІНІҢ МАТИМАТИКАЛЫҚ ЖӘНЕ АЛЬГОЙТИМИЙ МОДЕЛДЕРІ

Аннотация. Мақалада ақпаратты өңдеу және басқарудың математикалық және алгоритмдік модельдері ұсынылған. Алгоритм барлық рұқсат етілген деректер бойынша стандартталған болуы керек, себебі алгоритмді жасау өте креативті процесс, сондықтан ол айтарлықтай шығындар мен уақытты және ақыл-ойды қажет етеді, сондықтан ол бірегей міндеттерді шешуге мүмкіндік береді және бір мәселені шешу үшін әзірленген. Ақпараттық модельдердің мақсаты туралы ақпарат көбінесе экономикалық, әлеуметтік, ұйымдық немесе техникалық сипаттағы шешімдерді дайындау және қабылдау үшін пайдаланылуы мүмкін модельдеу объектісінің ең жақсы көрсеткіштеріне қол жеткізу үшін деректерді алу болып табылады. Математикалық модельдер әртүрлі функционалдық тәуелділіктерді қарастырады, алайда математикалық модельдерді құрудың қазіргі заманғы жүйелерінің негізгі мәселесі зерттелетін жүйенің динамикасын сипаттайтын аналитикалық теңдеулерді алу болып табылады.
Түйін сөздер: информатика, ақпарат, алгоритмдік модель, компьютерлік жүйе, логикалық дизайн

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МАТЕМАТИЧЕСКИЕ И АЛГОРИТМИЧЕСКИЕ МОДЕЛИ СИСТЕМ ОБРАБОТКИ ИНФОРМАЦИИ И УПРАВЛЕНИЯ

Аннотация. В статье представлены математические и алгоритмические модели систем обработки информации и управления. Алгоритм должен быть стандартизирован для всех допустимых исходных данных, так как разработка алгоритма – это процесс достаточно творческий, поэтому требует значительные затраты и времени, и умственных усилий, в связи с чем, предпочтительно, чтобы он обеспечивал решение задач уникальными и разработанные для решения одной задачи. Относительно назначения информационных моделей, то зачастую в получении данных для достижения наилучших показателей деятельности объекта моделирования, которые могут быть использованы для подготовки и принятия решений экономического, социального, организационного или технического характера. Математические модели рассматривают множество различных функциональных зависимостей, однако, основной проблемой современных систем построения математических моделей по прежнему получение аналитических уравнений, описывающих динамику исследуемой системы.

Ключевые слова: информатика, информация, алгоритмическая модель, вычислительная система, логическое проектирование

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