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THE DECOMPOSITION METHODS OF COMPLEX DATA PROCESSING SYSTEMS

Abstract. This work deals with the mathematical model and algorithm of complex data processing systems decomposition. The task is narrowed down to the discrete programming block-symmetric task. For its solution, taking into account peculiarity of the model, the efficient solution algorithm is suggested.

Key words: block-symmetric model, algorithm, component, decomposition, task.

Introduction. The basis of information systems is the data processing system. The latter has a complex structure and a large amount of tasks interacting with databases depending on information systems being developed. Thereforeб when designing data processing systems there arises the necessity for decomposing the systems into loosely-bound components with separate groups of developers. It enables more effective designing of a data processing system and reduces time required for its creation. In this regard the need arises for developing effective methods of decomposing data processing systems into components.

The task set-up. For mathematical set-up of the task we enter the following variables and notations.

Assume that there are set multiple data processing systems tasks $A = \{a_i; i = \overline{1,I}\}$, multiple databases $B = \{b_j; j = \overline{1,J}\}$ for solving the tasks, $W = \|\omega_{ij}\|$ – interconnection matrix of multiple tasks and data bases connected to it. It is needed to break down the set up data processing system into separate components that minimize the interlink between them with the aim of distributing them among the system developers.

We enter the following variables

$$x_{mi} = \begin{cases} 1, if\ the\ task\ i\ is\ included\ in\ group\ m; \\ 0, otherwise \end{cases}$$

$$y_{jn} = \begin{cases} 1, if\ the\ database\ j\ is\ included\ in\ group\ n; \\ 0, otherwise \end{cases}$$

Then, we can define the task of breaking down the complex data processing system which minimizes connections between components, as follows

$$\sum_{m=1}^{\bar{M}} \sum_{i=1}^{\bar{I}} \sum_{j=1}^{\bar{J}} \sum_{n=1}^{\bar{N}} x_{mi}\, \omega_{ij}\, y_{jn} \to min$$

If there are constraints, into;

- number of tasks in group m

$$\sum_{i=1}^{I} x_{mi} \le S_{m,} m = 1, M,$$

Where *M*-number of groups of the data processing system;

- each task must be only in one group

$$\sum_{m=1}^{M} x_{mi} = 1, i = 1, I,$$

where *I* – number of tasks of the data processing system;

- number of data bases in group *n*

$$\sum_{j=1}^{J} y_{jn} \le C_{n,} n = 1, N,$$

where *N* – number of data bases of the data processing system;

- each data base must be only in one group

$$\sum_{n=1}^{N} y_{jn} = 1, j = 1, J,$$

J – number of data bases of the data processing system.

By the component we shall understand the composition of tasks in *m* group, composition of data bases in *n* group and interlink between groups *m* and *n*. Having said that, each component is distributed among the data processing systems developers with the consideration of complexity of each component and developers' qualification.

The defined task is related to the block-symmetrical tasks of discrete programming. For its solution there is proposed an effective algorithm.

The task solution algorithm. The task solution algorithm consists of the following steps. It is to be noted that for solving the task, the basis is defined by the number of breakdown components of the data processing system.

STEP 1. Entering of the matrix *W*. Selecting the basis in the matrix *W*. Switch to *step 2.*

STEP 2. Calculation of d_{mi} values and the matrices of $D = \|d_{mi'}\|$ forming solution search direction. Switch to *step 3.*

STEP 3. By searching the minimal element in D matrix by means of iteration, the solution $X = \|x_{mi}\|$ shall be defined. The condition of the intermediate matrix shall be recorded $\Pi = \|\pi_{mj}\|$, switch to *step 4.*

STEP 4. Calculation of the matrix d_{jn} with respect to π and formation of the matrix $D = \|d_{jn}\|$. Switch to *step 5.*

STEP 5. By searching the minimal element in D matrix by means of iteration, the solution $Y = \|y_{jn}\|$ shall be defined. Switch to *step 6.*

STEP 6. The outcome of the task solution: matrices X, Y and π. The value of the objective function $\omega = \|\pi\|$

Thus, on the basis of the block-symmetric models and methods many designing tasks of information systems can be solved.

REFERENCES

[1] Kaziev G.Z. The block symmetric models and methods of setting and solving discrete programming tasks // RoK Engineering Academy Periodical № 2 (10). Almaty, **2000**. p.55-59.

[2] Kaziev G.Z., Sagimbekova A.O., Nabieva G.S., Ospanova S.B. The effective solution algorithm of block-symmetric tasks //Periodical of K.I.Satpayev KazNTU.-Almaty, **2003**. № ¾ (37/38). p. 310-315.

[3] Umekov A.K., Kaziev G.Z., Abylhasenova D.H. Engineering methods of computer systems // International scientific journal. RoK application «Izdenis-Poisk», Series of natural and technical sciences №2 (1). Almaty, **2013**. p.121-125

[4] Posylkin M.A., Seagal I.H., Galimyanova N.N. Parallel computation algorithm for solving discrete optimization tasks of certain grades. M.: FIZMAT, **2002**.

[5] Seagal I.H., Ivanova A.P. Introduction to the applied discrete programming.-M.: FIZMATLIT, **2002**.

[6] Kaziyev G.Z., Markosiyan M.B., Taurbekova A.A. Methods of distribution of data processing systems to the nodes of computing systems. Number 430 (**2018**). Vol. 3. P.124-131. News of the national academy of sciences of the Republic of the Kazakhstan. Series of geology and technical sciences (in English)
http://www.geolog-technical.kz/images/pdf/g20184/124-131.pdf

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ДЕРЕКТЕР ҚОРЫН ӨҢДЕІҢ КҮРДЕЛІ ЖҮЙЕСІНІҢ ЫДЫРАУ ӘДІСТЕРІ

Аннотация. Берілген жұмыста деректер қорын өңдеудің күрделі жүйесінің ыдырау әдістерінің математикалық моделі және оны шешудің алгоритмі қарастырылған. Алдыға қойылған мақсат блоктық-симметриялық дискретті бағдарламалау мәселесі арқылы шешіліп және оны шешудің ерекше әдісінің тиімді алгоритмі ұсынылады.

Түйін сөздер: блок-симметриялық модель, алгоритм, компонент, ыдырау әдістері (декомпозиция), есеп.

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МЕТОДЫ ДЕКОМПОЗИЦИИ СЛОЖНЫХ СИСТЕМ ОБРАБОТКИ ДАННЫХ

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Аннотация. В работе рассматривается математическая модель и алгоритм декомпозиции сложных систем обработки данных. Задача сведена к блочно-симметричной задаче дискретного программирования. Для ее решения с учетом особенности модели предложен эффективный алгоритм решения.

Ключевые слова: блочно-симметричная модель, алгоритм, компонента, декомпозиция, задача

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