THE MATHEMATICAL SUBSTANTIATION OF THE ORGANIZATIONAL PROCESS OF THE AUTHORIZED ACCESS TO THE ORGANIZATIONAL-METHODICAL INFORMATION "THE DEAN'S OFFICE OF THE HIGHER EDUCATIONAL INSTITUTION"

Tamara Savchuk, Oksana Chumachenko, Ganna Bondarchuk

[1]Vinnytsia National Technical University

Khmelnitske Shosse, 95, Vinnytsia, 21021, Ukraine, Tel.: (0432) 44-68-48

Abstract

In the given work it was offered the mathematical substantiation of the organizational process of the authorized access to the data "The Dean's Office" that doesn't give a possibility to receive by subjects the unforeseen rights of access, the infringement of the integrity of the data. It was developed the system for the management of the database that automates the process of filling and changing the database. The developed mathematical substantiation will allow controlling the access to the database "The Dean's Office" in the researched subject domain. It is very important in our case as the database contains important and even confidential information

Today an effective organization of database is an actual problem in many spheres of human activity that can give a possibility to receive the access to the necessary information quickly and conveniently. Thus the problems of database's protection prom non-authorized access take an important place.

Let's examine the mathematical substantiation of the organizational process of the authorized access to the database "The Dean's Office of the Higher Educational Institution".

Let the subset {sel, del, upd} of the set {ins, sel, del, upd}, which we'll name the right of access, include the rights of data modification, where ins - the operation of reading, sel - the operation of writing, del - the operation of deleting, upd - the operation of reconstruction.

Let name the base "The Dean's Office of the Higher Educational Institution" as a B, and as a z-an informational object (the students, the scores, the grant), that can be showed by the expression $z = (I, \rho)$, where the I is a set of the informational tables (the scores, the mark, the rating of the students), and the ρ is the relation of the reference to the set of tables T (the academic group, the scores, the discipline, the course work, the mark etc.). Than the binary ratio $\rho \subseteq T^2$ is given in such way that $t_1 = (M_1, K_1)$, and $t_2 = (M_2, K_2)$ and $t_2 \rho t_1$, than the not-empty subset K_{12} is fixed in M_2. For the K_{12} is executed the condition of reference to the integrity of the tables:

$$D_{K_{12}} \subseteq D_{K_1}. \tag{1}$$

In this case let's name the K_{12} as the external key of the table t_1.

The pair

$$t = (M, K) \tag{2}$$

we'll name the table, where the M is the attributes of the table (for example to the table STUDENT corresponds such attributes: the form of studying, the previous education, the photo, the number of the test book etc.) and the K is the primary key of the table (the number of the test book, the name of the group etc.) [1]

The rectangular matrix M we'll name as the matrix of the rights of access to it. The line in it are named the base subjects and the element $M[u,(z,q)]$ in the line u and the column which corresponds to (z,q) as the right of the access of the subject to the data (z,q), where the q is the meaning of the primary key of the object z (for the object STUDENT the primary key is the number of the test book), which is called the identifier of this object. So, the set K_{12} is empty, and the subject u doesn't have the right of the access to the given (z,q); if one of the operations {ins, sel, del, upd} belongs to $M[u,(z,q)]$ than we can approve that the subject u in reference to the given (z,q) has the right of reading, writing, deleting or reconstruction. All the columns that correspond to the given (z,q) with fixed z we'll name the columns for the object z.[2]

Let's designate as a φ every of these operations, than $\varphi(M)$ is the matrix that is the result of the application of the φ to the matrix M. Let's assume that φ={φ₁, φ₂,..., φₙ} is an arbitrary sequence of designated operations. So,

$$\varphi(M) = \varphi_n(...(\varphi_2(\varphi_1(M)))...). \tag{3}$$

Let's introduce the designations: φ is an arbitrary enlistment from the operations of transformation of the matrix M; $\psi(M)$ is the formula of the algebra of expressions, built from elementary expressions like

$$r \in M[u,(z,q)], \tag{4}$$

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where $M[u,(z,q)]$ is an arbitrary element of matrix M; then the pair $k = (\psi(M),\varphi)$ appears as the command of change of the rights of access given by matrix M. In it the ψ is the condition to the use of the command. The result of the use of the command k to M is the matrix $k(M)$ such that $k(M) = M$ if $\psi(M) = \pi$ and $k(M) = \varphi(M)$ otherwise.

If $k = k_1 k_2 \ldots k_n$ is an arbitrary sequences of the commands of the change of the access rights to the M than the result of its application to the M we'll show like the matrix

$$k(M) = k_n(\ldots(k_2(k_1(M)))\ldots).$$ (5)

The set of the results of the application to the matrix M of different final sequences of commands from a set K the commands of the change of the access we'll designate as a $K^*(M)$. If M is the matrix of the rights of access to the database "The Dean's Office of the Higher Educational Institution", then the M matrix in the $K^*(M)$ is named the condition of the access to this database.

Let be the u an arbitrary subject of the database, μ is its condition of access, z (the student, the score, the grant) is its object, d is an arbitrary data, the same-type with z, s is the meaning of the primary key in the d and the P is a logical expression that belongs to the object z [3]. Let it be for the operation with the name Nam that can be described as

$$Nam \in \{Sel, Ins, Del, Upd\};$$ (6)

$\beta = (Z,\rho,\chi)$ is the database "The Dean's Office of the Higher Educational Institution "; u is the subject of the base β; μ is its condition of the access; z is the object in the β; α is the way of addressing of the data.

The operation effects only on the data in the base, changing the meanings of the tables in Z and storing the parameters ρ, χ. The result of the operation is the database, the same-type with the β.

The first two operations- Sel and Ins-are executed as sel and ins independently from the reference ρ and its properties χ in the database "The Dean's Office of the Higher Educational Institution":

$$Ins(u,\mu,\beta,z,d) = (Z^*,\rho,\chi), \text{ де } Z^* = Z - \{z\} \cup \{ins(u,\mu,z,d)\};$$
$$Sel(u,\mu,\beta,z,P) = (Z^*,\rho,\chi), \text{ де } Z^* = \{sel(u,\mu,z,P)\}.$$ (7)

The operations Upd and Del may be showed as upd and del in dependence from the parameters ρ and χ of the database "The Dean's Office of the Higher Educational Institution" in such way.

Then for Nam {ins, del, upd}:

$$nam(u,\mu,z,d) = \begin{cases} z, \text{ якщо } nam \notin \mu[u,(z,s)], \\ nam(z,d) \text{ в противному випадку} \end{cases};$$ (8)

we have

$$sel(u,\mu,z,P) = select(z - \{(z,q): sel \notin \mu[u,(z,q)]\},P);$$
$$del(u,\mu,z,P) = delete(z - \{(z,q): del \notin \mu[u,(z,q)]\},P);$$ (9)
$$upt(u,\mu,z,dP) = update(z - \{(z,q): upd \notin \mu[u,(z,q)]\},dP).$$

If in Z exists the object z_2 such that $z_2 \rho z$ and $\chi(z_2,z) = 0$, then

$$Del(u,\mu,\beta,z,\alpha) = Upt(u,\mu,\beta,z,\alpha) = \beta.$$ (10)

Otherwise

$$Del(u,\mu,\beta,z,\alpha) = (Z^*,\rho,\chi) \text{ i } Upt(u,\mu,\beta,z,\alpha) = (Z',\rho,\chi).$$ (11)

So, it was offered the mathematical substantiation of the organizational process of the authorized access to the data "The Dean's Office of the Higher Educational Institution" that doesn't give a possibility to receive by subjects the unforeseen rights of access, the infringement of the integrity of the data [4].

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