Интернет-журнал «Науковедение» ISSN 2223-5167 https://naukovedenie.ru/

Том 9, №5 (2017) https://naukovedenie.ru/vol9-5.php

URL статьи: https://naukovedenie.ru/PDF/38TAVN517.pdf

Статья опубликована 10.10.2017

Ссылка для цитирования этой статьи:
Кульба В.В., Сиротюк В.О., Сиротюк О.В. Модели и методы анализа и структуризации предметных областей пользователей облачных технологий // Интернет-журнал «НАУКОВЕДЕНИЕ» Том 9, №5 (2017) https://naukovedenie.ru/PDF/38TAVN517.pdf (доступ свободный). Загл. с экрана. Яз. рус., англ.

For citation: Kul'ba V.V., Sirotyuk V.O., Sirotyuk O.V. [Models and methods for analyzing and structuring the domains of cloud technologies users] Naukovedenie, 2017, Vol. 9, no. 5. Available at: http://naukovedenie.ru/PDF/38TAVN517.pdf (In Russ.)

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Models and methods for analyzing and structuring the domains of cloud technologies users

Abstract. The paper is devoted to the problem of using the paradigm of cloud computing during development of IT-systems. The article proposes formalized models and methods for analyzing users' domains and user classification as cloud database users (CDB) and users of local databases (LBD). Expediency is determined by given degree of generality between the domains of the set of users. Next, for a group of users of a private cloud based an object-oriented approach and an object-oriented data model (OODM), we design and analyze the object model of user requirements, the generalized object model of the domain and the canonical structure of the cloud database (CDB). Designing of object models of user requirements is carried out in 2 stages. At the first stage is carried out construction and normalization of information structures of users. At the second stage, users' data processing requirements are reflected on the generated information structures. The obtained results can later be used in the design of object-oriented logical and physical structures of CDB. The developed methods and algorithms were used to create the information infrastructure of the Eurasian Patent Office of the Eurasian Patent Organization.

Keywords: cloud technologies; domains; cloud databases users; local databases users; information commonality of users' domains; object of the domain; function of similarity of objects; object model of user requirements; generalized object model of the domain; object canonical structure of the cloud database

The paradigm of cloud computing is currently actively used in the implementation of IT-systems of a different class and purpose [1, 2]. The use of the cloud as an information and technology environment for distributed data processing, providing on a subscription basis ubiquitous network access for users to a pool of configurable on-demand resources (servers, storage systems, applications, software, databases, information and services) of the cloud provider, provides the following important benefits for the organization:

- a significant reduction in capital and operating expenses, including acquisition of expensive computer hardware, licensed system and application software, their constant maintenance and upgrade, the establishment and operation of IT departments;
- availability and mobility: access to information and applications can be obtained from anywhere in the world via computers and mobile devices (smartphones, laptops, tablets) connected to the Internet;
- agility and leading edge technologies: necessary resources (information, computing, software) are promptly provided, configured and released by the cloud provider at the request of users with minimal operational and time costs;
- cost-effectiveness: the paradigm of cloud computing is based on the fact that the required resources are provided to users on demand and are paid only for the actual use. The main type of services provided by cloud technologies are: SaaS (software as a service), PaaS (platform as a service) and IaaS (infrastructure as a service). Varieties of these services include STaaS (storage as a service), DBaaS (database as a service), INaaS (information as a service) and some others [1, 2, 3];
- reliability: clouds are based on full-fledged data centers, including dozens and hundreds of servers scattered over the Internet, powerful storage systems and various software created and maintained by specialized organizations staffed by highly skilled IT specialists. Construction and operation of such data centers require significant capital expenditures, which are unavailable for many organizations to build data centers on their own.

In Russia, cloud computing has not yet become so widespread as in the West. This is explained not only by the lack of understanding of the new paradigm, but also with extreme caution associated with the risks of "moving" business processes, software and information in the cloud and related security issues.

Depending on the purpose, there are 4 types of clouds [3]: private, public, community and hybrid.

Private cloud is represented in the form of an IT infrastructure, designed to be used usually by one organization (enterprise). A private cloud can be owned, managed, and operated by both the organization itself and the cloud provider, or a combination thereof. Physically, it can be located both inside the organization and outside it (on the side of the cloud provider).

The public cloud is an IT infrastructure designed for public use. A public cloud may be owned, managed and operated by commercial, scientific and governmental organizations (or any combination thereof) and physically located at the facilities of the service provider. Users do not have the ability to manage this cloud, and all responsibility for its maintenance is taken by the owner of the resource.

Community cloud. The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns. It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.

A hybrid cloud is a combination of two or more different cloud infrastructures (private and public). Often this type of cloud is used when the internal IT infrastructure of a private cloud does not cope with current tasks and some of the capacities and resources are moved to the public cloud (for example, processing of large volumes of statistical information). Therefore, the actual task currently facing the creators of the clouds is the integration of private and community clouds [4].

To provide users with the required information, the most important services are the provision of access to information (INaaS) and databases (DBaaS). Create these services in the presence of blueprints can be quickly with a significant effect. At the same time, the absence of formalized models and methods for analyzing and structuring the information of users of cloud computing makes it impossible to make informed decisions about the possibility of creating a private cloud for certain groups of users, determining the optimal composition and structure of the "cloud" database.

In this article, we review methods of cluster analysis of users' domains, providing their classification to users, for which it is advisable to use a private cloud and users, for which it is expedient to create their own (local) database (LDB). Expediency is determined by given degree of generality between the domains of the set of users. Next, for a group of users of a private cloud based an object-oriented approach and an object-oriented data model (OODM), we design and analyze the object model of user requirements, the generalized object model of the domain and the canonical structure of the "cloud" database (CDB). The obtained results can be used to build optimal logical and physical structures of object-oriented CDB. The proposed methods are based on the results of works obtained by the authors in the field of analysis and synthesis of optimal structures of local, distributed and object-oriented databases [5, 6, 7]. The developed models and methods do not take into account the economic aspects and features of cloud technologies associated with the feasibility of their selection (transition to them), which is a separate task of scientific research.

A flowchart diagram of the stages of analysis and structuring of user domains is shown in fig. 1.

Let’s review the methods of cluster analysis for the classification of the user's domains. The proposed methods are based on analysis of the degree of generality and evaluation of the similarity function of subject domains of a given set of users.

Let $U = \{u_k\}, k = \overline{1, K_0}$ is a set of users of the organization that can be located in geographically remote places, $D = \{d_j\}, j = \overline{1, n_0}$ – a complete, non-redundant set of information elements of the considered set of users, where n_0 is the number of elements in the complete set.

Let $D_k = \{d_{ki}\}, i = \overline{1, L_k^0}$ – the set of information elements describing the subject domain of the k-th user, L_k^0 - the number of information elements in the set.

The ratio of each user to the full set of information elements D is formalized in the form of an adjacency matrix $B = \|b_{kj}\|$ indexed along the axes by the set of users $U=\{u_k\}$ and a complete set of information elements $D = \{d_j\}$. Elements of the matrix $B = \|b_{kj}\|$ equals 1 if the information element dj refers to the information set of the user U_k, otherwise b_{kj} = 0.

Based on this input data, we define the combined set of information elements $D^0 = \{d_i\}, i = \overline{1, N}, N = \sum_k L_k^0$ obtained by combining the sets D_k and containing repeating information elements, i. e. $D^0 = \bigcup_{k=1}^{k_0} D_k$.

Next, we define the following set:

$$D_k^y = D^0 - D_k, \; k \in \overline{1, K_0}$$

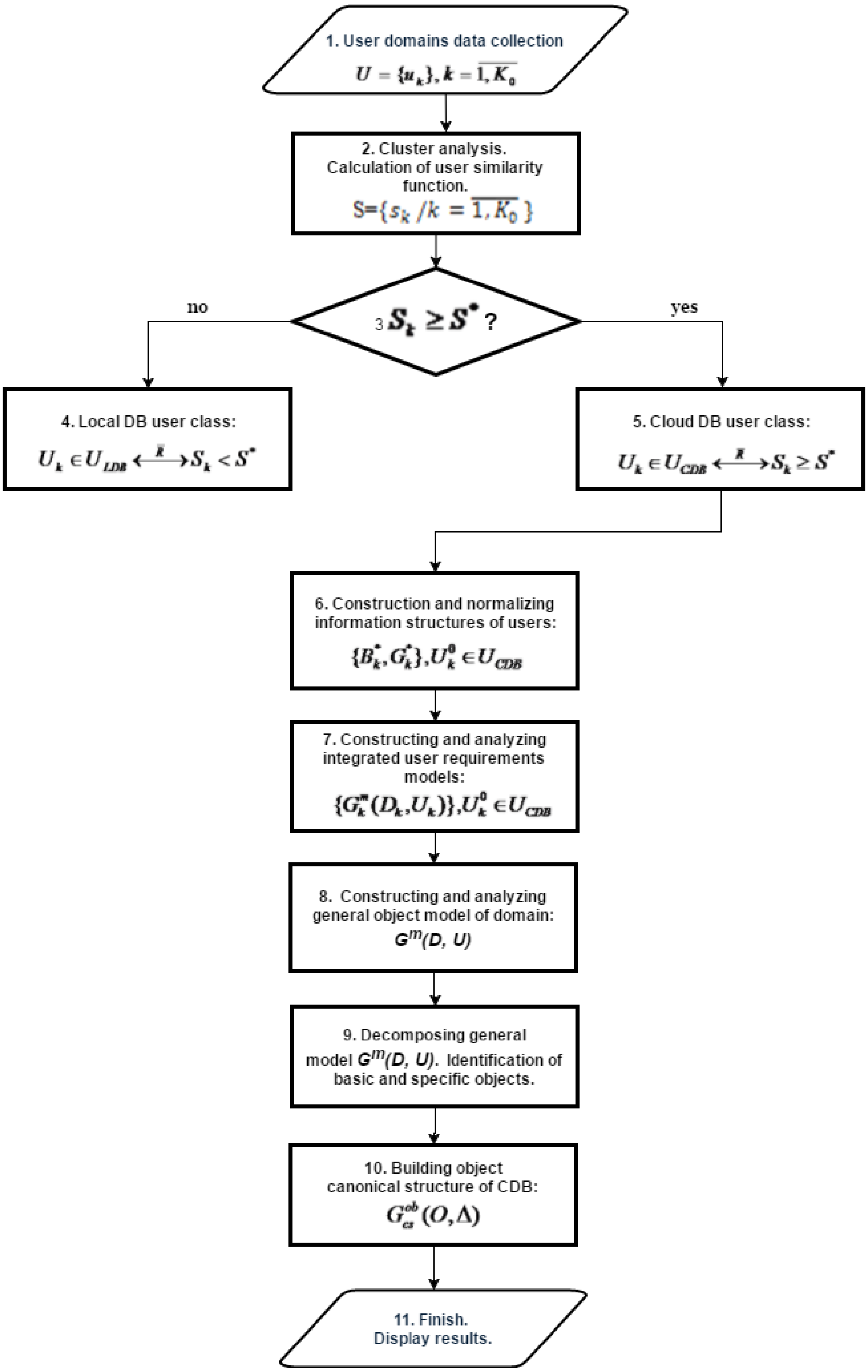

Figure 1. *Stages of analysis and structuring of user domains*

The degree of generality of information of users' domain areas is determined by the method of sequential obtaining and analysis of pairwise intersections of information sets of users with corresponding sets D_k^y.

Let $D_k^p = D_k \cap D_k^y$ be the set of common elements of the information set of an individual user D_k and D_y^k – a subset of users. If the set D_k^p is not empty, and the power of the intersection satisfies a given value, then the subject area of the k-th user has a sufficient degree of generality with the subject areas of the other users, which allows to consider it as a user of the CDB.

To obtain a quantitative characteristic of the degree of generality of the subject domain of the k-th user (specified by the set D_k) with the combined subject domain of other users (given by the set D_k^y), we use the notion of the similarity measure used in the theory of automatic classification.

There are sets D_k and D_k^y. The measure of similarity is the mapping of the intersection of sets $D_k^p = D_k \bigcap D_k^y$ into a set of real numbers, expressed by a nonnegative real function S_k which satisfies the condition $0 \le S_k \le 1$.

In the theory of automatic classification, a number of functions are used to calculate similarity between objects. An analysis of these functions performed in [6, 7] showed that the degree of the information commonality of users reflected most adequately by the function S = $\frac{p_{11}}{p_{11} + 2(p_{10} + p_{01})}$, since it allows to take into account the common (p_{11}) and specific (p_{10} and p_{01}) information elements in the sets.

Let's assign on the set of users U = {u_k} the relation R, which is determined by the magnitude of the similarity from the set S = {S_k}: $U_k \in U_{CDB} \xleftrightarrow{\bar{R}} S_k \ge S^*$, where U_{CDB} is the set of users of the CDB, S* is the critical similarity measure.

The ratio R of users belonging to the class U_{LDB}, for which it is advisable to design local databases, is defined as $U_k \in U_{LDB} \xleftrightarrow{\bar{R}} S_k < S^*$.

The formula $S_k \ge S^*$ is usually satisfied in the presence of users who solve similar tasks of managing and processing information.

Thus, as a result of the implementation of the cluster analysis procedures, set of users of the "cloud" database (CDB) $U_k^0 \in U_{CDB}$ and set of users of local databases (LDB) $U_k^0 \in U_{LDB}$ are formed.

On the following phase, for the group of users $U_k^0 \in U_{CDB}$, external models, the generalized external model and the object canonical structure of the CDB are constructed based on the methods of object-oriented design.

The use of these methods is not accidental. They most adequately reflect the technology of cloud computing and the services provided because they imply the encapsulation in one object of both data and methods (procedures) for their processing. This allows creating an open architecture database with inherent portability, mobility and interoperability properties; reduce the time, cost and complexity of database development by parallelizing the process of creating database structures and application programs between development teams, as well as the possibility of reusing legacy objects; ensure the ease of maintenance of databases and applications through the use of the principle of information opacity, which provides a hiding in the object of both data processing procedures and the data itself; the polymorphism property allows you to use the same procedures for sending messages for different objects that differ only in call variables [8, 9].

Let's introduce a number of necessary definitions.

Under the object we mean a certain set of information elements and methods (procedures) for their processing, as well as the relationships between them, which constitute a single whole from the point of view of the semantic and procedural aspects of the subject area.

Under the object model of user requirements, we will understand the information-functional structure formed as a result of performing operations of overlaying on graphs of information structures of users of technological components describing the procedures for searching and processing data.

Under the generalized object model of the domain we will understand the information-functional structure formed as a result of operations of imposing object models of user requirements.

Under the analysis of the generalized object model of the domain, we mean the process of reducing the variety of object requirements fixed in it to the basic (typical) and specific objects, as a result of which the object canonical structure of the database is constructed.

Designing of object models of user requirements is carried out in 2 stages.

At the first stage, construction and normalization of information structures of users is carried out using the methods proposed in [5].

At the second stage, users' data processing requirements are reflected on the generated information structures.

The initial data for the implementation of this stage are:

- formalized descriptions of normalized information structures of users, given in the form of adjacency matrices B_k^* and oriented graphs G_k^*, where group and information elements, keys and attributes of data groups are distinguished;
- formalized descriptions of user requirements for data processing.

Formalized descriptions of the requirements of the k-th user for data processing are specified using:

- a set of data processing procedures Fк = { $f_r^k / r = \overline{1, R_k}$ }, where f_r^k – r-th procedure of the k-th user;
- the matrix for using the l-th information element ($l \in L_k \subseteq L$) by the r-th procedure ($r \in R_k \subseteq R$) $W_k = \left\| w_{rl}^k \right\|$. Element w_{rl}^k = 1 if the l-th information element is used by the r-th procedure and w_{rl}^k = 0, otherwise;
- the structure of the search required for data processing, specified in the form of a data search tree on the information structure graph G_k^*.

The mapping of data processing requirements to graphs of user information structures is performed as follows.

The use of some r-th procedure for processing the data of the l-th element is formally represented on the graph G_k^* by a loop on the group d_j^g into which it enter, which indicates the processing of this group element.

The search trees required for processing the data are displayed with additional arcs in the graph G_k^*.

Thus, the formal object model of the requirements of the k-th user is represented in the form of a multigraph with one type of vertices and two types of arcs $G_k^m(D_k, U_k)$, where $D_k = \{d_l^k / l = \overline{1, L_k}, L_k \subseteq L\}$ – a set of information elements (including keys and data attributes), detected as a result of the methods described in; $U_k = U_k^{el} \bigcup U_k^{pr}$, where U_k^{el} – a set of arcs characterizing the structure of the interrelationships between information elements (data groups, keys and attributes), and U_k^{pr} – the set of arcs characterizing data processing technology for the k-th user in the form of an implementation of a set of search methods (procedures) and direct data processing, including loops and directly arcs.

The main characteristics of the object model requirements G_k^m are:

- Vector of technological weights of vertices $Z_\mu^k = \{z_{lk}^\mu\}$, where z_{lk}^μ is the technological weight of the d_l-th vertex of the graph $G_k^{об}$.
- The vector of technological thicknesses of arcs $Z_\eta^k = \{z_{ll',k}^\eta\}$, where $z_{ll'}^\eta$ is the technological thickness of the arc $(d_l, d_{l'})$ on the graph $G_k^{îá}$.

Technological weight z_{lk}^μ = const (where const $\in$ {0, 1, 2, ..., N}, the N-set of integers) denotes the degree of use of the information element d_l by a variety of data processing procedures. The larger the value z_{lk}^μ for some d_l, the more important is the d_l element in data processing.

The technological thickness of the arc $(d_l, d_{l'})$ $z_{ll',k}^\eta$ = const (where const $\in$ {0, 1, 2, ..., N}, N-set of integers) means the degree of use of the arc (ll ') in the process of searching for the required data. The larger the value $z_{ll',k}^\eta$ for some arc $(d_l, d_{l'})$, the more often this arc is used in the access paths to the data required for processing.

Definition of technological weights of vertices is carried out by summation of values of a matrix $W_k = \|w_{rl}^k\|$ on columns (information elements): $z_{lk}^\mu = \sum_{\forall r \in R_k} w_{rl}^k$.

The determination of the technological thicknesses of arcs is carried out by summing the arcs in the set

$$U_k^{pr}: \; z_{ll',k}^\eta = \sum_{l,l' \in U_k^{пр}} (d_l, d_{l'}).$$

Having calculated the main characteristics of the graph G_k^m, you can proceed to another formalized representation of the object model of user requirements – a weighted graph $G_k^{wg}(D_k^{wg}, U_k^{wg})$, where each vertex $d_l \in D_k^{wg}$ and arc $(d_l, d_{l^i}) \in U_k^{wg}$ are assigned the corresponding weights.

The construction of the generalized object model of the domain is carried out after the construction of object models for all user requirements by sequentially overlapping the multigraphs $G_k^{об}(D_k, U_k)$ on each other. The developed procedure is based on combining identical information elements independently of the level of their placement on the graphs $G_k^m(D_k, U_k)$.

The result of executing the overlay procedure is the multigraph of the generalized domain model $G^m(D,U)$ ordered by the levels of the hierarchy with one type of vertices D = $\{d_l / l = \overline{1,L}\}$ corresponding to the set of information elements and two types of arcs: U^{el} is the set of information interrelations between the elements $d_l \in D$ and U^{pr} – set of procedural (technological) interrelations between information elements, $U = U^{el} \cup U^{pr}$.

The main characteristics of the generalized object model of the domain are:

- The vector of information weights of the vertices of the graph G^m: $Z_\nu = \{z_l^\nu\}$, where z_l^ν is the information weight of the vertex $d_l \in D$. The information weight z_l^ν for some vertex dl is equal to a positive integer (0, 1, 2, ..., N) and characterizes the degree of need of many users in this element. The higher the value z_l^ν, the more important and necessary is the dl element to meet the information needs of users.
- The vector of technological weights of the vertices of the graph G^m: $Z_\mu = \{z_l^\mu\}$, where z_l^μ is the technological weight of the dl-th element (vertex), $z_l^\mu \in$ {0, 1, ..., N}.
- The vector of information thicknesses of the arcs of the graph G^m: $Z_\theta = \{z_{ll'}^\theta\}$, where $z_{ll'}^\theta$ is the information thickness of the arc $(d_l, d_{l'})$. The information thickness of the arc $(d_l, d_{l'})$ $z_{ll'}^\theta$ is equal to a positive integer (0, 1, 2, ..., N) and characterizes the degree of semantic connectivity of the elements dl and dl' in the given subject domain. The larger the value $z_{ll'}^\theta$, the more semantically associated the dl and dl' elements, which is confirmed by a subset of users in their information requirements.
- The vector of technological thicknesses of arcs of the graph G^m: $Z_\eta = \{z_{ll'}^\eta\}$, where $z_{ll'}^\eta$ – the technological thickness of the $(d_l, d_{l'})$, $z_{ll'}^\eta \in$ {0, 1, 2, ..., N}.

Next, based on the analysis of the generalized object model of the domain, the object canonical structure of the CDB is constructed by reducing the variety of object models of user requirements fixed in the generalized object model to basic (standard) and specific objects.

At the first stage of the analysis, the transition from the $G^m(D,U)$ multigraph to the weighted graph $G^{wg}(D,U)$ of the generalized object model of the domain is carried out. For this purpose, for each vertex of the graph G^m, their mean weights are calculated:

$$z_l^{cp} = \frac{z_l^\nu + z_l^\mu}{2}, \forall d_l \in D,$$

and for each connection – the average weight of the thicknesses of the arcs:

$$z_{ll'}^{cp} = \frac{z_{ll'}^\theta + z_{ll'}^\eta}{2}, \forall (d_l, d_{l'}) \in U$$

The weighted graph $G^{wg}(D,U)$ is represented as a digraph with one type of vertices and arcs, each of which has a certain average weight. The graph $G^{wg}(D,U)$ corresponds to the weighted adjacency matrix B = $\|b_{ij}\|$. The elements b_{ij} of the matrix B that lie not on the main diagonal are equal to positive real numbers corresponding to the weights of the arc thicknesses. The elements b_{ii} of the matrix B lying on the main diagonal are equal to the positive real numbers and correspond to the average weights of the vertices of the graph G^{wg}.

The second stage of the analysis solves the problem of decomposition of the weighted graph G^{wg} to a number of subgraphs corresponding to the basic (typical) and specific objects of the domain. This problem is solved under the following constraints:

- the number of information elements in one object (N);
- the number of procedures (methods) of data processing in one object (M);
- the possibility of including separate information elements in the composition of a single object. This constraint can be formally represented as an adjacency matrix $\overline{B} = \|\overline{b}_{ij}\|$ whose elements are $\overline{b}_{ij}$ = 1 if the information elements are semantically incompatible in the same object and $\overline{b}_{ij}$ = 0, if the appearance of elements d_i and d_j in the composition of one object is acceptable;
- to the level of typability, in which the objects to be constructed (as subgraphs of graph Gвз) can be attributed to the basic objects of the given domain (Y).

The level of typability is defined by the designer of the CDB and is defined as an integral characteristic of the information and technological connectivity of the objects.

The values of the constraints N, M and Y are chosen in such a way that at least a single vertex of the graph G^{wg} (D, U) is a separate object of the domain.

To solve the problem, the algorithm given in [7] can be used. As a result of its implementation, the following transformation is performed:

$$G^{wg}(D,U) \rightarrow G_{cs}^{ob}(0,\Delta),$$

where $G_{cs}^{ob}(O,\Delta)$ is the graph of the object canonical structure of the CDB whose vertices O = $\{O_\varepsilon / \varepsilon = \overline{1,\varepsilon_0}\}$ are the objects of the domain, and the arcs $\Delta = \{\delta_{\varepsilon\varepsilon'} / \varepsilon, \varepsilon' = \overline{1,\varepsilon_0}\}$ are the connections (or relations) between the objects.

Characteristics of the graph G_{cs}^{ob} are the integral characteristics of objects and the relationships between them. On the formed object canonical structure of the database, a number of basic O_{bas} and specific O_{spe} objects are distinguished.

Conclusion

Thus, the methods and algorithms proposed in this work allow us to classify users into a group of users of a private cloud and users of local databases, generate external models, a generalized external model, and the object canonical structure of the cloud database. In the future, these results are used in the synthesis of logical and physical structures of ODB cloud technologies. The developed methods and algorithms were used to create the information infrastructure of the Eurasian Patent Office of the Eurasian Patent Organization [10]. In the future, these results are used in the synthesis of logical and physical structures of CDB.

REFERENCES

1. Cloud Computing: Principles, Systems and Applications / Nick Antonopoulos, Lee Gillam – L.: Springer, 2010. – 379 p.
2. T. Batura, F. Murzin, D. Semich Cloud technologies: basic models, applications, concepts and development trends. Software products and systems, №3(107) / 2014, pp. 64-72. (in Russian).
3. Mell, Peter and Grance, Timothy. The NIST Definition of Cloud Compu-ting. Recommendations of the National Institute of Standards and Technology. NIST, 2011.
4. L. Chernjak Integration is the basis of the cloud. Open systems. DBMS, №07 / 2011. (in Russian).
5. Mamikonov, A., Aschimov, A., Kul'ba, V., Kosyachenko, S., Sirotyuk, V. Optimization of data structures in ACS. M.: Science, 1988, 256 p. (in Russian).
6. Kul'ba, V., Kovalevski, S., Kosyachenko, S., Sirotyuk, V. Theoretical bases of designing optimal structures of distributed databases. M.: SINTEG, 1999, 660 p. (in Russian).
7. Kul'ba, V., Mikrin, E., Sirotyuk, V., Sirotyuk, O. Models and methods for designing optimal structures of object-oriented databases in automated information-control systems. Scientific publication. M.: ICS Russian Academy of Sciences, 2005, 103 p. (in Russian).
8. Cattell R., Barry Douglas K., et al. The Object data standard: ODMG 3.0. Morgan Kaufman Publishers, 2000.
9. Booch Grady Object Solutions. Managing Object-Oriented Project. Addison-Wesley, 1996. 323 p.
10. Fayazov X., Sirotyuk V., Ovchinnikov A., Burzev A. Formation and development of the Eurasian patent information space. M.: INIZ «Patent», 2010, 124 p. (in Russian).

УДК 62

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Модели и методы анализа и структуризации предметных областей пользователей облачных технологий

Аннотация. Статья посвящена проблеме использования парадигмы облачных вычислений при разработке IT-систем. В статье предлагаются формализованные модели и методы анализа предметных областей пользователей и классификации пользователей на пользователей облачных баз данных (ОБД) и пользователей локальных баз данных (ЛБД). Целесообразность определяется наличием заданной степени общности между предметными областями множества пользователей. В дальнейшем для группы пользователей частного облака с использованием объектно-ориентированного подхода и объектно-ориентированной модели данных (ООМД) осуществляется построение и анализ объектных моделей требований пользователей, обобщенной объектной модели предметной области и объектной канонической структуры облачной БД (ОБД). Проектирование объектных моделей требований пользователей осуществляется в 2 этапа. На первом этапе осуществляется построение и нормализация информационных структур пользователей. На втором этапе осуществляется отображение на сформированные информационные структуры требований пользователей по обработке данных. Полученные результаты в дальнейшем могут использоваться при проектировании объектно-ориентированных логических и физических структур ОБД. Разработанные методы и алгоритмы использовались при создании информационной инфраструктуры Евразийского патентного ведомства Евразийской патентной организации.

Ключевые слова: облачные технологии; предметная область пользователей; пользователи облачных баз данных; пользователи локальных баз данных; информационная общность предметных областей пользователей; объект предметной области; функция подобия объектов; объектная модель требований пользователей; обобщенная объектная модель предметной области; объектная каноническая структура облачной базы данных

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ЛИТЕРАТУРА

1. Cloud Computing: Principles, Systems and Applications / Nick Antonopoulos, Lee Gillam – L.: Springer, 2010. – 379 p.
2. T. Batura, F. Murzin, D. Semich Cloud technologies: basic models, applications, concepts and development trends. Software products and systems, №3(107) / 2014, pp. 64-72. (in Russian).
3. Mell, Peter and Grance, Timothy. The NIST Definition of Cloud Compu-ting. Recommendations of the National Institute of Standards and Technology. NIST, 2011.
4. L. Chernjak Integration is the basis of the cloud. Open systems. DBMS, №07 / 2011. (in Russian).
5. Mamikonov, A., Aschimov, A., Kul'ba, V., Kosyachenko, S., Sirotyuk, V. Optimization of data structures in ACS. M.: Science, 1988, 256 p. (in Russian).
6. Kul'ba, V., Kovalevski, S., Kosyachenko, S., Sirotyuk, V. Theoretical bases of designing optimal structures of distributed databases. M.: SINTEG, 1999, 660 p. (in Russian).
7. Kul'ba, V., Mikrin, E., Sirotyuk, V., Sirotyuk, O. Models and methods for designing optimal structures of object-oriented databases in automated information-control systems. Scientific publication. M.: ICS Russian Academy of Sciences, 2005, 103 p. (in Russian).
8. Cattell R., Barry Douglas K., et al. The Object data standard: ODMG 3.0. Morgan Kaufman Publishers, 2000.
9. Booch Grady Object Solutions. Managing Object-Oriented Project. Addison-Wesley, 1996. 323 p.
10. Fayazov X., Sirotyuk V., Ovchinnikov A., Burzev A. Formation and development of the Eurasian patent information space. M.: INIZ «Patent», 2010, 124 p. (in Russian).