ABSTRACT AND REFERENCES

INFORMATION TECHNOLOGY. INDUSTRY CONTROL SYSTEMS

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A METHOD FOR THE IDENTIFICATION OF SCIENTISTS' RESEARCH AREAS BASED ON A CLUSTER ANALYSIS OF SCIENTIFIC PUBLICATIONS (p. 4-11)

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A method for the clustering of scientific publications is proposed in order to identify areas of scientists' research areas. In this method, the links between scientific publications and citations are represented in the form of a directed graph. There are two proposed techniques for finding a distance between publications in the method for clustering the scientific publications. The first technique is based on the calculation of the length of the minimal route between the corresponding vertices of the graph of links between publications through citation. The second procedure is based on the calculation of the degree of closeness by the content of abstracts of these publications using the Hamming distance on the basis of a locally-sensitive hashing method. After the application of the method for clustering this graph, considering the specificity of input data, it is proposed to merge clusters by the criterion of proximity of centers of gravity.

To identify scientists' research areas, it is proposed to initially use one of the expert methods for establishing a correspondence between the built clusters and the appropriate verbal representations of scientific areas. Next, to form for each scientist a set of areas for scientific research, taking into account the mapping of a set of scientists onto a number of scientific areas.

The methods proposed could be used in scientific and educational institutions, as well as private companies that are engaged in the creation of science-intensive technologies.

Keywords: clustering, area of scientific research, co-citation graph, locally-sensitive hashing.

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MATHEMATICAL MODELING OF SYSTEMIC COLOROMETRIC PARAMETERS UNMASKING WILD WATERFOWL (p. 12-18)

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The research presents results of modeling of systemic coloromet-ric parameters, unmasking wild waterfowl.

The problem of unmasking wild waterfowl is acquiring practical relevance in connection with problems of biosafety. Such problems are associated with hotbeds and ways of spreading of avian influenza and a number of other dangerous infections and infestations. Moreover, the study of regularities of formation of animals' protective coloration is of interest in terms of a number of fundamental problems of biology and ecology.

As a result of conducted research with the use of a new class of mathematical models (DMDS), the authors offered a formalized description of systemic aspects that distinguish between protective coloration of mallard ducks and colorometric parameters of plant communities. The idealized trajectory of the system, reflecting dynamics of colorometric parameters of phytocenosis in the habitat of mallard duck, was constructed. The idealized pseudo-trajectory of the system, reflecting a set of combinations of colorometric parameters of protective coloration of mallard duck, was constructed. The kind of systemic colorometric parameter, which allows unmasking the mallard duck against the background of phytocenosis, was determined. Root mean square deviation of values of difference of colorometric parameters of digital photography of the researched area was selected as the systemic colorometric parameter. The systemic colorometric parameter reflects variability of ratios of difference of values of colorometric parameters in the sample of microsegments, into which the segments of the image of the studied area are divided. The obtained results offer new approaches to development of remote methods of studying living conditions and migration routes of wild waterfowl.

Keywords: waterfowl, unmasking, protective coloration, colorometric parameters, image processing, rechronization, systemic aspect, trajectory of a system, phytocenosis, mallard duck.

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DEVELOPING THE MODELS OF PATTERNS IN THE DESIGN OF REQUIREMENTS TO AN INFORMATION SYSTEM AT THE KNOWLEDGE LEVEL (p. 19-26)

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Results of research into mining and processing of knowledge from IS requirements were analyzed. Modification of the frame-based model of knowledge that allows description of knowledge about structures of data and interaction processes is considered. The essence of modification is to extend the frame with descriptions of a totality of methods, associated with a frame as a whole, as well as descriptions of interfaces of a frame. This modification also makes it possible in a formalized way to describe the problem of automated synthesis of IS information and software as a set of one-to-one mappings of frame descriptions.

Theoretical-multiple models of structural IS requirements design patterns at the knowledge level were developed. These models allow describing the knowledge, derived from IS requirements descriptions in the form of a network of frames. This network consists of individual frames, interfaces of frames and relationships between them. The use of these models makes it possible to formalize the process of designing of IS architecture based on knowledge, derived from IS requirements descriptions, which significantly reduces the time spent on IS creation.

Theoretical-multiple models of behavioral IS requirements design patterns at the knowledge level were developed. These models establish the main features of operations of addition, modifications and deletion of elements of structural IS requirements design patterns. In addition, developed models describe operations on formation of knowledge-oriented descriptions of IS architecture in the form of a network of frames and interfaces. Application of these models enables us to standardize implementation of operations on the knowledge, derived from patterns, and on patterns of designing structural frames.

It was proposed to consider implementation of the developed models in the form of specialized data showcases and sets of SQL-commands that implement developed behavioral patterns.

Keywords: IT-service, needs, functional requirements, reuse, requirements design pattern, frame, tuple.

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DEVELOPMENT OF THE METHOD OF FEATURES LEARNING AND TRAINING DECISION RULES FOR THE PREDICTION OF VIOLATION OF SERVICE LEVEL AGREEMENT IN A CLOUDBASED ENVIRONMENT
(p. 26-33)

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We developed the algorithm of learning of the multilayer feature extractor based on ideas and methods of neural gas and sparse encoding, for the problem of prediction of violation of agreement conditions on the service level in a cloud-based environment. Effectiveness of the proposed extractor and autoencoder was compared by the results of physical simulation. It is shown that the proposed extractor requires approximately 1.6 times as few learning samples as the autoencoder for construction of error-free decision rules for learning and test samples. This allows us previously put into effect prediction mechanisms of controlling appropriate cloud-based services.

To build up decision rules, it is proposed to use transformation of the space of primary features using computationally efficient operations of comparison and "excluding OR" for construction in the radial basis of the binary space of secondary features of separate class containers. In this case, for binary feature encoding, it is proposed to use modification of the population algorithm of search for maximum value of the Kullback's information criterion. Modification implies consideration of compactness of images in the space of secondary features, which allows increasing the gap between distributions of classes and decreasing the negative effect of overfitting.

The authors explored dependence of decision accuracy for training and test samples of the system of prediction of violation of SLA conditions on parameters of the feature extractor and those of the classifier. The extractor configuration, acceptable in terms of accuracy and complexity, was selected. In this case, two time windows, which intersect in time by 50 % and read through 50 features, were used at the entrance of the extractor. The first layer of extractor coding contains 30 basis vectors, and the second layer – 20. Thus, the intralayer pooling and non-linearity were formed by concatenation of sparse codes of each window and by continuation of the resulting code twice as much in order to separate positive and negative code components and to transform the resulting code into the vector of sign-positive features.

Keywords: datacenter, sparse encoding, neural gas, information criterion, machine learning, swarm algorithm.

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OPTIMIZATION OF FUZZY CLASSIFICATION KNOWLEDGE BASES USING IMPROVING TRANSFORMATIONS (p. 33-41)

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The method of fuzzy classification knowledge base optimization using improving transformations in the form of solutions of fuzzy relational equations is proposed. The logic-algorithmic models of improving transformations are developed, on the basis of which the genetic algorithm of fuzzy knowledge base optimization is proposed.

Methods of rule generation and selection differ in computational complexity due to the redundancy of the initial model. The methods of candidate rule generation do not guarantee the optimum number of rules and optimum granularity of input variables. The selection process becomes more complicated with increasing number of criteria, in particular, when taking into account the rule length.

Improving transformations are: transition to a composite model for selecting output classes and rules; transition to a relational model for selecting input terms. The min-max clustering problem is solved by generating composite rules in the form of interval solutions of the trend system of equations. The number of rules in a class is determined by the number of solutions, and the granularity is determined by intervals of values of input variables in rules. The set of minimum solutions provides the minimum rule length. Linguistic interpretation of the solutions obtained is reduced to solving the relational clustering problem. The level of detail and the density of coverage are determined by the "input terms – output classes" relational matrix, and the dimensions of hyperboxes are tuned using triangular membership functions.

Improving transformations allow formalizing the process of fuzzy knowledge base generation and selection. Each improving transformation is related to the control variables (the number of terms, classes, rules) that affect the accuracy and complexity of the model. At the same time, consistent use of composite and relational improving transformations provides tuning process simplification.

Keywords: fuzzy knowledge base optimization, min-max clustering, solving fuzzy relational equations.

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DEVELOPING THE ARCHITECTURE OF INTEGRATED 5G MOBILE NETWORK BASED ON THE ADAPTATION OF LTE TECHNOLOGY (p. 42-49)

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The issues of constructing integrated fifth-generation mobile access networks based on the further development and modification of the LTE technology were studied. The LTE frame structure and features of using the LTE technology in real-time systems with packet delay control were analyzed. It was concluded that it is possible to reduce the time delays in the LTE radio channel by modifying the frame structure and the method of dynamic allocation of the time-frequency resource. A method was proposed for reducing delays in a radio channel by forming a dedicated logical channel in the ad hoc mode in which a channel allocation unit is formed based on the subframes. Moreover, combined synchronous and asynchronous multiplexing of real-time data into a synchronous sequence of packet transport modules was performed in the ad hoc channel. As a result of the studies, architecture and basic principles of the fifth-generation mobile access network based on modification of the LTE technology were developed. This will enable connection to the network of various sensor-equipped devices with individually specified requirements to the intensity of the data flow and allowable packet delays.

Keywords: fifth-generation communication, mobile access, integrated network, human-machine system, LTE technology, real-time mode.

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ONTOLOGICAL KNOWLEDGE BASES PRODUCTIVITY OPTIMIZATION THROUGH THE USE OF REASONER COMBINATION (p. 49-54)

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Reasoners are one of the main components of the ontological systems and the work of reasoners is the most resource-intensive task in ontology processing. The study proposes the reasoner combination method to enhance the performance of ontological systems. Its essence is selecting the most suitable reasoner out of the HermiT, Pellet and FaCT++ reasoners depending on the type of ontology. The distinctive feature of the research is combining the advantages of tableau and hypertableau methodologies.

The criterion, which has been developed, allows you to choose a reasoner for an ontology with optimal performance based on ontology components: TBox, ABox, RBox.

The results of the studies clearly show that the application of the reasoner combination method outstrips the performance of any particular reasoner, considering that the reasoner will process different types of ontology. The testing method was conducted on a set of 8 different ontologies: BP XP OBOL, FMA Lite Fly Taxonomy, Biological Process, DLP ExtDnS, MGED, DOLCE-Plans, SWEET Numerics.

The study resulted in the development of the method which will allow applying ontologies in the tasks that require high performance and processing of a large body of knowledge.

Keywords: reasoner combination, Jena, Virtuoso, hypertableau, tableau, HermiT, FaCT++, Pellet, ABox, TBox, RBox.

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DEVELOPMENT OF THE INFORMATION TECHNOLOGY FOR CHECKING TEXTUAL PROCEDURES FOR LOGICAL COHERENCE AND COMPLETENESS (p. 55-64)

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Analysis of existing approaches to the development of schedules (procedures) in a textual form containing description of branching processes was made. It was established that visualization with the help of the system analysis methods (in particular, BPMN notation) is the most effective tool for developing branching processes. It was also established that the absence of clear rules for development of schedules (procedures) in a textual form causes a fairly large number of errors in descriptions of the branching processes worked out by the specialists having no sufficient skills in using algorithmizing (of the forty checked process descriptions, errors were found in 75 % schemes converted from texts). The IT was developed for checking textual procedures containing descriptions of branching processes. It is based on visualization using BPMN notation which allows one to find errors of logical coherence and completeness. Effectiveness of the proposed IT was demonstrated on the example of checking a law text with a description of a branching process.

The developed IT is quite simple in its mastering for the specialists possessing a certain level of skills in algorithmization and can be applied in any sphere of activity describing processes in a textual form.

Keywords: process description visualization, branching processes, BPMN notation, errors in laws, textual description of processes.

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SOLUTION OF THE OPTIMIZATION PROBLEM ON THE CONTROL OVER OPERATION OF GAS PUMPING UNITS UNDER FUZZY CONDITIONS (p. 65-71)

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Since the gas transportation system of Ukraine has excessive capacity, it becomes a relevant task to choose such rotation frequencies of centrifugal compressors of the gas compressor units that would minimize the overall consumption of fuel gas on pumping.

Calculation of the volumetric productivity of a centrifugal compressor by the pressure differential on confuser produces an error of tens of percent due to the inaccuracy of measurement. Thus, it is advisable to consider volumetric productivity as a fuzzy magnitude with a triangular shape of the membership that makes it possible to build an adequate mathematical model of the process of natural gas compression. A triangular shape of the membership function is inconvenient when used in order to solve the problem on the optimal control over the process of natural gas compression. That is why, in the present work, it is proposed to approximate it by a Gaussian membership function. This allowed us to state the optimization problem in terms of fuzzy magnitudes and, on this basis, to develop effective methods for solving it with consideration of constraints for the controlling actions.

In order to obtain empirical models, based on the results of observing the work of GPU, we applied a method of synthesis of empirical models on the basis of genetic algorithms.

We developed algorithmic provision and software in the MATLAB environment and solved the problem of optimal control, which

made it possible to determine rotation frequencies of the rotors of centrifugal compressors of natural gas, at which the total costs of the fuel gas for the natural gas compression are minimal.

Since technological parameters of the gas pumping unit change over time, there appears a need to recalculate the model's parameters in order to solve the optimization problem on the process of natural gas compression. Determination of frequency of recalculation of the model's parameters is an unsolved scientific problem at present and it is a promising task for further research.

Keywords: genetic algorithms, fuzzy magnitude, process of gas compression, inlet confuser, optimal control.

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