ABSTRACT AND REFERENCES

INFORMATION TECHNOLOGY INDUSTRY CONTROL SYSTEMS

DESIGN OF A RECOMMENDATION SYSTEM BASED ON COLLABORATIVE FILTERING AND MACHINE LEARNING CONSIDERING PERSONAL NEEDS OF THE USER (p. 6–28)

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The paper reports a study into recommendation algorithms and determination of their advantages and disadvantages. The method for developing recommendations based on collaborative filtering such as Content-Based Filtering (CBF), Collaborative Filtering (CF), and hybrid methods of Machine Learning (ML) has been improved. The paper describes the design principles and functional requirements to a recommendation system in the form of a Web application for choosing the content required by user using movies as an example. The research has focused on solving issues related to cold start and scalability within the method of collaborative filtering. To effectively address these tasks, we have used hybrid training methods. A hybrid recommendation system (HRS) has been practically implemented for providing relevant content recommendations using movies as an example, taking into consideration the user's personal preferences based on the constructed hybrid method. We have improved an algorithm for developing content recommendations based on the collaborative filtering and Machine Learning for the combined filtration of similarity indicators among users or goods. The hybrid algorithm receives initial information in a different form, normalizes it, and generates relevant recommendations based on a combination of CF and CBF methods. Machine Learning is capable of defining those factors that influence the selection of relevant films, which improves development of recommendations specific to the user. To solve these tasks, a new improved method has been proposed, underlying which, in contrast to existing systems of recommendations, are the hybrid methods and Machine Learning. Machine Learning data for the designed HRS were borrowed from MovieLens. We have analyzed methods for developing recommendations to the user; existing recommendation systems have been reviewed. Our experimental results demonstrate that the operational indicators for the proposed HRS, based on the technology of CF+CBF+ML, outperform those for two individual models, CF and CBF, and such their combinations as CF CBF, CF+ML, and CBF+ML. We recommend using HRS to collect data on people's preferences in selecting goods and to providing relevant recommendations.

Keywords: commercial content, personalization, Machine Learning, SEO technology, search metrics, e-commerce, NLP.

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DEVELOPMENT OF THE INFORMATION SYSTEM FOR FORECASTING COLLISION BETWEEN BIRDS AND WIND FARMS (p. 29-40)

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The information system for processing the results of observations of birds on the territory of a wind farm was created. The information system ensures the storage and processing of the monitoring results, conducting statistical analysis of data and obtaining the forecast of the possibility of a collision of birds with blades of wind plants. Mathematical model of forecasting makes it possible to perform calculations in the case of incomplete information about the parameters of a wind wheel. The paper considers as an example the environmental situation on the territory of wind farm "Primorsk-1", which is located on the coast of the Sea of Azov. The information on 5923 registered birds of 45 species was processed. 72 birds of four species were identified in the dangerous zone of a collision of birds with rotor blades at the altitudes of 48 and 182 m: Larus ridibundus (43 birds), Merops apiaster (15 birds), Buteo buteo and Circus aeruginosus, respectively, 5 and 9 birds. Evaluation of risks of collisions was performed for one year of the wind park operation, taking into consideration the behavior of birds in different seasons of a year cycle (wintering, migration, and nesting). Based on the obtained data, the analysis of the possibility of the death of birds due to their collision with rotor blades was performed. The calculations were carried out using the model that was constructed according to the recommendations of the Fund "Scottish natural heritage". The probability of collision of a bird while being in the rotor space slightly depends on its geometrical dimensions and is within 11–14 %. Prediction of the total number of collisions in calculation per one turbine a year is at the level of 0.07–0.25 birds. Almost half out of this number refers to Larus ridibundus. The total number of collisions of all birds within one year of the operation of a wind farm with 26 turbines is nearly 1.7–6.5 birds. The obtained data are consistent with the results of the studies of European researchers.

Keywords: wind power plant, information system for forecasting birds' death, mathematical forecasting model.

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DEVELOPMENT OF AN APPROACH TO USING A STYLE IN SOFTWARE ENGINEERING (p. 41-51)

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An ontology-driven approach to applying styles in software engineering is developed in the study. The essence of the approach is to use ontology not only to represent styles but also to control the use of styles when creating and maintaining software. For such purposes, appropriate ontology and developer support tools are provided to represent a style, and tools (reasoners) are created on the ground of the ontological knowledge base to control the application of the style in work products of the software lifecycle phases. Based on descriptive logic, the knowledge base contains two components – terminological (TBox) and factual (ABox). The first component was created in advance by performing a domain analysis. The second component was created when analysing the representation of the corresponding work product.

For the purpose of typification in the context of the developed approach, templates for the kernel ontology of the software engineering style were created by analysing the concept of style in different domains. The basic characteristics of style as a domain-independent concept, which are presented in the templates, are formulated in the article. In this case, the Work Product Pattern Application pattern of the Unified Foundational Ontology is used to select the number of templates needed to represent the style. The pattern describes actions that may exist regarding the Work Product style.

An example of using the approach is considered by investigating the proposed ontology-driven method for programming style application in software engineering and building the architecture of the tool that implements it. Protégé use shows how to build the ontology of a programming style and programmer support. The architecture of the tool for controlling the application of style is developed and implemented in a work product of the design phase – a programme text. The basis of the architecture is the knowledge base of the corresponding style. The terminological component of the knowledge base contains information regarding programming languages and styles, and it is created in advance by the ontology developer. The actual component is created by the reasoner for each representation of the work product – the programme text.

The tools developed in the context of the proposed approach automate the processes that take place when applying styles to work products of the software lifecycle phases.

Keywords: software engineering, style template, ontology, descriptive logic, programming style.

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DEVELOPMENT OF MODELS AND ALGORITHMS FOR ESTIMATING THE POTENTIAL OF PERSONNEL AT HEALTH CARE INSTITUTIONS (p. 52-59)

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The problem of the development of models and methods for the estimation of the personnel potential of the health care institution is explored. Personnel potential is considered in terms of rendering medical services. It will be calculated as the maximum amount of certain types of health services that can be provided to consumers for a defined period of time by actual medical staff of an institution. An important condition in this case is maintaining the required quality of such services. The calculation of the indicators of the personnel potential of a health care institution, in particular, makes it possible to determine the ratio of the actual and standard work load on each individual employee of a health care institution. Based on the calculation of evaluation indicators of the work load of employees of institutions, it is possible to look for the ways of solving the problems of increasing the functional efficiency of health care establishments.

According to the system model, the verbal and mathematical statements of arising problems were constructed. To analyze the personnel potential of a health care institution, it is proposed to apply the concept of a credit – the smallest conditional unit of time allotted for the provision of services. The calculation formulas for the computation of the standard and actual loads on certain employees and on an institution in general were specified. The source data for the calculation are the results of expert surveys, as well as statistical data on the amount of services provided by a particular health care institution, as well as its employees. The result of the conducted research was the information-analytical system of evaluation of the personnel potential of a health care institution. The core of the developed system is the analytical unit, which includes models, methods and algorithms for determining the competence of experts' calculation of numeric expert evaluation of an object, calculation of the standard and actual load on employees and the institution, etc. The specific features of the data bank of the information-analytical system were determined. Its block diagram was presented.

The experimental verification of research results was carried out. An example of operation of the program was shown and the analysis of results was given.

The developed models and algorithms can be used successfully in the process of making managerial decisions in the health care area.

Keywords: information-analytical system, personnel potential, expert estimates, rendering medical services.

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DEVELOPMENT OF THE INFORMATION TECHNOLOGY FOR DECISION MAKING SUPPORT WHEN MANAGING REFRIGERATION UNITS (p. 60-71)

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We have studied patterns in the decision-making process related to the managerial influence on the part of the operator of a refrigerating unit as a multifactor energy system with internal and external disturbances.

An object such as a refrigeration unit cannot be fully formalized and described using the methods of conventional modeling as it has the properties of partial self-regulation and self-adjustment. Therefore, based on the application of the generalized model of a refrigeration unit, we have improved a decision support system that makes it possible to take into consideration the non-formalized information by means of a neuro-fuzzy component. The information technology has been developed to support decision making when managing different types of refrigeration units. Its implementation would make it possible to reduce the time required for equipment to enter the necessary operation mode and to stabilize a temperature regime at objects. That allows a decrease in the working time ratio of refrigeration equipment and reduces the influence of the human factor, which improves safety of the energy unit operation. Effectiveness of the technology has been experimentally investigated at a single-stage vapor-compression industrial ammonia refrigeration machine, at a single-stage vapor-compression freon refrigeration machine of central air conditioner and at a water- ammonia absorption-diffusion assembly of a household freezer the type of island freezer. The number of disturbing factors and the factors of influence varies in a wide range. The datasets intended to train a neuro-fuzzy system were built based on the results of experiments at actual equipment.

The proposed information technology could be used to construct computer simulators to enhance the competence and qualification of industrial-production personnel without training at the facilities of increased danger.

Keywords: information support to decision making, intelligent control of refrigeration equipment, neuro-fuzzy simulation.

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MANAGING A GREENHOUSE COMPLEX USING THE SYNERGETIC APPROACH AND NEURAL NETWORKS (p. 72-78)

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The paper considers the use of artificial neural networks in order to synthesize intelligent systems governed by a synergetic control law. It has been shown that so far all the studied objects and, therefore, control laws, have been considered linear, or have been treated to reduce them to such, thereby compromising their certain features. However, as evidenced by practice, actual objects are mostly nonlinear. Consideration of such objects with an attempt of their linearization leads to that the important characteristics of the entire process are lost. A greenhouse complex is mostly composed of such nonlinear objects of control. A greenhouse, as well as each process separately, are not exception.

We have proposed basic provisions to the synergistic approach related to the systems synthesis task. The synergistic synthesis of control law has been shown for a greenhouse complex under conditions of non-controlling changes in the technological parameters and external disturbances. The applied mathematical apparatus of fuzzy logic enables the implementation of fuzzy control. It manifests itself particularly positively under conditions when the processes are difficult to analyze by using conventional quantitative methods. As well as when the acquired information about the object is substandard, inaccurate, or ambiguous. This is exactly the type of information received for analysis and its subsequent use when growing vegetables at greenhouse complexes. We have proposed an algorithm to synthesize a neuro-network controller for a greenhouse complex based on the predefined synergetic control law. The algorithm is based on the performance of the synergistic controller that simulates values for temperature and humidity from an artificial neural network following our training it. A feature of the proposed integrated approach to the synthesis of an intelligent control system for a greenhouse complex is a combination of the principle of unification of the processes of self-organization and training a neural network at a preliminary stage. Such a combination ensures further stable functioning of the system aimed to intelligently control the cultivation of vegetable produce.

Keywords: synergistic controller, neural network, intelligent control, greenhouse complex, vegetable produce.

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