INFORMATION TECHNOLOGIES

DESIGNING A SEMI-AUTOMATED DECISION-MAKING SYSTEM FOR SELECTING RECIPIENTS OF SOCIAL SERVICES

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The object of this research is the decision-making process in the context of selecting recipients of social services using a semi-automated expert system. The main focus is on improving the mechanisms of assessment and selection of candidates eligible for assistance, in order to ensure a more efficient and objective allocation of resources.

The problem addressed in this study is the need to improve the accuracy and efficiency of decision-making processes in social services through the implementation of semi-automated systems. In particular, reducing subjective influence in selection processes, as well as reducing the time and resources required to process applications.

The study shows that the introduction of a semi-automated system can significantly reduce the response time to applications, increase the accuracy of candidate selection and ensure greater transparency in the decision-making process. The system, based on data analysis algorithms and production rules, is able to adapt to changing conditions and requirements, providing solutions based on up-to-date information.

The effectiveness of the semi-automated system is due to the use of modern technologies for processing large volumes of data and the use of complex mathematical models for the analysis of this data. The implementation of a modular system with individually adjustable parameters allows the system to accurately evaluate each case based on the expected criteria, ensuring a high level of adaptability and accuracy.

The results of the research can be applied in practice in various social security institutions, where there is a need to automate the processes of selection and decision-making. Important conditions for the effective implementation of the system are the availability of sufficient technical support, a high level of qualification of the personnel engaged in putting the system into operation, as well as a clear understanding of the rules and procedures that regulate social protection. In addition, to guarantee the successful application of the system, it is necessary to ensure compliance with all regulatory and legislative requirements, especially regarding the protection of personal data.

Keywords: expert decision-making block, expert system, production rule, social sphere, social service.

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ANALYSIS OF METHODS AND ALGORITHMS FOR PROCESSING UNSTRUCTURED TEXT DATA BASED ON JSON TECHNOLOGY

pages 10–18

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The object of research is the process of automating systems for structuring data from several sources. The subject of the research is methods and algorithms for implementing a complete system for automated and parallel processing, validation and structuring of data. One of the most problematic areas is the merging of databases with different structures and several common fields into a generalized structure. The research was aimed at developing a system to increase the efficiency of automation of big data processing.

As a result of the work, optimization methods were studied, the influence of their internal parameters on the operation of algorithms was analyzed, their main advantages and disadvantages were determined, and software was developed in which the corresponding methods were implemented. An algorithm for structuring data before processing has been obtained. Data structuring is achieved by performing the «mapping» operation. Mapping can take place by indexes of already cleaned data or using a defined dictionary with a given set of keys, which allows not to care about the sequence of storing values and their possible shift.

The practical significance of the developed system lies in the improvement of methods of collecting and processing information for the purpose of its further validation, cleaning and accumulation in

the following categories: geographic addresses and geo-coordinates, validation and automated addition of a mobile phone number to the international format, processing of car numbers (in modern and outdated format), VIN code of the engine and car brand, validation of urls of social networks, passport data and processing of personal data. Compared to similar methods for processing large volumes of data, the possibility of splitting the input file or stream into separate parts was used, the cleaned data from which is combined at the end of the system operation. Thanks to this, it is possible to process data whose size exceeds the available volume of the device's RAM, and the method of working with loosely structured text files in CSV format has been improved.

Keywords: validation, intelligent system, unstructured data, JSON, CSV, crowding, ETL, ELT, automated system.

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DEVELOPMENT OF FUZZIFIED NEURAL NETWORK FOR ENTERPRISE BANKRUPTCY RISK ESTIMATION

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The object of this study is the assessment of the level of enterprise bankruptcy risk. It is a critical component in assessing the financial condition of an enterprise, and also serves as an indicator that allows the management team to reduce potential risks and develop their own strategies to strengthen the financial condition of the enterprise. One of the most challenging aspects of bankruptcy forecasting is the complex financial situations of bankrupt companies. By accurately predicting the risk of bankruptcy, businesses can take preventive measures to mitigate financial difficulties and ensure long-term sustainability. Previous methods, such as Altman's Z-score, are not accurate enough, as presented in the study. The paper investigates a modern approach to bankruptcy prediction based on a neural network with complex neural elements, namely neural arithmetic logic units (NALUs) and a custom phasing layer. This layer can process complex raw numerical values, such as financial indicators relevant to the analysis of a company's bankruptcy. Compared to Altman's Z-score, the developed method demonstrates a better F1 score in bankruptcy classification (48 %). On the raw data, the neural network demonstrates an improvement in the F1 score by about 40 % compared to the classical multilayer perceptron (MLP) with linear layers and nonlinear activation functions. A modern replacement for ReLU called Mish was used, which achieves better generalization. It was also assumed that the addition of new neural elements, which provide the neural network with arithmetic capabilities, contributes to the performance of processing non-normalized input data. This work highlights the importance of using advanced neural network architectures to improve the accuracy and reliability of forecasting in financial risk assessment. Using the parameters presented in the study, managers of enterprises will be able to more accurately assess the risk of bankruptcy.

Keywords: statistical model, bankruptcy risk assessment, neural arithmetic, machine learning.

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DEVELOPMENT OF A PATIENT HEALTH MONITORING SYSTEM BASED ON A SERVICE-ORIENTED ARCHITECTURE USING ARTIFICIAL INTELLIGENCE

pages 23–29

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The object of the study is a patient health monitoring system that uses service-oriented architecture (SOA) and artificial intelligence (AI) to integrate and analyze medical data. Such a system integrates data from a variety of sources, including medical devices, health apps, electronic health records, and wearables and physiological performance recorders, providing a comprehensive approach to health monitoring. Thanks to SOA, the system is able to process large arrays of data in real time, providing the opportunity to quickly process and analyze them. This allows medical professionals to get a comprehensive picture of patients' health, taking into account both long-term trends and real-time indicators.

One of the most challenging areas is ensuring effective integration and processing of disparate data from various medical devices and applications for accurate diagnosis and prognosis of diseases. It is also important to create a system that is easily scalable and can be adapted to the needs of different medical facilities and various monitoring systems.

As a result of the research, it is concluded that the use of SOA allows creating flexible and scalable systems capable of integrating a wide range of medical devices and applications. The use of AI in these systems makes it possible to automatically detect deviations in health indicators, recognize pathologies in the early stages and predict the possible development of diseases. This is due to the fact that the proposed architecture has a number of features, in particular, the ability to collect, process and analyze large volumes of medical data in real time. Artificial intelligence algorithms provide high accuracy of diagnosis and forecasting thanks to the ability to quickly process complex data and find hidden patterns. Thanks to this, it is possible to obtain accurate and reliable indicators of the state of health of patients. Compared to similar known systems, it provides such advantages as increased efficiency of medical care, reduced risk of complications, early detection of diseases and a personalized approach to patient treatment, as well as the concentration of all data in one system.

Keywords: SOA, medical data processing, AI, edge computing, microservice architecture, data classification, medical Internet of Things.

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MODELING RELATIONSHIPS IN NON-COMMUTATIVE TWO-OPERAND TWO-BIT CET-OPERATIONS OF A DOUBLE CYCLE WHEN PERMUTING THE OPERANDS

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The object of the research is relationships in non-commutative two-operand two-bit CET-operations of a double cycle when operands are permuted. The article is devoted to studying the results of the computational experiment, which is in building a model of relationships in non-commutative two-operand two-bit CET-operations of a double cycle with the operands permutation in order to ensure the possibility of building cryptographic systems with XOR sequence encryption. The theoretical and practical results of the work are obtained on the basis of the computational experiment data. The results of researching the CET-operations data make it possible to build cryptographic systems with XOR sequence ciphering and to improve the quality of low-resource stream encryption systems. The mathematical description of the computational experiment results made it possible to establish relationships between pairs of non-commutative two-operand two-bit CET-operations of a double cycle when operands are permuted. The possibility of constructing a group of commutative two-operand two-bit CET-operations of a double cycle based on the modification of a known two-operand operation by one-operand operations to within the permutation of the crypto-transformation results has been studied. The correctness of constructing a group of CET-operations, both without operand permutation and such that allow operand permutation, has been verified. The model for building a group of asymmetric two-operand two-bit CET-operations of a double cycle, which allow the operands permutation is proposed. Applying the substitution model made it possible to obtain pairs of interrelated operations in this group. The obtained pairs of interconnected operations provide a description of modification for direct and inverse non-commutative CET operations when permuting the operands. The obtained results provide the possibility of building cryptographic systems that encrypt both the input open information under the control of the XOR sequence and the XOR sequence under the control of the input open information. Further research will be aimed at establishing relationships in non-commutative two-operand two-bit CET operations of the triple cycle when operands are permuted.

Keywords: cryptographic coding, low-resource cryptography, CET-operations, asymmetric operations, operands permutation, stream ciphering.

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SYSTEMS AND CONTROL PROCESSES

EVALUATION OF THE EFFICIENCY AND ACCURACY OF THE SYSTEM FOR COLLECTING AND PROCESSING EMG SIGNALS OBTAINED USING A BRACELET

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The object of research is a bracelet that uses the electromyography (EMG) method to control a bionic prosthesis. In the conditions of the development of modern biomedical technologies and robotics, such a system becomes key to improving the quality of life of people with disabilities, providing efficient and accurate control of prostheses. The problem addressed in the research is the development and analysis of a bionic prosthesis control system using a bracelet using the EMG method. The main focus is on the optimization of data collection and processing processes, as well as the development of machine learning algorithms for gesture recognition in order to improve the accuracy and efficiency of prosthetic control.

The essence of the obtained results is the development and testing of a new bionic prosthesis control system that uses EMG signals obtained with the help of a bracelet. The study showed that the classifier based on the support vector method outperforms other algorithms such as neural networks and decision trees, achieving an average accuracy of 90 %. The obtained data were successfully filtered and subjected to feature extraction, which allowed to create effective gesture recognition algorithms. The system was tested in real time, which confirmed its high accuracy and efficiency.

The proposed system includes an innovative bracelet for collecting EMG data, which are then processed and analyzed using modern machine learning algorithms. The innovativeness of the proposed approach lies not only in the high accuracy of gesture recognition, but also in the possibility of adapting the system to different types of bionic prostheses and operating conditions. This is achieved by using a classifier based on the support vector method, which demonstrates significantly higher accuracy compared to other algorithms such as neural networks and decision trees. The test results show an average accuracy of 92.5 %, which confirms the high efficiency of the system.

The use of this system involves the intensive use of EMG sensors, which allows more accurate determination of the user's intentions regarding the control of the prosthesis. This, in turn, contributes to the improvement of the quality of life of users, providing them with greater functionality and convenience in the use of bionic prostheses.

Keywords: bracelet, electromyography, bionic prosthesis, data acquisition system, signal processing, machine learning algorithms.

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OPTIMIZATION OF MERCHANDISE DELIVERY LOGISTICS: CASE STUDIES AT BEJAIA PORT

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The object of the study is the logistics of goods delivery by ports. This study presents a methodology designed to improve the efficiency of goods delivery logistics at the Bejaia port (Algeria). It prioritizes the optimization of empty container allocation to the ZEP zone, taking into account the geographical accessibility of the Tixter area, aiming to reduce the high costs linked with goods transportation. At the core of this strategy lies the use of simulation techniques to optimize truck fleets, ensuring maximum utilization rates and effective management of delivery operations by the Bejaia Mediterranean Terminal (BMT) for its clients. Addressing this challenge, the study offers an exhaustive analysis, integrating truck assignment

models and accessibility assessments of logistic zones. The results highlight the paramount significance of optimal resource allocation and synchronized client coordination for achieving streamlined goods delivery. It becomes apparent that employing these methodologies can yield substantial productivity improvements, emphasizing their pivotal role in strengthening the port's logistical infrastructure.

Via rigorous analysis and insights derived from data, this study elucidates avenues towards achieving operational excellence within the logistical infrastructure of the port. By harnessing innovative strategies to confront persistent challenges, such as optimizing truck fleets and strategically allocating resources, the research anticipates a profound transformation in the efficiency and cost-effectiveness of goods delivery operations. Ultimately, the integration of these methodologies holds the potential to propel the port of Bejaia towards enduring success and a competitive edge in the ever-evolving landscape of global trade. Through extensive efforts, this strategy can be extended to other national and international ports operating under similar conditions, as it provides valuable information and methodologies to optimize logistics and transportation operations.

Keywords: goods delivery, goods delivery logistics, port logistics, transport problem, accessibility matrix.

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CREATION OF AN IDENTIFIER DATABASE FOR THE AMMONIA SYNTHESIS COMPUTER CONTROL SYSTEM

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The object of research is the control system of the synthesis department of the large-tonnage ammonia production unit of the AM-1360 series. An analysis of the functioning conditions of the synthesis department was carried out. The significant influence of the content of inerts in the synthesis cycle on the energy efficiency of ammonia production is shown, the optimal value of which depends both on the accepted level of prices for energy carriers and on the method of using purge gases. The need to create a computer-integrated control technology to optimize the use of purge gases is established. The function of the identifier of such a control technology is defined, namely, continuous refinement based on current information about the state of the main sections of the synthesis department, such as the synthesis column, primary and secondary condensation. The operation of these stations takes place in the conditions of seasonal and daily changes in the heat load, which causes parametric uncertainty of such parameters of the connection of the mathematical model as the concentration of ammonia in the circulating gas at the outlet of the stations listed above. Numerical assessment of these uncertainties according to the results of analytical studies for such technological objects is most often performed using stochastic approximation methods. Let's note that the significant inertia of the objects of the synthesis department under certain conditions makes it impossible to adapt the parameter to its actual value.

An algorithmic base has been created for the formation of an information array of the identifier of the computer-integrated control technology of the ammonia synthesis department, which ensures the separation of transient modes under conditions of uncertainty and allows to perform the task of identifying processes in the synthesis column, in the primary and secondary condensation units. The proposed algorithm allows to perform convergence in the department both on the general and on the component material balances. The algorithm is implemented in the MatLab application program package and tested by means of simulation based on experimental data of industrial operation of AM-1360 series ammonia synthesis units.

Keywords: algorithmic database, identifier, computer-integrated control system, ammonia production.

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