INTELLIGENT DECISION SUPPORT SYSTEMS—AN ANALYSIS OF METHODS

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Annotation. *The article explores the integration of machine learning and multi-criteria decision-making methods. The objective of the research is to critically analyze state-of-the-art research methods used in intelligent decision support systems and to further identify their application areas, the significance of decision support systems, and the methods, approaches, frameworks, or algorithms exploited to solve complex problems.*

Key words: *effective method, intelligent technologies, information and organizational processes, neural network, modern mathematical model, modern and future intelligent decision support systems.*

INTRODUCTION

Any enterprise operates under conditions of risk and uncertainty, so it constantly faces the problem of survival and ensuring continuity of operation and development [1]. Analysis of the functioning of large enterprises and their management constitutes the main content of the work of managers, analysts, and specialists in the field of information processing [2, 5]. To solve this problem, managers have to make management decisions on choosing the direction of development of the enterprise, on maintaining and increasing their position in the market and market share, on preventing losses and reducing costs, as well as maintaining and increasing competitiveness. The validity and professional level of the decisions made ultimately determine the effectiveness of the enterprise.

In modern conditions, information plays an increasingly important role. However, the need to take into account a large number of economic, political, social, and legal factors when making management decisions significantly complicates the process of choosing the right solution. As a rule, this is due to the difficulties that arise in the process of collecting relevant, reliable and complete information on the issue of interest. The rapid increase in the volume of incoming and processed information leads to significant changes in the methods and methods of information analysis and requires not only the automation of the process of processing and studying data, but also the intellectualization of information and organizational processes, the construction

and implementation of effective methods and intelligent technologies for decision support (DPS) [4,6,7].

Over the past decades, information technologies have reached a high level of development. In this regard, most developing companies use automated tools that allow them to effectively store, process and distribute accumulated data [3]. Modern decision support systems (DSS) appeared thanks to the development of management information systems and database management systems (DBMS) and are systems adapted to solving current problems arising in management activities. It is a powerful tool that allows software and interactive computer systems. Currently, there is no single generally accepted definition of DSS, because the structure of the system directly depends on the tasks for which it is used, as well as on the available knowledge, data and information on the basis of which decisions are made.

To solve weakly structured or unstructured management problems that are quite difficult for natural intelligence to cope with, there is a need to create and use artificial intelligence systems for decision making, i.e. integrated intelligent control systems, the main components of which include databases and knowledge, a decision and logical inference unit, a model repository, etc. The creation of such systems was made possible thanks to the development and achievements of intelligent control based on developments in the field of artificial intelligence, knowledge engineering, data processing and mathematical modeling [1, 2, 5].

MATERIALS AND METHODS

Attempts to endow computer technology with intellectual abilities of a higher level (probabilistic methods of reasoning, logic, inductive inference, proof by analogy, etc.) have not yet yielded tangible results. Well-known methods and methods for automating the solution of control problems through the use of intelligent functions include:

– the use of neural networks and neurocomputers at the level of recognition (classification) and generalization of objects and situations;

In his works, the American neurophysiologist Francis Rosenblatt proposed his neural network model, which should be used for the task of automatic classification, which generally consists of dividing the feature space between a given number of classes.

These systems (and others like them) were called perceptrons and consisted essentially of a single layer of artificial neurons connected by weights to multiple inputs.

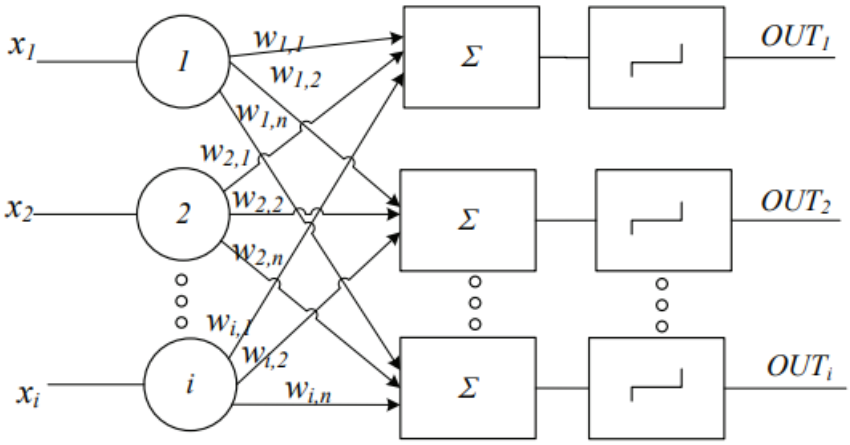


Fig. 1. Single layer perceptron

The beginning of modern mathematical modeling of neural computing was laid by the work of Hopfield in 1982, in which a mathematical model of associative memory on a neural network was formulated using the Hebbian rule for programming the network (Figure 2). The neural network computational energy function introduced into this model by Hopfield has become one of the new ways of developing artificial neural networks.

The disadvantage of the Hopfield model is their tendency to stabilize at a local rather than a global minimum of the energy function, so an evolutionary development of the model for solving combinatorial optimization problems and artificial intelligence problems is the Boltzmann machine.

Self-organizing feature map (SOFM - Self - Organizing Feature Map network), developed by Kohonen in the 1980s, has a set of input elements, the number of which corresponds to the dimension of the training vectors, and a set of output elements that serve as prototypes.

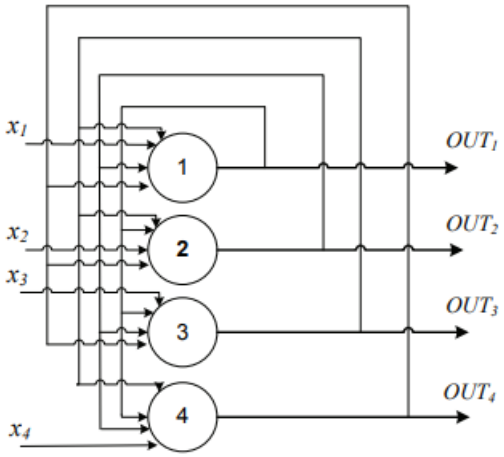
The basic architecture of the SOFM network is shown in Figure 3.

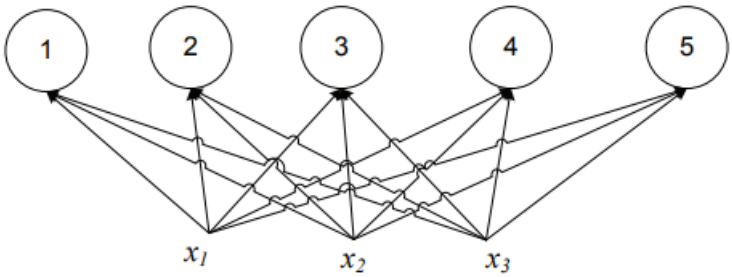
In the late 1980s, counter-propagation networks were developed that surpass the capabilities of single-layer networks. The training time in them, compared to networks with back propagation, can be reduced by a hundred times. Back propagation can provide a solution in applications where a long training procedure is not possible. Counter-propagation combines two well-known algorithms: the Kohonen self-organizing map and the Grossberg star. Their combination leads to properties that none of them have separately [4].

Techniques that, like counter-propagation, combine different network paradigms as building blocks can lead to networks closer to the brain in architecture than any other single native structures. It seems that in the brain it is the cascading connections of modules of different specializations that allow the required calculations to be performed.

Fig. 2. Hopfield network of 4 neurons

Fig. 3. Kohonen network with three input and five cluster elements, each





element of the input layer is connected to each element of the cluster layer

Thus, we can conclude that for the full implementation of intellectual abilities associated with analysis, forecasting, summarizing initial information on a complex management problem and, ultimately, making the right decision, modern and future intelligent decision support systems and intelligent systems accounting should be implemented using the latest progressive technologies, which are based on dynamic data models that can adapt to a specific situation and task, concepts of distributed artificial intelligence, parallel processing of huge volumes of data in the decision process, as well as methods for plausible output of results.

Therefore, one of the most promising ways to build intelligent decision support systems, data mining systems, control and forecasting systems is the use of modern scientific developments in the theory and practice of neural

networks, fuzzy models and methods of multicriteria selection and fuzzy logical inference.

Conclusion. Based on the analyses, the study identified that a decision support system based on multi-criteria approaches has major applications in various application domains. The research exploits the power of machine learning and artificial intelligence as an efficient alternative for solving complex problems where problem solution is based on multiple criteria. Furthermore, papers are analyzed using quality assessment criteria taking into account the scope of the domain and the significant of the contribution. The presented study will provide useful insight to the readers and experts in the various domains regarding the current status of research to provide more intelligent and effective models, frameworks, and practical solutions to cope with more complex decision-making problems.

REFERENCE:

1. Ali, R.; Hussain, A.; Nazir, S.; Khan, S.; Khan, H.U. Intelligent Decision Support Systems—An Analysis of Machine Learning and Multicriteria Decision-Making Methods. Appl. Sci. 2023, 13, 124261

2. Zhang, G.; Lu, J.; Gao, Y. Decision Making and Decision Support Systems. In Multi-Level Decision Making: Models, Methods and Applications; Springer: Berlin/Heidelberg, Germany, 2015; pp. 3–24.

3. Jiang, Y.; Qiu, B.; Xu, C.; Li, C. The Research of Clinical Decision Support System Based on Three-Layer Knowledge Base Model. J. Healthc. Eng. 2017, 2017, 6535286.

4. Pashkevich, A.; Shubenkova, K.; Makarova, I.; Sabirzyanov, D. Decision Support System to Improve Delivery of Large and Heavy Goods by Road Transport; Springer International Publishing: Cham, Switzerland, 2019.

5. Eraslan, E.; İÇ, Y.T. An improved decision support system for ABC inventory classification. Evol. Syst. 2019, 11, 683–696.

6. Bouzayane, S.; Saad, I. Intelligent Multicriteria Decision Support System for a Periodic Prediction; Springer International Publishing: Cham, Switzerland, 2019.

7. Chen, R.; Liu, Y.; Fan, H.; Zhao, J.; Ye, X. An integrated approach for automated physical architecture generation and multi-criteria evaluation for complex product design. J. Eng. Des. 2019, 30, 63–101.