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INTERDISCIPLINARY STRUCTURY ANALYSIS SYSTEMS IN THE FIELD OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES

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The article discusses the methodological strategies of integrated computer logistics in the field of artificial intelligence, focused on the tasks of the cognitive economy. The mechanism of the methodological synthesis of disciplinary structures into the system of cognitive sciences and the advantages research programs arising from this mechanism are shown.

Keywords: *artificial intelligence, information technology, cognitive activity, system of meanings, generative linguistics, neurons, neural network, thinking model, the fourth industrial revolution.*

Introduction

In a relatively short time of technological evolution, information technology has been transformed into artificial intelligence technology. Computer programs capable of self-learning, independent search for solutions to problems, and decision making have been developed. Software development is accompanied by scientific research through an interdisciplinary cluster of cognitive sciences. This cluster integrates mathematical logic, cognitive psychology, cognitive linguistics, neurophilosophy, neurophysiology, neurobiology, anthropology, philosophy of consciousness, artificial intelligence theory, cognitive management, cognitive economics, neuromarketing, Internet logistics of technology platforms, modeling methodology. Key positions in this research cluster are retained by cybernetics, focused on management tasks.

Strong artificial intelligence is developed on the basis of computer evolution programs. A direction of development was formed on the basis of evolutionary genetic and neural approaches. The thesis is used that human thinking and the brain have mental representations similar to computer data structures and computational procedures similar to computational algorithms. Since the human brain is identical to the computer in the content of processes in the form of calculations, the priority in the development of artificial intelligence is given to the simulation of cognitive processes that take place in the human brain. At the same time, the principle of demarcation between artificial intelligence and the decision-maker is maintained. Artificial intelligence is designed to make decisions, but not to make them, because subjective experience and will remain the competencies of people. The article discusses the methodological strategies of integrated computer logistics in the field of artificial intelligence, focused on the tasks of the cognitive economy.

Main part of the study

Information technology was created in the twentieth century on the basis of the paradigm of functionalism. According to this paradigm, the description of functional properties and relationships is logically independent of the description of physical properties and relationships. This means that the same functions can be reproduced on substrates with different properties. In this context of consideration, human thinking is similar to mathematical calculation. It was only necessary to develop, within the framework of formal logic, the programming mechanisms necessary for the transformation of natural language statements into statements of an artificial language, one of the modifications of which is the language of mathematical calculi. Mathematical logic coped with this task. Human thinking was formalized on the basis of a specific set of functions for processing information, storing and transmitting

information. At this stage, algorithms were developed for solving specific computational problems related to statistics, costing, document management, design and construction. Human thinking was freed from routine arithmetic calculations similar to the function of a calculator. After the computers were combined into an information network, they began to perform the function of transmitting and receiving information (feedback). It turned out to be relevant in the face of increased volumes of information necessary for decision-making. It was the beginning of cybernetics.

Information technology developers wanted to transfer more functions of human thinking to computer technologies. This means that in the description of the function of thinking it was necessary to introduce features of human consciousness. That was the beginning of the methodology of simulation modeling of information processing functions in the human mind. For this purpose, the categorial apparatus of cognitive science has been updated. He became the basis of the paradigm of cognitive sciences. The initial thesis of this paradigm is that people act on the basis of cognitive codes. Their behavior is a causal consequence of operations performed on the basis of these codes.

As a result of cognitive activity, a system of meanings (concepts fixed by the word) is created, which refers to the fact that the individual knows and thinks about the world. In a systematic form, these meanings are represented by a mentality, which is understood as a stable set of attitudes and predispositions of an individual or social group to perceive the world in a certain way. Mentality reflects the style of thinking, as well as mental attitude, national character, attitudes, values, behavior, activities, mental processes.

The subject of cognitive linguistics is the processes of perception, categorization, classification and understanding of the world, the accumulation of knowledge, that part of the information that is reflected and fixed in the forms of language. Frames (stereotypical situations, scenarios), concepts (the totality of all meanings expressed by the means of the language), aestaltes (integral additional images of fragments of the world) became the instruments of operation. The language sign system plays a role in coding and transformation of information. Categorization develops concepts in which the most relevant properties for everyday consciousness are concentrated. Generative (transformational) linguistics of N. Chomsky has become one of the grounds for creating a new generation of computer programs that take into account the characteristics of subjective reality [1]. Its essence is that transformational and structural rules, principles describe the creation and interiorization of language expressions. Using a finite set of grammar rules and concepts, people can create an unlimited number of sentences. The ability to structure expressions is an inherent part of the genetic program of humans. They are practically unaware of these structural principles. People only need to learn lexical units and morphemes in order to construct expressions. Understanding the language is not due to past experience of behavior, but to the mechanism of language acquisition (internal memory structure).

J. Fodor developed the theory of human brain activity with the concept of modularity of consciousness [2]. According to this approach, the human cognitive system consists of a central processor and modules. Central processors (conclusions) have access to the entire cognitive system of a person. They form censorship mechanisms. These mechanisms are culturally determined. Information that does not fit into cultural models does not reach the human mind, as it is censored. Censored (recognition, identity procedures) information is divided into modules (fragments). In the general semantic picture, it is collected only in the central processor. Information is structured to fit the cultural program. From the standpoint of connectionism, the mental activity of the brain is modeled through the distribution of activation signals between simple computational units (neurons), which it possible in conditions of fuzzy or insufficient data, contextually dependent concepts, and dynamic representations. Neurons can enter quantitatively measured states of activation and measure the weight of connections with each other, creating complex systems, configurations, described by a mathematical apparatus. Each configuration described by a mathematical vector is a representation of a mental state. A neural network, unlike computers of linear architecture, practically does not need preliminary programming. She is capable of self-learning, as a result of which she performs the functions of generalization, classification, prediction, speech recognition, images, memory research, learning processes. In 2010, the Image Net database was devel-

oped. It contains 15 million images in 22 thousand categories. Based on such a database, a neural network is capable of making practically error-free decisions.

Despite the successes in the field of artificial intelligence theory, computer programs in the field of cybernetics only contribute to human decision making. He remains the main actor. There was a rejection of the thesis about the isomorphism of a computer program and human consciousness. As a result, cognitive sciences have focused on the connection of the human psyche with the functions of his brain. Physicalism, psychologism, and functionalism were combined. The result of concentration of efforts was neuropsycholinguistics.

A statement is formulated that organisms use internal representations (representations) and perform computational operations on them [3]. Cognition in this sense is the controlled manipulation of representations.

The developers of the theory of behavioral economics and neuromarketing began to believe that the understanding of the situation and decision-making by individuals is formed by mechanisms of unconscious thinking. D. Kahneman believes that the role of rational judgment is overestimated [4]. It focuses only a small part of the perceived information, reaching the stage of analysis. In many cases, a judgment on a positive outcome of a choice is made on the basis of a subjective opinion of its correctness, without taking into account real facts. Reflective thinking systems are knowledge-based. Impulsive thinking systems are based on off-the-shelf schemes.

The unconscious thinking model is preferred because it is highly effective due to the low consumption of intellectual resources. No additional cognitive effort is required. Activation of ready-made patterns of social relations occurs without the participation of consciousness (automatic thinking). When there are many variables, the brain performs mental tasks better without the participation of consciousness. When there are few variables and the solution of the problem is reduced to the simplest logical operations, conscious thought works. As a result, unconscious thought is wider than conscious thought due to the limited capacity of working memory. The neural system is a biological carrier and a causal generator of mental states. These conditions are identical to neural states. The spatial and environmental organization of the human nervous system is ontologically integrated into the brain and generates neural and mental states. A particular individual is a carrier of a mentalized brain.

Formalization of decision-making processes is designed to ensure decision-making, but not to replace them. First of all, it is supposed to support decision-making based on poorly structured information; assessment of the situation and assessment of alternatives. A multi-criteria hierarchical assessment of the situation is implemented. The analysis of influences in the management of poorly structured situations is carried out. Provides intelligent support for management decisions involving intelligent. Methods of formation of enterprise development scenarios are used. Experts, analysts use ideas about the processes occurring in dynamic situations at the enterprise. They use scenarios for the development of the situation in the enterprise in rapidly changing conditions and correlations.

The fourth industrial revolution formulated the trend of a digital society based on the network structures of artificial intelligence. One of the conditions of this trend is the compatibility of all participants in social communication. The infrastructure of crowd platforms has been created. It is a place of updating the creative resources of society. Project applicants through crowd platforms have the opportunity to dialogue with potential investors and donors. If in a timely manner the project is gaining the necessary financial support, then it becomes innovative. According to this technique, the commercial crowdfunding platform «Ulej» (Ulej.by) operates in Belarus. Information support for startups is provided by the BTW-Portal of the creative industry. He also provides information support for projects.

One of the first issues of the creative industry in Belarus began to be considered by I. Matsevich [5]. She traced the evolution of social communities in a new paradigm. The conceptual apparatus used was developed in English-language studies on the creative industry («creative city» C. Landry) [6], «cluster» [7]). The subject of discussion was the importance of clusters in the field of creative economy for the development of social communities in the city. An important part of this process is the formation of the information environment of the cognitive economy and the mechanisms of functioning of cyber-physical systems.

Elements of the cognitive economy are «smart enterprise», «smart city» [8]. The basis of management practices is formed by methods and models of artificial intelligence, intelligent information systems, decision support systems, intelligent data processing. Intelligent production planning systems, dynamic expert systems for dispatching enterprise management, financial analysis and planning using neural networks and evolutionary algorithms, as well as intelligent investment portfolio management and risk management systems are used. An important explanation is the nature of the evolution of organizations and social institutions under structural uncertainty.

The basis is an understanding of the mental activity of a person and a model from the field of cognitive sciences. An interdisciplinary concept of heterodox economic theory has been formed. This theory integrated the sections of cognitive, experimental, and behavioral economies [9]. Formed business analytics, data mining, text mining, web mining, business intelligence. Hybrid intelligent systems have been developed that analyze the consciousness and logic of an expert. They consist of cognitive and analytical levels. The cognitive level provides information for processing at the analytical level. Cognitive methods of analyzing the consciousness of social agents used, testing is carried out of the quality of decision logic for their brain activity, for parametric tuning of intelligent decision support systems. Methods of pairing forecast models and evaluating unstructured situations are used based on cognitive modeling approaches. Models reproduce all stages of the decision support process – from analyzing the situation to choosing the best alternative. They are designed to support analysts in the face of uncertainty. The expert's knowledge about the situation is modeled in the aspect of his ideas and preferences regarding the control goal and the dynamic properties of the situation. The influence of emotions on decision making, learning processes, decision making in the absence of time is studied. According to the results of research, a whole group of cognitive distortions is classified.

The human-machine system combines the functions of human decision making and artificial intelligence decision making. In the process of creating the conditions for supporting decision-making, computer systems for analyzing situations and the method of cognitive maps used in them play an important role. Experts and analysts use ideas about processes that occur in dynamic situations modeled by a cognitive map. The importance of a cognitive map of the environment was noticed as early as 1948 by Tolman [10]. In his opinion, it determines the response of the body to the environment. System reconstruction with elements of visual clarity achieved by using diagrams and drawings in mind maps contributes to a better presentation and assimilation of knowledge (Tony Buzan [11]). Concept Maps emphasize the importance of previous experience in creating new concepts (Joseph D. Novak [12], David Ausubel [13]). B. Kosko substantiated the methodology of fuzzy cognitive maps – mathematical models that describe a problem situation and complex weakly structured systems [14]. These models allow you to study the evolution of the situation in terms of self-development, external influences. In the structure of the cognitive map, there are many concepts (vertices), as well as many relationships between concepts (arcs). Concepts are elements of the system under study. The same elements are the relationships between them. As a result, a structural diagram of causal relationships is created. A formalized modeling apparatus allows you to work with quantitative and qualitative data.

The cognitive map contains the basic laws of the observed situation known to the subject in the form of an oriented sign graph. The vertices of the graph are factors, signs, characteristics of the situation. Arcs capture cause-effect relationships between vertices. Fuzzy flow control methods have been developed in geographic information systems. A sectoral approach to modeling processes in local spaces of activity and management is used. Attention is paid to the analysis of complex control input factors, the potential strength of their influence, of their influence on the system parameters. Factors (domains) that have a large number of relationships with other factors are investigated. Factors are found that do not have relationships with other factors (orphan factors). Clusters (subsystems) are distinguished, as well as elements of the hierarchical organization of the cognitive map.

But not only knowledge and information provide effective decision making. An important role is played by the subjective human factor. Therefore, the cognitive economy is the knowledge of

how managers formulate goals, alternatives, how they reflect. Based on this knowledge, neuromarketing strategies are built.

Conclusion

Thus, the interdisciplinary logistics of artificial intelligence is focused on the tasks of ensuring decision-making, as well as on the development of effective computer programs for modeling complexly structured situations in the context of solving economic problems of regions and enterprises. In Belarus, this direction of the cognitive economy has become a trend. It is associated with the development of cyber-physical systems, as well as a systematic analysis of social structures based on models of a smart city, smart home and smart enterprise. The Belarusian National Technical University is a structure integrated into the cognitive economy because it has the resources of the Faculty of Information Technology and Robotics, engineering and economic specialties, and the International Institute of Distance Learning.

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ЛОЙКО А. И.

СИСТЕМЫ МЕЖДИСЦИПЛИНАРНОГО СТРУКТУРНОГО АНАЛИЗА В ОБЛАСТИ ТЕХНОЛОГИЙ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА

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В статье рассматриваются методологические стратегии интегрированной компьютерной логистики в области искусственного интеллекта, акцентированные на задачах когнитивной экономики. Показан механизм методологического синтеза дисциплинарных структур в систему когнитивных наук и вытекающие из этого механизма преимущества исследовательских программ.

Ключевые слова: *искусственный интеллект, информационные технологии, познавательная деятельность, система значений, генеративная лингвистика, нейроны, нейронная сеть, модель мышления, четвертая промышленная революция.*

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