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Methodological bases of innovative information systems in the field of computer linguistics (natural language processing)

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Abstract. *Innovative information systems are crucial for managing data, blending traditional methods with modern AI, machine learning, and deep learning. These systems are built on a modular, systematic approach, ensuring flexibility. In computational linguistics, these systems automate natural language processing. They use hybrid models, combining rules with neural networks, and leverage transformers and large language models for better context analysis. Verification and quality assessment are essential for reliability. These systems are vital for applications like chatbots, machine translation, and text analysis.*
Keywords: *innovative IT, computer linguistics, NLP.*

Introduction.

In the context of global instability [1], economic and social crises [2], [3], and the rapid development of information technologies, innovative information systems [4] are of particular importance. Their relevance is due to their ability to provide companies, organizations, and even government agencies with a prompt response to rapidly changing conditions, support informed decision-making, and minimize risks associated with uncertainty [5]. Innovative information systems are a set of hardware, software, and methodological solutions aimed at effective management, processing, and analysis of data in various fields of activity [6]. Their development is due to the need to adapt to ever-growing volumes of information, increasingly complex decision-making processes, and the dynamism of the external environment [7, 8]. The methodological foundations of such systems include a systems approach that allows information processes to be considered as interconnected elements of a single structure, and modularity that ensures flexibility, scalability, and the ability to integrate new technologies. Innovative information systems rely on a combination of traditional data processing methods, mathematical modeling, statistics, classical intelligent methods (knowledge based) [9], [10] and modern artificial intelligence algorithms [11], including machine learning and deep learning methods. In addition, an important aspect is the implementation of methods for assessing the quality, verification and ensuring the reliability of systems. This allows not only to create effective solutions, but also to guarantee their resistance to errors, adaptation to changing conditions and compliance with user requirements. Together, the methodological foundations of innovative information systems form an intelligent framework capable of supporting strategic management, automation of processes and processing of large amounts of information.

The Main Part.

Modern information systems in the field of computational linguistics are the result of the integration of linguistic knowledge and advanced data processing technologies. The main goal of such systems is to automate the analysis, understanding and

generation of natural language, which provides opportunities for creating intelligent interfaces, machine translation systems, chatbots, tools for analyzing large text arrays and other applications.

The methodological basis of these systems is built on a combination of a systems approach, hybrid models and innovative algorithms. A systems approach allows us to consider natural language processing as a complex process that includes syntactic, semantic, pragmatic and cognitive levels of analysis. Hybrid models combine rules and statistical methods with modern neural network technologies, which increases the accuracy and adaptability of systems.

Particular attention is paid to deep learning models, transformers and large language models that are able to take into account the context and build complex representations of meaning. These approaches allow us to create systems that can work in conditions of limited data (few-shot/zero-shot), providing innovativeness and flexibility of solutions. Finally, the methodology includes principles of evaluation and verification, which guarantee the quality, reliability and interpretability of the results, as well as integration with intelligent information systems for practical application in various fields of science, business and education.

Author's scientific and practical results:

1. Systematicity and modularity: Effective computer linguistic systems are built on a modular architecture, which ensures flexibility and scalability when integrating new algorithms and models.

2. Hybrid methods: A combination of rules, statistical models and neural network algorithms allows achieving high accuracy and adaptability in text processing.

3. Innovative technologies: The use of transformers and large language models makes it possible to analyze large volumes of data, recognize context and generate texts at a qualitatively new level.

4. Verification and interpretability: Quality assessment and transparency of algorithms are key to the implementation of systems in real practice.

5. Application in information systems: Innovative computer linguistic technologies are used in chatbots, decision support systems, automatic translation, text analysis and educational platforms, making them an integral part of modern intelligent information systems.

Conclusions.

As a result of the study of the methodological foundations of innovative information systems in the field of computational linguistics, it can be concluded that modern approaches to natural language processing require a comprehensive and systematic consideration of the processes of analysis, interpretation and generation of text. The key is the integration of traditional linguistic models with modern statistical and neural network methods, which allows combining the accuracy of formal rules with the flexibility of machine learning. The use of transformers and large language models opens up opportunities for a deeper understanding of the context, semantics and pragmatics of language, as well as for the generation of high-quality text data in various applications. The methodological basis of such systems involves the constant

improvement of algorithms and models taking into account the growing volumes of data and increasingly complex language processing tasks. Verification and quality assessment are becoming critically important, as they ensure the reliability, interpretability and practical applicability of systems. Innovative approaches in computational linguistics allow creating intelligent information systems capable of effectively interacting with the user, supporting decision-making, automating translation and text analysis, and adapting to new tasks and language situations. Thus, the methodological foundations of innovative information systems form not only a technical framework, but also a conceptual basis for the development of computational linguistics, ensuring the integration of knowledge, technologies, and practical applications. This makes such systems an integral part of the modern scientific, educational, and applied context, opening up new opportunities for automating intelligent processes and increasing the efficiency of working with text information.

Discussion.

Modern computational linguistics is developing in the context of a constant increase in the volume of text information and the complexity of tasks related to natural language processing (NLP). Hybrid information systems are an integration of various methods of language analysis: symbolic, based on rules and logic [12], and subsymbolic, using statistical models and neural networks [13]. This approach allows combining strict formalization of language rules with the adaptability and learnability of modern algorithms, which ensures high efficiency and versatility of systems [14]. The methodological basis of hybrid systems includes a system analysis of text processing processes, the construction of a multi-level architecture where morphological, syntactic, semantic and pragmatic analyses are implemented. Both classical linguistic models and modern transformers, deep neural networks and Large Language Models (LLM) are used. Hybrid systems also rely on ontologies, frames, and semantic networks to represent knowledge [15], which allows them to take into account the context, meaning, and pragmatics of texts. Of particular importance is the methodology for evaluating and verifying the results: systems must demonstrate not only high processing accuracy, but also interpretability, resistance to noise, and the ability to adapt to new language situations. The hybrid approach makes it possible to use systems in a variety of practical applications - from automatic translation and analysis of large text arrays to intelligent interfaces and educational platforms.

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