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SOFT COMPUTING IN MODERN PHILOLOGY

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Abstract. *The relevance of soft computing in modern philology is growing along with the need to analyze and process large amounts of linguistic data containing complex, ambiguous and culturally determined aspects. Soft computing opens up new possibilities for the study of linguistic phenomena, text structures, stylistics and cultural contexts, which is extremely important for modern philologists.*

Soft Computing in modern linguistics refers to methods and approaches that help to process and analyze language, taking into account its complexity, ambiguity and flexibility. These methods allow working with ambiguous, incomplete or imprecise data, which is often found in natural language. Linguistic tasks such as syntactic and semantic analysis, language recognition, machine translation/interpretation, morphological analysis, etc., often require a particularly flexible approach.

The article presents the results of research on the use of soft computing in modern philology, in particular, the relevance and importance of mathematical modeling of uncertainty (probability and vagueness) in modern philological scientific and practical research is proven, important cybernetic methods and algorithms of soft computing in mathematical linguistics are identified, applied soft computing technologies are systematized in machine linguistics, the priority directions of the applied application of soft computing in applied problems of linguistics are proposed.

Key words: *modern philology, machine linguistics, soft computing*

Introduction.

Modern philology increasingly integrates mathematical methods that allow to increase the accuracy, efficiency and scalability of the analysis of texts, linguistic phenomena and cultural contexts [1, 2]. The use of mathematical approaches in philology has a significant impact on theoretical and practical aspects of research [3], opening new horizons for processing and understanding complex textual data.

Soft Computing is an approach to the development of intelligent systems that is focused on solving problems associated with uncertainty, ambiguity, incompleteness, and approximate solutions [4, 5]. The main goal of soft computing is to create models and algorithms that can adapt and work in complex environments where exact mathematical solutions are unattainable or too difficult to implement.

Unlike "hard" calculations, where it is necessary to obtain an absolutely accurate result [6, 7], soft calculations allow approximation of solutions. This approach is based on the concept that modern problems may not have an ideal solution, but optimal or approximate results are reasonably acceptable and often even desirable.

Soft computing in philology is used to analyze complex linguistic phenomena and process textual data containing a significant amount of uncertainty and ambiguity [8]. Philology, which focuses on deep analysis of languages, texts, and cultural contexts, can benefit greatly from the application of soft computing methods. Such methods provide an opportunity to flexibly model language processes and work with complex, diverse aspects of language and literature.

Main text.

Soft Computing in Machine Linguistics is an approach that uses methods and algorithms that allow working with inaccuracies, incomplete information, and ambiguities in linguistic data. Soft computing is the opposite of traditional hard computing, which is focused on precision and well-defined processes. Soft computing is usually based on techniques such as:

A) Fuzzy Logic - allows you to work with imprecise or uncertain data, which can be useful in tasks of semantic analysis and natural language recognition. In other words, it allows modeling linguistic phenomena that do not have clear boundaries. For example, the definition of "high", "medium" or "low" level can be vague, and fuzzy logic helps to formalize these concepts for automatic processing (Figure. 1).

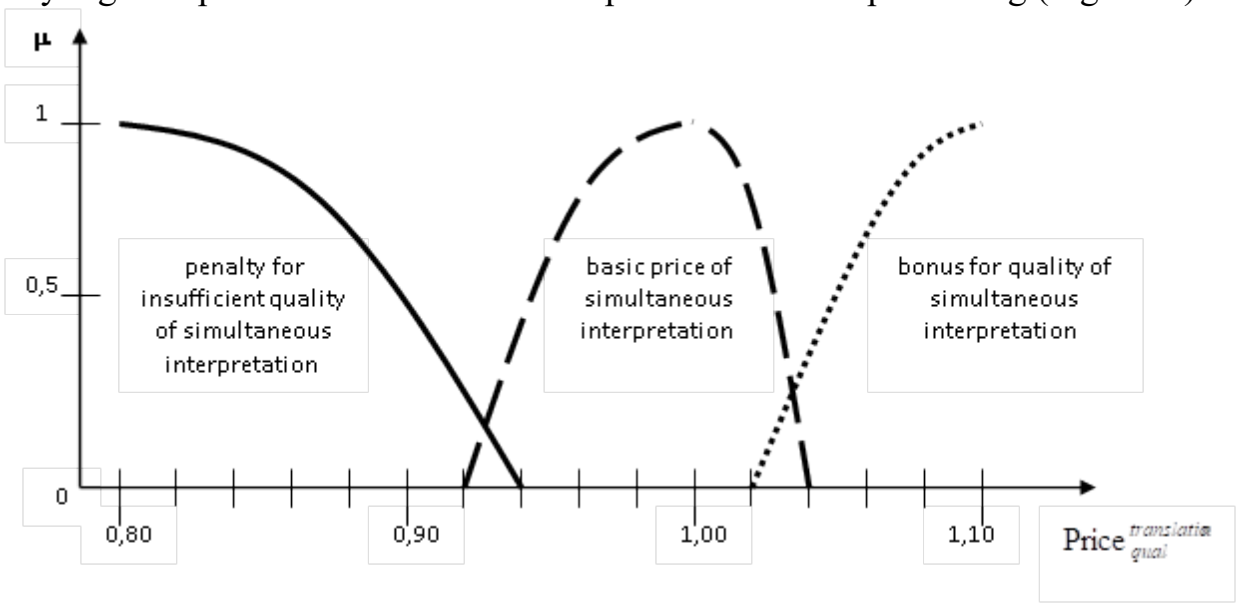

Figure 1 - The membership functions of the target fuzzy linguistic variable "Bonus-Malus coefficient for the final price regarding the actual quality of simultaneous interpretation"

the source: developed by the authors

B) Deep Neural Networks - provide the ability to learn on the basis of large volumes of data and identify complex patterns in texts. Deep neural networks are used in machine translation/interpretation, text recognition, text classification, and ultimately for recognition and analysis of recorded natural language and other language tasks [9, 10]. That is, it is deep machine learning that helps to detect

patterns in texts and adapt to various complex, complex language contexts [11] (provided there is large and representative input data for training such deep artificial neural networks (Figure 2)).

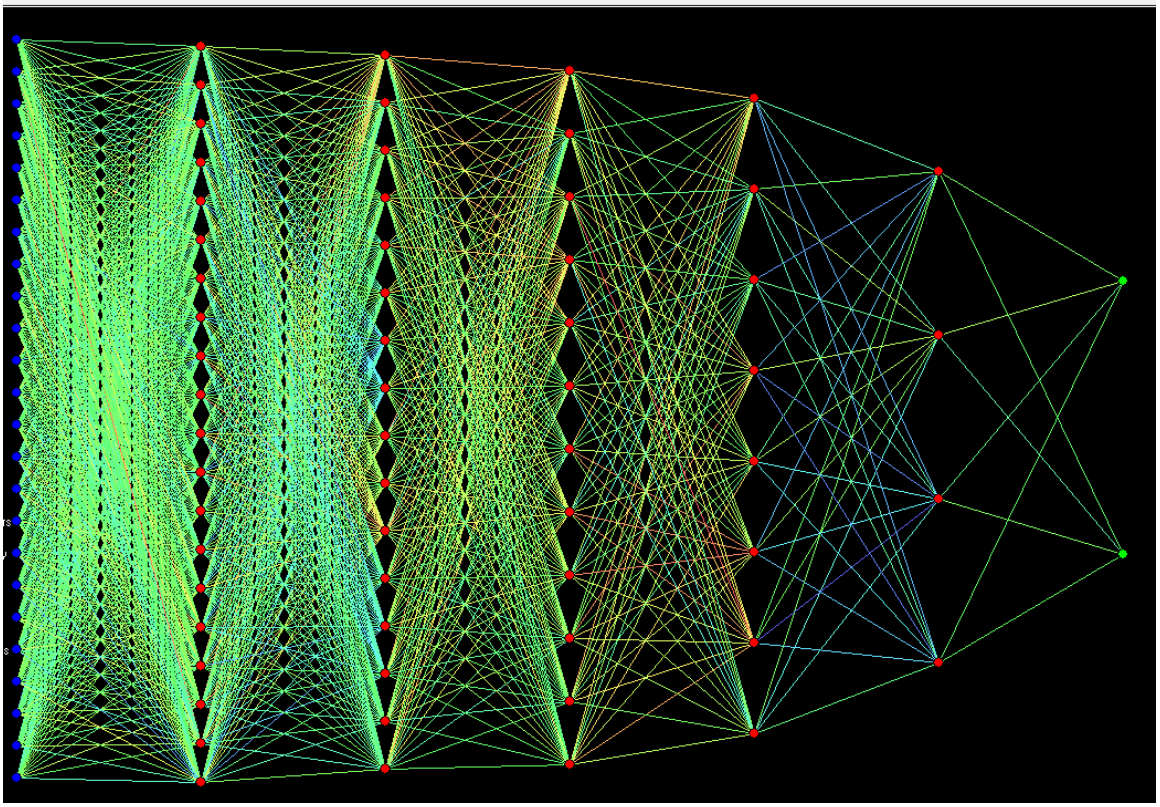

Figure 2 - Graph scheme of a trained Deep artificial neural network for binary classification of Big Text Data
(using trial version of Deductor software)
The source: developed an modeled by the authors

C) Genetic and Evolutionary Algorithms - are used to optimize processes that include many possible solutions, such as the search for optimal parameters in linguistic models (Figure 3). In other words, evolutionary algorithms optimize various models of linguistic processes, for example, the search for better parameters in the modeling of syntactic structures. The simpler technology of genetic algorithms is used to automate lexicographic tasks, for example, creating optimal dictionaries or linguistic rules.

D) Bayesian networks and probabilistic methods - allow to take into account uncertainty and create models that operate with language data based on probabilities. In other words, Probabilistic Models allow to estimate the probability of occurrence of certain words, phrases or grammatical structures in the text, which is important for language recognition and understanding.

Examples of the use of Soft Computing in philology and linguistics:

- Stylistic analysis: Soft computing helps to detect how the style of texts changes based on context or time, and automatically determine whether the text belongs to a specific genre or to author.

- Linguistic analysis: The study of connections between languages, the influence

of one language on others, the analysis of lexical borrowings, as well as the study of metaphors and semantics in different cultures.

- Analysis of literary texts: Modeling and analysis of plots, characters, textual metaphors or cultural contexts for a deeper understanding of their meaning.

- Machine translation/interpretation: soft computing helps to understand the context and correctly translate/interpret the meaning of phrases.

- Text analysis: text classification, determination of emotional tone, detection of meaning based on context [12].

- Voice processing: speech recognition and synthesis using flexible models that can adapt to different accents, pronunciation and noise.

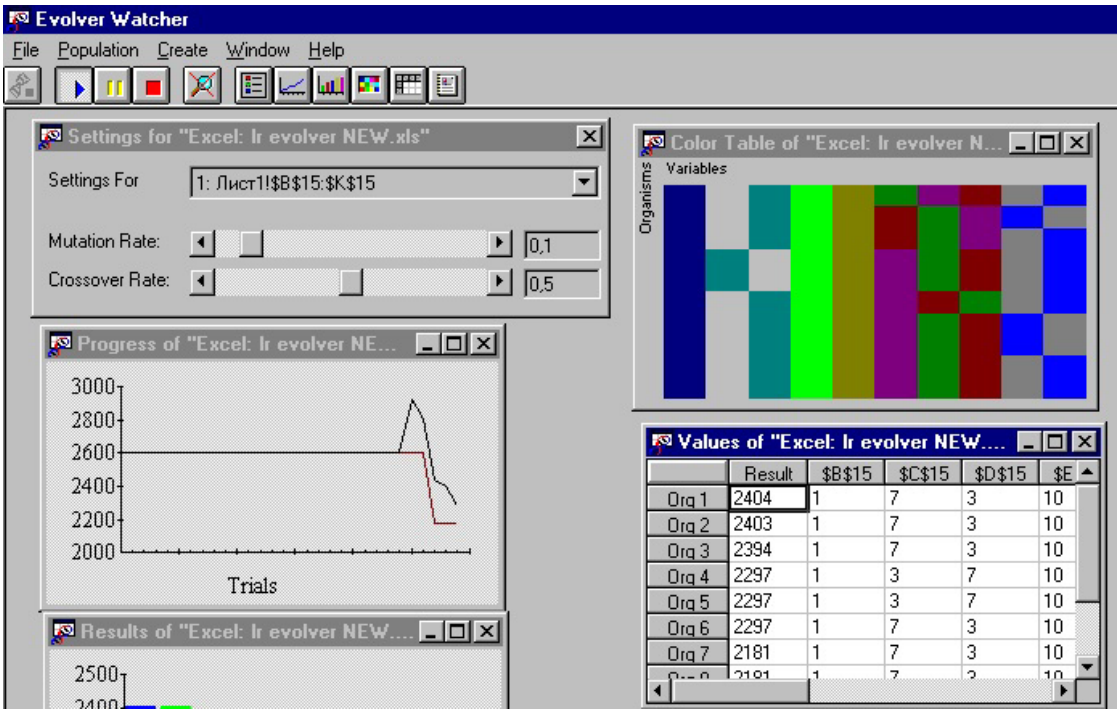

Figure 3 - The progress of the process of evolutionary optimization among different versions of the translation/interpretation in order to improve it as much as possible (using trial version of Evolver software)

The source: modeled by the authors

Summary and conclusions.

Mathematical methods in modern philology allow not only to automate the analysis of texts, but also to obtain new deep insights about language, culture and literature. They become indispensable tools for philological research [13], which require accuracy, objectivity and efficiency. This approach changes traditional research methods and makes philology even more interdisciplinary, opening up new opportunities for cooperation with other branches of science.

The relevance of soft computing in modern philology is determined by their ability to solve complex, ambiguous and multifaceted tasks that cannot be fully automated using traditional algorithms. This makes soft computing an important tool for philologists in the analysis of texts, language and cultural aspects.

In general, soft computing in philology is the powerful tool for studying complex, imprecise and ambiguous linguistic phenomena, which opens up new

possibilities for the analysis and interpretation of texts and language in general.

Thus, in machine linguistics, soft computing is used to solve problems where traditional methods are ineffective or require too strict constraints. For example, natural language analysis often involves ambiguous concepts, contexts, and syntactic features that require flexibility in processing.

Therefore, soft computing plays an important role in modern linguistics, as it allows creating adaptive, intelligent systems that take into account the complexity and diversity of language.

Discussion.

As a promising direction of their future research, the authors put forward the following debatable thesis: it is the hybrid methods of artificial intelligence in philology that are effective tools for the analysis of textual data that allow integrating various aspects of linguistics, providing more accurate and more contextual analysis. Hybrid methods of artificial intelligence in philology combine different approaches and algorithms in order to achieve better results in the analysis of language, texts, stylistics and cultural aspects. Hybrid methods of artificial intelligence [14, 15] can combine statistical models, machine learning methods, neural networks, fuzzy logic, as well as traditional algorithms for processing structured, semi-structured and unstructured big data [16] (for example, NLP). This will make it possible to create flexible, adaptive systems [17, 18] that are able to effectively work with multidimensional and ambiguous linguistic data.

It is this promising direction of the authors' future scientific research that will be reflected in subsequent publications.

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