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SPECIFICS AND PARTICULARITIES OF MACHINE LEARNING IN PHILOLOGICAL R&D MANAGEMENT AMID TURBULENT AND HIGH- RISK ENVIRONMENTS: A SHIVA AND WARMI PERSPECTIVE

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Abstract.

The article explores the features and specifics of the application of machine learning in the management of philological R&D in conditions of dynamic uncertainty, turbulence and systemic risks. The capabilities of ML for intelligent data analysis, forecasting, management of research resources and risks are determined. The need for an adaptive hybrid model "machine learning - expert - feedback" is substantiated, which meets the conditions of the SHIVA and WARMI environments.

Keywords: *digital philology, machine learning, philological R&D, artificial intelligence, intelligent control, uncertainty, turbulence, systemic risks, SHIVA, WARMI, adaptive control.*

Introduction.

Modern science is developing in conditions of fundamental complication of the environment, characterized by acceleration of information processes [1], growth of volumes of digital text data [2], [3], high variability of research requests [4], technological turbulence and strengthening of system risks. The traditional logic of organization of philological research, based mainly on stability of research objects [5], with respect to the foreseeable dynamics of scientific information and sequential carrying out of separate stages of research, is increasingly facing limitations. These limitations are especially clearly manifested in the field of philological Research and Development (R&D), where scientific activity is directly related to development of new methods of language and text analysis, creation of digital corpora, linguistic resources, intellectual information systems [6], systems of automatic processing of natural language [7], digital tools of text interpretation and other research.

The transition from relatively stable models of the external environment to more complex concepts of its description - VUCA, TUNA, BANI, SHIVA and WARMI - reflects the gradual increase in uncertainty, nonlinearity, fragility, interconnectedness

and speed of change. In the context of SHIVA and WARMI concepts, not only uncertainty and instability are of particular importance [8], but also the need for constant adaptation of research systems, rapid detection of weak signals, accounting for the multiplicity of interconnected risks and ensuring the sustainability of scientific and technological solutions. For philological R&D, this means a transition from predominantly static management of research projects to adaptive, intelligent and continuous management of knowledge, data, methods and resources [9].

One of the most promising tools for such a transition is Machine Learning (ML), which allows you to form intelligent mechanisms for processing large arrays of text and metatext information, identifying patterns, classifying and clustering research objects, predicting the dynamics of scientific processes, identifying anomalies [10] and supporting decision-making. However, the specifics of the application of machine learning in philological R&D are significantly different from its use in classical technical and economic tasks [11]. Philological objects have high semantic ambiguity, contextual dependence, cultural conditioning and dynamism, as a result of which the effectiveness of ML models is determined not only by the volume of data and computing resources, but also by the quality of linguistic interpretation [12]. Therefore, the study of the features and specifics of machine learning as a tool for managing philological R&D, and not only as a method of automated text processing, is of particular relevance. In this case, machine learning is considered at several interconnected levels: as a technology for analyzing scientific and linguistic information; as a research support tool; as a mechanism for forecasting and risk management; as a means of intelligent optimization of resource allocation; as an element of adaptive philological R&D architecture.

That is why the aim of the article is to systematically identify the features and specifics of the application of machine learning technologies in the management of philological R&D in conditions of dynamic uncertainty, turbulence and systemic risks characteristic of the SHIVA and WARMI environments.

The scientific novelty of the proposed approach lies in shifting the emphasis from the traditional understanding of machine learning as a tool for automatic text

analysis to its consideration as an intellectual contour for the management of philological R&D, which functions in a dynamic, nonlinear and risk-saturated external environment.

Main Part.

1. Transformation of the external environment and changing the conditions for managing philological R&D. Philological R&D is a special type of scientific research and scientific and technological activity that combines fundamental research into language and literature, the development of digital methods of analysis, the creation of corpora and linguistic resources, computational models and intelligent information systems. Unlike traditional philological research, R&D is focused not only on acquiring new knowledge, but also on its technological implementation. The modern external environment is characterized by the acceleration of information processes, the growth of digital data volumes, changing research requests, technological turbulence and the increase in systemic risks. In the SHIVA and WARMI concepts, the high speed of change, nonlinearity, interdependence of factors, uncertainty and the possibility of cascading risks are of particular importance. For philological R&D, this means the need to move from predominantly linear management to adaptive management, capable of constantly taking into account changes in data, technologies, research tasks and resources. In these conditions, machine learning becomes one of the tools for forming an intelligent and adaptive R&D management mechanism.

2. Machine learning as a tool for intellectualizing philological R&D management. Machine learning allows you to identify patterns in large data sets and use them for classification, forecasting, clustering, anomaly detection and decision-making support. In philology, ML is used to analyze vocabulary, semantics, syntax, stylistics, authorship, thematic structure and other characteristics of the text. However, its management potential is much broader than automated text analysis. In philological R&D, machine learning can be used to manage research data, identify promising areas, analyze scientific information, predict results and risks, support the choice of research methods and resource allocation. Thus, ML should be considered

as an intellectual superstructure over the R&D life cycle, combining data analysis, forecasting, decision support and adaptation of research processes.

3. Specificity of machine learning in relation to philological objects. Philological data differ from many other types of data in high semantic ambiguity, contextuality, cultural and historical conditioning, as well as dynamism. The same linguistic units can have different meanings depending on the context, genre and communicative situation. Therefore, the effectiveness of ML in philology is determined not only by the volume of data and computational capabilities, but also by the quality of the corpus, representativeness of the sample, correctness of the markup, research formulation of the problem and the possibility of meaningful interpretation of the results. Of particular importance are the problems of data elimination, unrepresentativeness of training samples, changes in language practices and data drift. Therefore, the application of ML requires a mandatory combination of algorithmic analysis with philological expertise.

4. Main directions of ML application in philological R&D management. One of the most important directions is the intelligent monitoring of the scientific environment. ML allows you to analyze publications, bibliographic data and thematic connections to identify new research directions, scientific niches and the dynamics of scientific interests. The second direction is to support the formation of research programs. Based on data analysis, ML can identify relationships between problems, methods, sources and expected results, contributing to more flexible R&D design. The third direction is automated classification and clustering of text and scientific materials, which allows you to structure large information arrays. The fourth direction is forecasting results and risks, including assessing the probability of technological, organizational and information problems. The fifth direction is to support the choice of research methods and resource allocation. Finally, ML can be used to evaluate R&D results, determine their prospects and find opportunities for further development and transfer of the results obtained.

5. Machine learning in uncertainty. Uncertainty manifests itself in incomplete information, changing research goals, the emergence of new data, and the inability to

determine in advance all the factors that affect the R&D outcome. ML does not eliminate uncertainty, but allows it to be intelligently processed by identifying probabilistic dependencies, evaluating alternative scenarios, and supporting decision-making. In the conditions of the SHIVA and WARMI environments, the transition from predicting a single future to scenario analysis and adaptive updating of models is especially important. The ML system must be able to regularly adjust and retrain as the research context changes.

6. Machine learning as a tool for managing turbulence. Turbulence manifests itself in rapid and difficult-to-predict changes in the scientific and technological environment: the emergence of new digital tools, changes in data structures, communication methods, and requirements for research activities. In such conditions, the linear R&D life cycle becomes insufficiently flexible. A cyclical process of monitoring, analyzing changes, adjusting the model, retraining and re-evaluating the results is necessary. Machine learning allows you to form a closed intellectual control loop: data on the state of R&D is fed into the analytical system, processed, compared with goals, after which recommendations are formed for adjusting research actions. Thus, ML becomes both an analytical and an adaptive management tool.

7. ML in managing systemic risks of philological R&D. Systemic risks arise from the interdependence of research data, software, computing infrastructure, digital corpora, scientific resources, research teams and results. ML can be used to detect anomalies, identify interdependent risk factors, analyze dynamics and generate early warnings. Methods for detecting anomalies, classifying risk situations and analyzing temporal dependencies are particularly promising. At the same time, machine learning is not always able to determine the causal nature of the identified risk. Therefore, systemic risk management should combine ML analytics with expert assessment and subject-matter philological interpretation.

8. Hybrid model of philological R&D management based on ML. The most promising is a hybrid model that combines machine learning and expert philological knowledge. It is based on five interdependent elements: data management; intelligent analytics; expert interpretation; management decision-making; feedback and

adaptation. In such a system, ML provides processing of large data sets, forecasting and pattern detection, the expert provides meaningful verification of results, and the feedback mechanism allows for constant adjustment of the research system. Such an architecture allows you to simultaneously use the advantages of automation and maintain the scientific validity and interpretability of the results.

9. Key issues and limitations. Key limitations of ML in philological R&D are data quality and representativeness, algorithmic bias, limited interpretability of complex models, data and concept drift, ethical and legal issues, and technological dependence on specific digital platforms and resources. Therefore, the implementation of ML should be accompanied by data quality control, model validation, data change monitoring, risk assessment, and expert verification of critically important results.

10. Adaptation of ML management to SHIVA and WARMI environments. In SHIVA and WARMI conditions, machine learning should be considered not as a static technology, but as an adaptive component of the research system. This involves a transition from static models to dynamically updated ones, from single training to regular retraining, from linear control to cyclical adaptation, from local optimization to systemic management of interconnected risks. The human-in-the-loop principle is of particular importance, in which the researcher retains the role of the subject of goal setting, interpretation of results and strategic decision-making. ML provides speed, scalability and analytical power, and philological expertise provides substantive validity and scientific interpretation. Thus, the most adequate SHIVA and WARMI environment is the adaptive architecture "ML + expert + feedback + external environment monitoring", which ensures the stability and flexibility of philological R&D in conditions of high uncertainty, turbulence and systemic risks.

Conclusions.

The conducted research allows us to conclude that machine learning is gaining importance in modern philological science, which significantly goes beyond automated text processing. In the conditions of the development of digital philology

and the complexity of the environment, ML becomes a promising tool for intellectualizing the management of philological R&D, which provides support for the processes of data analysis, the formation of research programs, forecasting, resource management and risks.

The specificity of the application of machine learning in philological R&D is due to the peculiarities of the research object itself. Language and text are characterized by semantic ambiguity, contextuality, historical and cultural conditioning, dynamism and high dependence on the quality of research data. Therefore, the transfer of ML technologies from other subject areas without appropriate philological adaptation does not provide the necessary reliability of the results.

In the conditions of SHIVA and WARMI environments, the adaptability of ML systems becomes of particular importance. Machine learning should be aimed not only at increasing the accuracy of forecasting, but also at the ability to quickly respond to changes in data, research goals, technological conditions and risk structures. This requires a transition from static models to dynamically updated ones and from linear R&D management to a cyclical system of monitoring, analysis, decision-making and feedback.

It has been established that the most promising direction is the use of ML to form an intelligent contour of philological R&D management. Such a contour should combine data management, intelligent analytics, forecasting, risk monitoring, expert interpretation and adaptive adjustment of research decisions.

It is fundamentally important that machine learning should not be considered as a replacement for a philological researcher. In conditions of uncertainty and systemic risks, the optimal hybrid model is “machine learning = expert = feedback”, in which algorithmic methods provide scalability and analytical depth, and a person is responsible for interpretation, verification, setting research goals and making strategic decisions. In general, machine learning creates the prerequisites for the formation of a new type of philological R&D management - adaptive, intelligent, risk-oriented and based on continuous knowledge updating. Prospects for further research are related to

the development of conceptual and economic-mathematical models of adaptive ML-management of philological R&D, the formation of systems for early detection of research and technological risks, the development of criteria for assessing the stability of ML-models to data drift, as well as the integration of machine learning, big data optimization into a single architecture for managing philological R&D in conditions of SHIVA and WARMI turbulence.

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