Ai and the development of rd works

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***Abstract*— Artificial intelligence (AI) has become a tool increasingly used in scientific research, science, finance, and many other aspects of everyday life of entrepreneurs and every human being. This issue is developing extremely quickly and, according to the author of the article, its operation should be formalized and certain limits should be set to what it can be used for in order to eliminate unfair competition. The article presents the prospects for the development of AI in scientific research and financial management. Analysis and criticism of the literature was used as a research method.**

Keywords— application of artificial intelligence, development prospects

I. INTRODUCTION

Artificial intelligence (AI) has become one of the most dynamically developing technological areas of the 21st century, revolutionizing the way research and development (R&D) is carried out (Adamczak, 2024). From the analysis of huge data sets to the automation of experimental processes, AI not only increases the efficiency of research, but also opens new scientific and technological horizons (Nawrat, 2023). Thanks to the use of machine learning algorithms, natural language processing and computer vision, scientists from various fields - from molecular biology, through engineering, to social sciences - gain tools that enable them to quickly discover patterns and relationships that were previously unattainable (Różanowski, 2007).

The role of AI in scientific research is particularly visible in areas such as designing new drugs, modeling chemical processes, or discovering materials with unique properties (Niewęgłowski, Wilczek, Madoń, Palmi, Wasyluk; 2021). Moreover, tools based on artificial intelligence are used not only in natural and technical sciences, but also in the humanities, supporting research on culture, language and history (Manovich, 2020).

Despite the enormous potential, the use of AI in research and development (RD) is also associated with challenges such as ensuring data quality, ethical aspects of the use of this technology and the need to adapt traditional research methods to new standards (Gasparski, 2019).

The aim of the work is to show how AI is transforming contemporary science and technology, as well as to outline future prospects for its development in the context of scientific research and corporate financial management. This article will analyze the most important aspects of the use of artificial intelligence in the context of RD works, present its benefits and discuss the challenges faced by contemporary researchers.

The article uses analysis and criticism of the literature.

II. AI HISTORY

AI is a field whose roots go back to philosophical considerations about the nature of thinking, logic and intelligence (Berka, Kreiser, 1971). Already in antiquity, Aristotle studied the principles of logical reasoning, which can be considered the first attempts to formalize thinking (Olesiński, 1998). In the 17th century, René Descartes developed the idea of the mechanical functioning of the body and mind, suggesting that certain processes could be automated (Steer, 2022). These concepts inspired later generations of scientists and engineers to build mechanical devices such as the Jacquet-Droz machines of the 18th century, which could imitate

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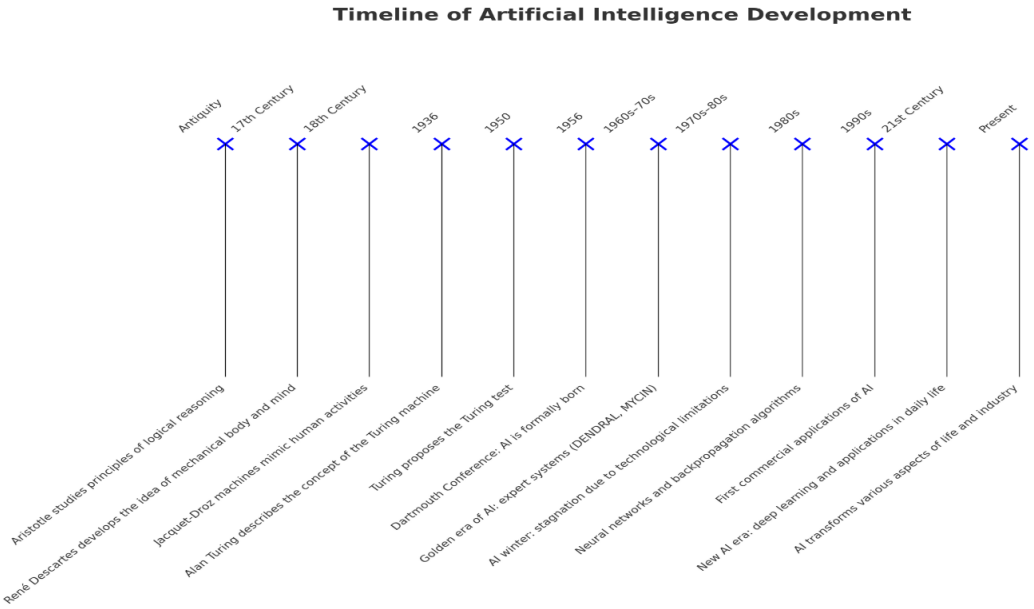
human activities such as writing and drawing (Mares, 1909).

The breakthrough towards modern artificial intelligence came in the 20th century with the development of mathematics, formal logic and computers. Alan Turing, one of the fathers of computer science, in 1936 described the concept of a Turing machine, a theoretical model of computation that became the basis for programming and thinking about artificial intelligence (Shannon, 1949). In 1950, he proposed the Turing test to assess whether a machine could imitate human intelligence without being noticed by an observer. This was an important step towards recognizing the ability of machines to perform tasks requiring intelligence (von Neumann, 1958).

The formal birth of artificial intelligence took place in 1956 at a conference at Dartmouth College, where John McCarthy, Marvin Minsky, Claude Shannon and Nathaniel Rochester presented the concept of creating machines capable of "thinking". This event is considered the beginning of AI as a separate scientific field (Artificial Intelligence, 1956). The first programs were then created, such as Logic Theorist by Allen Newell and Herbert Simon, which was able to prove mathematical theorems, and General Problem Solver (GPS), capable of solving general logical problems (Crevier, 1993). At that time, Frank Rosenblatt introduced the perceptron, which was an early form of a neural network (Bartkowiak, 2002, Marsland, 2014).

The timeline below shows the development of artificial intelligence over the years.

Figure 1. Development of artificial intelligence.



Source: own study based on bibliography

In the 1960s and 1970s, AI experienced a period of dynamic development, often referred to as the "golden era of artificial intelligence". Work began on expert systems such as DENDRAL and MYCIN, which were intended to support specialists in solving complex problems in fields such as chemistry and medicine. At the same time, machine learning algorithms and simulation models were developed, which allowed computers to "learn" from data (Słoniewski).

However, scientists' ambitions quickly encountered technological limitations. Computers of that era had too little computing power and memory resources were limited, which made it impossible to implement ambitious projects. There were also problems related to the lack of sufficient data sets and difficulties in formalizing many thought processes. As a result, interest in AI waned in the 1970s and 1980s, in what was termed the "AI winter." During this period, significant progress was lacking and research funding was drastically reduced (Górski, 2019).

Despite the difficulties, the development of theory and technology has not stopped completely. In the 1980s, new approaches emerged, such as neural networks inspired by the functioning of the human brain. Researchers such as Geoffrey Hinton contributed to the development of backpropagation algorithms that enabled neural networks to learn more efficiently. At this time, interest in AI increased again, and in the 1990s the first commercial applications appeared, such as speech and image recognition systems (Garfinkel, 1998).

Another revolution in AI occurred in the 21st century with the dynamic development of computer computing power, access to huge data sets and progress in machine learning algorithms. The emergence of new technologies, such as deep neural networks (deep learning), has ushered in a new era in artificial intelligence (Lee, Bengio, Hinton, 2015). AI has begun to find applications in areas such as medicine, finance, transport and entertainment, as well as in everyday life, e.g. in voice assistants or autonomous vehicles (Rzepecka, 2019, Derong, Chen, Peng, Zhang, Xu, Zhao, Wu, Zheng , Wang, Chen, 2024).

Currently, artificial intelligence is one of the key areas of research and technology development, and its potential seems almost unlimited. Despite ethical, technological and social challenges, AI continues to develop, transforming various aspects of life and opening new perspectives for science and technology. It is also worth mentioning that AI may affect data

security in various industries, e.g. accounting (Łojek, 2024).

III. THE DEVELOPMENT OF AI IN SCIENTIFIC RESEARCH

The development of AI opens new opportunities in the field of scientific research, transforming the way we conduct experiments, analyze data and formulate new hypotheses (Cellary, 2019). Table 1 shows the development prospects of AI in the field of scientific research.

TABLE 1. PROSPECTS FOR THE DEVELOPMENT OF AI IN SCIENTIFIC RESEARCH.

Perspective	Description	Examples of Applications
Automation of Research Processes	Automation of tasks such as literature review, conducting experiments, and data analysis	- Automatic review of scientific publications - Laboratory robots - Big data processing
New Methods of Modeling and Simulation	Creation of more advanced models and simulations using AI algorithms	- Predictive models in climatology - Molecular simulations in chemistry and biology
Acceleration of Scientific Discoveries	Use of AI to identify new materials, drugs, and technologies	- Error detection in data - Automatic documentation of experiments
Improvement of Research Reproducibility	Precise documentation and data analysis enhance the reproducibility of research results	- Error detection in data - Automatic documentation of experiments
Supporting Interdisciplinarity	Combining knowledge from various fields and supporting scientific collaboration	- Integration of data from biology and physics - Collaboration platforms for scientists
Ethics and Challenges Related to AI	Issues related to algorithm transparency, data ethics, and dependency on technology	- Development of ethical algorithms - Management of sensitive data

Source: own study based on Karski, 2019; Prieto – Gutierez, Segado – Boj, Da Silva França, 2023; Tiwari, Bardhan, Kumar, 2023.

AI is significantly changing the way scientific research is conducted, offering tools to automate and improve research processes. Automation includes tasks such as literature reviews, conducting laboratory experiments, and analyzing large data sets, allowing scientists to focus on interpreting results and formulating new hypotheses. AI also supports the creation of advanced predictive models and simulations that enable research in fields such as climatology, systems biology and chemistry, significantly accelerating the pace of scientific discoveries (Karski, 2019).

The integration of artificial intelligence in research also leads to improved reproducibility of results thanks to precise documentation and automatic tracking of experiments. In addition, AI promotes interdisciplinary research by integrating data and knowledge from various scientific fields and facilitating collaboration among researchers around the world. This approach leads to a holistic view of complex scientific problems that were previously difficult to understand from the perspective of a single discipline (Tiwari, Bardhan, Kumar, 2023; Prieto-Gutierrez, Segado-Boj, Da Silva França, 2023).

However, the development of AI in science also brings challenges, especially in terms of algorithm transparency, managing sensitive data and avoiding excessive dependence on technology. These issues require consideration of ethical aspects of AI development, such as designing ethical systems and ensuring that these tools support, rather than replace, human critical thinking. Despite these challenges, the potential of AI in scientific research is huge and can bring breakthrough changes in many fields of science (Królewski, Łukasik, Smęt, 2013).

AI also has great potential in discovering new technologies and solutions that can have a real impact on society and the economy. An example is the use of AI in medicine for faster drug discovery through molecular simulations or analysis of genetic data, which contributes to the development of personalized medicine and more precise therapies. In the area of materials science and engineering, AI algorithms help identify the properties of new materials, optimize their production processes and predict their potential applications. Thanks to this, scientists can not only reduce research costs, but also implement innovative solutions in practice faster, which accelerates technological progress in many key sectors of the economy (Nawojczyk, Królewski, 2016).

IV. DEVELOPMENT OF AI IN FINANCIAL MANAGEMENT

In addition, AI is playing an increasingly important role in financial management, introducing modern solutions that improve processes, increase security and support decision-making. Thanks to the use of advanced algorithms, financial institutions can manage risk more effectively, adapt services to customer needs and identify new opportunities on the market. The development of RD's works in this field additionally accelerates the implementation of innovative solutions.

TABLE 2. DEVELOPMENT OF AI IN FINANCIAL MANAGEMENT AND RD WORKS.

Area	Description	Example of Application
Process Automation	Streamlining routine operations	Accounting, forecasting
Analysis and Forecasting	Predicting trends and managing risks	Price forecasts, risk assessmen
Service Personalization	Tailoring offers to customer needs	Robo-advisors, chatbots
R&D Works	Development of new AI technologies	Explainable AI, predictive models

Source: own study.

The development of AI in financial management brings benefits to both individual clients and financial institutions. Process automation allows for significant cost reductions and increased operational efficiency, while service personalization supports building better relationships with customers. Thanks to predictive analysis and advanced risk management, institutions can make more informed investment decisions (Dudycz, 2013).

With the dynamic development of research and development,

AI is becoming more and more versatile. Explainable AI projects and advanced predictive models herald a future in which decisions made by algorithms will not only be more precise, but also understandable to users. As a result, AI has the potential to become one of the key pillars of financial management in the coming years (Tomaszek, 2022).

V. SUMMARY

The development of artificial intelligence has revolutionized the way we conduct scientific research and manage finances, becoming an integral part of the modern technological landscape. Thanks to the use of AI, it has become possible to accelerate research processes, automate routine tasks and generate innovative solutions that seemed unattainable until recently. The key advantage of this technology is the ability to analyze huge data sets and formulate new hypotheses, which contributes to the dynamic development of science and technology.

However, alongside the benefits, there are also challenges, such as the need to ensure the transparency of algorithms, an ethical approach to the use of data and managing the risks associated with technology dependence. To fully exploit the potential of AI, it is necessary to develop new standards and practices that enable humans and machines to work together harmoniously.

The future of research on artificial intelligence and its applications in various fields, such as medicine, engineering and finance, seems extremely promising. The implementation of ethical algorithms and the development of interdisciplinary approaches to solving problems will be key to the further development of this technology. In the face of the growing role of AI in the global scientific and economic ecosystem, it is worth continuing research on its potential and limitations to make it an even more effective and responsible tool in the hands of modern researchers and managers.

VI. REFERENCES

Adamczak, M. (2024). Naukowcy, wydawcy i bibliotekarze w nowej grze z ChatGPT i generatywną sztuczną inteligencją (GAI). Biuletyn EBIB, 2(213), Sztuczna inteligencja w bibliotekach – rewolucja czy ewolucja. Dostępne na: https://ebibojs.pl/index.php/ebib/article/view/912 [Dostęp 22.05.2024].

Bartkowiak, A. (2002). Sieci neuronowe: Notatki do wykładu „Sieci Neuronowe" dla studentów kierunku Informatyka na Uniwersytecie Wrocławskim. Dostępne na: https://archive.org/details/sieci-neuronowe-anna-bartkowiak [Dostęp 20.12.2024].

Berka, K., & Kreiser, L. (Eds.). (1971). Logik-Texte. Kommentierte Auswahl zur Geschichte der modernen Logik. Berlin: Akademie-Verlag.

Cellary, W. (2019). Przemysł 4.0 i Gospodarka 4.0. Biuletyn Polskiego Towarzystwa Ekono micznego, 3(86), 48–52.

Crevier, D. (1993). AI: The Tumultuous Search for Artificial Intelligence. New York, NY: BasicBooks.

Derong, X., Chen, W., Peng, W., Zhang, Ch., Xu, T., Zhao, X., Wu, X., Zheng, Y., Wang, Y., Chen, E. (2024). Large language models for generative information extraction: A survey. Frontiers of Computer Science, 18(6), 1-24.

Dudycz, H. (2013). Mapa pojęć jako wizualna reprezentacja wiedzy ekonomicznej. Monografie i Opracowania Uniwersytetu Ekonomicznego we Wrocławiu, (229).

Garfinkel, Y. (1998). History of Speech Recognition and Transcription Software, https://www.dragon-medical-transcription.com/historyspeechrecognition.html (dostęp dnia: 20.12.2024).

Gasparski, W. W. (2019). AI przedsiębiorczość: Sztuczna inteligencja jako wyzwanie dla prakseologii i etyki biznesu. Prakseologia, (161), 253–270.

Górski, S. (2019). Najważniejsze momenty w historii rozwoju AI #1. Od Turinga do pierwszej zimy. https://www.sztucznainteligencja.org.pl/najwazniejsze-momenty-w-historii-rozwoju-si-1-od-turinga-do-pierwszej-zimy/ (dostęp dnia: 20.12.2024).

Karski, M. (2019). Korzyści i zagrożenia wynikające z implementacji sztucznej inteligencji. Zeszyty Naukowe GWSH, 6, 45–58.

Królewski, J., Łukasik, S., & Smęt, M. (2013). Generating Textual Descriptions for Recommendation Results using Fuzzy Linguistic Summaries. Proceedings of the 2013 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE), 1–6.

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. Nature, 521(7553), 436-444.

Łojek, P. (2024). Zastosowanie sztucznej inteligencji w zarzadzaniu bezpieczeństwem procesów księgowych. Bezpieczeństwo. Teoria i Praktyka, Wydawnictwo Uniwersytetu Andrzeja Frycza Modrzewskiego w Krakowie – zaplanowany do druku.

Manovich, L. (2020). Cultural Analytics. Cambridge, MA: The MIT Press.

Mares, G. C. (1909). The History of the Typewriter. London: Guilbert Pitman.

Marsland, S. (2014). Machine Learning: An Algorithmic Perspective. Boca Raton, FL: CRC Press.

Nawojczyk, M., & Królewski, J. (2016). Using Big Data in innovation research. Zagadnienia Naukoznawstwa, 52(4), 431–449.

Nawrat, Z. (2024). Medycyna i ethos robotów. Ethos, 36(144), 169.

Niewęgłowski, K., Wilczek, N., Madoń, B., Palmi, J., & Wasyluk, M. (2024). Zastosowania sztucznej inteligencji (AI) w medycynie. Medycyna Ogólna i Nauki o Zdrowiu.

Olesiński, D. (1998). Myślenie i intuicja w filozofii Arystotelesa. w J. Bańka & A. Kiepas (Eds.), Aporie sensu: emotywizm i racjonalizm, 67–73.

Prieto-Gutierrez, J.-J., Segado-Boj, F., & Da Silva França, F. (2023). Artificial intelligence in social science: A study based on bibliometrics analysis. Computers and Society, 19(2) p. 149-162.

Różanowski, K. (2007). Sztuczna inteligencja: Rozwój, szanse i zagrożenia. Zeszyty Naukowe Warszawskiej Wyższej Szkoły Informatyki, 2(2), 109–135.

Rzepecka, P. (2019). W jakim stopniu sztuczna inteligencja jest w stanie zastąpić człowieka?, Studia Pedagogiczne. Problemy Społeczne, Edukacyjne i Artystyczne, Issue 34, p.161-171.

Shannon, C. E. (1949). The mathematical theory of communication. w C. E. Shannon & W. Weaver, The Mathematical Theory of Communication (s. 3–91). Urbana, IL: University of Illinois Press.

Słoniewski, K. https://www.mimuw.edu.pl/~klin/teaching/histkomp15-16/sloniewicz.pdf?utm (dostęp dnia: 20.12.2024).

Steer, N. (2022). The Time Warp: A religious philosophy to attain consciousness whilst contemplating time and space. Covenant Books, Inc.

Sztuczna Inteligencja. (2024). 1956: Konferencja w Dartmouth. Sztuczna Inteligencja. Dostępne na: https://www.sztucznainteligencja.org.pl/portfolio/1956-konferencja-w-dartmouth/ [Dostęp 20.12.2024].

Tiwari, A., Bardhan, S., & Kumar, V. (2023). A Bibliographic Study on Artificial Intelligence Research: Global Panorama and Indian Appearance. arXiv preprint arXiv:2308.00705.

Tomaszek, A. (2022). Rozwój sztucznej inteligencji i jej wpływ na rynek finansowy. Finanse i Prawo Finansowe, 2, 109-119.

von Neumann, J. (1958). The Computer and the Brain (1st ed.). New Haven: Yale University Press. (3rd ed., 2012). Foreword by Ray Kurzweil.