УДК – 910.1

Мирисломов М.М

Студент

Чирчикский государственный педагогический университет

ИНТЕГРАЦИЯ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В ИЗУЧЕНИИ ГЕОГРАФИИ: ПРОБЛЕМЫ И ВОЗМОЖНОСТИ

Аннотация: *В этом исследовании обсуждаются потенциал и проблемы интеграции искусственного интеллекта (ИИ) в изучение географии. Рассматривая основы ИИ и роль географии в эпоху глобализации, это исследование обрисовывает преимущества ИИ в изучении географии посредством интерактивной визуализации и персонализации обучения. Однако такие проблемы, как равный доступ к технологиям и подготовка учителей, являются серьезными проблемами в применении ИИ. В исследовании используется описательный метод с обзором литературы, который включает сбор, анализ и объяснение информации в литературе, имеющей отношение к интеграции искусственного интеллекта (ИИ) в изучение географии. Кроме того, в этом исследовании подчеркиваются возможности ИИ в анализе географических данных и решении глобальных проблем, таких как изменение климата. Также обсуждаются глубокие последствия интеграции ИИ в изучение географии, учитывая ее влияние на образование и общество. Это исследование дает целостную картину пересечения ИИ и географии, способствуя лучшему пониманию его потенциала и ограничений. Мы надеемся, что это исследование послужит руководством для практиков образования и исследователей по оптимизации потенциала ИИ в преподавании географии с учетом проблем, которые необходимо преодолеть, и возможностей, которые необходимо использовать.*

Ключевые слова: *География, изучение географии, искусственный интеллект (ИИ), географические данные, географическая информационная система (ГИС), машинное обучение, добровольная географическая информация (VGI), геопространственный искусственный интеллект (GeoAI)*

Mirislomov M.M

Student

Chirchik state pedagogical university

INTEGRATION OF ARTIFICIAL INTELLIGENCE IN GEOGRAPHY LEARNING: CHALLENGES AND OPPORTUNITIES

Abstract: *This study discusses the potential and challenges of integrating artificial intelligence (AI) into the study of geography. Reviewing the foundations of AI and the role of geography in the era of globalization, this study outlines the benefits of AI in geography learning through interactive visualization and personalization of learning. However, issues such as equal access to technology and teacher training are major challenges in the application of AI. The study uses a descriptive method with a literature review that involves collecting, analyzing and explaining information in the literature relevant to the integration of artificial intelligence (AI) in the study of geography. Additionally, this study highlights the potential of AI in analyzing geographic data and solving global problems such as climate change. The profound implications of integrating AI into the study of geography are also discussed, considering its impact on education and society. This research provides a holistic picture of the intersection of AI and geography, contributing to a better understanding of its potential and limitations. We hope that this study will serve as a guide for educational practitioners and researchers to optimize the potential of AI in geography teaching, taking into account the challenges that need to be overcome and the opportunities that need to be seized.*

Key words: *Geography, Geography learning, artificial intelligence (AI), geographic data, geographic information system (GIS), machine learning, Volunteer Geographic Information (VGI), geospatial artificial intelligence (GeoAI)*

INTRODUCTION.

Education is an important foundation in the formation of a competent generation that is ready to face the challenges of the modern world. In this context, Geography learning has a central role in helping students understand the complexity of interactions between humans and the environment. Along with technological advancements, especially in the field of Artificial Intelligence (AI), opportunities arise to integrate this technology in the Geography learning process. However, amidst the promising opportunities, there are a number of challenges that need to be addressed. One of the main opportunities of integrating Artificial Intelligence in Geography learning is to provide a more interactive and personalized learning experience. By utilizing AI technology, educators can design learning materials that suit students' individual needs and interests (Simon, 2019). For example, intelligent systems can analyze each student's learning progress and adapt learning content to suit their individual level of understanding. [1]

LITERATURE ANALYSIS AND METHODOLOGY.

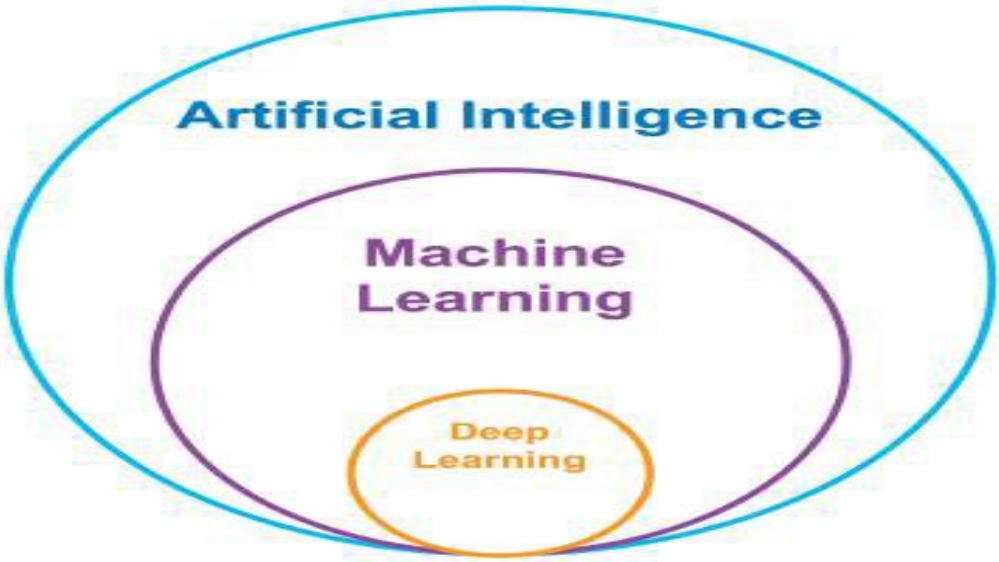
This research uses a descriptive method with a literature study approach to describe in detail about how the integration of artificial intelligence (AI) is done in the context of Geography learning. The main emphasis of this method is to understand the challenges and opportunities that arise when artificial intelligence technology is applied in the teaching and learning of Geography subjects. This literature study approach allows the researcher to summarize, analyze, and comprehensively explain the information in the relevant literature. Artificial Intelligence (AI) has received tremendous attention in recent years from academia, industry, and the general public. Despite its recent popularity,

the field was born back in 1956 at a workshop at Dartmouth College [2]. from its beginning, and has many different definitions [3]. Some definitions focus on designing intelligent machines that can act like humans. For example, the famous *Turing Test* was designed to see if the responses of a machine can be indistinguishable from those of a real person [4]. Some other definitions focus on designing and developing computational methods to complete tasks that typically require human intelligence, such as recognizing objects from images or understanding the meaning of natural language sentences. This entry is primarily based on the second type of definitions. The development of AI has experienced falls and rises. Following its early optimism in 1960s and 70s, AI research went through the "AI winter" due to the failures of AI methods in addressing real-world problems. The following decades witnessed several other waves of optimism and disappointment. Since the 21th century, and especially after 2010, there has been significant progress in AI research. Three major factors have contributed to this fast advancement of AI: big data, novel algorithms, and immense computational power. The emergence of ubiquitous sensors and user-generated content on the Web allows large amounts of data to be generated and collected at a rapid pace. Big data enables computers to "observe" many different aspects of the world, to learn the ways in which the world functions, and to predict the future based on existing observations. Meanwhile, novel algorithms and models have been developed, and the AI community has embraced various ideas and theories from other fields, such as statistics, economics, biology, and cognitive science, in addition to its tradition of logics. Third, high performance computing (HPC) provides the essential power for linking big data and new computational models, and allows the training of sophisticated models on large datasets to be completed within hours or days rather than weeks or months. These three major factors, namely big data, novel algorithms, and immense computational power, greatly fueled the remarkable development of AI in recent years [5].

RESULTS AND DISCUSSION

Geography is a science that studies the earth and its inhabitants, particularly the description of land, sea, and atmosphere, the distribution of animals and plants, as well as humans, and the labor that humans perform in accordance with the interrelationship of various natural forces. This uncontrollable and experimental discipline is constantly advancing in research efficiency and data analysis methods, from the traditional manual survey of geography to computer simulation technology, and then to artificial intelligence technology. Geographic data processing, graphic processing, information management, and other tasks in geography research require a great deal of normative knowledge and experience. Traditional manual research is simple, but the workload is enormous, and data processing efficiency is low. However, computer technology struggles to mimic human intelligence in reasoning, and it cannot reasonably summarize natural laws. Artificial intelligence and machine learning technology have effectively addressed these two issues. Through simulating human brain thinking in various geographical branches and engaging in intelligent data, graphic processing, and information management. It greatly improved work efficiency. This paper summarizes the random forest algorithm, neural network algorithm, and expert system technology, and further analyzes physical geography, human geography, and geographic information system application schemes. A more efficient artificial intelligence algorithm is obtained compared to manual calculation and computer simulation technology. The application of artificial intelligence algorithm in geography to replace the traditional method which relies excessively on artificial operation and expert work, can overcome many defects such as the computer storage capacity, speed and thinking reasoning limitations. Besides it plays a positive role in real-time dynamic monitoring of social life and natural environment. However, the overall application of artificial intelligence in geography is not balanced, and the research progress in different geographical branches is far different [6].

AI, as a broad field, encompasses many different approaches ranging from top down knowledge representation to bottom-up machine learning. There are three related concepts that have been frequently used in recent years: *AI*, *machine learning*, and *deep learning*. In general, *AI* is the broadest concept, *machine learning* is a sub field in AI, and *deep learning* is a special type of



machine learning. Figure 1 illustrates the relations among these three concepts. While the broad field of AI includes many approaches, its recent popularity is largely due to the outstanding performances of machine learning, especially deep learning. Therefore, this entry focuses on discussing these two types of AI approaches.

Figure 1. Relations among AI, machine learning, and deep learning[1].

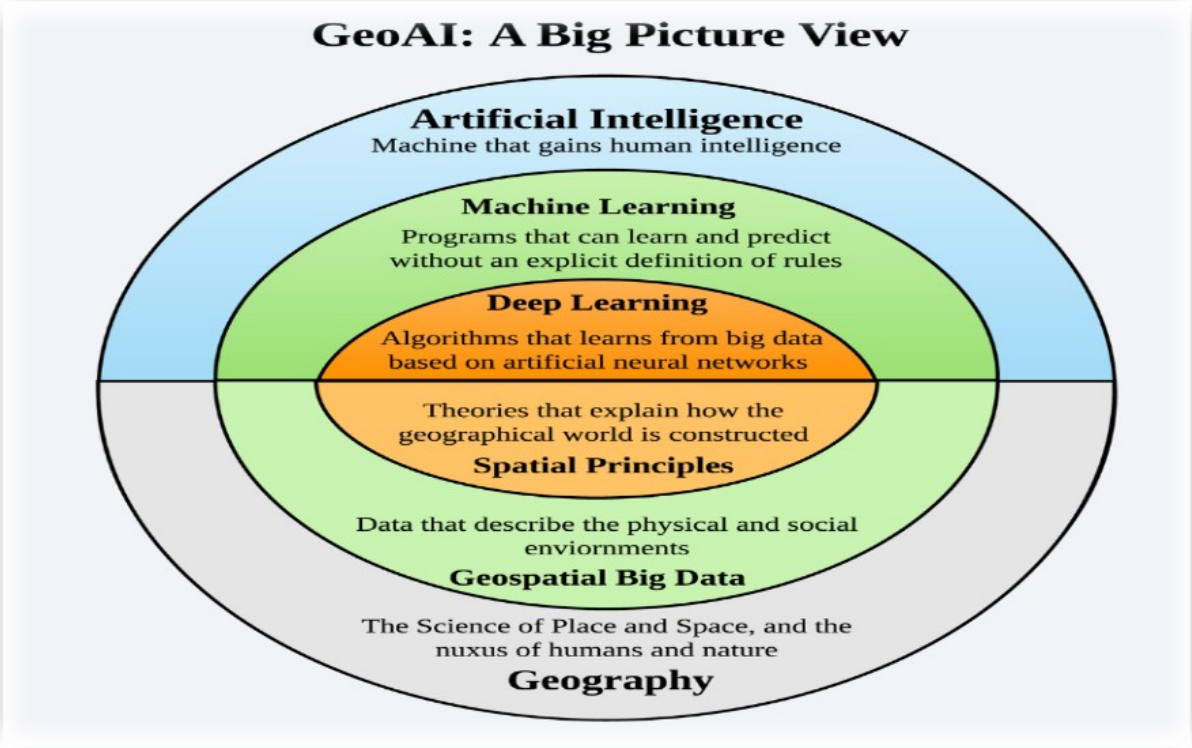
Geography is becoming a field of big data science. In the domain of physical geography, global observation systems, such as operational satellites, which provide continued monitoring of the environment, atmosphere, ocean, and other earth system components, are producing vast amount of remote sensing imagery at high or very high spatial, temporal, and spectral resolutions. The distributed sensor network systems deployed in cities are also collecting real-time data about the status of physical infrastructures and movement of people, vehicles, and other dynamic components of a (smart) city [8]. For social

[1] Bennett, L. 2018. Machine learning in ArcGIS. *ArcUser,* 21(2), 8-9.

applications, the prevalent use of location-based social media, GPS-enabled handheld devices, various Volunteer Geographic Information (VGI) platforms, and other “social sensors” have fostered the creation of massive information about human mobility, public opinion, and people’s digital footprints at scale. Besides being voluminous, these data sets contain a variety of formats, from structured geo-scientific data to semi-unstructured metadata to unstructured social media posts. These ever-increasing geospatial resources provide added value to existing research by allowing us to answer questions at a scale which was not previously possible. However, it also poses significant challenges for traditional analytical methods which were designed to handle small data sets of good quality [9]. To fully utilize the scientific value of geospatial big data, geographers started to switch gears toward data-driven geography, which relies on AI and machine learning to enable the discovery of new geospatial knowledge.

The term “GeoAI” was first coined at the 2017 ACM SIGSPATIAL conference [10]. It was then quickly adopted by high-tech companies, such as Microsoft and Esri, to refer to their enterprise solutions that combined location intelligence and artificial intelligence. Researchers frequently use this term when their research involves data mining, machine learning, and deep learning, a recent advance in AI. Here we define GeoAI as a new transdisciplinary research area that exploits and develops AI for location-based analytics using geospatial (big) data. Figure 2 depicts a big picture view of GeoAI. It integrates AI research with Geography, which is the science of place and space. If we agree that AI is about the development of machine intelligence that can reason like humans, GeoAI, which is the nexus of AI and Geography, aims at developing the next-generation machines that possess the ability to conduct spatial reasoning and location-based analytics, as do humans, with the aid of geospatial big data. Under the umbrella of AI, machine learning and other data-driven algorithms, which can mine and learn from massive amount of data without

being explicitly programmed, have become cornerstone technology. And deep learning, as a subset of machine learning, represents the breakthrough development that advances machine learning from a shallow to a deep architecture allowing the modeling and extraction of complex patterns via the utilization of artificial neural networks. To better fuse AI and Geography and establish GeoAI as a research discipline that will last, there needs to be a strong interlocking of the two fields. Geography offers a unique standpoint for understanding the world and society through the guidance of well-established



theories, such as Tobler's first law of Geography and the second law of Geography [11]. These theories and principles will expand current AI capabilities toward spatially-explicit GeoAI methods and solutions so that AI can be more properly adapted to the geospatial domain. Its research territory can also be enlarged by integrating with geospatial knowledge and spatial thinking [12].

Figure 2 . A big picture view of GeoAI [2].

[2] Li, Wenwen, and Chia-Yu Hsu. 2022. "GeoAI for Large-Scale Image Analysis and Machine Vision: Recent Progress of Artificial Intelligence in Geography" *ISPRS International Journal of Geo-Information* 11, no. 7: 385. https://doi.org/10.3390/ijgi11070385

CONCLUSION

The integration of artificial intelligence (AI) in geography learning is a blend of advanced technology and an understanding of the physical environment and human interaction. While it brings great opportunities in interactive visualization, personalization of learning, and in-depth geographic data analysis, challenges such as equitable access to technology, teacher training, and trust in technology also arise. Successful integration requires effective strategies and cross-sector collaboration. By overcoming challenges and capitalizing on opportunities, the integration of AI in geography learning can bring about a more dynamic and relevant education, preparing a generation ready to face global challenges with deep understanding and innovative solutions. It is clear that artificial intelligence and machine learning have played an important role in many unlisted branches of geography, such as physical geography, human geography, and geographic information systems. It has effectively reduced the difficulty of analyzing big data in geography, which improves data accuracy and reduces the uncertainty and randomness of traditional geography, thereby truly elevating geography to a new level. However, the use of artificial intelligence technology in geography is unbalanced, and it is now primarily used in a few fields such as GIS, RS, and urban construction. Other branches of geography's application scope should be broadened in the future to promote the research process of "intelligent geography" from all aspects. At the same time, the research method is oversimplified, so more related machine learning algorithms should be integrated and compared to find the best data analysis methods and decision-making management schemes unique to each geographical branch. The future development of both disciplines is expected to be brighter and more positive as a result of the irreversible trend of informatization, with the continuous infiltration and integration of artificial intelligence and geography.

LIST OF USED LITERATURES:

[1]. Rakuasa, Heinrich & Utami, Nabila. (2023). Integration of Artificial Intelligence in Geography Learning: Challenges and Opportunities. Sinergi International Journal of Education. 1. 75-83. 10.61194/education.v1i2.71.

[2]. Mccarthy, J. 1956. The Dartmouth Summer Research Project on Artificial Intelligence. *Dartmouth College, New Hampshire*.

[3]. Russell, S. J., Norvig, P., Canny, J. F., Malik, J. M. and Edwards, D. D., 2003. *Artificial intelligence: a modern approach.* Prentice hall Upper Saddle River.

[4]. Turing, A. 1950. Computing machinery and intelligence. *Mind,* 59, 433-460.

[5]. Hu, Yingjie & Li, Wenwen & Wright, Dawn & Aydin, Orhun & Wilson, Daniel & Maher, Omar & Raad, Mansour. (2019). Artificial Intelligence Approaches.

[6]. Tianyi Zhou 2023 *J. Phys.: Conf. Ser.* **2646** 012006 Journal of Physics: Conference Series, Volume 2646, International Conference on Software Engineering and Machine Learning 19/04/2023 - 19/04/2023 Oxford, UK

[7]. Bennett, L. 2018. Machine learning in ArcGIS. *ArcUser,* 21(2), 8-9.

[8]. Li,W.; Batty, M.; Goodchild, M.F. Real-Time GIS for Smart Cities. Int. J. Geogr. Inf. Sci. 2020, 34, 311–324.

[9]. Li, W.; Arundel, S.T. GeoAI and the Future of Spatial Analytics. In New Thinking about GIS; Li, B., Shi, X., Lin, H., Zhu, A.X., Eds.; Springer: Singapore, 2022.

[10] Mao, H.; Hu, Y.; Kar, B.; Gao, S.; McKenzie, G. GeoAI 2017 Workshop Report: The 1st ACM SIGSPATIAL International Workshop on GeoAI: @AI and Deep Learning for Geographic Knowledge Discovery: Redondo Beach, CA, USA-November 7, 2016. ACM Sigspatial Spec. 2017, 9, 25.

[11]. Goodchild, M.F. The Validity and Usefulness of Laws in Geographic Information Science and Geography. Ann. Assoc. Am. Geogr. 2004, 300-303

[12]. Li, Wenwen, and Chia-Yu Hsu. 2022. "GeoAI for Large-Scale Image Analysis and Machine Vision: Recent Progress of Artificial Intelligence in Geography" *ISPRS International Journal of Geo-Information* 11, no. 7: 385. https://doi.org/10.3390/ijgi11070385