

Artificial Intelligence: Understanding Its Impact and Applications in Modern Society

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ABSTRACT

It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable. While no consensual definition of Artificial Intelligence (AI) exists, AI is broadly characterized as the study of computations that allow for perception, reason and action. This study aims to provide a review of artificial intelligence based on industry information integration. It presents an overview of the scope of artificial intelligence using background, drivers, technologies, and applications, as well as logical opinions regarding the development of artificial intelligence. This paper may play a role in AI related research and should provide important insights for practitioners in the real world. The main contribution of this study is that it clarifies the state of the art of AI for future study.

KEYWORDS- machine learning, e-learning , neural networks, Natural language processing (NLP)

Introduction

Artificial Intelligence (AI) is the branch of computer science which deals with intelligence of machines where an intelligent agent is a system that takes actions which maximize its chances of success. It is the study of ideas which enable computers to do the things that make people seem intelligent. The central principles of AI include such as reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects. It is the science and engineering of making intelligent machines, especially intelligent computer programs.

AI is the general term for the science of artificial intelligence. It uses computers to simulate human intelligent behaviors and it trains computers to learn human behaviors such as learning, judgment, and decision-making [94]. AI is a knowledge project that takes knowledge as the object, acquires knowledge, analyzes and studies the expression methods of knowledge, and employs these approaches to achieve the effect of simulating human intellectual activities [19]. AI is a compilation of computer science, logic, biology, psychology, philosophy, and many other disciplines, and it has achieved remarkable results in applications such as speech recognition, image processing, natural language processing, the proving of automatic theorems, and intelligent robots [20]. AI plays an indispensable role in social development, and it has brought revolutionary results in improving labor efficiency, reducing labor costs, optimizing the structure of human resources, and creating new job demands.

DEFINITIONS AND CONCEPTS

Artificial Intelligence Artificial intelligence (AI) is an integration of computer science and physiology. Intelligence in simple language is the computational part of the ability to achieve goals in the world. Intelligence is the ability to think to imagine creating memorizing and understanding, recognizing patterns, making choices adapting to change and learn from experience. Artificial intelligence concerned with making computers behave like humans more human like fashion and in much less time than a human takes so is called as Artificial Intelligence (Poole and Goebel, 1998).

Learning

Learning is defined as the acquiring of knowledge or skill, in a particular domain. This definition is related to human beings. In psychology, various generalized definitions of learning have been proposed, and many of them interpret learning as the change in behavior of a being, subject to a given situation, or as a sequence of his or her repeated experiences in that situation.

Machine Learning

In simple words learning means either acquiring new knowledge or enhancing or updating individual's skills. Learning new knowledge is the combination of various processes such as acquisition of significant concepts, understanding their meanings and relationships to each other and to the area concerned. Skill enhancement can be interpreted in biological terms as reinforcing a pattern of neural connections for performing the desired function (Bavakutty, 2006).

Scientific study of algorithms and statistical models when the computer system used to perform a specific task is called Machine learning. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as training data, in order to make predictions or decisions without being explicitly programmed to perform the task (Bishop, 2006).

Methods

This study employs a systematic literature review methodology to comprehensively examine the benefits and challenges associated with the integration of Artificial Intelligence (AI) in research. A structured approach is adopted to identify relevant scholarly articles, conference papers, reports, and other sources addressing the use of AI in research across various disciplines. A systematic search strategy is devised to identify relevant literature, utilizing electronic databases such as PubMed, IEEE Xplore, Google Scholar, and Web of Science. Predefined search terms related to AI in research are employed, with Boolean operators and search filters utilized to refine search results and ensure the inclusion of peer-reviewed articles published within a specified timeframe.

ARTIFICIAL INTELLIGENCE METHODS

Machine Learning- It is one of the applications of AI where machines are not explicitly programmed to perform certain tasks; rather, they learn and improve from experience automatically. Deep Learning is a subset of machine learning based on artificial neural networks for predictive analysis. There are various machine learning algorithms, such as Unsupervised Learning, Supervised Learning, and Reinforcement Learning. In Unsupervised Learning, the algorithm does not use classified information to act on it without any guidance. In Supervised Learning, it deduces a function from the training data, which consists of a set of an input object and the desired output. Reinforcement learning is used by machines to take suitable actions to increase the reward to find the best possibility which should be taken in to account.

Natural Language Processing(NLP)

It is the interactions between computers and human language where the computers are programmed to process natural languages. Machine Learning is a reliable technology for Natural Language Processing to obtain meaning from human languages. In NLP, the audio of a human talk is captured by the machine. Then the audio to text conversation occurs, and then the text is processed where the data is converted into audio. Then the machine uses the audio to respond to humans. Applications of Natural Language Processing can be found in IVR (Interactive Voice Response) applications used in call centres, language translation applications like Google Translate and word processors such as Microsoft Word to check the accuracy of grammar in text. However, the nature of human languages makes the Natural Language Processing difficult because of the rules which are involved in the passing of information using natural language, and they are not easy for the computers to understand. So NLP uses algorithms to recognize and abstract the rules of the natural languages where the unstructured data from the human languages can be converted to a format that is understood by the computer.

Concept of Adaptive Learning in e-Learning

The concept of adaptive learning in e-learning revolves around the idea that learners have diverse backgrounds, learning preferences, and cognitive abilities. Traditional e-learning platforms often present the same content and activities to all learners, without considering their unique characteristics and needs. The same learning processes are experienced by all students in the existing conventional e-learning settings, since education has historically followed a “one style fits all” approach. The various learning preferences and styles of pupils are not taken into consideration in this sort of learning [5]. This approach may lead to suboptimal learning experiences, as some learners might find the content too challenging or too easy, resulting in disengagement or limited progress. Personalized learning, where education is tailored to a student’s specific requirements and learning preferences, has been made possible and assisted by the development of adaptive e-learning systems [6]. Adaptive learning systems leverage machine learning algorithms to gather, analyze, and interpret vast amounts of learner data. This data-driven approach enables the system to dynamically adjust the learning experience, offering personalized contents, resources, and activities that match each learner’s skills and goals by tailoring the learning pathway. Adaptive learning promotes self-paced learning, provides targeted support, and fosters a more effective and engaging educational environment.

Artificial Intelligence and Machine Learning

AI and ML have emerged as transformative technologies in various fields, including education. In the context of adaptive learning, AI and ML play a crucial role in enabling personalized and tailored learning experiences. AI refers to the development of intelligent machines that can simulate human intelligence

The role of AI and ML in gathering and analyzing learner data is crucial for providing personalized learning experiences. Advantages of AI-enabled learning systems include a better learning environment, schedule flexibility, the ability to provide immediate feedback, flexibility in controlling students’ learning experiences, and accelerated student development [14]. AI systems can process large amounts of data, learn from patterns and experiences, and make predictions or recommendations. With respect for each student’s talents, capabilities, and academic obstacles, AI permits the implementation of a variety of teaching methods [15]. AI and ML algorithms can collect learner data from various sources, including learning management systems, online platforms, assessments, and digital resources. These algorithms can gather data on learner demographics, performance metrics, interaction patterns, learning preferences, and other relevant information. Data collection can occur in real time or asynchronously, allowing adaptive learning systems to continuously update and refine learner profiles. AI and ML techniques excel at analyzing large and complex datasets. Once learner data are collected, these algorithms can process the data to uncover patterns, correlations, and trends. Through data analysis, adaptive learning systems can identify individual learner

characteristics, such as strengths, weaknesses, learning styles, and knowledge gaps. This analysis forms the foundation for creating personalized learning experiences. AI and ML algorithms can build learner models based on the analyzed data. Learner modeling involves creating representations of individual learners, including their cognitive abilities, knowledge levels, learning styles, and preferences. These models capture the unique characteristics of each learner and serve as a basis for personalizing the learning experience [16].

Advantages in the use of AI (Artificial Intelligence) in Research

Enhanced Efficiency and Precision Artificial Intelligence (AI) plays a crucial role in research by enhancing efficiency and precision across various fields. The integration of AI technologies in research processes has demonstrated promising results in terms of optimizing workflows, improving accuracy, and reducing costs. For example, AI can streamline research tasks such as data analysis, image interpretation, and material discovery, leading to quicker acquisition of refined results (Lau et al., 2021; Wang, 2024; You et al., 2023). Moreover, AI applications in research have the potential to revolutionize industries like healthcare, material engineering, and energy systems by enabling more intelligent, safe, and efficient processes (Coppola et al., 2021; Hu et al., 2021; Lipichanda, Deka, & Roy, 2023). One of the key advantages of AI in research is its capability to handle large datasets and repetitive tasks effectively, significantly enhancing the speed and accuracy of research outcomes (Kunze, 2024; You et al., 2023). AI-driven technologies like natural language processing, neural networks, and robotics have been proven to enhance learning and development processes, making research more efficient and productive (Bhatt & Muduli, 2022). Additionally, AI can assist in optimizing biomedical imaging protocols, leading to improved patient outcomes and cost savings in healthcare (Coppola et al., 2021).

Disadvantages and Challenges of AI in Research

Algorithmic Bias Algorithmic bias presents significant challenges in the use of Artificial Intelligence (AI) in research. Algorithmic bias can lead to unfair or discriminatory outcomes due to biased data, flawed algorithms, or inadequate representation of diverse populations (Dwivedi et al., 2021; Jetha et al., 2023; Mikdadi et al., 2022). This bias can result in inequitable treatment, perpetuation of stereotypes, and undermine the credibility and reliability of research findings (Nugent & Scott-Parker, 2021; Regona, Yiğitcanlar, Xia, & Li, 2022). One primary challenge associated with algorithmic bias in AI research is the disproportionate impact on marginalized groups. AI systems can perpetuate and exacerbate existing societal inequalities by reflecting and amplifying biases present in the training data (Jetha et al., 2023; Mikdadi et al., 2022). This can lead to discriminatory outcomes, exclusion of certain groups, and reinforcement of systemic biases, particularly affecting historically disadvantaged communities (Nugent & Scott-Parker, 2021; Regona et al., 2022).

Lack of Transparency

Transparency in AI research is crucial to ensure accountability, fairness, and ethical standards. Lack of transparency can lead to biased outcomes, erode trust, and hinder the adoption of AI technologies. Researchers emphasize the importance of transparency in AI systems to address challenges related to biased decision-making, unfair evaluations, and ethical concerns (Felzmann, Fosch-Villaronga, Lutz, & Tamò-Larrieux, 2020; Kiseleva, Kotzinos, & Hert, 2022; Lopez & Garza, 2023; Vinuesa et al., 2020). Efforts to enhance transparency in AI involve designing systems that are accountable, explainable, and interpretable, enabling users to understand the decision-making processes and outcomes of AI algorithms. By promoting transparency in AI research, researchers can mitigate biases, improve trust, and foster responsible AI development and deployment. Otherwise, it would lead to gaps in transparency, accountability, safety, and ethical standards of AI-based technology, which could be detrimental towards the development and sustainable use of AI.

Ethical Concerns

Ethical concerns present significant challenges in the application of Artificial Intelligence (AI) in research. The potential ethical challenges and disadvantages of AI in research encompass a wide range of issues, including bias, transparency, accountability, privacy, and fairness. Researchers and practitioners in the field of AI ethics have emphasized the importance of addressing these ethical concerns to ensure responsible and ethical AI development and deployment (Jobin & Ienca, 2019). One of the key ethical concerns in AI research is the issue of bias, which can lead to unfair outcomes and perpetuate existing societal inequalities. Addressing bias in AI systems is crucial to ensure fairness, equity, and non-discrimination in research applications (Cascella, 2024). Also, the lack of transparency in AI algorithms poses ethical challenges, as it can hinder understanding, accountability, and trust in AI systems (Ouchchy, Coin, & Dubljević, 2020). Ensuring transparency in AI research is essential to address concerns related to biased decision-making, unfair evaluations, and ethical implications (Jobin & Ienca, 2019).

CONCLUSIONS

This systematic literature review study provides a structured understanding of the state-of-the-art of AI research in IS. This was achieved by identifying 98 primary studies out of 1877 related AI articles over a fifteen-year period (2005 – 2020) and analyzed them with respect to (i) definitions of AI, (ii) frequency of publication by year, (iii) publication channels, (iv) research method and data collection type, (v) contribution type, (vi) type of AI and (vii) business value. A clear finding emerging from this systematic literature review is the need to (i) increase the number of rigorous academic studies on AI, especially regarding tools and models, (ii) be more detailed on the definition of AI used in studies, even when it is not the focus, and (iii) build on cumulative knowledge. Research on AI in IS is still largely unexplored. While there is a relatively sizable amount of literature concerning AI in some way, a comprehensive review of what is known about AI in IS is lacking. It is necessary to understand the advantages and disadvantages of Artificial Intelligence and machine learning for better user and its application in Libraries and Information Centers.

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