AI and ChatGPT Applications in Computer Science: A Review of Machine Learning Frameworks for Healthcare, Food Production, and Cybersecurity

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Abstract

The review presents the transformative uses of Artificial Intelligence (AI) and ChatGPT in the computer science in the context of machine learning frameworks applicable to healthcare, food production, and cybersecurity. It points out the efficiency, decision-making and innovation in these areas through advanced AI models. This paper talks about some of the most important frameworks, including TensorFlow, PyTorch, and Scikit-learn, and their contribution to creating intelligent systems. It further explores the ethical, privacy and transparency issues related to the inclusion of AI. This review identifies the role of responsible AI deployment and how ChatGPT may help to mediate human-machine communications in order to promote sustainable technological development in key areas by studying cross-domain effects.

Key words

AI, ChatGPT, Machine Learning, Healthcare, Food Production, Cybersecurity, Artificial Intelligence Frameworks, Data Privacy.

1. INTRODUCTION

One of the most disruptive trends in the computer science of today has been Artificial Intelligence (AI) that is transforming industries due to its capability to resemble human intelligence and simplify the procedure of making complicated decisions. Healthcare, agriculture, cybersecurity, and education are just some examples, the AI technologies (especially, machine learning (ML) and deep learning (DL) technologies) have transformed the way data is analyzed, interpreted, and used [1]. The latest and one of the latest developments in the field of AI is ChatGPT, a sophisticated natural language processing (NLP) model created by OpenAI, which proves the potential of conversational AI, which is currently growing in both academic and industrial contexts [2].

The onset of AI in computer science has given a tremendous boost to its capability to solve problems such that the systems are able to learn by analyzing the data, identify patterns and make predictions more precisely. Machine learning systems like TensorFlow and PyTorch and Scikit-learn have turned out to be essential to researchers and developers to develop smart systems that can solve domain-specific problems. Along with the fact that they allow large-scale computation, they ensure flexibility in the development, deployment, and evaluation of models, which, in turn, makes AI applications more accessible and effective [3].

ChatGPT and other types of generative AI models have expanded the limits of machine intelligence in recent years by allowing humans and machines to communicate to each other in a natural and context-sensitive way. This development has created new opportunities to use AI to solve problems that are not necessarily based on conventional computational activities, such as health care, food production, and cybersecurity three essential areas that have a direct impact on the well-being and stability of people and society [4]. In the medical field, AI can be used to aid in the diagnostic image, disease management, and individualized treatment guidelines. Machine learning is applied in food production to optimize agricultural production, detect the health of crops, and manage supply chains. On the same note, AI-based systems have been used to increase the amount of threat sensing, initiate response to incidents automatically, and bolster electronic protective systems in the context of cybersecurity [5].

Nonetheless, the quick advance of AI and ChatGPT technologies also has certain issues to do with data ethics, bias, privacy, and explain ability. These issues illustrate why the development of AI should be done responsibly and why interdisciplinary synergies between the computer scientists, the policymakers, and the domain experts are necessary [6]. The main goal of the review is to learn about the innovative solutions that have emerged with the help of AI and ChatGPT applications by supporting them with the help of advanced machine learning frameworks in the field of healthcare, food production, and cybersecurity. It will seek to offer a holistic view of their purposes, advantages, and restrictions as well as establish future prospects of sustainable and ethical use of AI in these areas [7].

2. AI AND CHATGPT TECHNOLOGIES

Artificial Intelligence (AI) is a general area of computer science that focuses on developing systems that would otherwise be handled by human intelligence. These are learning on the basis of information, reasoning, problem resolution, perception, as well as natural language understanding [8]. In the last few decades, AI has also come to be more complex with rule-based systems being replaced by more sophisticated machine learning (ML), and deep learning (DL) systems capable of handling large volumes of information and adapting to it through experience. It has been facilitated by the greater computational capabilities, the availability of massive datasets and the creation of robust artificial intelligence systems such as TensorFlow, PyTorch and Keras, which make it easier to create and implement complex models [9].

KEY POINTS ABOUT CHATGPT TECHNOLOGIES

Developed by OpenAI – Built using advanced large language models (LLMs) from the GPT (Generative Pre-trained Transformer) series

Current Model: GPT-5 – The latest version offers improved reasoning, context understanding, and multimodal capabilities (text + image)

Training Data – Trained on vast text and code datasets from books, websites, and other public sources to learn language patterns

Multimodal Input – Can process text and images together for richer, more contextual responses.

Figure: 1 showing key points about ChatGPT technologies

The significant area of AI is Natural Language Processing (NLP), the task that should allow machines to comprehend, interpret, and generate the human language. The most notable innovation in the field of NLP can be defined as the creation of ChatGPT (Chat Generative Pre-trained Transformer) by the OpenAI. ChatGPT is founded on the Transformer architecture that is a deep learning model with the ability to optimally handle sequential data [10]. ChatGPT can produce coherent, contextually relevant and human-like text responses through pre-training on huge text corpora and using fine-tuning to discuss tasks. Its context, emotion and nuance comprehension has enabled it to become an effective tool in a broad variety of applications, such as in education, healthcare, business communication and research assistance [11].

The AI and ChatGPT technologies have given rise to a paradigm in the interaction between computers and human beings. ChatGPT provides a connection between end-users and complicated AI systems, where natural language can be used to substitute standard programming instructions or interfaces [12]. This has enabled non-experts to use AI more, and has increased its industry usage. To illustrate, in the medical sector, ChatGPT can be used to help with patient interaction, medical records and diagnosing patients. It may be used in the context of cybersecurity to interpret the alerts, create automatic reports, and even to emulate phishing attacks to educate about their dangers [13].

Additionally, the integration of ChatGPT with other frameworks of machine learning improves its potential. Prediction, or anomaly detection ChatGPT can then be used as a layer of intelligent conversation that parses and describes AI-based insights in a way that users can easily understand when linked to ML algorithms to analyze data [14]. AIs and ChatGPT technologies are the intersection of computational intelligence and human interaction. Their inter-relationship allows them to automate with intelligence, gain more insights about data, and interact between humans and machines more easily, which is a landmark in computer science and its practical use [15].

3. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING ARCHITECTURES

Present-day intelligent systems are based on the Artificial Intelligence (AI) and Machine Learning (ML) models that allow researchers and developers to develop, train, and deploy complex models with minimal effort. These frameworks are ready-to-use algorithms, optimized computing

solutions, and customizable APIs which ease the development of machine learning applications, including data preprocessing and model analysis [16]. The development of these frameworks has greatly boosted the AI research and made advanced analytics more available to different industries, such as healthcare, agriculture, and cybersecurity [17].

The most popular ones are TensorFlow (created by Google) which includes deep learning models as well as classic machine learning models. TensorFlow is suitable in large data and real time applications owing to its scalability and distributed computing capabilities. The other top-ranked framework is the PyTorch which was created by AI Research Lab of Facebook and has the reputation of dynamic graph of computation, flexibility and simplicity [18]. The popularity of PyTorch in the research and academic world has been enormous because of its easy interface and excellent support with deep learning experiments [19]. Equally, Scikit-learn is a light and accessible architecture to use in classes of traditional ML algorithms including regression, clustering, and classification. It is most commonly applied in data analysis and rapid prototyping and is most commonly applied in smaller scale projects [20].

There are also other frameworks that have been made to contribute to the AI ecosystem, such as Keras, Microsoft Cognitive Toolkit (CNTK) and Apache MXNet. Keras, which is based on TensorFlow, provides a high-level neural network interface, which enables quick model construction and trial [21]. Microsoft created CNTK, which focuses on performance and efficiency with speech and image recognition. MXNet is however efficient in offering multi-language support and forms the backbone of the AI services that Amazon offers [22]. The common criteria used by developers when choosing a suitable AI or ML framework include computational efficiency, community support, support by hardware accelerators (i.e. GPUs or TPUs), and compatibility with existing systems. The type of framework impacts directly the level of scalability, accuracy and sustainability of AI applications [23].

New tendencies reveal the growing popularity of hybrid and automated systems, including AutoML, where the model selection and hyper parameter optimization are automated. The innovations bring the level of knowledge of an expert in code to minimum and allow to expand the applicability of AI technologies in areas [24]. The technological support of intelligent systems is extracted through AI and machine learning systems. Its ongoing development will result in

improved productivity of research, innovation, and the successful implementation of AI in different industries [25].

4. AI APPLICATIONS IN HEALTHCARE

Artificial Intelligence (AI) has become a disruptive technology in the healthcare sector that has catalyzed new innovations to improve the process of diagnosis, treatment, care of patients, and administration. The combination of machine learning (ML), deep learning (DL), and natural language processing (NLP) systems, which include ChatGPT, have dramatically enhanced the way medical data is analyzed by the healthcare community, as well as the overall provision of personalized care [26]. The expanding popularity of AI systems such as TensorFlow and PyTorch has made it possible to develop advanced models, which can process more complicated data, including medical images, genome data, and medical records [27].

Medical imaging and diagnostics is considered to be one of the most influential AI uses in healthcare. With a few deep learning models, the accuracy of interpretation of X-rays, MRI scans, and CT images now reaches that of human radiologists. Indicatively, convolutional neural networks (CNNs) have demonstrated speed and reliability in detecting tumors, fractures and abnormalities in images compared to manual techniques [28]. AI-based diagnostic devices will help clinicians in the early diagnosis of diseases and conduct timely interventions and better patient outcomes.

In predictive analytics, machine learning models are applied to forecast disease risks and disease outcomes using past health data. Predictive models are used to predict the risk of such chronic diseases like diabetes, heart disease, or cancer using patient lifestyle and genetic data. This allows doctors to put preventive measures and individual treatment programs into practice [29]. Another AI application helps in drug discovery and development, which saves a lot of time and money in the search of a possible drug candidate by means of simulation and computation analysis. The NLP models like ChatGPT have added an extra dimension to healthcare communication [30]. ChatGPT can help to automate clinical documentation, summarize patient histories, and create discharges. It also facilitates tele-medicine by enabling the patients to have natural and human-like conversations, give them medical information, appointment reminders, and mental health

assistance [31]. More so, ChatGPT can be useful in facilitating the work of healthcare professionals, acting as a medical assistant, answering questions regarding symptoms, medications and clinical guidelines in real-time [32].
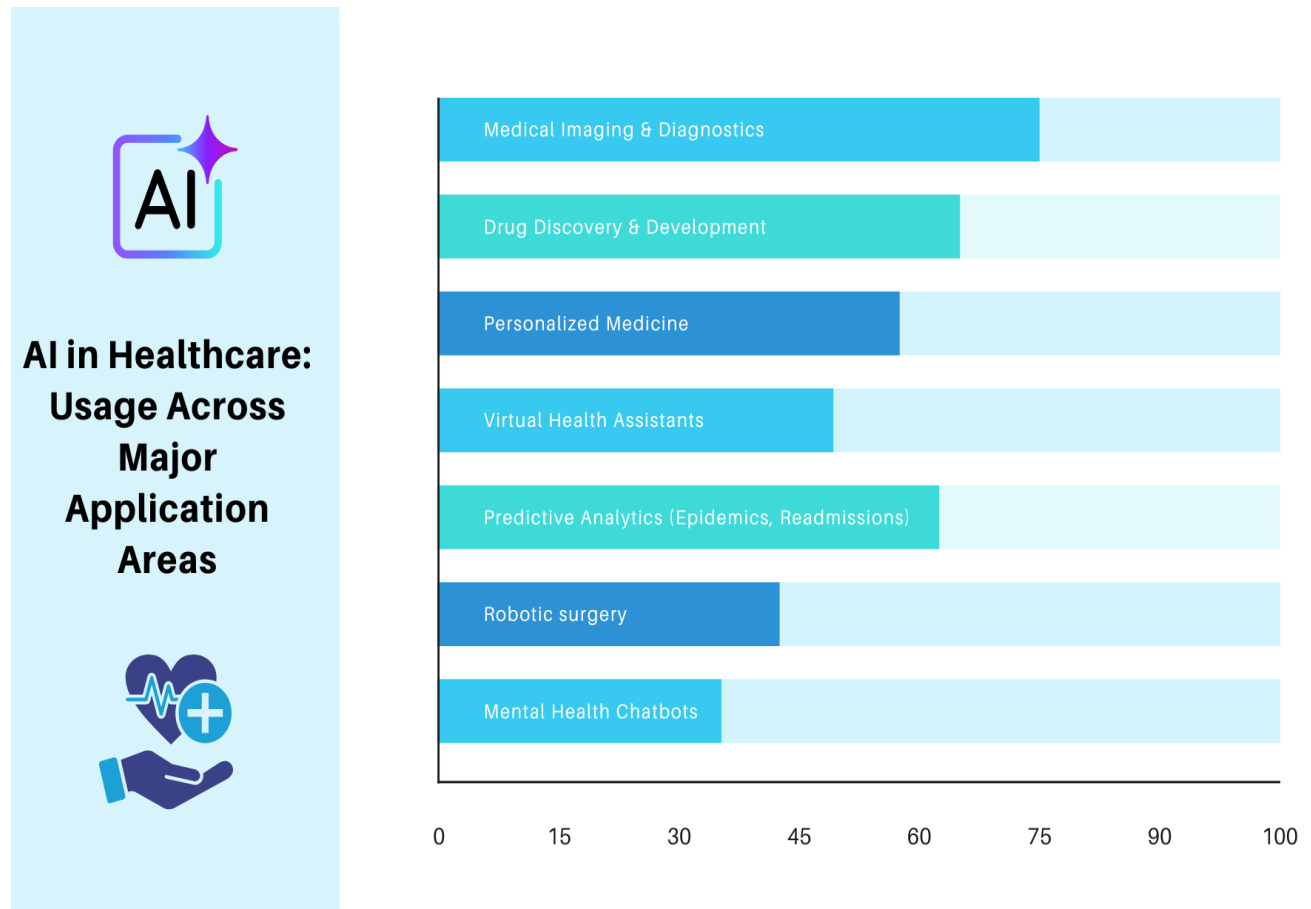

Figure: 2 showing Ai in healthcare usage across major application areas

In spite of these developments, using AI in healthcare raises the question of privacy of data and healthcare ethics as well as transparency of the model. The information about the patient has to be processed safely, and algorithms are to be developed without bias or discrimination. Also, it is important not to completely automatize processes and leave the judgment of a human [33]. The AI and ChatGPT applications have revolutionized the healthcare industry by bringing accuracy, effectiveness, and accessibility. These technologies are shaping a more responsive, data-driven and patient-centered healthcare system by collaborating with the human expertise of machines and their intelligence [34].

5. FOOD PRODUCTION APPLICATIONS

Machine Learning (ML) and Artificial Intelligence (AI) are rapidly changing the sphere of food production in the world, resolving the issues concerning food security, the sustainability of food production, quality control, and the efficiency of supply chains. This is because the adoption of AI-based technologies will allow making agricultural processes smarter, more efficient in resource allocation, and predictive, which will aid in ensuring stability and safety of food production [35]. The computational basis of creating intelligent systems to analyze agricultural data and predict outcomes or automate key processes throughout the food value chain can be based on machine learning frameworks that include TensorFlow, PyTorch, and Scikit-learn [36].

Crop monitoring and yield prediction is one of the most important uses of AI in this field. AI systems can be used to gather and process information on soil health, weather conditions, pests and nutrient concentration using satellites, sensors and Internet of Things (IoT) devices. This data are analyzed with machine learning algorithms to predict crop yields, identify diseases at their early stages, and prescribe specific farming treatments, including irrigation or fertilizer use. These scientific insights are more productive and less harmful on the environment [37]. AI is also crucial in the food processing and quality control. Deep learning computer vision systems can be used to examine products on assembly lines and detect defects, contamination, or size or color variation. Automated inspection is known to prevent waste, as well as ascertaining the quality and safety of the products to a great extent due to increased accuracy and consistency in manufacturing [38].

Python and other AI algorithms can be used in supply chain optimization to enhance logistics, demand prediction, and inventory management. Predictive analytics may be able to forecast consumer demand enabling producers to make changes on the volume of production and distribution channels [39]. This eliminates food waste and increases farm to table efficiency. The ChatGPT and conversational AI can be connected to the customer support department, where they can offer transparent information regarding the origin of food, nutrition, and safety certifications [40]. AI will also be used in sustainable agriculture causing practices that are environmentally friendly like precision farming, resource optimization and waste reduction. The information obtained in smart farms can be examined through machine learning models to regulate energy usage, water utilization, and balanced application of fertilizers [41].

Regardless of these developments, there are still challenges especially in implementing it at a high price, integrating the data and farmers must be made digital literate. These limitations will be one of the areas to address to make access to AI technologies equitable [42]. The AI and ChatGPT are transforming food production, which enhances efficiency, safety, and sustainability. Their implementation is the key to a future in which technology driven agriculture will address the increasing world demand of safe, nutritious and environmental friendly food [43].

6. CYBERSECURITY APPLICATIONS

It has become crucial to have Artificial Intelligence (AI) and Machine Learning (ML) in the contemporary approach to cybersecurity to implement a quicker, smarter, and more adaptive defense mechanism against a constantly changing environment of cyber threats. Conventional security systems in many cases use rule based algorithms and manual analysis, which is not adequate enough to support the speed and sophistication of contemporary cyberattacks [44]. With the help of AI-powered technologies with the help of TensorFlow, PyTorch, and Scikit-learn, organizations are now powered to detect anomalies, predict attacks, and respond to threats in real time with increased accuracy and efficiency [45].

Threat detection and prevention is one of the most important applications of AI in the field of cybersecurity. Massive data on network traffic and user behaviors can be analyzed using machine learning algorithms to determine unusual behaviors that may be associated with ill intentions. Through training on the past attack data, AI models are able to identify zero-day vulnerabilities, phishing attempts, and malware variants that can be very hard to detect by traditional security systems. In particular, deep learning models are useful in detecting minor anomalies that human operators or rule systems can miss [46].

In intrusion detection systems, or intrusion prevention systems, AI is also critically important. These systems use ML algorithms to track real-time network traffic and identify suspicious activity and automatically introduce countermeasures. Predictive analytics goes even further in supplementing such systems by predicting possible attacks on the basis of emergent threat intelligence and international cyber patterns [47].

NLP-based AI models, such as ChatGPT, are experiencing a revolution in communication and response mechanisms in cybersecurity. ChatGPT may help to create automatic security briefs, overview incident logs, as well as assist in cybersecurity awareness training by simulating phishing attacks or teaching users how to be safe online [48]. Also, ChatGPT may be a virtual security assistant, assisting analysts in extracting meaning out of multifaceted data, designing incident response, and conveying technical knowledge to teams in a comprehensible manner [49].

Nevertheless, there are also new challenges with the increased application of AI in cybersecurity. The use of AI systems can be exploited by adversaries using data poisoning, or model inversion, or adversarial attack, in which malicious inputs can play with AI models. Moreover, cyber defense automation should be periodically accompanied by human controls to avoid the problem of false positives and adhere to the ethical exploitation of AI [50]. The combination of AI and ChatGPT technologies has significantly increased cybersecurity resiliency. The tools improve the protection of the digital in government, finance, medical, and other sectors by integrating real-time monitoring, predictive intelligence, and automated response. With the development of cyber threats, AI-based cybersecurity will become one of the key pillars of data integrity protection and cyber infrastructure security [51].

7. THE CROSS-DOMAIN PROBLEMS AND OPPORTUNITIES

Though it is impossible to overestimate the potential of Artificial Intelligence (AI) and ChatGPT in the health care sector, food production, and even cybersecurity, the mass usage of these technologies introduces a range of cross-domain issues that need to be taken into account [52]. These issues are connected to the quality of the data, privacy, ethics, interpretability, and responsible use of AI. Meanwhile, the technologies are offering new innovations, cooperation, and sustainable growth in various fields. The awareness and resolution of such issues is important to guarantee that AI systems provide fair and reliable results [53].

A data quality and availability issue is one of the most important challenges. The operation of AI and machine learning models is very dependent on big data. In fields such as healthcare or agriculture, information might be partial, erratic or biased resulting in erroneous forecasts or unforeseen effects. The inability to develop standardized data collecting approaches also hinders

the introduction of AI in industries [54]. To have trustworthy AI-driven decision-making, clean, unbiased, and representative datasets are, therefore, important. Privacy and security are also significant concerns particularly in the case of sensitive data like patient health records, agricultural trade records or even cybersecurity logs [55].

The use or misuse of the AI generated data which is not authorized can give rise to ethical violations and regulatory breaches. The strong data governance frameworks and encryption technologies should be used to safeguard user privacy and ensure transparency and accountability. Ethical and legal compliance is another issue of concern [56]. The increased independence of AI systems provokes the question of responsibility, justice, and discrimination risks. To design an ethical AI, it is necessary that the algorithms should be readable and understandable and that they must reflect human values. Additionally, the disparity of AI laws in different countries also establishes further impediments to cross-border collaboration and deployment [57].

Nevertheless, AI and ChatGPT also present enormous possibilities of development. The cross-domain AI can be used to come up with smarter, more data-oriented solutions, like applying predictive healthcare analytics, using Agriourthood to improve food safety, or applying cybersecurity models to secure agr IoT networks [58]. Additionally, AI enables the cross-disciplinary cooperation between computer scientists, policymakers, and experts in a domain and results in more holistic solutions to problems [59]. The emphasis should be on responsible and explainable AI and make sure that technological innovations can be beneficial to the society at large. Through ethical considerations and transparency, the organizations will be able to use the full power of AI and ChatGPT to become innovative, efficient, and sustainable in various areas [60].

8. CONCLUSION

Artificial Intelligence (AI) and ChatGPT are already the game-changers in the history of computer science that transform the industries with the help of automation, smart decision-making, and human-machines cooperation. Their penetration into the vital areas like healthcare, food production, and cybersecurity proves the enormous opportunities of AI-driven systems to improve their efficiency, accuracy, and sustainability. The combination of machine learning systems, such

as TensorFlow, PyTorch, and Scikit-learn, along with natural language models, such as ChatGPT, has made it possible to construct intelligent solutions that can learn, reason, and communicate intelligently in previously human-only aspects.

Medical diagnostics, predictive analytics, and patient care have become the most practical use of AI in medical care and allow patients to be identified with an early diagnosis and given a personalized therapy. In the food sector, AI-based systems have enhanced the use of resources, better food quality, and supply chain management, among others, to achieve global food security. Equally, AI and ChatGPT have promoted digital resilience in cybersecurity by facilitating real-time incidence detection, automatic reactionary measures and sophisticated risk assessment. These applications show that AI is not only changing the computational processes, but it is also responding to urgent global problems.

Nevertheless, implementing AI and ChatGPT in other areas is not a smooth process. Data privacy issues, algorithmic bias, inability to explain, and ethical issues are all a significant barrier to mass adoption. To overcome them, it is important that effective regulatory frameworks are developed, there is interdisciplinary cooperation and continuous research work to make sure that AI systems can work openly and fairly. Furthermore, the human factor is essential one, or AI is expected to be taken as a supportive resource, that is, to support human decision-making instead of substituting it completely.

Moving forward, the future of AI and ChatGPT will be in responsible innovation, which is the creation of systems that are ethically, interpretally, and socially value-oriented. The further evolution of AI frameworks will probably allow more flexible and autonomous systems, which will gain more opportunities in various areas. The cooperation between scholars and industry representatives and policy-makers will be necessary so that the advantages of AI are justly shared. AI and ChatGPT are at the brink of a revolution in technology that has advanced computer science further. Its wise and thoughtful application will open the way to the smarter, safer and more sustainable future where technology and humanity can live in harmony.

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