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THE EQUILIBRIUM OF THE SYMBIOSIS OF HUMAN COMPLEXITY AND ARTIFICIAL INTELLIGENCE

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Abstract

The investigation of potential AI applications in diverse fields and facets of human life, habits, and society was encouraged by the well-documented developments of data-driven complicated machine learning techniques that emerged within the wave of artificial intelligence (AI). Deep learning models greatly lessen the need for domain-expert knowledge by enabling autonomous feature engineering surpassing conventional techniques that rely on manual feature engineering and attaining performance that is comparable to or even better than that of humans in certain areas. We require human-centric explainable AI (HC-XAI) that can offer human-understandable interpretations for their algorithmic behaviour and outcomes in order to fully trust, accept, and adopt newly emerging AI solutions in our daily lives and practices. This will allow us to maintain control over and continuously improve the performance, fairness, accountability, and explainability of AI applications over their whole lifecycle. Following this inspiration, the investigation of human-centric AI approaches and the creation of contextual explanatory models are the foundation of the recently emerging trend in diverse and multidisciplinary research communities. "Personalised Image Classification by Semantic Embedding and Active Learning," as demonstrated by Song, provides a positive illustration of the necessity of a mutualistic symbiosis between artificial intelligence (AI) and human intelligence (HI). These efforts are driving the symbiosis between artificial intelligence (AI) and human intelligence (HI), which serves as the foundation for the next wave of AI. From

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diagnosis to therapy, there is a lot of hope that the use of artificial intelligence (AI) will lead to significant advancements in healthcare.

Key words: *AI, machine learning techniques, human intelligence-HI, healthcare.*

Introduction

The so-called second wave of artificial intelligence (AI) has seen well-documented advancements in data-driven complicated machine learning techniques, which have encouraged the investigation of potential AI applications in a variety of fields and facets of human life, behaviour, and society. The majority of recent advances in artificial intelligence have been made possible by the application of representation learning to end-to-end trained deep neural network models in applications like video games, strategic board games, and image, text, and speech recognition. By making automatic feature engineering possible, deep learning models greatly lessen the need for domain-expert knowledge, surpassing conventional techniques that rely on manually created feature engineering and attaining performance that is comparable to or even better than that of humans in certain areas. (Horvatić, 2021). Human-centric explainable AI (HC-XAI) is necessary to fully trust, accept, and adopt newly emerging AI solutions in our daily lives and practices. This is because HC-XAI can interpret algorithmic behaviour and outcomes in a way that is understandable to humans, allowing us to control and continuously improve their performance, robustness, fairness, accountability, transparency, and explainability throughout the entire lifecycle of AI applications (Song, 2020; Popović et al., 2024, 2025).

The main goals of information-theoretic approaches are to improve algorithmic transparency and comprehend the learning dynamics of intricate machine learning algorithms (Tishby & Soatto, 2021, Moon, 2021; Bošković et al., 2023; 2024a, 2024b; Bošković & Popović, 2024; Stevanović et al., 2024). At one extreme, artificial intelligence (AI), also known as augmented intelligence, plays a supporting role in improving human capacities and cognitive performance. In order to mitigate the possible hazards of automated decisions, the objective is to increase the effectiveness of the human decision-making process by combining automation with human thinking.

The newly emerging trend of specifically creating diagnostic datasets to comprehend the inner workings of attention mechanism-based deep learning models for multivariate forecasting tasks is set by the contribution by Barić et al. (2021). "Benchmarking Attention-Based Interpretability of Deep Learning in Multivariate Time Series Predictions." A new benchmark of artificially created datasets with a visible underlying generating mechanism of numerous time series interactions with increasing complexity was created by the authors. Experimental findings using synthetically generated transparent benchmark datasets exposed significant flaws in the functionality and behaviour of the most advanced attention-based architectures available today. The majority of models revealed consistent and satisfactory prediction performance outcomes. Nevertheless, they frequently failed to provide

accurate interpretability, which, surprisingly, rises as the interactions between numerous time series get more complicated (i.e., the more difficult the task, the more accurate the model is in understanding its conclusions).
Following the successful use of channel attention mechanisms in the field of medical image segmentation, Jin et al. (2020), contributed "Optic Disc Segmentation Using Attention-Based U-Net and the Improved Cross-Entropy Convolutional Neural Network." The authors suggested a novel aggregation channel attention upsampling module to fully utilise the impact of context information on semantic segmentation by utilising channel dependencies and incorporating information of various scales into the attentio According to experimental results, using this attention mechanism improves performance in small area segmentation while balancing the contribution of dice coefficients and cross-entropy loss to the segmentation task. It also has a positive effect on the optic disc segmentation task of fundus images.
In Zhang's contribution (2020), "Visual Speech Recognition with Lightweight Psychologically Motivated Gabor Features," the authors created a novel, effective deep learning-based speech recognition system after drawing inspiration from human-centric glimpse-based psychological research on face recognition. This is a fantastic illustration of how human-like ideas investigated in several diverse domains might support the development of innovative, more intelligible, and effective deep learning-based AI systems (that could also learn from less data).
In keeping with this drive, the latest development in a variety of interdisciplinary research communities is centred on the investigation of human-centric AI methodologies and the creation of contextual explanatory models that drive the symbiotic relationship between artificial intelligence (AI) and human intelligence (HI), which serves as the foundation for the upcoming (third) wave of AI.

AI in medicine

Most facets of contemporary life, including entertainment, business, and healthcare, are being impacted by big data and machine learning. All of this information can be utilised to create extremely thorough personal profiles, which could be highly helpful for targeting and behavioural understanding as well as for forecasting healthcare trends. There is a lot of hope that the use of artificial intelligence (AI) will lead to significant advancements in every aspect of healthcare, from diagnosis to treatment. It is widely accepted that AI tools will support and improve human labour rather than take the place of doctors' and other healthcare professionals' jobs. AI is prepared to assist healthcare workers with a range of duties, including clinical documentation, patient outreach, administrative processing, and specialised assistance in areas like image analysis, patient monitoring, and medical device automation. Some of the most significant uses of AI in healthcare will be covered in this chapter, including those that are directly related to healthcare as well as those that are part of the healthcare value chain, such drug development and ambient assisted living (Miller & Brown, 2018).
The need for healthcare services is always growing, and there is a lack of medical professionals, particularly doctors, in many nations (Kirch and Petelle, 2017). In addition to enabling a new method of healthcare delivery through remote interactions

that is accessible from anywhere at any time, advancements in wireless technology and smartphones have opened up prospects for on-demand healthcare services through the use of health tracking apps and search platforms. In addition to helping lower expenses and avoid needless exposure to infectious diseases in the clinic, these services are pertinent for underprivileged areas and locations without specialists. In developing nations, where healthcare systems are growing and infrastructure may be tailored to fit present demands, telehealth technology is also pertinent (Combi et al., 2016; Stevanović et al., 2023). Although the idea is straightforward, these solutions still require extensive independent validation to demonstrate their efficacy and safety for patients.

AI-powered solutions are becoming increasingly important in the next generation of healthcare technology, as the healthcare ecosystem realises. AI is thought to be able to improve every process involved in the operation and provision of healthcare. The healthcare system's potential cost savings, for example, is a major factor in the adoption of AI applications. Applications of AI are predicted to reduce US healthcare spending by USD 150 billion annually by 2026. These cost savings are mostly the result of shifting the healthcare model from a reactive to a proactive one, emphasising health management over illness treatment. As a result, there should be fewer hospital stays, medical visits, and treatments. AI-based technologies will be crucial in promoting people's health. AI-based technology will play a significant part in assisting individuals in maintaining their health through ongoing coaching and monitoring, which will guarantee earlier diagnosis, more individualised therapies, and more effective follow-ups. It is anticipated that the AI-related healthcare market would expand quickly, reaching USD 6.6 billion by 2021, or a 40% compound yearly growth rate (Bresnick, 2017).

Healthcare uses of artificial intelligence and medical precision

Healthcare AI integration has revolutionary potential, but in order to fully realise this potential, major obstacles must be removed. This study emphasises the need for long-term research to fully evaluate AI's efficacy over time, particularly when it comes to treating comorbid illnesses when treatment complexity rises. To encourage responsible AI use, ethical concerns like data privacy, algorithmic bias, and accountability must be addressed immediately. Furthermore, improving healthcare workers' training on AI technology and incorporating patients in the creation of AI tools are crucial stages for successful deployment. The healthcare industry may use AI to greatly enhance diagnostic capabilities and treatment outcomes by encouraging interdisciplinary collaboration, creating thorough regulatory frameworks, and giving priority to the removal of biases in AI training data. In the end, this strategy will improve healthcare delivery, address complicated medical issues, and improve overall health outcomes by fostering more effective and equitable patient care across a range of demographics. It is widely accepted that AI tools will support and improve human labour rather than take the place of doctors' and other healthcare professionals' jobs. AI is prepared to assist healthcare workers with a range of duties, including clinical documentation, patient outreach, administrative processing, and specialised

assistance in areas like image analysis, patient monitoring, and medical device automation. Divergent views exist regarding the most advantageous uses of AI in healthcare. In 2018, Forbes predicted that the most crucial sectors will be clinical decision support, image analysis, robotic surgery, virtual assistants, and administrative workflows (Marr, 2018). The same topics were covered in a 2018 Accenture paper, which also covered cybersecurity, networked machines, and dose error reduction (Kalis et al., 2018). Important areas include robotics-assisted surgery, targeted and personalised medicine, cognitive gadgets, and electroceuticals, according to a 2019 McKinsey report (Singhal & Carlton, 2019).
Based on a patient's disease profile, diagnostic or prognostic data, or response to treatment, precision medicine offers the potential to customise healthcare actions for specific patients or groups of patients. Genomic variants and contributing factors to medical treatment, including age, gender, location, race, family history, immunological profile, metabolic profile, microbiome, and environmental vulnerability, will be taken into account in the customised treatment opportunity. Using individual biology instead of population biology at every stage of a patient's medical journey is the aim of precision medicine, Pictures 1-4, (Md Mobashir & Jessilyn , 2022).
The discipline of computer science known as artificial intelligence (AI) is concerned with developing systems that can carry out tasks that normally require human intelligence, including as learning, problem-solving, comprehending natural language, identifying patterns, and making judgements (Figure 1).

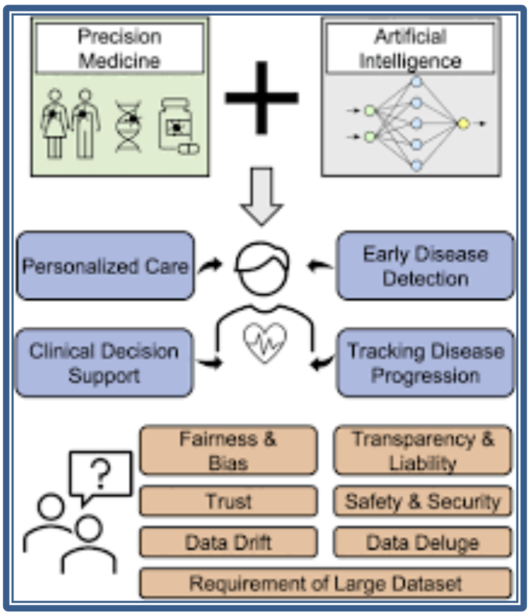

Figure 1. Precision medicine and AI in healtcare

AI includes everything from straightforward algorithms that automate repetitive activities to intricate systems that change and adapt over time, such as neural networks and machine learning models. AI was first used in medicine in the middle to late 20th century, but in the last few decades, its use has grown dramatically (Hassaine et al., 2020).

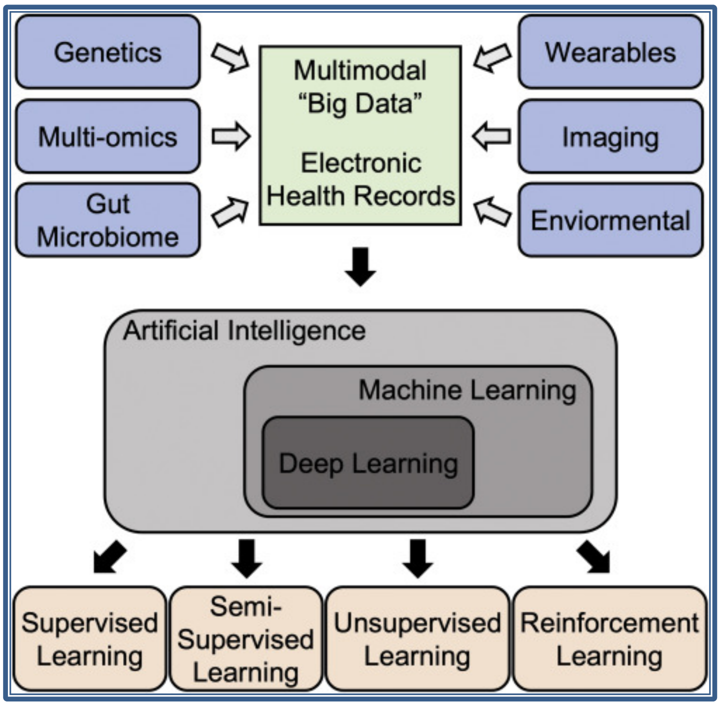

Figure 2. Machine learning, AI and deep learning.
Data analysis in healthcare using artificial intelligence.

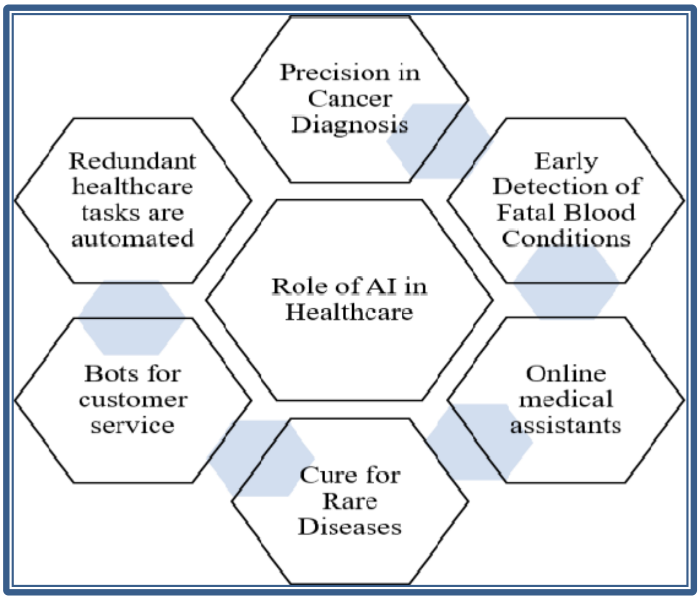

FIgure 3. Precision IA in medicine

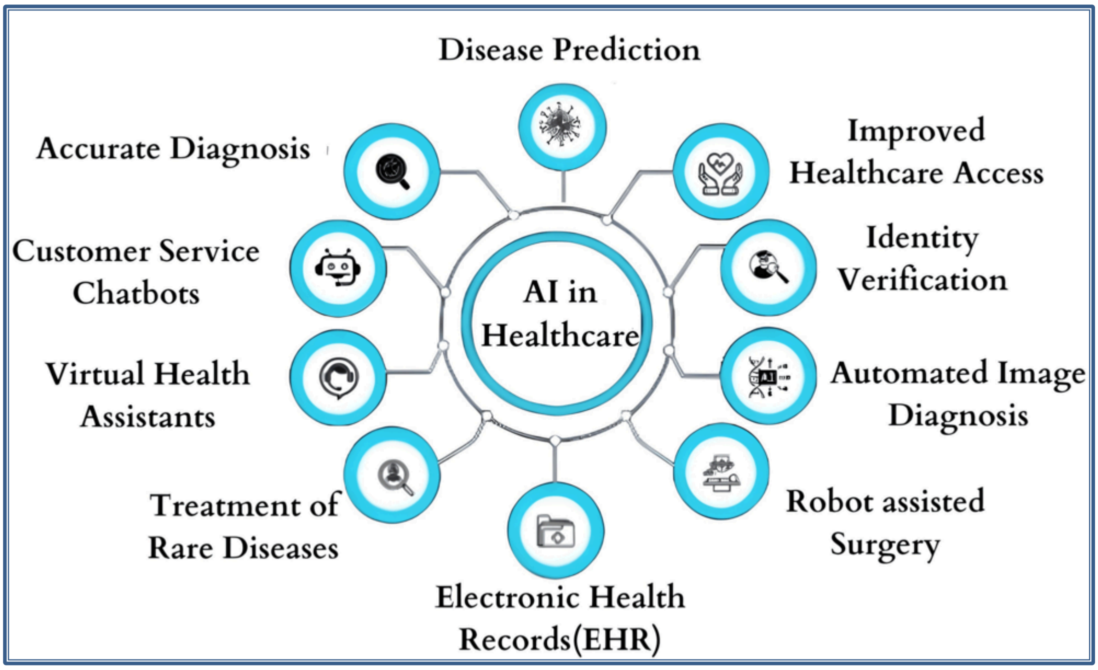

Figure 4. Role AI in healtcare

This entails gathering personal data from patients, such as genetic information, physiological monitoring data, or electronic medical records data, and using sophisticated models to customise their care. Reduced healthcare expenses, less adverse drug reactions, and improved drug action efficacy are some benefits of precision medicine (Konieczny & Roterman, 2019). Precision medicine innovation is anticipated to transform the delivery and assessment of health services while also offering significant advantages to patients. Although there are many different kinds of precision medicine projects, they can be broadly categorised into three clinical domains: sophisticated algorithms, digital health applications, and tests based on "omics."

Conclusion

The well-documented advancements in data-driven complex machine learning techniques that arose within the wave of artificial intelligence (AI) prompted the exploration of possible AI applications in various fields and aspects of human life, habits, and society. By providing autonomous feature engineering that outperforms traditional methods that rely on manual feature engineering and achieves performance that is on par with or even greater than that of humans in some domains, deep learning models significantly reduce the need for domain-expert knowledge. To completely trust, embrace, and integrate rapidly developing AI solutions into our daily lives and practices, we need human-centric explainable AI (HC-XAI) that can provide human-understandable interpretations for their algorithmic behaviour and consequences. This will enable us to keep control over and make constant improvements to the explainability, accountability, performance, and fairness of AI systems during their entire existence. Following this inspiration, the lately emerging trend in various and multidisciplinary research groups is based on the exploration of human-centric AI techniques and the development of contextual explanatory models. With Song's demonstration of "Personalised Image Classification by Semantic Embedding and Active Learning," the need for a mutualistic symbiosis between artificial intelligence (AI) and human intelligence (HI) is positively illustrated. The next wave of artificial intelligence (AI) is being built on the synergy between AI and HI, which is being fuelled by these initiatives.

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