Data visualization for explainability and data-driven decision-making in health and life sciences

Contact
Dr Sara Johansson Fernstad, sara.fernstad@newcastle.ac.uk

Research introduction
Innovation and decision-making are increasingly data-driven across many domains, turning to data science to unlock the potential and value of the data. This is particularly true in health and life-sciences where genomics technology is revolutionising knowledge generation. As the size, complexity and diversity of data increase, the use of AI and machine learning models becomes essential to interpret data and to guide decisions. While numerous AI models exist, there is often a lack of transparency as to how predictions are made and how data features may affect outcomes. Furthermore, decisions are often made by domain experts with limited understanding of the models and their limitations. This poses considerable challenges for decision-makers, particularly in the clinical domain where clinicians need to make fast and reliable decisions informed by complex data, while also being able to justify their decisions.

Data visualization can be described as the communication of complex data using interactive visual interfaces, and acts as a bridge between the data and the human who interpret and communicate it. As such, visualization is key to fully informed and justifiable human-centred decision-making guided by AI models. There are however considerable gaps in the design of usable visualization for explainable AI, particularly where the human decision-maker or visualization audience lacks understanding of the underlying models and data. Two PhD projects are suggested to address these research challenges

Project 1: Visualization for improved reliability and explainability of AI guided decisions: This project will address the challenge of reliable decision-making informed by complex data and AI models. The project will research and design novel visualization solutions that help decision-makers (e.g. clinicians, health professionals, life-science scientist etc.) to better understand model outcomes and predictions and how they are impacted by data features, to improve trust and better informed decisions.

Project 2: Explainability of data-driven decisions to non-expert audiences: This project will address the challenge of communicating and justifying data-driven decisions to non-expert audiences such as, e.g., the communication of data-driven clinical treatment decisions to patients. The project will research aspects such as communication, decision-making and trust in visualization, and design novel visualization solutions for communication.

Applicant skills/background
These projects generally require a background in computer science or related area, and/or background/skills in visualization, HCI, cognitive science or related areas. For project 1, experience of AI/ML is a benefit, while cognition, perception and HCI are of benefit for project 2.

References
- Ståhlbom et al. (2023) The thorny complexities of visualization research for clinical settings: A case study from genomics https://doi.org/10.3389/fbinf.2023.1112649
- Oral et al. (2024) A critical inquiry into visualization tools for decision making. https://ieeexplore.ieee.org/document/10292614
- Ahmad et al. (2018) Interpretable machine learning in healthcare. https://ieeexplore.ieee.org/document/8419428