

## **AI4MEDICINE: Artificial Intelligence (AI) and Machine Learning (ML) Approaches for Biomedical Data Analysis, Integration and Outcome Prediction**

The growing role of AI in scientific and translational endeavours, including those in medicine is self-evident. This proposal aims to leverage current and emerging generative AI and related approaches to develop an integrative agent-based system for biomedical data analysis, multi-domain integration and outcome prediction, with the overall goal of improving patient diagnosis, personalized interventions and improved clinical outcomes.

The overall principles of the project are: i) to capitalize on pre-trained foundational Large Language Models for Electronic Medical Records, biomedical imaging data, Omics, sequencing and other data modalities, while addressing domain specific classification and other data analysis and prediction tasks using fine tuning and related techniques; ii) to capitalize on the strengths of the multidisciplinary team of computer and data scientists as well as biomedical scientists and clinicians, while increasing horizontal integration between Collegium Medicum and informatics groups at NCU; iii) to leverage existing projects involving the use of AI and machine learning models in biomedicine, while developing transferable techniques, models and agents.

Dr. Jarosław Meller (Department of Informatics, NCU & University of Cincinnati), the overall project leader, has an established record of methodological and team science contributions at the intersection of biomedical data science and medicine, with focus on applications of AI/ML and data science techniques to gain mechanistic insights into disease processes and improve patient outcomes in cancer, autoimmune and brain disorders.

Other informatics co-leads include: i) Dr. Rafał Adamczak (Department of Informatics) overseeing ongoing efforts to develop AI-augmented intensive care systems in collaboration with the Department of Anesthesiology and Intensive Care; ii) Dr. Norbert Jankowski (Department of Informatics) coordinating algorithmic developments in transformer networks and related deep learning techniques for bioinformatics and biomedicine and iii) Dr. Tomasz Piotrowski (Department of Informatics) overseeing ongoing efforts to develop deep-learning solvers for the EEG inverse problem with applications to brain disorders; iv) Dr. Włodzisław Duch (Department of Informatics) providing AI expertise and advice. Co-leads on the medical side include Dr. Tomasz Grzybowski (Department of Forensic Medicine, Collegium Medicum) and Drs Michalina Kołodziejczak and Przemysław Jasiewicz (Department of Anesthesiology and Intensive Care, Collegium Medicum).

Parallel research efforts and projects considered as part of the strategic research initiatives, including the SOLAR-AI (Safe Optimized Learning for Aligned Reasoning in AI) project led by Dr. Piotr Przymus (Faculty of Mathematics and Computer Science), which aims to develop safe and interpretable AI systems for science and medicine, provide opportunities to further synergize and transfer solutions between these projects.

Overall, this project represents an opportunity to establish a globally competitive research hub in AI-assisted biomedicine and healthcare, while leveraging and strengthening horizontal integration across multiple academic and clinical units at NCU in the age of AI revolution.