The University of Manchester

GROUP WEEKLY REPORT

Team Number	13	Date	16/02/2024

Team member contributions

Piotr: carried out research about disease prediction
Hafsa: worked on disease classification → specifically genetic variant classification
Ziyu: Disease Classification 3 articles on AI predicting different kinds of disease.
Muying: carried out research about precision medicine -> specifically in cancer research
Shenhujing: Research on Three Deep Learning Applications for Drug Discovery
Hamwen: carried out research about precision medicine specifically in survival prediction research
Yufan: study four papers about AI application in disease prediction

Summary of findings

Disease prediction: DNN methods outperform other traditional statistical and regression-based methods, as long as enough high-quality data is present. DNN models can be mode more explainable through methods such as LIME and DeepLIFT. Disease prediction can be used to identify the risk of contracting a disease before birth or early in life. This way, diseases can be addressed early, and scarce resources can be allocated efficiently.

The research findings across various studies demonstrate the growing efficacy of AI and deep learning in medical diagnostics and disease prediction. These studies underline AI's potential to supplement and, in some cases, outperform traditional methods, offering non-invasive, efficient, and potentially more accurate diagnostic tools. They also highlight AI's role in healthcare advancement, despite challenges like data bias, model generalizability, and the "black-box" nature of deep learning. Overall, the stance is favourable towards AI applications in healthcare, advocating for their transformative impact on disease management and patient outcomes.

Disease Classification: main outcome was the usage of CNNs in genetic sequence variant detection and classification. DeepVariant seems to be a promising tool → many citations, through code documentation, big support community. Could be integrated into the NHS system, once limitations/challenges are met. Some discussion in the research community about moving from explainable AI → accountability AI.
The integration of Artificial Intelligence (AI) and Deep Learning (DL) models in disease classification has shown promising advancements in the field of medical diagnostics and research. These technologies offer innovative approaches to understanding complex patterns in genetic diseases, improving diagnostic accuracy, and tailoring treatments to individual genetic profiles. Studies have explored various diseases, including genetic disorders, cancers, and neurodegenerative conditions, demonstrating AI's potential to enhance early detection, predict disease progression, and facilitate personalized medicine. However, challenges such as data privacy, model generalizability, and the need for explainable AI models are critical considerations for the future development and implementation of these technologies in clinical settings. Ensuring the ethical use of AI, improving models' interpretability, and integrating AI tools seamlessly into healthcare systems remain essential goals.

Precision medicine/Survival prediction: Survival prediction is one of the key components of precision medicine, and this prediction is very valuable to both doctors and patients because it can help doctors choose the most appropriate treatment for their patients, especially in the fight against major diseases such as cancer. Survival prediction can be used to guide therapeutic decision-making, optimise treatment plans, and improve patients' survival rates. For example, by analysing the genetic data of a cancer patient, it is possible to predict the patient's response to certain chemotherapeutic drugs, so that the most effective treatment plan can be selected.
Drug discovery: The latest DL models for predicting DTI in most drug discoveries can be divided into three categories: drug based models, structure (graph) based models, and drug protein (disease) based models. These models use target drug information to calculate DTI and employ similarity search strategies. All article supports the application of AI

Team
We have identified a potential outline/structure for our reports

- Section 1: Definition of Scope and Analysis of the Problem
    - Introduce problem: use of deep learning in health care
        - What is deep learning
    - Importance of the problem
        - Potential applications
    - The report will aim to answer the question of whether deep learning is mature enough to be used in genomics
- Section 2: Discussion of Strategy to Address Problem
    - Divide this section in 4 parts, based on the 4 topics we are exploring
        - Drug discovery
        - Disease classification
        - Disease prediction
        - Precision medicine
- Section 3: Strategy Recommendation
    - Set of recommendations to be followed
        - If recommendation is positive, specify a pipeline that would leverage deep learning in healthcare
        - Data privacy, bias, and scalability
    - Discuss limitations, future directions

Plan for Next Week

Team:

- For each of the topics, investigate data privacy, scalability and bias in the models
- In our research, we will focus exclusively on the following diseases, in order to narrow down the scope of our work
    - Chronic diseases
        - Breast cancer
        - Diabetes type I
- Identify an end-to-end pipeline that would tackle each topic using AI

Piotr: shift focus from generic research about disease prediction using machine learning models to concerns regarding scalability, bias, and privacy of the models. In addition, come up with a pipeline that could be used to perform disease prediction based on genomic data within the NHS.
Yufan: develop a pipeline for disease prediction, focusing on the specific disease, for example how to use deep learning to predict breast cancer and type 1 diabetes.
Hafsa: work on developing a pipeline for disease classification using DL (specifically pathogenic variant classification), in the context of an NHS bioinformatics lab working on NGS. Focus on the specified diseases: breast cancer, diabetes.

Ziyu: develop a pipeline for disease classification, specified as the Breast cancer and diabetes.
Shenhujing: Develop a drug discovery pipeline, focusing on the application of specific in-depth learning in cancer and type 1 diabetes.
Muying: develop a pipeline for precision medicine using machine learning within the NHS, focus on breast cancer and type 1 diabetes.
Hanwen: develop a pipeline for precision medicine using deepl learning , focus on survival prediction in breast cancer and type 1 diabetes.