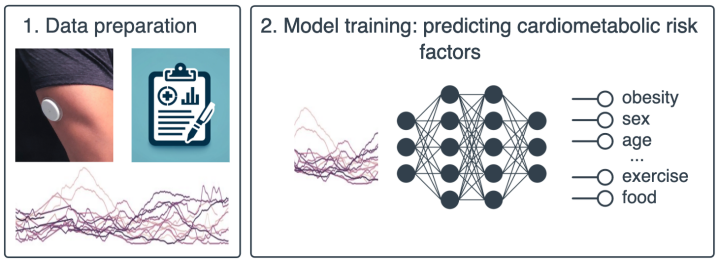
Deep neural networks for predicting cardiometabolic risk factors from wearable glucose monitors

Background: More than 530 million patients suffer from diabetes, a leading cause of death and contributor to a host of long-term serious health complications. To manage diabetes, patients need to closely monitor their blood glucose levels. This is often done through wearable continuous glucose monitoring (CGM) devices, which provide real-time feedback patients can use to decide on insulin injections throughout the day.

However, control of blood sugar levels remains challenging, as many variables influence the dynamics of a patient's glucose profile, including cardiometabolic risk factors such as obesity, age, or sex. These complex relationships are not yet fully understood, but they will need to be incorporated for effective treatment systems. A first step towards this goal is the automated prediction of risk factors from the wearable CGM signals.



Aim: In this project, the student will develop deep learning techniques to predict cardiometabolic risk factors from wearable signals from CGM devices.

Materials and Methods: The student will work on a publicly available wearable dataset. They will first preprocess the data to address missing values and to divide the timeseries into smaller segments. Next, in the core model development phase, the student will develop deep learning techniques to predict risk factors. We will start with an existing codebase for glucose forecasting which can be easily adapted to our task. This means she or he can get started quickly and can expect first results early. The student will compare Transformer models with convolutional neural network architectures. If successful, we already have various ideas for downstream applications and follow-up research questions. For example, to come one step closer to understanding the complex relationships between risk factors and wearable signals, we want to develop explainable AI techniques for understanding model behaviour. The student will work in a research group focused on data science for diabetes care, where we have a strong expertise in deep learning for biomedical data analysis.

Nature of the Thesis:
Literature review: 10%
Data exploration: 30%
Model development: 40%
Results analysis: 20%

Requirements:
Solid machine learning knowledge
Programming experience (Python, ideally Pytorch)
Interest/Experience with processing of high-dimensional data (e.g. wearable, timeseries, images)
Strong written and verbal communication skills

Supervisor(s):
Prof. Dr. Lisa Koch, Prof. Dr. Lilian Witthauer

Institutes: Lab for Machine Learning in Medicine

References:
Sergazinov, R., Chun, E., Rogovchenko, V., Fernandes, N. J., Kasman, N., & Gaynanova, I. (2024). GlucoBench: Curated List of Continuous Glucose Monitoring Datasets with Prediction Benchmarks. *In: The Twelfth International Conference on Learning Representations (ICLR).*
Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A.N., Kaiser, Ł. and Polosukhin, I. (2017). Attention is all you need. *In: Advances in neural information processing systems (NeurIPS)*.

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Please attach your transcripts when you reach out. We look forward to hearing from you!