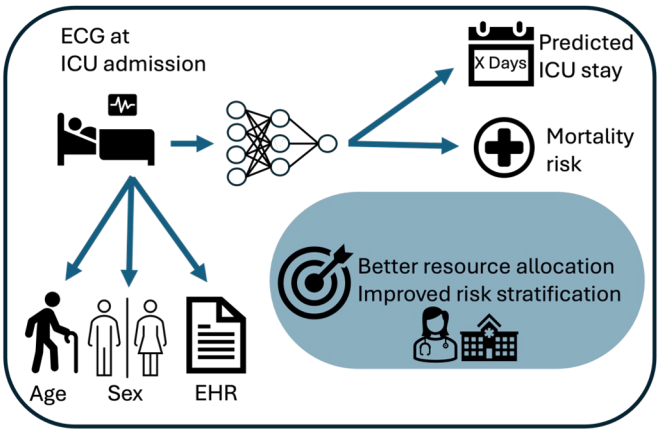
Master Thesis

Leibniz ScienceCampus
Digital Transformation of Research

Machine Learning-Based ICU Stay Prediction

Interdisciplinary topic co-supervised by FIZ Karlsruhe, KIT AIFB



Timely and accurate prediction of patient outcomes in the intensive care unit (ICU) is critical for guiding clinical decision-making, optimizing resource allocation, and improving patient survival. This thesis introduces a novel approach for predicting both the duration of ICU stay and patient mortality by leveraging raw electrocardiogram (ECG) data collected at the time of ICU admission. The modeling framework may utilize architectures such as convolutional neural networks (CNNs), long short-term memory networks (LSTMs), or alternative deep learning methods. A stepwise, multimodal modeling strategy will be adopted—beginning with ECG data alone and progressively incorporating demographic factors (e.g., age, sex) and electronic health record (EHR) variables—to evaluate the incremental contribution of each data modality to overall predictive performance.

This framework aims to bridge the gap between predictive performance and clinical relevance in ICU outcome forecasting using ECG data. In particular, it seeks to assess how effectively raw ECG signals—processed through deep learning models such as CNNs or LSTMs—can contribute to early risk stratification. The thesis will evaluate not only the accuracy of this multimodal pipeline but also the interpretability and clinical utility of the model outputs, with a focus on their potential integration into real-world ICU decision-making workflows.

Key contributions

- Preparation of ECG data from the MIMIC dataset [1].
- Designing and Implementing ML models to predict ICU stay and mortality.
- Evaluation of model accuracy and clinical interpretability.

Prerequisites

- Good programming skills in Python
- Background in Machine Learning approaches

Sources

[1] MIMIC dataset: https://paperswithcode.com/dataset/mimic-iv-ecg

[2] Iwase, Shinya, et al. *Prediction algorithm for ICU mortality and length of stay using machine learning*. Scientific reports 12.1 (2022): 12912.

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