Comparative Evaluation of Machine Learning and Deep Learning Approaches for Predicting Aplasia Duration from Multi-Modal EHR Data

Supervisor: Dr. Farnaz Rahimi

Duration of bone marrow aplasia following chemotherapy is a critical determinant of infection risk, transfusion needs, and hospital resource utilization in oncology patients. Early and accurate prediction of this duration allows timely interventions and improved patient outcomes. Electronic health records (EHRs) are a rich resource of data, collected during the hospitalization. They include diverse data types such as patient demographics, laboratory results, vital signs, medications, and diagnoses.

In this project, we aim to develop state-of-the-art machine learning and deep learning models to predict the duration of bone marrow aplasia following chemotherapy in two complementary scenarios: (1) a **classification task**, where aplasia duration is discretized into clinically meaningful categories such as rapid recovery, typical recovery, and delayed recovery, and (2) a **regression task**, where the goal is to predict the continuous duration in days.

To achieve this, we will primarily leverage temporal laboratory measurements, as they capture longitudinal changes in a patient's clinical state. We will first establish baseline performance by training and evaluating traditional machine learning models, including Logistic Regression, Random Forest, and Gradient Boosting methods. Building upon these results, we will then develop and benchmark advanced temporal deep learning models, including Long Short-Term Memory networks (LSTM), BEHRT-based architectures adapted for clinical time-series data, and the Temporal Fusion Transformer (TFT). The performance of all models will be assessed across both classification and regression tasks.

The project will proceed in the following steps:

- Literature review on related classification and regression approaches in clinical prediction tasks, with a particular focus on temporal data modeling.
- Familiarize with the benchmark datasets such as MIMIC-IV.
- Train traditional machine learning models and evaluate their performance on both classification and regression tasks.
- Develop and train advanced temporal deep learning models, and compare their performance against the baseline approaches.

Requirements:

- Proficiency in Python programming.
- Strong knowledge of machine learning models and their evaluation methods

*** Depending on the results, the project can be continued as a master Thesis.*