Digital ICU : MA - Interpretable Time-Series Neural Network with Attention Mechanism for Highly Imbalanced Multivariate Patient Data

General Info

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Project Abstract

Digitalization in healthcare has led to the increasing use of digital medical systems in the Intensive Care Unit (ICU). They generate a large amount of data, such as the vital signs of patients, the blood gas analysis results, and the medication that a patient receives. This data can be analyzed using machine learning and data analytics techniques to help clinicians identify clinical deterioration in patients earlier and determine if a patient's treatment is working.

The multivariate patient data is however not in optimal format for machine learning models. Firstly, while vital signs can be recorded at relatively high frequency (e.g. every 5 minutes), measurements such as lab tests are usually done once or twice per day according to the decision of clinicians. The decision making of the model can be dominated by the dense data in this case. Secondly, the proportion of missing values can be very high in the patient data and several modals (specific lab tests) can be completely missing for certain patients.

Beside the detection of deterioration, this project also aims to interpret the model's decision making, i.e., which input is abnormal and contributes more to the prediction result.

Tasks Description

- Investigate time-series models for patient deterioration prediction with integrated feature importance estimation
- Improve time-series model for highly imbalanced data
- Investigate correlations and missing data patterns in patient data to improve the model performance
- Visualize the model's decision making process

Technical Prerequisites

- Good knowledge in machine learning and deep learning
- Python, experiences with libraries like pandas, scikit-learn, pytorch, matplotlib, etc.