Detection of ARDS in time series clinical data using Deep Learning models

(Master Thesis)

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Motivation

This master thesis is written within the ASIC (Algorithmic surveillance of ICU patients) Use Case of the SMITH (Smart Medical Information Technology for Healthcare) project which aims to improve the treatment of patients with acute respiratory distress syndrome (ARDS). ARDS is a severe medical condition associated with massive disruption of gas exchange and lung damage and has a high mortality rate. According to the LUNG SAFE Study, this can partly be attributed to a late or missed diagnosis. To address this shortcoming, sequential monitoring of intensive care data can be helpful to survey patients and detect a potential ARDS at an early stage. Since this is a very time-consuming process, AI methods can assist healthcare professionals in this regard.

State of the Art

There exist various approaches to support the classification of ARDS and non-ARDS patients using machine learning models. During previous theses at the chair Informatik 11 different models like a random forest algorithm or a Bayesian network have been implemented for the classification of ARDS using relevant parameters defined by physicians of the project. However, in recent years, deep learning has become an outstanding performing method for according classification problems. In literature, most research uses deep learning models for the classification of ARDS in image data like X-Rays and chest radiographs. However, in recent studies, deep learning models were also applied on time series data with promising results. To our knowledge there exist no such deep learning model using time series data to detect ARDS.

Objective

The objective of this master's thesis is to create a deep learning model which detects ARDS at an early stage using time series data as input, focusing on relevant parameters defined for possible ARDS patients. The performance of the model will be evaluated and compared to already existing approaches. The model will be trained and tested using intensive care patient data from multiple publicly available databases (MIMIC IV, eICU etc.) as well as data from the university hospital Aachen.

Planned Procedure

During an initial literature research, possible architectures and structures of deep learning models will be analyzed and the best suited one for time series data chosen. Afterwards, the relevant data will be preprocessed to fit the according model architecture. Here, a detailed analysis and visualization of the data will help to support the later results. With the processed data the deep learning model will be trained and evaluated using k-fold cross validation incorporating different data sets to address a possible transferability. Finally, the information on the model and implementation is summarized and discussed in the written master thesis.

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