AIMLab.

MACHINE LEARNING FOR PHYSIOLOGICAL TIME SERIES ANALYSIS

Syllabus

The task of discovering novel medical knowledge from complex, large-scale and high-dimensional physiological patient data, collected during medical care, is central to innovation in medicine. In this specialization course you will learn about the usage of machine learning within the context of physiological time series analysis. The course will cover the common sources of physiological signals recorded in medical practice, feature engineering ("digital biomarkers") in the time and frequency domain, entropy measures and deep representation learning approaches. In particular, the usage of CNN and RNN (e.g. LSTM, GRU) for analyzing long continuous stream of physiological data with time dependencies. The necessary theory will be covered. The course assessment will be based on a publication review, presentation and reproduction of a research paper (typically IEEE TBME type) using an open dataset. This is a specialization course and students should come with an engineering background in signal processing and classical machine learning.

- Graduate course.
- Number of credits: 2.
- Format: 2h of lecture per week and 1h of TA.
- Course assessment: project.
- Number of TA: 1.

Examples of lectures:

Part 1: Introduction and classical approaches

- Sources of physiological time series in medical practice.
- Feature engineering: time, frequency, fractal domain, entropy.
- Blind source separation: independent component analysis.
- State-space modelling: Kalman Filter.

Part 2: Deep learning

- CNN for 1-D time series analysis and spectral transformation.
- Analysis of temporal data: RNN (LSTM, GRU) and TCN.
- Transfer learning for domain adaptation.
- Interpretability of DL models.

- Semi-supervised learning.
- Data augmentation approaches for physiological time series.

Part 3: Research and competition in the field

- Common practical challenges: class imbalance, establishment of a medical ground truth for annotations, population sample.
- ML competition in cardiovascular signal processing.

Prerequisites:

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