**Bachelor Project**

**English title: Representation learning of multimodal data using multiview machine learning**

**Danish title: Representation learning af multimodal data ved brug af Multiview machine learning**

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**Period:** 12.02.2024-16.06.2024, ECTS 15

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**Description:**

As data collection becomes increasingly automatic and more complex, methods of utilizing the data must evolve as well. Learning from multiple representations of the same data with multiview machine learning is a way of taking advantage of the abundance of data generated. This project focuses on training a classification model from ECG data and text descriptions of the same patients to increase classification accuracy. The project will be based on a current state-of-the-art model and aims at reproducing the model’s results and apply it to new data and test the effectiveness of using other methods for pre-processing data before training and testing.

**Timeline:**

Running deliverables and plans

Throughout the project: Writing the thesis continually throughout the project duration for keeping up to date with current work and progress.

Week 1-4: 12/02/2024-10/03/2024

Literature study of the main paper in focus, “ETP”, as well as relevant literature for reproducing the model components. This literature includes previous works that are referenced in ETP. Setting up a “to-do” list with said models and work from previous literature which needs to be implemented.

Preliminary work in preparation of implementation, such as preparing git repository, setting up environments and loading the primary dataset, PTB-XL.

End of week 4: 13/03/2024

**Milestone:** Hand-in project plan.

Week 5-7: 11/03/2024-31/03/2024

Implementation of models for preprocessing. Namely, ResNet18 for encoding ECG signals, and ClinicalBERT for encoding text. Success criteria is producing embeddings for both types of signals. If there is extra time, implementation of linear projectors to produce the multi-modal embedding space as well.

Week 8-10: 01/04/2024-21/04/2024

Implementation of linear projectors if not already done. Implementation of training and test loop and comparing to the original work.

Week 11-13: 22/04/2024-12/05/2024

Testing the models on new datasets.

Implementation of testing loop for performing zero-shot classification and accuracy testing.

Week 14-18:

Assuming the ETP model is fully implemented and evaluated.

Investigating the text reports semantics using data augmentations, to understand how strong an effect the medical language semantics have on the model effectiveness.

Investigating the ECG signals in the PTB-XL dataset by training on only the ones that have been reviewed multiple times by medical professionals.

Turning the model setup into a contrastive learning setup, like the one used in:

<https://doi.org/10.1007/s10489-023-04453-3>

or

<https://proceedings.neurips.cc/paper_files/paper/2023/hash/6818dcc65fdf3cbd4b05770fb957803e-Abstract-Conference.html>

**Specific learning objectives:**

The student can

* Explain general concepts on representation learning and feature extraction.
* Understand and implement multiview machine learning methods using Python.
* Apply zero-shot learning methods.
* Combine and modify machine learning models for separate downstream tasks.

**General learning objectives:**

<http://sdb.dtu.dk/2018/35/708#x_Master's_thesis>

**In addition, the student**

* can identify and reflect on technical scientific issues and understand the interaction between the various components that make up an issue;
* can, on the basis of a clear academic profile, apply elements of current research at international level to develop ideas and solve problems;
* masters technical scientific methodologies, theories and tools, and has the capacity take a holistic view of and delimit a complex, open issue, see it in a broader academic and societal perspective and, on this basis, propose a variety of possible actions;
* can, via analysis and modelling, develop relevant models, systems and processes for solving technological problems;
* can communicate and mediate research-based knowledge both orally and in writing;
* is familiar with and can seek out leading international research within his/her specialist area;
* can work independently and reflect on own learning, academic development and specialization;
* masters technical problem-solving at a high level through project work, and has the capacity to work with and manage all phases of a project – including preparation of timetables, design, solution and documentation.