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MSc Thesis
Topic: Building a Data Analysis Platform for the EARDREAM Project

EARDREAM is a project established by a team at ETH (led by Raphael Polania) to predict the onset of Alzheimer's disease by analyzing human brain signals. Devices worn by users collect a lot of data (approximately 1GB per user per day), which has to be collected from the devices, preprocessed and transferred into a centralized storage system. Once the data is uploaded, this centralized system needs to support data analysis processes. Existing analysis processes have to be adapted to the system, i.e., the functionality to support them needs to be implemented. However, it would also be interesting to look at potential future uses of the system and maybe implement some of the functionality needed for them.

Currently, a lot of the data preprocessing and loading is done manually and the most important goal of this MSc thesis is to automate the preprocessing, transfer, loading, and storage processes to support the operation of the EARDREAM analysis platform. The work is structured roughly into the following tasks:

Tasks

T1: Understanding and analyzing the existing project

The first task for the student is to familiarize themselves with the EARDREAM project and to analyze the existing dataset, analysis processes, and strategic future initiatives. The outcome of this step is a deep understanding of the modus operandi of the EARDREAM team, the raw as well as processed data format as well as any metadata (such as annotations for the purpose of data provenance) necessary to support the current operation. Ideally, future strategic initiatives deemed critical by the EARDREAM team should also be collected. The collected information should be condensed into a (preliminary) list of requirements and use cases to be covered by a prototype.

T2: Understanding and analyzing the current state-of-the-art of EEG signal processing
The second task focuses on establishing a sound theoretical basis regarding the algorithms, data structures, and architectures of data pipelining for EEG data from a structured literature review. The outcome here should be a structured list of potential techniques that can be leveraged to support the specific use cases and requirements established in T1, as well as the drawbacks and advantages of the approaches considered.

T3: Implementing a prototype
Based on the (preliminary) results of the first two tasks, this task is about building a first prototype for uploading, preprocessing, storing and accessing the data. In a first step, a sample architecture is created, using the approaches listed in T2. The prototype is then implemented and its suitability to the documented use cases is evaluated in collaboration with the EARDREAM team. The insights from the creation process are documented and a deeper understanding of the process should be gained. Depending on the feedback for the prototype and the results of the suitability evaluation, this could lead to the development of more than one prototype, as well as iterations of the tasks up to this point.

T4: Summarizing the findings in a report/thesis
At the end of the project, a report/thesis describing the requirements and the prototype implementation(s) needs to be written up. This should include all the insights gained through the iterations of T1, T2 and T3 so that based on the report, an architecture for the final system can be developed in a follow-up project.

T5: Presentation
Present the thesis in a DBTG meeting (25 minutes presentation).

Supervisor: Sven Helmer (helmer@ifi.uzh.ch)

Start date: 1 February/March 2023

End date: 6 months later

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