Title: Investigating EEG Microstate Analysis for Cognitive State Characterization

This project proposal outlines a short research endeavor focused on exploring and analyzing EEG signals through the lens of microstate analysis. EEG microstates represent fundamental neural activity patterns that recur over time and are closely tied to cognitive processes. This study aims to develop a robust methodology for identifying and characterizing microstates within EEG data, with the overarching goal of gaining deeper insights into cognitive states and their underlying neural dynamics. It enhances our understanding of the neural underpinnings of cognition and cognitive state changes. This has a great potentia for clinical applications, such as assessing cognitive impairments or tracking treatment effects.

Objectives:

1. Develop a framework for identifying EEG microstates using python.
2. Analyze the temporal dynamics of microstates during different cognitive tasks.
3. Investigate the potential correlation between microstate patterns and cognitive states.

Methodology:
1. Data Collection:Collect EEG data from a diverse group of participants while they perform distinct cognitive tasks.
2. Preprocessing: Apply preprocessing techniques to enhance data quality, including filtering and artifact removal.
3. Segmentation: Divide continuous EEG data into epochs for analysis.
4. Topographical Mapping: Compute scalp potential maps for each epoch to capture spatial patterns.
5. Microstate Clustering: Utilize advanced clustering algorithms (e.g., k-means, hierarchical clustering) to group similar topographical maps into microstates.
6. Template Creation: Create representative templates for each microstate cluster.
7. Temporal Analysis: Investigate temporal dynamics by analyzing the transitions and durations of microstates over time.
8. Cognitive Correlations: Examine how microstate patterns vary across different cognitive tasks or mental states.

Expected Outcomes:
1. Identification of Stable Microstates: Identify distinct and stable microstate patterns across participants.
2. Temporal Dynamics: Gain insights into how microstates transition over time during various cognitive tasks.
3. Cognitive Correlations: Explore the potential relationship between microstate patterns and cognitive processes.
4. Visualization: Visualizatioin and interpretation of the microstates.

Supervision:

1. Lu Li (lu@simula.no)
2. RabindraK Khadka (rabindra@oslomet.no)