As part of research in Prof. Nitzan Censor’s lab on the encoding of episodic memory, we plan to contribute code to preprocess TMS-evoked potentials (TEPs) measured by EEG. The experiment involves participants wearing an EEG headset while engaging in a memory task. During the experiment, participants will be subjected to a single-pulse TEP, and the reaction to it will be measured by the headset. The measured reaction represents their level of consciousness and concentration at the given moment. The purpose of the experiment is to search for a correlation between the level of consciousness and success in the memory task. However, TMS pulses create significant artifacts in the EEG measurement. Our project is designated to preprocess the data in a way that will not be contaminated by these artifacts while still maintaining a high level of continuity. We will write a Python code that receives raw EEG data, identifies and subtracts the TEP contaminated part, and completes the missing part using an interpolation method to be determined in more advanced stages of the project.

The tools that we plan to utilize are the EEG signal files, Python MNE library and interpolation numerical analysis. The EEG signal is processed into three files which are read and cultivated by the MNE library. The MNE library is an open source code on github which aims to contribute to EEG signal processing research by developing new and efficient functions and algorithms to improve EEG analysis and its accessibility. It provides many useful tools such as plotting, matrix representations, statistical analysis and even integration of mathematical functions. We aim to use these capabilities to create a precise algorithm that indicates the time range of the TMS pulse artifacts. We will then remove the contaminated data and replace it with new data created by the most suitable interpolation method. Interpolation is a numerical analysis used to construct new data points based on a range of known data points. There are several methods of Interpolation and we will base our choice on the existing research and the needs of our lab.

The goal of our project is to create a preprocessing algorithm to remove artifacts and enable analysis of the existing TEP EEG data while maintaining the highest levels of correctness and continuity according to the existing data. The first milestone is developing an algorithm which marks the range of the main TMS pulse caused artifacts in order to remove and replace them. The algorithm will be based on the characteristics which were discovered through thorough research on the subject. We aim to find the most accurate indicators in order to mark the contaminated in the most precise time. The second milestone is constructing the missing data parts with the most suitable interpolation method. The interpolation method will be chosen to optimally fit the normal and expected brain activity during the experiment. We will then test the interpolation by trying to predict segments from real uncontaminated data from other experiments in the lab. After completing these two milestones, which are the core of our project, we will decide whether to adjust our product to handle more artifacts or making it more accessible and sharing it.

By solving this problem, we will enable the data analysis stage of this experiment, preprocess data from future experiments in this lab, and possibly contribute to other research using similar tools for similar purposes.