**Data**:

1. We mostly use the OS\_Basic dataset. It has folders named as numbers each representing a rat.
2. Rats: 1, 3, 4, 6, 9, 11, 13
3. The OS stands for **O**bject **S**pace task. This task is to study cumulative memory formation. Novel tasks are thought to be first stored in the Hippocampus and then over time integrated in the prefrontal cortex. NREM sleep has been shown to be very important for this.  
   [Object Space Task — Genzel Lab](https://www.genzellab.com/object-space-task-1)  
   Link to paper: <https://doi.org/10.1371/journal.pbio.3000322>
4. Each Rat folder has condition folders, we work with OR\_N folders. OR\_N stands for Overlapping Novelty.
5. We have 5 post-trials for each dataset. The fifth is usually longer than others. These folders have recordings for Hippocampus and Prefrontal Cortex and also the sleep states.

**Sleep Scoring values**: The scoring files are arrays of numbers

* 1 - Awake
* 2 - Intermediate
* 3 - Non-REM
* 4 - Intermediate
* 5 - REM

**Filtering Considerations**:

1. FIR filter vs IIR Filter
2. Delta band = (0.1, 4) Hz

**Steps**:

1. Load all 5 post-trials for a Rat-Condition-Region (like Rat-4 OR\_N PFC)
2. Z-scoring: Separately for each post-trial (hence each recording)
3. Filtering: Bandpass on 0.1-4 Hz, using FIR or IIR filter
4. Get IP, IF and IA using EMD
5. Extract cycles from IP using EMD
6. Define metrics on each cycle, this can be used to further filter the data
7. Select cycles with is\_good=True and get metrics dataframe (also includes cycle timings)
8. Using cycle timings and the sleep\_scoring data, define the sleep state value for each cycle
9. Align all cycles to 128 points as UMAP requires all data to be of same size. There are different methods for alignment
10. Add all the metrics and cycles to a single dataframe and save in an HDF5 file. We can filter the cycles according to any metric.
11. Get Intrinsic dimension, it is almost always 4
12. Get a 3D UMAP embedding with default parameter settings

**Metrics on cycles**:

1. Cycle duration: Length of cycles
2. Peak2trough ratio: P/(P+T) where P represents the time in the peak region and T the trough region. Hence this represents the fraction of the whole signal length at which the signal changes sign.
3. asc2desc ratio: A/(A+D) where A is the amount of time the signal is rising (before peak and after trough) and D is the time it is falling.
4. Amplitude of the cycle
5. Peak value
6. Trough Value
7. mean IF
8. max IF
9. range IF

EMD Library: [Empirical Mode Decomposition in Python — emd 0.0.1.dev127 documentation](https://emd.readthedocs.io/en/stable/)

UMAP Library: [UMAP: Uniform Manifold Approximation and Projection for Dimension Reduction — umap 0.5 documentation](https://umap-learn.readthedocs.io/en/latest/)