

PSYCH 5621 Intro to the ERP

Week 15: EEG Data Analysis based on Python

Guest Lecturer:

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PSYCH 5621

11/28/2023 TUESDAY

Python Pipeline of EEG Data Analysis

(preprocess -> ERP analysis -> time-frequency analysis;
single-subject analysis -> multiple-subject analysis)

11/30/2023 THURSDAY

Advanced EEG Data Analyses

(MVPA: classification-based decoding, representational similarity analysis;
Link between EEG and Deep Learning in cognitive neuroscience)

Python Pipeline of EEG Data Analysis

Why Python? (from ChatGPT)

- Open Source and Cost-Effective
- Rich Library Ecosystem
- Community Support and Development
- Integration with Machine Learning and AI
- Flexibility and Versatility
- Reproducibility and Collaboration
- Customization and Extensibility

Python Pipeline of EEG Data Analysis

Why Python? (Personal View)

- Newer packages

[HTML] [EEGLAB: an open source toolbox for analysis of single-trial EEG dynamics including independent component analysis](#)

[A Delorme](#), [S Makeig](#) - Journal of neuroscience methods, 2004 - Elsevier

We have developed a toolbox and graphic user interface, **EEGLAB**, running under the crossplatform MATLAB environment (The Mathworks, Inc.) for processing collections of single-trial ...

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FieldTrip: open source software for advanced analysis of MEG, EEG, and invasive electrophysiological data

[R Oostenveld](#), [P Fries](#), [E Maris](#)... - Computational ..., 2011 - dl.acm.org

... **FieldTrip** from other (publicly available) toolboxes as described elsewhere in this issue. We will first describe **FieldTrip** ... This paper ends with some concluding remarks on the **FieldTrip** ...

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[HTML] [PyMVPA: A python toolbox for multivariate pattern analysis of fMRI data](#)

[M Hanke](#), [YO Halchenko](#), [PB Sederberg](#), [SJ Hanson](#)... - Neuroinformatics, 2009 - Springer

... , and open-source software toolbox, called **PyMVPA**, for the application of classifier-based analysis techniques to fMRI datasets. **PyMVPA** makes use of Python's ability to access ...

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[HTML] [MEG and EEG data analysis with MNE-Python](#)

[A Gramfort](#), [M Luessi](#), [E Larson](#)... - Frontiers in ..., 2013 - frontiersin.org

... **EEG** data analysis pipelines by writing **Python** scripts. Moreover, MNE-**Python** is tightly integrated with the core **Python** ... as the greater neuroimaging ecosystem in **Python** via the Nibabel ...

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[HTML] [NeuroRA: a Python toolbox of representational analysis from multi-modal neural data](#)

[Z Lu](#), [Y Ku](#) - Frontiers in neuroinformatics, 2020 - frontiersin.org


... , **EEG**, MEG, fMRI, et al. and even different species. Our **toolbox** NeuroRA is developed based on **Python** ... threshold and output to a data format that could be opened in other **toolboxes**. ...






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Old MATLAB EEG Packages

New Python EEG Packages

Why Python? (Personal View)

- 
[Install](#)
[Documentation](#)
[API Reference](#)
[Get help](#)
[Development](#)

1.6

Section Navigation

 - Tutorials**
 - Introductory tutorials
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 - Design philosophy
 - Example datasets
 - Command-line tools
 - Migrating from other analysis software
 - The typical M/EEG workflow
 - How to cite MNE-Python

Tutorials

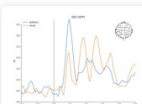
These tutorials provide narrative explanations, sample code, and expected output for the most common MNE-Python analysis tasks. The emphasis here is on thorough explanations that get you up to speed quickly, at the expense of covering only a limited number of topics. The sections and tutorials are arranged in a fixed order, so in theory a new user should be able to progress through in order without encountering any cases where background knowledge is assumed and unexplained. More experienced users (i.e., those with significant experience analyzing EEG/MEG signals with different software) can probably skip around to just the topics they need without too much trouble.

Note

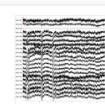
If tutorial-scripts contain plots and are run locally, using the interactive flag with `python -i tutorial_script.py` keeps them open.

Introductory tutorials


These tutorials cover the basic EEG/MEG pipeline for event-related analysis, introduce the [mne.Info](#), [events](#), and [mne.Annotations](#) data structures, discuss how sensor locations are handled, and introduce some of the configuration options available.



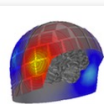
Overview of MEG/EEG analysis with MNE-Python



Modifying data in-place



Parsing events from raw data

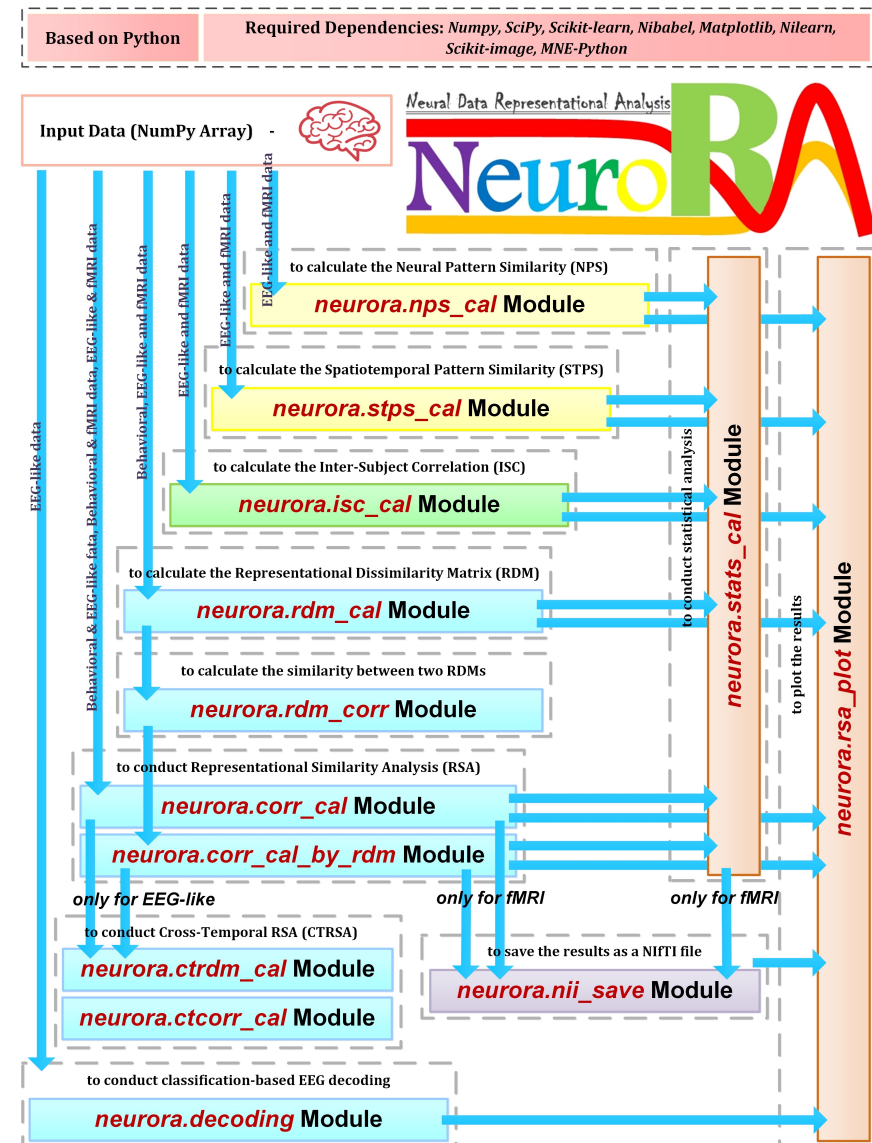


The Info data structure

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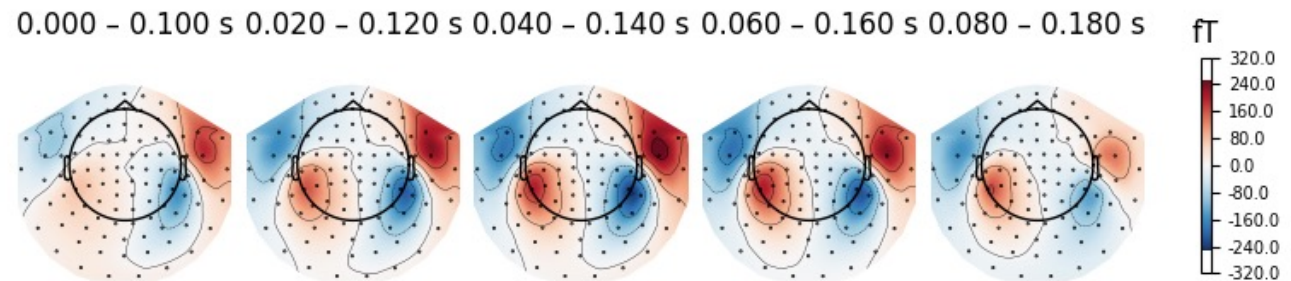
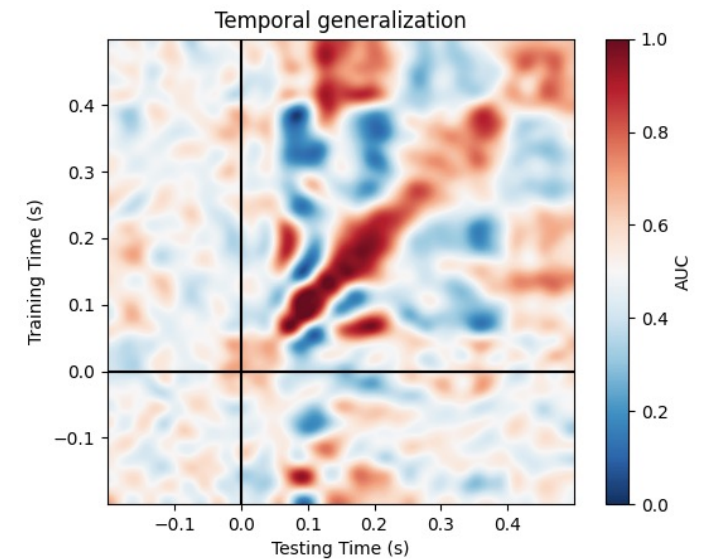
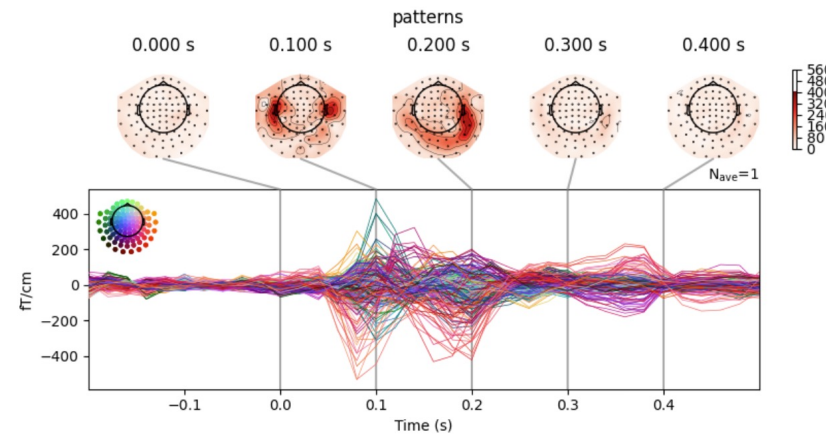
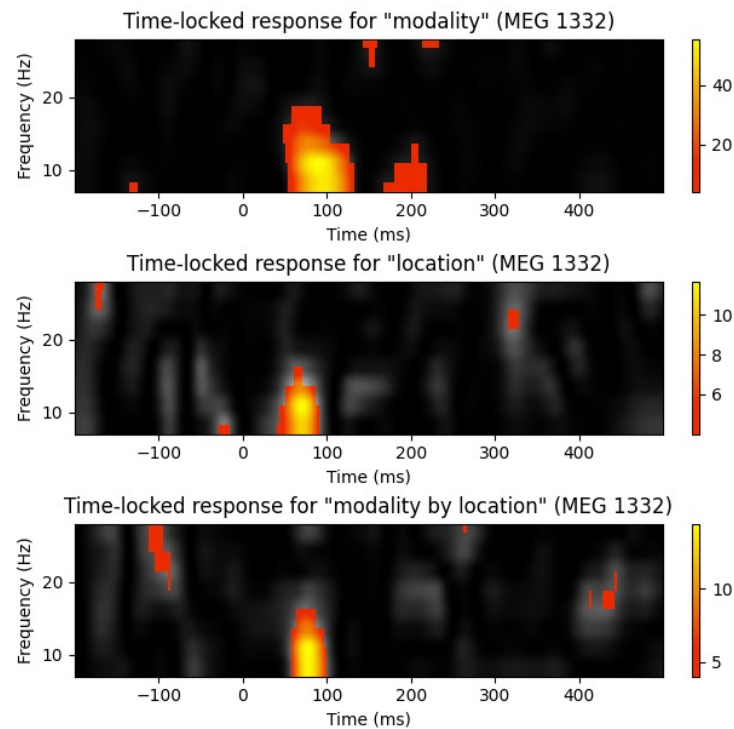
[Edit on GitHub](#)



Python Pipeline of EEG Data Analysis

Why Python? (Personal View)

- Easier to plot nice figures



GOAL of today's class

Everyone can learn to use Python to do EEG data analysis, from loading the data to plotting the results.

Tutorial:

<https://github.com/ZitongLu1996/Python-EEG-Handbook>

Resources

EEGlab tutorial:

<https://eeglab.org/tutorials/>

MNE tutorial:

https://mne.tools/stable/auto_tutorials/index.html

Recognize ICAs:

<https://labeling.ucsd.edu/tutorial/labels>

Q&A

Any question about the final project?