

Machine Learning Methods for Neural Data Analysis

Poisson processes

Final project

- **Monday, Feb 27:** Project proposal (1pg).
 - Groups (2-3 people)
 - Project goals
 - Dataset(s)
- **Thursday, March 2:** Lab 6 (last graded lab) due.
- **Friday, March 3 and 10:** Work on Labs 7 and 8 in class — optionally finish for extra credit.
- **Friday, March 17:** In-class presentations (11:20-1:20pm, lunch provided)
- **Friday, March 24:** Final report due (12pm)

Types of final projects

- The final project is an opportunity to **apply what you've learned** to a **problem of interest** to you.
- For example, you could:
 - **Implement a method** from a recent research paper and recapitulate its results on synthetic data.
 - **Use a method** from class to study a scientific question of interest.
 - **Adapt a method** from class and apply it to a novel dataset.
 - **Propose and implement an extension** to an existing method that would address some of its limitations.
- Your project must involve some coding. Ideally more than just applying code from lab to a new dataset.

Datasets

- NeuroMatch Academy has curated some **large-scale neural and behavioral datasets**:
 - <https://compneuro.neuromatch.io/projects/neurons/README.html>
 - <https://compneuro.neuromatch.io/projects/behavior/README.html>
- We've also created many **project templates** that could spark ideas:
 - https://compneuro.neuromatch.io/projects/docs/project_templates.html
- Many (most?) modern neuroscience papers also release subsets of their data.

Thought experiment

Poisson processes

Sampling a Poisson process

Interval distribution

Poisson process likelihood

Limit of the discrete time model

Renewal processes

Conditional intensity function

Hawkes processes

Multivariate Hawkes processes

Maximum likelihood estimation

Poisson superposition and thinning

Hawkes processes as cascades of Poisson processes

Nonlinear Hawkes processes