Berkeley summer course in mining and modeling neuroscience data

July 9-20, 2018
Redwood Center for Theoretical Neuroscience, UC Berkeley
Organizers: Fritz Sommer, Bruno Olshausen &
Jeff Teeters (HWNI, UC Berkeley)

Scope
This course is for students and researchers with backgrounds in mathematics and computational sciences who are interested in applying their skills toward problems in neuroscience. It will introduce the major open questions of neuroscience and teach state-of–the-art techniques for analyzing and modeling neuroscience data sets. The course is designed for students at the graduate level and researchers with background in a quantitative field such as engineering, mathematics, physics or computer science who may or may not have a specific neuroscience background. The goal of this summer course is to help researchers find new exciting research areas and at the same time to strengthen quantitative expertise in the field of neuroscience. The course is sponsored by the National Institute of Health, the National Science Foundation from a grant supporting activities at the data sharing repository CRCNS.org, and the Helen Wills Neuroscience Institute at UC Berkeley.

Format
The course is "hands on" in that it will include exercises in how to use and modify existing software tools and apply them to data sets, such as those available in the CRCNS.org repository.

Course Instructors

Robert Kass, Carnegie Mellon University, Pittsburgh
Sonja Grün, Juelich Research Center, Germany
Frederic Theunissen, University of California Berkeley
Odelia Schwartz, University of Miami
Stephanie Palmer, University of Chicago
Maneesh Sahani, Gatsby Unit, University College London

Course Moderators

Fritz Sommer and Jeff Teeters, Redwood Center for Theoretical Neuroscience.

Speakers
To complement the main course instruction there will be lectures in the evenings by local Berkeley and UCSF neuroscientists presenting their research using quantitative approaches.

Requirements
Applicants should be familiar with linear algebra, probability, differential and integral calculus and have some experience using MatLab and Python. Each student must bring a laptop with both MatLab and Python installed.

Cost
There is no cost to attend. Non-local attendees will be reimbursed for economy travel expenses (up to a maximum of $500 domestic and $600 foreign) and will have most meals provided.

Housing
Rooms in the University dorms will be provided for those non-local attendees who need accommodations. Most dorm rooms are double occupancy (shared).

Food
Almost all meals will be provided to non-local attendees and some meals will be provided to local attendees.

How to apply
To apply, submit the online form linked from: http://crcns.org/course. A curriculum vitae and a letter of recommendation are required. The course is limited to 25 students.

Deadlines
Applications must be received by **April 20**. Notifications of acceptance will be given by May 15.

Questions
Questions about the course can be sent to course [at] crcns.org.

Topics covered (subject to change):
Basic approaches:
- The problem of neural coding
- Population coding
- Spike trains, firing rate, point processes, and generalized linear models
- Statistical thinking in neuroscience
- Overview of stimulus-response function models
- Theory of model fitting / regularization / hypothesis testing
- Bayesian methods
- Spike sorting
- Estimation of stimulus-response functionals: regression methods, spike-triggered covariance
- Variance analysis of neural response
- Estimation of SNR. Coherence

Information theoretic approaches:
- Information transmission rates
- Scene statistics approaches and neural modeling

Techniques for analyzing multiple-channel recordings:
- Unitary event analysis
- Proper surrogates for spike synchrony analysis
- Sparse coding/ICA methods, vanilla and methods including statistical models of nonlinear dependencies
- Deep learning and supervised learning
- Methods for assessing functional connectivity
- Generalized Linear Models
- Multivariate phase coupling
- Statistical issues in network identification
- Low-dimensional latent dynamical structure in network activity – Gaussian process factor analysis and newer approaches
- Extracting population responses to experimental inputs - LDA, DPCA and other low-rank regression