Marine Biological Laboratory
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2002 MBL Special Topics Course

Methods in Computational Neuroscience

August 4 - September 1, 2002

Animals interact with a complex world, encountering a wide variety of challenges: they must gather data about the environment, discover useful structures in these data, store and recall information about past events, plan and guide actions, learn the consequences of these actions, etc. These are, in part, computational problems that are solved by networks of neurons, from roughly 100 cells in a small worm to 100 billion in humans. Careful study of the natural context for these tasks leads to new mathematical formulations of the problems that brains are solving, and these theoretical approaches in turn suggest new experiments to characterize neurons and networks. This interplay between theory and experiment is the central theme of this course.

In each of the first three weeks, the course will focus on a distinct question: Can we measure the quality of the brain's solutions to the complex computational problems that arise in the natural environment? Can these problems be decomposed into manageable pieces, and can we relate such mathematical decompositions to the observable properties of individual neurons and circuits? Can we identify the molecular mechanisms that provide the building blocks for these computations, and understand how these building blocks are organized into cells and circuits that perform useful functions?

Core presentations at the start of each week will be given jointly by theorists and experimentalists who have worked, often together, on the same problems. As each week progresses, the issues brought up in these presentations will be illustrated by laboratory demonstrations; tutorials will fill in background material; and seminars will provide a sampling of work on closely related problems. The final, and crucial, component of each week's activities is a set of exercises that begin with raw experimental data and invite the students to follow and generalize the paths outlined in the lectures. These exercises will involve both quantitative analysis of the data and exploration of models through analytic and numerical techniques. To reinforce the theme of collaboration between theory and experiment, exercises will be done by teams of students that combine theoretical and experimental backgrounds.

The fourth week of the course is reserved for student projects. These projects provide the opportunity to work closely with the resident faculty, to develop ideas that grew out of the lectures and seminars, and to connect these ideas with problems from the students' own research topics.

This course is appropriate for graduate students, postdocs and faculty in a variety of fields, from zoology and ethology to physics and mathematics. Students are expected to have a strong background in one discipline, and to have made some effort to introduce themselves to a complementary discipline. The course is limited to 24 students, who will be chosen to balance the representation of theoretical and experimental backgrounds.

Application Deadline:
March 7, 2002

Admission to MBL courses is competitive; student selection is determine by review committees appointed for each individual course. Women and minorities are encouraged to apply.

All Inclusive Course Fee:
$1,850
Room & board provided at no additional charge.

Financial Aid:
Financial assistance is available to admitted students, including non-U.S. citizens. Financial aid requests are not a factor in admissions decisions.

For application forms and information, contact:
Carol Hamel, Admissions Coordinator
(508) 289-7401
admissions@mbl.edu
OR
Visit our web-site:
http://courses.mbl.edu

The MBL is an EEO/Affirmative Action Institution.

Course Directors:
William Bialek, *Princeton University;*
and Rob de Ruyter van Steveninck,
NEC Research Institute

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