Computational Neuroscience

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Computational neuroscience is a relatively new interdisciplinary area of inquiry that is concerned with how components of animal and human nervous systems interact to produce behaviors. It relies on quantitative and modeling approaches to understand the function of the nervous system and to design human-made devices that duplicate behaviors. Course work in computational neuroscience can prepare students for graduate studies in neurobiology or psychology, or in the mathematical or engineering sciences. It can lead to either traditional academic careers or to opportunities in the corporate world.

An undergraduate degree in computational neuroscience is not available at the University of Chicago, but students concentrating in biological sciences, computer science, mathematics, physics, psychology, or statistics can easily fashion an organized course of study in computational neuroscience by selecting appropriate general education courses and general education electives.

For updated information on Computational Neuroscience activities and programs, see *cns.bsd.uchicago.edu.*

Suggested General Education Courses:

Students concentrating in biological science should elect either the BIOS 20180s or 20190s sequence.
MATH 15100-15200. Calculus I, II or MATH 16100-16200. Honors Calculus I, II
SOSC 14100-14200-14300. Mind I, II, III

Suggested Electives:

BIOS 24204. Cellular Neurobiology
BIOS 24205. Systems Neuroscience
BIOS 24211. Neuroethology
BIOS 24214. Cognitive Neuroscience
BIOS 24221-24222-24223. Computational Neuroscience I, II, III
BIOS 29405-29406-29407. Mathematical and Statistical Methods for Neuroscience, I, II, III
PSYC 20700. Experimental Approaches to Systems Neurobiology
PSYC 25600. Introduction to Cognitive Psychology
PSYC 28000. Sensation and Perception
PSYC 28300. Attention

Faculty associated with this interdisciplinary area participate in a three-quarter sequence in computational neuroscience, teach upper-level courses relevant to computational neuroscience, and participate in an ongoing Computational Neuroscience Seminar series.

Faculty

Y. Amit, B. Bertenthal, D. Bradley, Z. Chi, J. Cowan, J. Ebersole, J. Goldsmith, D. Hanck, N. Hatsopoulos, K. Hecox, L. Kay, V. Maljkovic, D. Margoliash, M. McClintock, J. Milton, P. Niyogi, H. Nusbaum, J. Pokorny, J. Ramirez, T. Regier, S. Shevell, S. Small, V. Smith-Pokorny, J.-P. Spire, V. L. Towle, P. Ulinski

Courses

Computational Neuroscience Sequence

BIOS 24221. Computational Neuroscience I: Single Neuron Computation. (=ORGB 34400) *PQ: Prior course in cellular neurobiology or consent of instructor required; prior or concurrent registration in MATH 20000 recommended. P. Ulinski, Staff. Autumn. L.*

BIOS 24222. Computational Neuroscience II: Vision. (=ORGB 34500, PSYC 32400) *PQ: BIOS 28700 and a prior course in systems neurobiology, or consent of instructor required; prior or concurrent registration in MATH 20100 recommended. P. Ulinski, Staff. Winter. L.*

BIOS 24223. Computational Neuroscience III: Language. (=ORGB 34600, PSYC 34400) *PQ: Consent of instructor. T. Regier, Staff. Spring.*

Courses in Cell and Molecular Neurobiology

BIOS 24204. Cellular Neurobiology. *PQ: Completion of the general education requirement for the biological sciences. Prior physics course recommended. D. Hanck, P. Lloyd. Spring. L.*

BIOS 24236. Cellular Neurobiology. *PQ: Completion of the general education requirement for the biological sciences. Prior physics course recommended. D. Hanck, P. Lloyd. Spring.*

NPHP 31800. Cellular Neurobiology. This course is concerned with the structure and function of the nervous system at the cellular level. The cellular and subcellular components of neurons and their basic membrane and electrophysiological properties are described. Cellular and molecular aspects of interactions between neurons are studied. This leads to functional analyses of the mechanisms involved in the generation and modulation of behavior in selected model systems. *P. Lloyd. Autumn.*

NPHP 32300. Molecular Neurobiology. This course is devoted to the examination of current research in the molecular biology of the nervous system. We explore the structure and function of macromolecules that control, propagate, and elicit neural signaling. Topics include: (1) structural elements of neurons and glia, (2) structure and function of the synapse, (3) aspects of the molecular basis of neural signaling, and (4) gene expression in neural systems. Lectures draw on journal literature to present a state-of-the-art background of the topic and the current questions being explored, as well as problems and aspects. *W. Green, D. McGehee, K. Houamed. Spring.*

Courses in Systems and Cognitive Neurobiology

BIOS 24205. Systems Neuroscience. *PQ: BIOS 24236 or 24204, or consent of instructor. J. Ramirez, J. Goldberg. Autumn. L.*

BIOS 24211. Neuroethology. (=PSYC 31500) *PQ: BIOS 24204 or consent of instructor. Prior or concurrent registration in PHYS 14200. Prior knowledge of basic cellular mechanisms of neurons and basic anatomy of the vertebrate central nervous system. Labs meet once a week and may require time beyond the posted schedule. D. Margoliash. Winter. L.*

BIOS 24214. Cognitive Neuroscience. (=CPNS 3002) *PQ: One year of college-level calculus and a course in systems neuroscience. N. Hatsopoulos. Spring. L.*

NPHP 31500. Mammalian Neuroanatomy. This is a lab-centered course that teaches students the basic anatomy of the mammalian CNS and PNS. This course is coordinated with NURB 31600. Students learn the major structures present at each level of the neuraxis and to recognize them in rodents, cats, and primates. Somatosensory, visual, auditory, vestibular, and olfactory sensory systems are presented in more depth. For each of these sensory systems, as well as for the motor system, the nuclear organization and cellular architecture of selected regions is discussed. *P. Mason, R. McCrea. Autumn. L.*

NPHP 31600. Neurophysiology. This is a seminar course that teaches students the basic physiology of the mammalian CNS and PNS. Students study the physiology that is associated with the sensory and motor systems studied in NPHP 31500. In addition to reading review chapters, students read classic original articles. *P. Mason, R. McCrea. Winter.*

Courses in Psychophysics and Cognitive Science

PSYC 25600. Introduction to Cognitive Psychology. (=EDUC 25600/35600) *V. Maljkovic. Winter.*

PSYC 28000. Sensation and Perception. (=BPSY 28000) *D. Bradley. Winter.*

PSYC 28300/38300. Attention. (=BPSY 28300) *V. Maljkovic, H. Nusbaum. Winter.*

PSYC 32600. Speech Perception. *H. Nusbaum. Spring.*

PSYC 38500. Cognitive Neuropsychology. (=BPSY 38300) *H. Nusbaum. Winter.*

PSYC 38700. Connectionist Modeling: Techniques. *PQ: Knowledge of programming, basic calculus, and linear algebra helpful. T. Regier. Winter.*

Courses in Mathematics

BIOS 29405. Mathematical and Statistical Methods for Neuroscience I.
(=CPNS 30020) *J. Foss. Autumn. L.*

BIOS 29406. Mathematical and Statistical Methods for Neuroscience II.
(=CPNS 30021) *Y. Amit. Winter.*

BIOS 29407. Mathematical and Statistical Methods of Neuroscience III.
(=CPNS 30022) *Spring. L.*