

## Introduction to Computational Neuroscience

Winter Term 2014  
Course Syllabus

Place and time: Room BT-100 (MNI), Wednesdays 13:00-16:00  
Coordinator: Christopher Pack, Ph.D.  
Neurology & Neurosurgery  
Email: christopher.pack@mcgill.ca  
Office hours: by appointment  
Instructors: Curtis Baker, Maurice Chacron, Paul Cisek, Erik Cook, Kathy Cullen, Dan Guitton, Patrick Mineault, Christopher Pack, Amir Shmuel, Jesper Sjostrom, Theo Zanos  
Teaching Assistant: Dave Liu (liu.liu2@mail.mcgill.ca)

**OBJECTIVES:** This course will present an introduction to computational neuroscience. Levels of analysis will span the range from dendrites and synapses to networks of neurons, with a particular focus on single-neuron models of sensory processing and motor control. Students will learn how to model the relationship between sensory stimuli and neuron activity, and between neuronal activity and behavior. These models will be introduced by the instructor in each lecture, and students will simulate the models during in-class programming labs. Basic mathematical concepts will be presented during tutorial sessions, and more advanced concepts will be covered during lectures.

**ORGANIZATION:** Each class will last three hours. The first part will be a formal lecture introducing an experimental observation along with a modeling framework. During the second part of the class, students will develop and/or modify Matlab code to perform simulations of the model under discussion. The last class will be devoted to presentation of students' final projects.

**TEXT:** *Theoretical Neuroscience* by P. Dayan and L. Abbott (MIT Press, 2001).

**PREREQUISITES:** Calculus, Linear Algebra, Differential Equations.

**GRADING:** 50% weekly homework assignments, 50% final project.

DATE	THEME	INFORMATION
8 Jan 2014	Dr. Paul Cisek: <i>Models of decision-making</i>	<b>Reading:</b> Gold and Shadlen (2007)
15 Jan 2014	Dr. Erik Cook: <i>Neural Decoding</i>	<b>Reading:</b> Chapter 3 of D & A

22 Jan 2014	Dr. Chris Pack: <i>Reverse Correlation and Visual Receptive Fields</i>	<b>Reading:</b> Chapter 2 of D & A
29 Jan 2014	Dr. Curtis Baker: <i>Supervised Learning in Neural Networks</i>	<b>Reading:</b> MacKay Chapters
5 Feb 2014	Patrick Mineault: <i>Generalized Linear Models</i>	<b>Reading:</b> Paninski, Pillow, Lewi (2006)
12 Feb 2014	Dr. Jesper Sjostrom: <i>Unsupervised Learning in Neural Networks</i>	<b>Reading:</b> Song, Miller, and Abbott (2000)
19 Feb 2014	Dr. Dan Guitton: <i>Models of the Oculomotor Plant</i>	<b>Reading:</b> Robinson (1964)
26 Feb 2014	Dr. Kathy Cullen: <i>Control systems/vestibular</i>	<b>Reading:</b> Goldberg et al. (2012)
5 Mar 2014	NO CLASS – study week	
12 Mar 2014	Dr. Erik Cook: <i>Model Neurons: Neuroelectronics</i>	<b>Reading:</b> Chapter 5 of D & A <b><u>Term paper proposals due</u></b>
19 Mar 2014	Dr. Maurice Chacron: <i>Neural Encoding</i>	<b>Reading:</b> Chapter 1 of D & A
26 Mar 2014	Dr. Theodoros Zanos <i>Oscillations</i>	
2 Apr 2014	Dr. Amir Shmuel: <i>Models of large-scale networks</i>	<b>Reading:</b> Sporns & Zwi (2004) <b>Assignment:</b> Class discussion – participation required.
9 Apr 2014	Student presentations	

McGill University values academic integrity. Therefore all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see <http://www.mcgill.ca/integrity/> for more information).

In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.