McGill University, Department of Neurology & Neurosurgery

NEUR 531-603

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.

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| DATE | THEME | INFORMATION |
| 8 Jan 2014 | Dr. Paul Cisek:  *Models of decision-making* | **Reading:** Gold and Shadlen (2007) |
| 15 Jan 2014 | Dr. Erik Cook:  *Neural Decoding* | **Reading:** Chapter 3 of D & A |
| 22 Jan 2014 | Dr. Chris Pack: *Reverse Correlation and Visual Receptive Fields* | **Reading:** Chapter 2 of D & A |
| 29 Jan 2014 | Dr. Curtis Baker: *Supervised Learning in Neural Networks* | **Reading:** MacKay Chapters |
| 5 Feb 2014 | Patrick Mineault: *Generalized Linear Models* | **Reading:** Paninski, Pillow, Lewi (2006) |
| 12 Feb 2014 | Dr. Jesper Sjostrom: *Unsupervised Learning in Neural Networks* | **Reading**: Song, Miller, and Abbott (2000) |
| 19 Feb 2014 | Dr. Dan Guitton:  *Models of the Oculomotor Plant* | **Reading:** Robinson (1964) |
| 26 Feb 2014 | Dr. Kathy Cullen: *Control systems/vestibular* | **Reading:** Goldberg et al. (2012) |
| 5 Mar 2014 | NO CLASS – study week |  |
| 12 Mar 2014 | Dr. Erik Cook:  *Model Neurons: Neuroelectronics* | **Reading:** Chapter 5 of D & A  ***Term paper proposals due*** |
| 19 Mar  2014 | Dr. Maurice Chacron: *Neural Encoding* | **Reading:** Chapter 1 of D & A |
| 26 Mar 2014 | Dr. Theodoros Zanos*Oscillations* |  |
| 2 Apr 2014 | Dr. Amir Shmuel: *Models of large-scale networks* | **Reading:** Sporns & Zwi (2004)  **Assignment:** 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.*