Location: Robinson 105 (FAS)

Meeting Time: Monday 19:00-20:29

Course Description:
Vision is arguably our most dominant and most important sense. The visual system processes vast amounts of data continuously, and it can identify relevant objects in our complex environment faster and more accurately than any artificial system. Yet, as recently as 2012, a revolution in computer vision has begun to allow computers to approach human level performance, in some cases even outperforming humans. What led to this improvement? Deep neural networks: several neural networks stacked on top of each other. These networks have some striking similarities to circuits of the human visual system, and by studying them, we can learn about how our brainsâ€™ own circuits function. In this class, we will learn both the fundamentals of the visual system circuitry (from retina to the visual cortex) as well as the structure and logic of neural network algorithms. In doing so, we will learn how artificial and natural networks can parse and recognize objects, detect direction and speed of motion, and modulate attention. We will be studying neural networks conceptually, so no prerequisites in math or computer science are needed.

Instructor:

Till S. Hartmann, Ph. D.

Harvard Medical School - Department of Neurobiology

220 Longwood Avenue

Warren Alpert Building room 218

Boston, MA 02115

+1 (551) 208 â€“ 7652

till@hms.harvard.edu

Prerequisites:

The prerequisites for this tutorship are Life Sciences 1a, Molecular and Cellular Biology 80 or 81, and permission of the instructor. While the occasional equation will pop up, there are no prerequisites for mathematics or computer science. To complete the programming assignments, you will need to use MATLAB. If you are new to programming, I recommend you attend the MATLAB Bootcamp (Sept. 1-5; various times, Advanced registration is required).

Course Goals:

The main goal of this course is both to gain a basic understanding of the visual system as well as learn how â€œscience worksâ€. We will achieve this goal through a combination of lectures taught by the instructor, having the students read and discuss scientific articles, and program aspects of neural networks in MATLAB. The articles will all focus on the visual system, but will also explore overlap with deep neural networks. At the end of the year, you should come away with a strong understanding of visual system function. You will also gain some intuitions on how a deep neural network works. The coding aspect of the class will give you a better understanding of the mechanisms behind it.

Format:

During class, we will discuss papers introducing key concepts and discuss their implementation into software code. The papers will be presented by one to two students. Additionally, the instructor will introduce the articles for the next week and provide background information.

Attendance policy:

Weekly attendance is required. Two unexcused absences throughout the year will result in the drop of a whole letter grade. Absences will only be excused if 1) you contact us in advance of the absence; and 2) you complete an additional assignment that we agree upon in lieu of your participation in that class.

Grading:

20% Discussion/class participation (every class)

20% Quizzes before class

20% Coding assignments

20% Writing assignment

20% Paper presentation

Work Expectations:

In this small setting, students are required to actively participate. Participation involves not only asking questions about the topic, but also commenting on experiments, methods, and discussion of hypotheses. It is therefore crucial to read the assigned material and complete the coding exercises. The class preparation should take 2-4 hours per week outside class to work through the assigned reading or perform the coding.

Students have the choice whether they want to present once per semester by themselves, or whether they want to team up with another student and present twice. The presenters will lead the discussion of the paper, but the whole class should be continuously engaged. Guidelines for the presenter will be provided in class.

In each semester, the students will write one review of one of the research articles the present. If a student chooses to present with a classmate twice, each student has to write a review about one of the different articles. A one-page summary is due four days before the presentation in class. The final review (2-3 pages) is due seven days after the presentation.

All Harvard College policies regarding plagiarism apply. In class, I will provide students with guidelines about how to incorporate citations into scientific writing. Please read and follow them carefully. If you have any questions about the correct use of materials that are not your own (e.g., images, data, ideas, theories, etc.), please contact me

Course Summary below is subject to change