Biological and Artificial Intelligence
Neuro 140
Harvard College/Graduate School of Arts and Sciences: 207645
Spring 2021

Overview
Class website
Location
Meeting times
First class
Contact information and office hours
Prerequisites
Topics
Suggested books
Projects
Grading
Schedule

Overview

This course provides a foundational overview of the fundamental ideas in computational neuroscience and the study of Biological Intelligence. At the same time, the course will connect the study of brains to the blossoming and rapid development of ideas in Artificial Intelligence. Topics covered include the biophysics of computation, neural networks, machine learning, Bayesian models, theory of learning, deep convolutional networks, generative adversarial networks, neural coding, control and dynamics of neural activity, applications to brain-machine interfaces, connectomics, among others. Lectures will be taught by leading Harvard experts in the field.
Lectures presented by: **Ba, Barbu, Drugowitsch, Gershman, Janson, Kreiman, Mahadevan, Mathis, Oliva, Pehlevan, Serre, Sompolinsky, Ullman**

Class website

http://klab.tch.harvard.edu/academia/classes/BAI/bai.html

https://canvas.harvard.edu/courses/84784 (login required)

Lecture notes, slides, reading assignments, and other information will be posted in the class web site.

Location: Zoom Online Meeting

Meeting Times
Tuesdays: 3:00 pm to 5:00 pm

FIRST CLASS = January 26, 2021

Contact information and office hours

Main faculty: Gabriel Kreiman
gabriel.kreiman@tch.harvard.edu
3 Blackfan Circle, CLS 18047. Boston, MA 02115
Office hours:
https://calendar.x.ai/gabrielkreiman/virtual

Teaching assistants:

Spandan Madan
spandan_madan@g.harvard.edu

Colin Conwell
colinconwell@gmail.com

Prerequisites:
Recommended:
Math (Maa/Mab, Math1A,1B, Math19a or equivalent).
Physical Sciences 1.
Life Sciences 1a (or Life and Physical Sciences A)
Life Sciences 1b. [or equivalent]
MCB80
CS50

Topics:

- Introduction to artificial intelligence
- Introduction to computational neuroscience
- Machine learning
- Reinforcement learning
- Visual recognition
- Computer vision
- Deep convolutional networks
- Neural networks
- Neural coding
- Learning and memory
- Animal intelligence
- Collective intelligence

Suggested books

There won't be an official book for the class. Here are some interesting books that touch upon some of the topics covered in class. The class will not follow any of these books.

- Kreiman G. Biological and Computer Vision (2021). Cambridge University Press.
- Ullman S (1996) High-level vision. MIT Press.
- Wandell BA (1995) Foundations of vision. Sunderland Sinauer Associates.
- Chalupa LM and Werner JS (editors) (2003). The Visual Neurosciences. MIT Press.
- Ripley. Pattern recognition and neural networks (1996). Cambridge University Press.
- Rao, Olshausen and Lewicki (eds) (2002). Probabilistic models of the brain. MIT Press.
- Koch C (2005) The quest for consciousness. Roberts & Company Publishers.
- Dayan and Abbott (2002). Theoretical Neuroscience. MIT Press.
- Horn BKP. (1986) Robot Vision. MIT Press.
- Kriegeskorte N and Kreiman G. (2011) Understanding visual population codes. MIT Press.
- Davies ER. (2005). Machine Vision, Third Edition: Theory, Algorithms, Practicalities (Signal Processing and its Applications). Elsevier.
- Sutton RS, Barto AG. (2018) Reinforcement Learning: An Introduction. MIT Press.
- Vapnik, V. (1998). The Nature of Statistical Learning Theory. Springer.
- Tegmark, M (2017) Life 3.0: Being Human in the Age of Artificial Intelligence. Random House.
- Poole D, Mackworth, A. (2017) Artificial Intelligence: foundations of computational agents, 2nd edition, Cambridge University Press.
- Poggio TA, Anselmi F. Visual Cortex and Deep Networks (2016). MIT Press

Projects

A highlight of the course will be hands-on direct exposure to projects in the field:

- A list of projects will be provided the first week
- Students have to choose one and only one project
- With approval from the TA and Faculty, students can propose a variation of one of the proposed projects or a project of their own.
- Students work on their projects throughout the course. There will be office hours and consultation with the TAs via email request
- Approximately half-way through the course (see schedule), students must give a short presentation of their ongoing work with the project.
- At the end of the course (see schedule), students must hand-in a final report on their project.
- At the end of the course (see schedule), students must give a final presentation of their project.

Grading

Final grades will be computed as follows:

Deliverable 1:	5%
Deliverable 2:	5%
Midterm project proposal:	20%
Deliverable 4:	5%
Final project report:	65%

Schedule

Schedule posted on class web site