

Computational Neuroscience

Larry Abbott, Ken Miller, Ashok Litwin Kumar, Stefano Fusi,

TAs: Denis Turcu, Elom Amematsro, Ramin Khajeh, Matteo Alleman

Meetings: Tuesdays 2:00-3:30 & Thursdays 1:30-3:00

Text - Theoretical Neuroscience by P. Dayan and L.F. Abbott (MIT Press)

Webpage - <https://ctn.zuckermaninstitute.columbia.edu/courses>

January

- 12 (Larry) Introduction to the Course and to Theoretical Neuroscience
- 14 (Larry) Electrical Properties of Neurons, Integrate-and-Fire Model
- 19 (Larry) Adaptation, Synapses, Spiking Networks (Assignment 1)
- 21 (Larry) Numerical Methods, Filtering
- 26 (Larry) The Hodgkin-Huxley Model (Assignment 2)
- 27 Assignment 1 Due
- 28 (Larry) Types of Neuron Models and Networks (Assignment 3)

February

- 2 (Ken) Linear Algebra I
- 3 Assignment 2 Due
- 4 (Ken) Linear Algebra II
- 9 (Ken) PCA and Dimensionality Reduction (Assignment 4)
- 10 Assignment 3 Due
- 11 (Ken) Rate Networks/E-I networks I
- 16 (Ken) Rate Networks/E-I networks II (Assignment 5)
- 17 Assignment 4 Due
- 18 (Ken) Unsupervised/Hebbian Learning, Developmental Models
- 23 (Ashok) Introduction to Probability, Encoding, Decoding (Assignment 6)
- 24 Assignment 5 Due
- 25 (Sean) GLMs

March

- 2 Spring Break
- 4 Spring Break
- 9 (Ashok) Decoding, Fisher Information I
- 10 Assignment 6 Due
- 11 (Ashok) Decoding, Fisher Information II
- 16 (Ashok) Information Theory (Assignment 7)
- 18 (Ashok) – Optimization
- 23 (Ashok) – Optimization II (Assignment 8)
- 24 Assignment 7 Due
- 25 (Stefano) Perceptron
- 30 (Stefano) Multilayer Perceptrons and Mixed Selectivity (Assignment 9)
- 31 Assignment 8 Due

April

- 1 (Stefano) – Deep Learning I (backpropagation)
- 6 (Stefano) – Deep Learning II (convolutional networks) (Assignment 10)
- 7 Assignment 9 Due
- 8 (Stefano) Learning in Recurrent Networks

- 13 (Stefano) Continual Learning and Catastrophic Forgetting (Assignment 11)
- 14 Assignment 10 Due
- 15 (Stefano) Reinforcement Learning
- 21 Assignment 11 Due