

## **Computational Neuroscience**

**Larry Abbott, Ken Miller, Ashok Litwin Kumar, Stefano Fusi, Sean Escola**

**TAs:** Ho Yin Chau, Elom Amematsro, David Clark, Zhenrui Liao

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

**Location:** Green Science Center, Fifth Floor, Rm L5.084

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

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

### **September**

- 6 (Larry) Introduction to Course and to Computational Neuroscience
- 8 (Larry) Electrical Properties of Neurons, Integrate-and-Fire Model
- 13 (Larry) Numerical Methods, Filtering (Assignment 1)
- 15 (Larry) The Hodgkin-Huxley Model
- 20 (Larry) Types of Neuron Models and Networks (Assignment 2)
- 21 Assignment 1 Due
- 22 (Stefano) Adaptation, Synapses, Synaptic Plasticity
- 27 (Sean) Generalized Linear Models

### **October**

- 28 Assignment 2 Due
- 29 (Ken) Linear Algebra I (Assignment 3)
- 4 (Ken) Linear Algebra II
- 6 (Ken) PCA and Dimensionality Reduction
- 11 (Ken) Rate Networks/E-I networks I (Assignment 4)
- 12 Assignment 3 Due
- 13 (Ken) Rate Networks/E-I networks II
- 18 (Ken) Unsupervised/Hebbian Learning, Developmental Models (Assignment 5)
- 19 Assignment 4 Due
- 20 (Ashok) Introduction to Probability, Encoding, Decoding
- 25 (Ashok) Decoding, Fisher Information I
- 26 Assignment 5 Due
- 27 (Ashok) Decoding, Fisher Information II (Assignment 6)

### **November**

- 1 (Ashok) Information Theory
- 3 (Ashok) Optimization I (Assignment 7)
- 8 Holiday
- 9 Assignment 6 Due
- 10 (Ashok) Optimization II
- 15 (Stefano) The Perceptron (Assignment 8)
- 16 Assignment 7 Due
- 17 (Stefano) Multilayer Perceptrons and Mixed Selectivity
- 22 (Stefano) Deep Learning (Assignment 9)
- 23 Assignment 8 Due
- 24 Holiday
- 29 (Sean) Learning in Recurrent Networks

### **December**

- 1 (Stefano) Continual Learning and Catastrophic Forgetting

- 6 (Stefano) Reinforcement Learning (Assignment 10)
- 7 Assignment 9 Due
- 8 (Larry) Course Wrapup
- 14 Assignment 10 Due