Unit #8 (March 21 & 26), Modeling neural circuits

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In Wednesday’s lecture, we will start by discussing goals and uses of computational modeling and theoretical neuroscience. We emphasize that theory and modeling can well accompany and synergize with experimental approaches. We will give an overview of different scales in modeling and the advantages and disadvantages of different approaches to computational modeling. We end with specific examples of computational models in the context of visual object recognition.

On Monday, we will discuss the following paper in class.


Your assignment this week is to write a “Short summary and assessment” of the paper. As you are reading the paper, here are some questions to think about.

- What are the types of computations that are possible with this type of network and what are the key aspects of the circuitry that endow the network with those properties?
- What are some of the main assumptions and simplifications in this network?
- Do you think that they make sense? Why/why not?
- A key aspect in any computational model is the number of free parameters. What are the parameters in this type of model and which parameters are hard-wired and which ones are tuned? More generally, why do modelers generally try to avoid parameters?
- What aspect(s) of the circuitry examined in this paper seem biologically plausible? Which aspect(s) do not seem realistic? Why? Why not? Do you think that they make sense? Why/why not?
- Is the circuit robust to noise/fluctuations/external or internal malfunction? Consider noise in each unit, consider failure in transmitting neural signals, consider killing some of the neurons in the circuit, consider changes in the input to the circuit. Think also about other transformations and perturbations that you can come up with that are interesting from a biological viewpoint. How would this circuit behave?
- Assume that you are a neurophysiologist recording the activity of individual neurons. How would you look for evidence for or against the type of properties or computations proposed in this model?