#### 607 SEM Neural Coding

How is information from the world represented by neural activity? The nature of the neural code remains a topic of intense debate. Topics include tuning curves and receptive fields, spike train analysis, firing rates vs. temporal codes, oscillations and synchrony, sparseness and population codes.

1 credit, meeting one day a week for 1:30.

# Friday October 7 1:30 pm

DeCharms & Zador - Neural Representation and the Cortical Code.

Overview of neural coding and representation, specifically dealing with cortex and the relationship to perception and behavior.

### Friday October 14 1:30 pm

Konig et al - Integrator or Coincidence Detector? The Role of the Cortical Neuron Revisited. A theoretical discussion of how the biophysical properties of cortical neurons may or may not affect how they encode information into action potentials. Depending on the integration window, neurons could either act as temporal integrators or as coincidence detectors on their synaptic inputs.

### Friday October 21 1:30 pm

Wehr & Laurent - Neural Coding of Odors by Oscillatory Sequences of Firing. A study of neural coding in the grasshopper olfactory system, where neurons synchronize to a global oscillation in a stimulus-dependent fashion.

# Friday October 28 1:30 pm

Mehta, Lee & Wilson - Role of Experience and Oscillations in Transforming a Rate Code into a Temporal Code.

This paper looks at a form of temporal coding called phase precession, and relates it to firing rates at different time scales, in the context of sequence learning.

Harris et al - Spike Train Dynamics Predicts Theta-Related Phase Precession in Hippocampal Pyramidal Cells.

A counterpoint to the Mehta paper, suggesting that phase precession doesn't code anything but is essentially a consequence of the biophysics of dendritic integration.

# Friday November 4 1:30 pm

Bialek et al - Reading a Neural Code.

The seminal reverse correlation paper, which set the stage for decoding the information transmitted by single spikes.

# Friday November 11 1:30 pm

Pouget & Dayan - Inference and Computation with Population Codes.

What kinds of computation is population coding good for? Does distributed activity just represent the stimulus? This paper reviews the idea that distributed activity represents

uncertainty about the stimulus, and that the computations done on this representation can best be understood as Bayesian inference.

### Friday November 18 1:30 pm

Hanloser, Kozhevnikov, & Fee - An Ultra-Sparse Code Underlies the Generation of Neural Sequences in a Songbird

Recent data from the zebrafinch song system, showing that pre-motor neurons use a temporally sparse and precise code.

### Friday December 2 1:30 pm

Olshausen & Field - Sparse Coding of Sensory Inputs

A review of sparse coding in sensory systems. What does sparseness mean, what is it good for, and what's the evidence for it?

### Friday December 9 1:30 pm

Platt & Glimcher - Neural Correlates of Decision Variables in Parietal Cortex If sensory neurons represent sensory stimuli, and motor neurons represent motor output, what about the neurons in the middle? What do they represent, and with what code? This paper proposes that brain areas in between the sensory and motor sides are involved in decisions, and that their activity represents decision-theoretic variables such as expected gain.