

Syllabus:

Introduction to System-Level Computational Neuroscience

(graduate-level course proposed by Alexei Samsonovich)

Main textbook:

Trappenberg, T. P. (2002) *Fundamentals of Computational Neuroscience*. Oxford UP.

Supplementary textbooks:

Dayan, P., and Abbott, L. F. (2005). *Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems*. MIT Press.

O'Reilly, R. C., and Munakata, Y. (2000). *Computational Explorations in Cognitive Neuroscience*. MIT Press.

This course will provide an introduction to computational system-level neuroscience for beginning graduate students. The underlying dogma is that the brain is a growing information processing system. The goal is to understand how the cognitive growth and the human-level cognition emerge from interactions of neuronal networks. Specifically, the following topics will be covered:

1. Mathematical models of neurons: structure, activity, plasticity
2. Neural code: mechanisms, function and behavioral correlates
3. Topographical vs. cognitive mapping in the developing brain
4. Neural network models: architecture, dynamics and learning rules
5. Attractors, continuous attractor networks and the brain
6. Semantic cognitive mapping and episodic memory indexing
7. Higher-order cognitive representations in the brain

Today there is no single textbook that provides a comprehensive introduction to all the above topics. Therefore, the course will be supplemented by additional readings selected from mainstream journals. In addition, online resources and software tools will be used in assignments. The focus is on understanding the system-level information processing.

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