Title: Neural circuit mechanisms of cognition in artificial and biological neural networks

David Freedman, Ph.D.

Professor, Department of Neurobiology
Chair, Graduate Program in Computational Neuroscience

University of Chicago, USA

Abstract: We have a remarkable ability to interpret incoming sensory stimuli and plan task-appropriate behavioral responses. This talk will present parallel experimental and computational approaches aimed at understanding the circuit mechanisms and computations underlying flexible perceptual and categorical decisions. In particular, our work is aimed at understanding how visual feature encoding in upstream sensory cortical areas is transformed across the cortical hierarchy into more flexible task-related encoding in the parietal and prefrontal cortices. The experimental studies utilize multielectrode recording approaches to monitor activity of neuronal populations, as well as reversible cortical inactivation approaches, during performance of visually based decision-making tasks. In parallel, our computational work employs machine learning approaches to train recurrent artificial neural networks to perform the same tasks as in the experimental studies, allowing a deeper investigation of putative neural circuit mechanisms used by both artificial and biological networks to solve cognitively demanding behavioral tasks..

Short Biography: Dr. Freedman is a Professor at the University of Chicago in the Department of Neurobiology and the Chair of the Graduate Program in Computational Neuroscience. Dr. Freedman got his PhD in Systems Neuroscience from MIT in 2002 where he worked with Dr. Earl Miller investigating how the prefrontal cortex is involved in high-level visual processing and categorization in monkeys. He then did a postdoc at the Harvard Medical School in the laboratory of Dr. Johan Assad before joining the University of Chicago faculty in 2008. His lab at the University of Chicago uses sophisticated neurophysiological techniques to monitor the activity of neuronal ensembles during behavioral tasks which require visual recognition, decision making, and learning. To identify key computational mechanisms used by the brain, his lab also employs advanced quantitative approaches such as neural network modeling and machine learning. Dr. Freedman has won many honors, awards and fellowships and his work has been funded by NIH, NSF, Brain Research Foundation and others.