Kenneth Harris, University College London

Title: "The Neural Marketplace"

Abstract:

The brain consists of billions of neurons, which together form the world's most powerful information processing machine. The fundamental principles that allow these cells to organize into computing networks are unknown. This talk will describe a hypothesis for neuronal self-organization, in which competition for retroaxonal factors causes neurons to form functional networks, through processes akin to those of a free-market economy.

Classically, neurons communicate by anterograde conduction of action potentials. However, information can also pass backward along axons, a process that is well characterized during the development of the nervous system. Recent experiments have shown that information about changes to a neuron's output synapses may pass backward along the axon, and cause changes in the same neurons inputs. Here we suggest a computational role for such "retroaxonal" signals in adult learning. We hypothesize that strengthening of a neuron's output synapses stabilizes recent changes in the same neuron's inputs. During learning, the input synapses of many neurons undergo transient changes, resulting in altered spiking activity. If this in turn promotes strengthening of output synapses, the recent synaptic changes will be stabilized; otherwise they will decay. A representation of sensory stimuli therefore evolves that is tailored to the demands of behavioral tasks. The talk will describe experimental evidence in support of this hypothesis, and a mathematical theory for how networks constructed along these principles can learn information-processing tasks.