

Learning in Neuronal networks of the Brain: From Synaptic Plasticity to Memories

Prof. Dr. Wulfram Gerstner

École polytechnique fédérale de Lausanne

What happens in your brain when you learn to ride a bike or memorize a new word? In this talk, I will discuss mathematical models of memory formation and learning. Neurons communicate with each other in form of short electrical pulses. The pulses travel along 'axonal' cables that ramify and form thousands of synapses with other neurons. The strength of a synaptic connection is the location where memories are stored. Mathematical learning rules describe how and when these synaptic connections change. Simulations and analysis of neural network models show how such learning rules, located at the level of synaptic connections, can lead to global changes in brain function via formation of memories. While the classic Hopfield model from 1982, which for the first time linked the physics of spin glasses to the brain, assumed that memories are pre-learned, modern models of brain-inspired neural network try to understand how online learning upon exposure to new events is possible.