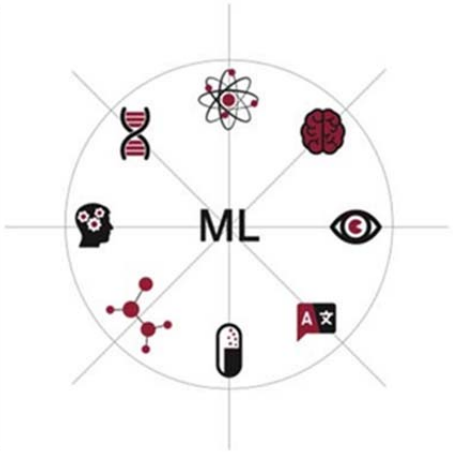


**Cluster of Excellence**
Machine Learning:
New Perspectives for Science

www.ml-in-science.uni-tuebingen.de

# *Cluster Colloquium "Machine Learning"*

Seminar Series of the Cluster of Excellence

---

## **Wednesday July 3, 2019, 2:00 - 3:00 pm**, followed by Get Together

***Lecture Hall, AI Research Building***
*Maria von Linden-Str. 6 (ground floor), 72076 Tübingen*

---

## Machine Learning, Neuroscience, and Spiking Neural Networks

**Robert Legenstein**
Institute for Theoretical Computer Science, Graz University of Technology, Austria
*(Host: Harald Baayen)*

---

The astonishing computational and learning capabilities of the human brain have inspired computer scientists from the very start of this scientific discipline. The McCulloch-Pitts neuron model, introduced in 1943, was developed to study information processing in the brain. At the same time, it was the first artificial neuron model and provided the basis for modern deep learning. Many modern machine learning techniques are inspired by neuroscience, but this inspiration comes more on a conceptual, abstract level. On the other hand, according to our current understanding of computation and learning in the brain, we have to conclude that these processes differ from modern deep learning approaches in several fundamental ways. One fundamental difference concerns the basic units of computation themselves, that are neurons and synaptic connections. In contrast to artificial neural networks, the communication in biological neural networks is predominantly based on spikes. It is long being debated what benefits, if any, spike-based communication has over the communication scheme of artificial neural networks - without a clear conclusion yet. In fact, spiking neural networks are rarely seen in practice as they turned out to be hard to optimize. In this talk I will discuss our recent efforts to build bridges between Neuroscience and Machine Learning using recurrent networks of spiking neurons (rSNNs). I will discuss recently developed training algorithms for rSNNs that show that rSNNs can be optimized efficiently. I will further discuss variants of these learning algorithms that are both biologically plausible and well-suited for implementation in neuromorphic hardware. I will discuss how these findings can help to develop links between Machine Learning and Neuroscience on a more fundamental level.