

## SCIENTIFIC SEMINAR

### **Causality and probabilistic inference in spiking neural networks**

#### Problem description:

Causality is tightly coupled to probability theory. Its purpose is to mathematically and logically reason about effects and causes, for instance to determine dependencies within chains of activity. However, it is unclear and not fully agreed upon how causality is embedded in spiking neural networks.

In contrast, probabilistic population codes are known to play an important role in neuroscience and well studied. Several neurons participate in the formation of such a representation by adjusting their respective firing rate. Downstream neurons can subsequently infer information encoded by pre-synaptic probabilistic populations.

In this seminar, the student shall research and understand causality, and its link to probability theory. Subsequently he/she shall research possible neural networks that implement causality detection with a special emphasis on spiking neural networks. Finally, the student shall research the possibility to embed both causality and probabilistic inference within one singular spiking neural network. To succeed, the student will have to

1. understand causality, e.g. Pearl-Halpern's definitions
2. understand probabilistic population codes
3. research spiking neural networks for either
4. research if there exist spiking networks that implement both

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