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University of Bremen

Information regarding Lecture

"Theoretical Neurophysics"

Elective Physics Master

Summer term 2022, Lecture Fr. 12:00-14:00, Exercise: Fr. 14:00-16:00
Preliminary meeting 22.04.2022, 12:00-14:00, Cognium, room 1030

Contents of the lecture:

Our brain is a complex non-linear system in which billions of interconnected simple elements perform amazing feats such as object recognition, memory and perception in an interaction with their environment. With its versatile concepts and formal tools, physics gives us the key to a quantitative description of neuronal dynamics and for understanding computation in the brain. In our lecture we will present a spectrum of methods to describe, analyse and simulate fundamental processes in the brain. Topics include neurons and neuron models, interactions and collective phenomena, memory (capacity) and synaptic plasticity, (multi-layer) perceptrons and backpropagation, self-organisation and cortical maps, and an introduction to basic concepts of machine learning.

Required prior knowledge:

The lecture builds is accompanied by exercises in which formal methods are practised and neural systems are analysed mathematically. Some exercises will take place directly on the computer to numerically simulate and graphically display neural networks. Elementary programming skills in a suitable language (e.g. Matlab or Python+Matplotlib+Numpy) are assumed. Course language is English.