

## Course Description: Neuro 403-1 Theoretical Neurosciences

6 ECTS

Contact Person: Dr. Udo Ernst

Offer: winter semester

Assessment of module: written examination

### Related Courses

Computational Neuroscience I, Module 403 a Dr. Udo Ernst Udo Ernst  
Statistical Methods, Dr. Thorsten Fehr

### Learning contents

#### *Computational Neuroscience I*

Participants will be introduced to fundamental concepts in Computational Neuroscience. In the first term, we will study basic encoding and decoding schemes, analysis of neural signals, and the dynamics of single neurons. In the second term, we will focus on synapses and neural networks, and study emergent phenomena such as computation and classification, learning and memory, pattern formation, and synchronization. Students will develop the competency to understand and to use basic mathematical methods from Computational Neurosciences, and they will gain knowledge about paradigmatic models and theories in that field. These competencies will be trained in exercises where students will apply analytical methods to study neural dynamics and information processing in the brain. Skills acquired in this course will be essential for working in a neuroscience lab, in particular for analyzing data, testing theories, and performing simulations of brain function.

*Basic knowledge in elementary calculus (functions, equation solving, differentiation, integration, probability theory) is required.*

#### *Statistical Methods*

The course will start with rehearsing methods from descriptive statistics, in particular on concepts important for understanding neuronal data. Subsequently, we will focus in parallel on methods useful for investigating the brain as an information-processing system, and on methods needed to analyze behavioral or neural data (e.g., EEG, fMRI, Electrophysiology).

In this course, you will acquire the necessary skills to perform analysis of neural or behavioral data in a lab situation. In particular, you will learn how to plan experiments yielding meaningful statistics, and how to select and to apply appropriate statistical tests. In parallel, you will understand how to compute with probabilities and how to perform inference and estimation on noisy data. Hereby you acquire the competency to study encoding and decoding of information of the brain.