

PhD project: Structure identification of mesoscopic biological interaction networks from data

The Helmholtz School for Data Science in Life, Earth and Energy (HDS-LEE) provides an interdisciplinary environment for educating the next generation of data scientists in close contact to domain-specific knowledge and research. All three domains – life & medical sciences, earth sciences, and energy systems/materials – are characterized by the generation of huge heterogeneously structured data sets, which have to be evaluated in order to obtain a holistic understanding of very complex systems.

Project overview

Biological systems are characterized by a multitude of mutually interacting mechanisms affecting the systems response on external stimulation, controlling e.g. efficacy of therapies in patients. Hence, effective computational methods for learning all relevant mechanisms involved in a therapy from the massive data are crucial for precision medicine.

In the project, we will develop a novel hybrid approach integrating both mechanistic understanding and machine learning in order to systematically identify unknown modes of action of biological processes and their interaction. Based on the identification of patterns in large combinatorial drug-cell response screens, which are specific for tree-like sub-structures of the networks of modes of action, in the proposed project we aim to develop a method for systematic reengineering of model networks from the identified tree-like substructures. The method will be evaluated on two data sets representing responses of cells on drugs and stimuli.

Work plan

The project will be performed in three steps:

- 1) characterization of correlative patterns in data which can be associated to tree-like sub-networks of the hybrid model network.
- 2) Development of a generic algorithm for network reengineering from tree-like sub-networks.
- 3) The performance of the network reconstruction algorithm will be evaluated by means of two applications addressing different levels of application

Your profile

- a completed master's degree in mathematics, computer science, natural sciences or engineering
- TOEFL or equivalent evidence of English-speaking skills
- a high level of scholarship as indicated, for example, by bachelor and master study transcripts and two reference letters
- good programming skills, e.g. C++ under Unix/Linux
- experience with any of the following would be a plus: Python, R, TensorFlow
- excellent communication and organizational skills

Our offer

- 3 year position with a salary according to TVL 13 100%.
- program at the graduated school with comprehensive training courses, e.g. in parallel computing, machine learning and deep learning, visualization, and scientific computing
- PhD students are encouraged to attend international conferences and can be selected for a period to stay abroad

Apply to and contact for further information: Prof. Dr. Andreas Schuppert schuppert@ices.rwth-aachen.de

Apply until: 30th June 2019

Starting date: 1st August 2019