The Department of Physiology, University of Bern and the Kirchhoff-Institute for Physics, University of Heidelberg jointly invite applications for a

Master’s thesis on “Artificial evolution in neuromorphic systems”

Our research is concerned with understanding and analytically describing various aspects of neural network dynamics. On the modeling side, we are mainly interested in functional networks (i.e., networks that do something that we consider useful), for which we take inspiration from both biology and AI research. An essential aspect of model functionality concerns robustness, since one of our goals is the embedding of functional networks in neuromorphic substrates and their application to real-world problems.

A specific focus of our ongoing work are phenomenological models of synaptic plasticity. Synaptic plasticity describes changes of the coupling strengths between neurons in the nervous systems and is fundamental for learning and memory. We have recently demonstrated that automated search methods based on evolutionary algorithms provide complementary strengths to analytical approaches.

We now aim to mitigate one significant drawback of evolutionary algorithms, their high computational cost, by leveraging neuromorphic systems as accelerators for our simulations. Neuromorphic systems present a radical departure from traditional computing substrates, blurring the lines between compute units and memory, and allowing massively parallel execution at single synapse resolution.

The goals of this thesis are (1) building a reusable pipeline for executing evolutionary searches for synaptic plasticity models on the BrainScaleS-2 neuromorphic system, (2) demonstrating its functionality by discovering new models on standard benchmark problems, and (3) investigating the efficiency of neuromorphic acceleration relative to numerical simulation.

We are looking for a highly motivated and talented student with strong communication skills who enjoys working at the interface of several disciplines, in particular computational neuroscience and machine learning. The ideal candidate is currently pursuing a MSc in Physics, Computer Science, or a related field. They have demonstrated knowledge of Python for simulation and data analysis, and a keen interest in furthering our understanding of biological and artificial computation. Good knowledge of English (written and oral) is mandatory. Experience in working with version control systems, clusters, and C/C++ would be beneficial.

The position is offered by a collaboration between the Electronic Visions Group at the Kirchhoff-Institute for Physics, University of Heidelberg and the NeuroTMA Lab at the Department of Physiology, University of Bern. If you are interested, please send your CV and transcript along with a brief description of your motivation to Dr. Eric Müller (mueller@kip.uni-heidelberg.de), Dr. Mihai A. Petrovici (mihai.petrovici@unibe.ch) and Dr. Jakob Jordan (jakob.jordan@unibe.ch). The position is open starting from November 1st, 2023. The review of applications will continue until the position is filled.

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1. https://elifesciences.org/articles/66273