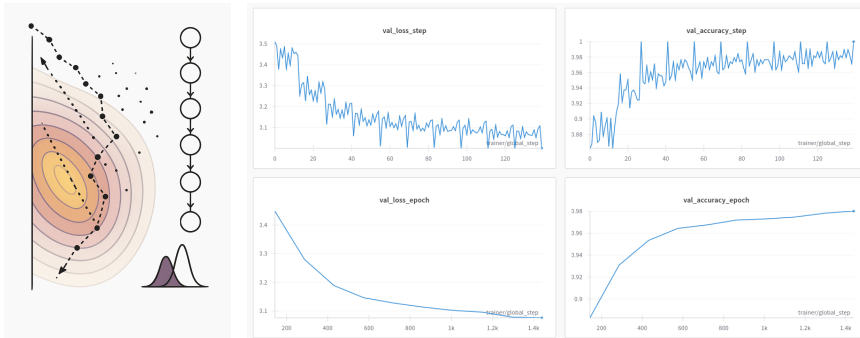# KIT
Karlsruhe Institute of Technology

mrt

Research Assistant (Graduate Student)

Markov chain-based optimization (left), Stochastic training process (right)

Diffusion-based Approaches in Stochastic Optimization

Stochastic optimization represents a powerful approach to solving complex optimization problems by strategically incorporating randomness. When facing high-dimensional, nonlinear objective problems, the optimization landscape often contains multiple local optima. To circumvent undesirable local minima, exploration of diverse regions of the optimization landscape is necessary. Some algorithms with theoretical guarantees for its certainty of their overall position require gradient computations, especially in deep learning. Other novel approaches are based on diffusion to act in the optimization landscape. We aim to adapt the gradient-based methods with theoretical guarantees to these diffusion-based approaches.

This position enables insights in state-of-the-art scientific work, which incorporates involvement in a scientifically demanding task.

The proposed position entails the following tasks:

+ Literature research about stochastic optimization methods for diffusion-based neural networks
+ Implementing methods / in papers proposed algorithms in Python
+ Visualizing optimization landscapes and simulation results for publications

Relevant Literature

- Li, Q., Teh, Y. W., & Pascanu, R. (2025). NoProp: Training Neural Networks without Back-propagation or Forward-propagation.
- Song, Y., Durkan, C., Murray, I., & Ermon, S. (2021). Maximum Likelihood Training of Score-Based Diffusion Models. Advances in Neural Information Processing Systems, 34, 1415–1428.
- Ho, J., Jain, A., & Abbeel, P. (2020). Denoising Diffusion Probabilistic Models. Advances in Neural Information Processing Systems, 33, 6840–6851.
- Li, H., Xu, Z., Taylor, G., Studer, C., & Goldstein, T. (n.d.). Visualizing the Loss Landscape of Neural Nets.

Remuneration according to a ∼35h/month HiWi position at the KIT
Possibility of a subsequent Master's thesis in the same subject area (depending on your degree/program)

Institute of Measurement and Control Systems (MRT)
Prof. Dr.-Ing. Christoph Stiller

Advisor:
Dominik Strutz, M.Sc.

Programming language(s):
Python   (proficient)

System, Framework(s):
Linux/Windows, Pytorch/Lightning

Required skills:
- Familiarity with academic research papers
- Prior knowledge in statistical theory
- Ability to work independently

Language(s):
German or English

For more information please contact:

Dominik Strutz

Room: 232
Phone: +49 721 608-46769
Email: Dominik.Strutz@kit.edu

To directly apply, please send your CV and transcript of records (ToR; for first term graduate students also the ToR of the previous program/degree) to the e-mail address provided above.