Physics-consistent Machine Learning

Call for Master's thesis

Basic Facts

Official Supervision	Prof. Christopher Albert, ITPCP TU Graz
Technical Supervision	Johanna Moser (PhD Studentin am ITPCP TU Graz)
Field of Study	Differential Equations/Computational Physics/Probability theory
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Possible Content

Most of physics, as well as many models in other fields, can be described using differential equations. Solving those is however still highly non-trivial and reliable numerical methods are needed. Nowadays, the trend is to use the significant advances in the field of machine learning to solve every problem, and so the term "physics-informed machine learning" has been coined. The most prominent approach is that of physics-informed neural networks (PINNs), where violation of the underlying differential equation is penalized during training. While often leading to good results, this method does not guarantee to yield an actual solution to the equation and is moreover oftentimes difficult to train. Concepts for linear differential equations that are currently being developed for Gaussian processes can also be used for neural networks and may lead to enhanced performance, i.e. faster convergence and/or more exact results compared to the established PINNs. To test this hypothesis, the existing Gaussian Process code needs to be adapted to neural networks and subsequently systematically compared to PINNs.

Prerequisites and Outcomes

Programming skills in python required. Other topics are also available, and the focus can be tailored to individual interests if required; feel free to get in touch to discuss this!
Learning Outcomes:

- 1 Masterthesis
- Ability to work on a research project independently
- Scientific writing skills
- Programming experience in the field of Machine Learning
- In-depth knowledge of algebraic concepts, depending on your interests
- Hopefully lots of fun and a passion for research :-)

I am looking forward to working with you! Johanna Moser