Physics-informed Deep Neural Networks

Contents

Objectives

- Develop intuition about the potential applications of the ability to combine existing physical knowledge with data
- Develop intuition about the importance of symmetries in helping us learn with less data
- Use physics-informed neural networks to solve ordinary differential equations
- Use physics-informed neural networks to solve partial differential equations
- Use physics-informed neural networks to solve high-dimensional stochastic partial differential equations

Here, it is not my intension to give you a complete exposition of the theory. This would take several pages. Instead, I am going to provide you with some references for learning more about the topics that are of interest to you. In the hands-on activities, we will see specific examples of everything.

References

- Lagaris et al. 1998 is one of the first papers to use neural networks to solve ODEs and PDEs.
- Raisi et al. 2019 is the first succesful application of physics-informed neural networks in model ODE and PDE problems (forward and inverse).
- Karumuri et al. 2020 is an application of physics-informed neural networks to high-dimensional uncertainty propagation.
- Kondor 2018 is an example of how physical symmetries can be incorporated in the neural network structure. The application is representing energies of molecules.

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