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On the Convergence and Generalization of Physics Informed Neural Networks

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Physics informed neural networks (PINNs) are deep learning based techniques for solving partial differential equations (PDEs). Guided by data and physical laws, PINNs find a neural network that approximates the solution to a system of PDEs. Such a neural network is obtained by minimizing a loss function in which any prior knowledge of PDEs and data are encoded.

Despite its remarkable empirical success, there is little theoretical justification for PINNs. In this talk, we will present a recent result on a mathematical foundation of the PINNs methodology.
As the number of data grows, PINNs generate a sequence of minimizers which correspond to a sequence of neural networks. A natural question to ask is whether the sequence of minimizers converges to the solution to the PDE. We answer the question by focusing on two classes of PDEs: elliptic and parabolic. To the best of our knowledge, this is the first theoretical work that shows the consistency of the PINNs methodology.