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Interpolating Between BSDEs and PINNs: Deep Learning for Elliptic and Parabolic Boundary Value Problems

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Summary for general readers:

Solving high-dimensional partial differential equations is a recurrent challenge in economics, science and engineering. In recent years, a great number of computational approaches have been developed, most of them relying on a combination of randomization (Monte Carlo sampling) and deep learning based approximation. In this paper, we review the literature and suggest a novel methodology that interpolates between the two main existing paradigms (commonly referred to as based on BSDEs and PINNs). Our contribution opens the door towards a unified understanding of numerical approaches for high-dimensional PDEs, as well as for implementations that combine the strengths of different algorithms. We also provide generalizations to eigenvalue problems and perform extensive numerical studies, including calculations of the ground state for nonlinear Schrödinger operators and committor functions relevant in molecular dynamics.

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