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An Introduction to Solving Differential Equations with Physics-Informed Neural Networks

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Artificial Intelligence is revolutionising the way we solve complex problems in science. One example is the Physics-Informed Neural Network (PINN)—a machine learning approach that offers an effective framework for solving differential equations by embedding physical laws directly into the neural network's training process. Unlike traditional numerical methods for solving differential equations, such as finite difference and finite element schemes, PINNs do not rely on expensive computations on fine grids. They also offer the flexibility to incorporate experimental or noisy data, making them particularly useful in settings where data and models must be combined. In this talk, I will provide a gentle introduction to neural networks and explain how PINNs extend these ideas to solve differential equations. I will also present a PyTorch-based Python package I have developed for implementing PINNs and demonstrate its use through a selection of results obtained from my own research.

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