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Some mathe-physical perspectives and effective theories on deep learning

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Deep learning has ushered significant changes in how analysis and modelling in multiple scientific disciplines is pursued. Unsurprisingly, existing insights from many fields have made their way to deep learning as well, informing the methods by which we study and analyze this relatively modern, but increas- ingly important scientific field. In this work, we will introduce how ideas from Koopman Operator Theory, Renormalization Group theory, and Numerical analysis can individually inform/characterize separate aspects of deep learning (Neural Network sizes, architectures, optimization, etc). We will then show how we can combine those insights to build very efficient Neural Network Differential Equation solvers.