Operator Learning: Theory and Algorithms

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Abstract

Learning operators between infinitely dimensional spaces is an important learning task arising in wide applications in machine learning, imaging science, mathematical modeling and simulations, etc. This talk presents the theoretical foundation and efficient numerical algorithms for the nonparametric estimation of these operators using deep neural networks. First, a novel discretization-invariant learning scheme based on data-driven kernel learning is proposed with numerical examples to demonstrate the concept of operator learning. Second, a general theoretical framework is proposed to lay the foundation of operator learning. Non-asymptotic upper bounds for the estimation error of the empirical risk minimizer are derived. Under the assumption that the target operator has low local dimensionality or is supported near a low-dimensional manifold, our error bounds of operator learning achieve attractive rates in the number of training samples without the curse of dimensionality.