CRUNCH Seminars at Brown, Division of Applied Mathematics

Friday - February 26, 2021

Theoretical Guarantees of Machine Learning Methods for Solving High Dimensional PDEs

Yulong Lu , University of Massachusetts, Amherst

Neural network-based machine learning methods, including the most notably deep learning have achieved extraordinary successes in numerous fields. Despite the rapid development of learning algorithms based on neural networks, their mathematical analysis is far from understood. In particular, it has been a big mystery that neural network-based machine learning methods work extremely well for solving high dimensional problems.

In this talk, we will demonstrate the power of neural network methods for solving high dimensional problems PDEs. Specifically, we will discuss an a priori generalization error analysis of the Deep Ritz Method for solving high dimensional elliptic problems. Assuming the exact solution lies in a low-complexity function space called spectral Barron space, we show that the convergence rate of the generalization error is independent of dimension. We also develop a new solution theory for the PDEs of consideration on the spectral Barron space, which can be viewed as an analog of the classical Sobolev regularity theory for PDEs.