Topic Course: MA 59500N
Time: TuTh 10:30a-11:45a
Place: MATH 215

Neural Networks and Numerical Methods for Partial Differential Equations

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Neural Networks (NNs) have achieved astonishing performance in computer vision, natural language processing, and many other artificial intelligence tasks. This success encourages wide applications to other fields, including recent studies of using NNs to numerically solve partial differential equations (PDEs).

This course will first introduce NNs as a new class of approximating functions and its approximation properties to functions. We will then discuss NN-based numerical methods for solving computationally challenging problems arising from continuum mechanics with applications to Darcy's flow in porous media, elastic equations for solids, incompressible Newtonian fluid flow, and Maxwell's equations in electromagnetic. Topics include accurate discretization method, efficient training algorithm, and adaptive construction of NN.

A tentative list of contents:

- Mathematical Models of Continuum Mechanics
- Least-squares Formulations
- Neural Networks and their Approximation Properties
- Least-Squares Neural Network Methods
- Training Algorithms
- Adaptive Network Enhancement Method

Prerequisite: MA 514 or equivalent