

**CRUNCH Seminars at Brown, Division of Applied Mathematics**

**Friday – December 27, 2019**

**A Machine Learning Framework for Solving High-Dimensional Mean Field  
Game and Mean Field Control Problemsing**

Liu Yang

Mean field games (MFG) and mean field control (MFC) are critical classes of multi-agent models for efficient analysis of massive populations of interacting agents. Their areas of application span topics in economics, finance, game theory, industrial engineering, crowd motion, and more. In this paper, we provide a flexible machine learning framework for the numerical solution of potential MFG and MFC models. State-of-the-art numerical methods for solving such problems utilize spatial discretization that leads to a curse-of-dimensionality. We approximately solve high-dimensional problems by combining Lagrangian and Eulerian viewpoints and leveraging recent advances from machine learning. More precisely, we work with a Lagrangian formulation of the problem and enforce the underlying Hamilton-Jacobi-Bellman (HJB) equation that is derived from the Eulerian formulation. Finally, a tailored neural network parameterization of the MFG/MFC solution helps us avoid any spatial discretization. One significant numerical result is the approximate solution of a 100-dimensional optimal transport problem, an instance of a potential MFG, on a standard work station. These results open the door to much-anticipated applications of MFG and MFC models that were beyond reach with existing numerical methods.