Fokker-Planck Equations and Machine Learning

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Abstract

As the continuous limit of many discretized algorithms, PDEs can provide a qualitative description of algorithm's behavior and give principled theoretical insight into many mysteries in machine learning. In this talk, I will give a theoretical interpretation of several machine learning algorithms using Fokker-Planck (FP) equations. In the first one, we provide a mathematically rigorous explanation of why resampling outperforms reweighting in correcting biased data when stochastic gradient-type algorithms are used in training. In the second one, we propose a new method to alleviate the double sampling problem in model-free reinforcement learning, where the FP equation is used to do error analysis for the algorithm. In the last one, inspired by an interactive particle system whose mean-field limit is a non-linear FP equation, we develop an efficient gradient-free method that finds the global minimum exponentially fast.