New Stochastic Gradient Descent Algorithms for Nonconvex Composite Optimization

Quoc Tran-Dinh
Department of Statistics and Operations Research
University of North Carolina at Chapel Hill, NC, USA
Email: quoctd@email.unc.edu

Abstract

We develop two efficient stochastic gradient-based algorithms to solve a class of composite nonconvex optimization problems that covers both finite-sum and expectation settings. In the first part of the talk, we propose a new stochastic proximal gradient framework that utilizes a well-known biased stochastic estimator called SARAH. The algorithm consists of two steps: a proximal gradient and an averaging step making it different from existing nonconvex proximal-type algorithms. It only requires an average smoothness assumption of the nonconvex objective term and additional bounded variance assumption if applied to expectation problems. It works with both constant and adaptive step-sizes, while allowing single-sample and mini-batches. In all these cases, we prove that our algorithms can achieve the best-known complexity bounds. In the second part of this talk, we introduce a novel hybrid approach to form new stochastic estimators for objective functions and propose a hybrid stochastic proximal gradient method to solve composite nonconvex optimization problems. Unlike several existing methods, our algorithm has only a single loop without taking snapshots. It can achieve the best-known oracle complexity bounds using both constant and adaptive step-sizes. We also discuss many variants of our algorithms and illustrate them on several numerical examples including binary classification and neural network training using available and common datasets.

A short bio

Quoc Tran-Dinh is currently an assistant professor at the Department of Statistics and Operations Research, University of North Carolina at Chapel Hill. He obtained his Bachelor at Vietnam National University in Hanoi, and his Ph.D. at the Department of Electrical Engineering and Optimization in Engineering Center at KU Leuven, Belgium. He was a postdoctoral researcher for three years at the Ecole Polytechnique Federale de Lausanne (EPFL), Switzerland, before joining UNC-Chapel Hill. His research mainly focuses on numerical methods for continuous optimization including convex and nonconvex optimization and applications.