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"Dual Algorithms for Large-Scale Learning Problems"

Now Classical First-Order (FO) algorithms of convex optimization, such as Mirror Descent algorithm or Nesterov's optimal algorithm for smooth convex optimization, are well known to have optimal (theoretical) complexity estimates which do not depend on the problem dimension. However, to attain the optimality, the domain of the problem should admit a "good proximal setup". The latter essentially means that (i) the problem domain should satisfy certain geometric conditions (or be of "favorable geometry"), and (ii) the practical use of these methods is conditioned by our ability to solve efficiently an auxiliary optimization task – computing the proximal transformation -- at each iteration of the method. More often than not these two conditions are satisfied in optimization problems arising in computational learning, what explains the fact that FO methods of proximal type recently became methods of choice when solving various learning problems. Yet, they meet their limits in several important problems such as multi-task learning with large number of tasks, where the problem domain does not exhibit favorable geometry, and learning and matrix completion problems with nuclear norm constraint, when the numerical cost of solving the auxiliary problem becomes prohibitive in large-scale problems.

We propose a novel approach to solving nonsmooth optimization problems arising in learning applications where Fenchel-type representation of the objective function is available. The approach is based on applying FO algorithms to the dual problem and using the accuracy certificates supplied by the method to recover the primal solution. While suboptimal in terms of accuracy guaranties, the proposed approach does not rely upon "good proximal setup" for the primal problem but assume that the problem domain admits a Linear Optimization oracle -- the ability to efficiently maximize a linear form on the domain of the primal problem.

Bio:
Anatoli Juditsky received the M.S.E.E. in 1985 from the Moscow Institute of Physics and Technology and the Ph.D. degree in Electrical Engineering in 1989 from the Institute of Control Sci., Moscow, USSR. Since 1999 he is Professor at the Department of Mathematics and Informatics (IM2AG) of the University Joseph Fourier, Grenoble, France; he held a research position at INRIA-IRISA, Rennes, in 1991-1996, and then at INRIA, Grenoble, in 1996-1999. His current research interests include stochastic and large-scale convex optimization, statistical theory and their applications.