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Paper 1:

Efficiently Escaping Saddle Points under Generalized Smoothness via Self-Bounding Regularity

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Summary:

- In this paper, we study the problem of non-convex optimization on functions that are not necessarily smooth using first order methods. Smoothness (functions whose gradient and/or Hessian are Lipschitz) is not satisfied by many machine learning problems in both theory and practice, motivating a recent line of work studying the convergence of first order methods to first order stationary points under appropriate generalizations of smoothness. We develop a novel framework to study convergence of first order methods to first and \textit{second} order stationary points under generalized smoothness, under more general smoothness assumptions than the literature. Using our framework, we show appropriate variants of GD and SGD (e.g. with appropriate perturbations) can converge not just to first order but also \textit{second order stationary points} in runtime polylogarithmic in the dimension. To our knowledge, our work contains the first such result, as well as the first 'non-textbook' rate for non-convex optimization under generalized smoothness. We demonstrate that several canonical non-convex optimization problems fall under our setting and framework.

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