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A Local Convergence Theory for the Stochastic Gradient Descent Method in Non-Convex Optimization with Non-isolated Local Minima

Author: Taehee Ko and Xiantao Li

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Summary for general readers:

A huge success in modern machine learning applications is attributed to the feasibility of non-convex optimization via effective optimization techniques such as the stochastic gradient descent (SGD). But at the theoretical level, it is still not clear why the SGD works for the task of non-convex optimization, especially when non-isolated local minima are present. In this paper, we present a local convergence analysis of the SGD in non-convex optimization with non-isolated minima. We propose new non-convex conditions that characterize a large class of non-convex loss functions with non-isolated minima. Under those conditions, we prove the concentration inequalities of the SGD that characterized the convergence behavior. Some numerical results confirm the existence of a deep neural network satisfying the weakest non-convex condition among the proposed ones.