BSc Thesis Abstract

Adaptive Randomized Algorithms – Simultaneous Perturbation Stochastic Approximation

Eszter Dáni

Supervisor: Dr. Balázs Csanád Csáji

Stochastic approximation (SA) methods are commonly used for optimization problems. The field of stochastic approximation came into existence in 1951 when Robbins and Monro introduced the basic stochastic approximation algorithm. The two main type of SA algorithms are the gradient-based ones, respectively the gradient-free algorithms. In the practical world, there are often situations when the stochastic gradient is barely definable or it is impossible to determine it. In these cases, we assume that only measurements of the loss function, especially noisy measurements, are available.

The aim of the paper is demonstrating and comparing two gradient-free methods regarding the efficiency of them. These stochastic approximations are one of the most acknowledged algorithm in this area. Firstly, I present the Finite-difference Stochastic Approximation (FDSA), also known as the Kiefer-Wolfowitz algorithm. This method estimates the stochastic gradient via adjusting each variable of the minimizing vector, one at a time. If the dimension of the search space is too large, it can rather slow done the FDSA algorithm.

Secondly, I introduce the Simultaneous Perturbation Stochastic Approximation algorithm which was invented by J. C. Spall. In case of the SPSA, the approximation requires only two measurements of the loss function since using this method, the parameters are being adjusted simultaneously with the help of a random perturbation vector.

In conclusion, SPSA and FDSA under certain conditions achieve the same level of statistical accuracy, but Spall's algorithm requires p times fewer observations where p is the dimension of the optimization problem.

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