

# Iteration Complexity of Randomized Block-Coordinate Descent Methods for Minimizing a Composite Function

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In this paper we develop a randomized block-coordinate descent method for minimizing the sum of a smooth and a simple nonsmooth block-separable convex function and prove that it obtains an  $\epsilon$ -accurate solution with probability at least  $1-\rho$  in at most  $O(\frac{n}{\epsilon} \log \frac{1}{\rho})$  iterations, where  $n$  is the number of blocks. For strongly convex functions the method converges linearly. This extends recent results of Nesterov [Efficiency of coordinate descent methods on huge-scale optimization problems, CORE Discussion Paper #2010/2], which cover the smooth case, to composite minimization, while at the same time improving the complexity by the factor of 4 and removing  $\epsilon$  from the logarithmic term. More importantly, in contrast with the aforementioned work in which the author achieves the results by applying the method to a regularized version of the objective function with an unknown scaling factor, we show that this is not necessary, thus achieving true iteration complexity bounds. In the smooth case we also allow for arbitrary probability vectors and non-Euclidean norms. Finally, we demonstrate numerically that the algorithm is able to solve huge-scale  $\ell_1$ -regularized least squares and support vector machine problems with a billion variables.

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