

A problem generator and performance of methods for big data optimization

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Abstract

We present an instance generator for problems:

$$\text{minimize } f_\tau(x) := \tau \|x\|_1 + \frac{1}{2} \|Ax - b\|_2^2, \quad (1)$$

where $A \in \mathbb{R}^{m \times n}$, $b \in \mathbb{R}^m$ and $\tau > 0$. The generator is inspired by the one presented in Section 6 of [2], for details see [1]. The advantage of our modified version is that it allows to control the properties of matrix A and the optimal solution $\tilde{x}$ of (1). For example, the sparsity of matrix A , its spectral decomposition, the sparsity and the norm of $\tilde{x}$. The generator has very low memory requirements and scales well with the dimensions of the problem. We believe that the flexibility of the proposed generator will cover the need for generation of various good test problems.

Using the proposed generator we study the performance of first- and second-order optimization methods as the conditioning and the dimensions of the problem increase **up to one trillion**.

References

- [1] K. Fountoulakis and J. Gondzio. Performance of first- and second-order methods for big data optimization. *Technical Report ERGO 15-005*, 2015. Software available at <http://www.maths.ed.ac.uk/ERGO/trillion/>.
- [2] Yu. Nesterov. Gradient methods for minimizing composite functions. *Mathematical Programming*, 140(1):125–161, 2013.