Problem Complexity and Method Efficiency in Optimization
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John Wiley, U.K./U.S.A., 1983. 388 pp. £26.00
ISBN 0 471 10345 4

The book is a translation of the Russian edition and it is based on a number of papers by the authors. In general, they try to measure the effectiveness of "numerical methods in solving mathematical programming problems". They attempt to estimate the "complexity" of these problems and also the "laboriousness" of the relevant methods in order to find their "potentially attainable lower limits for the amount of labour needed to solve a given type of problem" and to "construct methods which attain these limits". Precise definitions of the terms "complexity", "laboriousness", "class of problems", "sources of information about the problem" and "error of the results" are given and used.

The introductory first chapter is a necessary prerequisite for the understanding of what follows, although the same chapter ends with an examination of smooth but not necessarily convex problems, where the authors obtain lower bounds for the complexity of a given class of problems. The irregular growth of the complexity of these problems as the error of the results decreases and/or their dimension increases led the authors to concentrate on the convex problems only in the subsequent chapters.

Chapters 2, 3 and 4 examine the convex problems which can be solved by first-order methods when the values of the derivatives of the problem components can be calculated exactly. Estimates of the complexity of this class of problems for different ranges of the errors of the results are obtained. Also it turns out that, as the dimension of the problem increases, its complexity behaves according to the properties of the convex set on which the problems are defined.

Chapters 5 and 6 examine the case where the values of the components in the problem include stochastic noise. Methods presented and used in Chapter 3 are modified and used here to derive a number of results, mainly estimates of the laboriousness of the methods.

Problems with smooth, strongly convex components are examined in Chapter 7. In Chapter 8 the authors attempt, with negative results, to find out whether any of the standard methods of solving strongly convex problems can realize the potential limits they themselves have obtained; at the same time it is shown that none of these methods is better than the gradient method.

Finally, a non-conclusive examination of the zeroth-order methods of solving convex problems is presented in Chapter 9.

In their preface, the authors state that the book "should be accessible to a reader having the formal training of a numerical analyst interested in optimization theory". It certainly is accessible and should be recommended to all those who are interested in the area, and particularly in convex programming. However, I feel that the title should include a more precise indication of the contents of the book, such as "Convex Problem Complexity and Method Efficiency in Optimizaton", for those readers from different disciplines who might expect a more general thesis on the concepts of "problem" and "optimization".

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