Preface

The book is devoted to the study of approximate solutions of optimization problems in the presence of computational errors. We present a number of results on the convergence behavior of algorithms in a Hilbert space, which are known as important tools for solving optimization problems and variational inequalities. According to the results known in the literature, these algorithms should converge to a solution. In this book, we study these algorithms taking into account computational errors which are always present in practice. In this case the convergence to a solution does not take place. We show that our algorithms generate a good approximate solution, if computational errors are bounded from above by a small positive constant. In practice it is sufficient to find a good approximate solution instead of constructing a minimizing sequence. On the other hand, in practice computations can induce numerical errors and if one uses optimization methods to solve minimization problems these methods usually provide only approximate solutions of the problems. Our main goal is, for a known computational error, to find out what an approximate solution can be obtained and how many iterates one needs for this.

This monograph contains 16 chapters. Chapter 1 is an introduction. In Chap. 2, we study the subgradient projection algorithm for minimization of convex and nonsmooth functions. The mirror descent algorithm is considered in Chap. 3. The gradient projection algorithm for minimization of convex and smooth functions is analyzed in Chap. 4. In Chap. 5, we consider its extension which is used for solving linear inverse problems arising in signal/image processing. The convergence of Weiszfeld's method in the presence of computational errors is discussed in Chap. 6. In Chap. 7, we solve constrained convex minimization problems using the extragradient method. Chapter 8 is devoted to a generalized projected subgradient method for minimization of a convex function over a set which is not necessarily convex. In Chap. 9, we study the convergence of a proximal point method in a Hilbert space under the presence of computational errors. Chapter 10 is devoted to the local convergence of a proximal point method in a metric space under the presence of computational errors. In Chap. 11, we study the convergence of a proximal point method to a solution of the inclusion induced by a maximal monotone operator, under the presence of computational errors. In Chap. 12, the convergence of the subgradient method for solving variational inequalities is proved under the presence of computational errors. The convergence of the subgradient method to a common solution of a finite family of variational inequalities and of a finite family of fixed point problems, under the presence of computational errors, is shown in Chap. 13. In Chap. 14, we study continuous subgradient method. Penalty methods are studied in Chap. 15. Chapter 16 is devoted to Newton's method. The results of Chaps. 2–6, 14, and 16 are new. The results of other chapters were obtained and published during the last 5 years.

The author believes that this book will be useful for researchers interested in the optimization theory and its applications.

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