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Sinopsis

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This book develops geometric techniques for proving the polynomial time solvability of problems in convexity theory, geometry, and - in particular - combinatorial optimization. It offers a unifying approach based on two fundamental geometric algorithms: - the ellipsoid method for finding a point in a convex set and - the basis reduction method for point lattices. The ellipsoid method was used by Khachiyan to show the polynomial time solvability of linear programming. The basis reduction method yields a polynomial time procedure for certain diophantine approximation problems. A combination of these techniques makes it possible to show the polynomial time solvability of many questions concerning poyhedra - for instance, of linear programming problems having possibly exponentially many inequalities. Utilizing results from polyhedral combinatorics, it provides short proofs of the poynomial time solvability of many combinatiorial optimization problems. For a number of these problems, the geometric algorithms discussed in this book are the only techniques known to derive polynomial time solvability. This book is a continuation and extension of previous research of the authors for which they received the Fulkerson Prize, awarded by the Mathematical Programming Society and the American Mathematical Society.