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## Preface

Since the advent of computers, the significance of algorithms has risen steadily in all fields of mathematics. At the University of Bonn this has led to the introduction of a new course of lectures for beginning students, alongside the two basic courses Analysis and Linear Algebra, namely Algorithmic Mathematics. This book comprises the content of this new course which the authors have taught several times and which consists of around 30 lectures of 90 min each, plus exercise tutorials. While the book assumes no more than high school knowledge, it is challenging for readers without mathematical experience.

In contrast to most other introductory texts on algorithms which are probably intended predominantly for computer science students, our emphasis is on a strict and rigorous mathematical presentation. Exact definitions, precise theorems, and carefully executed elegant proofs are in our view indispensable, particularly at the beginning of mathematical studies. Moreover, the book contains many worked examples, explanations, and references for further study.

Our choice of themes reflects our intention to present as wide a spectrum of algorithms and algorithmic problems as possible without a deeper knowledge of mathematics. We treat basic concepts (Chaps. 1, 2, and 3), numerical problems (Chaps. 4 and 5), graphs (Chaps. 6 and 7), sorting algorithms (Chap. 8), combinatorial optimization (Chaps. 9 and 10), and Gaussian elimination (Chap. 11). As themes are often interrelated, the order of the chapters cannot be changed without possibly having to refer to later sections. The reader will be introduced not only to the classic algorithms and their analysis but also to important theoretical foundations and will discover many cross-references and even unsolved research problems.

One cannot really understand algorithms and work with them without being able to implement them as well. Thus we have, alongside the mathematical themes, included an introduction to the programming language C++ in this book. In doing so we have, however, endeavored to restrict the technical details to the necessary minimum—this is not a programming course!—while still presenting the student lacking programming experience with an introductory text.

Our carefully designed programming examples have a twofold purpose: first to illustrate the main elements of C++ and also to motivate the student to delve further, and second to supplement the relevant theme. Clearly one cannot become a versatile programmer without actually doing it oneself, just as one cannot learn

mathematics properly without doing exercises and solving problems oneself. One cannot emphasize this too strongly and we encourage all beginning students to do so.

It is our sincere wish that all our readers will enjoy studying Algorithmic Mathematics!

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Algorithmic Mathematics

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