

REVIEWS, COMMENTS

A New Book on Competitive Programming

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Abstract: This paper presents a new book on competitive programming: *Competitive Programmer's Handbook*. The purpose of the book is to provide a modern introduction to competitive programming, and the book is especially intended for future IOI and ICPC participants.

Keywords: competitive programming, book

1 Introduction

While the popularity of competitive programming is growing every year, there are not many books devoted to the topic. Thus, in 2013, I started the project of writing a new book on competitive programming. The purpose of the book is to give a thorough introduction to modern competitive programming and to be accessible to readers without background in programming contests. Initially I wrote the book in Finnish, and I had to rewrite the entire book several times before the result was satisfactory. Then, in 2016, I decided to translate the book into English, because most people in the competitive programming community can't read Finnish. The title of the book became *Competitive Programmer's Handbook* (in Finnish: *Kisakoodarin käsikirja*).

Of course, before writing the book, I carefully studied the existing books on competitive programming. In 2003, Skiena and Revilla wrote the pioneering book in the field, *Programming Challenges*. Then, between 2010 and 2013, the Halim brothers published three books called *Competitive Programming 1–3*. My book would resemble those

books, but it would also contain topics that are not discussed in them. There is also the book *Looking For a Challenge?* that was distributed during the IOI 2012. This book contains a collection of difficult problems from Polish contests, so it was targeted to a different audience.

Actually, the book is still under construction, but it is almost ready and the current version of the book is available online at:

<http://cses.fi/book.html>

I have already received a large amount of feedback from the competitive programming community that have greatly improved the quality of the book, and I appreciate all comments and suggestions regarding the book.

2. Book Contents

The book is divided into three parts, each of which contains ten chapters. The book covers almost all topics in the IOI syllabus, and also many topics outside the syllabus that may appear, for example, in ICPC contests.

Here is an overview of the contents of the book:

Part 1: Basic techniques

- the concept of time complexity
- sorting algorithms
- C++ data structures
- algorithm design techniques (complete search, greedy algorithms, dynamic programming)
- amortized analysis
- processing range queries on arrays
- using bit operations in algorithms

Part 2: Graph algorithms

- graph traversal (depth-first and breadth-first searches)
- shortest paths (Bellman–Ford, Dijkstra, Floyd–Warshall)
- tree algorithms (diameter, minimum spanning tree, queries on trees)
- topological sorting and strongly connected components
- Eulerian and Hamiltonian paths
- maximum flow/minimum cut theorem and its applications

Part 3: Advanced topics

- mathematical topics (number theory, combinatorics, matrices, probability, number theory)

- string algorithms (trie, string hashing, Z-algorithm)
- square root algorithms
- advanced segment trees
- geometric and sweep line algorithms

The primary purpose of the book is to *teach* the above topics to a reader. However, the book also attempts to give proper references to the techniques in the scientific literature.

3. Future Plans

My plan is to release the final version of the book this year (2017). Since many people have requested for practice problems, there will also be a collection of such problems available online.

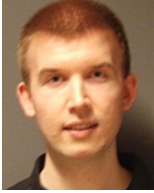
It is clear that there are still a large number of more advanced topics that the book doesn't cover. Examples of such topics are as follows:

- finding bridges and articulation points in graphs
- tree decompositions
- dynamic programming optimization
- advanced string algorithms (e.g. suffix arrays)
- minimum-cost maximum flows
- mathematical topics (Gaussian elimination, advanced number theory, linear programming)

Thus, there would be material for even *another* book on competitive programming that may appear someday.

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A. Laaksonen received his PhD in Computer Science from the University of Helsinki. He is one of the organizers of the Finnish Olympiad in Informatics, and a coach and a team leader of Finnish BOI and IOI teams. He is the author of the book *Competitive Programmer's Handbook* and one of the developers of the CSES contest system.