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Cambridge University Press
978-1-108-71682-6 — Competitive Programming in Python
Christoph Dürr , Jill-Jênn Vie , Translated by Greg Gibbons , Danièle Gibbons
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Competitive Programming in Python

Want to kill it at your job interview in the tech industry? Want to win that coding competition? Learn all the algorithmic techniques and programming skills you need from two experienced coaches, problem-setters, and judges for coding competitions. The authors highlight the versatility of each algorithm by considering a variety of problems and show how to implement algorithms in simple and efficient code. What to expect:

* Master 128 algorithms in Python.
* Discover the right way to tackle a problem and quickly implement a solution of low complexity.
* Understand classic problems like Dijkstra's shortest path algorithm and Knuth–Morris–Pratt's string matching algorithm, plus lesser-known data structures like Fenwick trees and Knuth's dancing links.
* Develop a framework to tackle algorithmic problem solving, including: Definition, Complexity, Applications, Algorithm, Key Information, Implementation, Variants, In Practice, and Problems.
* Python code included in the book and on the companion website.

Christoph Dürr is a senior researcher at the French National Center for Scientific Research (CNRS), affiliated with the Sorbonne University in Paris. After a PhD in 1996 at Paris-Sud University, he worked for one year as a postdoctoral researcher at the International Computer Science Institute in Berkeley and one year in the School of Computer Science and Engineering in the Hebrew University of Jerusalem in Israel. He has worked in the fields of quantum computation, discrete tomography and algorithmic game theory, and his current research activity focuses on algorithms and optimisation. From 2007 to 2014, he taught a preparation course for programming contests at the engineering school École Polytechnique, and acts regularly as a problem setter, trainer, or competitor for various coding competitions. In addition, he loves carrot cake.

Jill-Jênn Vie is a research scientist at Inria in machine learning. He is an alumnus from École normale supérieure Paris-Saclay, where he founded the algorithmic club of Paris-Saclay (CAPS) and coached several teams for the International Collegiate Programming Contest (ICPC). He published a book in theoretical computer science to help students prepare for prestigious French competitive exams such as *Grandes Écoles* or *agrégation*, and directed a television show "Blame the Algorithm" about the algorithms that govern our lives. He is part of the advisory board of the French Computer Science Society (SIF), itself a member of the International Federation for Information Processing (IFIP).

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Competitive Programming in Python

128 Algorithms to Develop Your Coding Skills

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JILL-JÊNN VIE
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Translated by Greg Gibbons and Danièle Gibbons

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University Printing House, Cambridge CB2 8BS, United Kingdom

One Liberty Plaza, 20th Floor, New York, NY 10006, USA

477 Williamstown Road, Port Melbourne, VIC 3207, Australia

314–321, 3rd Floor, Plot 3, Splendor Forum, Jasola District Centre, New Delhi – 110025, India

79 Anson Road, #06–04/06, Singapore 079906

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www.cambridge.org
Information on this title: www.cambridge.org/9781108716826
DOI: 10.1017/9781108591928

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Translation from the French language edition:
Programmation efficace - 128 algorithmes qu'il faut avoir compris et codés en Python au cour de sa vie
By Christoph Dürr & Jill-Jênn Vie
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www.editions-ellipses.fr
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First published 2021

Printed in the United Kingdom by TJ Books Limited, Padstow Cornwall

A catalogue record for this publication is available from the British Library.

Library of Congress Cataloging-in-Publication Data
Names: Dürr, Christoph, 1969– author. | Vie, Jill-Jênn, 1990– author. | Gibbons, Greg, translator. | Gibbons, Danièle, translator.
Title: Competitive programming in Python : 128 algorithms to develop your coding skills / Christoph Dürr, Jill-Jênn Vie ; translated by Greg Gibbons, Danièle Gibbons.
Other titles: Programmation efficace. English
Description: First edition. | New York : Cambridge University Press, 2020. | Includes bibliographical references and index.
Identifiers: LCCN 2020022774 (print) | LCCN 2020022775 (ebook) | ISBN 9781108716826 (paperback) | ISBN 9781108591928 (epub)
Subjects: LCSH: Python (Computer program language) | Algorithms.
Classification: LCC QA76.73.P98 D8713 2020 (print) | LCC QA76.73.P98 (ebook) | DDC 005.13/3–dc23
LC record available at https://lccn.loc.gov/2020022774
LC ebook record available at https://lccn.loc.gov/2020022775

ISBN 978-1-108-71682-6 Paperback

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Preface

Algorithms play an important role in our society, solving numerous mathematical problems which appear in a broad spectrum of situations. To give a few examples, think of planning taxi routes given a set of reservations (see Section 9.12); assigning students to schools in a large urban school district, such as New York (see Section 9.4); or identifying a bottleneck in a transportation network (see Section 9.8). This is why job interviews in the IT (Information Technology) industry test candidates for their problem-solving skills. Many programming contests are organised by companies such as Google, Facebook and Microsoft to spot gifted candidates and then send them job offers. This book will help students to develop a culture of algorithms and data structures, so that they know how to apply them properly when faced with new mathematical problems.

Designing the right algorithm to solve a given problem is only half of the work; to complete the job, the algorithm needs to be implemented efficiently. This is why this book also emphasises implementation issues, and provides full source code for most of the algorithms presented. We have chosen Python for these implementations. What makes this language so enticing is that it allows a particularly clear and refined expression, illustrating the essential steps of the algorithm, without obscuring things behind burdensome notations describing data structures. Surprisingly, it is actually possible to re-read code written several months ago and even understand it!

We have collected here 128 algorithmic problems, indexed by theme rather than by technique. Many are classic, whereas certain are atypical. This work should prove itself useful when preparing to solve the wide variety of problems posed in programming contests such as ICPC, Google Code Jam, Facebook Hacker Cup, Prologin, France-ioi, etc. We hope that it could serve as a basis for an advanced course in programming and algorithms, where even certain candidates for the 'agrégation de mathématiques option informatique' (French competitive exam for the highest teacher's certification) will find a few original developments. The website `tryalgo.org`, maintained by the authors, contains links to the code of this book, as well as to selected problems at various online contests. This allows readers to verify their freshly acquired skills.

This book would never have seen the light of day without the support of the authors' life partners. Danke, Hương. Merci, 智子. The authors would also like to thank the students of the École polytechnique and the École normale supérieure of Paris-Saclay, whose practice, often nocturnal, generated a major portion of the

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material of this text. Thanks to all those who proofread the manuscript, especially René Adad, Evripidis Bampis, Binh-Minh Bui-Xuan, Stéphane Henriot, Lê Thành Dũng Nguyễn, Alexandre Nolin and Antoine Pietri. Thanks to all those who improved the programs on GitHub: Louis Abraham, Lilian Besson, Ryan Lahfa, Olivier Marty, Samuel Tardieu and Xavier Carcelle. One of the authors would especially like to thank his past teacher at the Lycée Thiers, Monsieur Yves Lemaire, for having introduced him to the admirable gem of Section 2.5 on page 52.

We hope that the reader will pass many long hours tackling algorithmic problems that at first glance appear insurmountable, and in the end feel the profound joy when a solution, especially an elegant solution, suddenly becomes apparent.

Finally, we would like to thank Danièle and Greg Gibbons for their translation of this work, even of this very phrase.

Attention, it's all systems go!

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