Cambridge University Press
978-0-521-85748-2 - Switching and Finite Automata Theory, Third Edition
Zvi Kohavi and Niraj K. Jha
Frontmatter
More information

Switching and Finite Automata Theory

Understand the structure, behavior, and limitations of logic machines with this thoroughly updated third edition.

New topics include:
- CMOS gates
- logic synthesis
- logic design for emerging nanotechnologies
- digital system testing
- asynchronous circuit design

The intuitive examples and minimal formalism of the previous edition are retained, giving students a text that is logical and easy to follow, yet rigorous. Kohavi and Jha begin with the basics, and then cover combinational logic design and testing, before moving on to more advanced topics in finite-state machine design and testing. The theory is made easier to understand with 200 illustrative examples, and students can test their understanding with over 350 end-of-chapter review questions.

Zvi Kohavi is Executive Vice President and Director General at Technion–Israel Institute of Technology. He is Professor Emeritus of the Computer Science Department at Technion, where he held the position of Sir Michael and Lady Sobell Chair in Computer Engineering and Electronics.

Niraj K. Jha is a Professor at Princeton University and a Fellow of the IEEE and ACM. He is a recipient of the AT&T Foundation Award and NEC Preceptorship Award for research excellence, the NCR Award for teaching excellence, and Princeton's Graduate Mentoring Award.

Switching and Finite Automata Theory

Third Edition

Zvi Kohavi
Technion–Israel Institute of Technology

Niraj K. Jha
Princeton University

CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo, Delhi

Cambridge University Press
The Edinburgh Building, Cambridge CB2 8RU, UK

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org
Information on this title: www.cambridge.org/9780521857482

First published 1970
Second edition 1978
Third edition 2010

Printed in the United Kingdom at the University Press, Cambridge

A catalog record for this publication is available from the British Library

Library of Congress Cataloguing in Publication data
Kohavi, Zvi.
Switching and finite automata theory / Zvi Kohavi. – 3rd ed. / Niraj Jha.
p. cm.
ISBN 978-0-521-85748-2 (hardback)
1. Sequential machine theory. 2. Switching theory. I. Jha, Niraj K. II. Title.
QA267.5.S4K64 2009
511.3′5 – dc22 2009036353

ISBN 978-0-521-85748-2 Hardback

Additional resources for this publication at www.cambridge.org/9780521857482

Contents

Preface

Topics in switching and finite automata theory have been an important part of the curriculum in electrical engineering and computer science departments for several decades. The third edition of this book builds on the comprehensive foundation provided by the second edition and adds: significant new material in the areas of CMOS logic; modern two-level and multi-level logic synthesis methods; logic design for emerging nanotechnologies; test generation, design for testability and built-in self-test for combinational and sequential circuits; modern asynchronous circuit synthesis techniques; etc. We have attempted to maintain the comprehensive nature of the earlier edition in providing readers with an understanding of the structure, behavior, and limitations of logical machines. At the same time, we have provided an up-to-date context in which the presented techniques can find use in a variety of applications. We start with introductory material and build up to more advanced topics. Thus, the technical background assumed on the part of the reader is minimal.

This edition maintains the style of the previous edition in providing a logical and rigorous discussion of various topics with minimal formalism. Thus, theorems and algorithms are preceded by several intuitive examples to ease understanding. The original references for various topics are provided. Of course, readers who want to dig deeper into a subject would need to consult later works also.

The book is divided into three parts. The first part consists of Chapters 1 and 2. It provides introductory background. The second part consists of Chapters 3 through 8. It deals with combinational logic. The third part consists of Chapters 9 through 16. It is concerned with finite automata. Several chapters contain specific topics that are not prerequisites for subsequent chapters, e.g. Chapters 6, 7, 11–16. Such chapters can be selected at the preference of instructors. Sections marked with a star may be omitted without loss of continuity.

The book can be used for courses at the junior or senior levels in electrical engineering and computer science departments as well as at the beginning graduate level. It is intended as a text for a two-semester sequence. The first semester can be devoted to switching theory (Chapters 1, 3–11) and the second semester to finite automata theory (Chapters 2, 12–16). Other partitions into two semesters are also possible, keeping in mind that Chapters 3–5 are prerequisites for the rest of the book and Chapters 9 and 10 are prerequisites for Chapters 12–16.

Some chapters have undergone major revision and others only minor revision. Two sections have been added to Chapter 4, on heuristic and multi-output two-level circuit minimization. A section has been added to Chapter 5 on CMOS circuit realizations. Chapter 6 has been completely rewritten with an emphasis on technology-independent multi-level logic synthesis as well as on technology mapping. Chapter 7 has been updated with synthesis techniques geared towards emerging nanotechnologies that can efficiently implement threshold, majority, and minority logic. Chapter 8 has also been completely rewritten to include a discussion of fault models, structural testing, I_{DDQ} testing, delay fault testing, synthesis for testability, and testing for nanotechnologies. All these topics provide the underpinning for the testing of modern integrated circuits. Minor changes have been made to the flip-flop section in Chapter 9. Chapter 11 has been updated with material on the synthesis of asynchronous circuits that allow multiple input changes, including burst-mode circuits. The substantial revisions of Chapter 13 include the addition of material on sequential test generation, design for testability, and built-in self-test. These concepts are also important for understanding how modern integrated circuits are tested. The problem sets have been expanded in all the above chapters.

The previous edition has been used at many universities, which encouraged us to undertake the task of revising the book. We are grateful for the feedback and comments from Professors Sudhakar Reddy, Israel Koren, and Robert Dick. We are also indebted to students and colleagues at Technion and at Princeton University for providing a stimulating environment that made this revision possible.

Last, but not the least, Niraj would like to thank his father, Dr Chintamani Jha, and his wife, Shubha, without whose encouragement and understanding this edition would not have been possible.

Zvi Kohavi
Niraj K. Jha