



Data Structures for Engineering Software

Peter P. Silvester

McGill University

Computational Mechanics Publications Southampton Boston





Peter P. Silvester Department of Electrical Engineering McGill University 3480 University Street Montreal, PQ Canada H3A 2A7 **Computational Mechanics Publications** Ashurst Lodge, Southampton, SO4 2AA, UK Telephone: 44 (0) 703 293223 Fax: 44 (0) 703 292853 Pref: E-mail: cmi@ib.rl.ac.uk 1. In For USA, Canada and Mexico: **Computational Mechanics Inc** 25 Bridge Street, Billerica, MA 01821, USA Telephone: (508) 667-5841 Fax: (508) 667-7582 2. Bi British Library Cataloguing-in-Publication Data A Catalogue record for this book is available from the British Library ISBN 1-85312-233-5 Computational Mechanics Publications, Southampton ISBN 1-56252-157-8 Computational Mechanics Publications, Boston 3. Ar Library of Congress Catalog Card Number 93-71429 This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically those of translation, reprinting, re-use of illustrations, broadcasting, reproduction by photocopying machine or similar means, and storage in data banks. 4. Mu © Computational Mechanics Publications 1993 Printed in Great Britain by Bookcraft Ltd. The use of registered names, trademarks, etc., in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the 5. Lin relevant protective laws and regulations and therefore free for general use.



Contents

Preface	vii
1. Introduction to data structures	1
What are data structures?	1
Engineering software	7
Programs in this book	11
Problems	12
2. Bits, bytes and numbers	13
Data storage in binary machines	13
Integer notations	17
Real numbers	21
Character encoding	24
Problems	26
3. Arrays and vectors	28
Elementary operations on arrays	28
Linear arrays	29
Vector operations	34
Sparse vector storage	39
Hashed storage	44
Searching	53
Sorting	58
Problems	62
4. Multidimensional arrays	64
Array storage	64
Matrix arithmetic	70
Special storage forms	78
Sparse matrices	86
Problems	92
5. Linear dynamic structures	94
Stacks	94
Queues	98
Path-tracing problems	102



hampton

ne whole or part nting, re-use of r similar means,

does not imply, exempt from the

eral use.

on

vi Data Structures for Engineering Softwa		ineering Software
Lists		107
Problems		112
6. Lists and pointers		113
Linked lists		113
Pointers in high-le	aval languages	117
	ever languages	121
List operations		
Multiple linking		129
Threaded lists Problems		134 141
7. Tree structures		143
Trees and tree-orie	ented processes	143
Binary trees		149
Balanced trees		158
Complete trees and	d heaps	162
Heap management		167
Problems		174
Appendix		177
Readings		177
The ASCII charac	ter set	178
Index		179
		¥0
	11	



DOCKET

Explore Litigation Insights



Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time** alerts and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

