

Programming Pearls

Second Edition

JON BENTLEY

Bell Labs, Lucent Technologies
Murray Hill, New Jersey

ACM Press
New York, New York

v:Addison-Wesley

Boston • San Francisco • New York • Toronto • Montreal
London • Munich • Paris • Madrid
Capetown • Sydney • Tokyo • Singapore • Mexico City

CONTENTS

Part I: PRELIMINARIES	1
Column 1: Cracking the Oyster	3
A Friendly Conversation • Precise Problem Statement . Program Design Implementation Sketch . Principles • Problems . Further Reading	
Column 2: Aha! Algorithms	11
Three Problems . Ubiquitous Binary Search . The Power of Primitives Getting It Together: Sorting . Principles • Problems • Further Reading . Implementing an Anagram Program	
Column 3: Data Structures Programs	21
A Survey Program • Form-Letter Programming . An Array of Examples . Structuring Data . Powerful Tools for Specialized Data . Principles • Prob- lems . Further Reading	
Column 4: Writing Correct Programs	33
The Challenge of Binary Search . Writing the Program • Understanding the Program . Principles . The Roles of Program Verification . Problems Further Reading	
Column 5: A Small Matter of Programming	45
From Pseudocode to C . A Test Harness • The Art of Assertion . Auto- mated Testing . Timing • The Complete Program . Principles . Problems . Further Reading • Debugging	
Part II: PERFORMANCE	59
Column 6: Perspective an Performance	61
A Case Study . Design Levels • Principles • Problems • Further Reading	
Column 7: The Back of the Envelope	67
Basic Skills • Performance Estimates • Safety Factors . Little's Law . Principles . Problems • Further Reading • Quick Calculations in Everyday Life	

Column 8: Algorithm Design Techniques	77
The Problem and a Simple Algorithm • Two Quadratic Algorithms • A Divide-and-Conquer Algorithm . A Scanning Algorithm • What Does It Matter? . Principles • Problems . Further Reading	
Column 9• Code Tuning	87
A Typical Story . A First Aid Sampler • Major Surgery — Binary Search . Principles . Problems . Further Reading	
Column 10: Squeezing Space	99
The Key — Simplicity . An Illustrative Problem . Techniques for Data Space • Techniques for Code Space • Principles . Problems . Further Reading . A Big Squeeze	
Part III: THE PRODUCT	113
Column 11: Sorting	115
Insertion Sort • A Simple Quicksort . Better Quicksorts • Principles . Problems . Further Reading	
Column 12: A Sample Problem	125
The Problem . One Solution • The Design Space • Principles • Problems • Further Reading	
Column 13: Searching	133
The Interface • Linear Structures . Binary Search Trees • Structures for Integers . Principles . Problems . Further Reading . A Real Searching Problem	
Column 14: Heaps	147
The Data Structure . Two Critical Functions . Priority Queues . A Sorting Algorithm • Principles . Problems • Further Reading	
Column 15: Strings of Pearls	161
Words • Phrases • Generating Text . Principles • Problems • Further Reading	
Epilog to the First Edition	175
Epilog to the Second Edition	177
Appendix 1: A Catalog of Algorithms	179
Appendix 2: An Estimation Quiz	183
Appendix 3: Cost Models for Time and Space	185

Appendix 4: Rules for Code Tuning	191
Appendix 5: C++ Classes for Searching	197
Hints for Selected Problems	201
Solutions to Selected Problems	205
Index	233