



# DATA STRUCTURES AND ALGORITHMS WITH OBJECT-ORIENTED DESIGN PATTERNS IN JAVA™

**BRUNO B. PREISS**

Surinamee University of Technology



3105100060604

# Contents

<b>CHAPTER 1</b>	<b>Introduction</b>	<b>1</b>
1.1	What This Book Is About	1
1.2	Object-Oriented Design	2
1.3	Object Hierarchies and Design Patterns	3
1.4	The Features of Java You Need to Know	4
1.5	How This Book Is Organized	4
<b>CHAPTER 2</b>	<b>Algorithm Analysis</b>	<b>6</b>
2.1	A Detailed Model of the Computer	7
2.2	A Simplified Model of the Computer	22
	Exercises	32
	Programming Projects	33
<b>CHAPTER 3</b>	<b>Asymptotic Notation</b>	<b>35</b>
3.1	An Asymptotic Upper Bound—Big Oh	35
3.2	An Asymptotic Lower Bound—Omega	47
3.3	More Notation—Theta and Little Oh	50
3.4	Asymptotic Analysis of Algorithms	50
	Exercises	63
	Programming Projects	66
<b>CHAPTER 4</b>	<b>Foundational Data Structures</b>	<b>67</b>
4.1	Arrays	67
4.2	Multi-Dimensional Arrays	74
4.3	Singly-Linked Lists	81

Exercises	92
Programming Projects	93

## **CHAPTER 5 Data Types and Abstraction** **95**

5.1 Abstract Data Types	95
5.2 Design Patterns	97
Exercises	116
Programming Projects	118

## **CHAPTER 6 Stacks, Queues, and Deques** **120**

6.1 Stacks	120
6.2 Queues	135
6.3 Deques	145
Exercises	151
Programming Projects	152

## **CHAPTER 7 Ordered Lists and Sorted Lists** **155**

7.1 Ordered Lists	155
7.2 Sorted Lists	179
Exercises	191
Programming Projects	193

## **CHAPTER 8 Hashing, Hash Tables, and Scatter Tables** **194**

8.1 Hashing—The Basic Idea	194
8.2 Hashing Methods	197
8.3 Hash Function Implementations	201
8.4 Hash Tables	211
8.5 Scatter Tables	218
8.6 Scatter Table Using Open Addressing	227
8.7 Applications	241
Exercises	244
Programming Projects	246

## **CHAPTER 9 Trees** **247**

9.1 Basics	248
9.2 <i>N</i> -ary Trees	251

9.3	Binary Trees	254
9.4	Tree Traversals	256
9.5	Expression Trees	258
9.6	Implementing Trees	261
	Exercises	288
	Programming Projects	290

## **CHAPTER 10 Search Trees** **292**

10.1	Basics	292
10.2	Searching a Search Tree	294
10.3	Average Case Analysis	296
10.4	Implementing Search Trees	302
10.5	AVL Search Trees	308
10.6	M-Way Search Trees	321
10.7	B-Trees	331
10.8	Applications	342
	Exercises	343
	Programming Projects	345

## **CHAPTER 11 Heaps and Priority Queues** **347**

11.1	Basics	348
11.2	Binary Heaps	349
11.3	Leftist Heaps	359
11.4	Binomial Queues	368
11.5	Applications	383
	Exercises	387
	Programming Projects	389

## **CHAPTER 12 Sets, Multisets, and Partitions** **391**

12.1	Basics	391
12.2	Array and Bit-Vector Sets	392
12.3	Multisets	401
12.4	Partitions	410
12.5	Applications	422
	Exercises	424
	Programming Projects	426

<b>CHAPTER 13</b>	<b>Garbage Collection</b>	<b>427</b>
13.1	What Is Garbage?	428
13.2	Reference Counting Garbage Collection	430
13.3	Mark-and-Sweep Garbage Collection	434
13.4	Stop-and-Copy Garbage Collection	437
13.5	Mark-and-Compact Garbage Collection	439
	Exercises	443
	Programming Projects	443
<b>CHAPTER 14</b>	<b>Algorithmic Patterns and Problem Solvers</b>	<b>446</b>
14.1	Brute-Force and Greedy Algorithms	446
14.2	Backtracking Algorithms	450
14.3	Top-Down Algorithms: Divide and Conquer	459
14.4	Bottom-Up Algorithms: Dynamic Programming	469
14.5	Randomized Algorithms	477
	Exercises	487
	Programming Projects	489
<b>CHAPTER 15</b>	<b>Sorting Algorithms and Sorters</b>	<b>491</b>
15.1	Basics	491
15.2	Sorting and Sorters	492
15.3	Insertion Sorting	494
15.4	Exchange Sorting	499
15.5	Selection Sorting	510
15.6	Merge Sorting	519
15.7	A Lower Bound on Sorting	524
15.8	Distribution Sorting	526
15.9	Performance Data	532
	Exercises	535
	Programming Projects	537
<b>CHAPTER 16</b>	<b>Graphs and Graph Algorithms</b>	<b>538</b>
16.1	Basics	539
16.2	Implementing Graphs	547
16.3	Graph Traversals	556
16.4	Shortest-Path Algorithms	570
16.5	Minimum-Cost Spanning Trees	580

16.6 Application: Critical Path Analysis

589

Exercises

594

Programming Projects

597

## **APPENDIX A Java and Object-Oriented Programming**

**599**

A.1 Variables

599

A.2 Parameter Passing

601

A.3 Objects and Classes

604

A.4 Inner Classes

609

A.5 Inheritance and Polymorphism

610

A.6 Exceptions

619

## **APPENDIX B Class Hierarchy Diagrams**

**621**

## **APPENDIX C Character Codes**

**623**

## **Bibliography**

**625**

## **Index**

**627**