Reges & Stepp

BUILDING JAVA™ PROGRAMS

A BACK TO BASICS APPROACH

4TH EDITION

PEARSON

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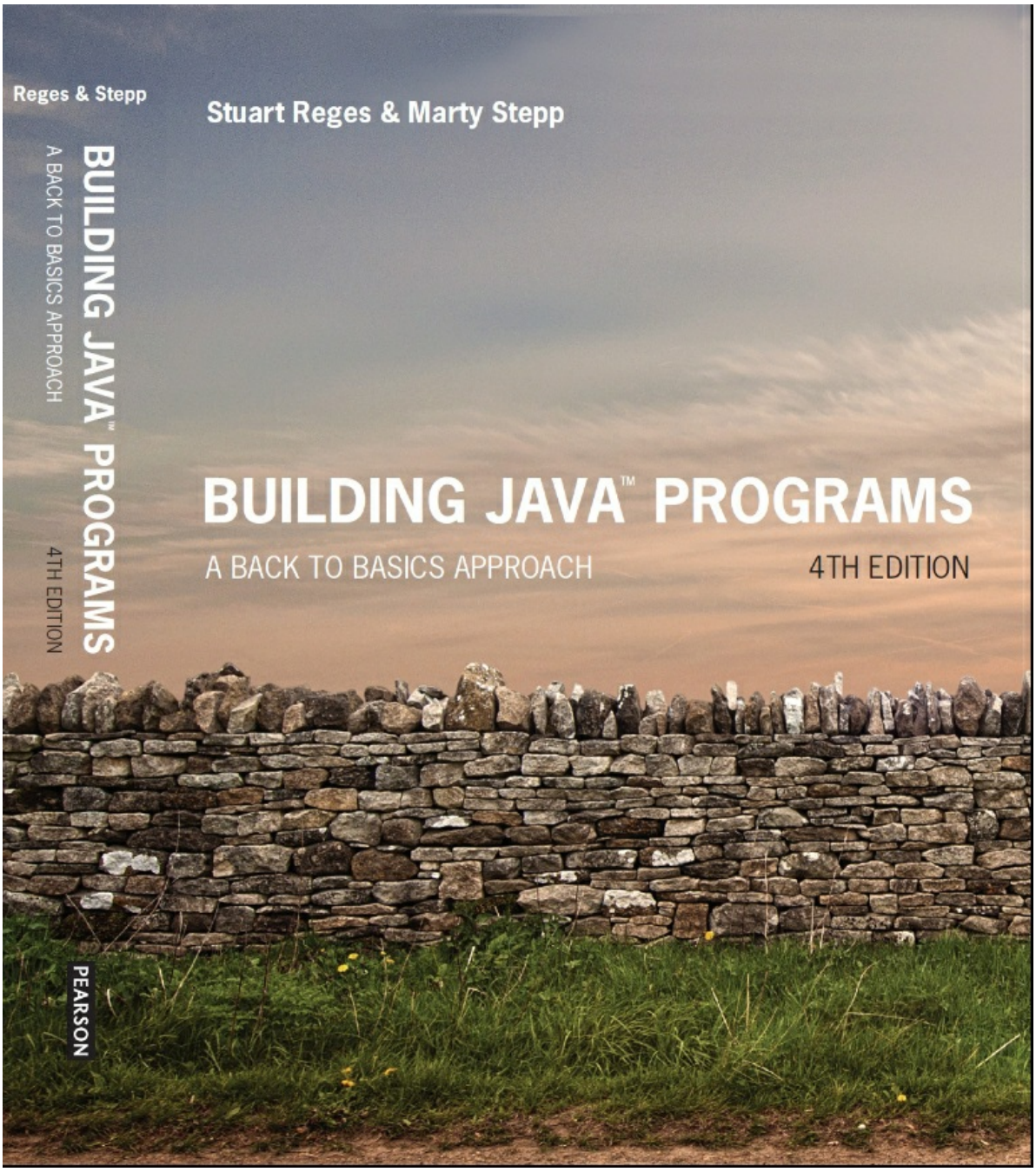
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Building Java Programs

A Back to Basics Approach

Fourth Edition

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PEARSON

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Preface

The newly revised fourth edition of our *Building Java Programs* textbook is designed for use in a two-course introduction to computer science. We have class-tested it with thousands of undergraduates, most of whom were not computer science majors, in our CS1-CS2 sequence at the University of Washington. These courses are experiencing record enrollments, and other schools that have adopted our textbook report that students are succeeding with our approach.

Introductory computer science courses are often seen as “killer” courses with high failure rates. But as Douglas Adams says in *The Hitchhiker's Guide to the Galaxy*, “Don't panic.” Students can master this material if they can learn it gradually. Our textbook uses a layered approach to introduce new syntax and concepts over multiple chapters.

Our textbook uses an “objects later” approach where programming fundamentals and procedural decomposition are taught before diving into object-oriented programming. We have championed this approach, which we sometimes call “back to basics,” and have seen through years of experience that a broad range of scientists, engineers, and others can learn how to program in a procedural manner. Once we have built a solid foundation of procedural techniques, we turn to object-oriented programming. By the end of the course, students will have learned about both styles of programming.

Here are some of the changes that we have made in the fourth edition:

- New chapter on functional programming with Java 8. As explained below, we have introduced a chapter that uses the new language features available in Java 8 to discuss the core concepts of functional programming.

- New section on images and 2D pixel array manipulation. Image manipulation is becoming increasingly popular, so we have expanded our `DrawingPanel` class to include features that support manipulating

images as two-dimensional arrays of pixel values. This extra coverage will be particularly helpful for students taking an AP/CS A course because of the heavy emphasis on two-dimensional arrays on the AP exam.

- Expanded self-checks and programming exercises. Many chapters have received new self-check problems and programming exercises. There are roughly fifty total problems and exercises per chapter, all of which have been class-tested with real students and have solutions provided for instructors on our web site.

Since the publication of our third edition, Java 8 has been released. This new version supports a style of programming known as functional programming that is gaining in popularity because of its ability to simply express complex algorithms that are more easily executed in parallel on machines with multiple processors. ACM and IEEE have released new guidelines for undergraduate computer science curricula, including a strong recommendation to cover functional programming concepts.

We have added a new Chapter 19 that covers most of the functional concepts from the new curriculum guidelines. The focus is on concepts, not on language features. As a result, it provides an introduction to several new Java 8 constructs but not a comprehensive coverage of all new language features. This provides flexibility to instructors since functional programming features can be covered as an advanced independent topic, incorporated along the way, or skipped entirely. Instructors can choose to start covering functional constructs along with traditional constructs as early as Chapter 6. See the dependency chart at the end of this section.

The following features have been retained from previous editions:

- Focus on problem solving. Many textbooks focus on language details when they introduce new constructs. We focus instead on problem solving. What new problems can be solved with each construct? What pitfalls are novices likely to encounter along the way? What are the most common ways to use a new construct?

- Emphasis on algorithmic thinking. Our procedural approach allows us to

emphasize algorithmic problem solving: breaking a large problem into smaller problems, using pseudocode to refine an algorithm, and grappling with the challenge of expressing a large program algorithmically.

- Layered approach. Programming in Java involves many concepts that are difficult to learn all at once. Teaching Java to a novice is like trying to build a house of cards. Each new card has to be placed carefully. If the process is rushed and you try to place too many cards at once, the entire structure collapses. We teach new concepts gradually, layer by layer, allowing students to expand their understanding at a manageable pace.

- Case studies. We end most chapters with a significant case study that shows students how to develop a complex program in stages and how to test it as it is being developed. This structure allows us to demonstrate each new programming construct in a rich context that can't be achieved with short code examples. Several of the case studies were expanded and improved in the second edition.

- Utility as a CS1+CS2 textbook. In recent editions, we added chapters that extend the coverage of the book to cover all of the topics from our second course in computer science, making the book usable for a two-course sequence. Chapters 12–19 explore recursion, searching and sorting, stacks and queues, collection implementation, linked lists, binary trees, hash tables, heaps, and more. Chapter 12 also received a section on recursive backtracking, a powerful technique for exploring a set of possibilities for solving problems such as 8 Queens and Sudoku.

Layers and Dependencies

Many introductory computer science books are language-oriented, but the early chapters of our book are layered. For example, Java has many control structures (including for-loops, while-loops, and if/else-statements), and many books include all of these control structures in a single chapter. While that might make sense to someone who already knows how to program, it can

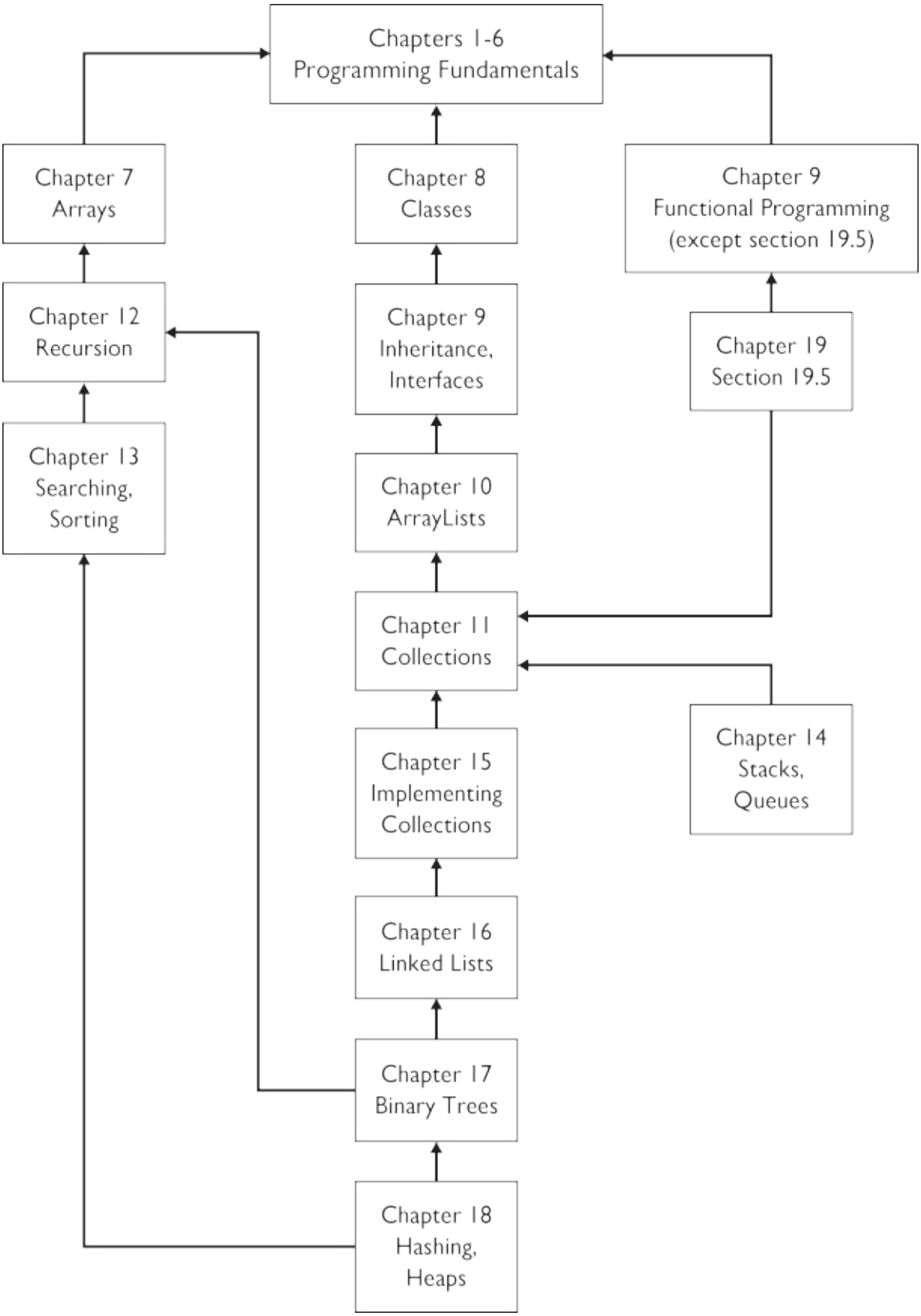
be overwhelming for a novice who is learning how to program. We find that it is much more effective to spread these control structures into different chapters so that students learn one structure at a time rather than trying to learn them all at once.

The following table shows how the layered approach works in the first six chapters:

Chapter	Control Flow	Data	Programming Techniques	Input/Output
1	methods	`String` literals	procedural decomposition	`println`, `print`
2	definite loops (`for`)	variables, expressions, `int`, `double`	local variables, class constants, pseudocode	
3	return values	using objects	parameters	console input, 2D graphics (optional)
4	conditional (`if/else`)	`char`	pre/post conditions, throwing exceptions	`printf`
5	indefinite loops (`while`)	`boolean`	assertions, robust programs	
6		`Scanner`	token/line-based file processing	file I/O

Chapters 1–6 are designed to be worked through in order, with greater flexibility of study then beginning in Chapter 7. Chapter 6 may be skipped, although the case study in Chapter 7 involves reading from a file, a topic that is covered in Chapter 6.

The following is a dependency chart for the book:


Chapters 1-6
Programming Fundamentals
Chapter 7
Arrays
Chapter 8
Classes
Chapter 9
Functional Programming
(except section 19.5)
Chapter 12
Recursion
Chapter 9
Inheritance,
Interfaces
Chapter 19
Section 19.5
Chapter 13
Searching,
Sorting
Chapter 10
ArrayLists
Chapter 11
Collections
Chapter 14
Stacks,
Queues
Chapter 15
Implementing
Collections
Chapter 16
Linked Lists
Chapter 17
Binary Trees
Chapter 18
Hashing,
Heaps

Supplements

http://www.buildingjavaprograms.com/

Answers to all self-check problems appear on our web site and are accessible to anyone. Our web site has the following additional resources for students:

- Online-only supplemental chapters, such as a chapter on creating Graphical User Interfaces
- Source code and data files for all case studies and other complete program examples
- The **`DrawingPanel` class** used in the optional graphics Supplement 3G

Our web site has the following additional resources for teachers:

- PowerPoint slides suitable for lectures
- Solutions to exercises and programming projects, along with homework specification documents for many projects
- Sample exams and solution keys
- Additional lab exercises and programming exercises with solution keys
- Closed lab creation tools to produce lab handouts with the instructor's choice of problems integrated with the textbook

To access protected instructor resources, contact us at authors@buildingjavaprograms.com. The same materials are also available at http://www.pearsonhighered.com/cs-resources. To receive a password for this site or to ask other questions related to resources, contact your Pearson sales representative.

MyProgrammingLab

MyProgrammingLab is an online practice and assessment tool that helps students fully grasp the logic, semantics, and syntax of programming. Through practice exercises and immediate, personalized feedback, MyProgrammingLab improves the programming competence of beginning students who often struggle with basic concepts and paradigms of popular high-level programming languages. A self-study and homework tool, the MyProgrammingLab course consists of hundreds of small practice exercises organized around the structure of this textbook. For students, the system automatically detects errors in the logic and syntax of code submissions and offers targeted hints that enable students to figure out what went wrong, and why. For instructors, a comprehensive grade book tracks correct and incorrect answers and stores the code inputted by students for review.

For a full demonstration, to see feedback from instructors and students, or to adopt MyProgrammingLab for your course, visit the following web site: http://www.myprogramminglab.com/

VideoNotes

We have recorded a series of instructional videos to accompany the textbook. They are available at the following web site: www.pearsonhighered.com/cs-resources

Roughly 3–4 videos are posted for each chapter. An icon in the margin of the page indicates when a VideoNote is available for a given topic. In each video, we spend 5–15 minutes walking through a particular concept or problem, talking about the challenges and methods necessary to solve it. These videos make a good supplement to the instruction given in lecture classes and in the textbook. Your new copy of the textbook has an access code that will allow you to view the videos.

Acknowledgments

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Stuart Reges

Marty Stepp

Break through

To Improving results

MyProgammingLab™

Through the power of practice and immediate personalized feedback, MyProgrammingLab helps improve your students' performance.

Programming Practice

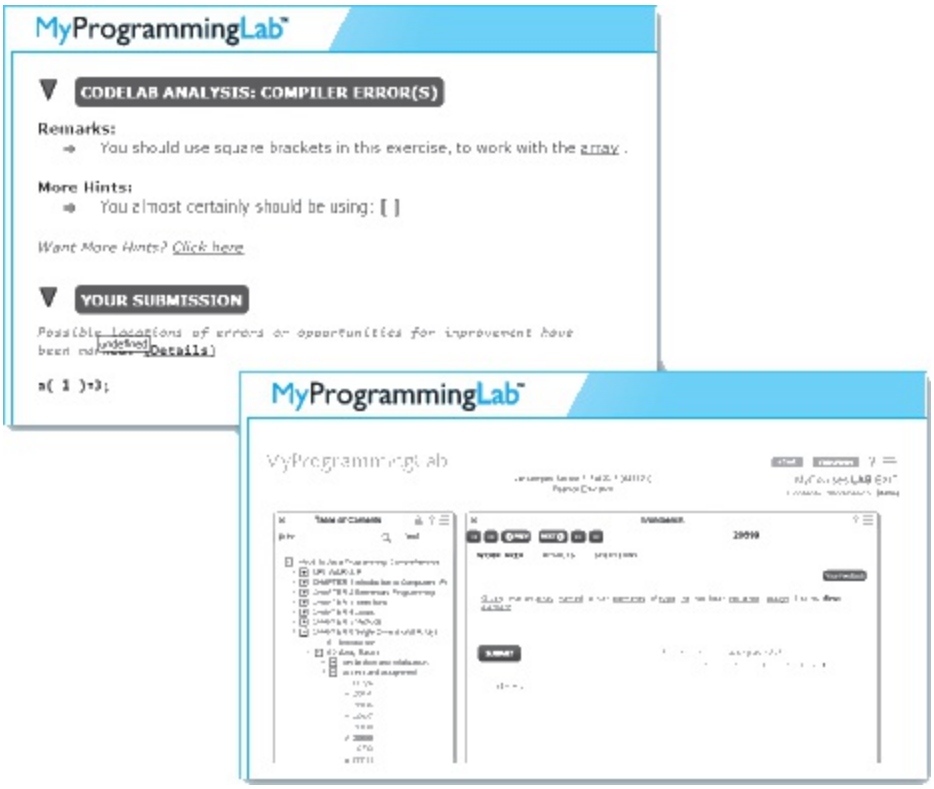
With MyProgrammingLab, your students will gain firs-hand programming experience in an interactive online environment.

Immediate, Personalized Feedback

MyProgrammingLab automatically detects errors in the logic and syntax of their code submission and offers targeted hints that enables students to figure out what went wrong and why.

Graduated Complexity

MyProgrammingLab breaks down programming concepts into short, understandable sequences of exercises. Within each sequence the level and sophistication of the exercises increase gradually but steadily.



Dynamic Roster

Students' submissions are stored in a roster that indicates whether the submission is correct, how many attempts were made, and the actual code submissions from each attempt.

Pearson eText

The Pearson eText gives students access to their textbook anytime, anywhere

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LOCATION OF VIDEO NOTES IN THE TEXT

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Brief Contents

Contents