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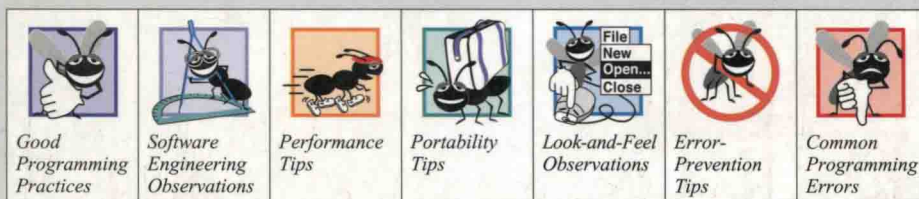
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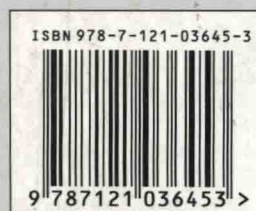
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(第五版)

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英文版

□□□ Introducing □□□□

OOD with the UML

and DESIGN

PATTERNS

SERVLETS

JDBCTM, JSPTM

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本书附带CD-ROM



国外计算机科学教材系列

Java 大学教程

(第五版) (英文版)

Java How to Program

Fifth Edition

H. M Deitel

[美]

Deitel & Associates, Inc.

著

P. J. Deitel

Deitel & Associates, Inc.

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Publishing House of Electronics Industry

北京 · BEIJING

内 容 简 介

本书是专为初学 JAVA 编程的读者准备的。全书共分 25 章及 7 个附录, 前 3 章主要讲述计算机、Internet、Web 及 Java 应用、Java Applet 等概念, 后面的章节涉及控制语句、方法、数组、面向对象编程、字符串和字符、图形和 Java2D、GUI 组件、异常处理、多线程、文件和流、网络编程、多媒体编程、数据结构、位操作、集合、JDBC、Servlets、JSP 等内容。全书包含数百个“活代码”程序, 便于读者自学。以 7 种不同的小图标列出的提示性段落也是本书的特色之一。

本书适合作为大中专相关专业的教材, 也适合希望学习 JAVA 编程的初学者。

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FIFTH EDITION

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JAVA

HOW TO PROGRAM

FIFTH EDITION

H. M. Deitel
Deitel & Associates, Inc.

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TO

To Terrell Hull and James Huddleston:

For your steadfast commitment to excellence in teaching and writing about Java and object technology.

For your extraordinary contributions as reviewers and for your insistence that we “get it right.”

Thank you for being our mentors, our colleagues and our friends.

It is a privilege to work with consummate software professionals.

Harvey and Paul Deitel

1. The first part of the paper is devoted to a general discussion of the problem.

2. In the second part, we shall consider the case of a single particle.

3. The third part is devoted to the case of a system of particles.

4. In the fourth part, we shall consider the case of a continuous medium.

5. The fifth part is devoted to the case of a system of continuous media.

6. The sixth part is devoted to the case of a system of continuous media.



Preface

Welcome to Java! At Deitel & Associates, we write college-level programming-language textbooks and professional books and work hard to keep our books up-to-date. Writing *Java How to Program, Fifth Edition*, (5/e for short), was a joy. This book and its support materials have everything instructors and students need for an informative, interesting, challenging and entertaining Java educational experience. As the book goes to publication, it is compliant with the latest version of Java—the *Java 2 Platform, Standard Edition (J2SE), version 1.4.1* — and with object-oriented design using the latest version of the *UML (Unified Modeling Language)* from the Object Management Group (OMG). We tuned the writing, the pedagogy, our coding style, the book's ancillary package and added a substantial treatment of developing database-driven Internet- and Web-based applications. We moved the *Tour of the Book* to the Preface. The tour will help instructors, students and professionals get a sense of the rich coverage the book provides of Java object-oriented programming, object-oriented design with the UML, and developing Internet- and Web-based applications. If you are evaluating the book, please be sure to read the *Tour of the Book*, which starts on page 33.

Whether you are an instructor, a student, an experienced professional or a novice programmer, this book has much to offer. Java is a world-class programming language for developing industrial-strength computer applications for devices ranging from cell phones and PDAs to the largest enterprise servers. We carefully audited the manuscript against the *Java Language Specification*,¹ which defines Java. As a result, the programs you create by studying this text should work with any J2SE 1.4.1 compatible Java platform.

In this Preface, we overview *Java How to Program, 5/e*'s comprehensive suite of educational materials that help instructors maximize their students' Java learning experience. We explain conventions we use, such as syntax coloring the code examples, "code washing" and highlighting important code segments to help focus students' attention on the key concepts introduced in each chapter. We overview the new features of *Java How to Program, 5/e*, including our enhanced treatment of object-oriented programming, Web-application development with servlets and JSP, the enhanced optional elevator-simulation object-oriented design (OOD) case study with the UML, the overview of design patterns and the extensive use of UML diagrams that have been upgraded to UML version 1.4 standards.

Prentice Hall has bundled a CD with the text that contains Sun Microsystem's *J2SE 1.4.1 Software Development Kit* (J2SDK) and their *Sun ONE Studio 4 (Community Edition)*, integrated development environment (IDE). To further support novice programmers, we offer several free *DIVE-INTO™ Series* publications that explain how to compile, execute and debug Java programs using the J2SDK, Sun ONE Studio (Community Edition) and Borland's *JBuilder Personal* edition. These publications are located at www.deitel.com/books/downloads.html with the resources for *Java How to Program, 5/e*.

We overview the complete package of ancillary materials available to instructors and students using *Java How to Program, 5/e*. These include an *Instructor's Resource CD* with solutions to most of the book's chapter exercises and a *Test-Item File* with hundreds of multiple-choice questions and answers. Additional instructor resources are available at the book's Companion Web Site (www.prenhall.com/deitel), which includes a *Syllabus Manager* and customizable PowerPoint® Lecture Notes. Numerous support materials are available for students at the Companion Web Site, as well. For instructors who want to hold closed-lab sessions (or highly structured homework assignments), we provide a lab manual, *Java in the Lab, Lab Manual to Accompany Java How to Program, Fifth Edition*. This publication includes carefully constructed Prelab Activities, Lab Exercises and Postlab Activities for a closed lab setting. Instructors can obtain the solutions manual to *Java in the Lab* from their regular Prentice Hall representatives.

We overview *The Java 2 Multimedia Cyber Classroom, 5/e* — an interactive, multimedia CD-based version of the book. This learning aid provides extensive interactivity features including hyperlinking, text search, audio "walkthroughs" of programs, Flash® animations and hundreds of exercises and solutions. We describe how to order both the *Cyber Classroom* and *The*

¹ Electronic HTML and PDF copies of the *Java Language Specification* are available free at the Sun Microsystem's Java Web site at java.sun.com/docs/books/jls/index.html.

Complete Java 2 Training Course, 5/e, boxed product, which contains the *Cyber Classroom* and the textbook later in the preface.

We discuss several DEITEL™ e-learning initiatives, including an explanation of Deitel content available for the *Blackboard*, *CourseCompass* and *WebCT* Course Management Systems, each of which supports *Java How to Program, 5/e*. *Premium CourseCompass*, which offers enhanced Deitel content based on *The Java 2 Multimedia Cyber Classroom, 5/e*, will be available for Summer 2003 courses.

In preparation for this edition, *Java How to Program, 4/e*, was reviewed by 35 distinguished academics and industry professionals. After applying their comments, the manuscript for *Java How to Program, 5/e*, was reviewed by 44 distinguished academics and industry professionals. We list all the reviewers names and affiliations in the acknowledgements. The Preface concludes with information about the authors and about Deitel & Associates, Inc. Please send an e-mail to deitel@deitel.com if you have questions as you read this book; we will respond promptly. Please visit our Web site, www.deitel.com, regularly and be sure to sign up for the *Deitel™ Buzz ONLINE* e-mail newsletter at www.deitel.com/newsletter/subscribe.html. We use the Web site and the newsletter to keep our readers current on *Java How to Program, 5/e*, and all other DEITEL™ publications and services.

New Features in Java How to Program, Fifth Edition

This edition contains many new features and enhancements including:

Full-Color Presentation

This book is in full color to show programs and their outputs as they typically appear on a computer screen. We syntax color all the Java code, as do most Java integrated-development environments and code editors. This greatly improves code readability—an especially important goal, given that this book contains over 23,000 lines of code. Our syntax-coloring conventions are as follows²:

- comments appear in green
- keywords appear in dark blue
- errors and JSP scriptlet delimiters appear in red
- constants and literal values appear in light blue
- all other code appears in black

Code Highlighting

We have added extensive code highlighting. In our code walkthroughs, we have eliminated most of the “redundant” code snippets that appeared inline in the text in earlier editions. We kept them in the earliest portion of the book as a pedagogic device to help novices. We want the reader to see all new code features in context, so from Chapter 4 forward, our code walkthroughs simply refer to the line numbers of the new code segments inside complete source programs. To make it easier for readers to spot the featured segments, we highlight them in bright yellow. This helps students review the material rapidly when preparing for exams or labs.

“Code Washing”

Code washing is our term for applying extensive comments, using meaningful identifiers, applying indentation and using vertical spacing to separate meaningful program units. This process results in programs that are much more readable and self-documenting. We have done extensive “code washing” of all the source code programs in the text, the lab manual, the ancillaries and the *Cyber Classroom*.

Tuned Treatment of Object-Oriented Programming in Chapters 9 and 10

This is one of the most significant improvements in this new edition. We performed a high-precision upgrade of *Java How to Program, 4/e*, Chapter 9 and split it into two chapters. The improvements make the material clearer and more accessible to students and professionals, especially those studying object-oriented programming for the first time.

Chapter 9, Object-Oriented Programming: Inheritance. The new Chapter 9 carefully walks the reader through a five-example sequence that demonstrates `private` data, `protected` data and software reuse via inheritance. We begin by demonstrating a class with `private` instance variables and `public` methods to manipulate that data. Next, we implement a

2 本书代码段中已取消颜色的区分——编者注。

second class with several additional capabilities. To do this, we duplicate much of the first example's code. In our third example, we begin our discussion of inheritance and software reuse—we use the class from the first example as a superclass and inherit its data and functionality into a new subclass. This example introduces the inheritance mechanism and demonstrates that a subclass cannot access its superclass's `private` members directly. This motivates our fourth example, in which we introduce `protected` data in the superclass and demonstrate that the subclass can indeed access the `protected` data inherited from the superclass. The last example in the sequence demonstrates proper software engineering by defining the superclass's data as `private` and using the superclass's `public` methods (that were inherited by the subclass) to manipulate the superclass's `private` data from the subclass. We follow the five-part introduction with a three-level class hierarchy that employs the software engineering techniques introduced earlier in the chapter. The chapter closes with a discussion of software engineering with inheritance.

Chapter 10, Object-Oriented Programming: Polymorphism. The new Chapter 10 builds on the inheritance concepts presented in Chapter 9 and focuses on the relationships among classes in a class hierarchy. Chapter 10 uses a three-example sequence to present the powerful processing capabilities that these relationships enable. We begin with an example that illustrates the “is-a” relationship between a subclass object and its superclass type. This relationship enables the subclass object to be treated as an object of its superclass. We show that we are able to assign a subclass object's reference to a superclass variable and invoke the superclass's methods on that object. This example uses polymorphism, which enables a program to process objects of classes related by a class hierarchy as objects of their superclass type. When a method is invoked via a superclass variable, the subclass-specific version of that method is invoked. In our second example, we demonstrate that the reverse is not true—a superclass object is not considered to be an object of its subclass type—and we show that compiler errors occur if a program attempts to manipulate a superclass object in this manner. Our third example demonstrates that the only methods which can be invoked through a superclass variable are those methods defined by the superclass type. The example shows that attempts to invoke subclass-only methods result in compilation errors. The chapter continues with a case study on polymorphism in which we process an array of variables that contain references to objects. All the objects referenced by the elements of the array have a common abstract superclass containing the set of methods common to every class in the hierarchy. We conclude with a case study that demonstrates how a program that processes objects polymorphically can still perform type-specific processing by determining the type of the object currently being processed.

Java New I/O (NIO) APIs

Java's New I/O APIs are significant new additions to J2SE 1.4. We overview portions of these APIs in sections of three chapters. Section 11.8 demonstrates NIO's regular expression capabilities, which enable programs to search strings for character patterns. Section 17.13 introduces NIO's high-performance I/O classes that enable developers to take advantage of buffers, channels, charsets and more. This section also presents an example of using channels and buffers to write data to, and read data from, a file. Section 18.11 continues our discussion of the NIO APIs with an introduction to selectors and non-blocking I/O for implementing high-performance network servers. We then implement a distributed chat program that demonstrates these capabilities. Sections 11.8 and 17.13 also provide Web links for further study of the NIO APIs.

Database and Web-Applications Development with JDBC, Servlets and JSP

By popular demand, we have returned several topics to *Java How to Program, Fifth Edition*. Chapter 23, Java Database Connectivity with JDBC, demonstrates how to build data-driven applications with the JDBC™ API. Chapter 24, Servlets, and Chapter 25, JavaServer Pages™ (JSP), expand our treatment of Internet and Web programming topics and have everything readers need to begin developing their own Web-based applications that will run on the Internet! Readers will learn how to build so-called *n*-tier applications, in which the functionality provided by each tier can be distributed to separate computers across the Internet or executed on the same computer. In particular, we build a three-tier Web-based survey application and a three-tier Web-based guestbook application. Each application's information is stored in the application's data tier—in this book, a database implemented with IBM's Java-based Cloudscape database product (a trial version is on the CD that accompanies this book). The user enters requests and receives responses at each application's client tier, which is typically a computer running a Web browser such as Microsoft Internet Explorer or Netscape. Web browsers, of course, know how to communicate with Web sites throughout the Internet. The middle tier contains both a Web server and one or more application-specific servlets (in the case of our survey application) or JavaServer Pages (in the case of our guestbook application). We use Apache's Tomcat Web server as our application server for these examples. Tomcat, which is the reference implementation for the servlets and JavaServer Pages technologies, is included on the CD that accompanies this book and is available free for down-

load from `www.apache.org`. Tomcat communicates with the client tier across the Internet using the HyperText Transfer Protocol (HTTP). We discuss the crucial role of the Web server in Web programming and provide many examples demonstrating interactions between a Web browser and a Web server.

Unified Modeling Language™ (UML)

The Unified Modeling Language™ (UML) has become the preferred graphical modeling language for designing object-oriented systems. In *Java How to Program, Fourth Edition*, we used the UML in optional sections only, and we used conventional flowchart segments and inheritance diagrams to reinforce the explanations. We have fully converted the diagrams in the book to be UML 1.4 compliant. In particular, we upgraded all the figures in the UML/OOD Elevator Simulation case study; we converted all the flowcharts in Chapters 4 and 5 on Control Statements, to UML activity diagrams; and we converted all the inheritance diagrams in Chapters 9, 10, 12-13 and 15 to UML class diagrams.

This *Fifth Edition* carefully tunes the optional (but highly recommended) case study we present on object-oriented design using the UML. The case study was submitted to a distinguished team of OOD/UML reviewers, including leaders in the field from Rational (the creators of the UML) and the Object Management Group (responsible for maintaining and evolving the UML). In the case study, we fully implement an elevator simulation. In the “Thinking About Objects” sections at the ends of Chapters 1–8, 10–14, 16 and 19, we present a carefully paced introduction to object-oriented design using the UML. We present a concise, simplified subset of the UML then guide the reader through a first design experience intended for the novice object-oriented designer/programmer. The case study is fully solved. It is not an exercise; rather, it is an end-to-end learning experience that concludes with a detailed walkthrough of the Java code. In each of the first five chapters, we concentrate on the “conventional” methodology of structured programming, because the objects that we build will use these structured-program pieces. We conclude each chapter with a “Thinking About Objects” section, in which we present an introduction to object-oriented design (OOD) using the UML. These “Thinking About Objects” sections help students develop an object-oriented design, so that they immediately can use the object-oriented programming concepts they begin learning in Chapter 8. In the first of these sections at the end of Chapter 1, we introduce basic concepts and terminology of OOD. In the optional “Thinking About Objects” sections at the ends of Chapters 2–5, we consider more substantial issues, as we undertake a challenging problem with the techniques of OOD. We analyze a typical problem statement that requires a system to be built, determine the objects needed to implement that system, determine the attributes these objects need to have, determine the behaviors these objects need to exhibit and specify how the objects need to interact with one another to meet the system requirements. We accomplish this even before we discuss how to write Java programs. In Appendices D–F, we include a Java implementation of the object-oriented system we designed in the earlier chapters. This case study will help prepare students for the kinds of substantial projects they will encounter in industry. We employ a carefully developed, incremental object-oriented design process to produce a UML model for our elevator simulator. From this design, we produce a substantial working Java implementation using key programming notions, including classes, objects, encapsulation, visibility, composition and inheritance.

Discovering Design Patterns

These optional sections introduce popular object-oriented design patterns. Over the past decade, the software engineering industry has made significant progress in the field of *design patterns* — proven architectures for constructing flexible and maintainable object-oriented software.³ Using design patterns can substantially reduce the complexity of the design process. We present several design patterns in Java, but these can be implemented in any object-oriented language, such as C++, C# or Visual Basic .NET. We describe several design patterns used by Sun Microsystems in the Java API. We use design patterns in many programs in this book, which we will identify in our “Discovering Design Patterns” sections. These programs provide examples of using design patterns to construct reliable, robust object-oriented software.

Teaching Approach

Java How to Program, Fifth Edition contains a rich collection of examples, exercises, and projects drawn from many fields to provide the student with a chance to solve interesting real-world problems. The book concentrates on the principles of good software engineering and stresses program clarity. We avoid arcane terminology and syntax specifications in favor of teaching by example. Our code examples have been tested on popular Java platforms. We are educators who teach edge-of-the-practice topics in industry classrooms worldwide. The text emphasizes good pedagogy.

³ Gamma, Erich, Richard Helm, Ralph Johnson, and John Vlissides. *Design Patterns; Elements of Reusable Object-Oriented Software*. (Massachusetts: Addison-Wesley, 1995).