

Contents

Chapter 1 Introduction to Computers and Java 35

1.1 COMPUTER BASICS 36

Hardware and Memory 37

Programs 40

Programming Languages, Compilers, and Interpreters 41

Java Bytecode 43

Class Loader 45

1.2 A SIP OF JAVA 46

History of the Java Language 46

Applications and Applets 47

A First Java Application Program 48

Writing, Compiling, and Running a Java Program 53

1.3 PROGRAMMING BASICS 55

Object-Oriented Programming 55

Algorithms 59

Testing and Debugging 61

Software Reuse 62

1.4 GRAPHICS SUPPLEMENT 64

A Sample Graphics Applet 64

Size and Position of Figures 66

Drawing Ovals and Circles 68

Drawing Arcs 69

Running an Applet 71

Chapter 2 Basic Computation 81

2.1 VARIABLES AND EXPRESSIONS 82

Variables 83

Data Types 85

Java Identifiers	87
Assignment Statements	89
Simple Input	92
Simple Screen Output	94
Constants	94
Named Constants	96
Assignment Compatibilities	97
Type Casting	99
Arithmetic Operators	102
Parentheses and Precedence Rules	105
Specialized Assignment Operators	106
Case Study: Vending Machine Change	108
Increment and Decrement Operators	113
More About the Increment and Decrement Operators	114
2.2 THE CLASS String	115
String Constants and Variables	115
Concatenation of Strings	116
String Methods	117
String Processing	119
Escape Characters	122
The Unicode Character Set	123
2.3 KEYBOARD AND SCREEN I/O	125
Screen Output	125
Keyboard Input	128
Other Input Delimiters (Optional)	133
Formatted Output with printf (Optional)	135
2.4 DOCUMENTATION AND STYLE	137
Meaningful Variable Names	137
Comments	138
Indentation	141
Using Named Constants	141
2.5 GRAPHICS SUPPLEMENT	143
Style Rules Applied to a Graphics Applet	144
Creating a Java GUI Application with the JFrame Class	144
Introducing the Class JOptionPane	147
Reading Input as Other Numeric Types	157

Programming Example: Change-Making Program
with Windowing I/O 158

Chapter 3 Flow of Control: Branching 173

3.1 THE if-else STATEMENT 174

The Basic if-else Statement 175

Boolean Expressions 182

Comparing Strings 187

Nested if-else Statements 192

Multibranch if-else Statements 194

Programming Example: Assigning Letter Grades 196

Case Study: Body Mass Index 199

The Conditional Operator (*Optional*) 202

The exit Method 202

3.2 THE TYPE boolean 203

Boolean Variables 204

Precedence Rules 205

Input and Output of Boolean Values 208

3.3 THE switch STATEMENT 210

Enumerations 216

3.4 GRAPHICS SUPPLEMENT 217

Specifying a Drawing Color 218

A Dialog Box for a Yes-or-No Question 221

Chapter 4 Flow of Control: Loops 233

4.1 JAVA LOOP STATEMENTS 234

The while Statement 235

The do-while Statement 238

Programming Example: Bug Infestation 243

Programming Example: Nested Loops 249

The for Statement 251

Declaring Variables within a for Statement 257

Using a Comma in a for Statement (*Optional*) 258

The for-each Statement 260

4.2 PROGRAMMING WITH LOOPS 260

The Loop Body 261

Initializing Statements 262

Controlling the Number of Loop Iterations 263

Case Study: Using a Boolean Variable to End a Loop 265*Programming Example: Spending Spree* 267

The break Statement and continue Statement in Loops

(Optional) 270

Loop Bugs 273

Tracing Variables 275

Assertion Checks 277

4.3 GRAPHICS SUPPLEMENT 279*Programming Example: A Multiface Applet* 279

The drawstring Method 284

Chapter 5 Defining Classes and Methods 301**5.1 CLASS AND METHOD DEFINITIONS 303**

Class Files and Separate Compilation 305

Programming Example: Implementing a Dog Class 305

Instance Variables 306

Methods 309

Defining void Methods 312

Defining Methods That Return a Value 313

Programming Example: First Try at Implementing a Species Class 318

The Keyword this 322

Local Variables 324

Blocks 326

Parameters of a Primitive Type 327

5.2 INFORMATION HIDING AND ENCAPSULATION 333

Information Hiding 334

Precondition and Postcondition Comments 334

The public and private Modifiers 336

Programming Example: A Demonstration of Why Instance Variables Should Be Private 339*Programming Example: Another Implementation of a Class of Rectangles* 340

Accessor Methods and Mutator Methods 342

<i>Programming Example: A Purchase Class</i>	346
Methods Calling Methods	350
Encapsulation	356
Automatic Documentation with javadoc	359
UML Class Diagrams	360

5.3 OBJECTS AND REFERENCES 361

Variables of a Class Type	362
Defining an equals Method for a Class	367
<i>Programming Example: A Species Class</i>	371
Boolean-Valued Methods	374
<i>Case Study: Unit Testing</i>	376
Parameters of a Class Type	378
<i>Programming Example: Class-Type Parameters Versus Primitive-Type Parameters</i>	382

5.4 GRAPHICS SUPPLEMENT 386

The Graphics Class	386
<i>Programming Example: Multiple Faces, but with a Helping Method</i>	388
The Graphics2D Class and the Java2D™ API	392
The init Method	394
Adding Labels to an Applet	395

Chapter 6 More About Objects and Methods 417

6.1 CONSTRUCTORS 419

Defining Constructors	419
Calling Methods from Constructors	428
Calling a Constructor from Other Constructors (<i>Optional</i>)	431

6.2 STATIC VARIABLES AND STATIC METHODS 433

Static Variables	433
Static Methods	434
Dividing the Task of a main Method into Subtasks	441
Adding a main Method to a Class	442
The Math Class	444
Wrapper Classes	447

6.3 WRITING METHODS 453

<i>Case Study: Formatting Output</i>	453
Decomposition	459

Addressing Compiler Concerns 460

Testing Methods 462

6.4 OVERLOADING 464

Overloading Basics 464

Overloading and Automatic Type Conversion 467

Overloading and the Return Type 470

Programming Example: A Class for Money 472

6.5 INFORMATION HIDING REVISITED 479

Privacy Leaks 479

6.6 ENUMERATION AS A CLASS 483

6.7 PACKAGES 485

Packages and Importing 486

Package Names and Directories 487

Name Clashes 490

6.8 GRAPHICS SUPPLEMENT 491

Adding Buttons 491

Event-Driven Programming 493

Programming Buttons 493

Programming Example: A Complete Applet with Buttons 497

Adding Icons 500

Changing Visibility 502

Programming Example: An Example of Changing Visibility 502

Chapter 7 Arrays 525

7.1 ARRAY BASICS 527

Creating and Accessing Arrays 528

Array Details 531

The Instance Variable Length 534

More About Array Indices 537

Initializing Arrays 540

7.2 ARRAYS IN CLASSES AND METHODS 542

Case Study: Sales Report 542

Indexed Variables as Method Arguments 550

Entire Arrays as Arguments to a Method 553

Arguments for the Method `main` 554

Array Assignment and Equality 555

Methods That Return Arrays 558

7.3 PROGRAMMING WITH ARRAYS AND CLASSES 562

Programming Example: A Specialized List Class 562

Partially Filled Arrays 570

7.4 SORTING AND SEARCHING ARRAYS 572

Selection Sort 572

Other Sorting Algorithms 576

Searching an Array 578

7.5 MULTIDIMENSIONAL ARRAYS 579

Multidimensional-Array Basics 580

Multidimensional-Array Parameters and Returned Values 583

Java's Representation of Multidimensional Arrays 586

Ragged Arrays (*Optional*) 587

Programming Example: Employee Time Records 589

7.6 GRAPHICS SUPPLEMENT 595

Text Areas and Text Fields 595

Programming Example: A Question-and-Answer Applet 595

The Classes `JTextArea` and `JTextField` 598

Drawing Polygons 600

Chapter 8 Inheritance, Polymorphism, and Interfaces 623

8.1 INHERITANCE BASICS 624

Derived Classes 626

Overriding Method Definitions 630

Overriding Versus Overloading 631

The `final` Modifier 631

Private Instance Variables and Private Methods of a Base Class 632

UML Inheritance Diagrams 634

8.2 PROGRAMMING WITH INHERITANCE 637

Constructors in Derived Classes 637

The `this` Method—Again 639

Calling an Overridden Method 639

<i>Programming Example: A Derived Class of a Derived Class</i>	640
Another Way to Define the equals Methods in Undergraduate	645
Type Compatibility	645
The Class Object	650
A Better equals Method	652
8.3 POLYMORPHISM	654
Dynamic Binding and Inheritance	654
Dynamic Binding with toString	657
8.4 INTERFACES AND ABSTRACT CLASSES	659
Class Interfaces	659
Java Interfaces	660
Implementing an Interface	661
An Interface as a Type	663
Extending an Interface	666
<i>Case Study: Character Graphics</i>	667
<i>Case Study: The Comparable Interface</i>	680
Abstract Classes	684
8.5 GRAPHICS SUPPLEMENT	686
The Class JApplet	687
The Class JFrame	687
Window Events and Window Listeners	690
The ActionListener Interface	692
What to Do Next	692

Chapter 9 Exception Handling 705

9.1 BASIC EXCEPTION HANDLING 706

Exceptions in Java	707
Predefined Exception Classes	717

9.2 DEFINING YOUR OWN EXCEPTION CLASSES 719

9.3 MORE ABOUT EXCEPTION CLASSES 729

Declaring Exceptions (Passing the Buck)	729
Kinds of Exceptions	732
Errors	734
Multiple Throws and Catches	735
The finally Block	741

Rethrowing an Exception (*Optional*) 742

Case Study: A Line-Oriented Calculator 743

9.4 GRAPHICS SUPPLEMENT 755

Exceptions in GUIs 755

Programming Example: A JFrame GUI Using Exceptions 755

Chapter 10 Streams, File I/O, and Networking 773

10.1 AN OVERVIEW OF STREAMS AND FILE I/O 775

The Concept of a Stream 775

Why Use Files for I/O? 776

Text Files and Binary Files 776

10.2 TEXT-FILE I/O 778

Creating a Text File 778

Appending to a Text File 784

Reading from a Text File 786

10.3 TECHNIQUES FOR ANY FILE 789

The Class `File` 789

Programming Example: Reading a File Name
from the Keyboard 789

Using Path Names 791

Methods of the Class `File` 792

Defining a Method to Open a Stream 794

Case Study: Processing a Comma-Separated Values File 796

10.4 BASIC BINARY-FILE I/O 799

Creating a Binary File 799

Writing Primitive Values to a Binary File 801

Writing Strings to a Binary File 804

Some Details About `writeUTF` 805

Reading from a Binary File 806

The Class `EOFException` 812

Programming Example: Processing a File of Binary Data 814

10.5 BINARY-FILE I/O WITH OBJECTS AND ARRAYS 819

Binary-File I/O with Objects of a Class 819

Some Details of Serialization 823

Array Objects in Binary Files 824

10.6 NETWORK COMMUNICATION WITH STREAMS 827**10.7 GRAPHICS SUPPLEMENT 833**

Programming Example: A JFrame GUI for Manipulating Files 833

Chapter 11 Recursion 855**11.1 THE BASICS OF RECURSION 856**

Case Study: Digits to Words 860

How Recursion Works 864

Infinite Recursion 868

Recursive Methods Versus Iterative Methods 870

Recursive Methods That Return a Value 872

11.2 PROGRAMMING WITH RECURSION 876

Programming Example: Insisting That User Input Be Correct 876

Case Study: Binary Search 878

Programming Example: Merge Sort—A Recursive Sorting Method 886

Chapter 12 Dynamic Data Structures and Generics 903**12.1 ARRAY-BASED DATA STRUCTURES 905**

The Class `ArrayList` 906

Creating an Instance of `ArrayList` 906

Using the Methods of `ArrayList` 908

Programming Example: A To-Do List 912

Parameterized Classes and Generic Data Types 915

12.2 THE JAVA COLLECTIONS FRAMEWORK 915

The Collection Interface 915

The Class `HashSet` 916

The Map Interface 918

The Class `HashMap` 918

12.3 LINKED DATA STRUCTURES 921

The Class `LinkedList` 921

Linked Lists 922

Implementing the Operations of a Linked List 925

A Privacy Leak 932

Inner Classes 933

Node Inner Classes 934
Iterators 934
The Java Iterator Interface 946
Exception Handling with Linked Lists 946
Variations on a Linked List 948
Other Linked Data Structures 950

12.4 GENERICS 951

The Basics 951
Programming Example: A Generic Linked List 954

APPENDICES

- 1 Getting Java** 975
- 2 Running Applets** 976
- 3 Protected and Package Modifiers** 978
- 4 The DecimalFormat Class** 979
Other Pattern Symbols 980
- 5 Javadoc** 983
Commenting Classes for Use within javadoc 983
Running javadoc 984
- 6 Differences Between C++ and Java** 986
Primitive Types 986
Strings 986
Flow of Control 986
Testing for Equality 987
main Method (Function) and Other Methods 987
Files and Including Files 987
Class and Method (Function) Definitions 988
No Pointer Types in Java 988
Method (Function) Parameters 988
Arrays 988
Garbage Collection 989
Other Comparisons 989
- 7 Unicode Character Codes** 990
- 8 Introduction to Java 8 Functional Programming** 991

INDEX 996