



# Contents

Chapters 26–34 and Appendices F–N are PDF documents posted online at the book’s Companion Website (located at [www.pearsonhighered.com/deitel/](http://www.pearsonhighered.com/deitel/)). See the inside front cover for information on accessing the Companion Website.

**Foreword** **xxiii**

**Preface** **xxv**

**Before You Begin** **xxxix**

<b>I</b>	<b>Introduction to Computers, the Internet and Java</b>	<b>I</b>
1.1	Introduction	2
1.2	Hardware and Software	4
	1.2.1 Moore’s Law	4
	1.2.2 Computer Organization	5
1.3	Data Hierarchy	6
1.4	Machine Languages, Assembly Languages and High-Level Languages	9
1.5	Introduction to Object Technology	10
	1.5.1 The Automobile as an Object	10
	1.5.2 Methods and Classes	11
	1.5.3 Instantiation	11
	1.5.4 Reuse	11
	1.5.5 Messages and Method Calls	11
	1.5.6 Attributes and Instance Variables	11
	1.5.7 Encapsulation and Information Hiding	12
	1.5.8 Inheritance	12
	1.5.9 Interfaces	12
	1.5.10 Object-Oriented Analysis and Design (OOAD)	12
	1.5.11 The UML (Unified Modeling Language)	13
1.6	Operating Systems	13
	1.6.1 Windows—A Proprietary Operating System	13
	1.6.2 Linux—An Open-Source Operating System	14
	1.6.3 Android	14
1.7	Programming Languages	15
1.8	Java	17
1.9	A Typical Java Development Environment	17
1.10	Test-Driving a Java Application	21

1.11	Internet and World Wide Web	25
1.11.1	The Internet: A Network of Networks	26
1.11.2	The World Wide Web: Making the Internet User-Friendly	26
1.11.3	Web Services and Mashups	26
1.11.4	Ajax	27
1.11.5	The Internet of Things	27
1.12	Software Technologies	28
1.13	Keeping Up-to-Date with Information Technologies	30

## 2 Introduction to Java Applications; Input/Output and Operators 34

2.1	Introduction	35
2.2	Your First Program in Java: Printing a Line of Text	35
2.3	Modifying Your First Java Program	41
2.4	Displaying Text with <code>printf</code>	43
2.5	Another Application: Adding Integers	45
2.5.1	<code>import</code> Declarations	45
2.5.2	Declaring Class Addition	46
2.5.3	Declaring and Creating a Scanner to Obtain User Input from the Keyboard	46
2.5.4	Declaring Variables to Store Integers	47
2.5.5	Prompting the User for Input	48
2.5.6	Obtaining an <code>int</code> as Input from the User	48
2.5.7	Prompting for and Inputting a Second <code>int</code>	49
2.5.8	Using Variables in a Calculation	49
2.5.9	Displaying the Result of the Calculation	49
2.5.10	Java API Documentation	49
2.6	Memory Concepts	50
2.7	Arithmetic	51
2.8	Decision Making: Equality and Relational Operators	54
2.9	Wrap-Up	58

## 3 Introduction to Classes, Objects, Methods and Strings 69

3.1	Introduction	70
3.2	Instance Variables, <i>set</i> Methods and <i>get</i> Methods	71
3.2.1	Account Class with an Instance Variable, a <i>set</i> Method and a <i>get</i> Method	71
3.2.2	AccountTest Class That Creates and Uses an Object of Class Account	74
3.2.3	Compiling and Executing an App with Multiple Classes	77
3.2.4	Account UML Class Diagram with an Instance Variable and <i>set</i> and <i>get</i> Methods	77
3.2.5	Additional Notes on Class AccountTest	78

3.2.6	Software Engineering with <code>private</code> Instance Variables and <code>public set</code> and <code>get</code> Methods	79
3.3	Primitive Types vs. Reference Types	80
3.4	Account Class: Initializing Objects with Constructors	81
3.4.1	Declaring an Account Constructor for Custom Object Initialization	81
3.4.2	Class <code>AccountTest</code> : Initializing Account Objects When They're Created	82
3.5	Account Class with a Balance; Floating-Point Numbers	84
3.5.1	Account Class with a <code>balance</code> Instance Variable of Type <code>double</code>	85
3.5.2	<code>AccountTest</code> Class to Use Class <code>Account</code>	86
3.6	(Optional) GUI and Graphics Case Study: Using Dialog Boxes	90
3.7	Wrap-Up	93

## 4 Control Statements: Part 1; Assignment, ++ and -- Operators 101

4.1	Introduction	102
4.2	Algorithms	102
4.3	Pseudocode	103
4.4	Control Structures	103
4.5	<code>if</code> Single-Selection Statement	105
4.6	<code>if...else</code> Double-Selection Statement	106
4.7	Student Class: Nested <code>if...else</code> Statements	111
4.8	<code>while</code> Repetition Statement	113
4.9	Formulating Algorithms: Counter-Controlled Repetition	115
4.10	Formulating Algorithms: Sentinel-Controlled Repetition	119
4.11	Formulating Algorithms: Nested Control Statements	126
4.12	Compound Assignment Operators	131
4.13	Increment and Decrement Operators	131
4.14	Primitive Types	134
4.15	(Optional) GUI and Graphics Case Study: Creating Simple Drawings	135
4.16	Wrap-Up	139

## 5 Control Statements: Part 2; Logical Operators 152

5.1	Introduction	153
5.2	Essentials of Counter-Controlled Repetition	153
5.3	<code>for</code> Repetition Statement	155
5.4	Examples Using the <code>for</code> Statement	159
5.5	<code>do...while</code> Repetition Statement	163
5.6	<code>switch</code> Multiple-Selection Statement	165
5.7	Class <code>AutoPolicy</code> Case Study: Strings in <code>switch</code> Statements	171
5.8	<code>break</code> and <code>continue</code> Statements	174
5.9	Logical Operators	176
5.10	Structured Programming Summary	182
5.11	(Optional) GUI and Graphics Case Study: Drawing Rectangles and Ovals	187
5.12	Wrap-Up	190

<b>6</b>	<b>Methods: A Deeper Look</b>	<b>200</b>
6.1	Introduction	201
6.2	Program Modules in Java	201
6.3	static Methods, static Fields and Class Math	203
6.4	Declaring Methods with Multiple Parameters	205
6.5	Notes on Declaring and Using Methods	208
6.6	Method-Call Stack and Stack Frames	209
6.7	Argument Promotion and Casting	210
6.8	Java API Packages	211
6.9	Case Study: Secure Random-Number Generation	213
6.10	Case Study: A Game of Chance; Introducing enum Types	218
6.11	Scope of Declarations	222
6.12	Method Overloading	225
6.13	(Optional) GUI and Graphics Case Study: Colors and Filled Shapes	227
6.14	Wrap-Up	230
<b>7</b>	<b>Arrays and ArrayLists</b>	<b>243</b>
7.1	Introduction	244
7.2	Arrays	245
7.3	Declaring and Creating Arrays	246
7.4	Examples Using Arrays	247
7.4.1	Creating and Initializing an Array	247
7.4.2	Using an Array Initializer	248
7.4.3	Calculating the Values to Store in an Array	249
7.4.4	Summing the Elements of an Array	251
7.4.5	Using Bar Charts to Display Array Data Graphically	251
7.4.6	Using the Elements of an Array as Counters	253
7.4.7	Using Arrays to Analyze Survey Results	254
7.5	Exception Handling: Processing the Incorrect Response	256
7.5.1	The try Statement	256
7.5.2	Executing the catch Block	256
7.5.3	toString Method of the Exception Parameter	257
7.6	Case Study: Card Shuffling and Dealing Simulation	257
7.7	Enhanced for Statement	262
7.8	Passing Arrays to Methods	263
7.9	Pass-By-Value vs. Pass-By-Reference	265
7.10	Case Study: Class GradeBook Using an Array to Store Grades	266
7.11	Multidimensional Arrays	272
7.12	Case Study: Class GradeBook Using a Two-Dimensional Array	275
7.13	Variable-Length Argument Lists	281
7.14	Using Command-Line Arguments	283
7.15	Class Arrays	285
7.16	Introduction to Collections and Class ArrayList	287
7.17	(Optional) GUI and Graphics Case Study: Drawing Arcs	291
7.18	Wrap-Up	294

<b>8</b>	<b>Classes and Objects: A Deeper Look</b>	<b>315</b>
8.1	Introduction	316
8.2	Time Class Case Study	316
8.3	Controlling Access to Members	321
8.4	Referring to the Current Object's Members with the <code>this</code> Reference	322
8.5	Time Class Case Study: Overloaded Constructors	324
8.6	Default and No-Argument Constructors	330
8.7	Notes on <i>Set</i> and <i>Get</i> Methods	330
8.8	Composition	332
8.9	<code>enum</code> Types	335
8.10	Garbage Collection	337
8.11	<code>static</code> Class Members	338
8.12	<code>static</code> Import	342
8.13	<code>final</code> Instance Variables	343
8.14	Package Access	344
8.15	Using <code>BigDecimal</code> for Precise Monetary Calculations	345
8.16	(Optional) GUI and Graphics Case Study: Using Objects with Graphics	348
8.17	Wrap-Up	352
<b>9</b>	<b>Object-Oriented Programming: Inheritance</b>	<b>360</b>
9.1	Introduction	361
9.2	Superclasses and Subclasses	362
9.3	<code>protected</code> Members	364
9.4	Relationship Between Superclasses and Subclasses	365
9.4.1	Creating and Using a <code>CommissionEmployee</code> Class	365
9.4.2	Creating and Using a <code>BasePlusCommissionEmployee</code> Class	371
9.4.3	Creating a <code>CommissionEmployee–BasePlusCommissionEmployee</code> Inheritance Hierarchy	376
9.4.4	<code>CommissionEmployee–BasePlusCommissionEmployee</code> Inheritance Hierarchy Using <code>protected</code> Instance Variables	379
9.4.5	<code>CommissionEmployee–BasePlusCommissionEmployee</code> Inheritance Hierarchy Using <code>private</code> Instance Variables	382
9.5	Constructors in Subclasses	387
9.6	Class Object	387
9.7	(Optional) GUI and Graphics Case Study: Displaying Text and Images Using Labels	388
9.8	Wrap-Up	391
<b>10</b>	<b>Object-Oriented Programming: Polymorphism and Interfaces</b>	<b>395</b>
10.1	Introduction	396
10.2	Polymorphism Examples	398
10.3	Demonstrating Polymorphic Behavior	399
10.4	Abstract Classes and Methods	401

10.5	Case Study: Payroll System Using Polymorphism	404
10.5.1	Abstract Superclass <code>Employee</code>	405
10.5.2	Concrete Subclass <code>SalariedEmployee</code>	407
10.5.3	Concrete Subclass <code>HourlyEmployee</code>	409
10.5.4	Concrete Subclass <code>CommissionEmployee</code>	411
10.5.5	Indirect Concrete Subclass <code>BasePlusCommissionEmployee</code>	413
10.5.6	Polymorphic Processing, Operator <code>instanceof</code> and Downcasting	414
10.6	Allowed Assignments Between Superclass and Subclass Variables	419
10.7	<code>final</code> Methods and Classes	419
10.8	A Deeper Explanation of Issues with Calling Methods from Constructors	420
10.9	Creating and Using Interfaces	421
10.9.1	Developing a <code>Payable</code> Hierarchy	422
10.9.2	Interface <code>Payable</code>	423
10.9.3	Class <code>Invoice</code>	424
10.9.4	Modifying Class <code>Employee</code> to Implement Interface <code>Payable</code>	426
10.9.5	Modifying Class <code>SalariedEmployee</code> for Use in the <code>Payable</code> Hierarchy	428
10.9.6	Using Interface <code>Payable</code> to Process Invoices and Employees Polymorphically	430
10.9.7	Some Common Interfaces of the Java API	431
10.10	Java SE 8 Interface Enhancements	432
10.10.1	<code>default</code> Interface Methods	432
10.10.2	<code>static</code> Interface Methods	433
10.10.3	Functional Interfaces	433
10.11	(Optional) GUI and Graphics Case Study: Drawing with Polymorphism	433
10.12	Wrap-Up	436

## **11 Exception Handling: A Deeper Look** **441**

11.1	Introduction	442
11.2	Example: Divide by Zero without Exception Handling	443
11.3	Example: Handling <code>ArithmeticExceptions</code> and <code>InputMismatchExceptions</code>	445
11.4	When to Use Exception Handling	451
11.5	Java Exception Hierarchy	451
11.6	<code>finally</code> Block	454
11.7	Stack Unwinding and Obtaining Information from an Exception Object	459
11.8	Chained Exceptions	461
11.9	Declaring New Exception Types	464
11.10	Preconditions and Postconditions	465
11.11	Assertions	465
11.12	<code>try-with-Resources</code> : Automatic Resource Deallocation	467
11.13	Wrap-Up	467

## **12 GUI Components: Part I** **473**

12.1	Introduction	474
------	--------------	-----

12.2	Java's Nimbus Look-and-Feel	475
12.3	Simple GUI-Based Input/Output with JOptionPane	476
12.4	Overview of Swing Components	479
12.5	Displaying Text and Images in a Window	481
12.6	Text Fields and an Introduction to Event Handling with Nested Classes	485
12.7	Common GUI Event Types and Listener Interfaces	491
12.8	How Event Handling Works	493
12.9	JButton	495
12.10	Buttons That Maintain State	498
	12.10.1 JCheckBox	499
	12.10.2 JRadioButton	501
12.11	JComboBox; Using an Anonymous Inner Class for Event Handling	504
12.12	JList	508
12.13	Multiple-Selection Lists	511
12.14	Mouse Event Handling	513
12.15	Adapter Classes	518
12.16	JPanel Subclass for Drawing with the Mouse	522
12.17	Key Event Handling	525
12.18	Introduction to Layout Managers	528
	12.18.1 FlowLayout	530
	12.18.2 BorderLayout	532
	12.18.3 GridLayout	536
12.19	Using Panels to Manage More Complex Layouts	538
12.20	JTextArea	539
12.21	Wrap-Up	542
<b>13</b>	<b>Graphics and Java 2D</b>	<b>555</b>
13.1	Introduction	556
13.2	Graphics Contexts and Graphics Objects	558
13.3	Color Control	559
13.4	Manipulating Fonts	566
13.5	Drawing Lines, Rectangles and Ovals	571
13.6	Drawing Arcs	575
13.7	Drawing Polygons and Polylines	578
13.8	Java 2D API	581
13.9	Wrap-Up	588
<b>14</b>	<b>Strings, Characters and Regular Expressions</b>	<b>596</b>
14.1	Introduction	597
14.2	Fundamentals of Characters and Strings	597
14.3	Class String	598
	14.3.1 String Constructors	598
	14.3.2 String Methods length, charAt and getChars	599
	14.3.3 Comparing Strings	600

14.3.4	Locating Characters and Substrings in Strings	605
14.3.5	Extracting Substrings from Strings	607
14.3.6	Concatenating Strings	608
14.3.7	Miscellaneous String Methods	608
14.3.8	String Method <code>valueOf</code>	610
14.4	Class <code>StringBuilder</code>	611
14.4.1	<code>StringBuilder</code> Constructors	612
14.4.2	<code>StringBuilder</code> Methods <code>length</code> , <code>capacity</code> , <code>setLength</code> and <code>ensureCapacity</code>	612
14.4.3	<code>StringBuilder</code> Methods <code>charAt</code> , <code>setCharAt</code> , <code>getChars</code> and <code>reverse</code>	614
14.4.4	<code>StringBuilder</code> <code>append</code> Methods	615
14.4.5	<code>StringBuilder</code> Insertion and Deletion Methods	617
14.5	Class <code>Character</code>	618
14.6	Tokenizing Strings	623
14.7	Regular Expressions, Class <code>Pattern</code> and Class <code>Matcher</code>	624
14.8	Wrap-Up	633

## **15** Files, Streams and Object Serialization **644**

15.1	Introduction	645
15.2	Files and Streams	645
15.3	Using NIO Classes and Interfaces to Get File and Directory Information	647
15.4	Sequential-Access Text Files	651
15.4.1	Creating a Sequential-Access Text File	651
15.4.2	Reading Data from a Sequential-Access Text File	655
15.4.3	Case Study: A Credit-Inquiry Program	657
15.4.4	Updating Sequential-Access Files	661
15.5	Object Serialization	662
15.5.1	Creating a Sequential-Access File Using Object Serialization	663
15.5.2	Reading and Deserializing Data from a Sequential-Access File	668
15.6	Opening Files with <code>JFileChooser</code>	670
15.7	(Optional) Additional <code>java.io</code> Classes	673
15.7.1	Interfaces and Classes for Byte-Based Input and Output	673
15.7.2	Interfaces and Classes for Character-Based Input and Output	675
15.8	Wrap-Up	676

## **16** Generic Collections **684**

16.1	Introduction	685
16.2	Collections Overview	685
16.3	Type-Wrapper Classes	687
16.4	Autoboxing and Auto-Unboxing	687
16.5	Interface <code>Collection</code> and Class <code>Collections</code>	687
16.6	Lists	688
16.6.1	<code>ArrayList</code> and <code>Iterator</code>	689
16.6.2	<code>LinkedList</code>	691

16.7	Collections Methods	696
16.7.1	Method <code>sort</code>	697
16.7.2	Method <code>shuffle</code>	700
16.7.3	Methods <code>reverse</code> , <code>fill</code> , <code>copy</code> , <code>max</code> and <code>min</code>	702
16.7.4	Method <code>binarySearch</code>	704
16.7.5	Methods <code>addAll</code> , <code>frequency</code> and <code>disjoint</code>	706
16.8	Stack Class of Package <code>java.util</code>	708
16.9	Class <code>PriorityQueue</code> and Interface <code>Queue</code>	710
16.10	Sets	711
16.11	Maps	714
16.12	<code>Properties</code> Class	718
16.13	Synchronized Collections	721
16.14	Unmodifiable Collections	721
16.15	Abstract Implementations	722
16.16	Wrap-Up	722
<b>17</b>	<b>Java SE 8 Lambdas and Streams</b>	<b>729</b>
17.1	Introduction	730
17.2	Functional Programming Technologies Overview	731
17.2.1	Functional Interfaces	732
17.2.2	Lambda Expressions	733
17.2.3	Streams	734
17.3	<code>IntStream</code> Operations	736
17.3.1	Creating an <code>IntStream</code> and Displaying Its Values with the <code>forEach</code> Terminal Operation	738
17.3.2	Terminal Operations <code>count</code> , <code>min</code> , <code>max</code> , <code>sum</code> and <code>average</code>	739
17.3.3	Terminal Operation <code>reduce</code>	739
17.3.4	Intermediate Operations: Filtering and Sorting <code>IntStream</code> Values	741
17.3.5	Intermediate Operation: Mapping	742
17.3.6	Creating Streams of <code>ints</code> with <code>IntStream</code> Methods <code>range</code> and <code>rangeClosed</code>	743
17.4	<code>Stream&lt;Integer&gt;</code> Manipulations	743
17.4.1	Creating a <code>Stream&lt;Integer&gt;</code>	744
17.4.2	Sorting a <code>Stream</code> and Collecting the Results	745
17.4.3	Filtering a <code>Stream</code> and Storing the Results for Later Use	745
17.4.4	Filtering and Sorting a <code>Stream</code> and Collecting the Results	745
17.4.5	Sorting Previously Collected Results	745
17.5	<code>Stream&lt;String&gt;</code> Manipulations	746
17.5.1	Mapping Strings to Uppercase Using a Method Reference	747
17.5.2	Filtering Strings Then Sorting Them in Case-Insensitive Ascending Order	748
17.5.3	Filtering Strings Then Sorting Them in Case-Insensitive Descending Order	748
17.6	<code>Stream&lt;Employee&gt;</code> Manipulations	748
17.6.1	Creating and Displaying a <code>List&lt;Employee&gt;</code>	750

17.6.2	Filtering Employees with Salaries in a Specified Range	751
17.6.3	Sorting Employees By Multiple Fields	752
17.6.4	Mapping Employees to Unique Last Name Strings	754
17.6.5	Grouping Employees By Department	755
17.6.6	Counting the Number of Employees in Each Department	756
17.6.7	Summing and Averaging Employee Salaries	756
17.7	Creating a <code>Stream&lt;String&gt;</code> from a File	758
17.8	Generating Streams of Random Values	761
17.9	Lambda Event Handlers	763
17.10	Additional Notes on Java SE 8 Interfaces	763
17.11	Java SE 8 and Functional Programming Resources	764
17.12	Wrap-Up	764

## **18 Recursion** **776**

18.1	Introduction	777
18.2	Recursion Concepts	778
18.3	Example Using Recursion: Factorials	779
18.4	Reimplementing Class <code>FactorialCalculator</code> Using Class <code>BigInteger</code>	781
18.5	Example Using Recursion: Fibonacci Series	783
18.6	Recursion and the Method-Call Stack	786
18.7	Recursion vs. Iteration	787
18.8	Towers of Hanoi	789
18.9	Fractals	791
	18.9.1 Koch Curve Fractal	791
	18.9.2 (Optional) Case Study: Lo Feather Fractal	792
18.10	Recursive Backtracking	801
18.11	Wrap-Up	802

## **19 Searching, Sorting and Big O** **810**

19.1	Introduction	811
19.2	Linear Search	812
19.3	Big O Notation	814
	19.3.1 $O(1)$ Algorithms	814
	19.3.2 $O(n)$ Algorithms	815
	19.3.3 $O(n^2)$ Algorithms	815
	19.3.4 Big O of the Linear Search	816
19.4	Binary Search	816
	19.4.1 Binary Search Implementation	817
	19.4.2 Efficiency of the Binary Search	820
19.5	Sorting Algorithms	820
19.6	Selection Sort	821
	19.6.1 Selection Sort Implementation	821
	19.6.2 Efficiency of the Selection Sort	824
19.7	Insertion Sort	824

19.7.1	Insertion Sort Implementation	825
19.7.2	Efficiency of the Insertion Sort	827
19.8	Merge Sort	827
19.8.1	Merge Sort Implementation	828
19.8.2	Efficiency of the Merge Sort	832
19.9	Big O Summary for This Chapter’s Searching and Sorting Algorithms	833
19.10	Wrap-Up	834

**20 Generic Classes and Methods 839**

20.1	Introduction	840
20.2	Motivation for Generic Methods	840
20.3	Generic Methods: Implementation and Compile-Time Translation	842
20.4	Additional Compile-Time Translation Issues: Methods That Use a Type Parameter as the Return Type	845
20.5	Overloading Generic Methods	848
20.6	Generic Classes	849
20.7	Raw Types	856
20.8	Wildcards in Methods That Accept Type Parameters	860
20.9	Wrap-Up	864

**21 Custom Generic Data Structures 869**

21.1	Introduction	870
21.2	Self-Referential Classes	871
21.3	Dynamic Memory Allocation	871
21.4	Linked Lists	872
21.4.1	Singly Linked Lists	872
21.4.2	Implementing a Generic List Class	873
21.4.3	Generic Classes ListNode and List	878
21.4.4	Class ListTest	878
21.4.5	List Method insertAtFront	878
21.4.6	List Method insertAtBack	879
21.4.7	List Method removeFromFront	880
21.4.8	List Method removeFromBack	881
21.4.9	List Method print	882
21.4.10	Creating Your Own Packages	882
21.5	Stacks	886
21.6	Queues	890
21.7	Trees	893
21.8	Wrap-Up	900

**22 GUI Components: Part 2 911**

22.1	Introduction	912
22.2	JSlider	912

22.3	Understanding Windows in Java	916
22.4	Using Menus with Frames	917
22.5	JPopupMenu	925
22.6	Pluggable Look-and-Feel	928
22.7	JDesktopPane and JInternalFrame	933
22.8	JTabbedPane	936
22.9	BoxLayout Layout Manager	938
22.10	GridBagLayout Layout Manager	942
22.11	Wrap-Up	952

## **23**    **Concurrency**    **957**

23.1	Introduction	958
23.2	Thread States and Life Cycle	960
23.2.1	<i>New</i> and <i>Runnable</i> States	961
23.2.2	<i>Waiting</i> State	961
23.2.3	<i>Timed Waiting</i> State	961
23.2.4	<i>Blocked</i> State	961
23.2.5	<i>Terminated</i> State	961
23.2.6	Operating-System View of the <i>Runnable</i> State	962
23.2.7	Thread Priorities and Thread Scheduling	962
23.2.8	Indefinite Postponement and Deadlock	963
23.3	Creating and Executing Threads with the Executor Framework	963
23.4	Thread Synchronization	967
23.4.1	Immutable Data	968
23.4.2	Monitors	968
23.4.3	Unsynchronized Mutable Data Sharing	969
23.4.4	Synchronized Mutable Data Sharing—Making Operations Atomic	974
23.5	Producer/Consumer Relationship without Synchronization	976
23.6	Producer/Consumer Relationship: ArrayBlockingQueue	984
23.7	(Advanced) Producer/Consumer Relationship with synchronized, wait, notify and notifyAll	987
23.8	(Advanced) Producer/Consumer Relationship: Bounded Buffers	994
23.9	(Advanced) Producer/Consumer Relationship: The Lock and Condition Interfaces	1002
23.10	Concurrent Collections	1009
23.11	Multithreading with GUI: SwingWorker	1011
23.11.1	Performing Computations in a Worker Thread: Fibonacci Numbers	1012
23.11.2	Processing Intermediate Results: Sieve of Eratosthenes	1018
23.12	sort and parallelSort Timings with the Java SE 8 Date/Time API	1025
23.13	Java SE 8: Sequential vs. Parallel Streams	1027
23.14	(Advanced) Interfaces Callable and Future	1030
23.15	(Advanced) Fork/Join Framework	1034
23.16	Wrap-Up	1034

<b>24</b>	<b>Accessing Databases with JDBC</b>	<b>1045</b>
24.1	Introduction	1046
24.2	Relational Databases	1047
24.3	A books Database	1048
24.4	SQL	1052
24.4.1	Basic SELECT Query	1052
24.4.2	WHERE Clause	1053
24.4.3	ORDER BY Clause	1055
24.4.4	Merging Data from Multiple Tables: INNER JOIN	1056
24.4.5	INSERT Statement	1058
24.4.6	UPDATE Statement	1059
24.4.7	DELETE Statement	1060
24.5	Setting up a Java DB Database	1060
24.5.1	Creating the Chapter's Databases on Windows	1061
24.5.2	Creating the Chapter's Databases on Mac OS X	1062
24.5.3	Creating the Chapter's Databases on Linux	1063
24.6	Manipulating Databases with JDBC	1063
24.6.1	Connecting to and Querying a Database	1063
24.6.2	Querying the books Database	1067
24.7	RowSet Interface	1080
24.8	PreparedStatement	1082
24.9	Stored Procedures	1098
24.10	Transaction Processing	1098
24.11	Wrap-Up	1099
<b>25</b>	<b>JavaFX GUI: Part I</b>	<b>1107</b>
25.1	Introduction	1108
25.2	JavaFX Scene Builder and the NetBeans IDE	1109
25.3	JavaFX App Window Structure	1110
25.4	<b>Welcome App—Displaying Text and an Image</b>	1111
25.4.1	Creating the App's Project	1111
25.4.2	NetBeans <b>Projects</b> Window—Viewing the Project Contents	1113
25.4.3	Adding an Image to the Project	1114
25.4.4	Opening JavaFX Scene Builder from NetBeans	1114
25.4.5	Changing to a VBox Layout Container	1115
25.4.6	Configuring the VBox Layout Container	1116
25.4.7	Adding and Configuring a Label	1116
25.4.8	Adding and Configuring an ImageView	1116
25.4.9	Running the Welcome App	1117
25.5	<b>Tip Calculator App—Introduction to Event Handling</b>	1118
25.5.1	Test-Driving the <b>Tip Calculator</b> App	1119
25.5.2	Technologies Overview	1119
25.5.3	Building the App's GUI	1122
25.5.4	TipCalculator Class	1126
25.5.5	TipCalculatorController Class	1128

25.6	Features Covered in the Online JavaFX Chapters	1133
25.7	Wrap-Up	1134

## **Chapters on the Web** **1141**

### **A Operator Precedence Chart** **1143**

### **B ASCII Character Set** **1145**

### **C Keywords and Reserved Words** **1146**

### **D Primitive Types** **1147**

### **E Using the Debugger** **1148**

E.1	Introduction	1149
E.2	Breakpoints and the run, stop, cont and print Commands	1149
E.3	The print and set Commands	1153
E.4	Controlling Execution Using the step, step up and next Commands	1155
E.5	The watch Command	1158
E.6	The clear Command	1160
E.7	Wrap-Up	1162

## **Appendices on the Web** **1165**

## **Index** **1167**

## **Online Chapters and Appendices**

Chapters 26–34 and Appendices F–N are PDF documents posted online at the book’s Companion Website (located at [www.pearsonhighered.com/deite1/](http://www.pearsonhighered.com/deite1/)). See the inside front cover for information on accessing the Companion Website.

## **26 JavaFX GUI: Part 2**

## **27 JavaFX Graphics and Multimedia**

## **28 Networking**

## **29 Java Persistence API (JPA)**

## **30 JavaServer™ Faces Web Apps: Part I**

- 31** **JavaServer™ Faces Web Apps: Part 2**
- 32** **REST-Based Web Services**
- 33** **(Optional) ATM Case Study, Part 1:  
Object-Oriented Design with the UML**
- 34** **(Optional) ATM Case Study, Part 2:  
Implementing an Object-Oriented Design**
- F** **Using the Java API Documentation**
- G** **Creating Documentation with javadoc**
- H** **Unicode®**
- I** **Formatted Output**
- J** **Number Systems**
- K** **Bit Manipulation**
- L** **Labeled break and continue Statements**
- M** **UML 2: Additional Diagram Types**
- N** **Design Patterns**

