

Contents

Part 1 Introduction to Object Orientation

1	Introduction to Object Orientation	3
1.1	Introduction	3
1.2	Programming Paradigms	3
1.3	Revolution Versus Evolution	4
1.4	Why Learn a New Programming Paradigm?	5
1.4.1	Software Industry Blues	5
1.4.2	The Advantages Claimed for Object Orientation	7
1.4.3	What Are the Problems and Pitfalls of Object Orientation?	7
1.5	Pedigree of Object-Oriented Languages	10
1.6	Fundamentals of Object Orientation	11
1.7	The Basic Principles of Object Orientation	12
1.8	Encapsulation	13
1.9	Inheritance	14
1.10	Abstraction	16
1.11	Polymorphism	17
1.11.1	Overloading Operators	17
1.11.2	Overriding Operators	18
1.12	Summary	18
1.13	Further Reading	19
2	Elements of Object Orientation	21
2.1	Introduction	21
2.2	Terminology	21
2.3	Types of Hierarchy	23
2.4	The Move to Object Technology	25
2.5	Summary	25
2.6	Exercises	26
2.7	Further Reading	26
3	Constructing an Object-Oriented System	27
3.1	Introduction	27
3.2	The Application: Windscreen Wipe Simulation	27
3.3	Where Do We Start?	28
3.4	Identifying the Objects	29
3.5	Identifying the Services Or Methods	30
3.6	Refining the Objects	31
3.7	Bringing it All Together	31
3.8	Where Is the Structure?	34
3.9	Summary	35
3.10	Exercise	35
3.11	Further Reading	36

Part 2 Introduction to the Java Language

4	A Brief History of Time, the Universe and Java	39
4.1	Introduction	39
4.2	What Is Java?	39
4.3	Objects in Java	40
4.4	History	40
4.5	Commercial Versions of Java	41
4.6	The Java Environment	41
4.6.1	What Is in a Name?	42
4.6.2	What Is JavaScript?	44
4.6.3	Applications and Applets	44
4.6.4	Applications in Java	44
4.7	Further Reading	45
4.8	Where to Get More Information	45
5	A Little Java	47
5.1	Introduction	47
5.2	Setting up the Development Environment	48
5.3	Compiling and Executing Java	48
5.4	Using the Java Documentation Tool	50
5.5	Summary	51
5.6	Further Reading	51
6	Java Building Blocks	53
6.1	Introduction	53
6.2	The Basics of the Language	53
6.2.1	Some Terminology	54
6.2.2	The Message-Passing Mechanism	54
6.2.3	The Statement Terminator	54
6.3	Classes	54
6.3.1	Class Definitions	55
6.3.2	Classes and Messages	55
6.3.3	Instances and Instance Variables	56
6.3.4	Classes and Inheritance	56
6.3.5	Instance Creation	58
6.3.6	Constructors	59
6.3.7	Static Initialization Blocks	59
6.3.8	Finalize Methods	60
6.3.9	Supplied Classes	60
6.4	Method Definitions	61
6.4.1	The Comments Section	61
6.4.2	The Local Variables Section	61
6.4.3	The Statements Section	62
6.4.4	The Return Operator	63
6.4.5	An Example Method	63
6.5	Interface Definitions	64
7	Java Constructs	67
7.1	Introduction	67
7.2	Numbers and Numeric Operators	67
7.2.1	Numeric Values	67
7.2.2	Arithmetic Operators	68

7.3	Characters and Strings	69
7.3.1	Characters	69
7.3.2	Strings	69
7.4	Assignments	70
7.5	Variables	71
7.5.1	Temporary Variables	71
7.5.2	Pseudo Variables	72
7.5.3	Variable Scope	73
7.5.4	Special Values – True, False and Null	73
7.6	Messages and Message Selectors	73
7.6.1	Invoking Methods	73
7.6.2	Precedence	74
7.7	Summary	74
7.8	Further Reading	74
8	An Example Java Class	75
8.1	Introduction	75
8.2	Defining a Class	75
8.2.1	Creating the Class	75
8.2.2	Defining a Class Comment	76
8.3	Defining a Method	76
8.3.1	The main Method	76
8.3.2	The Constructor	76
8.3.3	The Accessor Methods	77
8.3.4	The Updater Method	78
8.3.5	The birthday Method	78
8.4	Creating an Instance	78
Part 3 Java and Object Orientation		
9	Classes, Inheritance and Abstraction	83
9.1	Introduction	83
9.2	Classes Revisited	83
9.2.1	What Are Classes For?	84
9.2.2	Class-Side Methods	84
9.2.3	A Class or an Instance	85
9.3	Inheritance in Classes	86
9.3.1	The Role of a Subclass	86
9.3.2	Capabilities of Classes	87
9.3.3	Restricting a Subclass	88
9.4	Abstract Classes	89
9.5	Constructors and Their Use	90
9.6	The main Method	91
10	Encapsulation and Polymorphism	93
10.1	Introduction	93
10.2	Encapsulation	93
10.2.1	Class Modifiers	93
10.2.2	Variable Modifiers	93
10.2.3	Method Modifiers	94
10.3	Packages	94
10.3.1	Declaring a Package	94
10.3.2	An Example Package	95

10.3.3	Accessing Package Elements	96
10.3.4	An Example of Using a Package	96
10.4	Polymorphism	97
10.4.1	Dynamic or Late Binding	97
10.4.2	Method Selection	98
11	Inner Classes and Reflection	101
11.1	Introduction	101
11.2	What Are Inner Classes?	101
11.3	Types of Inner Class	103
11.3.1	Nested Top-Level Classes	103
11.3.2	Member Inner Classes	104
11.3.3	Method Level/Local Inner Classes	104
11.3.4	Anonymous Inner Classes	105
11.4	How and When Should I Use Inner Classes?	105
11.4.1	As Helper Classes	105
11.4.2	As Event Handlers	105
11.4.3	As Anonymous Event Handlers	106
11.4.4	Laying Out a Java Class With Inner Classes	106
11.4.5	Inner class guidelines	107
11.5	The Reflection API	107
12	Data Structures	113
12.1	Introduction	113
12.2	Data Structure Classes	113
12.3	The Abstract Class Dictionary	114
12.4	The Hashtable Class	114
12.5	The Vector Class	115
12.6	The Stack Class	118
12.7	A Queue Class	118
12.8	Enumeration	118
12.9	Arrays	119
12.9.1	Arrays of Objects	120
12.9.2	Basic Type Arrays	121
12.9.3	Multi-Dimensional Arrays	121
12.9.4	The main Method	122
12.10	Memory Management	124
12.10.1	Why Have Automatic Memory Management?	124
12.10.2	Memory Management in Java	125
12.10.3	When Is Garbage Collection Performed?	125
12.10.4	Checking the Available Memory	125
12.11	Exercise: Vectors	126
12.12	Summary	127
12.13	Further Reading	127
13	The Collections API	129
13.1	Introduction	129
13.2	What Is in the Collections API?	129
13.3	Collection Interfaces	131
13.3.1	Collection	131
13.3.2	Set	133
13.3.3	List	133
13.3.4	Map	134

13.3.5	Comparisons	135
13.4	Abstract Implementations	135
13.4.1	AbstractCollection	135
13.4.2	AbstractSet	136
13.4.3	AbstractList	136
13.4.4	AbstractSequentialList	137
13.4.5	AbstractMap	137
13.5	Concrete Implementations	137
13.5.1	HashSet	138
13.5.2	ArraySet	139
13.5.3	ArrayList	139
13.5.4	LinkedList	140
13.5.5	HashMap	141
13.5.6	ArrayMap	141
13.5.7	TreeMap	142
13.6	The Collections Class	142
13.7	Iteration Over Collections	143
13.8	Array Sorting and Searching	144
13.9	Choosing a Collection class	144
13.10	Summary	144

Part 4 Further Java

14	Control and Iteration	149
14.1	Introduction	149
14.2	Control Structures	149
14.2.1	The If Statement	149
14.2.2	The Conditional Operator	151
14.2.3	The switch Statement	151
14.3	Iteration	153
14.3.1	for Loops	153
14.3.2	while Loops	154
14.3.3	do Loops	154
14.3.4	An Example of Loops	155
14.4	Recursion	155
14.5	Summary	156
15	An Object-Oriented Organizer	157
15.1	Introduction	157
15.2	The Organizer Class	157
15.3	The Class Definition	158
15.4	The Updating Protocol	158
15.5	The Accessing Protocol	159
15.6	The main Method	160
15.7	Exercise – the Financial Manager Project	161
16	Streams and Files	163
16.1	Introduction	163
16.2	Streams	163
16.2.1	What Is a Stream?	163
16.2.2	Readers and Writers: Character Streams	165
16.2.3	Stream Tokenizers	167
16.2.4	Using the IO Classes	167

16.3	Files	171
16.3.1	Accessing File Information	171
16.3.2	The <code>FileReader</code> Class Constructors	171
16.3.3	The <code>FileWriter</code> Class Constructors	172
16.3.4	The <code>BufferedReader</code> Class Constructors	172
16.3.5	The <code>BufferedWriter</code> Class Constructors	172
16.3.6	The <code>StreamTokenizer</code> Class	172
16.3.7	The <code>PrintWriter</code> Class Constructors	173
16.3.8	Handling File IO Errors	173
16.4	Accessing a File	173
16.5	Creating a File	175
16.6	Input From the Console	176
16.7	Summary	177
17	Serialization	179
17.1	Introduction	179
17.1.1	Saving Objects	180
17.1.2	Reading Objects	180
17.2	The <code>ObjectOutputStream</code> Class	180
17.3	The <code>ObjectInputStream</code> Class	180
17.4	The <code>Serializable</code> Interface	181
17.5	The <code>transient</code> Keyword	182
17.6	The <code>Externalizable</code> Interface	182
17.7	A Simple Serialization Application	183
17.7.1	The <code>Person</code> Class	183
17.7.2	The <code>Family</code> Class	183
17.7.3	The <code>Test</code> Class	184
17.8	Exercise – Using Files With the Financial Manager	186
17.9	Summary	188
18	Observers and Observables	189
18.1	Introduction	189
18.2	The Dependency Mechanism	189
18.2.1	Why Do We Want Dependency?	189
18.2.2	How Does Dependency Work?	190
18.2.3	Constructing Dependencies	190
18.2.4	A Simple Dependency Example	191
18.2.5	Making Dependency Work for You	192
18.2.6	The “Changed” Methods	193
18.3	The <code>Observer</code> Interface	193
18.4	Extending the Dependency Example	194
18.5	Exercise – Dependency and the Financial Manager	196
18.6	Summary	196
Part 5 Graphical Interfaces and Applets		
19	Graphic Programming Using the Abstract Window Toolkit	199
19.1	Introduction	199
19.2	Windows as Objects	199
19.3	Windows in Java	200
19.4	The Abstract Window Toolkit	200
19.5	The <code>Component</code> Class	201
19.6	The <code>Container</code> Class	203

19.7	The Panel Class	204
19.8	The Frame Class	204
19.9	The Graphics Class	205
19.10	A Worked Graphical Application	207
19.10.1	The ExampleFrame Class	207
19.10.2	The ExamplePanel Class	209
19.11	Further Reading	210
20	User Interface Programming	211
20.1	Introduction	211
20.2	The Event Delegation Model	211
20.2.1	The Philosophy Behind the Event Model	211
20.2.2	A Partial Example	213
20.2.3	The Listener Interfaces	214
20.3	GUI Component Classes	215
20.3.1	The Button Class	215
20.3.2	The Checkbox Class	216
20.3.3	The CheckboxGroup Class	217
20.3.4	The Label Class	218
20.3.5	The TextComponent Class	218
20.3.6	The TextField Class	219
20.3.7	The TextArea Class	219
20.4	Additional AWT Classes	220
21	Managing Component Layout	221
21.1	Introduction	221
21.2	The FlowLayout Manager	221
21.3	The BorderLayout Manager	222
21.4	The GridLayout Manager	223
21.5	The GridBagLayout Manager	224
21.6	The CardLayout Manager	227
21.7	A Simple GUI Example	227
22	Putting the Swing into Java	231
22.1	Introduction	231
22.2	Swing, the JFC and the JDK	231
22.3	What Is the MVC?	232
22.4	Swinging the MVC Into Action	233
22.5	Transitioning to Swing	234
22.5.1	The SimpleGallery Application	234
22.6	A Swinging Gallery	237
22.7	Things to Remember	242
22.8	Online References	243
23	A GUI Case Study	245
23.1	Introduction	245
23.1.1	The Model-View-Handler Architecture	246
23.1.2	Event Listeners	247
23.1.3	Observers and Observables	247
23.1.4	Frames, Panels and Layout Managers	247
23.2	The Class Structure	248
23.2.1	The AccountInterface Class	248

23.2.2	The WindowHandler class	250
23.2.3	The JPanel Classes	250
23.2.4	The Handler Classes	251
23.2.5	The Account Class	254
23.3	The Instance Structure	255
23.4	Exercise – A GUI for the Financial Manager	255
23.5	Summary	256
23.6	Further Reading	256
24	The Lowdown on Layouts, Borders and Containers	257
24.1	Introduction	257
24.2	Containers in Swing	257
24.3	Layouts for Containers	258
24.3.1	The FlowLayout Manager	258
24.3.2	The BorderLayout Manager	259
24.3.3	The GridLayout Manager	259
24.3.4	The GridBagLayout Manager	260
24.3.5	BoxLayout	260
24.3.6	OverlayLayout	262
24.4	Borders in Swing	262
24.4.1	The BorderFactory	264
24.4.2	Empty Borders	265
24.4.3	LineBorder class	266
24.4.4	BevelBorder and SoftBevelBorder	266
24.4.5	EtchedBorder	267
24.4.6	The MatteBorder class	267
24.4.7	The TitledBorder	268
24.4.8	CompoundBorder class	269
24.5	Using Panels, Layouts and Borders	270
24.6	Planning a Display	270
24.7	Online References	271
25	Combining Graphics and GUI Components	273
25.1	Introduction	273
25.2	The SwingDraw Application	273
25.3	The Structure of the Application	273
25.4	The Interactions Between Objects	277
25.4.1	The Draw Constructor	278
25.4.2	Changing the Type of Graphic Object	278
25.4.3	Adding a Graphic Object	279
25.4.4	Moving a Graphic Object	280
25.5	The Classes	281
25.5.1	The SwingDraw Class	281
25.5.2	The DrawMenuBar class	283
25.5.3	The DrawToolBar and ButtonPanel Classes	284
25.5.4	The ToolHandler Class	285
25.5.5	The Drawing Class	286
25.5.6	The DrawingPanel Class	287
25.5.7	The DrawingController Class	289
25.5.8	The LookAndFeelPanel Class	291
25.5.9	The DrawingException Class	292
25.5.10	The Figure Class	293
25.5.11	The Square Class	295

25.5.12	The Circle Class	295
25.5.13	The Line Class	295
25.5.14	The TextFigure Class	297
25.5.15	The TextDialog Class	298
25.6	Exercises	298
25.7	Summary	299
26	Swing Data Model Case Study	301
26.1	Introduction	301
26.2	The JTree Swing Component	301
26.2.1	The JTree Constructors	302
26.2.2	The JTree API	303
26.2.3	Changing the Model	304
26.3	The JTree Package	305
26.3.1	Interfaces	305
26.3.2	Classes	305
26.3.3	The DefaultMutableTreeNode class	306
26.4	Building the Data Model	307
26.5	Building the GUI Application	308
26.6	Online Resources	314
27	Java: Speaking in Tongues	315
27.1	Introduction	315
27.2	Locale	316
27.3	Properties Objects	317
27.4	ResourceBundle Introduction	318
27.4.1	Naming Properties Files	319
27.4.2	Property Inheritance	320
27.4.3	Accessing Property Values	320
27.5	Formatting Output	321
27.6	Summary	322
27.7	Online References	322
28	The CUTting Edge	323
28.1	Introduction	323
28.2	The Simple Editor	323
28.3	Cutting and Copying Data	324
28.4	Pasting Data	325
28.5	Drag and Drop	327
28.5.1	DragLabel	327
28.5.2	DropTextArea	329
28.6	Summary	331
Part 6 Internet Working		
29	Sockets in Java	335
29.1	Introduction	335
29.2	Socket to socket communication	335
29.3	Setting Up a Connection	335
29.4	An Example Client-Server Application	336
29.4.1	The System Structure	336
29.4.2	Implementing the Server Application	336
29.4.3	Implementing the Client Application	338

30	Applets and the Internet	341
30.1	Introduction	341
30.2	Applet Security	342
30.3	The Applet Class	342
30.4	Working With Applets	344
30.5	The Account Applet	344
30.5.1	Change the Root Class Definition	345
30.5.2	Define the <code>init</code> Method	345
30.6	A Brief Introduction to HTML	346
30.7	The <code><applet></code> HTML Tag	347
30.8	Accessing HTML Files	348
30.9	Swing and Applets	349
30.10	Exercise: Tic-Tac-Toe Applet	349
30.10.1	What to Do	349
30.10.2	Notes	350
30.11	Summary	350
30.12	Further Reading	350
31	Servlets: Serving Java up on the Web	353
31.1	Introduction	353
31.2	How Servlets Work	354
31.3	The Structure of the Servlet API	355
31.4	An Example Servlet	356
31.5	Why Use Servlets?	359
31.6	Summary	360
31.7	Further Reading	360
32	Java Server Pages	361
32.1	Introduction	361
32.2	What Is a JSP?	361
32.3	A Very Simple JSP	363
32.4	The Components of a JSP	364
32.4.1	Directives	365
32.4.2	Actions	365
32.4.3	Implicit Objects	366
32.4.4	JSP Scripting	366
32.5	Making JSPs Interactive	367
32.6	Why Use JSPs?	368
32.7	Problems With JSPs	368
33	Java Database Connectivity	371
33.1	Introduction	371
33.2	What Is JDBC?	371
33.3	What the Driver Provides	373
33.4	Registering Drivers	373
33.5	Opening a Connection	374
33.6	Obtaining Data From a Database	375
33.7	Creating a Table	377
33.8	Applets and Databases	378
33.9	Mini SQL	379
33.10	Further Reading	379
33.11	Online References	379

Part 7 Java Development

34	Java Style Guidelines	383
34.1	Introduction	383
34.2	Code Layout	383
34.3	Variables	383
34.3.1	Naming Variables	383
34.3.2	Using Variables	385
34.4	Classes	386
34.4.1	Naming Classes	386
34.4.2	The Role of a Class	387
34.4.3	Creating New Data Structure Classes	387
34.4.4	Class Comments	387
34.4.5	Using a Class or an Instance	388
34.5	Interfaces	388
34.6	Enumerated Types	388
34.7	Methods	389
34.7.1	Naming Methods	389
34.7.2	Using Methods	390
34.7.3	Class Methods and Instance Methods	391
34.7.4	Static Initialization Blocks	391
34.7.5	Constructors	391
34.7.6	The finalize Method	391
34.7.7	Programming in Terms of Objects	391
34.7.8	Positioning of Methods	391
34.8	Scoping	392
34.9	Statement Labels	393
35	Exception Handling	395
35.1	Introduction	395
35.2	What Is an Exception?	395
35.3	What Is Exception Handling?	396
35.4	Throwing an Exception	397
35.5	Catching an Exception	398
35.6	Defining an Exception	400
36	Concurrency	403
36.1	Introduction	403
36.2	Concurrent Processes	403
36.3	Threads	404
36.3.1	Thread States	404
36.3.2	Creating a Thread	405
36.3.3	Thread Groups	405
36.4	The Thread Class	405
36.4.1	Implementing a Thread	406
36.4.2	Synchronization	407
36.5	A Time Slicing Example	408
36.5.1	Using Schedulers	408
36.5.2	The Time Slicing Source Code	408

Part 8 Object-Oriented Design

37	Object-Oriented Analysis and Design	415
37.1	Introduction	415
37.2	Object-Oriented Design Methods	415
37.3	Object-Oriented Analysis	415
37.4	The Booch Method	416
37.4.1	The Steps in the Booch Method	416
37.4.2	Strengths and Weaknesses	417
37.5	The Object Modeling Technique	417
37.5.1	The Analysis Phase	417
37.5.2	The Design Phase	418
37.5.3	The Implementation Phase	418
37.5.4	Strengths and Weaknesses	419
37.6	The Objectory Method	419
37.6.1	The Requirements Phase	419
37.6.2	The Analysis Phase	419
37.6.3	The Construction Phase	419
37.6.4	Strengths and Weaknesses	420
37.7	The Fusion Method	420
37.8	The Unified Modeling Language	421
37.9	Summary	421
38	The Unified Modeling Language	423
38.1	Introduction	423
38.2	The Meta-Model	424
38.3	The Models	424
38.4	Use Case Diagrams	425
38.5	The Object Model	426
38.5.1	Representing Classes	426
38.5.2	Representing Objects	428
38.5.3	Representing Relationships	428
38.6	Packages	432
38.7	Sequence Diagrams	434
38.8	Collaboration Diagrams	435
38.9	State Machine Diagrams	437
38.9.1	Start Points	437
38.9.2	Events	438
38.9.3	A Set of Transitions	438
38.9.4	A Set of State Variables	439
38.9.5	A Set of States	439
38.9.6	A Set of Exit Points	440
38.10	Deployment Diagrams	440
38.11	Summary	440
39	The Unified Process	443
39.1	Introduction	443
39.2	The Unified Process	443
39.2.1	Overview of the Unified Process	444
39.2.2	Life Cycle Phases	445
39.2.3	Phases, Iterations and Workflows	446
39.2.4	Workflows and Activities	448
39.3	Requirements Workflow	448

39.3.1	Interface Descriptions	449
39.4	Analysis Workflow	449
39.4.1	Analysis Model Classes	449
39.4.2	Constructing the Analysis Model	451
39.5	Design Workflow	454
39.5.1	Identifying Classes	454
39.5.2	Refining the Set of Classes	455
39.5.3	Identifying and Refining Attributes	455
39.5.4	Identifying and Refining Operations	455
39.5.5	Design Use Case Realizations	456
39.5.6	Generating a Sequence Diagram	456
39.5.7	Building a Statechart Diagram	456
39.5.8	Identifying and Refining Associations	457
39.5.9	Identifying Interfaces and Inheritance	457
39.5.10	Remaining Steps	458
39.6	Implementation Workflow	458
39.7	Testing Workflow	458
39.8	Summary	458

Part 9 The Future

40	Areas of Java and Object Technology not Covered	461
40.1	Introduction	461
40.2	Language Areas	461
40.2.1	Native Code	461
40.3	Java Virtual Machine	462
40.4	JavaBeans	462
40.5	Enterprise JavaBeans	463
40.6	Remote Method Invocation	464
40.7	Java and C++	465
40.8	CORBA	466
40.9	Java Naming and Directory Interface	467
40.10	Java and XML	468
40.11	Java 2D and Java 3D	468
40.12	Object-Oriented Databases	469

Appendices

A	The Java API Packages	471
B	Java Keywords	472

References	473
-------------------	------------

Index	477
--------------	------------