

Contents

Preface	xix
From Object Orientation to Patterns to True Object Orientation	xxi
From Artificial Intelligence to Patterns to True Object Orientation	xxviii
A Note About Conventions Used in This Book	xxx
Feedback	xxxiv
New in the Second Edition	xxxiv
Acknowledgments	xxxv

PART I

An Introduction to Object-Oriented Software Development	1
--	----------

Chapter 1

The Object-Oriented Paradigm	3
Overview	3
Before the Object-Oriented Paradigm: Functional Decomposition	4
The Problem of Requirements	6
Dealing with Changes: Using Functional Decomposition	8
Dealing with Changing Requirements	11
The Object-Oriented Paradigm	15
Object-Oriented Programming in Action	23
Special Object Methods	27
Summary	28
Review Questions	30

Chapter 2
The UML—The Unified Modeling Language _____ 33

Overview _____ 33
 What Is the UML? _____ 33
 Why Use the UML? _____ 34
 The Class Diagram _____ 35
 Interaction Diagrams _____ 42
 Summary _____ 45
 Review Questions _____ 45

PART II
The Limitations of Traditional Object-Oriented Design _____ 47

Chapter 3
A Problem That Cries Out for Flexible Code ____ 49

Overview _____ 49
 Extracting Information from a CAD/CAM System _____ 49
 Understand the Vocabulary _____ 50
 Describe the Problem _____ 52
 The Essential Challenges and Approaches _____ 55
 Summary _____ 58
 Review Questions _____ 59

Chapter 4
A Standard Object-Oriented Solution _____ 61

Overview _____ 61
 Solving with Special Cases _____ 61
 Summary _____ 70
 Review Questions _____ 71

PART III**Design Patterns** _____ **73****Chapter 5****An Introduction to Design Patterns** _____ **75**

Overview _____ 75

Design Patterns Arose from Architecture and Anthropology _____ 76

Moving from Architectural to Software Design Patterns _____ 81

Why Study Design Patterns? _____ 83

Other Advantages of Studying Design Patterns _____ 88

Summary _____ 90

Review Questions _____ 90

Chapter 6**The Facade Pattern** _____ **93**

Overview _____ 93

Introducing the Facade Pattern _____ 93

Learning the Facade Pattern _____ 94

Field Notes: The Facade Pattern _____ 97

Relating the Facade Pattern to the CAD/CAM Problem _____ 99

Summary _____ 99

Review Questions _____ 99

Chapter 7**The Adapter Pattern** _____ **101**

Overview _____ 101

Introducing the Adapter Pattern _____ 101

Learning the Adapter Pattern _____ 102

Field Notes: The Adapter Pattern _____ 107

Relating the Adapter Pattern to the CAD/CAM Problem _____ 111

Summary _____ 112

Review Questions _____ 112

Chapter 8
Expanding Our Horizons _____ **115**

Overview _____ 115

Objects: The Traditional View and the New View _____ 117

Encapsulation: The Traditional View and the New View _____ 119

Find What Is Varying and Encapsulate It _____ 123

Commonality and Variability Analysis and Abstract Classes ____ 127

The Qualities of Agile Coding _____ 130

Summary _____ 135

Review Questions _____ 136

Chapter 9
The Strategy Pattern _____ **139**

Overview _____ 139

An Approach to Handling New Requirements _____ 139

The International E-Commerce System Case Study:

 Initial Requirements _____ 142

Handling New Requirements _____ 143

The Strategy Pattern _____ 152

Field Notes: Using the Strategy Pattern _____ 154

Summary _____ 156

Review Questions _____ 157

Chapter 10
The Bridge Pattern _____ **159**

Overview _____ 159

Introducing the Bridge Pattern _____ 159

Learning the Bridge Pattern: An Example _____ 161

An Observation About Using Design Patterns _____ 172

Learning the Bridge Pattern: Deriving It _____ 173

The Bridge Pattern in Retrospect _____ 183

Field Notes: Using the Bridge Pattern _____ 183

Summary _____ 188

Review Questions _____ 191

Chapter 11**The Abstract Factory Pattern _____ 193**

Overview _____ 193

Introducing the Abstract Factory Pattern _____ 193

Learning the Abstract Factory Pattern: An Example _____ 194

Learning the Abstract Factory Pattern: Implementing It _____ 202

Field Notes: The Abstract Factory Pattern _____ 207

Relating the Abstract Factory Pattern to the CAD/CAM

Problem _____ 211

Summary _____ 211

Review Questions _____ 212

PART IV**Putting It All Together: Thinking in Patterns ____ 215****Chapter 12****How Do Experts Design? _____ 217**

Overview _____ 217

Building by Adding Distinctions _____ 217

Summary _____ 226

Review Questions _____ 226

Chapter 13**Solving the CAD/CAM Problem
with Patterns _____ 229**

Overview _____ 229

Review of the CAD/CAM Problem _____ 229

Thinking in Patterns _____ 231

Thinking in Patterns: Step 1 _____ 233

Thinking in Patterns: Step 2a _____ 233

Thinking in Patterns: Step 2b _____ 239

Thinking in Patterns: Step 2c _____ 244

Thinking in Patterns: Steps 2a and 2b Repeated (Facade) _____ 244

Thinking in Patterns: Steps 2a and 2b Repeated (Adapter)	245
Thinking in Patterns: Steps 2a and 2b Repeated (Abstract Factory)	246
Thinking in Patterns: Step 3	246
Comparison with the Previous Solution	247
Summary	249
Review Questions	250

PART V

Toward a New Paradigm of Design	251
--	------------

Chapter 14

The Principles and Strategies of Design

Patterns	253
-----------------	------------

Overview	253
The Open-Closed Principle	254
The Principle of Designing from Context	255
The Principle of Encapsulating Variation	261
Abstract Classes vs. Interfaces	262
The Principle of Healthy Skepticism	264
Summary	265
Review Questions	266

Chapter 15

Commonality and Variability Analysis	269
---	------------

Overview	269
Commonality and Variability Analysis and Application Design	269
Solving the CAD/CAM Problem with CVA	270
Summary	277
Review Questions	277

Chapter 16

The Analysis Matrix	279
----------------------------	------------

Overview	279
----------	-----

In the Real World: Variations _____ 279

The International E-Commerce System Case Study: Handling
 Variation _____ 280

Field Notes _____ 291

Summary _____ 294

Review Questions _____ 294

Chapter 17

The Decorator Pattern _____ 297

Overview _____ 297

A Little More Detail _____ 297

The Decorator Pattern _____ 300

Applying the Decorator Pattern to the Case Study _____ 301

Another Example: Input/Output _____ 305

Field Notes: Using the Decorator Pattern _____ 307

The Essence of the Decorator Pattern _____ 309

Summary _____ 310

Review Questions _____ 310

PART VI

Other Values of Patterns _____ 313

Chapter 18

The Observer Pattern _____ 315

Overview _____ 315

Categories of Patterns _____ 315

More Requirements for the International E-Commerce
 Case Study _____ 317

The Observer Pattern _____ 319

Applying the Observer to the Case Study _____ 319

Field Notes: Using the Observer Pattern _____ 325

Summary _____ 327

Review Questions _____ 328

Chapter 19
The Template Method Pattern _____ **331**

Overview _____ 331

More Requirements for the International E-Commerce
 Case Study _____ 331

The Template Method Pattern _____ 332

Applying the Template Method to the International
 E-Commerce Case Study _____ 333

Using the Template Method Pattern to Reduce Redundancy ____ 334

Field Notes: Using the Template Method Pattern _____ 340

Summary _____ 341

Review Questions _____ 343

PART VII
Factories _____ **345**

Chapter 20
Lessons from Design Patterns: Factories ____ **347**

Overview _____ 347

Factories _____ 347

The Universal Context Revisited _____ 349

Factories Follow Our Guidelines _____ 351

Limiting the Vectors of Change _____ 353

Another Way to Think About It _____ 354

Different Roles of Factories _____ 355

Field Notes _____ 355

Summary _____ 356

Review Questions _____ 356

Overview _____ 359

Chapter 21
**The Singleton Pattern and the Double-Checked
 Locking Pattern** _____ **359**

Introducing the Singleton Pattern _____ 360

Applying the Singleton Pattern to the Case Study _____ 361
 A Variant: The Double-Checked Locking Pattern _____ 364
 Reflections _____ 367
 Field Notes: Using the Singleton and Double-Checked Locking
 Patterns _____ 368
 Summary _____ 369
 Review Questions _____ 369

Chapter 22

The Object Pool Pattern _____ 371

Overview _____ 371
 A Problem Requiring the Management of Objects _____ 372
 The Object Pool Pattern _____ 381
 Observation: Factories Can Do Much More Than Instantiation _ 381
 Summary _____ 384
 Review Questions _____ 384

Chapter 23

The Factory Method Pattern _____ 385

Overview _____ 385
 More Requirements for the Case Study _____ 385
 The Factory Method Pattern _____ 386
 Factory Method Pattern and Object-Oriented Languages _____ 387
 Field Notes: Using the Factory Method Pattern _____ 388
 Summary _____ 390
 Review Questions _____ 390

Chapter 24

Summary of Factories _____ 393

Overview _____ 393
 Steps in the Software Process _____ 393
 Parallels in Factories and XP Practices _____ 395
 Scaling Systems _____ 395



PART VIII	
Endings and Beginnings	397
Chapter 25	
Design Patterns Reviewed: A Summation and a Beginning	399
Overview	399
A Summary of Object-Oriented Principles	400
How Design Patterns Encapsulate Implementations	401
Commonality and Variability Analysis and Design Patterns	401
Decomposing a Problem Domain into Responsibilities	402
Patterns and Contextual Design	403
Relationships Within a Pattern	404
Design Patterns and Agile Coding Practices	405
Field Notes	406
Summary	407
Review Questions	408
Chapter 26	
Bibliography	409
Design Patterns Explained: The Web Site Companion	410
Recommended Reading	410
Recommended Reading for Java Programmers	412
Recommended Reading for C++ Programmers	413
Recommended Reading for COBOL Programmers	414
Recommended Reading on eXtreme Programming	414
Recommended Reading on General Programming	415
Personal Favorites	415
Index	419