Contents

Preface xvii

Who This Book Is For xx

Acknowledgments xxi

Colophon xxiii

Introduction 1

Architecture 1

Enterprise Applications 2

Kinds of Enterprise Application 5

Thinking About Performance 6

Patterns 9

The Structure of the Patterns 11

Limitations of These Patterns 13

PART 1: The Narratives 15

Chapter 1: Layering 17

The Evolution of Layers in Enterprise Applications 18

The Three Principal Layers 19

Choosing Where to Run Your Layers 22

Chapter 2: Organizing Domain Logic 25

Making a Choice 29

Service Layer 30

Chapter 3: Mapping to Relational Databases 33

Architectural Patterns 33

The Behavioral Problem 38

Reading in Data 40
Structural Mapping Patterns 41
Mapping Relationships 41
Inheritance 45
Building the Mapping 47
Double Mapping 48
Using Metadata 49
Database Connections 50
Some Miscellaneous Points 52
Further Reading 53

Chapter 4: Web Presentation **55**
View Patterns 58
Input Controller Patterns 61
Further Reading 61

Chapter 5: Concurrency *(by Martin Fowler and David Rice)* **63**
Concurrency Problems 64
Execution Contexts 65
Isolation and Immutability 66
Optimistic and Pessimistic Concurrency Control 67
Preventing Inconsistent Reads 68
Deadlocks 70
Transactions 71
ACID 71
Transactional Resources 72
Reducing Transaction Isolation for Liveness 73
Business and System Transactions 74
Patterns for Offline Concurrency Control 76
Application Server Concurrency 78
Further Reading 80

Chapter 6: Session State **81**
The Value of Statelessness 81
Session State 83
Ways to Store Session State 84

Chapter 7: Distribution Strategies **87**
The Allure of Distributed Objects 87
Remote and Local Interfaces 88

Where You Have to Distribute 90
Working with the Distribution Boundary 91
Interfaces for Distribution 92

Chapter 8: Putting It All Together 95

Starting with the Domain Layer 96
Down to the Data Source Layer 97
Data Source for *Transaction Script (110)* 97
Data Source for *Table Module (125)* 98
Data Source for *Domain Model (116)* 98
The Presentation Layer 99
Some Technology-Specific Advice 100
Java and J2EE 100
.NET 101
Stored Procedures 102
Web Services 103
Other Layering Schemes 103

PART 2: The Patterns 107

Chapter 9: Domain Logic Patterns 109

Transaction Script 110
How It Works 110
When to Use It 111
The Revenue Recognition Problem 112
Example: Revenue Recognition (Java) 113
Domain Model 116
How It Works 116
When to Use It 119
Further Reading 119
Example: Revenue Recognition (Java) 120
Table Module 125
How It Works 126
When to Use It 128
Example: Revenue Recognition with a Table Module (C#) 129
Service Layer *(by Randy Stafford)* 133
How It Works 134
When to Use It 137

Further Reading 137
Example: Revenue Recognition (Java) 138

Chapter 10: Data Source Architectural Patterns 143

Table Data Gateway 144
How It Works 144
When to Use It 145
Further Reading 146
Example: Person Gateway (C#) 146
Example: Using ADO.NET Data Sets (C#) 148
Row Data Gateway 152
How It Works 152
When to Use It 153
Example: A Person Record (Java) 155
Example: A Data Holder for a Domain Object (Java) 158
Active Record 160
How It Works 160
When to Use It 161
Example: A Simple Person (Java) 162
Data Mapper 165
How It Works 165
When to Use It 170
Example: A Simple Database Mapper (Java) 171
Example: Separating the Finders (Java) 176
Example: Creating an Empty Object (Java) 179

Chapter 11: Object-Relational Behavioral Patterns 183

Unit of Work 184
How It Works 184
When to Use It 189
Example: *Unit of Work* with Object Registration (Java) *(by David Rice)* 190
Identity Map 195
How It Works 195
When to Use It 198
Example: Methods for an *Identity Map* (Java) 198

Lazy Load 200
How It Works 200
When to Use It 203
Example: Lazy Initialization (Java) 203
Example: Virtual Proxy (Java) 203
Example: Using a Value Holder (Java) 205
Example: Using Ghosts (C#) 206

Chapter 12: Object-Relational Structural Patterns 215

Identity Field 216
How It Works 216
When to Use It 220
Further Reading 221
Example: Integral Key (C#) 221
Example: Using a Key Table (Java) 222
Example: Using a Compound Key (Java) 224
Foreign Key Mapping 236
How It Works 236
When to Use It 239
Example: Single-Valued Reference (Java) 240
Example: Multitable Find (Java) 243
Example: Collection of References (C#) 244
Association Table Mapping 248
How It Works 248
When to Use It 249
Example: Employees and Skills (C#) 250
Example: Using Direct SQL (Java) 253
Example: Using a Single Query for Multiple Employees (Java) *(by Matt Foemmel and Martin Fowler)* 256
Dependent Mapping 262
How It Works 262
When to Use It 263
Example: Albums and Tracks (Java) 264
Embedded Value 268
How It Works 268
When to Use It 268

Further Reading 270
Example: Simple Value Object (Java) 270
Serialized LOB 272
How It Works 272
When to Use It 274
Example: Serializing a Department Hierarchy in XML (Java) 274
Single Table Inheritance 278
How It Works 278
When to Use It 279
Example: A Single Table for Players (C#) 280
Loading an Object from the Database 281
Class Table Inheritance 285
How It Works 285
When to Use It 286
Further Reading 287
Example: Players and Their Kin (C#) 287
Concrete Table Inheritance 293
How It Works 293
When to Use It 295
Example: Concrete Players (C#) 296
Inheritance Mappers 302
How It Works 303
When to Use It 304

Chapter 13: Object-Relational Metadata Mapping Patterns 305

Metadata Mapping 306
How It Works 306
When to Use It 308
Example: Using Metadata and Reflection (Java) 309
Query Object 316
How It Works 316
When to Use It 317
Further Reading 318
Example: A Simple *Query Object* (Java) 318

Repository *(by Edward Hieatt and Rob Mee)* 322
How It Works 323
When to Use It 324
Further Reading 325
Example: Finding a Person's Dependents (Java) 325
Example: Swapping *Repository* Strategies (Java) 326

Chapter 14: Web Presentation Patterns. 329

Model View Controller 330
How It Works 330
When to Use It 332
Page Controller 333
How It Works 333
When to Use It 334
Example: Simple Display with a Servlet Controller and a JSP View (Java) 335
Example: Using a JSP as a Handler (Java) 337
Example: Page Handler with a Code Behind (C#) 340
Front Controller 344
How It Works 344
When to Use It 346
Further Reading 347
Example: Simple Display (Java) 347
Template View 350
How It Works 351
When to Use It 354
Example: Using a JSP as a View with a Separate Controller (Java) 355
Example: ASP.NET Server Page (C#) 357
Transform View 361
How It Works 361
When to Use It 362
Example: Simple Transform (Java) 363
Two Step View 365
How It Works 365
When to Use It 367

Example: Two Stage XSLT (XSLT) 371
Example: JSP and Custom Tags (Java) 374
Application Controller 379
How It Works 380
When to Use It 381
Further Reading 382
Example: State Model *Application Controller* (Java) 382

Chapter 15: Distribution Patterns 387

Remote Facade 388
How It Works 389
When to Use It 392
Example: Using a Java Session Bean as a *Remote Facade* (Java) 392
Example: Web Service (C#) 395
Data Transfer Object 401
How It Works 401
When to Use It 406
Further Reading 407
Example: Transferring Information About Albums (Java) 407
Example: Serializing Using XML (Java) 411

Chapter 16: Offline Concurrency Patterns 415

Optimistic Offline Lock *(by David Rice)* 416
How It Works 417
When to Use It 420
Example: Domain Layer with *Data Mappers (165)* (Java) 421
Pessimistic Offline Lock *(by David Rice)* 426
How It Works 427
When to Use It 431
Example: Simple Lock Manager (Java) 431
Coarse-Grained Lock *(by David Rice and Matt Foemmel)* 438
How It Works 438
When to Use It 441
Example: Shared *Optimistic Offline Lock (416)* (Java) 441
Example: Shared *Pessimistic Offline Lock (426)* (Java) 446
Example: Root *Optimistic Offline Lock (416)* (Java) 447

Implicit Lock (*by David Rice*) 449
How It Works 450
When to Use It 451
Example: Implicit *Pessimistic Offline Lock (426)* (Java) 451

Chapter 17: Session State Patterns 455

Client Session State 456
How It Works 456
When to Use It 457
Server Session State 458
How It Works 458
When to Use It 460
Database Session State 462
How It Works 462
When to Use It 464

Chapter 18: Base Patterns. 465

Gateway 466
How It Works 466
When to Use It 467
Example: A Gateway to a Proprietary Messaging Service (Java) 468
Mapper 473
How It Works 473
When to Use It 474
Layer Supertype 475
How It Works 475
When to Use It 475
Example: Domain Object (Java) 475
Separated Interface 476
How It Works 477
When to Use It 478
Registry 480
How It Works 480
When to Use It 482

Example: A Singleton Registry (Java) 483
Example: Thread-Safe *Registry* (Java)
(by Matt Foemmel and Martin Fowler) 484
Value Object 486
How It Works 486
When to Use It 487
Money 488
How It Works 488
When to Use It 490
Example: A Money Class (Java)
(by Matt Foemmel and Martin Fowler) 491
Special Case 496
How It Works 497
When to Use It 497
Further Reading 497
Example: A Simple Null Object (C#) 498
Plugin *(by David Rice and Matt Foemmel)* 499
How It Works 499
When to Use It 500
Example: An Id Generator (Java) 501
Service Stub *(by David Rice)* 504
How It Works 504
When to Use It 505
Example: Sales Tax Service (Java) 505
Record Set 508
How It Works 508
When to Use It 510

References **511**

Index 517