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
### CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where You Have to Distribute</td>
<td>90</td>
</tr>
<tr>
<td>Working with the Distribution Boundary</td>
<td>91</td>
</tr>
<tr>
<td>Interfaces for Distribution</td>
<td>92</td>
</tr>
<tr>
<td><strong>Chapter 8: Putting It All Together</strong></td>
<td>95</td>
</tr>
<tr>
<td>Starting with the Domain Layer</td>
<td>96</td>
</tr>
<tr>
<td>Down to the Data Source Layer</td>
<td>97</td>
</tr>
<tr>
<td>Data Source for <em>Transaction Script</em> (110)</td>
<td>97</td>
</tr>
<tr>
<td>Data Source for <em>Table Module</em> (125)</td>
<td>98</td>
</tr>
<tr>
<td>Data Source for <em>Domain Model</em> (116)</td>
<td>98</td>
</tr>
<tr>
<td>The Presentation Layer</td>
<td>99</td>
</tr>
<tr>
<td>Some Technology-Specific Advice</td>
<td>100</td>
</tr>
<tr>
<td>Java and J2EE</td>
<td>100</td>
</tr>
<tr>
<td>.NET</td>
<td>101</td>
</tr>
<tr>
<td>Stored Procedures</td>
<td>102</td>
</tr>
<tr>
<td>Web Services</td>
<td>103</td>
</tr>
<tr>
<td>Other Layering Schemes</td>
<td>103</td>
</tr>
<tr>
<td><strong>PART 2: The Patterns</strong></td>
<td>107</td>
</tr>
<tr>
<td><strong>Chapter 9: Domain Logic Patterns</strong></td>
<td>109</td>
</tr>
<tr>
<td>Transaction Script</td>
<td>110</td>
</tr>
<tr>
<td>How It Works</td>
<td>110</td>
</tr>
<tr>
<td>When to Use It</td>
<td>111</td>
</tr>
<tr>
<td>The Revenue Recognition Problem</td>
<td>112</td>
</tr>
<tr>
<td>Example: Revenue Recognition (Java)</td>
<td>113</td>
</tr>
<tr>
<td>Domain Model</td>
<td>116</td>
</tr>
<tr>
<td>How It Works</td>
<td>116</td>
</tr>
<tr>
<td>When to Use It</td>
<td>119</td>
</tr>
<tr>
<td>Further Reading</td>
<td>119</td>
</tr>
<tr>
<td>Example: Revenue Recognition (Java)</td>
<td>120</td>
</tr>
<tr>
<td>Table Module</td>
<td>125</td>
</tr>
<tr>
<td>How It Works</td>
<td>126</td>
</tr>
<tr>
<td>When to Use It</td>
<td>128</td>
</tr>
<tr>
<td>Example: Revenue Recognition with a Table Module (C#)</td>
<td>129</td>
</tr>
<tr>
<td>Service Layer <em>(by Randy Stafford)</em></td>
<td>133</td>
</tr>
<tr>
<td>How It Works</td>
<td>134</td>
</tr>
<tr>
<td>When to Use It</td>
<td>137</td>
</tr>
</tbody>
</table>
CONTENTS

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

- 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
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Further Reading</td>
<td>270</td>
</tr>
<tr>
<td>Example: Simple Value Object (Java)</td>
<td>270</td>
</tr>
<tr>
<td>Serialized LOB</td>
<td>272</td>
</tr>
<tr>
<td>How It Works</td>
<td>272</td>
</tr>
<tr>
<td>When to Use It</td>
<td>274</td>
</tr>
<tr>
<td>Example: Serializing a Department Hierarchy in</td>
<td>274</td>
</tr>
<tr>
<td>XML (Java)</td>
<td></td>
</tr>
<tr>
<td>Single Table Inheritance</td>
<td>278</td>
</tr>
<tr>
<td>How It Works</td>
<td>278</td>
</tr>
<tr>
<td>When to Use It</td>
<td>279</td>
</tr>
<tr>
<td>Example: A Single Table for Players (C#)</td>
<td>280</td>
</tr>
<tr>
<td>Loading an Object from the Database</td>
<td>281</td>
</tr>
<tr>
<td>Class Table Inheritance</td>
<td>285</td>
</tr>
<tr>
<td>How It Works</td>
<td>285</td>
</tr>
<tr>
<td>When to Use It</td>
<td>286</td>
</tr>
<tr>
<td>Further Reading</td>
<td>287</td>
</tr>
<tr>
<td>Example: Players and Their Kin (C#)</td>
<td>287</td>
</tr>
<tr>
<td>Concrete Table Inheritance</td>
<td>293</td>
</tr>
<tr>
<td>How It Works</td>
<td>293</td>
</tr>
<tr>
<td>When to Use It</td>
<td>295</td>
</tr>
<tr>
<td>Example: Concrete Players (C#)</td>
<td>296</td>
</tr>
<tr>
<td>Inheritance Mappers</td>
<td>302</td>
</tr>
<tr>
<td>How It Works</td>
<td>302</td>
</tr>
<tr>
<td>When to Use It</td>
<td>303</td>
</tr>
<tr>
<td>Example: Players and Their Kin (C#)</td>
<td>304</td>
</tr>
<tr>
<td>Chapter 13: Object-Relational Metadata Mapping Patterns</td>
<td>305</td>
</tr>
<tr>
<td>Metadata Mapping</td>
<td>306</td>
</tr>
<tr>
<td>How It Works</td>
<td>306</td>
</tr>
<tr>
<td>When to Use It</td>
<td>308</td>
</tr>
<tr>
<td>Example: Using Metadata and Reflection (Java)</td>
<td>309</td>
</tr>
<tr>
<td>Query Object</td>
<td>316</td>
</tr>
<tr>
<td>How It Works</td>
<td>316</td>
</tr>
<tr>
<td>When to Use It</td>
<td>317</td>
</tr>
<tr>
<td>Further Reading</td>
<td>318</td>
</tr>
<tr>
<td>Example: A Simple Query Object (Java)</td>
<td>318</td>
</tr>
</tbody>
</table>
Contents

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