

Contents

Visual Summary of the Pattern Language	xvii
Foreword	xix
Preface	xxi
Acknowledgments	xxvii
Introduction	xxix
Refactoring a Test	xlvi
 PART I. The Narratives	 1
Chapter 1. A Brief Tour	3
About This Chapter	3
The Simplest Test Automation Strategy That Could Possibly Work	3
Development Process	4
Customer Tests	5
Unit Tests	6
Design for Testability	7
Test Organization	7
What's Next?	8
Chapter 2. Test Smells	9
About This Chapter	9
An Introduction to Test Smells	9
What's a Test Smell?	10
Kinds of Test Smells	10
What to Do about Smells?	11
A Catalog of Smells	12
The Project Smells	12
The Behavior Smells	13
The Code Smells	16
What's Next?	17

Chapter 3. Goals of Test Automation	19
About This Chapter	19
Why Test?	19
Economics of Test Automation	20
Goals of Test Automation	21
Tests Should Help Us Improve Quality	22
Tests Should Help Us Understand the SUT	23
Tests Should Reduce (and Not Introduce) Risk	23
Tests Should Be Easy to Run	25
Tests Should Be Easy to Write and Maintain	27
Tests Should Require Minimal Maintenance as the System Evolves Around Them	29
What's Next?	29
Chapter 4. Philosophy of Test Automation	31
About This Chapter	31
Why Is Philosophy Important?	31
Some Philosophical Differences	32
Test First or Last?	32
Tests or Examples?	33
Test-by-Test or Test All-at-Once?	33
Outside-In or Inside-Out?	34
State or Behavior Verification?	36
Fixture Design Upfront or Test-by-Test?	36
When Philosophies Differ	37
My Philosophy	37
What's Next?	37
Chapter 5. Principles of Test Automation	39
About This Chapter	39
The Principles	39
What's Next?	48
Chapter 6. Test Automation Strategy	49
About This Chapter	49
What's Strategic?	49
Which Kinds of Tests Should We Automate?	50
Per-Functionality Tests	50
Cross-Functional Tests	52

Which Tools Do We Use to Automate Which Tests?	53
Test Automation Ways and Means	54
Introducing xUnit	56
The xUnit Sweet Spot	58
Which Test Fixture Strategy Do We Use?	58
What Is a Fixture?	59
Major Fixture Strategies	60
Transient Fresh Fixtures	61
Persistent Fresh Fixtures	62
Shared Fixture Strategies	63
How Do We Ensure Testability?	65
Test Last—at Your Peril	65
Design for Testability—Upfront	65
Test-Driven Testability	66
Control Points and Observation Points	66
Interaction Styles and Testability Patterns	67
Divide and Test	71
What's Next?	73
Chapter 7. xUnit Basics	75
About This Chapter	75
An Introduction to xUnit	75
Common Features	76
The Bare Minimum	76
Defining Tests	76
What's a Fixture?	78
Defining Suites of Tests	78
Running Tests	79
Test Results	79
Under the xUnit Covers	81
Test Commands	82
Test Suite Objects	82
xUnit in the Procedural World	82
What's Next?	83



Chapter 8. Transient Fixture Management	85
About This Chapter	85
Test Fixture Terminology	86
What Is a Fixture?	86
What Is a Fresh Fixture?	87
What Is a Transient Fresh Fixture?	87
Building Fresh Fixtures	88
In-line Fixture Setup	88
Delegated Fixture Setup	89
Implicit Fixture Setup	91
Hybrid Fixture Setup	93
Tearing Down Transient Fresh Fixtures	93
What's Next?	94
Chapter 9. Persistent Fixture Management	95
About This Chapter	95
Managing Persistent Fresh Fixtures	95
What Makes Fixtures Persistent?	95
Issues Caused by Persistent Fresh Fixtures	96
Tearing Down Persistent Fresh Fixtures	97
Avoiding the Need for Teardown	100
Dealing with Slow Tests	102
Managing Shared Fixtures	103
Accessing Shared Fixtures	103
Triggering Shared Fixture Construction	104
What's Next?	106
Chapter 10. Result Verification	107
About This Chapter	107
Making Tests Self-Checking	107
Verify State or Behavior?	108
State Verification	109
Using Built-in Assertions	110
Delta Assertions	111
External Result Verification	111
Verifying Behavior	112
Procedural Behavior Verification	113
Expected Behavior Specification	113

Reducing Test Code Duplication	114
Expected Objects	115
Custom Assertions	116
Outcome-Describing Verification Method	117
Parameterized and Data-Driven Tests	118
Avoiding Conditional Test Logic	119
Eliminating “if” Statements	120
Eliminating Loops	121
Other Techniques	121
Working Backward, Outside-In	121
Using Test-Driven Development to Write Test Utility Methods	122
Where to Put Reusable Verification Logic?	122
What’s Next?	123
Chapter 11. Using Test Doubles	125
About This Chapter	125
What Are Indirect Inputs and Outputs?	125
Why Do We Care about Indirect Inputs?	126
Why Do We Care about Indirect Outputs?	126
How Do We Control Indirect Inputs?	128
How Do We Verify Indirect Outputs?	130
Testing with Doubles	133
Types of Test Doubles	133
Providing the Test Double	140
Configuring the Test Double	141
Installing the Test Double	143
Other Uses of Test Doubles	148
Endoscopic Testing	149
Need-Driven Development	149
Speeding Up Fixture Setup	149
Speeding Up Test Execution	150
Other Considerations	150
What’s Next?	151
Chapter 12. Organizing Our Tests	153
About This Chapter	153
Basic xUnit Mechanisms	153

Right-Sizing Test Methods	154
Test Methods and Testcase Classes	155
Testcase Class per Class	155
Testcase Class per Feature.....	156
Testcase Class per Fixture	156
Choosing a Test Method Organization Strategy	158
Test Naming Conventions	158
Organizing Test Suites.....	160
Running Groups of Tests	160
Running a Single Test	161
Test Code Reuse	162
Test Utility Method Locations	163
TestCase Inheritance and Reuse	163
Test File Organization	164
Built-in Self-Test	164
Test Packages	164
Test Dependencies	165
What's Next?	165
Chapter 13. Testing with Databases	167
About This Chapter	167
Testing with Databases	167
Why Test with Databases?	168
Issues with Databases	168
Testing without Databases.....	169
Testing the Database	171
Testing Stored Procedures	172
Testing the Data Access Layer.....	172
Ensuring Developer Independence.....	173
Testing with Databases (Again!)	173
What's Next?	174
Chapter 14. A Roadmap to Effective Test Automation	175
About This Chapter	175
Test Automation Difficulty	175
Roadmap to Highly Maintainable Automated Tests	176
Exercise the Happy Path Code	177
Verify Direct Outputs of the Happy Path	178

Verify Alternative Paths	178
Verify Indirect Output Behavior	179
Optimize Test Execution and Maintenance	180
What's Next?	181
PART II. The Test Smells	183
Chapter 15. Code Smells	185
Obscure Test	186
Conditional Test Logic	200
Hard-to-Test Code	209
Test Code Duplication	213
Test Logic in Production	217
Chapter 16. Behavior Smells	223
Assertion Roulette	224
Erratic Test	228
Fragile Test	239
Frequent Debugging	248
Manual Intervention	250
Slow Tests	253
Chapter 17. Project Smells	259
Buggy Tests	260
Developers Not Writing Tests	263
High Test Maintenance Cost	265
Production Bugs	268
PART III. The Patterns	275
Chapter 18. Test Strategy Patterns	277
Recorded Test	278
Scripted Test	285
Data-Driven Test	288
Test Automation Framework	298
Minimal Fixture	302
Standard Fixture	305
Fresh Fixture	311

Shared Fixture	317
Back Door Manipulation	327
Layer Test	337
Chapter 19. xUnit Basics Patterns	347
Test Method	348
Four-Phase Test	358
Assertion Method	362
Assertion Message	370
Testcase Class	373
Test Runner	377
Testcase Object	382
Test Suite Object	387
Test Discovery	393
Test Enumeration	399
Test Selection	403
Chapter 20. Fixture Setup Patterns	407
In-line Setup	408
Delegated Setup	411
Creation Method	415
Implicit Setup	424
Prebuilt Fixture	429
Lazy Setup	435
Suite Fixture Setup	441
Setup Decorator	447
Chained Tests	454
Chapter 21. Result Verification Patterns	461
State Verification	462
Behavior Verification	468
Custom Assertion	474
Delta Assertion	485
Guard Assertion	490
Unfinished Test Assertion	494
Chapter 22. Fixture Teardown Patterns	499
Garbage-Collected Teardown	500

Automated Teardown	503
In-line Teardown	509
Implicit Teardown	516
Chapter 23. Test Double Patterns	521
Test Double	522
Test Stub	529
Test Spy	538
Mock Object	544
Fake Object	551
Configurable Test Double	558
Hard-Coded Test Double	568
Test-Specific Subclass	579
Chapter 24. Test Organization Patterns	591
Named Test Suite	592
Test Utility Method	599
Parameterized Test	607
Testcase Class per Class	617
Testcase Class per Feature	624
Testcase Class per Fixture	631
Testcase Superclass	638
Test Helper	643
Chapter 25. Database Patterns	649
Database Sandbox	650
Stored Procedure Test	654
Table Truncation Teardown	661
Transaction Rollback Teardown	668
Chapter 26. Design-for-Testability Patterns	677
Dependency Injection	678
Dependency Lookup	686
Humble Object	695
Test Hook	709
Chapter 27. Value Patterns	713
Literal Value	714

Derived Value	718
Generated Value	723
Dummy Object	728
PART IV. Appendixes	733
Appendix A. Test Refactorings	735
Appendix B. xUnit Terminology	741
Appendix C. xUnit Family Members	747
Appendix D. Tools.....	753
Appendix E. Goals and Principles	757
Appendix F. Smells, Aliases, and Causes	761
Appendix G. Patterns, Aliases, and Variations	767
Glossary	785
References	819
Index.....	835