

the art of

UNIT TESTING

with Examples in .NET



MANNING

ROY OSHEROVE

Contents

foreword	xv
preface	xvii
acknowledgments	xix
about this book	xx
about the cover illustration	xxiii

PART 1 GETTING STARTED 1

1 The basics of unit testing 3

1.1	Unit testing—the classic definition	4
	The importance of writing “good” unit tests	5
	◦ We’ve all written unit tests (sort of)	5
1.2	Properties of a good unit test	6
1.3	Integration tests	7
	Drawbacks of integration tests compared to automated unit tests	9
1.4	Good unit test—a definition	11
1.5	A simple unit test example	12
1.6	Test-driven development	16
1.7	Summary	19

2 A first unit test 21

2.1	Frameworks for unit testing	22
	What unit-testing frameworks offer	22
	◦ The xUnit frameworks	25

2.2	Introducing the LogAn project	25
2.3	First steps with NUnit	26
	Installing NUnit	26
	◦ Loading up the solution	26
	◦ Using the NUnit attributes in your code	29
2.4	Writing our first test	30
	The Assert class	31
	◦ Running our first test with	
	NUnit	32
	◦ Fixing our code and passing the	
	test	33
	◦ From red to green	33
2.5	More NUnit attributes	34
	Setup and teardown	34
	◦ Checking for expected	
	exceptions	36
	◦ Ignoring tests	38
	◦ Setting	
	test categories	39
2.6	Indirect testing of state	40
2.7	Summary	44

PART 2 CORE TECHNIQUES 47

3	Using stubs to break dependencies	49
3.1	Introducing stubs	50
3.2	Identifying a filesystem dependency in LogAn	51
3.3	Determining how to easily test LogAnalyzer	52
3.4	Refactoring our design to be more testable	55
	Extract an interface to allow replacing underlying	
	implementation	55
	◦ Inject stub implementation	
	into a class under test	58
	◦ Receive an	
	interface at the constructor level (constructor	
	injection)	58
	◦ Receive an interface as a property	
	get or set	64
	◦ Getting a stub just before a	
	method call	66
3.5	Variations on refactoring techniques	74
	Using Extract and Override to create stub	
	results	75
3.6	Overcoming the encapsulation problem	77
	Using internal and [InternalsVisibleTo]	78
	◦ Using the [Conditional] attribute	79
	◦ Using #if	
	and #endif with conditional compilation	80
3.7	Summary	80

4 Interaction testing using mock objects 82

- 4.1 State-based versus interaction testing 83
- 4.2 The difference between mocks and stubs 84
- 4.3 A simple manual mock example 87
- 4.4 Using a mock and a stub together 89
- 4.5 One mock per test 94
- 4.6 Stub chains: stubs that produce mocks or other stubs 95
- 4.7 The problems with handwritten mocks and stubs 96
- 4.8 Summary 97

5 Isolation (mock object) frameworks 99

- 5.1 Why use isolation frameworks? 100
- 5.2 Dynamically creating a fake object 102
 - Introducing Rhino Mocks into your tests 102 ◦
 - Replacing a handwritten mock object with a dynamic one 103
- 5.3 Strict versus nonstrict mock objects 106
 - Strict mocks 106 ◦ Nonstrict mocks 107
- 5.4 Returning values from fake objects 108
- 5.5 Creating smart stubs with an isolation framework 110
 - Creating a stub in Rhino Mocks 110 ◦ Combining dynamic stubs and mocks 112
- 5.6 Parameter constraints for mocks and stubs 115
 - Checking parameters with string constraints 115 ◦
 - Checking parameter object properties with constraints 118 ◦ Executing callbacks for parameter verification 120
- 5.7 Testing for event-related activities 121
 - Testing that an event has been subscribed to 122 ◦
 - Triggering events from mocks and stubs 123 ◦
 - Testing whether an event was triggered 124
- 5.8 Arrange-act-assert syntax for isolation 126
- 5.9 Current isolation frameworks for .NET 130
 - NUnit.Mocks 130 ◦ NMock 131 ◦ NMock2 131 ◦ Typemock Isolator 132 ◦ Rhino Mocks 132 ◦ Moq 134

5.10 Advantages of isolation frameworks	134
5.11 Traps to avoid when using isolation frameworks	135
Unreadable test code	135
Verifying the wrong things	136
Having more than one mock per test	136
Overspecifying the tests	136
5.12 Summary	137

PART 3 THE TEST CODE 139

6 Test hierarchies and organization 141

6.1 Having automated builds run automated tests	142
Anatomy of an automated build	142
Triggering builds and continuous integration	144
Automated build types	144
6.2 Mapping out tests based on speed and type	145
The human factor of separating unit from integration tests	146
The safe green zone	147
6.3 Ensuring tests are part of source control	148
6.4 Mapping test classes to code under test	148
Mapping tests to projects	148
Mapping tests to classes	149
Mapping tests to specific methods	150
6.5 Building a test API for your application	150
Using test class inheritance patterns	151
Creating test utility classes and methods	167
Making your API known to developers	168
6.6 Summary	169

7 The pillars of good tests 171

7.1 Writing trustworthy tests	172
Deciding when to remove or change tests	172
Avoiding logic in tests	178
Testing only one thing	179
Making tests easy to run	180
Assuring code coverage	180
7.2 Writing maintainable tests	181
Testing private or protected methods	182
Removing duplication	184
Using setup methods in a maintainable manner	188
Enforcing test isolation	191
Avoiding multiple asserts	198

Avoiding testing multiple aspects of the same object 202 ◦ Avoiding overspecification in tests 205

7.3 Writing readable tests 209

Naming unit tests 210 ◦ Naming variables 211 ◦ Asserting yourself with meaning 212 ◦ Separating asserts from actions 214 ◦ Setting up and tearing down 214

7.4 Summary 215

PART 4 DESIGN AND PROCESS 217

8 Integrating unit testing into the organization 219

8.1 Steps to becoming an agent of change 220

Be prepared for the tough questions 220 ◦ Convince insiders: champions and blockers 220 ◦ Identify possible entry points 222

8.2 Ways to succeed 223

Guerrilla implementation (bottom-up) 223 ◦ Convincing management (top-down) 224 ◦ Getting an outside champion 224 ◦ Making progress visible 225 ◦ Aiming for specific goals 227 ◦ Realizing that there will be hurdles 228

8.3 Ways to fail 229

Lack of a driving force 229 ◦ Lack of political support 229 ◦ Bad implementations and first impressions 230 ◦ Lack of team support 230

8.4 Tough questions and answers 231

How much time will this add to the current process? 231 ◦ Will my QA job be at risk because of this? 233 ◦ How do we know this is actually working? 234 ◦ Is there proof that unit testing helps? 234 ◦ Why is the QA department still finding bugs? 235 ◦ We have lots of code without tests: where do we start? 235 ◦ We work in several languages: is unit testing feasible? 236 ◦ What if we develop a combination of software and hardware? 236 ◦ How can we know we don't have bugs in our tests? 236 ◦ I see in my debugger that my code works fine: why do I need tests? 237 ◦ Must we do TDD-style coding? 237

8.5 Summary 238

9 Working with legacy code	239
9.1 Where do you start adding tests?	240
9.2 Choosing a selection strategy	242
Pros and cons of the easy-first strategy	242
Pros and cons of the hard-first strategy	243
9.3 Writing integration tests before refactoring	244
9.4 Important tools for legacy code unit testing	246
Isolate dependencies easily with Typemock Isolator	246
Depender	248
Find testability problems with JMockit for Java legacy code	248
Use Vise while refactoring your Java code	250
Use FitNesse for acceptance tests before you refactor	251
Read Michael Feathers' book on legacy code	253
Use NDepend to investigate your production code	253
Use ReSharper to navigate and refactor production code	253
Detect duplicate code (and bugs) with Simian	254
Detect threading issues with Typemock Racer	254
9.5 Summary	254
Appendix A Design and testability	256
Appendix B Extra tools and frameworks	268
Index	284