

CONTENTS IN DETAIL

FOREWORD by Bryan Hunter	xv
PREFACE	xix
ACKNOWLEDGMENTS	xxi
INTRODUCTION	xxiii
Whom Is This Book For?xxiv
How Is This Book Organized?xxiv
Additional Resourcesxxvi
1	
MEET F#	1
F# in Visual Studio	2
Project Templates	2
Project Organization	4
Significance of Whitespace	5
Grouping Constructs	6
Namespaces	6
Modules	7
Expressions Are Everywhere	8
Application Entry Point	9
Implicit Return Values	9
Your First F# Program	10
Summary	12
2	
F# INTERACTIVE	13
Running F# Interactive	13
F# Interactive Output	15
The it Identifier	15
Playing in the Sandbox	15
#help	16
#quit	16
#load	16
#r	17
#l	17
#time	17
Scripting	18
F# Interactive Options	20
--load	20
--use	21
--reference	21
--lib	21

--define	21
--exec	22
--	22
--quiet	22
--optimize	23
--tailcalls	23
Summary	23

3 FUNDAMENTALS 25

Immutability and Side Effects	26
Functional Purity	27
Bindings	28
let Bindings	28
use Bindings	30
do Bindings	33
Identifier Naming	33
Core Data Types	33
Boolean Values and Operators	34
Numeric Types	34
Characters	37
Strings	37
Type Inference	39
Nullability	41
Options	41
Unit Type	42
Enumerations	43
Flags Enumerations	43
Reconstructing Enumeration Values	45
Flow Control	45
Looping	45
Branching	47
Generics	48
Automatic Generalization	49
Explicit Generalization	50
Flexible Types	52
Wildcard Pattern	52
Statically Resolved Type Parameters	52
When Things Go Wrong	53
Handling Exceptions	53
Raising Exceptions	55
Custom Exceptions	56
String Formatting	58
Type Abbreviations	59
Comments	59
End-of-Line Comments	60
Block Comments	60
XML Documentation	60
Summary	62

4	STAYING OBJECTIVE	63
Classes		64
Constructors		64
Fields		68
Properties		69
Methods		73
Events		77
Structures		80
Inheritance		81
Casting		82
Overriding Members		83
Abstract Classes		84
Abstract Members		85
Virtual Members		87
Sealed Classes		87
Static Members		88
Static Initializers		88
Static Fields		89
Static Properties		89
Static Methods		90
Mutually Recursive Types		91
Interfaces		91
Implementing Interfaces		92
Defining Interfaces		93
Custom Operators		94
Prefix Operators		94
Infix Operators		95
New Operators		96
Global Operators		96
Object Expressions		97
Type Extensions		99
Summary		101

5	LET'S GET FUNCTIONAL	103
What Is Functional Programming?		104
Programming with Functions		104
Functions as Data		104
Interoperability Considerations		105
Currying		106
Partial Application		106
Pipelining		107
Function Composition		108
Recursive Functions		109
Tail-Call Recursion		110
Mutually Recursive Functions		111
Lambda Expressions		112
Closures		112

Functional Types	113
Tuples	113
Record Types	118
Discriminated Unions	122
Defining Discriminated Unions	123
Additional Members	129
Lazy Evaluation	130
Summary	132

6 GOING TO COLLECTIONS 133

Sequences.	134
Creating Sequences	134
Working with Sequences	137
Arrays	142
Creating Arrays	142
Working with Arrays	144
Multidimensional Arrays	147
Jagged Arrays	148
Lists	149
Creating Lists	149
Working with Lists	150
Sets	152
Creating Sets	152
Working with Sets	153
Maps	155
Creating Maps	156
Working with Maps	156
Converting Between Collection Types	157
Summary	158

7 PATTERNS, PATTERNS, EVERYWHERE 159

Match Expressions	159
Guard Clauses	160
Pattern-Matching Functions	161
Exhaustive Matching.	162
Variable Patterns	163
The Wildcard Pattern	163
Matching Constant Values.	164
Identifier Patterns	164
Matching Union Cases	164
Matching Literals	165
Matching Nulls	165
Matching Tuples	166
Matching Records	167
Matching Collections	168
Array Patterns	168
List Patterns	168
Cons Patterns	169

Matching by Type	169
Type-Annotated Patterns	169
Dynamic Type-Test Patterns	170
As Patterns	171
Combining Patterns with AND	171
Combining Patterns with OR	172
Parentheses in Patterns	172
Active Patterns	173
Partial Active Patterns	174
Parameterized Active Patterns	176
Summary	176

8 MEASURING UP 177

Defining Measures	178
Measure Formulas	178
Applying Measures	179
Stripping Measures	180
Enforcing Measures	181
Ranges	182
Converting Between Measures	182
Static Conversion Factors	182
Static Conversion Functions	183
Generic Measures	184
Custom Measure-Aware Types	184
Summary	185

9 CAN I QUOTE YOU ON THAT? 187

Comparing Expression Trees and Quoted Expressions	188
Composing Quoted Expressions	190
Quoted Literals	190
.NET Reflection	191
Manual Composition	192
Splicing Quoted Expressions	194
Decomposing Quoted Expressions	194
Parsing Quoted Expressions	195
Substituting Reflection	197
Summary	199

10 SHOW ME THE DATA 201

Query Expressions	201
Basic Querying	203
Filtering Data	204
Accessing Individual Items	207
Sorting Results	209
Grouping	210
Paginating	211

Aggregating Data	213
Detecting Items	214
Joining Multiple Data Sources	215
Extending Query Expressions	219
Type Providers	221
Available Type Providers	222
Using Type Providers	223
Example: Accessing an OData Service	224
Example: Parsing a String with RegexProvider	226
Summary	228

11

ASYNCHRONOUS AND PARALLEL PROGRAMMING 229

Task Parallel Library	230
Potential Parallelism	231
Data Parallelism	231
Task Parallelism	234
Asynchronous Workflows	241
Creating and Starting Asynchronous Workflows	242
Cancelling Asynchronous Workflows	245
Exception Handling	247
Asynchronous Workflows and the Task Parallel Library	248
Agent-Based Programming	250
Getting Started	250
Scanning for Messages	251
Replying to Messages	252
Example: Agent-Based Calculator	253
Summary	255

12

COMPUTATION EXPRESSIONS 257

Anatomy of a Computation Expression	258
Example: FizzBuzz	261
Example: Building Strings	264
Summary	269

INDEX 271