Pro LINQ

Language Integrated Query in C# 2008

Joseph C. Rattz, Jr.

Apress®

Pro LINQ: Language Integrated Query in C# 2008

Copyright © 2007 by Joseph C. Rattz, Jr.

All rights reserved. No part of this work may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information storage or retrieval system, without the prior written permission of the copyright owner and the publisher.

ISBN-13 (pbk): 978-1-59059-789-7

ISBN-10 (pbk): 1-59059-789-3

Printed and bound in the United States of America 9 8 7 6 5 4 3 2 1

Trademarked names may appear in this book. Rather than use a trademark symbol with every occurrence of a trademarked name, we use the names only in an editorial fashion and to the benefit of the trademark owner, with no intention of infringement of the trademark.

Lead Editor: Ewan Buckingham
Technical Reviewer: Fabio Ferracchiati
Editorial Board: Steve Anglin, Ewan Buckingham, Tony Campbell, Gary Cornell, Jonathan Gennick, Jason Gilmore, Kevin Goff, Jonathan Hassell, Matthew Moodie, Joseph Ottinger, Jeffrey Pepper, Ben Renow-Clarke, Dominic Shakeshaft, Matt Wade, Tom Welsh
Senior Project Manager: Tracy Brown Collins
Copy Editors: Heather Lang and Jennifer Whipple
Associate Production Director: Kari Brooks-Copony
Production Editor: Katie Stence
Compositor: Pat Christenson
Proofreader: Dan Shaw
Indexer: Carol Burbo
Artist: Kinetic Publishing Services, LLC
Cover Designer: Kurt Krames
Manufacturing Director: Tom Debolski

Distributed to the book trade worldwide by Springer-Verlag New York, Inc., 233 Spring Street, 6th Floor, New York, NY 10013. Phone 1-800-SPRINGER, fax 201-348-4505, e-mail orders-ny@springer-sbm.com, or visit http://www.springeronline.com.

For information on translations, please contact Apress directly at 2855 Telegraph Avenue, Suite 600, Berkeley, CA 94705. Phone 510-549-5930, fax 510-549-5939, e-mail info@apress.com, or visit http://www.apress.com.

The information in this book is distributed on an “as is” basis, without warranty. Although every precaution has been taken in the preparation of this work, neither the author(s) nor Apress shall have any liability to any person or entity with respect to any loss or damage caused or alleged to be caused directly or indirectly by the information contained in this work.

The source code for this book is available to readers at http://www.apress.com. You will need to answer questions pertaining to this book in order to successfully download the code.

For my amazing wife Vickey, who managed to keep our house
a home all by herself for these past, long 17 months.
Thank you for doing the things that gave me time to work on this book.

Contents at a Glance

About the Author xvii
About the Technical Reviewer xix
Acknowledgments xxi

PART 1 Pro LINQ: Language Integrated Query in C# 2008

CHAPTER 1 Hello LINQ 3
CHAPTER 2 C# 3.0 Language Enhancements for LINQ 19

PART 2 LINQ to Objects

CHAPTER 3 LINQ to Objects Introduction 53
CHAPTER 4 Deferred Operators 63
CHAPTER 5 Nondeferred Operators 133

PART 3 LINQ to XML

CHAPTER 6 LINQ to XML Introduction 187
CHAPTER 7 The LINQ to XML API 193
CHAPTER 8 LINQ to XML Operators 273
CHAPTER 9 Additional XML Capabilities 301

PART 4 LINQ to DataSet

CHAPTER 10 LINQ to DataSet Operators 339
CHAPTER 11 Additional DataSet Capabilities 373

PART 5 LINQ to SQL

CHAPTER 12 LINQ to SQL Introduction 381

CHAPTER 13 LINQ to SQL Tips and Tools 391

CHAPTER 14 LINQ to SQL Database Operations 415

CHAPTER 15 LINQ to SQL Entity Classes 457

CHAPTER 16 The DataContext 499

CHAPTER 17 Concurrency Conflicts 557

CHAPTER 18 Additional SQL Capabilities 573

INDEX 585

Contents

About the Author xvii
About the Technical Reviewer xix
Acknowledgments xxi

PART 1 ■■■ **Pro LINQ: Language Integrated Query in C# 2008**

■ **CHAPTER 1 Hello LINQ** 3

A Paradigm Shift 3
Query XML 4
Query a SQL Server Database 5
Introduction 6
LINQ Is About Data Queries 6
Components 7
How to Obtain LINQ 8
LINQ Is Not Just for Queries 8
Tips to Get You Started 11
Use the var Keyword When Confused 11
Use the Cast or OfType Operators for Legacy Collections 12
Prefer the OfType Operator to the Cast Operator 13
Don't Assume a Query Is Bug-Free 14
Take Advantage of Deferred Queries 15
Use the DataContext Log 15
Use the LINQ Forum 16
Summary 16

CHAPTER 2 C# 3.0 Language Enhancements for LINQ 19

New C# 3.0 Language Additions 19
Lambda Expressions 19
Expression Trees. 24
Keyword var, Object Initialization, and Anonymous Types. 25
Extension Methods 30
Partial Methods. 34
Query Expressions 37
Summary 50

PART 2 LINQ to Objects

CHAPTER 3 LINQ to Objects Introduction 53

LINQ to Objects Overview 53
IEnumerable<T>, Sequences, and the Standard Query Operators 54
Returning IEnumerable<T>, Yielding, and Deferred Queries 55
Func Delegates 58
The Standard Query Operators Alphabetical Cross-Reference 59
Summary 61

CHAPTER 4 Deferred Operators 63

Referenced Namespaces 63
Referenced Assemblies 63
Common Classes 63
The Deferred Operators by Purpose 65
Restriction 65
Projection. 67
Partitioning 76
Concatenation. 83
Ordering. 86
Join. 102
Grouping 106
Set 111
Conversion. 117
Element 123
Generation. 128
Summary 131

CHAPTER 5 **Nondeferred Operators** 133

Referenced Namespaces 133
Common Classes 133
The Nondeferred Operators by Purpose 136
Conversion 136
Equality 148
Element 151
Quantifiers 164
Aggregate 170
Summary 183

PART 3 **LINQ to XML**

CHAPTER 6 **LINQ to XML Introduction** 187

Introduction 190
Cheating the W3C DOM XML API 190
Summary 192

CHAPTER 7 **The LINQ to XML API** 193

Referenced Namespaces 193
Significant API Design Enhancements 193
XML Tree Construction Simplified with Functional Construction 194
Document Centricity Eliminated in Favor of Element Centricity 196
Names, Namespaces, and Prefixes 197
Node Value Extraction 200
The LINQ to XML Object Model 202
Deferred Query Execution, Node Removal, and the Halloween Problem 203
XML Creation 206
Creating Elements with XElement 206
Creating Attributes with XAttribute 208
Creating Comments with XComment 209
Creating Containers with XContainer 210
Creating Declarations with XDeclaration 210
Creating Document Types with XDocumentType 211

Creating Documents with XDocument 212
Creating Names with XName 213
Creating Namespaces with XNamespace 214
Creating Nodes with XNode 214
Creating Processing Instructions with XProcessingInstruction . . . 214
Creating Streaming Elements with XStreamingElement 216
Creating Text with XText 217
Creating CData with XCData 218
XML Output 218
Saving with XDocument.Save() 218
Saving with XElement.Save() 219
XML Input 220
Loading with XDocument.Load() 220
Loading with XElement.Load() 222
Parsing with XDocument.Parse() or XElement.Parse() 223
XML Traversal 224
Traversal Properties 225
Traversal Methods 228
XML Modification 242
Adding Nodes 242
Deleting Nodes 247
Updating Nodes 249
XElement.SetElementValue() on Child XElement Objects 253
XML Attributes 255
Attribute Creation 255
Attribute Traversal 255
Attribute Modification 258
XML Annotations 263
Adding Annotations with XObject.AddAnnotation() 263
Accessing Annotations with XObject.Annotation() or XObject.Annotations() 263
Removing Annotations with XObject.RemoveAnnotations() 264
Annotations Example 264
XML Events 267
XObject.Changing 268
XObject.Changed 268
A Couple of Event Examples 268
Trick or Treat, or Undefined? 272
Summary 272

CHAPTER 8 LINQ to XML Operators 273

Introduction to LINQ to XML Operators 273
Ancestors 274
Prototypes 274
Examples 274
AncestorsAndSelf 278
Prototypes 278
Examples 278
Attributes 280
Prototypes 280
Examples 281
DescendantNodes 283
Prototypes 283
Examples 283
DescendantNodesAndSelf 284
Prototypes 284
Examples 284
Descendants 286
Prototypes 286
Examples 286
DescendantsAndSelf 288
Prototypes 288
Examples 288
Elements 290
Prototypes 291
Examples 291
InDocumentOrder 293
Prototypes 293
Examples 293
Nodes 294
Prototypes 295
Examples 295
Remove 296
Prototypes 296
Examples 296
Summary 299

CHAPTER 9 Additional XML Capabilities 301

Referenced Namespaces 301
Queries 301
No Reaching 302
A Complex Query 304
Transformations 309
Transformations Using XSLT 310
Transformations Using Functional Construction 312
Tips 314
Validation 320
The Extension Methods 320
Prototypes 320
Obtaining an XML Schema 321
Examples 322
XPath 334
Prototypes 334
Examples 335
Summary 335

PART 4 LINQ to DataSet

CHAPTER 10 LINQ to DataSet Operators 339

Assembly References 340
Referenced Namespaces 340
Common Code for the Examples 340
DataRow Set Operators 341
Distinct 342
Except 345
Intersect 347
Union 349
SequenceEqual 352
DataRow Field Operators 353
Field<T> 357
SetField<T> 362
DataTable Operators 365
AsEnumerable 365
CopyToDataTable<DataRow> 366
Summary 371

CHAPTER 11 Additional DataSet Capabilities 373

Required Namespaces 373
Typed DataSets 373
Putting It All Together 375
Summary 378

PART 5 LINQ to SQL

CHAPTER 12 LINQ to SQL Introduction 381

Introducing LINQ to SQL 382
The DataContext 383
Entity Classes 384
Associations 384
Concurrency Conflict Detection 385
Concurrency Conflict Resolution 385
Prerequisites for Running the Examples 386
Obtaining the Appropriate Version of the Northwind Database 386
Generating the Northwind Entity Classes 386
Generating the Northwind XML Mapping File 387
Using the LINQ to SQL API 388
IQueryable<T> 388
Some Common Methods 388
GetStringFromDb() 388
ExecuteStatementInDb() 389
Summary 390

CHAPTER 13 LINQ to SQL Tips and Tools 391

Introduction to LINQ to SQL Tips and Tools 391
Tips 391
Use the DataContext.Log Property 391
Use the GetChangeSet() Method 393
Consider Using Partial Classes or Mapping Files 393
Consider Using Partial Methods 393

Tools 393
SQLMetal 393
The Object Relational Designer 400
Use SQLMetal and the O/R Designer Together 413
Summary 413

CHAPTER 14 LINQ to SQL Database Operations 415

Prerequisites for Running the Examples 415
Some Common Methods 415
Using the LINQ to SQL API 415
Standard Database Operations 416
Inserts 416
Queries 420
Updates 443
Deletes 446
Overriding Database Modification Statements 449
Overriding the Insert Method 449
Overriding the Update Method 450
Overriding the Delete Method 450
Example 450
Overriding in the Object Relational Designer 453
Considerations 453
SQL Translation 453
Summary 455

CHAPTER 15 LINQ to SQL Entity Classes 457

Prerequisites for Running the Examples 457
Entity Classes 457
Creating Entity Classes 457
XML External Mapping File Schema 484
Projecting into Entity Classes vs. Nonentity Classes 485
Extending Entity Classes with Partial Methods 490
Important System.Data.Linq API Classes 492
EntitySet<T> 492
EntityRef<T> 492
Table<T> 494
IExecuteResult 495
ISingleResult<T> 496
IMultipleResults 496
Summary 497

CHAPTER 16 The DataContext 499

Prerequisites for Running the Examples 499
Some Common Methods 499
Using the LINQ to SQL API 499
[Your]DataContext Class 499
The DataContext Class 500
Primary Purposes 503
DataContext() and [Your]DataContext() 509
SubmitChanges() 521
DatabaseExists() 527
CreateDatabase() 528
DeleteDatabase() 530
CreateMethodCallQuery() 530
ExecuteQuery() 532
Translate() 534
ExecuteCommand() 536
ExecuteMethodCall() 537
GetCommand() 544
GetChangeSet() 545
GetTable() 547
Refresh() 549
Summary 555

CHAPTER 17 Concurrency Conflicts 557

Prerequisites for Running the Examples 557
Some Common Methods 557
Using the LINQ to SQL API 557
Concurrency Conflicts 557
Optimistic Concurrency 558
Pessimistic Concurrency 568
An Alternative Approach for Middle Tiers and Servers 570
Summary 572

CHAPTER 18 Additional SQL Capabilities 573

Prerequisites for Running the Examples 573
Using the LINQ to SQL API 573
Using the LINQ to XML API 573
Database Views 573
Entity Class Inheritance 575
Transactions 580
Summary 582

INDEX 585