Contents

Preface xxi
Before You Begin xxxiv

I Introduction 1
1.1 Introduction 2
1.2 Microsoft’s Windows® Operating System 2
1.3 C, C++, Objective-C and Java 3
1.4 C# 3
1.5 Extensible Markup Language (XML) 4
1.6 Introduction to Microsoft .NET 4
1.7 The .NET Framework and the Common Language Runtime 4
1.8 Test-Driving the Advanced Painter Application 5
1.9 Introduction to Object Technology 8
1.10 Wrap-Up 10

II Dive Into® Visual C# 2010 Express 11
2.1 Introduction 12
2.2 Overview of the Visual Studio 2010 IDE 12
2.3 Menu Bar and Toolbar 17
2.4 Navigating the Visual Studio IDE 19
   2.4.1 Solution Explorer 21
   2.4.2 Toolbox 22
   2.4.3 Properties Window 23
2.5 Using Help 24
2.6 Using Visual Programming to Create a Simple Program that Displays Text and an Image 27
2.7 Wrap-Up 38
2.8 Web Resources 39

III Introduction to C# Applications 40
3.1 Introduction 41
3.2 A Simple C# Application: Displaying a Line of Text 41
Contents

3.3 Creating a Simple Application in Visual C# Express 46
3.4 Modifying Your Simple C# Application 53
3.5 Formatting Text with Console.Write and Console.WriteLine 56
3.6 Another C# Application: Adding Integers 57
3.7 Arithmetic 59
3.8 Decision Making: Equality and Relational Operators 61
3.9 Wrap-Up 65

4 Introduction to Classes and Objects 66
4.1 Introduction 67
4.2 Classes, Objects, Methods, Properties and Instance Variables 67
4.3 Declaring a Class with a Method and Instantiating an Object of a Class 68
4.4 Declaring a Method with a Parameter 72
4.5 Instance Variables and Properties 75
4.6 UML Class Diagram with a Property 80
4.7 Software Engineering with Properties and set and get Accessors 81
4.8 Auto-Implemented Properties 82
4.9 Value Types vs. Reference Types 83
4.10 Initializing Objects with Constructors 84
4.11 Floating-Point Numbers and Type decimal 87
4.12 Wrap-Up 93

5 Control Statements: Part 1 94
5.1 Introduction 95
5.2 Control Structures 95
5.3 if Single-Selection Statement 97
5.4 if...else Double-Selection Statement 98
5.5 while Repetition Statement 102
5.6 Counter-Controlled Repetition 103
5.7 Sentinel-Controlled Repetition 107
5.8 Nested Control Statements 112
5.9 Compound Assignment Operators 115
5.10 Increment and Decrement Operators 115
5.11 Simple Types 118
5.12 Wrap-Up 119

6 Control Statements: Part 2 120
6.1 Introduction 121
6.2 Essentials of Counter-Controlled Repetition 121
6.3 for Repetition Statement 122
6.4 Examples Using the for Statement 127
6.5 do...while Repetition Statement 131
6.6 switch Multiple-Selection Statement 132
6.7 break and continue Statements 140
6.8 Logical Operators 142
6.9 Wrap-Up 148

7 Methods: A Deeper Look 149
7.1 Introduction 150
7.2 Packaging Code in C# 150
7.3 static Methods, static Variables and Class Math 151
7.4 Declaring Methods with Multiple Parameters 154
7.5 Notes on Declaring and Using Methods 157
7.6 Method-Call Stack and Activation Records 158
7.7 Argument Promotion and Casting 159
7.8 The .NET Framework Class Library 160
7.9 Case Study: Random-Number Generation 162
7.9.1 Scaling and Shifting Random Numbers 166
7.9.2 Random-Number Repeatability for Testing and Debugging 166
7.10 Case Study: A Game of Chance (Introducing Enumerations) 167
7.11 Scope of Declarations 172
7.12 Method Overloading 174
7.13 Optional Parameters 177
7.14 Named Parameters 178
7.15 Recursion 179
7.16 Passing Arguments: Pass-by-Value vs. Pass-by-Reference 182
7.17 Wrap-Up 185

8 Arrays 187
8.1 Introduction 188
8.2 Arrays 188
8.3 Declaring and Creating Arrays 189
8.4 Examples Using Arrays 190
8.5 Case Study: Card Shuffling and Dealing Simulation 199
8.6 foreach Statement 203
8.7 Passing Arrays and Array Elements to Methods 205
8.8 Passing Arrays by Value and by Reference 208
8.9 Case Study: Class GradeBook Using an Array to Store Grades 212
8.10 Multidimensional Arrays 217
8.11 Case Study: GradeBook Using a Rectangular Array 222
8.12 Variable-Length Argument Lists 227
8.13 Using Command-Line Arguments 229
8.14 Wrap-Up 231

9 Introduction to LINQ and the List Collection 232
9.1 Introduction 233
Contents

9.2 Querying an Array of int Values Using LINQ  234
9.3 Querying an Array of Employee Objects Using LINQ  238
9.4 Introduction to Collections  243
9.5 Querying a Generic Collection Using LINQ  246
9.6 Wrap-Up  248
9.7 Deitel LINQ Resource Center  248

10 Classes and Objects: A Deeper Look  249
10.1 Introduction  250
10.2 Time Class Case Study  250
10.3 Controlling Access to Members  254
10.4 Referring to the Current Object’s Members with the this Reference  255
10.5 Indexers  257
10.6 Time Class Case Study: Overloaded Constructors  261
10.7 Default and Parameterless Constructors  267
10.8 Composition  267
10.9 Garbage Collection and Destructors  270
10.10 static Class Members  271
10.11 readonly Instance Variables  275
10.12 Data Abstraction and Encapsulation  276
10.13 Time Class Case Study: Creating Class Libraries  277
10.14 internal Access  282
10.15 Class View and Object Browser  283
10.16 Object Initializers  285
10.17 Time Class Case Study: Extension Methods  288
10.18 Delegates  291
10.19 Lambda Expressions  293
10.20 Anonymous Types  296
10.21 Wrap-Up  298

11 Object-Oriented Programming: Inheritance  300
11.1 Introduction  301
11.2 Base Classes and Derived Classes  302
11.3 protected Members  304
11.4 Relationship between Base Classes and Derived Classes  305
  11.4.1 Creating and Using a CommissionEmployee Class  305
  11.4.2 Creating a BasePlusCommissionEmployee Class without Using Inheritance  311
  11.4.3 Creating a CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy  316
  11.4.4 CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy Using protected Instance Variables  319
  11.4.5 CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy Using private Instance Variables  323
11.5 Constructors in Derived Classes  329
11.6 Software Engineering with Inheritance 329
11.7 Class object 330
11.8 Wrap-Up 331

12 OOP: Polymorphism, Interfaces and Operator Overloading 332
12.1 Introduction 333
12.2 Polymorphism Examples 335
12.3 Demonstrating Polymorphic Behavior 336
12.4 Abstract Classes and Methods 339
12.5 Case Study: Payroll System Using Polymorphism 341
12.5.1 Creating Abstract Base Class Employee 342
12.5.2 Creating Concrete Derived Class SalariedEmployee 345
12.5.3 Creating Concrete Derived Class HourlyEmployee 346
12.5.4 Creating Concrete Derived Class CommissionEmployee 348
12.5.5 Creating Indirect Concrete Derived Class BasePlusCommissionEmployee 349
12.5.6 Polymorphic Processing, Operator is and Downcasting 351
12.5.7 Summary of the Allowed Assignments Between Base-Class and Derived-Class Variables 356
12.6 sealed Methods and Classes 357
12.7 Case Study: Creating and Using Interfaces 357
12.7.1 Developing an IPayable Hierarchy 359
12.7.2 Declaring Interface IPayable 360
12.7.3 Creating Class Invoice 360
12.7.4 Modifying Class Employee to Implement Interface IPayable 362
12.7.5 Modifying Class SalariedEmployee for Use with IPayable 363
12.7.6 Using Interface IPayable to Process Invoices and Employees Polymorphically 365
12.7.7 Common Interfaces of the .NET Framework Class Library 367
12.8 Operator Overloading 368
12.9 Wrap-Up 371

13 Exception Handling 372
13.1 Introduction 373
13.2 Example: Divide by Zero without Exception Handling 373
13.3 Example: Handling DivideByZeroExceptions and FormatExceptions 376
13.3.1 Enclosing Code in a try Block 378
13.3.2 Catching Exceptions 379
13.3.3 Uncatched Exceptions 379
13.3.4 Termination Model of Exception Handling 380
13.3.5 Flow of Control When Exceptions Occur 381
13.4 .NET Exception Hierarchy 381
13.4.1 Class SystemException 381
13.4.2 Determining Which Exceptions a Method Throws 382
Contents

| 13.5 | finally Block | 383 |
| 13.6 | The using Statement | 389 |
| 13.7 | Exception Properties | 390 |
| 13.8 | User-Defined Exception Classes | 395 |
| 13.9 | Wrap-Up | 398 |

14 Graphical User Interfaces with Windows Forms: Part 1  399

| 14.1 | Introduction | 400 |
| 14.2 | Windows Forms | 401 |
| 14.3 | Event Handling | 403 |
| 14.3.1 | A Simple Event-Driven GUI | 403 |
| 14.3.2 | Visual Studio Generated GUI Code | 405 |
| 14.3.3 | Delegates and the Event-Handling Mechanism | 407 |
| 14.3.4 | Another Way to Create Event Handlers | 408 |
| 14.3.5 | Locating Event Information | 408 |
| 14.4 | Control Properties and Layout | 410 |
| 14.5 | Labels, TextBoxes and Buttons | 414 |
| 14.6 | GroupBoxes and Panels | 417 |
| 14.7 | CheckBoxes and RadioButtons | 420 |
| 14.8 | PictureBoxes | 428 |
| 14.9 | ToolTips | 430 |
| 14.10 | NumericUpDown Control | 432 |
| 14.11 | Mouse-Event Handling | 434 |
| 14.12 | Keyboard-Event Handling | 437 |
| 14.13 | Wrap-Up | 440 |

15 Graphical User Interfaces with Windows Forms: Part 2  441

| 15.1 | Introduction | 442 |
| 15.2 | Menus | 442 |
| 15.3 | MonthCalendar Control | 451 |
| 15.4 | DateTimePicker Control | 452 |
| 15.5 | LinkLabel Control | 455 |
| 15.6 | ListBox Control | 459 |
| 15.7 | CheckedListBox Control | 463 |
| 15.8 | ComboBox Control | 466 |
| 15.9 | TreeView Control | 470 |
| 15.10 | ListView Control | 475 |
| 15.11 | TabControl Control | 481 |
| 15.12 | Multiple Document Interface (MDI) Windows | 486 |
| 15.13 | Visual Inheritance | 493 |
| 15.14 | User-Defined Controls | 498 |
| 15.15 | Wrap-Up | 502 |
16 Strings and Characters 504
16.1 Introduction 505
16.2 Fundamentals of Characters and Strings 506
16.3 string Constructors 507
16.4 string Indexer, Length Property and CopyTo Method 508
16.5 Comparing strings 509
16.6 Locating Characters and Substrings in strings 512
16.7 Extracting Substrings from strings 515
16.8 Concatenating strings 516
16.9 Miscellaneous string Methods 517
16.10 Class StringBuilder 518
16.11 Length and Capacity Properties, EnsureCapacity Method and Indexer of Class StringBuilder 519
16.12 Append and AppendFormat Methods of Class StringBuilder 521
16.13 Insert, Remove and Replace Methods of Class StringBuilder 523
16.14 Char Methods 526
16.15 Regular Expressions 528
  16.15.1 Simple Regular Expressions and Class Regex 529
  16.15.2 Complex Regular Expressions 534
  16.15.3 Validating User Input with Regular Expressions and LINQ 535
  16.15.4 Regex Methods Replace and Split 540
16.16 Wrap-Up 542

17 Files and Streams 543
17.1 Introduction 544
17.2 Data Hierarchy 544
17.3 Files and Streams 546
17.4 Classes File and Directory 547
17.5 Creating a Sequential-Access Text File 556
17.6 Reading Data from a Sequential-Access Text File 565
17.7 Case Study: Credit Inquiry Program 569
17.8 Serialization 575
17.9 Creating a Sequential-Access File Using Object Serialization 576
17.10 Reading and Deserializing Data from a Binary File 580
17.11 Wrap-Up 582

18 Databases and LINQ 584
18.1 Introduction 585
18.2 Relational Databases 586
18.3 A Books Database 587
18.4 LINQ to SQL 590
18.5 Querying a Database with LINQ 591
  18.5.1 Creating LINQ to SQL Classes 592
  18.5.2 Data Bindings Between Controls and the LINQ to SQL Classes 595
18.6 Dynamically Binding Query Results  599
  18.6.1 Creating the Display Query Results GUI  600
  18.6.2 Coding the Display Query Results Application  600
18.7 Retrieving Data from Multiple Tables with LINQ  602
18.8 Creating a Master/Detail View Application  608
  18.8.1 Creating the Master/Detail GUI  609
  18.8.2 Coding the Master/Detail Application  610
18.9 Address Book Case Study  613
  18.9.1 Creating the Address Book Application's GUI  615
  18.9.2 Coding the Address Book Application  616
18.10 Tools and Web Resources  618
18.11 Wrap-Up  619

19 Web App Development with ASP.NET  620
  19.1 Introduction  621
  19.2 Web Basics  622
  19.3 Multitier Application Architecture  623
19.4 Your First Web Application  625
  19.4.1 Building the WebTime Application  627
  19.4.2 Examining WebTime.aspx's Code-Behind File  636
19.5 Standard Web Controls: Designing a Form  636
19.6 Validation Controls  641
19.7 Session Tracking  647
  19.7.1 Cookies  648
  19.7.2 Session Tracking with HttpSessionState  649
  19.7.3 Options.aspx: Selecting a Programming Language  652
  19.7.4 Recommendations.aspx: Displaying Recommendations Based on Session Values  655
19.8 Case Study: Database-Driven ASP.NET Guestbook  657
  19.8.1 Building a Web Form that Displays Data from a Database  659
  19.8.2 Modifying the Code-Behind File for the Guestbook Application  662
19.9 Case Study: ASP.NET AJAX  664
19.10 Case Study: Password-Protected Books Database Application  665
19.11 Wrap-Up  666

20 Searching and Sorting  666
  20.1 Introduction  667
  20.2 Searching Algorithms  667
    20.2.1 Linear Search  668
    20.2.2 Binary Search  672
  20.3 Sorting Algorithms  677
    20.3.1 Selection Sort  677
    20.3.2 Insertion Sort  681
    20.3.3 Merge Sort  685
20.4 Summary of the Efficiency of Searching and Sorting Algorithms  691
20.5 Wrap-Up  691

21 Data Structures  692
21.1 Introduction  693
21.2 Simple-Type structs, Boxing and Unboxing  693
21.3 Self-Referential Classes  694
21.4 Linked Lists  695
21.5 Stacks  708
21.6 Queues  712
21.7 Trees  715
   21.7.1 Binary Search Tree of Integer Values  716
   21.7.2 Binary Search Tree of IComparable Objects  723
21.8 Wrap-Up  728

22 Generics  730
22.1 Introduction  731
22.2 Motivation for Generic Methods  732
22.3 Generic-Method Implementation  734
22.4 Type Constraints  737
22.5 Overloading Generic Methods  739
22.6 Generic Classes  740
22.7 Wrap-Up  749

23 Collections  751
23.1 Introduction  752
23.2 Collections Overview  752
23.3 Class Array and Enumerators  755
23.4 Nongeneric Collections  758
   23.4.1 Class ArrayList  758
   23.4.2 Class Stack  762
   23.4.3 Class Hashtable  765
23.5 Generic Collections  770
   23.5.1 Generic Class SortedDictionary  770
   23.5.2 Generic Class LinkedList  772
23.6 Covariance and Contravariance for Generic Types  776
23.7 Wrap-Up  778

24 GUI with Windows Presentation Foundation  780
24.1 Introduction  781
24.2 Windows Presentation Foundation (WPF)  781
24.3 XML Basics  783
24.4 Structuring Data  786
24.5 XML Namespaces  791
Contents

24.6 Declarative GUI Programming Using XAML 795
24.7 Creating a WPF Application in Visual C# Express 796
24.8 Laying Out Controls 798
  24.8.1 General Layout Principles 798
  24.8.2 Layout in Action 799
24.9 Event Handling 804
24.10 Commands and Common Application Tasks 812
24.11 WPF GUI Customization 816
24.12 Using Styles to Change the Appearance of Controls 817
24.13 Customizing Windows 823
24.14 Defining a Control’s Appearance with Control Templates 826
24.15 Data-Driven GUIs with Data Binding 831
24.16 Wrap-Up 837
24.17 Web Resources 838

25 WPF Graphics and Multimedia 839
25.1 Introduction 840
25.2 Controlling Fonts 840
25.3 Basic Shapes 842
25.4 Polygons and Polylines 843
25.5 Brushes 847
25.6 Transforms 853
25.7 WPF Customization: A Television GUI 855
25.8 Animations 864
25.9 (Optional) 3-D Objects and Transforms 867
25.10 Speech Synthesis and Speech Recognition 873
25.11 Wrap-Up 880

26 XML and LINQ to XML 881
26.1 Introduction 882
26.2 Document Type Definitions (DTDs) 882
26.3 W3C XML Schema Documents 886
26.4 Extensible Stylesheet Language and XSL Transformations 893
26.5 LINQ to XML: Document Object Model (DOM) 902
26.6 LINQ to XML Class Hierarchy 906
26.7 LINQ to XML: Namespaces and Creating Documents 915
26.8 XSLT with Class XslCompiledTransform 918
26.9 Wrap-Up 920
26.10 Web Resources 920

27 Web App Development with ASP.NET: A Deeper Look 921
27.1 Introduction 922
27.2 Case Study: Password-Protected Books Database Application 922
27.2.1 Examining the ASP.NET Web Site Template 923
27.2.2 Test-Driving the Completed Application 925
27.2.3 Configuring the Website 927
27.2.4 Modifying the Default.aspx and About.aspx Pages 930
27.2.5 Creating a Content Page That Only Authenticated Users Can Access 931
27.2.6 Linking from the Default.aspx Page to the Books.aspx Page 932
27.2.7 Modifying the Master Page (Site.master) 933
27.2.8 Customizing the Password-Protected Books.aspx Page 935

27.3 ASP.NET Ajax 940
27.3.1 Traditional Web Applications 940
27.3.2 Ajax Web Applications 941
27.3.3 Testing an ASP.NET Ajax Application 942
27.3.4 The ASP.NET Ajax Control Toolkit 943
27.3.5 Using Controls from the Ajax Control Toolkit 944

27.4 Wrap-Up 947

28 Web Services 948

28.1 Introduction 949
28.2 WCF Services Basics 950
28.3 Simple Object Access Protocol (SOAP) 950
28.4 Representational State Transfer (REST) 951
28.5 JavaScript Object Notation (JSON) 951

28.6 Publishing and Consuming SOAP-Based WCF Web Services 952
28.6.1 Creating a WCF Web Service 952
28.6.2 Code for the WelcomeSOAPXMLService 952
28.6.3 Building a SOAP WCF Web Service 953
28.6.4 Deploying the WelcomeSOAPXMLService 955
28.6.5 Creating a Client to Consume the WelcomeSOAPXMLService 956
28.6.6 Consuming the WelcomeSOAPXMLService 958

28.7 Publishing and Consuming REST-Based XML Web Services 960
28.7.1 HTTP get and post Requests 960
28.7.2 Creating a REST-Based XML WCF Web Service 960
28.7.3 Consuming a REST-Based XML WCF Web Service 963

28.8 Publishing and Consuming REST-Based JSON Web Services 964
28.8.1 Creating a REST-Based JSON WCF Web Service 964
28.8.2 Consuming a REST-Based JSON WCF Web Service 966

28.9 Blackjack Web Service: Using Session Tracking in a SOAP-Based WCF Web Service 968
28.9.1 Creating a Blackjack Web Service 968
28.9.2 Consuming the Blackjack Web Service 973

28.10 Airline Reservation Web Service: Database Access and Invoking a Service from ASP.NET 982
28.11 Equation Generator: Returning User-Defined Types 986
28.11.1 Creating the REST-Based XML EquationGenerator Web Service 989
28.11.2 Consuming the REST-Based XML EquationGenerator Web Service 990
## Contents

### 28.11.3 Creating the REST-Based JSON WCF EquationGenerator Web Service

28.11.4 Consuming the REST-Based JSON WCF EquationGenerator Web Service

### 28.12 Wrap-Up

### 28.13 Deitel Web Services Resource Centers

### 29 Silverlight and Rich Internet Applications

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>29.1 Introduction</td>
<td>1001</td>
</tr>
<tr>
<td>29.2 Platform Overview</td>
<td>1001</td>
</tr>
<tr>
<td>29.3 Silverlight Runtime and Tools Installation</td>
<td>1002</td>
</tr>
<tr>
<td>29.4 Building a Silverlight WeatherViewer Application</td>
<td>1002</td>
</tr>
<tr>
<td>29.4.1 GUI Layout</td>
<td>1005</td>
</tr>
<tr>
<td>29.4.2 Obtaining and Displaying Weather Forecast Data</td>
<td>1007</td>
</tr>
<tr>
<td>29.4.3 Custom Controls</td>
<td>1013</td>
</tr>
<tr>
<td>29.5 Animations and the FlickrViewer</td>
<td>1016</td>
</tr>
<tr>
<td>29.6 Images and Deep Zoom</td>
<td>1025</td>
</tr>
<tr>
<td>29.6.1 Getting Started With Deep Zoom Composer</td>
<td>1027</td>
</tr>
<tr>
<td>29.6.2 Creating a Silverlight Deep Zoom Application</td>
<td>1030</td>
</tr>
<tr>
<td>29.7 Audio and Video</td>
<td>1038</td>
</tr>
<tr>
<td>29.8 Wrap-Up</td>
<td>1043</td>
</tr>
</tbody>
</table>

### 30 ATM Case Study, Part 1: Object-Oriented Design with the UML

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>30.1 Introduction</td>
<td>1045</td>
</tr>
<tr>
<td>30.2 Examining the ATM Requirements Document</td>
<td>1045</td>
</tr>
<tr>
<td>30.3 Identifying the Classes in the ATM Requirements Document</td>
<td>1053</td>
</tr>
<tr>
<td>30.4 Identifying Class Attributes</td>
<td>1060</td>
</tr>
<tr>
<td>30.5 Identifying Objects’ States and Activities</td>
<td>1064</td>
</tr>
<tr>
<td>30.6 Identifying Class Operations</td>
<td>1068</td>
</tr>
<tr>
<td>30.7 Identifying Collaboration Among Objects</td>
<td>1075</td>
</tr>
<tr>
<td>30.8 Wrap-Up</td>
<td>1082</td>
</tr>
</tbody>
</table>

### 31 ATM Case Study, Part 2: Implementing an Object-Oriented Design

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>31.1 Introduction</td>
<td>1088</td>
</tr>
<tr>
<td>31.2 Starting to Program the Classes of the ATM System</td>
<td>1088</td>
</tr>
<tr>
<td>31.3 Incorporating Inheritance and Polymorphism into the ATM System</td>
<td>1093</td>
</tr>
<tr>
<td>31.4 ATM Case Study Implementation</td>
<td>1100</td>
</tr>
<tr>
<td>31.4.1 Class ATM</td>
<td>1101</td>
</tr>
<tr>
<td>31.4.2 Class Screen</td>
<td>1106</td>
</tr>
<tr>
<td>31.4.3 Class Keypad</td>
<td>1107</td>
</tr>
</tbody>
</table>
31.4.4 Class CashDispenser 1108
31.4.5 Class DepositSlot 1109
31.4.6 Class Account 1110
31.4.7 Class BankDatabase 1112
31.4.8 Class Transaction 1115
31.4.9 Class BalanceInquiry 1116
31.4.10 Class Withdrawal 1117
31.4.11 Class Deposit 1121
31.4.12 Class ATMCaseStudy 1124
31.5 Wrap-Up 1124

A  Operator Precedence Chart 1127

B  Simple Types 1129

C  ASCII Character Set 1131

D  Number Systems 1132
D.1 Introduction 1133
D.2 Abbreviating Binary Numbers as Octal and Hexadecimal Numbers 1136
D.3 Converting Octal and Hexadecimal Numbers to Binary Numbers 1137
D.4 Converting from Binary, Octal or Hexadecimal to Decimal 1137
D.5 Converting from Decimal to Binary, Octal or Hexadecimal 1138
D.6 Negative Binary Numbers: Two’s Complement Notation 1140

E  UML 2: Additional Diagram Types 1142
E.1 Introduction 1142
E.2 Additional Diagram Types 1142

F  Unicode® 1144
F.1 Introduction 1145
F.2 Unicode Transformation Formats 1146
F.3 Characters and Glyphs 1147
F.4 Advantages/Disadvantages of Unicode 1147
F.5 Using Unicode 1148
F.6 Character Ranges 1150

G  Using the Visual C# 2010 Debugger 1152
G.1 Introduction 1153
Contents

G.2 Breakpoints and the Continue Command 1153
G.3 DataTips and Visualizers 1159
G.4 The Locals and Watch Windows 1160
G.5 Controlling Execution Using the Step Into, Step Over, Step Out and Continue Commands 1163
G.6 Other Debugging Features 1166
G.6.1 Edit and Continue 1166
G.6.2 Exception Assistant 1168
G.6.3 Just My Code™ Debugging 1169
G.6.4 Other Debugger Features 1169

Index 1170