



Contents

Chapters 24–31 and Appendices D–G are PDF documents posted online at the book's Companion Website (located at www.pearsonhighered.com/deitel/).

Preface **xvii**

Before You Begin **xxvii**

1 Introduction to Computers, the Internet and Visual C# **I**

1.1	Introduction	2
1.2	Computer Organization	2
1.3	Personal Computing, Distributed Computing and Client/Server Computing	4
1.4	Hardware Trends	4
1.5	Microsoft's Windows® Operating System	4
1.6	Machine Languages, Assembly Languages and High-Level Languages	5
1.7	Visual Basic	6
1.8	C, C++, Objective-C and Java	6
1.9	C#	7
1.10	The Internet and the World Wide Web	7
1.11	Extensible Markup Language (XML)	8
1.12	Introduction to Microsoft .NET	9
1.13	The .NET Framework and the Common Language Runtime	9
1.14	Test-Driving the Advanced Painter Application	10
1.15	Introduction to Object Technology	12
1.16	Wrap-Up	15
1.17	Web Resources	15

2 Dive Into® Visual C# 2010 Express **24**

2.1	Introduction	25
2.2	Overview of the Visual Studio 2010 IDE	25
2.3	Menu Bar and Toolbar	30
2.4	Navigating the Visual Studio IDE	32
2.4.1	Solution Explorer	34
2.4.2	Toolbox	35
2.4.3	Properties Window	36
2.5	Using Help	37

2.6	Using Visual Programming to Create a Simple Program that Displays Text and an Image	40
2.7	Wrap-Up	51
2.8	Web Resources	52

3 Introduction to C# Applications 60

3.1	Introduction	61
3.2	A Simple C# Application: Displaying a Line of Text	61
3.3	Creating a Simple Application in Visual C# Express	66
3.4	Modifying Your Simple C# Application	74
3.5	Formatting Text with <code>Console.Write</code> and <code>Console.WriteLine</code>	76
3.6	Another C# Application: Adding Integers	77
3.7	Memory Concepts	81
3.8	Arithmetic	82
3.9	Decision Making: Equality and Relational Operators	85
3.10	Wrap-Up	90

4 Introduction to Classes, Objects, Methods and strings 101

4.1	Introduction	102
4.2	Classes, Objects, Methods, Properties and Instance Variables	102
4.3	Declaring a Class with a Method and Instantiating an Object of a Class	103
4.4	Declaring a Method with a Parameter	107
4.5	Instance Variables and Properties	111
4.6	UML Class Diagram with a Property	115
4.7	Software Engineering with Properties and <code>set</code> and <code>get</code> Accessors	116
4.8	Auto-Implemented Properties	117
4.9	Value Types vs. Reference Types	118
4.10	Initializing Objects with Constructors	119
4.11	Floating-Point Numbers and Type <code>decimal</code>	122
4.12	Wrap-Up	128

5 Control Statements: Part I 136

5.1	Introduction	137
5.2	Algorithms	137
5.3	Pseudocode	138
5.4	Control Structures	138
5.5	<code>if</code> Single-Selection Statement	140
5.6	<code>if...else</code> Double-Selection Statement	141
5.7	<code>while</code> Repetition Statement	146
5.8	Formulating Algorithms: Counter-Controlled Repetition	147
5.9	Formulating Algorithms: Sentinel-Controlled Repetition	152
5.10	Formulating Algorithms: Nested Control Statements	160
5.11	Compound Assignment Operators	165

5.12	Increment and Decrement Operators	165
5.13	Simple Types	168
5.14	Wrap-Up	169
6	Control Statements: Part 2	183
6.1	Introduction	184
6.2	Essentials of Counter-Controlled Repetition	184
6.3	for Repetition Statement	186
6.4	Examples Using the for Statement	190
6.5	do...while Repetition Statement	194
6.6	switch Multiple-Selection Statement	196
6.7	break and continue Statements	203
6.8	Logical Operators	205
6.9	Structured-Programming Summary	211
6.10	Wrap-Up	216
7	Methods: A Deeper Look	226
7.1	Introduction	227
7.2	Packaging Code in C#	227
7.3	static Methods, static Variables and Class Math	229
7.4	Declaring Methods with Multiple Parameters	232
7.5	Notes on Declaring and Using Methods	236
7.6	Method-Call Stack and Activation Records	237
7.7	Argument Promotion and Casting	237
7.8	The .NET Framework Class Library	239
7.9	Case Study: Random-Number Generation	241
	7.9.1 Scaling and Shifting Random Numbers	245
	7.9.2 Random-Number Repeatability for Testing and Debugging	245
7.10	Case Study: A Game of Chance (Introducing Enumerations)	246
7.11	Scope of Declarations	251
7.12	Method Overloading	253
7.13	Optional Parameters	256
7.14	Named Parameters	257
7.15	Recursion	258
7.16	Passing Arguments: Pass-by-Value vs. Pass-by-Reference	261
7.17	Wrap-Up	264
8	Arrays	280
8.1	Introduction	281
8.2	Arrays	281
8.3	Declaring and Creating Arrays	282
8.4	Examples Using Arrays	284
8.5	Case Study: Card Shuffling and Dealing Simulation	293
8.6	foreach Statement	298

x Contents

8.7	Passing Arrays and Array Elements to Methods	299
8.8	Passing Arrays by Value and by Reference	301
8.9	Case Study: Class <code>GradeBook</code> Using an Array to Store Grades	305
8.10	Multidimensional Arrays	310
8.11	Case Study: Class <code>GradeBook</code> Using a Rectangular Array	315
8.12	Variable-Length Argument Lists	321
8.13	Using Command-Line Arguments	322
8.14	Wrap-Up	324

9 Introduction to LINQ and the List Collection 344

9.1	Introduction	345
9.2	Querying an Array of <code>int</code> Values Using LINQ	346
9.3	Querying an Array of <code>Employee</code> Objects Using LINQ	350
9.4	Introduction to Collections	355
9.5	Querying a Generic Collection Using LINQ	358
9.6	Wrap-Up	360
9.7	Deitel LINQ Resource Center	360

10 Classes and Objects: A Deeper Look 364

10.1	Introduction	365
10.2	Time Class Case Study	365
10.3	Controlling Access to Members	369
10.4	Referring to the Current Object's Members with the <code>this</code> Reference	370
10.5	Time Class Case Study: Overloaded Constructors	372
10.6	Default and Parameterless Constructors	378
10.7	Composition	379
10.8	Garbage Collection and Destructors	382
10.9	<code>static</code> Class Members	383
10.10	<code>readonly</code> Instance Variables	386
10.11	Data Abstraction and Encapsulation	388
10.12	Class View and Object Browser	389
10.13	Object Initializers	391
10.14	Wrap-Up	391

11 Object-Oriented Programming: Inheritance 398

11.1	Introduction	399
11.2	Base Classes and Derived Classes	400
11.3	<code>protected</code> Members	402
11.4	Relationship between Base Classes and Derived Classes	403
11.4.1	Creating and Using a <code>CommissionEmployee</code> Class	403
11.4.2	Creating a <code>BasePlusCommissionEmployee</code> Class without Using Inheritance	408
11.4.3	Creating a <code>CommissionEmployee–BasePlusCommissionEmployee</code> Inheritance Hierarchy	414

11.4.4	CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy Using <code>protected</code> Instance Variables	417
11.4.5	CommissionEmployee–BasePlusCommissionEmployee Inheritance Hierarchy Using <code>private</code> Instance Variables	421
11.5	Constructors in Derived Classes	426
11.6	Software Engineering with Inheritance	427
11.7	Class object	428
11.8	Wrap-Up	429

12 OOP: Polymorphism, Interfaces and Operator Overloading **435**

12.1	Introduction	436
12.2	Polymorphism Examples	438
12.3	Demonstrating Polymorphic Behavior	439
12.4	Abstract Classes and Methods	442
12.5	Case Study: Payroll System Using Polymorphism	444
12.5.1	Creating Abstract Base Class <code>Employee</code>	445
12.5.2	Creating Concrete Derived Class <code>SalariedEmployee</code>	448
12.5.3	Creating Concrete Derived Class <code>HourlyEmployee</code>	449
12.5.4	Creating Concrete Derived Class <code>CommissionEmployee</code>	451
12.5.5	Creating Indirect Concrete Derived Class <code>BasePlusCommissionEmployee</code>	452
12.5.6	Polymorphic Processing, Operator <code>is</code> and Downcasting	454
12.5.7	Summary of the Allowed Assignments Between Base-Class and Derived-Class Variables	459
12.6	<code>sealed</code> Methods and Classes	460
12.7	Case Study: Creating and Using Interfaces	460
12.7.1	Developing an <code>IPayable</code> Hierarchy	462
12.7.2	Declaring Interface <code>IPayable</code>	463
12.7.3	Creating Class <code>Invoice</code>	463
12.7.4	Modifying Class <code>Employee</code> to Implement Interface <code>IPayable</code>	465
12.7.5	Modifying Class <code>SalariedEmployee</code> for Use with <code>IPayable</code>	466
12.7.6	Using Interface <code>IPayable</code> to Process Invoices and Employees Polymorphically	468
12.7.7	Common Interfaces of the .NET Framework Class Library	470
12.8	Operator Overloading	471
12.9	Wrap-Up	474

13 Exception Handling: A Deeper Look **479**

13.1	Introduction	480
13.2	Example: Divide by Zero without Exception Handling	480
13.3	Example: Handling <code>DivideByZeroExceptions</code> and <code>FormatExceptions</code>	483
13.3.1	Enclosing Code in a <code>try</code> Block	485
13.3.2	Catching Exceptions	486

13.3.3	Uncaught Exceptions	486
13.3.4	Termination Model of Exception Handling	487
13.3.5	Flow of Control When Exceptions Occur	488
13.4	.NET Exception Hierarchy	488
13.4.1	Class <code>SystemException</code>	488
13.4.2	Determining Which Exceptions a Method Throws	489
13.5	<code>finally</code> Block	490
13.6	The <code>using</code> Statement	496
13.7	Exception Properties	497
13.8	User-Defined Exception Classes	502
13.9	Wrap-Up	505

14 Graphical User Interfaces with Windows Forms: Part 1 **510**

14.1	Introduction	511
14.2	Windows Forms	512
14.3	Event Handling	514
14.3.1	A Simple Event-Driven GUI	514
14.3.2	Visual Studio Generated GUI Code	516
14.3.3	Delegates and the Event-Handling Mechanism	518
14.3.4	Another Way to Create Event Handlers	519
14.3.5	Locating Event Information	519
14.4	Control Properties and Layout	521
14.5	Labels, TextBoxes and Buttons	525
14.6	GroupBoxes and Panels	528
14.7	CheckBoxes and RadioButtons	531
14.8	PictureBoxes	539
14.9	ToolTips	541
14.10	NumericUpDown Control	543
14.11	Mouse-Event Handling	545
14.12	Keyboard-Event Handling	548
14.13	Wrap-Up	551

15 Graphical User Interfaces with Windows Forms: Part 2 **561**

15.1	Introduction	562
15.2	Menus	562
15.3	MonthCalendar Control	571
15.4	DateTimePicker Control	572
15.5	LinkLabel Control	575
15.6	Listbox Control	579
15.7	CheckedListBox Control	583
15.8	ComboBox Control	586
15.9	TreeView Control	590

15.10	Listview Control	595
15.11	TabControl Control	601
15.12	Multiple Document Interface (MDI) Windows	606
15.13	Visual Inheritance	613
15.14	User-Defined Controls	618
15.15	Wrap-Up	622
16	Strings and Characters	630
16.1	Introduction	631
16.2	Fundamentals of Characters and Strings	632
16.3	string Constructors	633
16.4	string Indexer, Length Property and CopyTo Method	634
16.5	Comparing strings	635
16.6	Locating Characters and Substrings in strings	638
16.7	Extracting Substrings from strings	641
16.8	Concatenating strings	642
16.9	Miscellaneous string Methods	643
16.10	Class StringBuilder	644
16.11	Length and Capacity Properties, EnsureCapacity Method and Indexer of Class StringBuilder	645
16.12	Append and AppendFormat Methods of Class StringBuilder	647
16.13	Insert, Remove and Replace Methods of Class StringBuilder	649
16.14	Char Methods	652
16.15	(Online) Introduction to Regular Expressions	654
16.16	Wrap-Up	655
17	Files and Streams	661
17.1	Introduction	662
17.2	Data Hierarchy	662
17.3	Files and Streams	664
17.4	Classes File and Directory	665
17.5	Creating a Sequential-Access Text File	674
17.6	Reading Data from a Sequential-Access Text File	683
17.7	Case Study: Credit Inquiry Program	687
17.8	Serialization	693
17.9	Creating a Sequential-Access File Using Object Serialization	694
17.10	Reading and Deserializing Data from a Binary File	698
17.11	Wrap-Up	700
18	Databases and LINQ	707
18.1	Introduction	708
18.2	Relational Databases	709
18.3	A Books Database	710
18.4	LINQ to SQL	713

18.5	Querying a Database with LINQ	714
18.5.1	Creating LINQ to SQL Classes	715
18.5.2	Data Bindings Between Controls and the LINQ to SQL Classes	718
18.6	Dynamically Binding Query Results	722
18.6.1	Creating the Display Query Results GUI	723
18.6.2	Coding the Display Query Results Application	723
18.7	Retrieving Data from Multiple Tables with LINQ	725
18.8	Creating a Master/Detail View Application	731
18.8.1	Creating the Master/Detail GUI	732
18.8.2	Coding the Master/Detail Application	733
18.9	Address Book Case Study	736
18.9.1	Creating the Address Book Application's GUI	738
18.9.2	Coding the Address Book Application	739
18.10	Tools and Web Resources	741
18.11	Wrap-Up	742

19 Web App Development with ASP.NET 748

19.1	Introduction	749
19.2	Web Basics	750
19.3	Multitier Application Architecture	751
19.4	Your First Web Application	753
19.4.1	Building the WebTime Application	755
19.4.2	Examining WebTime.aspx 's Code-Behind File	764
19.5	Standard Web Controls: Designing a Form	764
19.6	Validation Controls	769
19.7	Session Tracking	775
19.7.1	Cookies	776
19.7.2	Session Tracking with HttpSessionState	777
19.7.3	Options.aspx : Selecting a Programming Language	780
19.7.4	Recommendations.aspx : Displaying Recommendations Based on Session Values	783
19.8	Case Study: Database-Driven ASP.NET Guestbook	785
19.8.1	Building a Web Form that Displays Data from a Database	787
19.8.2	Modifying the Code-Behind File for the Guestbook Application	790
19.9	Online Case Study: ASP.NET AJAX	792
19.10	Online Case Study: Password-Protected Books Database Application	792
19.11	Wrap-Up	792

20 Searching and Sorting 799

20.1	Introduction	800
20.2	Searching Algorithms	801
20.2.1	Linear Search	801
20.2.2	Binary Search	805
20.3	Sorting Algorithms	810
20.3.1	Selection Sort	810

20.3.2	Insertion Sort	814
20.3.3	Merge Sort	818
20.4	Summary of the Efficiency of Searching and Sorting Algorithms	824
20.5	Wrap-Up	824

21 Data Structures 830

21.1	Introduction	831
21.2	Simple-Type structs, Boxing and Unboxing	831
21.3	Self-Referential Classes	832
21.4	Linked Lists	833
21.5	Stacks	846
21.6	Queues	850
21.7	Trees	853
21.7.1	Binary Search Tree of Integer Values	854
21.7.2	Binary Search Tree of IComparable Objects	861
21.8	Wrap-Up	866

22 Generics 873

22.1	Introduction	874
22.2	Motivation for Generic Methods	875
22.3	Generic-Method Implementation	877
22.4	Type Constraints	880
22.5	Overloading Generic Methods	882
22.6	Generic Classes	883
22.7	Wrap-Up	892

23 Collections 898

23.1	Introduction	899
23.2	Collections Overview	899
23.3	Class Array and Enumerators	902
23.4	Nongeneric Collections	905
23.4.1	Class ArrayList	905
23.4.2	Class Stack	909
23.4.3	Class Hashtable	912
23.5	Generic Collections	917
23.5.1	Generic Class SortedDictionary	917
23.5.2	Generic Class LinkedList	919
23.6	Covariance and Contravariance for Generic Types	923
23.7	Wrap-Up	925

Chapters on the Web 932

A	Operator Precedence Chart	933
B	Simple Types	935
C	ASCII Character Set	937
	Appendices on the Web	938
	Index	939

Chapters 24–31 and Appendices D–G are PDF documents posted online at the book’s Companion Website (located at www.pearsonhighered.com/deitel/).

24	GUI with Windows Presentation Foundation	
25	WPF Graphics and Multimedia	
26	XML and LINQ to XML	
27	Web App Development with ASP.NET: A Deeper Look	
28	Windows Communication Foundation (WCF) Web Services	
29	Silverlight and Rich Internet Applications	
30	ATM Case Study, Part 1: Object-Oriented Design with the UML	
31	ATM Case Study, Part 2: Implementing an Object-Oriented Design	
D	Number Systems	
E	UML 2: Additional Diagram Types	
F	Unicode®	
G	Using the Visual C# 2010 Debugger	