

# Contents

Foreword .....	xxv
About the Author .....	xxvii
About the Technical Reviewer .....	xxix
Acknowledgments .....	xxxi
Introduction .....	xxxiii

## PART 1 ■■■ Windows Forms Fundamentals

■ CHAPTER 1	<b>User Interface Architecture</b> .....	3
	Classes and Objects .....	4
	The Roles of Classes .....	4
	Classes and Types .....	4
	User Interface Classes in .NET .....	9
	Controls Are Classes. ....	9
	Controls Can Contain Other Controls .....	10
	Controls Can Extend Other Controls .....	12
	Inheritance and the Form Class .....	14
	Accessing Controls .....	16
	Components .....	18
	Interacting with a Control .....	19
	Overriding Methods .....	20
	The View-Mediator Pattern .....	20
	Smart Controls .....	22
	Smart Forms .....	22
	Visual Studio .....	23
	Generating User-Interface Code in Visual Studio .....	25
	The Component Tray .....	27
	The Hidden Designer Code .....	28
	Application Lifetime .....	31
	Designing Windows Forms Applications .....	33
	Encapsulation .....	33
	Developing in Tiers. ....	36
	The Last Word .....	39

<b>CHAPTER 2</b>	<b>Control Basics</b>	41
	The Windows Forms Package	41
	The .NET Solution	42
	The Control Class	43
	Control Relations	46
	Windows XP Styles	47
	Position and Size	48
	Overlapping Controls	50
	Color	52
	Alpha Blending	54
	Fonts and Text	55
	System Fonts	57
	Large Fonts	57
	Access Keys	58
	Focus and the Tab Sequence	59
	Responding to the Mouse and Keyboard	61
	Handling the Keyboard	61
	Handling the Mouse	66
	A Mouse/Keyboard Example	67
	Mouse Cursors	68
	Low-Level Members	70
	The Last Word	71
<b>CHAPTER 3</b>	<b>Forms</b>	73
	The Form Class	73
	Form Size and Position	77
	Scrollable Forms	81
	Showing a Form	83
	Custom Dialog Windows	83
	Form Interaction	86
	Form Ownership	89
	Prebuilt Dialogs	91
	Resizable Forms	94
	The Problem of Size	95
	Minimum and Maximum Form Size	96
	Anchoring	96
	Docking	100
	Autosizing	101

Splitting Windows .....	104
Building Split Windows with Panels .....	106
Other Split Windows .....	107
The Last Word .....	110
<b>CHAPTER 4 The Classic Controls .....</b>	<b>111</b>
The Classic Control Gallery .....	111
Labels .....	111
LinkLabel .....	112
Button .....	114
TextBox .....	115
RichTextBox .....	117
CheckBox and RadioButton .....	122
PictureBox .....	122
List Controls .....	123
Other Domain Controls .....	127
The Date Controls .....	129
The DateTimePicker .....	130
MonthCalendar .....	132
Container Controls .....	134
The TabControl .....	135
AutoComplete .....	137
Drag-and-Drop .....	139
“Fake” Drag-and-Drop .....	139
Authentic Drag-and-Drop .....	140
Extender Providers .....	143
The NotifyIcon .....	145
ActiveX Controls .....	148
Should You Import ActiveX Controls? .....	149
The Last Word .....	150
<b>CHAPTER 5 Images and Resources .....</b>	<b>151</b>
The Image Class .....	151
Common Controls and Images .....	152
The ImageList .....	154

Resources .....	158
Adding a Type-Safe Resource .....	159
How Type-Safe Resources Work .....	161
Form Resources .....	164
Creating Additional Resource Files .....	165
Localization .....	166
Creating a Localizable Form .....	167
How Localization Works .....	168
The Last Word .....	171
<b>CHAPTER 6 Lists and Trees .....</b>	<b>173</b>
ListView Basics .....	173
View Modes .....	173
More Advanced ListViews .....	182
ListView Sorting .....	182
Label Editing .....	186
ListView Grouping .....	187
Searching and Hit Testing .....	189
ListView Virtualization .....	189
TreeView Basics .....	195
TreeView Structure .....	195
TreeView Navigation .....	197
Manipulating Nodes .....	200
Selecting Nodes .....	202
More Advanced TreeViews .....	204
Node Pictures .....	205
Expanding and Collapsing Levels .....	206
TreeView Drag-and-Drop .....	207
The Last Word .....	210
<b>CHAPTER 7 Drawing with GDI+ .....</b>	<b>211</b>
Understanding GDI+ .....	212
Paint Sessions with GDI+ .....	213
Accessing the Graphics Object .....	213
Painting and Repainting .....	214
Refreshes and Updates .....	216
Painting and Resizing .....	218

The Graphics Class .....	219
Rendering Mode and Antialiasing .....	221
Pens .....	222
Brushes .....	226
Drawing Text .....	231
The GraphicsPath .....	234
More-Advanced GDI+ .....	235
Alpha Blending .....	236
Clipping .....	237
Coordinate Systems and Transformations .....	240
Performing a Screen Capture .....	242
Optimizing GDI+ Painting .....	244
Painting and Debugging .....	244
Double Buffering .....	244
Painting Portions of a Window .....	249
Hit Testing .....	252
Painting Windows Controls .....	255
The ControlPaint Class .....	256
Visual Styles .....	257
Visual Style Support .....	258
Drawing with the VisualStyleRenderer .....	258
Using a Control Renderer .....	261
The Last Word .....	262

<b>CHAPTER 8</b>	<b>Data Binding .....</b>	<b>263</b>
	Introducing Data Binding .....	264
	.NET Data Binding .....	264
	Basic Data Binding .....	266
	Data Consumers .....	267
	Data Providers .....	267
	A Data Access Component .....	268
	Binding to a List (Complex Binding) .....	270
	Binding to a Grid (Complex Binding) .....	272
	Binding to Any Control (Simple Binding) .....	273
	Unusual Single-Value Binding .....	274

Common Data-Binding Scenarios .....	276
Updating with Data Binding .....	276
Formatting Data with a Format String .....	278
Formatting Data with the Format and Parse Events .....	280
Advanced Conversions .....	282
Creating a Lookup Table .....	285
Row Validation and Changes .....	287
Data Binding Exposed .....	288
Navigation with Data Binding .....	289
Reacting to Record Navigation .....	290
Creating Master-Detail Forms .....	291
Creating a New Binding Context .....	293
Validating Bound Data .....	294
Binding to Custom Objects .....	296
Overriding ToString() .....	300
Supporting Grid Binding .....	301
Automatic Data Binding .....	304
Binding Directly to a Database (Table Adapters) .....	304
Using a Strongly Typed DataSet .....	309
Binding Directly to a Custom Object .....	310
Data-Aware Controls .....	313
A Decoupled TreeView with Just-in-Time Nodes .....	314
The Last Word .....	318

## PART 2 ■■■ Custom Controls

CHAPTER 9 Custom Control Basics .....	321
Understanding Custom Controls .....	321
Types of Custom Controls .....	322
Custom Components .....	324
Control Projects .....	326
The Library Project .....	326
The Disposable Pattern .....	328
The Client Project .....	330
Automatic Toolbox Support .....	330
Customizing the Toolbox .....	331

The GAC .....	333
Creating a Key .....	334
Applying a Key to a Control Assembly .....	334
Attaching Keys in Visual Studio .....	335
Installing a Control in the GAC .....	335
The Last Word .....	336
<b>CHAPTER 10 User Controls .....</b>	<b>337</b>
Understanding User Controls .....	337
The Progress User Control .....	338
Creating the Progress User Control .....	338
Testing the Progress User Control .....	340
The Back Door .....	341
User Control Design .....	342
An Automatic Progress Bar .....	343
The Bitmap Thumbnail Viewer .....	344
Creating the BitmapViewer User Control .....	345
Testing the BitmapViewer Control .....	350
BitmapViewer Events .....	351
Performance Enhancements and Threading .....	352
Simplifying Layout .....	355
User Controls and Dynamic Interfaces .....	355
The Wizard Model .....	356
The Wizard Step .....	357
The Wizard Controller .....	359
Testing the Wizard .....	362
The Last Word .....	363
<b>CHAPTER 11 Derived Controls .....</b>	<b>365</b>
Understanding Derived Controls .....	365
Extending Controls .....	366
Derived Controls or User Controls? .....	367
The ProjectTree Control .....	368
The Data Class .....	369
Node Images .....	370
Node Groups .....	371
Adding Projects .....	372
Project Selection .....	374
A Custom TreeNode .....	376
Design-Time Support .....	377

The DirectoryTree Control .....	377
Filling the Tree .....	378
Directory Selection .....	379
Deriving Forms .....	380
A Simple Derived Form .....	381
Making an Ancestor Control Available .....	382
Adding a Property in the Ancestor Form .....	383
Dealing with Events .....	384
The Last Word .....	386
<b>CHAPTER 12 Owner-Drawn Controls .....</b>	<b>389</b>
Understanding Owner-Drawn Controls .....	389
A Simple Owner-Drawn ListBox .....	390
A More Advanced Owner-Drawn ListBox .....	391
An Owner-Drawn TreeView .....	396
Owner-Drawn Custom Controls .....	403
Double Buffering .....	403
The MarqueeLabel Control .....	404
The GradientPanel Control .....	406
The SimpleChart Control .....	411
The CollapsiblePanel Control .....	418
The Last Word .....	423
<b>CHAPTER 13 Design-Time Support for Custom Controls .....</b>	<b>425</b>
Design-Time Basics .....	425
The Key Players .....	426
Basic Attributes .....	427
Attributes and Inheritance .....	430
The Toolbox Bitmap .....	431
Debugging Design-Time Support .....	433
Code Serialization .....	436
Basic Serialization .....	437
Default Values .....	438
Making Serialization Decisions Programmatically .....	439
Serialization Type .....	441
Batch Initialization .....	442
Localizable Properties .....	445



Type Conversion .....	446
Dealing with Nested Objects .....	446
Creating a Type Converter .....	448
Attaching a Type Converter .....	451
The ExpandableObjectConverter .....	452
Creating a Nested Object with a Constructor .....	455
Custom Serialization with CodeDOM .....	458
Providing Standard Values .....	458
Type Editors .....	461
Using Prebuilt Type Editors .....	462
Using Custom Type Editors .....	464
The Last Word .....	473

## PART 3 ■■■ Modern Controls

■ CHAPTER 14 Tool, Menu, and Status Strips .....	477
ToolStrip Basics .....	477
The ToolStripItem .....	479
The ToolStripContainer .....	487
The ToolStrip and ToolStrip .....	492
Creating a Status Bar .....	493
ToolStrip Menus .....	496
A Main Menu .....	500
A Context Menu .....	502
ToolStrip Customization .....	504
Hosting Other Controls in the ToolStrip .....	504
Taking Control of Overflow Menus .....	509
Allowing Runtime Customization .....	512
Customizing the ToolStrip Rendering .....	514
The ToolStripManager .....	515
Customizing a Renderer .....	517
Changing the Colors of the ProfessionalToolStripRenderer .....	519
The Last Word .....	520
■ CHAPTER 15 The DataGridView .....	521
The DataGridView Legacy .....	521
Introducing the DataGridView .....	522
The DataGridView and Very Large Data Sources .....	523

Bare-Bones Data-Binding .....	525
The DataGridView Objects .....	527
Column Headers .....	530
Creating an Unbound Grid .....	531
Cell Selection .....	533
Navigation Events .....	536
Column-Based Sorting .....	537
Formatting the DataGridView .....	539
Column and Row Resizing .....	539
DataGridView Styles .....	545
Custom Cell Formatting .....	548
Hiding, Moving, and Freezing Columns .....	551
Using Image Columns .....	552
Using Button Columns .....	556
Editing and Validation with the DataGridView .....	558
Editing Events .....	560
Default Values for New Rows .....	560
Handling Errors .....	561
Validating Input .....	563
Constraining Choices with a List Column .....	566
DataGridView Customization .....	567
Custom Cell Painting .....	567
Custom Cells .....	570
Custom Cell Edit Controls .....	573
The Last Word .....	578
<b>CHAPTER 16 Sound and Video .....</b>	<b>579</b>
The SoundPlayer .....	579
Synchronous and Asynchronous Playback .....	580
System Sounds .....	583
Advanced Media with DirectShow .....	583
Using Quartz.dll Through Interop .....	583
Playing MP3, MIDI, WMA, and More .....	584
Showing MPEG and Other Video Types .....	589
The Last Word .....	591

<b>CHAPTER 17</b>	<b>The WebBrowser</b> .....	593
	WebBrowser Basics .....	593
	Navigating to a Page .....	594
	WebBrowser Events .....	596
	A WebBrowser Example .....	597
	Printing, Saving, and Fine-Tuning .....	599
	Blending Web and Windows Interfaces .....	601
	Build a DOM Tree .....	601
	Extract All Links .....	604
	Scripting a Web Page with .NET Code .....	606
	Scripting an HTML Form .....	610
	The Last Word .....	611

## PART 4 ■■■ Windows Forms Techniques

<b>CHAPTER 18</b>	<b>Validation and Masked Editing</b> .....	615
	Validating at the Right Time .....	615
	Validation Events .....	617
	The Validation Event Sequence .....	617
	Handling Validation Events .....	619
	Closing a Form with Validating .....	620
	The ErrorProvider .....	621
	Showing Error Icons .....	622
	Customizing Error Icons .....	624
	Regular Expressions .....	625
	Regular Expression Basics .....	626
	Validating with Regular Expressions .....	628
	Custom Validation Components .....	630
	Understanding the ASP.NET Validation Controls .....	630
	Building the BaseValidator .....	631
	Building Three Custom Validators .....	635
	Using the Custom Validators .....	638
	Masked Edit Controls .....	642
	Creating a Mask .....	642
	The MaskedTextBox Class .....	645
	MaskedTextBox Events .....	647
	Registering a Custom Mask .....	649
	Creating Custom Masked Controls .....	650
	The Last Word .....	654

<b>CHAPTER 19</b>	<b>Multiple and Single Document Interfaces</b> .....	655
	The Evolution of Document Interface Models .....	655
	MDI Essentials .....	659
	Finding Your Relatives .....	660
	Synchronizing MDI Children .....	661
	MDI Window List .....	663
	MDI Layout .....	664
	Merging Menus .....	665
	Managing Interface State .....	668
	Document-View Architecture .....	670
	A Document-View Ordering Program .....	671
	Multiple-Document SDI Applications .....	684
	Gaps in the Framework .....	690
	The Last Word .....	691
<b>CHAPTER 20</b>	<b>Multithreading</b> .....	693
	Multithreading Basics .....	693
	The Goals of Multithreading .....	694
	Options for Asynchronous Programming .....	695
	Asynchronous Delegates .....	696
	Polling and Callbacks .....	699
	Multithreading in a Windows Application .....	700
	The Worker Component .....	701
	The Asynchronous Call .....	703
	Marshalling Calls to the Right Thread .....	705
	Locking and Synchronization .....	708
	The BackgroundWorker Component .....	712
	A Simple BackgroundWorker Test .....	713
	Tracking Progress .....	714
	Supporting a Cancel Feature .....	716
	The Thread Class .....	718
	Creating a ThreadWrapper .....	720
	Creating the Derived Task Class .....	722
	Creating and Tracking Threads .....	723
	Improving the Thread Wrapper .....	726
	Task Queuing .....	728
	The Last Word .....	732

<b>CHAPTER 21</b>	<b>Dynamic Interfaces and Layout Engines</b>	<b>733</b>
	The Case for Dynamic User Interface	733
	Dynamic Content	734
	An Adaptable Menu Example	735
	A Database-Driven Adaptable Menu	737
	Creating Controls at Runtime	741
	Managing Control Layout	742
	The Layout Event	743
	A Simple Hand-Made Layout Manager	744
	Problems with the Simple Layout Manager	747
	Layout Engines	748
	Creating a Custom Layout Engine	749
	The FlowLayoutPanel	751
	The FlowBreak Extended Property	752
	Margins and Padding	753
	Automatic Scrolling and Sizing	754
	The TableLayoutPanel	755
	Row and Column Styles	756
	Generating New Columns and Rows	758
	Positioning Controls	759
	Extended Properties with the TableLayoutPanel	760
	Layout Panel Examples	761
	TableLayoutPanel: A Localizable Dialog Box	761
	TableLayoutPanel: BiPane Proportional Resizing	763
	TableLayoutPanel: A List of Settings	764
	TableLayoutPanel: Forms From a File	766
	FlowLayoutPanel: A Modular Interface	776
	Markup-Based User Interface	778
	XAML	779
	WFML	779
	The Last Word	779
<b>CHAPTER 22</b>	<b>Help Systems</b>	<b>781</b>
	Understanding Help	781
	Classic “Bad Help”	782
	Types of Help	783
	Help-Authoring Tools	786

Basic Help with the HelpProvider .....	787
Simple Pop-Ups .....	789
External Web Pages .....	790
Compiled Help Files .....	791
HTML Help with the HelpProvider .....	792
Creating a Basic HTML Help File.....	792
Using Context-Sensitive Help .....	797
Control-Based and Form-Based Help.....	797
Invoking Help Programmatically .....	798
Using Database-Based Help .....	799
Using Task-Based Help .....	800
Creating Your Own Help.....	802
Application-Embedded Support .....	803
Affordances.....	804
Agents .....	805
The Last Word .....	811

## PART 5 ■■■ **Advanced Custom Controls**

■ <b>CHAPTER 23 Skinned Forms and Animated Buttons .....</b>	<b>815</b>
Shaped Forms and Controls .....	815
A Simple Shaped Form.....	816
Creating a Background for Shaped Forms.....	817
Moving Shaped Forms .....	821
Shaped Controls .....	822
Animated Buttons .....	822
Basic Animated Buttons.....	823
A Base Class for Animated Buttons .....	823
Improving the Performance of Owner-Drawn Controls .....	839
Caching Images .....	839
Reusing Images .....	842
The Last Word .....	843
■ <b>CHAPTER 24 Dynamic Drawing with a Design Surface .....</b>	<b>845</b>
A Drawing Program with Controls .....	845
The Shape Control .....	846
The Drawing Surface .....	849

A Drawing Program with Shape Objects .....	855
The Shape Class .....	856
The Shape Collection .....	863
The Drawing Surface .....	866
The Last Word .....	877
<b>CHAPTER 25 Custom Extender Providers .....</b>	<b>879</b>
Understanding Extender Providers .....	879
The StatusStripHelpLabel Provider .....	881
Choosing a Base Class .....	881
Choosing the Control to Extend .....	881
Providing the Extended Property .....	882
Implementing the SetXxx() and GetXxx() Methods .....	883
Testing the Provider .....	885
Changing How Extended Properties Appear .....	886
The HelpIconProvider .....	886
Choosing a Base Class .....	886
Providing the Extended Property .....	887
The Last Word .....	892
<b>CHAPTER 26 Advanced Design-Time Support .....</b>	<b>893</b>
Control Designers .....	893
Filtering Properties and Events .....	896
Interacting with the Mouse .....	901
Selection and Resize Rules .....	902
Designer Verbs .....	903
Designer Services .....	907
Smart Tags .....	912
The Action List .....	913
The DesignerActionItem Collection .....	915
The Control Designer .....	917
Container and Collection Controls .....	918
Collection Controls .....	918
Container Controls .....	926
Licensing Custom Controls .....	928
Simple LIC File Licensing .....	929
Custom LIC File Licensing .....	931
More-Advanced License Providers .....	931
The Last Word .....	934

<b>APPENDIX A</b>	<b>Creating Usable Interfaces</b>	935
	Why Worry About the Interface?	935
	A Brief History of User Interfaces	936
	The Command-Line Era	936
	The Question-Answer Model	938
	The Menu-Driven Model	940
	The GUI Era	940
	Creativity vs. Convention	942
	Consistency in .NET	942
	The “Act Like Microsoft Office” Principle	943
	Administrative Utilities	943
	Know Your Application Type	944
	Know Your User	945
	Handling Complexity	945
	Segmenting Information	946
	Inductive User Interface	947
	Helpful Restrictions	947
	Restricting the User’s Ability to Make a Mistake	947
	Restricting the User’s Choices	948
	Restricting the User’s Imagination	949
	The Last Word	949
<b>APPENDIX B</b>	<b>ClickOnce</b>	951
	The Ground Rules	952
	The ClickOnce Installation Model	952
	ClickOnce Requirements	953
	ClickOnce Limitations	954
	A Simple ClickOnce Deployment	954
	Choosing a Location	955
	Deployed Files	959
	Installing a ClickOnce Application	960
	Updating a ClickOnce Application	961
	ClickOnce Options	962
	Publish Version	962
	Updates	963
	Prerequisites	964
	Options	965



ClickOnce Security .....	966
ClickOnce Security Prompts .....	967
Partial Trust and ClickOnce .....	967
The Last Word .....	969
<b>INDEX</b> .....	<b>971</b>