Symbols & Number
@ (at symbol) for attribute references, 707
[] (curly brackets), 526
14-15 Puzzle, 135–139

A
AccelerationRatio attribute, 908
accelerator keyboard events, 304–307
affine transforms, 838
alignment
content within buttons, 68
Ellipse class, for, 58
formatting text TOOLBar, 337–339
horizontal. See HorizontalAlignment property
StackPanels, buttons within, 92
vertical. See VerticalAlignment property
Angle property, animating, 909, 931–933
animation
AccelerationRatio attribute, 908
Animatable abstract class, 791, 819, 861
AnimationBase abstract classes, 861
AnimationClock type, 863, 889
AnimationTimeline abstract class, 861, 863
arbitrary paths, 929
By attribute, 869
AutoReverse property, 869, 892–893
BeginAnimation method, 863
BeginTime attribute, 871, 873–874
ColorAnimation class, 875–876
CreateClock method, 863
cross-element triggering, 875–876
cutoffTime attribute, 871
DecelerationRatio attribute, 908
delaying after events, 871
dependency properties, 860–861, 863
DispatcherTimer for, 859–860
doubleAnimations. See DoubleAnimation class
durations. See durations, animation
forever RepeatBehavior, 870, 892
HandoffBehavior property, 877–878
iteration, 870
key-frames. See key-frame animations
MatrixAnimationUsingPath class, 929
multiple animation support, 871–872
ParallelTimeline elements, 873–875
Path animation. See Path animation classes
PathGeometry property, 929
PointAnimation, 887, 929–930
From property, 863
To property, 863–869
From property, 868–869
To property, 868–869
RepeatBehavior attribute, 870, 873
repetitious markup issues, 876
retained graphics system, 860
smoothing, 892–893
SpeedRatio property, 873
Spline<Type>KeyFrame classes, 919–926
start criteria, 863–864
storyboards for. See storyboards
StringAnimationUsingKeyFrames, 918
Styles with. See styles, animation of
targets, 866–867
timeline abstract class, 861
timers, basing on, 859–860
timewr objects, 862
transforms, of. See transforms, animating
triggers for, 864, 866, 868
Application objects
allowed number of, 6
creating, 3
events defined for, 8
inheriting, 8–10
MainWindows property, 10–11
obtaining, ways for, 8
OnStartup method, 8–10
override methods, 8–10
Run method, 4, 6, 12
SessionEnding event, 8, 10
ShutdownMode property, 12–13
Windows property, 11–12
XAML files for defining, 479–480
ApplicationCommands class, 73–76, 308–311, 317, 422–425
arcs, 792, 794–797, 813
ArrangeOverride method
Arrange method calls, 207
calls to, 204
custom panel implementation, 235, 237, 246, 254, 255
LayoutTransform property with, 831
overriding for child elements, 203–204
purpose of, 209–210
return value of, 210
sizeFinalWidth calculation, 209
assembly resources, 71, 523–524
attached properties

AffectsParent flags, 241, 242
attributes, 521
dependency properties, compared to, 241
DockProperty example, 154–155
metadata options, 241
XAML syntax, 871
attributes
interrogating, 504
XAML representations of, 519, 521–522

B
Background property of Window
brushes for, 26, 29
client areas, setting for, 26
default transparency, 144
defined, 22
setting with templates, 668–669
SolidColorBrush brushes, setting with, 26–27
BAML files, 474–475
BeginStoryboard class
class hierarchy of, 880–881
ControllableStoryboardAction classes with, 880–883
EnterActions collections, 879
ExitActions collections, 879
HandoffBehavior property, 877–878
multiple animations from, 866
Name attribute assignment, 881
triggers, 864, 866
Bevel line joins, 774–777
Bézier curves
advantages of, 800–801, 804
assumptions for drawing formulas, 804
BezierSegment class, 800
boundaries of, 804
constants defining, 806
control points, 798–799
convex hulls, 804
cubic form, 806
deck points, 798
equations for, 808–809
joining, 804–805
mathematics of, 806–809
multiple joined, 804–805
parametric form, 806
path mini-language, 812–813
PathFigure StartPoint for, 800
PathGeometry, defining in, 930–931
PolyBezierSegment objects, 804–805
quadratic, 811–812, 813
required methods for, 792
slope at endpoints, 807–808
smooth cubic, 813–814
spline nature of, 798. See also splines
Spline<T>KeyFrame classes, 919–926
varieties of, 792
binding
BindingNavigator control, 734–735
button commands with event handlers, 74–76
button data to properties, 78–79
class for. See Binding class
data. See data binding
Binding class
BindingMode enumeration, 607–608
button data binding with, 79
Converter property, 366, 617–620
DataContext with, 610–611
ElementName property, 606–607, 627
Mode property, 607–610
MultiBinding elements, 623–625
Path property, 606–607, 615–616
quotation marks, placement of, 606–607
RelativeSource property, 636–638
setting bindings on targets, syntax for, 606–607
Source property, 607, 630
syntax for, 607
UpdateSourceTrigger property, 626–627
BitmapImage class, 53–54, 56, 940–941
bitmaps. See also Image class
array arguments for, 946
BitmapSource class, 939–940, 945
bits, creating from, 945
toons from, 71–73
creating, 942–947
cropping, 948, 954
dimensions of objects, determining, 962
DrawingContexts for. See DrawingContext class
DrawingGroups. See DrawingGroup class
elements, displaying in, 943–945
file types supported, 940
Palette property, 940, 945
parameterless constructors for, 941
pixel formats, 940, 942, 945
RenderTargetBitmap class, 942–943
Rotation property, 941
saving, 942
size issues, 945, 962
Source property, setting to Uri, 941
Stretch property, 943
stride arguments, 945–946
transforming, 948
Viewport property, 963–965
holding text, 60, 61–62, 329–331
BookReader application, 592–598
borders
  Border class, 135
  BorderBrush property, 42
  BorderThickness property, 42
  content, around, 48
  GradientBrush class with, 42–43
  suppressing sizing borders, 48

Brush type
  Background property of Window, 22
  BorderBrush property, 42
  BorderThickness property, 42
  BrushConverter class, 507
  BrushMappingMode property, 33
  Changed event, 29
  class hierarchy for, 26, 958
  DrawingBrush, 960
  Foreground property, 43
  Freezable class, 29
  gradient brushes, See gradient brushes;
    LinearGradientBrush class
  ImageBrushes, See images, ImageBrush class
  linear gradients, See LinearGradientBrush class
  multiple color gradients, 37
  radial gradient brushes, See RadialGradientBrush
    class
  Shape class properties, 760
  solid brushes in XAML, 507
  SolidColorBrush color brushes, 26–31
  text color, 48
  TileBrush-derived classes, 958
  types of graphics allowed with, 939
  VisualBrush class, 959
  XAML with, 507, 508–509, 539–541

Brushes type, 29
  bubbling events, 165, 168

Button class
  aligning content, 68
  Background (color) property, 70–71
  binding, 74–76, 78–79
  bitmaps for, 71–73
  ButtonBase, See ButtonBase class
  ButtonChrome class, 143, 165, 219
  Canvas objects as content for, 133
  check boxes, See CheckBox controls
  Clip property, 814
  color, changing, 67, 70–71
  Command property, 73–76
  Content property of, 66–67
  ContentTemplate elements, 680
  controls, as a kind of, See controls
  DataContext property, 78
  defined, 65
  derived classes, 76
  Focus method, 67
  font settings, 70
  Foreground (color) property, 70–71
  Height property, 69
  HorizontalAlignment property, 68–69
  images for, 71–73
  input focus, 67
  keyboard shortcuts for, 67
  Margin property, 68
  multiple objects in content, 98
  Name property, 93
  Padding property, 68
  panels, holding in, 90
  radio buttons, See RadioButton controls
  setting to Content property of Window, 66
  sharing formatting properties, See styles
  sizing buttons, 68–69
  styles, targeting with, 645
  Template property of, 663, 666. See also
    ControlTemplate class; templates
  TextBlock class, binding in templates, 666–667
    toggle buttons, See ToggleButton class
  ToolTips for, 79–80
  Triggers section samples, 864, 865–866
  Uri class to access resources, 72
  VerticalAlignment property, 68–69
  visual images of, 959
  Width property, 69
  XAML for, 514–515

ButtonBase class, 66–67, 68, 76, 160

C
  calendars, 693–704
  Canvas class
    animating properties of, 871–872
    attached properties, 241
    Bottom property, 761
    buttons, as content for, 133
    Children collection, 180
    class hierarchy, 89
    coordinate systems for, 844–846
    guideline for using, 133
    Height property, 131
    isDrawing property, 175–176
    layering of elements, 131
    Left property, 760, 761
    locations of elements, specifying, 131
    mouse events with, 175–176
    origin, setting, 844–846
    overlapping elements, 131
    printing, 375
    purpose of, 90, 131
    RenderTransform, setting, 844–846
    Right property, 761
    Shape objects, positioning, 131, 760–761
Check Box controls

Canvas class, continued
SizeChanged event, 905
size elements, 131
text placement, 135
Top property, 760, 761
Width property, 131
Check Box controls, 76, 77–79, 670
Checked event, 77
Child elements
Arrange method, 203–204, 207
Child property, 206–208
Children property of Panel, 235
five common overrides, 203–204
GetVisualChild method, 203, 206
Measure method of children, 207, 208–209
MeasureOverride method, 203, 206–209
OnRender method, 204
single-child. See single-child elements
size of parents, 208–209
VisualChildrenCount property, overriding, 203, 206
Class attribute, XAML, 470–471, 472
class hierarchy, WPF, 5
classes, splitting with partial keyword, 323
Click events
ClickMode property, 68
of MenuItem, 290
routing of, 166–167
client areas, 23, 26–27
clipboard commands, 75, 434–441
code-behind files, data binding in XAML to replace, 605
CollectionView class
arranging views, overview of, 745
can properties, 745
constructor, 734
currency manager for, 734
current position methods, 734
events of, 734
filtering with, 747–754
GetDefaultView method to create, 735
grouping with, 754–758
IEnumeratable implementation, 734
index navigation, 734
Predicate delegate, 747
properties of, 734
PropertyChanged events, 746
purpose of, 734
Refresh method, 746–747
sorting, 746
color. See also Color class; Color structure; Color structure; Colors class; Colors class
ColorAnimation class, 875–876, 891, 918–919
ColorAnimationUsingKeyFrames, 918
DynamicResources for, 539–541
system wide change messages, 538–539
text, setting for, 48
ToolBar example for text, 329–331
Color class
Color elements, XAML, 510–512
reflection, obtaining members by, 259
ToString method results, 263
Color structures, 23–25
Colors class
Color structures in, 263
defined, 25
reflection, obtaining members by, 259, 265
Web browser color support, 25–26
CombinedGeometry class, 787–790
ComboBox controls
default state, 330
events of, 330, 331
focus issues, 331
IsEditable property, 330–331
items, populating, 330
ToolBar containers of, 330–331
user issues, 331
command line arguments, 10
Command property of ButtonBase class, 73–76
Command property of MenuItem, 290
CommandBinding, 546–548
CommandBindings property of UIElement class, 74–75
commands, keyboard, binding to menu items, 308–311
console windows, compiler flag control of, 5
Content property
borders, 48
Button class, setting to, 66–67
compositing, importance of, 63
ContentControl class, derivation from, 45
ContentPresenter elements, 208
element sizing issues, 189
font settings, 46–47
FrameworkElement class, 52
Image class, 52
notification of events, 51
object type of, 45
one object limitation issue, 45
panels, setting to, 90–91
purpose of, 45
SizeToContent property, 48
string issues, 50–51
templates with, 666, 679
text string, setting to, 45–46
ToString methods with, 48–49
UIElement class, 51–52
user-input events, 61–62
XAML for, 514–516
ContentControl class
Button class, relationship to, 66–67
ContentPresenter class, 669–670
DataTemplate objects with, 679, 683–685
HeaderedContentControl class, 100
multiple objects in content. See Panel class
panels. See Panel class
purpose of, 45
templates for setting content, 677–679
ContentElement class
defined, 60
event routing, 169
IsMouseOver property, 169
relation to UIElement, 60
styles not supported, 650
user-input events, 61–62
ContentPresenter class, 669–670, 677–680, 685
ContentProperty, data binding with, 515–516, 607
ContextMenu controls, 312–315
ControllableStoryboardAction class, 880–883
controls
border reactions to mouseovers, 67
buttons. See Button class
check boxes. See CheckBox controls
class hierarchy for, 65, 223
color response to clicks, 67
Control class as parent of, 65, 185, 257
custom. See custom controls
data binding of, 78–79. See also data binding
defined, 65
dependency properties, 144
derivations of common controls, 257
FormattedText constructors with, 195
HeaderedContentControl class, 100
hierarchical data display. See TreeView controls
ItemsControl class, 257–258
label controls. See Label class
list boxes. See ListBox controls
list views. See ListView controls
looklessness of, 663
namespaces for, 65
property overview, 65
radio buttons. See RadioButton controls
sharing formatting properties of. See styles
single-child. See single-child elements
StatusBar class, 339–340
templates. See ControlTemplate class; templates
text boxes. See RichTextBox controls; TextBox controls
toggle buttons. See ToggleButton class
tree views. See TreeView controls
ControlTemplate class
button assignments to, 220–223
class hierarchy of, 664
ContentPresenter class, 669–670
ContentTemplateSelector property, 685–688
creating, purpose of, 664
defaults for, examining, 672–677
defined, 219, 663
element creation timing, 220
FrameworkElementFactory objects, 219
properties, specifying, 219
purpose of, 663
resources, defining as, 667
Setter objects, 220
Styles, combining with, 669
TargetType property, 665, 667
template creation, 219
triggers, 220, 665, 667, 670, 672
VisualTree property of, 219
converting formats, 948
convex hulls, 804
cropping systems, 844–847
cropping, 685
custom controls
background colors, 200
Control base class for, 185
Focusable property, 185
images, displaying in, 202
Margin property sizing effects, 189
single-child. See single-child elements
sizing of, 195–199
UIElement class child elements for, 243–244
custom elements
backdrop colors, 200
consumers, setting size properties for, 188, 190
Content property sizing issues, 189
Control base class for, 185
desired size, 188–189
Fill Property, 192–193
Focusable property, 185
FrameworkElement base class for, 185
Grid class sizing issues, 189
images, displaying in, 202
Margin property, 188–189
MeasureOverride method, 188–193
natural size, 190
single-child. See single-child elements
sizing of. See sizing of custom elements
UIElement base class for, 185
custom panels
AffectsParent flags, 241, 242
alignment issues, 239
ArrangeOverride method, 235, 237, 241, 254, 255
attached properties with, 239–241
Children property of Panel, 235
Children property of UIElementCollection, 242–244
FrameworkElement-based, 242, 244–246
GetVisualChildren handling, 235
custom panels, continued
InternalChildren property, 235
MeasureOverride method, 235, 237, 241, 246, 253–254
not inherited from Panel, 242–244
OnRender with, 235
Panel, advantages of inheriting from, 235
RenderTransform, 254
SizeToContent effects, 239
sizing of elements, 241
UniformGrid class, 235–237
VisualChildrenCount handling, 235

D
dashed lines, 777–780
data binding
Binding class for. See Binding class
BindingMode enumeration, 607–608
buttons to properties, 78–79
conversions of types for, 617–620
DataContext property, 610–611
defined, 605
delayed updating, 625–627
dependency properties, 366, 607, 612, 615
DependencyObject, 607, 629–630
ElementName property of Binding class, 606–607, 627
event handlers, replacement of, 605
events defined for, 631–632
flags, metadata, 615
FrameworkPropertyMetadataOptions, 615
GetBindingExpression method, 627
INotifyPropertyChanged interface, 631
IValueConverter, 617
Mode property, 607–610
multi-bindings, 620–625, 635–636
notification mechanisms, 612
OneTime mode, 608, 609
OneWay mode, 607–608, 609, 612
OneWayToSource mode, 608, 609
Path property, 615–616
purpose of, 605
RelativeSource property, 636–638, 652–653
SetBinding method, 607
setting on targets, 606–607
sources, 605, 607, 627–628, 630
static property references, 627
styles using for Value attributes, 650, 652–653
syntax for, 607
targets, defined, 605
between two controls, 605–606
TwoWay mode, 608, 609
UpdateSourceTrigger property, 626–627
XAML. See XAML data binding
data entry
adding objects to collections, 727
BindingNavigator control, 734–735
classes, creating for, 719–721, 726
CollectionChanged events, 727
CollectionView class, 734–735, 747–751
creating new records, 733
data binding of properties for, 721, 723
DataContext property as binding source, 723, 741
DataTemplate objects with, 741–743
DataTrigger tags, 741–743
deleting records, 733
event handlers for menu items, 739
Executed event handlers for, 724
file structure, single records, 726
filtering views, 745, 747–754
forms for, 721–723
grouping views, 745, 754–758
indexing collections, 727, 730–733, 734
INotifyPropertyChanged interface, 719–721
ListBoxes for data display, 741–745, 755–756
menus for, 723–724
navigation, 729, 733, 735
null entries for fields, 734
ObservableCollection class for, 727–729
opening files, 726, 729
overview, 719
PersonPanel example, 721–723
PropertyChanged events, 719–721, 727–729, 746
public classes, creating for, 719–721
Refresh method, 746–747
saving files, 726, 729
sorting views, 745–746
XmlSerializer with, 729
databases, 727–729, 734–736
DataContext property of FrameworkElement
binding sources, as, 723
data entry implementation example, 741
serializing, 726
source objects, setting for data binding, 610–611
DataFormats class, 88, 324
DataTemplate objects
class hierarchy of, 664
ContentTemplates, assigning to, 679–680
ContentTemplateSelector property, 685–688
DataTemplateSelector class, 685–688
DataTrigger tags, 707, 715, 741–743
DataType property of, 683
GridView class with, 663–664
HierarchicalDataTemplate, 353, 355, 708, 710
ItemTemplate property, 692–693
ListBox controls with, 281, 285
purpose of, 663, 664
SelectTemplate method, 685–688
Triggers sections, 688–691, 741–743
visual trees of, 680
DataTrigger tags, 707, 715
DoubleAnimation class

983
DoubleAnimationUsingKeyFrames class

 durations, animation
 CuToffTime attribute, 871
default, 868
 Duration structures, 862
 Forever option, 868, 892
 format for, 868
 percentage values for KeyTime property, 915
 RepeatBehavior attribute, 870
 SpeedRatio property, 873
 Storyboard, effects on multiple objects, 892
 Timeline type, 863
 TimeSpan objects, 862
total duration, 871

dynamic layout, 89
DynamicResource, 538–541

Element tree implementation, 328–329, 434–441

element trees
dependency properties, 143
routed input events, 157–158
Window objects, typical, 208
elements
arranging in panels. See custom panels
custom. See custom elements
defined, 51
desired size, 188–189
FrameworkElement class, 52
natural size, 190
single-child. See single-child elements

eclipses
alignment of, 58
dimensions, setting, 760
DrawEllipse method, 62–63, 956–957
EllipseGeometry class, 785, 885, 892–893
rendering paradigm, 760
sizing of, 57–58
Stretch member, 58
styles with, 651
em sizes, 46–47
engraving effect, 849
enumerations, 458, 506
environment information, 532–533
EvenOdd FillRule, 767–771
event handlers
AddHandler method, 93–94, 166–167
binding button commands to, 74–76
data bindings to replace, 605
eliminating, advantage of, 270
naming conventions, 7
PropertyChangedEventHandler, 719–721
RoutedEventArgs objects, 93
SelectionChanged events, 330
sender casting, 93
senders, 164–165
source hierarchy issues, 97–98
Window objects, obtaining, 8
XAML representations of, 519–520, 522
events
Application class, of, 8
bubbling events, 165, 168
button clicks, 65–66
Changed event of Freezable, 29
Checked event, 77
Click event routing, 166–167
custom routed event creation, 168–169
data binding, defining for, 631–632
enabled elements issue, 158
EventSetter objects of styles, 654–655
EventTrigger class, 656–657, 864, 866, 868, 878
Exit event, 8
INotifyPropertyChanged interface, 631
keyboard event routing, 167–168, 180–183
menu events, 290
mouse events. See mice
PropertyChanged events, 719–721
purpose of, 6
routed. See routed input events
SelectionChanged events, 330
senders, 164–165
source elements, 158
Startup event, 8
stylist. See stylus information
TextChanged events, 181
tunneling events, 165, 168
visibility issues, 158
XAML representations of, 519–520, 522
Expsander controls, 596

F
file formats for distribution, 545
files
file operations of RichTextBox, 324–328
FileSystemInfo class, 103–104
opening for data entry, 726
Fill property, 192–193, 507, 885
FillBehavior property of animation objects, 863, 869, 870
filtering, 745–754
Find menu implementation, 442–443
focus, 67, 180–181, 185
fonts
Baseline property of FontFamily, 851–852
Button class, controlling for, 70
custom, 815–818
defined, 46–47
dependency properties, 144
dialog boxes for picking, 392–409
events, 46–47
FontSize, 46, 47, 60, 141–146, 524–525
Fonts SystemFontFamilies, 400
FontStretch dependency, 144
FontStyle property, 47, 62, 144
FontWeight property, 47, 62, 144
italics, 47
LineSpacing property, 853
listing all available, 400
oblique, 47
outlines for, geometric, 815–818
rasterization, 815
setting to static properties, 506
styles, setting for, 640
tilted text shadows, 853
Foreground property of Brush type
ColorAnimationUsingKeyFrames, 918
dependency, 144
Image class with, 55
purpose of, 43
setting with templates, 668–669
styles, setting for, 640
text color, setting for, 48
TextBlocks with, 60–61
FormattedText type, 193–199, 202, 633, 815
forms, data entry, 721–723. See also data entry
Frame class
background colors, setting, 571
CanGoBack property, 579–580
CanGoForward property, 579–580
Content property, 567
event support, 574
GoBack method, 579–580
Navigate method, 574, 577–578
NavigateUri property, 566
NavigationUIVisibility, 575, 577
NavigationWindow as holder, 571
Next buttons for, 582
Page files as Sources for, 571
Previous buttons for, 582
Source property, 83
FrameworkElement class
ApplyTemplate method, 697
Control class relationship to, 65
custom panels based on, 242, 244–246
dependency properties, 144
elements, as base class for, 185
EventTrigger class, 864
FindName property of, 93
GetBindingExpression method, 627
Image class, 52
FrameworkElementFactory objects

FrameworkElement class, continued
LayoutTransform property, 819
Margin property, 55, 68, 188–189
MeasureCore method, 188–189
MeasureOverride method, 188–193
multiple children support, 235
overriding OnRender, 62–63
Panel class hierarchy, 89
printing, 375
purpose of, 52
raster and bitmap derived classes, 939
RenderTransform, 254
Resources property, 524
SetBinding method, 78–79, 607
shapes. See Shape class
Style property of, 640
FrameworkElementFactory objects, 219, 665
FrameworkPropertyMetadataOptions, 615
FrameworkTemplate abstract class, 664–666
Freezable class, 29–31

G
Geometry class
ArcSegments. See arcs
BuildGeometry method, 815–818
class hierarchy of, 783
Clip property, 814–815
CombinedGeometry. See CombinedGeometry class
Data property of Path, 783
EllipseGeometry class, 785
font customization, 815–818
GeometryCollection type, 785
GeometryGroup class, 785–787
LineGeometry class of, 784
LineSegment class, 792
PathFigure objects, 791–792
PathGeometry objects. See PathGeometry class
PathSegment objects, 791–792
PolyBezierSegment class, 804–805
purpose of, 783
QuadraticBezierSegment class, 811–812
RectangleGeometry class, 784–785
specification of objects, 783
Transform property of, 843
XAML markup for, 783
GeometryDrawing class, 950–954
GeometryGroup class, 785–787
GlyphRunDrawing class, 951
gradient brushes
borders with, 42–43
defined, 31
GradientStop class, 895–899
GradientStops property, 37
linear. See LinearGradientBrush class
MappingMode property, 33
multiple color gradients, 37
place in Brush class hierarchy, 26
radial. See RadialGradientBrush class
XAML representation of, 512–513
graphical shapes
Canvas class with, 760
Canvas.Left and Top properties, 760
capabilities of Shape objects, 760
class hierarchy, 759–760
composites, constructing, 760
curve creation, 762–765
eclipses. See ellipses
EvenOdd FillRule, 767–771
Fill property, 760
fill rules for, 765, 767–771
FrameworkElement ancestry of, 759
Grid objects for holding, 761
line caps, 772–774
line joins, 774–777
lines. See Line class
NonZero FillRule, 767–771
panel types suitable for composites, 760
paths. See Path class
pens for. See Pen class
polygons. See Polygon class
polylines. See Polyline class
positioning lines in Canvas, 761, 764
rectangles. See Rectangle class
rendering paradigms, 760
scaling, 766–767
Shapes library, 759–760
strokes. See Stroke Class
Style elements with, 766
XAML for property definitions, 772
graphics
bitmaps. See bitmaps
composites. See DrawingImage class
coordinate systems for Canvas, 844–846
paths, 790
retained graphics system, 860
Shape classes. See Shape class
dependency property effects on, 145
transforms. See transforms
texture. See vector graphics
Grid class
class hierarchy, 89
ColumnDefinition property, 112–113
controls, adding to, 113
creating objects of, 111
custom element sizing issues, 189
dependency property effects on, 145
graphical shape compositions in, 761
GridColumn class, 112
GridSplitter objects. See GridSplitter class
GridUnitType enumeration, 112
key-frame animations
- arbitrary paths, 929
- Boolean type, 911
- Char type, 911
class hierarchy for, 910
ColorAnimationUsingKeyFrames, 918–919
DiscreteDoubleKeyFrame class, 910, 912–913
DiscretePointKeyFrame class, 913–914
Discrete<TYPE>KeyFrame classes, 910
double type. See DoubleAnimationUsingKeyFrames
DoubleKeyFrame class, 910, 912
element specification order, 912
KeyFrames property, 910
KeySpline property, 919–926
KeyTime property, 912–915
Linear/<TYPE>KeyFrame classes, 910
LinearColorKeyFrame class, 918–919
LinearDoubleKeyFrame class, 910, 912–913
LinearPointKeyFrame class, 914–915
Matrix type, 911
Object type, 911
Paced KeyTime property, 915
percentage values for KeyTime property, 915
PointAnimationUsingKeyFrames, 913–914
purpose of, 910
Spline<TYPE>KeyFrame classes, 910, 919–926
String type, 911, 918
table of types for, 911
<TYPE>KeyFrame classes, 910
Uniform KeyTime property, 914
Value property, 912, 913
keyboard events
- accelerators, 304–307
- Focusable property, 180–181
- GotKeyboardFocus, 181
- IsKeyboardFocused property, 180
- Key enumeration, 181
- KeyboardDevice type, 183
- KeyDown, 181
- KeyEventArg, 181, 305
- KeyGesture class, 305, 307–308, 311
- KeyUp, 181
- Marches method, 305
- routing of, 167–168
- Source property with, 181
- TextInput, 181
tunneling, 181
keyboard shortcuts for buttons, 67

Label class, 80, 536
LayoutTransform property
- ArrangeOverride calls, 831
- compared to RenderTransform, 823
defined, 819
- line widths, effect on, 844
- Matrix, setting directly, 842
- MeasureOverride calls, 831–832
- RenderTransform compared to, 831–833, 883–885
- rules for, 831
- ScaleTransform with, 827
- SkewTransform with, 829–830
- TranslateTransform with, 824
- translations ignored, 833
lazy loading, 345–346
line caps, 772–774, 778–779
Line class, 761–780
line joins, 774–777
LinearColorKeyFrame class, 918–919
LinearDoubleKeyFrame class, 910, 912–913
LinearGradientBrush class
- angle of gradient, 33
- BrushMappingMode property, 33
calculation tricks, 34–35
- ColorInterpolationMode property, 33
- components of, 31
- constructors for, 32, 33
- EndPoint property, 37
- freezing, 33
- GradientStops property, 37
- horizontal gradients, 33
- MappingMode property, 33, 35
- multiple color gradients, 37
- padding, 33
- Reflect setting, 33–34
- SpreadMethod property, 33
- StartPoint property, 37
- units for specifying, 32–33
- updating backgrounds of windows, 37
XAML, representing in, 507, 512–513
LinearPointKeyFrame class, 914–915
LineGeometry class, 784–785
lines, path mini-language representation, 813
LineSegment class, 792–793, 797
ListBox controls
- adding items, 258, 265, 275
- alignment, centering, 261
- Background property, binding with, 269–270, 283–284
- binding selected values, 272
- Brush objects, storing, 267–269
class hierarchy for, 258–257
components of, 255
creating objects, 258
Ctrl key with, 261
DataTemplate objects with, 281, 285, 353. See also DataTemplate objects
deselecting items, 261
DisplayMemberPath property, 266
elements allowed in, 258
filling the ListBox, 258
filters, 751–754
focus rectangles, 261
font size settings, 275
grouping data with CollectionView, 754–758
GroupStyle property, 758
inheritance from, 277–278
initializing selection, 261
ItemCollection type, 238
Items property, 258
ItemsControl as parent, 257, 758
ItemSource property, 705
ItemsPanel property, 279, 284–285
ItemsPanelTemplates, 663–664, 693–704
ItemSource property, 258, 265
ItemTemplate property, 279–281, 285, 353, 692–693, 707
keyboard control of, 261, 284
Label controls as items, 272–273
ListBoxItem class for, 273–275
ListView descendent class. See ListView controls
multiple item selection, 262
panel replacement, 691
purpose of, 257
RemoveItems property, 275
ScrollIntoView method, 261
SelectionChanged event, 262, 275
SelectionMode property, 262
Shape objects in, 270–271
sizing, specifying, 261
sorting in, 746
StackPanel objects in, 275–277, 281
templates for. See ItemsPanelTemplate
ToolTip in, 283
ToString methods of objects for items, 263
visual trees for, 281
ListView controls
adding items to, 362–363
Columns collections, 360
DataTemplate objects for, 364–366
GridView class, 360
Items property, 360, 362–363
ItemsSource property, 360, 368–369
ListBox parent properties, 360
ListViewItem class, 360
purpose of, 360
sorting items, 363–364
View property, 360, 361, 363
local isolated storage, 85
local user application data, 414
localizing dates with DateTimeFormatInfo, 258
logical trees, 143, 206, 212
lookless controls, 663

M
Main method, 307
MainWindows property of Application, 10–11, 12
margins
Button class margins, 68
custom element sizing effects, 189
FrameworkElement Margin property, 68
Margin property of Image, 55
print settings, 383–385
printing settings, 378
StackPanels, for, 92–93
markup extensions
Binding. See Binding class
curly brackets for, 526
DynamicResource, 538–541
StaticResource, 524, 525–526, 537
StaticResourceExtension class, 526, 528
x:Key, 645, 648
x:Static. See x: Static markup extension
x:Type, 644–646
xx:Data, 705
matrices
defined, 838
identity matrices, 839
key-frame animation types, 911
LayoutTransform, setting directly, 842
M properties, 839–840
Matrix structure, 839–840
MatrixAnimationUsingPath class, 929, 934–937
MatrixTransform class, 842
multiplication of, 838
non-commutative nature of, 838
Offset properties, 839–840
RenderTransform, setting directly, 842
rotation strings, 848
ScaleTransform equivalence, 840–841
symbols for, 838
Transform class, 840, 841
transform formulas, 839
transforms without translation, 839
TranslateTransform equivalence, 840
Measure method, 207, 208–209, 831
MeasureOverride method

MeasureOverride method
aspect ratio maintenance, 190
Brush thickness with, 192–193
button sizing calculation, 199–200
calls to, 189, 204
child element sizing, 203, 206–207
childless elements, 190
clipping issues, 194
Content set to element, 189
custom panel implementation, 235, 237, 246, 254
default return value, 190
defined, 188–189
FormattedText objects with, 199
Grid objects as parents, 189
HorizontalAlignment effects, 190
Image class with, 190
infinity exceptions, 190–191
LayoutTransform property with, 831–832
Margin property with, 189, 200
Measure method of children, 207, 208–209
MeasureCore, relation to, 188–189
MinWidth and MinHeight, effects of setting, 190
natural size, indicating, 190
overriding, 189
Padding property with, 199
Pen class thickness with, 192–193
purpose of, 188–189
sizeAvailable argument, 189, 194, 201–202
sizeFinal.Width calculation, 209
SizeToContent property with, 189
StackPanel objects with, 189
Width and Height, effects of setting, 190

menus
accelerators, 304–307
CanExecute handlers, 308–311
Checked events, 290, 294
checked items, 290, 294–295, 297–300
class hierarchies of, 289, 290
Click events, 290, 291, 294
command bindings for, 308–311
Command property, 290, 308
construction overview, 291
custom menus. See ContextMenu controls
controls as menu items, 300–302
data binding in, 293, 301–302, 308–311
Dictionary objects for, 307–308
disabling items, 290
DockPanel objects for, 294
events defined by MenuItem, 290
Headers, 289, 289–290, 291, 311
Icon property of MenuItem, 290, 300, 302–304
IsCheckable property, 290, 294–295
IsChecked property, 290, 294–295
item types allowed, 290
items property, 289, 290
keyboard input handling, 304–305
KeyGesture class, 305, 307–308, 311
Marches method for keyboard events, 305
Menu elements, 546
Menu type, 289, 290, 291
MenuItem type, 289, 290, 311, 446
mutually exclusive checked items, 295
new MenuItem creation, 291
OnPreviewKeyDown method overrides, 305, 307
RoutedUICommand type, 308–311
Separator controls, 290
structure of, 289
submenus, 289, 290, 300, 302–304
tag property of MenuItem, 297
text for, setting, 291, 311
toolbars incorporating, 337
top-level, 290
Unchecked events, 290, 294
underline character, 291, 304–305
MessageBox class. See methods, overriding, 8–10
mice
ButtonState property, 169–170
Canvas, events with, 175–176
capturing process, 171–172
ChangedButton property, 169–170
ClickMode property of buttons, 68
cursor representation, 171
GetPosition method, 169
MouseOver property, 169
left vs. right events, 170
LeftButton property, 169
MiddleButton property, 169
Mouse class static properties, 170–171
Mouse events, 169–171
MouseButton enumeration, 169–170
MouseButtonEventArgs, 169–170
MouseButtonState enumeration, 169
MouseDown events. See MouseDown events
OnMouseUp method, 175
OnPreviewMouseDown method, 160
OnRender method graphical objects, 187
pointer location, obtaining, 28
Preview events, 160, 169–176
RightButton property, 169
routed events, 169–176
up and down event pairing, 171
Miter line joins, 774–777
modal dialog boxes, 13
modeless dialog boxes, 13, 437–441
monitors, 25
mouse. See mice
MouseDown events
  ButtonState property for, 169–170
  coordinates for, 7–8
  defined, 6
  event handler example, 6–7
  handlers for, 7–8
  MouseDownEvent for, 160
  OnMouseDown, relationship to, 158
  overriding OnMouseDown, 15
multi-bindings, 620–625, 635–636

N
Name attributes, 697
namespaces
  ClrNamespace property, 504
  commonly used by WPF, 3
  System, associating with XAML, 510–512
  XAML, 459, 470, 475–476
  XmlNamespace property, 504
  XmlnsDefinitionAttribute, 504
navigation applications
  BookReader. See BookReader application
  browser applications. See XAML Browser Applications
defined, 545
  fragment navigation, 596
  frames. See Frame class
  NavigationWindows. See NavigationWindow class
  TabControl class, 596
NavigationWindow class
  Application.Current property for obtaining, 569
  Back button, 570
  CanGo properties, 579–580
  Content property, 567
  event support, 574
  Forward button, 570
  frames in. See Frame class
  GetNavigationService method, 569
  GoBack method, 579–580
  journal, 570
  Navigate method, 569, 577–578
  NavigateUri property, 566
  NavigationService property of Page for obtaining, 569
  Next buttons for, 582
  Page elements, 567–570
  Previous buttons for, 582
  purpose of, 565–566
  RequestNavigate event handler, 569
  ShowsNavigationUI, 575
  Source property, 566–567
  StartupUri attribute, 566, 597
  Title property of Page, 567
  visited links journal, 570, 579–580
nesting panels, 94–95
NonZero FillRule, 767–771
Notepad Clone example, 413–453
numeric type converters, 618–619, 622

O
oblique text, 47
ObservableCollection class, 727–729, 734–735, 746, 754
OnMouseDown events, 158–159
OnRender method
calls to, 186–187, 204
clipping issues, 194, 201–202
drawing surface assumptions, 186
DrawingContext as parameter for, 955–956
DrawText method in, 193–195
FormattedText type with, 193–199
InvalidateVisual calls, 538–539
MeasureOverride method calls, 189
mouse event relation to graphical objects, 187
overriding, 62–63, 204
Pen class thickness with, 192
purpose of, 51
RenderSize property, 186–187
RenderTransform property with, 831
retention of graphical objects, 186–187
opacity
  animating, 893, 917, 933
  DrawingGroup, setting for, 954
  opening files for data entry, 726, 729
  origins, setting for Canvas, 844–846
  overriding methods, 8–10, 203–204
  Owner property of Window objects, 13

P
Padding property of controls, 68
Page class
  animation example, 875–876
  FlowDocuments in, 572
  Frame objects, as Source for, 571
  NavigationService class, 569
  NavigationWindows with, 567
  PageFunction class, 584–586
  XAML Browser Application use of, 598
pagination for printing, 387–390, 411, 425–434
Panel class
canvases. See Canvas class
  Children property of, 89–90, 91, 235. See also custom panels
class hierarchy for, 89
customizing. See custom panels
  DockPanels. See DockPanel class
dynamic layout for, 89
  Grid panels. See Grid class
  handlers for children's events, 167
  inheriting from. See custom panels
  InternalChildren property, 235
  nesting, 94–95
  purpose of, 89
  StackPanels. See StackPanel class
UniformGrids. See UniformGrid class
WrapPanels. See WrapPanel class
parsing

BrushConverter class, 507
conversions of types, 504–506
EnumConverter class, 506
Parse method of Double, 504–506
Path strings for data binding, 616
ThicknessConverter class, 505–506
XAML by System.Windows.Markup, 462
XmlReader.Load for, 462–463
partial keyword, 323, 416
Paste commands, implementing, 74–76, 320
Path animation classes
DoubleAnimationUsingPath, 930–934
MatrixAnimationUsingPath class, 934–937
PathAnimationSource.Angle, 931
purpose of, 929
Path class (geometrical shape)
amination of. See Path animation classes
ArcSegments. See arcs
Clip property, 814–815
closed figures, 790
Combine method, 53
CombinedGeometry. See CombinedGeometry class
Data property of, 783, 785
defined, 781
EllipseGeometry class, 785
figures, 790
FillRule issues, 793
font customization, 815–818
Geometry type, 783
GeometryGroup class, 785–787
graphics paths defined, 790
LineGeometry class, 784
LineSegment class, 792
multiple elements, 786–787
open figures, 790
PathFigure objects, 791–792
PathGeometry objects. See PathGeometry class
PathSegment objects, 791
Segments property, 791, 792
StartPoint property, 791, 792
PathGeometry class
animation classes with, 929–930
Bézier curves defined in, 930–931
figures, 790
Figures property, 791, 792
FillRule property, 791, 794
graphics paths, 790
subpaths, 790
PathSegment class
arbitrary polygon creation, 792
ArcSegments. See arcs
Bézier curves with, 802
class hierarchy for, 791
defined, 791
PathSegmentCollection, 792
PolyLineSegment class, 793–794
Pen class
DashCap property, 777
DashStyle property, 777
PenLineCap enumeration, 772–774, 778–779
PenLineJoin enumeration, 774–777
properties, table of, 771–772
pixels
device independent units, 17
formats, 945
PixelFormat class, 940, 942
png files. See bitmaps
point sizes of fonts, 47
PointAnimation class, 887–888
PointAnimationUsingKeyFrames, 913–914, 926
PointAnimationUsingPath class, 929–930
PointCollections, 761–763
pointers, mouse, obtaining locations of, 28
Points property, 761–763
points, specifying collections of, 506
PolyBezierSegment class, 804–805
Polygon class
arbitrary polygon creation, 792
creating objects in a canvas, 133
curve creation, 762–765
fill rules for, 133, 765, 767–769
Grid class with, 761
Points property, 761–763
StrokeLineJoin property, 774–777
Style definitions for, 768–769
Polyline class
coordinate system marking with, 846
curve creation, 762–765
fill rules for, 765, 767–769
Grid class with, 761
line joins, 774–777
Points property, 761–763
positioning in Content, 763
purpose of, 177–180
PolyLineSegment class, 793–794
positioning Window objects, 16–20
PresentationCore reference, adding, 4
preview events, 85–86, 169–176
printing
Arrange method requirement, 387
banner printing, 388–392, 409–411
color presentation. See Color structures
DocumentPage class, 387, 390
DocumentPaginator class, 387–390
drawingVisual class, 375–377, 390
GetPage method, 387, 390
Grid objects, 385–387
margin settings, 378
Measure method requirement, 387
multi-page documents, 387
multiple pages, 385
multiple printers, 378
PageOrientation property of PrintTicket, 427
PageRangeSelection property, 377
pagination, 387–390
PrintableAreaWidth/Height properties, 377
PrintDialog class, 375–378
PrintDocument method, 387
Printer Preferences field, 377
PrintQueue field, 375, 378
PrintTicket class, 375, 377–378, 427
PrintVisual method, 377, 385–387
Visual type, 375, 385, 387, 390
projects
code files, adding, 4
creating new, 4
properties of, setting, 5
references, adding, 4
properties. See also properties under specific classes
attached. See attached properties
dependency. See dependency properties
determination by reflection, 504
EnumConverter class, 506
parsing inconsistent string representations, 504–506
XAML representations of, 508–510, 514–515, 521, 606

Q–R
QuadraticBezierSegment class, 811–812
RadialGradientBrush class, 38–41
RadioButton controls, 76, 100–102, 646, 669
raster graphics, 939. See also bitmaps
rasterization, 815
ReachFramework.dll, 377–378
Rectangle class
Canvas.Left and Top properties, 760
dimensions, setting, 760
drawRectangle methods, 956–957
Grid class with, 761
rendering paradigm, 760
StrokeLineJoin property, 774–777
RectangleGeometry class, 784–785
recursing directory trees, 344–345, 351–353
references, adding using Solution Explorer, 4
topology, metadata, 31
reflections of graphics, 965–966
reflections of text, 855–856
RenderSize property
ArrangeOverride return values, 210
dimension calculation for, 187
drop down menu, setting, 819
drop shadow creation, 848–849
LayoutTransform associated with, 377–383
Matrix, setting directly, 842
MatrixTransform, setting to, 937
OnRender method, 831
RadialPanel example using, 254
RenderTransformOrigin property, 833–835
rules for, 831
ScaleTransform, with, 827
ScaleTransformOrigin property, 833–835
rules for, 831
ScaleTransform with, 827
set to TranslateTransform, 821
SkewTransform with, 829–830
TranslateTransform with, 824
Value property, 841
RepeatBehavior animation, 870, 873, 892, 893
resources
adding to projects, 71
assembly, 71, 523–524
defined, 71
locally defined. See XAML resources
ResourceDictionary type, 524
ResourceKey property, 537–538
StaticResource syntax, 641, 644
styles, defining in, 640–641
template selection, 685–686
templates, defining as, 667
Uri class to accessing, 72
XAML. See XAML resources
retained graphics system, 860
RichTextBox controls
command processing, 320
Document property, 88
FlowDocument class, 330, 500–502
FontFamily, setting, 330
formats used, 85
keystroke visibility issue, 85–86
loading files with, 324–328
RotateTransform

RichTextBox controls, continued
preview events, 85–86
purpose of, 80
saving files with, 324–328
Selection property, 329–330
TextRange class, 88, 329–330
toolbars, inside, 319–320
RotateTransform
affine transforms, 838
Angle property of, 830–831, 916
animating, 879–880
Center properties of, 830, 831, 833
coordinate system issues, 846
formulas, 837–838
line rotation techniques, 835–837
MatrixTransform equivalence, 842
negative angles, 831
Path rotation, 888
rotating around center, 833–834
rotating TextBlock objects, 854–855
syntax for, 821
XAML example, 820–821
rotating bitmaps, 941
Round line joins, 774–777
routed input events
AddHandler method, 166–167, 168
advantages of, 165
bubbling events, 165, 168
capturing, 166, 171–172
class hierarchy of RoutedEventArgs, 157–158
Click event routing, 166–167
ContentElement class events, 169
custom event creation, 168–169
defined, 157–158
Device property of RoutedEventArgs, 161
enabled elements issue, 158
Handled flag, 161, 166
InputEventArgs, 161
keyboard events, 167–168
mouse events, 169–176
no default implementations of events, 159
OriginalSource property, 160–161, 164–166, 169
purpose of, 158
raising custom events, 168–169
RegisterRoutedEvent method, 168
RemoveHandler method, 168
RoutedEvent property, 160, 164, 864
RoutedEventType, 160, 168
RoutedEventArgs class, 160–161, 164, 165, 168–169
RoutedEventArgs class, 160–161, 164, 165, 168–169
RoutedEventArgs class, 160–161, 164, 165, 168–169
RoutedEventArgs class, 160–161, 164, 165, 168–169
RoutedEventArgs class, 160–161, 164, 165, 168–169
RoutedEventArgs class, 160–161, 164, 165, 168–169
RoutingStrategy, 168
senders, 165–166
sequence of control, 165
Source property, 160–161, 164–166
TimeStamp property of InputEventArgs, 161
tunneling events, 165, 168
UIElement events, 158
visibility issues, 158
Run method of Application class, 4, 6, 12

S
saving files for data entry, 726, 729
ScaleTransform
ActualWidth property, effect on, 826
Center properties, 824, 826, 827
Matrix equivalence, 840–841
properties of, 824
RenderSize property, effect on, 826
RenderTransform vs. LayoutTransform, 827
Scale properties, 824–827
scaling formula, 826–827
syntax for, 821
XAML example, 820–821
scaling graphic images, 766–767
crRGB color space, 24–25
ScrollBar controls
data binding example, 614–615
derivation of, 127
double values used for properties, 127
events of, 97–98
Orientation property, 127
Scroll events, 127
SmallChange property, 127
Template property of, 663
ScrollViewer class
Margin property, 97
purpose of, 95
ScrollBar events, 97–98
SizeToContent with, 97
StackPanels and contents of, 95–96
visibility properties, 97
WrapPanel with, 103
security permissions, 598
senders, 164–166
Separator controls of menus, 290
serialization, 434–447
shadows, creating, 965–966
Shape class. See also graphical shapes
Brush type properties, 760
Canvas class with, 760
class hierarchy of, 56–57, 759
composites, constructing, 760
curve creation, 762–765
Ellipse class of. See ellipses
EvenOdd FillRule, 767–771
Fill property, 760
fill rules for, 765, 767–769
Grid objects for holding composites, 761
line caps, 772–774
Line class of. See Line class line joins, 774–777
NonZero FillRule, 767–771
paths. See Path class Polygons. See Polygon class Polylines. See Polyline class positioning in Canvas objects, 760–761
Rectangles. See Rectangle class rendering paradigms, 760
Shapes library, 759
strokes with. See Stroke class
Style elements with, 766
XAML for property definitions, 772
shapes, graphic. See graphical shapes
ShowDialog method, 13, 83, 377, 379
sine wave simulation, 762–763
single-child elements
AddLogicalChild method, 206, 212
Arrange method, 203–204, 207
ArrangeOverride method, 203–204, 207, 209–210
Child property, 206–208
Decorator objects, 210
DesiredSize property, 207, 209
drawingVisual class, 224
element trees of, 208
five common overrides, 203–204
GetVisualChild method, 203, 206, 224–226
layout process description, 208
logical trees, 206
Measure method of children, 207–209
MeasureOverride method, 203, 206–209
OnRender method, 204
sequence of calls for overridden methods, 204
sizing of, 208–209
templates. See templates
visual trees, 206, 208
VisualChildrenCount, 203, 206, 224–226
single-threaded apartments, 4
SizeToContent property
custom element sizing issues, 189
custom panels effects, 239
purpose of, 48
ScrollViewer class use of, 97
sizing windows to image sizes, 55
sizing of custom elements
alignment property effects, 187
aspect ratio maintenance, 190
calculation by MeasureOverride, 199–200
child element effects on, 206–209
childless elements, 190
clipping, 188, 194, 201–202
desired size, 188–189
DesiredSize property, 209
FormattedText type issues, 193–199
HorizontalAlignment property effects, 187, 190
Margin property effects on, 187, 189
MaxWidth and MaxHeight, 187, 190
MeasureOverride method. See MeasureOverride method
minimum preferred size, 188–189
MinWidth and MinHeight, 190
natural size, indicating, 190
public property caveat, 188
RenderSize property. See RenderSize property
Width and Height, 187, 188, 190, 191
sizing Window objects, 16–20
SkewTransform
Angle properties, 827–828
Center properties, 829
creating, 821
formulas for, 828–829
horizontal skew, 828
large angles, 829
LayoutTransform vs. RenderTransform, 829–830
properties of, 827
rotation with, 829
vertical skew, 828
XAML example, 820–821
smoothing animations, 892–893
SolidColorBrushColor brushes, 26–32
sorting, 363–364, 745–746
sources, data binding
DataContext property, 610–611
defined, 605
Mode property, 607–610
notification mechanisms, 612
RelativeSource property, 636–638
requirements, 607
Source property of Binding class, 607–608, 627, 630
spline
Bézier curves as, 798. See also Bézier curves
KeySpline property, 919–926
SplineDoubleKeyFrame class, 910, 920
SplinePointKeyFrame, 926, 930
Spline<Type>KeyFrame classes, 910, 919–926
splitters, 122–127
sRGB color space, 24
StackPanel class
alignment of buttons, 92
Background brushes for, 91
button Name property, 93
Children collection of, 91, 93
class hierarchy, 89
ContentProperty attribute, 515–516
custom element sizing issues, 189
default arrangement of children, 91
event monitoring, 93–94
FindName property with, 93
index for children, 93
inside buttons, allowing multiple objects, 98
StackPanel class, continued
margins for, 92–93
nesting panels, 94–95
Orientation Property, 91
purpose of, 90
styles with, 641
template role for other classes, 690–691
ToolBar button and text display with, 320
transform issues, 831
VirtualizingStackPanel, 690–691
XAML snippet example, 457–458
stand-alone XAML, 460
Startup event of Application class, 8
StatusBar class, 339, 690–691, 693–696
storyboards
attached properties of, 865
BeginStoryboard class, 864, 866
class hierarchy for, 864–865
consolidation of multiple timelines, 865
ControllableStoryboardAction. See
ControllableStoryboardAction class
defined, 864
durations, effects on subordinate objects, 892
EnterActions collections, 879
ExitActions collections, 879
Forever setting, 892
HandoffBehavior property, 877–878
multiple animation support, 871–872
ParallelTimeline elements, 873–875
PauseStoryboard action, 883
RepeatBehavior attribute, 873
SeekStoryboard action, 883
SpeedRatio property, 873
TARGET_NAME attached properties, 866–867, 868
TargetProperty references, 866, 871
TimelineGroup ancestor of, 871
triggers, acting as, 866
Stretch properties, 54–55, 190, 962–963
strings
immutability of, 50
StringAnimationUsingKeyFrames, 918
StringBuilder objects, 50–51
Stroke class
colors, 550
DashCap property, 780
DrawingAttributes property, 550, 552–553, 555–557, 562
DrawingGroup objects, 552–553
DrawingImage class, 553
GetGeometry method, 552–553
InkCanvas property for, 177
PressureFactor property, 550
property for, 192–193
Save method, 550
saving as XAML Drawing Files, 552–553
Stroke collections of InkCanvas, 549–550
StrokeDash properties, 777–779, 780
StrokeLinejoin property, 774–777
StrokeMiterLimit property, 777
StrokeThickness property, 772, 893
stylus effects, 550
StylusPoints property, 550
table of, 771–772
styles
animation of, 876–880
BasedOn attribute, 646–649
class definition, 639
ControlTemplate objects, controlling, 669
data binding Values, 650, 652–653
DataTrigger class, 659–660
defined, 639
dependency property issues, 650
EventSetter objects, 639, 653–655
FlowDocument objects, 653–654
FontSize property, setting, 640, 645
Foreground property, setting, 640, 645
gradient brushes in, 643–644
graphics using, 651–653
heterogenous elements, applying to, 641–642
hierarchy of styles, defining, 649
Image objects not supported, 650
IsSealed property, 656
keys, 646–647
Line class with, 652–653
local settings, precedence of, 640
multiple resource sections, same key with, 642–643
null Values, 640
precedence of settings, 640, 647–648
Property attribute, 639
purpose of, 639
RadioButton margin settings, 646
referencing, 640
RelativeSource property, 652–653
Resources, 640–644
restrictions on, 650
Setters property, 639, 645
StaticResource markup extension, 641, 644
Style class definition, 639
Style property of FrameworkElement, 640
TargetType property, 644–646
templates compared to, 663
Triggers property, 656–660
unique properties of elements with, 642
Value attribute, 639, 643, 650
XAML resources for, 527
XAML Setter syntax, 639
x.Key attribute, 645, 648
x.Type extension, 644–646
stylus information, 167, 177–180, 550–555
subpaths, 790
Table class, Grid objects compared to, 111
Tablet PCs
  eraser mode, 553–555
  InkCanvas interface, 177, 180, 545–546
  PressureFactor property, 550
  strokes, 177, 549–550
  stylus events, 167, 177, 550
  StylusPlugin namespace, 177
TargetName attached properties, 866–868, 879
TargetProperty for animations, 866
targets, data binding, 605, 607–610, 629–630
taskbars, 12, 378
templates
  ApplyTemplate method, 697
  binding to Content properties, 670, 680
  binding to data, 710
  CellTemplate objects, 663–664
  class hierarchy of, 664
  content, changing only, 677–679
  ContentPresenter class with, 669–670
  ContentTemplateSelector property, 685–688
  Control class Template property, 219–223, 663–664, 672–677
  ControlTemplates. See ControlTemplate class
  DataTemplates. See DataTemplate objects
  DataTrigger tags, 707
defaults for, examining, 672–677
  FindResource method with, 685
  FrameworkTemplate base class, 664
  Help system using, 710–717
  HierarchicalDataTemplate type, 354–355, 663–664
  IsSealed property, 664
  ItemsControl class with, 690–691
  ItemsPanelTemplates. See ItemsPanelTemplate objects
  ItemTemplate property, 279–281, 663–664, 692–693, 707
  ItemTemplates. See ItemTemplate property
  Name attributes, 697
  resource selection, 685–686
  resources, defining as, 667
  Resources property, 664
  SelectTemplate method, 685–688
  styles compared to, 663
  TemplateBinding markup extension, 666–667
  TextBlock class, binding to controls, 666–667
  TreeView controls using, 709–710
  VisualTree property, 664–665
  XAML for template definitions, 665
termination of programs, 5, 12
text
  Bold objects, 60
  button content, 70
  Canvas objects, placement in, 135
  color, setting, 48
  Content property, setting to, 45–46
  coordinate system issues, 846
  custom fonts for, 815–818
  DrawText method, 193–195
  drop shadows, 848–849
  em sizes, 46–47
  file I/O, 85
  FontFamily, setting, 46–47
  FontSize, setting, 46, 47
  FontStyle property, 47
  FontWeight property, 47
  FormattedText type, 193–199, 202
  italics, 47, 60
  oblique, 47
  point sizes, 47
  properties for, setting, 46–49
  reflecting, 855–856
  rich text. See RichTextBlock control
  rotating, 854–857
  StringBuilder objects, 50–51
  styles, setting for, 653–654
  TextBlock objects. See TextBlock class
  TextDecorationLocation enumeration, 315
  ToString methods for generating, 48–49
  wrapping, property for, 425–434, 446–448
TextBlock class
  AcceptsReturn property, 83
  binding with templates, 666–667
  Bold objects, 60
  content property, 516
  dialog box access to Text, 82
  FontSize property, 60
  Foreground property of, 60–61
  implicit creation of objects, 59
  Inlines property of, 59, 60, 516
  Italic objects, 60
  Opacity, animating, 917
  parent class, 59
  purpose of, 58
  rotating TextBlock objects, 854–855
  styles, targeting with, 645
  templates, binding to controls, 666–667
  user-input events, 61–62
TextBox controls
  binding to, 447–449, 625
  class hierarchy for, 80
  expansion to fit text, 83
  filters with, 751–754
  rich. See RichTextBox controls
  Text property of, 80
  TextWrapping property, 425–434
TextBoxElement classes, 653
Thickness structure, 55
threading, 4
TileBrush class, 958, 962–965
Timeline type

Timeline type, 863–865, 871, 873–875. See also storyboards

timers
- animation based on, 859–860
- AnimationClock type, 863
- comparison of Timer classes, 41
- CreateClock method, 863
- disadvantages for animation, 899
- DispatcherTimer class, 41
- TimerOnTick method, 860

TimeSpan objects, 862
titles, setting for Window objects, 21

ToggleButton class, 76–79

ToolBar class
- ApplicationCommands for, 317
- BandIndex property, 323, 324
- buttons for, 319, 320, 327
- class hierarchy for, 321
- components for, 317
- creating toolbars, 317–319
- DockPanels with, 324
- Edit menu command examples, 328–329
- event handlers, 319
- focus, setting, 319
- formatting text, 329–331
- grid images, 320
- Header property, 317, 320, 322–323
- Items collection, 317
- keyboard interfaces, 319
- menus as members in, 337
- Orientation property, 322–323
- placement of toolbars, 317
- populating toolbars, 317–319
- positioning toolbars in trays, 322–323
- RichTextBox controls in, 319–320, 324
- RoutedUICommand objects for, 317–320
- StackPanels for text with buttons, 320
- text with buttons, 320
- ToolBarOverflowPanel, 321
- ToolBarPanel, 321
- ToolBarTray class, 321–323, 324
- tooltips, 317, 319
- width issues, 321

ToolTip class
- ListBox controls, using in, 283
- multiple objects in content. See Panel class setting up for buttons, 79–80
- toolbar buttons with, 317, 319

ToString methods, 48–49

transforms
- affine transforms, 838
- animating, 879–880, 886
- class hierarchy for, 819–820
- coordinate systems for Canvas, 844–846
- defined, 819

- DesiredSize property, effects on, 831
- drawing area vs. elements, 822–823
- drop shadows, 848–849
- Geometry class, Transform property of, 843
- horizontal skew, 828
- LayoutTransform property, 819, 823, 824, 829–833
- line widths, effect on, 844
- matrices for. See matrices
- MatrixTransform class, 842
- Path objects with, 843
- purpose of, 819
- RadialPanel example of, 254
- RenderTransform property, 819, 821, 823, 824, 829–830
- RenderTransform vs. LayoutTransform, 831–833
- RenderTransformOrigin property, 833–835
- rotations, 820–823, 829, 830–831, 833–834
- ScaleTransform, 820–821, 824–827, 840–841, 850–851
- SkewTransform, 820–821, 827–830, 850–851
- StackPanel issues, 831
- TransformGroup class, 843, 857, 902
- TranslateTransform, 820–821, 823–824, 840, 902
- types of objects transformable, 819
- UIElement basis for, 819
- UniformGrid issues, 831–832
- Value property of Transform class, 840, 852
- vertical skew, 828
- XAML multiplications with, 851–852

TranslateTransform property
- animations, 902
- C# example, 821
- drop shadows, 848–849
- LayoutTransform vs. RenderTransform with, 824
- Matrix equivalence, 840
- origin calculation, 824
- properties of, 823
- XAML example, 820–821

transparency, 23, 55–56. See also opacity

TreeView controls
- bitmap graphics in, 346
- class hierarchy, 341
- Collapse event, 345–346
- dependency properties of, 366
- directories, displaying, 343–354
- DispatcherObject descendents, displaying, 356–357
- events of, 345–346
- Grids with, 353
- Header property, 341–342, 347
- HierarchicalDataTemplate class, 353, 355
- IsSelected property, 345–346
- ItemCollection objects, 343
- Items property, 341, 343
- ItemsSource property, 356, 709–710
- ItemTemplate property, 353, 356, 663–664
lazy loading, 345–346
  navigating, 343
OnExpanded method, 349
OnSelected method, 347
populating, 342–354
purpose of, 341
recursion of, 344–354, 351–353
refreshing, 350–351
SelectedItemChanged event, 345–346, 353
strategy for discovery time minimalization, 345
templates with, 709–710
TreeViewItem class, 341, 343, 356
TypeTreeView class, 356–357
Unselected event, 345–346
Windows Explorer pane as example, 341

triggers for animation
  Actions property, 864
BeginStoryboard class, 864, 866
cross-element triggering, 875–876
elements with events, 864
EventTrigger class, 864, 868, 878, 883
Loaded event triggers, 883
Name attributes of elements with events, 864
purpose of, 864
RoutedEventArgs property, 864
SourceName property of EventTrigger, 864, 868
TargetName attributes, 868
Trigger class, 878–879
TriggerAction objects, 864, 880, 881
TriggerBase objects, 864
Triggers section samples, 864, 865–866, 883

Triggers property of Style
  class hierarchy, 650–657
DataTrigger class, 659–660
defined, 656
EventTrigger class, 656–657
mechanics of, 657
precedence rules, 658
Setters property, 657
syntax of, 657
TriggerBase class, 656
type of, 656
tunneling events, 165, 168

Type class, 31, 366–367
typefaces. See also fonts
  button content, 70
defined, 46
em sizes, 46–47
FontFamily, setting, 46–47
FontSize, setting, 46, 47
point sizes, 47
typeface objects, 193–194

U

UIElement class
  Arrange method, 203–204
  child elements based on, 243–244
class hierarchy for, 223
CommandBindings property, 74
Content property use of, 51–52
dependency properties, 144
events defined by, 6
Image class, 52
input, routing. See routed input events
OnRender method, 51
Panel class hierarchy, 89
printing instances of, 387
purpose of, 51
RenderSize property, 186–187
RenderTransform property of, 819
RenderTransformOrigin property, 833–834
shapes. See Shape class
transformability of, 819
UIElementCollection class, 93, 235, 242–244

underline character in menus, 291

UniformGrid class
  child elements of, 130
class hierarchy, 89
custom panels mimicking, 235–237
ListBox controls, displaying in, 691
ListBox controls using, 281–283
purpose of, 90, 130
transform issues, 831–832

URIs (Uniform Resource Identifiers)
  accessing resources with, 72
Uri constructor, 53
Uri objects, 940
user application data, 414

V

vector graphics
  defined, 939
DrawingGroups. See DrawingGroup class
GeometryDrawing class, 950–951
Vector type, 28, 36–37
vertical skew, 828
VerticalAlignment property, 55, 68–69, 187–188
video, 952, 957
Viewbox class, 98, 766–767, 846–847, 969–976
viewing data. See CollectionView; data entry
Viewport property, 963–965
virtual methods, overriding, 160
visibility events, 158
visited links journals. See journals
Visual class

Visual class
class hierarchy for, 223–224
GetVisualChild method, 203
printing, See printing. Visual type
styles not supported, 650
visual tree components, 223
VisualChildrenCount property, 203
visual objects, 143
visual trees
AddVisualChild method, 206, 212, 224
building for TreeView controls, 356
components of, 223
DataTemplates, of, 680
defined, 143
dependency property propagation, 144
GetVisualChild method, 224–226
ListBox controls, for, 281
VisualChildrenCount, 224–226
VisualTree property of ControlTemplate, 219
VisualTreeHelper class, 208
Window objects, typical, 208
Visual type, 375, 387
VisualBrush class, 959, 962, 963–965
VisualChildrenCount property, 203, 206, 235
visuals. See DrawingVisual class; visual trees

W
Web browser color support, 25–26
Window class
ActualHeight property, 16–20
ActualWidth property, 16–20
Background property, 22
client areas, 23
content. See Content property
ContentControl as parent class, 45
creating objects, 3
element tree of, 208
event handlers obtaining, 8
Foreground property, 955
formats for, setting, 21–22
Height property, 16–20
inheritance from, 13–17
initialization, 15
Left property, 18–20
MainWindow property of Application, 10–11, 12
minimum size of, 18
MouseDown events, 15
multiple instances of, 10–13
multiple objects in content. See Panel class
Owner property, 13
parent class of, 45
parts of, 6
positioning on screens, 16–20
purpose of, 4
ResizeMode property, 22
Show method, 4
ShowDialog method, 13
sizing, 16–20
styles for, setting, 21–22
taskbar, multiple windows in, 12
Title property, 4, 21
Top property, 18–20
topmost property, 22
Width property, 16–20
WindowCollection class, 11–12
WindowColor property, 31
WindowStartupLocation property, 19
WindowState property, 22
WindowStyle property, 21
XAML representation of, 548–549
Windows property of Application class, 11–12
WindowsBase reference, 4
WinFX Windows Application project type, 529
wizards
defined, 575
fixed sized windows, 577
journals for, 580
navigation buttons for, 575
Next buttons for, 582
PageFunction class, 584–586
Previous buttons for, 582
state requirement, 575
work area of screens, 18–19
WrapPanel class
class hierarchy, 89
ItemHeight property, 102–103
Orientation property, 102–103
purpose of, 90, 102–103
ScrollViewer with, 103
template role for Menu, 690–691
wrapping text, 425–434, 446–448

X-Y
XAML Browser Applications, 597–603
XAML Cruncher program, 487–519
XAML data binding
conversions of types for, 617–620
DataContext, setting, 610–611
delayed updating, 625–627
dependency properties, 612, 615
DependencyObject derived targets, 629–630
events defined for, 631–632
multi-bindings, 620–625, 635–636
Path property, 615–616
RelativeSource property, 636–638
Source property, 627–628, 630
between two controls, 605–606
UpdateSourceTrigger property, 626–627
x:Name attribute, 615
XAML (Extensible Application Markup Language)
advantages of, 458
Application object, files for, 479–480, 482–483
attached properties, 517–518, 521
attributes, 514–515, 519, 521–522
BAML files, 474–475
browser applications, 597–603
Build Action for, 471–472, 481
Button tags, 514–515
C# code equivalence example, 457
casting as buttons, 463–464
CDATA sections, 484
Class attribute, 470–471, 472, 477–478
class names with attributes, 519
class selection by XmlReader.Load, 503–504
code behind files with, 469–471, 473–474, 476–477
Code element, 470, 484
CommandBinding elements, 546–548
compiling with source code, 469–470, 475
converse expressions in, 457
constructors, replacing with, 458
Content property, 514–516
content, setting to, 463, 466, 475
Cruncher program. See XAML Cruncher program
{} (curly brackets), 526
custom classes in, 475–478
data binding. See XAML data binding
defined, 457
Drawing Files, saving strokes as, 552–553
element names, interpreting, 521–522
element tree representation, 461
EmbeddedCode project, 483
embedding C# in, 483–484
embedding in C# programs, 462
empty element syntax, 458
everification assignments, 458
error messages for, 460
ev event handlers, 458, 464, 466, 469–470, 473, 474
events, 519–520, 522
files, loading, 468–469
gradient brushes, defining, 512–513
graphical shapes creation example, 765–766
Image elements, 486
InitializeComponent method, 474, 475, 480
launching files of as programs, 459–460
locating elements by name, 466
loose XAML, 460
markup extensions in. See markup extensions
multiplications using transforms, 851–852
Name attributes, 473
names of elements, interpreting, 521–522
namespaces, 459, 470, 475–476, 510–512
non-WPF, 470
object elements, 507
objects, reusing. See XAML resources
Page class creation, 460
 parsing, 462, 503–504
partial class definitions, 471, 472–473
property attributes, 508
property elements, 508–510, 514–515
purpose of, 457, 458
resources in executables, as, 464–466
resources, local. See XAML resources
root elements, 461
specification, 470
stand-alone files, 460
StartupUri attribute, 481, 483
Stream objects with Load, 462–463, 466
string variable assignment, 462
styles created in. See styles
syntax, importance of learning, 458
template creation with, 665–666. See also templates
transforms with. See transforms
visual appearance role of, 458
Visual Studio designer for, 458
Web site launches of, 460
Window class representation, 548–549
Window classes with XAML and code-behind, 471
Window-derived classes entirely in, 478–479
window hierarchies in, 457–458
Window objects loaded into Application objects, 467
Window objects Owner property, 469
Window root elements prohibited, 461, 467
x prefix, 470
XAML-only projects, 481–482
XmlReader.Load method, 460, 462–464, 469, 475, 487, 503–504
XmlWriter.Save method, 462
x:Static, 532–537
x:Type extension, 644–646
x:Data elements, 705
XML data islands, 705, 708
XmlNamespace property, 504
xmlns attribute, 459
XmlnsDefinitionAttribute, 504
XmlTextWriter, 469
XAML resources
Add method, 528
application-wide resources, 529–530
Application.Resource tags, 532
availability of, 524
C# for adding, 528
classes defining Resources property, 524
comms classes in, 618, 620
{} (curly brackets), 526
defined, 523–524
defining elements as resources, 528
dynamicresource, 538–541
FindResource method, 528–529
format of, 524
XAML resources, continued
forward referencing, 539
instance properties, 535–536
Internet Explorer permissions, 533
key lookups, 526–527
Key properties, 537
local nature of, 524
namespace associations, 532–533
placement of Resources section, 526
purpose of, 523–524, 527
ResourceDictionary root elements, 542–544
ResourceKey attributes, 525–526, 537–538
Resources property, 524
scope of, 524
setting properties, 524
sharing among applications, 542–543
sharing of, 528
StaticResource, 524, 525–526, 537
storage object type, 524
styles with. See styles
syntax, 526
system-associated keys, 541
updates, 536–537
Visual Studio creation of, 520–530
x:Static, 532–537
x:Static markup extension
C# defined properties, 533–534
DynamicResource, 538–541
file structure options, 535
Internet Explorer permissions, 533
Key properties, 537
namespace associations, 532–533
non-WPF class access, 532
purpose of, 532
ResourceKey property, 537–538
Source property of Binding class, 627
syntax, 532
type consistency required, 532
updates, 536–537
x:Type markup extension, 644–646
x:XData elements, 705
XML (Extensible Markup Language)
application version of. See XAML (Extensible Application Markup Language)
attribute assignments, 457
data islands, 705, 708
Deserialization method, 414
element components, 457
empty element syntax, 458
local user application data, 414
serialization, 414–416, 726, 729
@ symbol for attribute references, 707
user application data, 414
x:XData elements, 705
XmlNamespace property, 504
XmlNsDefinitionAttribute, 504
XPath property, 705–707, 709–710
YellowPad project, 550–554