JavaFX GUI: Part 2

Based on Chapter 13 of
Java How to Program, 11/e

Introduction

- In this chapter, you'll:
  - Use additional layouts (`TitledPane`, `BorderPane` and `Pane`) and controls (`RadioButton-` and `ListView`).
  - Handle mouse and `RadioButton` events.
  - Set up event handlers that respond to property changes on controls (such as the value of a `Slider`).
  - Display `Rectangles` and `Circles` as nodes in the scene graph
  - Bind a collection of objects to a `ListView` that displays the collection's contents
  - Customize the appearance of a `ListView`'s cells.

Laying Out Nodes in a Scene Graph

- A layout determines the size and positioning of nodes in the scene graph
- In general, a node's size should *not* be defined *explicitly*
  - Doing so often creates a design that looks pleasing when it first loads, but deteriorates when the app is resized or the content updates

Laying Out Nodes in a Scene Graph (cont.)

- In addition to the `width` and `height` properties, most JavaFX nodes have the properties `prefWidth`, `prefHeight`, `minWidth`, `minHeight`, `maxWidth` and `maxHeight` that specify a node's *range* of acceptable sizes as it's laid out within its parent node
  - The minimum size properties specify a node's smallest allowed size in points
  - The maximum size properties specify a node's largest allowed size in points
  - The preferred size properties specify a node's preferred width and height that should be used by the layout in most cases.

Laying Out Nodes in a Scene Graph (cont.)

- A node's position should be defined *relative* to its parent node and the other nodes in its parent
- JavaFX layout panes are container nodes that arrange their child nodes in a scene graph *relative to one another*, based on their sizes and positions
  - Child nodes are controls, other layout panes, shapes and more.
- Most JavaFX layout panes use *relative positioning*—if a layout-pane node is resized, it adjusts its children's sizes and positions accordingly, based on their preferred, minimum and maximum sizes

Laying Out Nodes in a Scene Graph (cont.)

- Figure 13.1 describes each of the JavaFX layout panes, including those presented in Chapter 12 (previous lecture)
- In this chapter, we'll use `Pane`, `BorderPane`, `GridPane` and `VBox` from the `javafx.scene.layout` package

Layout	Description
`AnchorPane`	Enables you to set the position of child nodes relative to the pane's edges. Resizing the pane does not alter the layout of the nodes.
`BorderPane`	Includes five areas—top, bottom, left, center and right—where you can place nodes. The top and bottom regions fill the `BorderPane`'s width and are vertically sized to their children's preferred heights. The left and right regions fill the `BorderPane`'s height and are horizontally sized to their children's preferred widths. The center area occupies all of the `BorderPane`'s remaining space. You might use the different areas for tool bars, navigation, a main content area, etc.
`FlowPane`	Lays out nodes consecutively—either horizontally or vertically. When the boundary for the pane is reached, the nodes wrap to a new line in a horizontal `FlowPane` or a new column in a vertical `FlowPane`.

Fig. 13.1 | JavaFX layout panes. (Part 1 of 2.)

Layout	Description
`GridPane`	Creates a flexible grid for laying out nodes in rows and columns.
`Pane`	The base class for layout panes. This can be used to position nodes at fixed locations—known as absolute positioning.
`StackPane`	Places nodes in a stack. Each new node is stacked atop the previous node. You might use this to place text on top of images, for example.
`TilePane`	A horizontal or vertical grid of equally sized tiles. Nodes that are tiled horizontally wrap at the `TilePane`'s width. Nodes that are tiled vertically wrap at the `TilePane`'s height.
`HBox`	Arranges nodes horizontally in one row.
`VBox`	Arranges nodes vertically in one column.

Fig. 13.1 | JavaFX layout panes. (Part 2 of 2.)

Painter App: `RadioButtons`, Mouse Events and Shapes

- In this section, you'll create a simple Painter app (Fig. 13.2) that allows you to drag the mouse to draw
- First, we'll overview the technologies you'll use, then we'll discuss creating the app's project and building its GUI
- Finally, we'll present the source code for its `Painter` and `PainterController` classes.

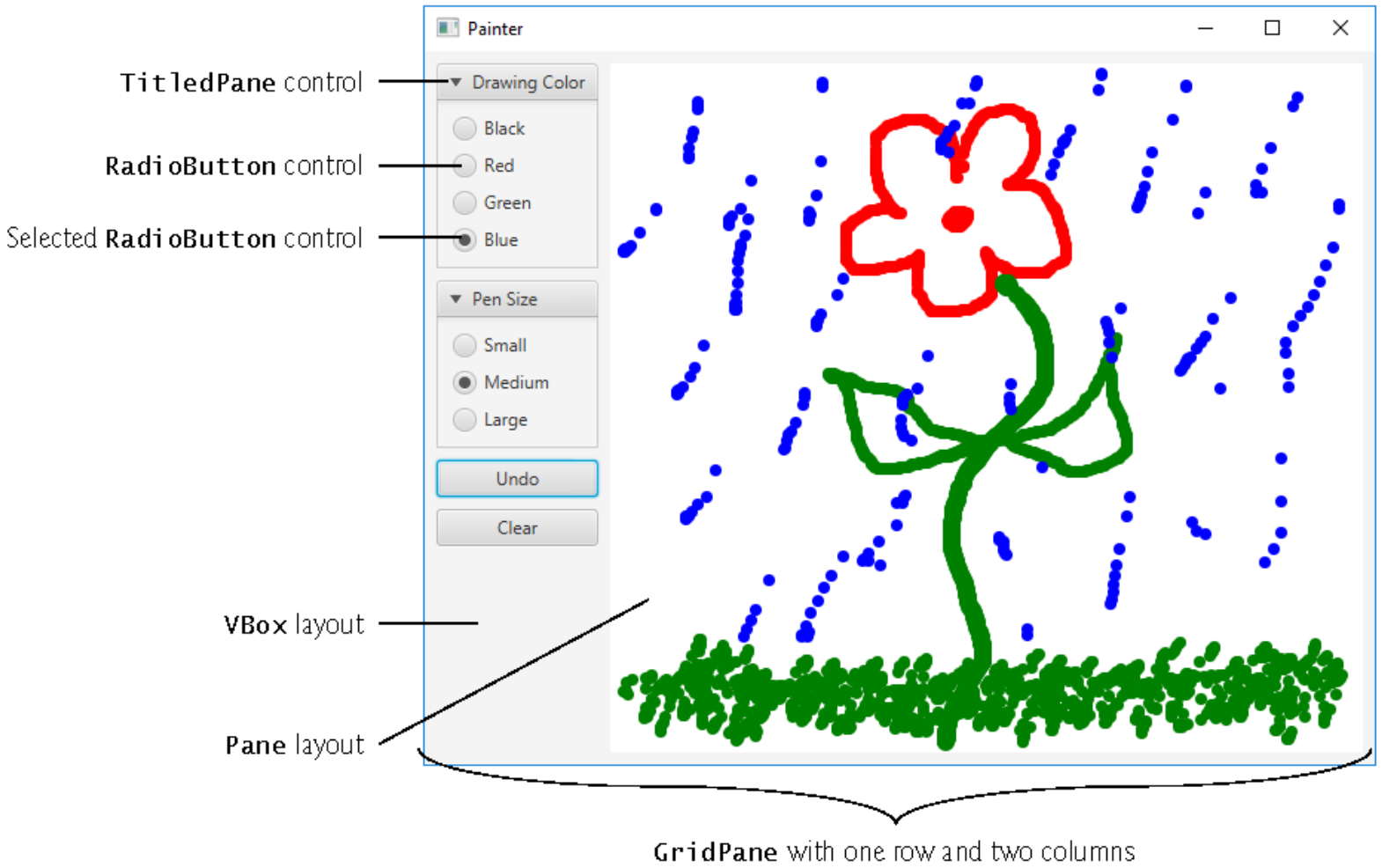


Fig. 13.2 | **Painter** app.

Technologies Overview

RadioButtons and ToggleGroups

- `RadioButton`s function as *mutually exclusive* options
- You add multiple `RadioButtons` to a `ToggleGroup` to ensure that only one `RadioButton` in a given group is selected at a time
- For this app, you'll use JavaFX Scene Builder's capability for specifying each `RadioButton`'s `ToggleGroup` in FXML
  - Can also create a `ToggleGroup` in Java, then use a `RadioButton`'s `setToggleGroup` method to specify its `ToggleGroup`.

Technologies Overview (cont.)

BorderPane Layout Container

- A `BorderPane` layout container arranges controls into one or more of the five regions shown in Fig. 13.3
- The top and bottom areas have the same width as the `BorderPane`
- The left, center and right areas fill the vertical space between the top and bottom areas
- Each area may contain only one control or one layout container that, in turn, may contain other controls

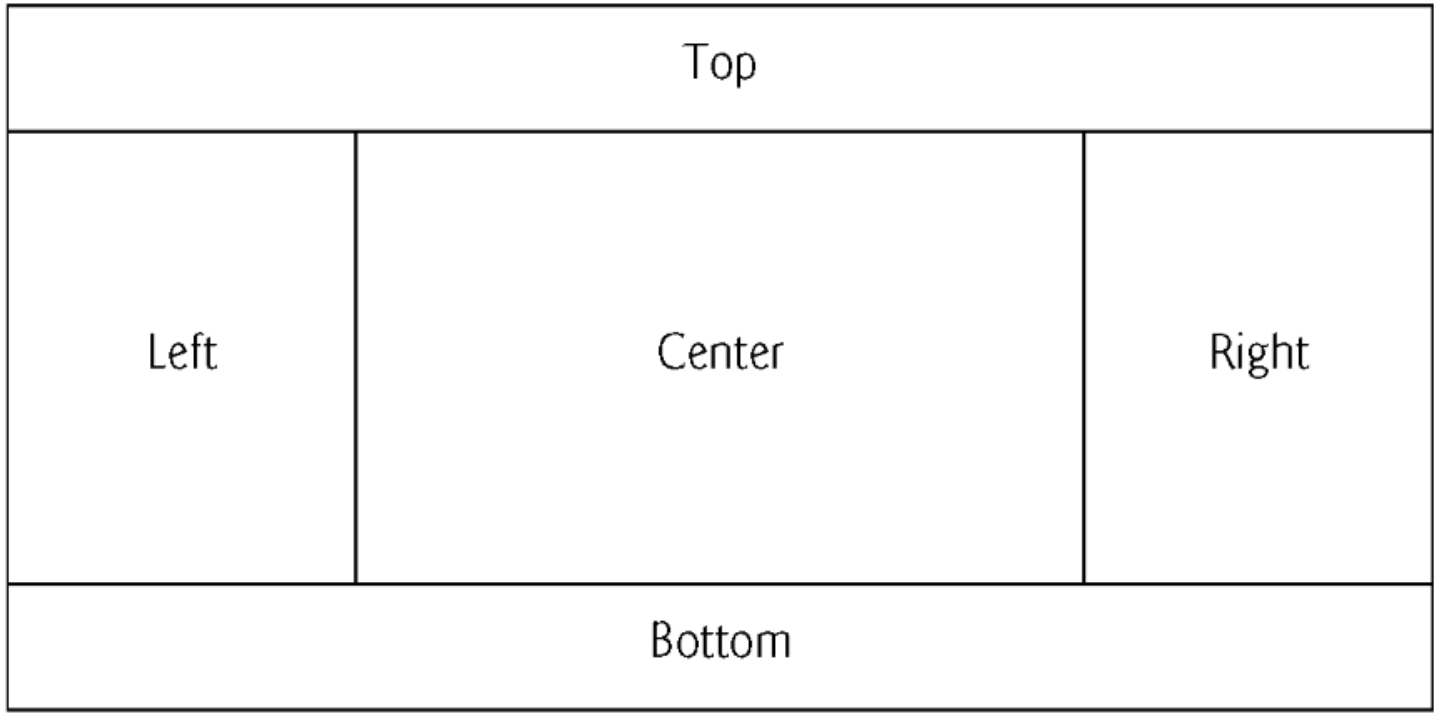


Fig. 13.3 | BorderPane's five areas.

Look-and-Feel Observation 13.1

All the areas in a `BorderPane` are optional: If the top or bottom area is empty, the left, center and right areas expand vertically to fill that area. If the left or right area is empty, the center expands horizontally to fill that area.

Technologies Overview (cont.)

Mouse Event Handling

- When you drag the mouse, the app's controller responds by displaying a `Circle` (in the currently selected color and pen size) at the current mouse position in the `Pane`
- JavaFX nodes support various mouse events (Fig. 13.4)
- You'll configure an `onMouseDragged` event handler for this app's `Pane`
- JavaFX supports other input events
  - For example, for touchscreen devices there are various touch-oriented events and for keyboards there are various key events
- For a complete list of JavaFX node events, see the `Node` class's properties that begin with the word "on" at:
  - `http://docs.oracle.com/javase/8/javafx/api/javafx/scene/Node.html`

Mouse events	When the event occurs for a given node
`onMouseClicked`	When the user clicks a mouse button—that is, presses and releases a mouse button without moving the mouse—with the mouse cursor within that node.
`onMouseDragEntered`	When the mouse cursor enters a node's bounds during a mouse drag—that is, the user is moving the mouse with a mouse button pressed.
`onMouseDragExited`	When the mouse cursor exits the node's bounds during a mouse drag.
`onMouseDragged`	When the user begins a mouse drag with the mouse cursor within that node and continues moving the mouse with a mouse button pressed.
`onMouseDragOver`	When a drag operation that started in a *different* node continues with the mouse cursor over the given node.

Fig. 13.4 | Mouse events. (Part 1 of 2.)

Mouse events	When the event occurs for a given node
`onMouseDragReleased`	When the user completes a drag operation that began in that node.
`onMouseEntered`	When the mouse cursor enters that node's bounds.
`onMouseExited`	When the mouse cursor exits that node's bounds.
`onMouseMoved`	When the mouse cursor moves within that node's bounds.
`onMousePressed`	When user presses a mouse button with the mouse cursor within that node's bounds.
`onMouseReleased`	When user releases a mouse button with the mouse cursor within that node's bounds.

Fig. 13.4 | Mouse events. (Part 2 of 2.)

Technologies Overview (cont.)

Setting a Control's User Data

- Each control has a `setUserData` method that receives an `Object`
- Use this to store any object you'd like to associate with that control
- With each drawing-color `RadioButton`, we store the specific `Color` that the `RadioButton` represents
- With each pen size `RadioButton`, we store an `enum` constant for the corresponding pen size
- We then use these objects when handling the `RadioButton` events.

Creating the `Painter.fxml` File

- Create a folder on your system for this example's files, then open Scene Builder and save the new FXML file as `Painter.fxml`
- If you already have an FXML file open, you also can choose File > New to create a new FXML file, then save it

Building the GUI

- In this section, we'll discuss the Painter app's GUI
- Rather than providing the exact steps as we did in Chapter 12, we'll provide general instructions for building the GUI and focus on specific details for new concepts

Technologies Overview (cont.)

`TitledPane` Layout Container

- A `TitledPane` layout container displays a title at its top and is a collapsible panel containing a layout node, which in turn contains other nodes
- You'll use `TitledPanes` to organize the app's `Radio-Buttons` and to help the user understand the purpose of each `RadioButton` group

Technologies Overview (cont.)

JavaFX Shapes

- The `javafx.scene.shape` package contains various classes for creating 2D and 3D shape nodes that can be displayed in a scene graph
- You'll programmatically create `Circle` objects as the user drags the mouse, then attach them to the app's drawing area so that they're displayed in the scene graph.

Pane Layout Container

- Each `Circle` you programmatically create is attached to an `Pane` layout (the drawing area) at a specified *x*-*y* coordinate measured from the `Pane`'s upper-left corner.

Software Engineering Observation 13.1

As you build a GUI, it's often easier to manipulate layouts and controls via Scene Builder's *Hierarchy* window than directly in the stage design area.

Building the GUI (cont.)

fx:id Property Values for This App's Controls

- Figure 13.5 shows the fx:id properties of the Painter app's programmatically manipulated controls
- As you build the GUI, you should set the corresponding fx:id properties in the FXML document, as we discussed in Chapter 12

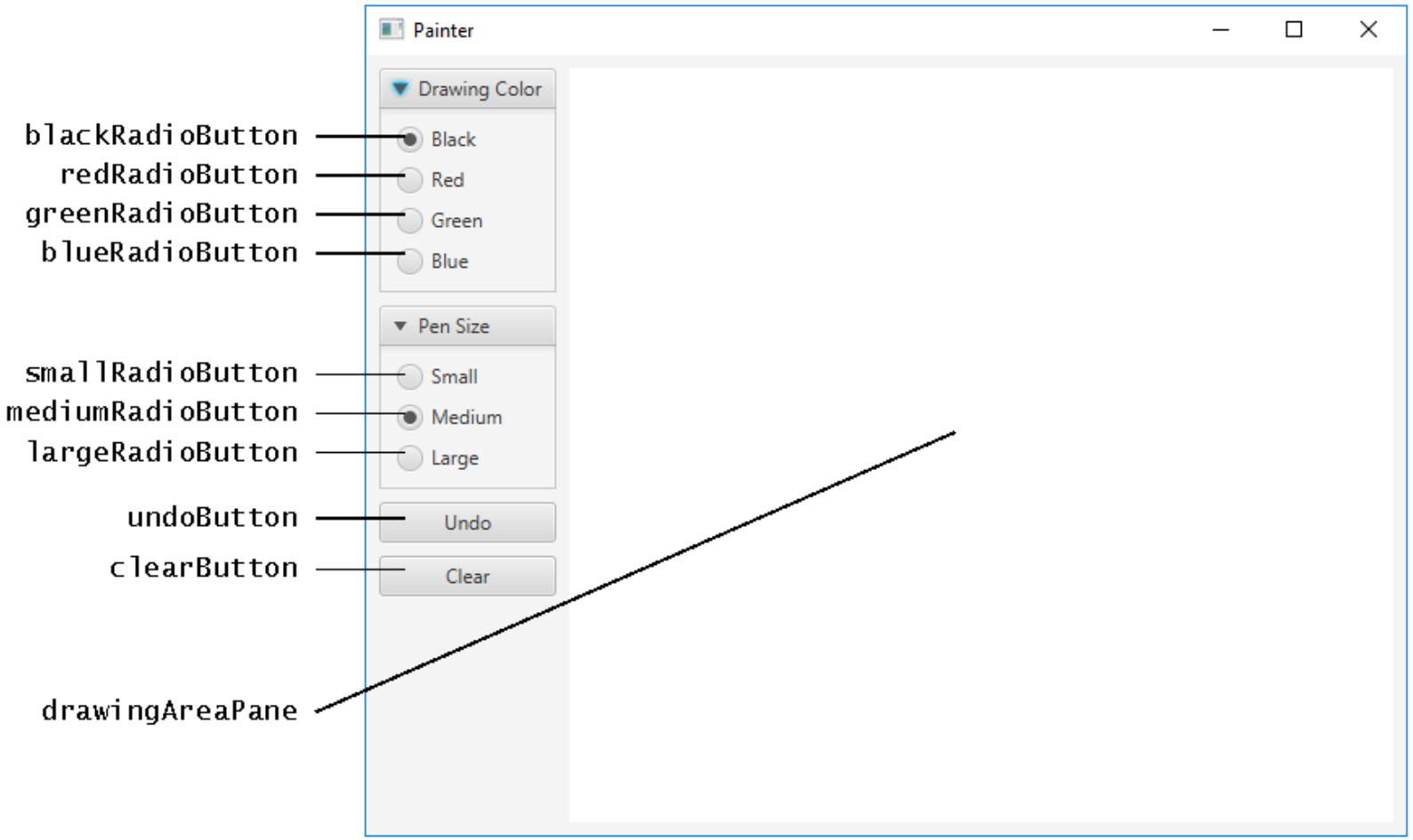
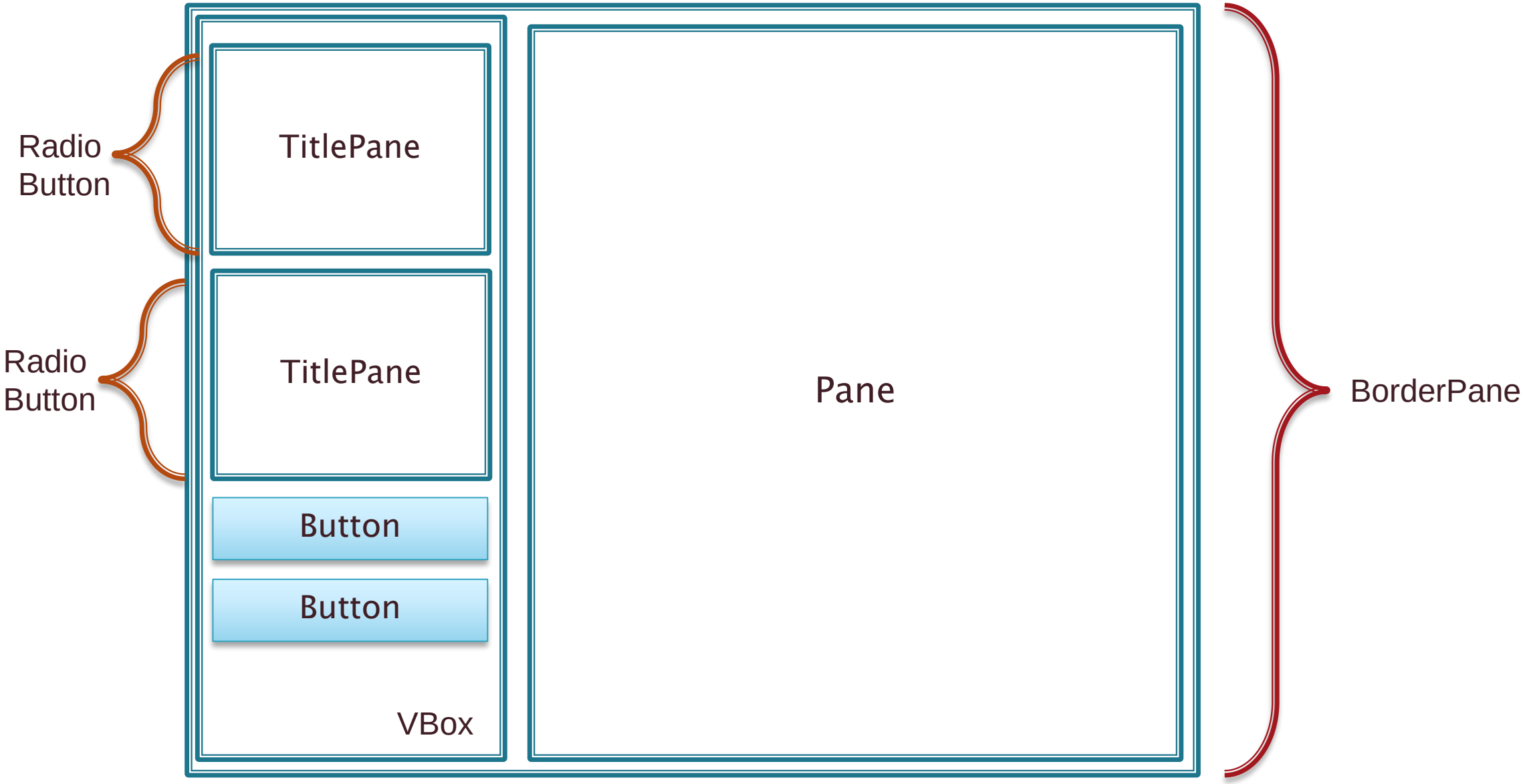


Fig. 13.5 | **Painter** GUI labeled with **fx:id**s for the programmatically manipulated controls.



Building the GUI (cont.)

Step 1: Adding a `BorderPane` as the Root Layout Node

- Drag a `BorderPane` from the Scene Builder Library window's Containers section onto the content panel

Step 2: Configuring the `BorderPane`

- We set the `GridPane`'s Pref Width and Pref Height properties to `640` and `480` respectively
- Recall that the stage's size is determined based on the size of the root node in the FXML document
- Set the `BorderPane`'s Padding property to `8` to inset it from the stage's edges

Building the GUI (cont.)

Step 3: Adding the VBox and Pane

- Drag a `VBox` into the `BorderPane`'s left area and an `Pane` into the center area
- As you drag over the `BorderPane`, Scene Builder shows the layout's five areas and highlights the area in which area the item you're dragging will be placed when you release the mouse
- Set the `Pane`'s fx:id to `drawingAreaPane` as specified in Fig. 13.5
- For the `VBox`, set its Spacing property (in the Inspector's Layout section) to `8` to add some vertical spacing between the controls that will be added to this container

Building the GUI (cont.)

Step 3: Adding the VBox and Pane (cont.)

- Set its right Margin property to 8 to add some horizontal spacing between the VBox and the Pane be added to this container
- Also reset its Pref Width and Pref Height properties to their default values (USE_COMPUTED_SIZE) and set its Max Height property to MAX_VALUE
- This will enable the VBox to be as wide as it needs to be to accommodate its child nodes and occupy the full column height

Building the GUI (cont.)

Step 3: Adding the VBox and Pane (cont.)

- Reset the `Pane`'s Pref Width and Pref Height to their default `USE_COMPUTED_SIZE` values, and set its Max Width and Max Height to `MAX_VALUE` so that it occupies the full width and height of the `BorderPane`'s center area
- In the JavaFX CSS category of the Inspector window's Properties section, click the field below Style (which is initially empty) and select `-fx-background-color` to indicate that you'd like to specify the `Pane`'s background color
- In the field to the right, specify `white`.

Building the GUI (cont.)

Step 4: Adding the `TitledPanes` to the VBox

- From the Library window's Containers section, drag two TitledPane (empty) objects onto the VBox
- For the first `TitledPane`, set its Text property to `Drawing Color`
- For the second, set its Text property to `Pen Size`

Building the GUI (cont.)

Step 5: Customizing the `TitledPanes`

- Each `TitledPane` in the completed GUI contains multiple `RadioButtons`
- We'll use a `VBox` within each `TitledPane` to help arrange those controls
- Drag a `VBox` onto each `TitledPane`
- For each `VBox`, set its Spacing property to `8` and its Pref Width and Pref Height to `USE_COMPUTED_SIZE` so the `VBoxes` will be sized based on their contents

Building the GUI (cont.)

Step 6: Adding the `RadioButtons` to the `VBox`

- From the Library window's Controls section, drag four `RadioButtons` onto the `VBox` for the Drawing Color `TitledPane`, and three `RadioButtons` onto the `VBox` for the Pen Size `Titled-Pane`, then configure their Text properties and fx:ids as shown in Fig. 13.5
- Select the `blackRadioButton` and ensure that its Selected property is checked, then do the same for the `mediumRadioButton`.

Building the GUI (cont.)

Step 7: Specifying the `ToggleGroups` for the `RadioButtons`

- Select all four `RadioButtons` in the first `TitledPane`'s `VBox`, then set the Toggle Group property to `colorToggleGroup`
- When the FXML file is loaded, a `ToggleGroup` object by that name will be created and these four `RadioButtons` will be associated with it to ensure that only one is selected at a time
- Repeat this step for the three `RadioButtons` in the second `TitledPane`'s `VBox`, but set the Toggle Group property to `sizeToggleGroup`

Building the GUI (cont.)

Step 8: Changing the `TitledPanes`' Preferred Width and Height

- For each `TitledPane`, set its Pref Width and Pref Height to `USE_COMPUTED_SIZE` so the `Titled-Panes` will be sized based on their contents.

Step 9: Adding the `Buttons`

- Add two `Buttons` below the `TitledPanes`, then configure their Text properties and fx:ids as shown in Fig. 13.5
- Set each `Button`'s Max Width property to `MAX_VALUE` so that they fill the `VBox`'s width

Building the GUI (cont.)

Step 10: Setting the Width the VBox

- We'd like the VBox to be only as wide as it needs to be to display the controls in that column
- To specify this, select the VBox in the Document window's Hierarchy section
- Set the column's Min Width and Pref Width to `USE_COMPUTED_SIZE`, then set the Max Width to `USE_PREF_SIZE` (which indicates that the maximum width should be the preferred width)
- Also, reset the Max Height to its default `USE_COMPUTED_SIZE` value
- The GUI is now complete and should appear as shown in Fig. 13.5.

Building the GUI (cont.)

Step 11: Specifying the Controller Class's Name

- As we mentioned in Section 12.5.2, in a JavaFX FXML app, the app's controller class typically defines instance variables for interacting with controls programmatically, as well as event-handling methods
- To ensure that an object of the controller class is created when the app loads the FXML file at runtime, you must specify the controller class's name in the FXML file:
  - Expand Scene Builder's Controller window (located below the Hierarchy window).
  - In the Controller Class field, type `PainterController`

Building the GUI (cont.)

Step 12: Specifying the Event-Handler Method Names

- Next, you'll specify in the Inspector window's Code section the names of the methods that will be called to handle specific control's events:
  - For the `drawingAreaPane`, specify `drawingAreaMouseDragged` as the On Mouse Dragged event handler (located under the Mouse heading in the Code section)
    - This method will draw a circle in the specified color and size for each mouse-dragged event.
  - For the four Drawing Color `RadioButtons`, specify `colorRadioButtonSelected` as each `RadioButton`'s On Action event handler
    - This method will set the current drawing color, based on the user's selection.

Building the GUI (cont.)

Step 12: Specifying the Event-Handler Method Names (cont.)

- For the three Pen Size `RadioButtons`, specify `sizeRadioButtonSelected` as each `RadioButton`'s On Action event handler. This method will set the current pen size, based on the user's selection.
- For the Undo `Button`, specify `undoButtonPressed` as the On Action event handler. This method will remove the last circle the user drew on the screen.
- For the Clear `Button`, specify `clearButtonPressed` as the On Action event handler. This method will clear the entire drawing.

Building the GUI (cont.)

Step 13: Generating a Sample Controller Class

- As you saw in Section 12.5, Scene Builder generates the initial controller-class skeleton for you when you select View > Show Sample Controller Skeleton
- You can copy this code into a `PainterController.java` file and store the file in the same folder as `Painter.fxml`
- We show the completed `PainterController` class in Section 13.3.5.

`Painter` Subclass of `Application`

- Figure 13.6 shows class `Painter` subclass of `Application` that launches the app, which performs the same tasks to start the Painter app as described for the Tip Calculator app in Section 12.5.4

```
1  // Fig. 13.5: Painter.java
2  // Main application class that loads and displays the Painter's GUI.
3  import javafx.application.Application;
4  import javafx.fxml.FXMLLoader;
5  import javafx.scene.Parent;
6  import javafx.scene.Scene;
7  import javafx.stage.Stage;
8
9  public class Painter extends Application {
10    @Override
11    public void start(Stage stage) throws Exception {
12       Parent root =
13          FXMLLoader.load(getClass().getResource("Painter.fxml"));
```

Fig. 13.6 | Main application class that loads and displays the **Painter**'s GUI.

```
14
15          Scene scene = new Scene(root);
16          stage.setTitle("Painter"); // displayed in window's title bar
17          stage.setScene(scene);
18          stage.show();
19       }
20
21       public static void main(String[] args) {
22          launch(args);
23       }
24    }
```

Fig. 13.6 | Main application class that loads and displays the **Painter**'s GUI.

`PainterController` Class

- Figure 13.7 shows the final version of class `PainterController` with this app's new features highlighted

```
1  // Fig. 13.6: PainterController.java
2  // Controller for the Painter app
3  import javafx.event.ActionEvent;
4  import javafx.fxml.FXML;
5  import javafx.scene.control.RadioButton;
6  import javafx.scene.control.ToggleGroup;
7  import javafx.scene.input.MouseEvent;
8  import javafx.scene.layout.Pane;
9  import javafx.scene.paint.Color;
10 import javafx.scene.paint.Paint;
11 import javafx.scene.shape.Circle;
12
```

Fig. 13.7 | Controller for the **Painter** app. (Part 1 of 7.)

```
13  public class PainterController {
14     // enum representing pen sizes
15     private enum PenSize {
16        SMALL(2),
17        MEDIUM(4),
18        LARGE(6);
19
20        private final int radius;
21
22        PenSize(int radius) {this.radius = radius;} // constructor
23
24        public int getRadius() {return radius;}
25     };
26
```

Fig. 13.7 | Controller for the **Painter** app. (Part 2 of 7.)

```
27      // instance variables that refer to GUI components
28      @FXML private RadioButton blackRadioButton;
29      @FXML private RadioButton redRadioButton;
30      @FXML private RadioButton greenRadioButton;
31      @FXML private RadioButton blueRadioButton;
32      @FXML private RadioButton smallRadioButton;
33      @FXML private RadioButton mediumRadioButton;
34      @FXML private RadioButton largeRadioButton;
35      @FXML private Pane drawingAreaPane;
36      @FXML private ToggleGroup colorToggleGroup;
37      @FXML private ToggleGroup sizeToggleGroup;
38
39      // instance variables for managing Painter state
40      private PenSize radius = PenSize.MEDIUM; // radius of circle
41      private Paint brushColor = Color.BLACK; // drawing color
42
```

Fig. 13.7 | Controller for the **Painter** app. (Part 3 of 7.)

```
43      // set user data for the RadioButtons
44      public void initialize() {
45         // user data on a control can be any Object
46         blackRadioButton.setUserData(Color.BLACK);
47         redRadioButton.setUserData(Color.RED);
48         greenRadioButton.setUserData(Color.GREEN);
49         blueRadioButton.setUserData(Color.BLUE);
50         smallRadioButton.setUserData(PenSize.SMALL);
51         mediumRadioButton.setUserData(PenSize.MEDIUM);
52         largeRadioButton.setUserData(PenSize.LARGE);
53      }
54
```

Fig. 13.7 | Controller for the **Painter** app. (Part 4 of 7.)

```
55      // handles drawingArea's onMouseDragged MouseEvent
56      @FXML
57      private void drawingAreaMouseDragged(MouseEvent e) {
58         Circle newCircle = new Circle(e.getX(), e.getY(),
59            radius.getRadius(), brushColor);
60         drawingAreaPane.getChildren().add(newCircle);
61      }
62
63      // handles color RadioButton's ActionEvents
64      @FXML
65      private void colorRadioButtonSelected(ActionEvent e) {
66         // user data for each color RadioButton is the corresponding Color
67         brushColor =
68            (Color) colorToggleGroup.getSelectedToggle().getUserData();
69      }
70
```

Fig. 13.7 | Controller for the **Painter** app. (Part 5 of 7.)

```
71      // handles size RadioButton's ActionEvents
72      @FXML
73      private void sizeRadioButtonSelected(ActionEvent e) {
74         // user data for each size RadioButton is the corresponding PenSize
75         radius =
76            (PenSize) sizeToggleGroup.getSelectedToggle().getUserData();
77      }
78
79      // handles Undo Button's ActionEvents
80      @FXML
81      private void undoButtonPressed(ActionEvent event) {
82         int count = drawingAreaPane.getChildren().size();
83
84         // if there are any shapes remove the last one added
85         if (count > 0) {
86            drawingAreaPane.getChildren().remove(count - 1);
87         }
88      }
```

Fig. 13.7 | Controller for the **Painter** app. (Part 6 of 7.)

```
89
90      // handles Clear Button's ActionEvents
91      @FXML
92      private void clearButtonPressed(ActionEvent event) {
93         drawingAreaPane.getChildren().clear(); // clear the canvas
94      }
95   }
```

Fig. 13.7 | Controller for the **Painter** app. (Part 7 of 7.)

PainterController Class

PenSize enum

- Lines 15–25 define the nested `enum` type `PenSize`, which specifies three pen sizes—`SMALL`, `MEDIUM` and `LARGE`
- Each has a corresponding radius that will be used when creating a `Circle`-object to display in response to a mouse-drag event
- Java allows you to declare classes, interfaces and `enum`s as nested types inside other classes
  - Except for the anonymous inner class introduced in Section 12.5.5, all the classes, interfaces and `enum`s we've discussed were top level—that is, they *were* not declared *inside* another type
  - The `enum` type `PenSize` is declared here as a `private` nested type because it's used only by class `PainterController`

Color Chooser App: Property Bindings and Property Listeners

- In this section, we present a Color Chooser app (Fig. 13.8) that demonstrates property bindings and property listeners

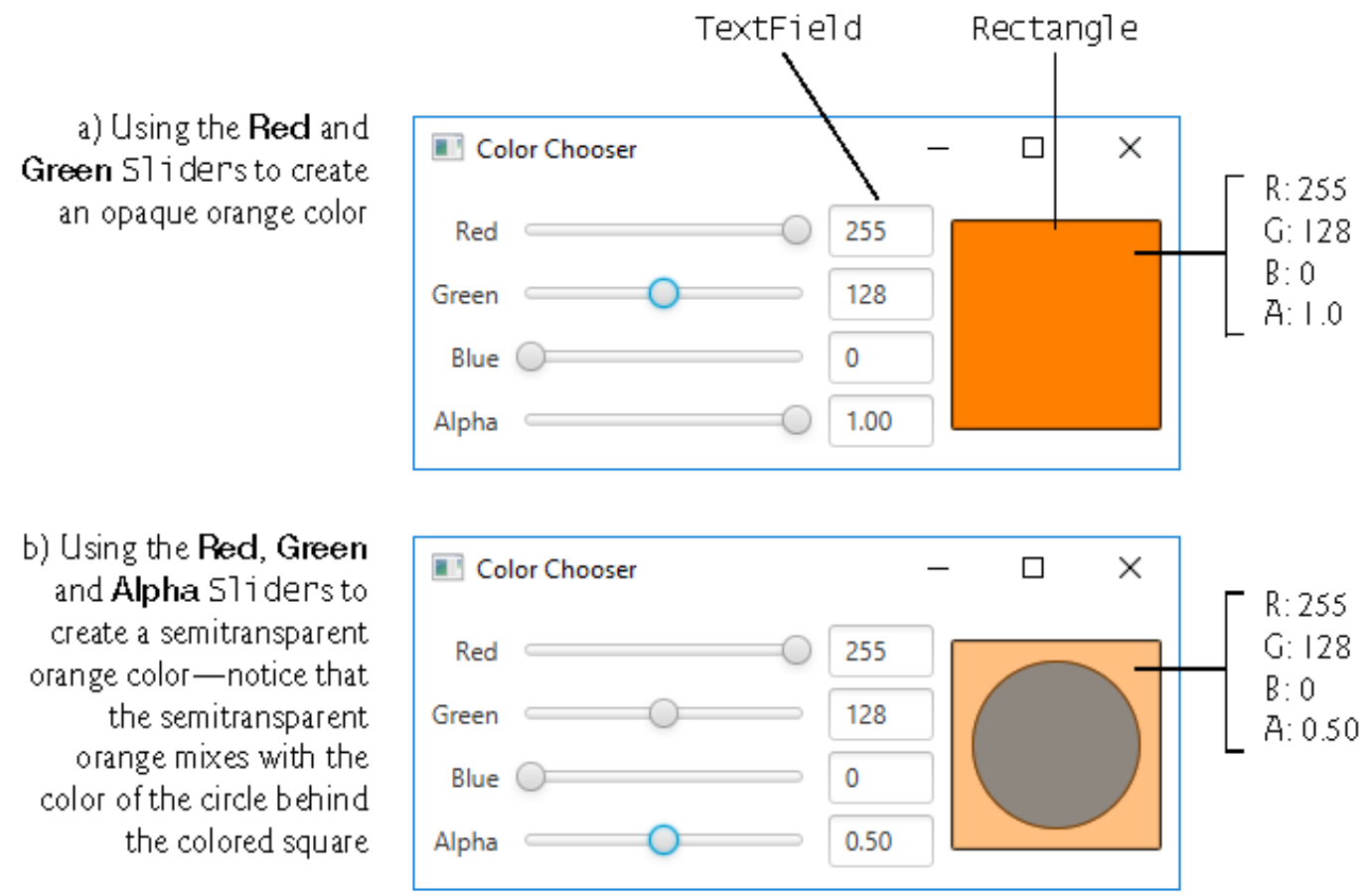


Fig. 13.8 | **Color Chooser** app with opaque and semitransparent orange colors.

Technologies Overview

RGBA Colors

- The app uses the RGBA color system to display a rectangle of color based on the values of four `Sliders`
- In RGBA, every color is represented by its red, green and blue color values, each ranging from 0 to 255, where 0 denotes no color and 255 full color
- The alpha value (A)—which ranges from 0.0 to 1.0—represents a color's *opacity*, with 0.0 being completely *transparent* and 1.0 completely *opaque*
  - The color displayed in Fig. 13.8(b) is *semitransparent*
- You'll use a `Color` object that's created with RGBA values to fill a `Rectangle` that displays the `Color`.

Technologies Overview (cont.)

Properties of a Class

- JavaFX makes extensive use of properties
- A property is defined by creating *set*/*get* methods named as follows

```
public final void setPropertyName(Type propertyName)
public final Type getPropertyName()
```

- Typically, such methods manipulate a corresponding *private* instance variable that has the same name as the property, but this is not required
  - Methods `setHour` and `getHour` together represent a property named `hour` and typically would manipulate a private `hour` instance variable
- If the property represents a `boolean` value, its *get* method name typically begins with "`is`" rather than "`get`"—for example, `ArrayList` method `isEmpty`.

Software Engineering Observation 13.2

Methods that define properties should be declared `final` to prevent subclasses from overriding the methods, which could lead to unexpected results in client code.

Technologies Overview (cont.)

Property Bindings

- JavaFX properties are *observable*—when a property's value changes, other objects can respond accordingly
  - This is similar to event handling
- One way to respond to a property change is via a property binding—enables a property of one object to be updated when a property of another changes
  - You'll use property bindings to enable a `TextField` to display the corresponding `Slider`'s current value when the user moves that `Slider`'s thumb
- Property bindings are not limited to JavaFX controls
- Package `javafx.beans.property` contains many classes that you can use to define bindable properties in your own classes

Technologies Overview (cont.)

Property Listeners

- Property listeners are similar to property bindings
- A property listener is an event handler that's invoked when a property's value changes
  - In this app, when a `Slider`'s value changes, a property listener will store the value in a corresponding instance variable, create a new `Color` based on the values of all four `Sliders` and set that `Color` as the fill color of a `Rectangle` object that displays the current color
- More on properties, property bindings and property listeners:
  - http://docs.oracle.com/javase/8/javafx/properties-binding-tutorial/binding.htm

Building the GUI

- In this section, we'll discuss the Color Chooser app's GUI
- As you build the GUI, recall that it's often easier to manipulate layouts and controls via the Scene Builder Document window's Hierarchy section than directly in the stage design area
- Before proceeding, open Scene Builder and create an FXML file named `ColorChooser.fxml`.

Building the GUI (cont.)

fx:id Property Values for This App's Controls

- Figure 13.9 shows the fx:id properties of the Color Choooser app's programmatically manipulated controls
- As you build the GUI, you should set the corresponding fx:id properties in the FXML document, as you learned in Chapter 12

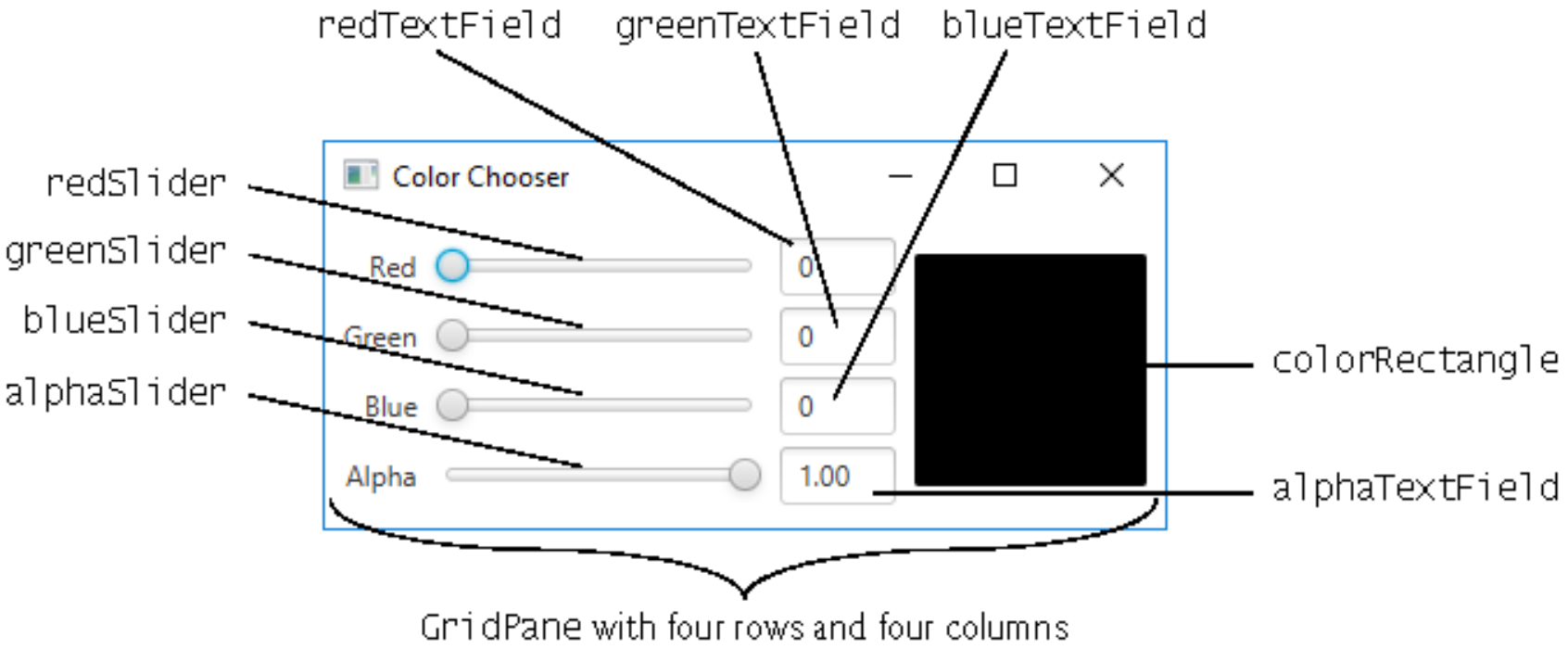


Fig. 13.9 | **Color Chooser** app's programmatically manipulated controls labeled with their **fx:id**s.

Building the GUI (cont.)

Step 1: Adding a `GridPane`

- Drag a `GridPane` from the Library window's Containers section onto Scene Builder's content panel

Step 2: Configuring the `GridPane`

- This app's `GridPane` requires four rows and four columns
- Use the techniques you've learned previously to add two columns and one row to the `GridPane`
- Set the `GridPane`'s Hgap and Padding properties to `8` to inset the `GridPane` from the stage's edges and to provide space between its columns

Building the GUI (cont.)

Step 3: Adding the Controls

- Using Fig. 13.9 as a guide, add the `Labels`, `Sliders`, `TextFields`, a `Circle` and a `Rectangle` to the `GridPane`—`Circle` and `Rectangle` are located in the Scene Builder Library's Shapes section
- When adding the `Circle` and `Rectangle`, place both into the rightmost column's first row
- Be sure to add the `Circle` *before* the `Rectangle` so that it will be located *behind* the rectangle in the layout
- Set the text of the `Labels` and `TextFields` as shown and set all the appropriate fx:id properties as you add each control.

Building the GUI (cont.)

Step 4: Configuring the `Sliders`

- For the red, green and blue `Sliders`, set the Max properties to `255` (the maximum amount of a given color in the RGBA color scheme)
- For the alpha `Slider`, set its Max property to `1.0` (the maximum opacity in the RGBA color scheme).

Step 5: Configuring the `TextFields`

- Set all of the `TextField`'s Pref Width properties to `50`.

Building the GUI (cont.)

Step 6: Configuring the `Rectangle`

- Set the `Rectangle`'s Width and Height properties to `100`, then set its Row Span property to `Remainder` so that it spans all four rows.

Step 7: Configuring the `Circle`

- Set the `Circle`'s Radius property to `40`, then set its Row Span property to `Remainder` so that it spans all four rows.

Building the GUI (cont.)

Step 8: Configuring the Rows

- Set all four columns' Pref Height properties to `USE_COMPUTED_SIZE` so that the rows are only as tall as their content

Step 9: Configuring the Columns

- Set all four columns' Pref Width properties to `USE_COMPUTED_SIZE` so that the columns are only as wide as their content
- For the leftmost column, set the Halignment property to `RIGHT`
- For the rightmost column, set the Halignment property to `CENTER`.

Step 10: Configuring the `GridPane`

- Set the `GridPane`'s Pref Width and Pref Height properties to `USE_COMPUTED_SIZE` so that it sizes itself, based on its contents
- Your GUI should now appear as shown in Fig. 13.9

Building the GUI (cont.)

Step 11: Specifying the Controller Class's Name

- To ensure that an object of the controller class is created when the app loads the FXML file at runtime, specify `ColorChooserController` as the controller class's name in the FXML file as you've done previously.

Step 12: Generating a Sample Controller Class

- Select View > Show Sample Controller Skeleton, then copy this code into a `ColorChooserController.java` file and store the file in the same folder as `ColorChooser.fxml`

`ColorChooser` Subclass of `Application`

- Figure 13.6 shows the `ColorChooser` subclass of `Application` that launches the app
- This class loads the FXML and displays the app as in the prior JavaFX examples

```
1  // Fig. 13.8: ColorChooser.java
2  // Main application class that loads and displays the ColorChooser's GUI.
3  import javafx.application.Application;
4  import javafx.fxml.FXMLLoader;
5  import javafx.scene.Parent;
6  import javafx.scene.Scene;
7  import javafx.stage.Stage;
8
9  public class ColorChooser extends Application {
10    @Override
11    public void start(Stage stage) throws Exception {
12       Parent root =
13          FXMLLoader.load(getClass().getResource("ColorChooser.fxml"));
```

Fig. 13.10 | Application class that loads and displays the **Color Chooser**'s GUI. (Part 1 of 2.)

```
14
15          Scene scene = new Scene(root);
16          stage.setTitle("Color Chooser");
17          stage.setScene(scene);
18          stage.show();
19       }
20
21       public static void main(String[] args) {
22          launch(args);
23       }
24    }
```

Fig. 13.10 | Application class that loads and displays the **Color Chooser**'s GUI. (Part 2 of 2.)

`ColorChooserController` Class

- Figure 13.11 shows the final version of class `ColorChooserController` with this app's new features highlighted

```
1  // Fig. 13.9: ColorChooserController.java
2  // Controller for the ColorChooser app
3  import javafx.beans.value.ChangeListener;
4  import javafx.beans.value.ObservableValue;
5  import javafx.fxml.FXML;
6  import javafx.scene.control.Slider;
7  import javafx.scene.control.TextField;
8  import javafx.scene.paint.Color;
9  import javafx.scene.shape.Rectangle;
10
```

Fig. 13.11 | Controller for the `ColorChooser` app. (Part 1 of 5.)

```
11  public class ColorChooserController {
12     // instance variables for interacting with GUI components
13     @FXML private Slider redSlider;
14     @FXML private Slider greenSlider;
15     @FXML private Slider blueSlider;
16     @FXML private Slider alphaSlider;
17     @FXML private TextField redTextField;
18     @FXML private TextField greenTextField;
19     @FXML private TextField blueTextField;
20     @FXML private TextField alphaTextField;
21     @FXML private Rectangle colorRectangle;
22
```

Fig. 13.11 | Controller for the `ColorChooser` app. (Part 2 of 5.)

```
23      // instance variables for managing
24      private int red = 0;
25      private int green = 0;
26      private int blue = 0;
27      private double alpha = 1.0;
28
29      public void initialize() {
30         // bind TextField values to corresponding Slider values
31         redTextField.textProperty().bind(
32            redSlider.valueProperty().asString("%.0f"));
33         greenTextField.textProperty().bind(
34            greenSlider.valueProperty().asString("%.0f"));
35         blueTextField.textProperty().bind(
36            blueSlider.valueProperty().asString("%.0f"));
37         alphaTextField.textProperty().bind(
38            alphaSlider.valueProperty().asString("%.2f"));
39
```

Fig. 13.11 | Controller for the `ColorChooser` app. (Part 3 of 5.)

```
40          // listeners that set Rectangle's fill based on Slider changes
41          redSlider.valueProperty().addListener(
42             new ChangeListener<Number>() {
43                @Override
44                public void changed(ObservableValue<? extends Number> ov,
45                   Number oldValue, Number newValue) {
46                   red = newValue.intValue();
47                   colorRectangle.setFill(Color.rgb(red, green, blue, alpha));
48                }
49             }
50          );
51          greenSlider.valueProperty().addListener(
52             new ChangeListener<Number>() {
53                @Override
54                public void changed(ObservableValue<? extends Number> ov,
55                   Number oldValue, Number newValue) {
56                   green = newValue.intValue();
57                   colorRectangle.setFill(Color.rgb(red, green, blue, alpha));
58                }
59             }
60          );
```

Fig. 13.11 | Controller for the `ColorChooser` app. (Part 4 of 5.)

```
61          blueSlider.valueProperty().addListener(
62             new ChangeListener<Number>() {
63                @Override
64                public void changed(ObservableValue<? extends Number> ov,
65                   Number oldValue, Number newValue) {
66                   blue = newValue.intValue();
67                   colorRectangle.setFill(Color.rgb(red, green, blue, alpha));
68                }
69             }
70          );
71          alphaSlider.valueProperty().addListener(
72             new ChangeListener<Number>() {
73                @Override
74                public void changed(ObservableValue<? extends Number> ov,
75                   Number oldValue, Number newValue) {
76                   alpha = newValue.doubleValue();
77                   colorRectangle.setFill(Color.rgb(red, green, blue, alpha));
78                }
79             }
80          );
81       }
82    }
```

Fig. 13.11 | Controller for the `ColorChooser` app. (Part 5 of 5.)

`ColorChooserController` Class (cont.)

Instance Variables

- Lines 13–27 declare the controller's instance variables
- Variables `red`, `green`, `blue` and `alpha-` store the current values of the `redSlider`, `greenSlider`, `blueSlider` and `alphaSlider-`, respectively
- These values are used to update the `colorRectangle`'s fill color each time the user moves a `Slider`'s thumb.

`ColorChooserController` Class (cont.)

Method `initialize`

- Lines 29–81 define method `initialize`, which initializes the controller after the GUI is created
- In this app, `initialize` configures the property bindings and property listeners.

ColorChooserController Class (cont.)

Property-to-Property Bindings

- Lines 31–38 set up property bindings between a `Slider`'s value and the corresponding `Text-Field`'s text so that changing a `Slider` updates the corresponding `TextField`
- Consider lines 31–32, which bind the `redSlider`'s `valueProperty` to the `redText-Field's textProperty`:

```
redTextField.textProperty().bind(
   redSlider.valueProperty().asString("%.0f"));
```

ColorChooserController Class (cont.)

Property-to-Property Bindings (cont.)

- Each `TextField` has a `text` property that's returned by its `textProperty` method as a `StringProperty` (package `javafx.beans.property`)
- `StringProperty` method `bind` receives an `ObservableValue` as an argument
- When the `ObservableValue` changes, the bound property updates accordingly
- In this case the `ObservableValue` is the result of the expression `redSlider.valueProperty().asString("%.0f")`

ColorChooserController Class (cont.)

Property-to-Property Bindings (cont.)

- `Slider`'s `valueProperty` method returns the `Slider`'s `value` property as a `DoubleProperty`—an observable `double` value
- Because the `TextField`'s `text` property must be bound to a `String`, we call `DoubleProperty` method `asString`, which returns a `StringBinding` object (an `ObservableValue`) that produces a `String` representation of the `DoubleProperty`
- This version of `asString` receives a format-control `String` specifying the `DoubleProperty`'s format

ColorChooserController Class (cont.)

Property Listeners

- To perform an arbitrary task when a property's value changes, register a property listener
- Lines 41–80 register property listeners for the `Sliders`' `value` properties
- Consider lines 41–50, which register the `ChangeListener` that executes when the user moves the `redSlider`'s thumb
- Each `ChangeListener` stores the `int` value of the `newValue` parameter in a corresponding instance variable, then calls the `colorRectangle`'s `setFill` method to change its color, using `Color` method `rgb` to create the new `Color` object

Cover Viewer App: Data-Driven GUIs with JavaFX Collections

- Often an app needs to edit and display data
- JavaFX provides a comprehensive model for allowing GUIs to interact with data
- In this section, you'll build the Cover Viewer app (Fig. 13.12), which binds a list of `Book` objects to a `ListView`
- When the user selects an item in the `ListView`, the corresponding `Book`'s cover image is displayed in an `ImageView`.

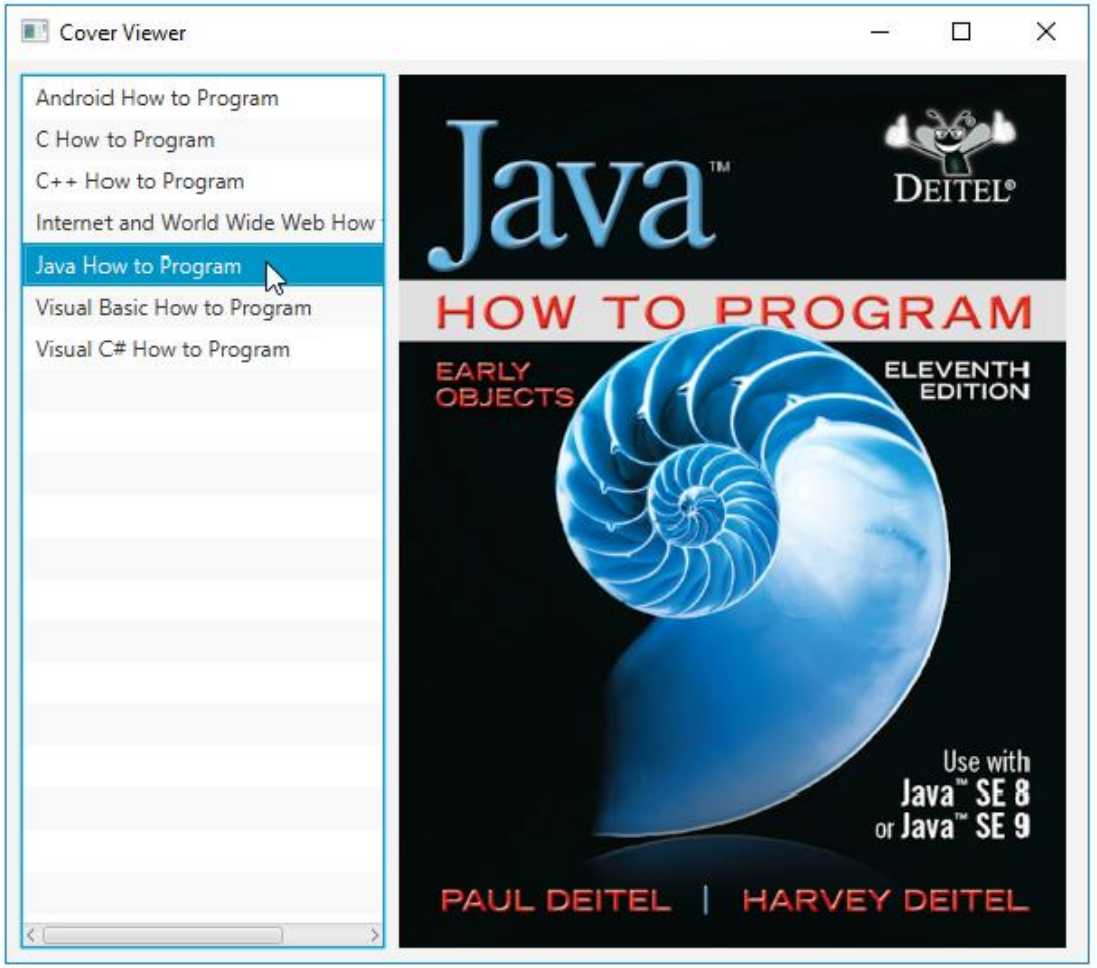


Fig. 13.12 | **Cover Viewer** with *Java How to Program* selected.

Technologies Overview

- This app uses a `ListView` control to display a collection of book titles
- Though you can individually add items to a `ListView`, in this app you'll bind an `ObservableList` object to the `ListView`
  - If you make changes to an `ObservableList`, its observer (the `ListView` in this app) will automatically be notified of those changes
- Package `javafx.collections` defines `ObservableList` (similar to an `ArrayList`) and other observable collection interfaces
- The package also contains class `FXCollections`, which provides `static` methods for creating and manipulating observable collections
- You'll use a property listener to display the correct image when the user selects an item from the `ListView`—in this case, the property that changes is the selected item

Adding Images to the App's Folder

- From this chapter's examples folder, copy the `images` folder (which contains the `large` and `small` subfolders) into the folder where you'll save this app's FXML file, and the source-code files `CoverViewer.java` and `CoverViewerController.java`
- Though you'll use only the `large` images in this example, you'll copy this app's folder to create the next example, which uses both sets of images

Building the GUI

- In this section, we'll discuss the Cover Viewer app's GUI
- As you've done previously, create a new FXML file, then save it as `CoverViewer.fxml`.

fx:id Property Values for This App's Controls

- Figure 13.13 shows the fx:id properties of the Cover Viewer app's programmatically manipulated controls
- As you build the GUI, you should set the corresponding fx:id properties in the FXML document

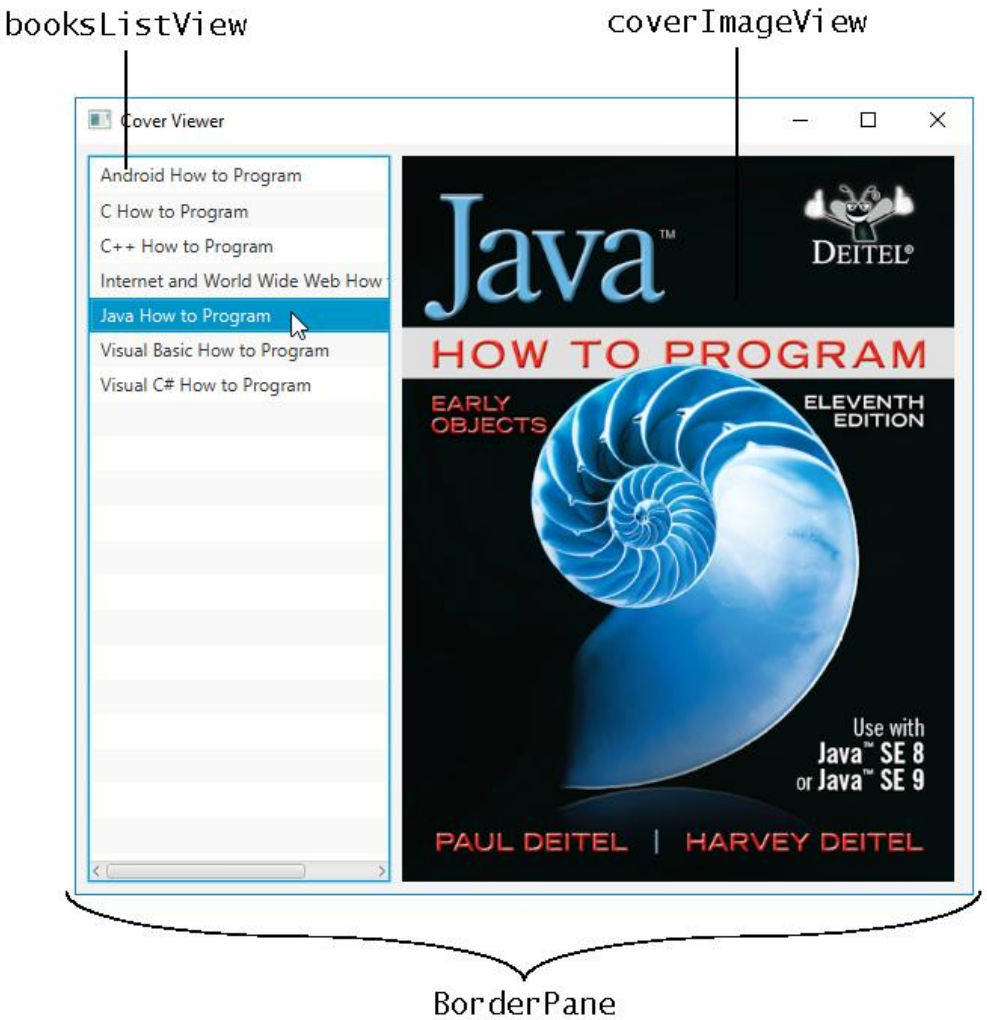


Fig. 13.13 | **Cover Viewer** app's programmatically manipulated controls labeled with their **fx:id**s.

Building the GUI (cont.)

Adding and Configuring the Controls

- Using the techniques you learned previously, create a `BorderPane`
- In the left area, place a `ListView` control, and in the center area, place an `ImageView` control
- For the `ListView`, set the following properties:
  - Margin—`8` (for the right margin) to separate the `ListView` from the `ImageView`
  - Pref Width—`200`
  - Max Height—`MAX_VALUE`
  - Min Width, Min Height, Pref Height and Max Width—`USE_COMPUTED_SIZE`

Building the GUI (cont.)

Adding and Configuring the Controls (cont.)

- For the `ImageView`, set the Fit Width and Fit Height properties to `370` and `480`, respectively
- To size the `BorderPane` based on its contents, set its Pref Width and Pref Height to `USE_COMPUTED_SIZE`
- Also, set the Padding property to `8` to inset the `BorderPane` from the stage.

Building the GUI (cont.)

Specifying the Controller Class's Name

- To ensure that an object of the controller class is created when the app loads the FXML file at runtime, specify `CoverViewerController` as the controller class's name in the FXML file as you've done previously.

Generating a Sample Controller Class

- Select View > Show Sample Controller Skeleton, then copy this code into a `CoverViewerController.java` file and store the file in the same folder as `CoverViewer.fxml`

CoverViewer Subclass of `Application`

- Figure 13.14 shows class `CoverViewer` subclass of `Application`

```
1  // Fig. 13.13: CoverViewer.java
2  // Main application class that loads and displays the CoverViewer's GUI.
3  import javafx.application.Application;
4  import javafx.fxml.FXMLLoader;
5  import javafx.scene.Parent;
6  import javafx.scene.Scene;
7  import javafx.stage.Stage;
8
9  public class CoverViewer extends Application {
10    @Override
11    public void start(Stage stage) throws Exception {
12       Parent root =
13          FXMLLoader.load(getClass().getResource("CoverViewer.fxml"));
14
15       Scene scene = new Scene(root);
16       stage.setTitle("Cover Viewer");
17       stage.setScene(scene);
18       stage.show();
19    }
20
21    public static void main(String[] args) {
22       launch(args);
23    }
24 }
```

Fig. 13.14 | Main application class that loads and displays the **Cover Viewer**'s GUI.

`CoverViewerController` Class

- Figure 13.15 shows the final version of class `CoverViewerController` with the app's new features highlighted

```
1  // Fig. 13.14: CoverViewerController.java
2  // Controller for Cover Viewer application
3  import javafx.beans.value.ChangeListener;
4  import javafx.beans.value.ObservableValue;
5  import javafx.collections.FXCollections;
6  import javafx.collections.ObservableList;
7  import javafx.fxml.FXML;
8  import javafx.scene.control.ListView;
9  import javafx.scene.image.Image;
10 import javafx.scene.image.ImageView;
11
```

Fig. 13.15 | Controller for **Cover Viewer** application. (Part 1 of 4.)

```
12  public class CoverViewerController {
13     // instance variables for interacting with GUI
14     @FXML private ListView<Book> booksListView;
15     @FXML private ImageView coverImageView;
16
17     // stores the list of Book Objects
18     private final ObservableList<Book> books =
19        FXCollections.observableArrayList();
20
```

Fig. 13.15 | Controller for **Cover Viewer** application. (Part 2 of 4.)

```
21      // initialize controller
22      public void initialize() {
23         // populate the ObservableList<Book>
24         books.add(new Book("Android How to Program",
25            "/images/small/androidhtp.jpg", "/images/large/androidhtp.jpg"));
26         books.add(new Book("C How to Program",
27            "/images/small/chtp.jpg", "/images/large/chtp.jpg"));
28         books.add(new Book("C++ How to Program",
29            "/images/small/cpphtp.jpg", "/images/large/cpphtp.jpg"));
30         books.add(new Book("Internet and World Wide Web How to Program",
31            "/images/small/iw3htp.jpg", "/images/large/iw3htp.jpg"));
32         books.add(new Book("Java How to Program",
33            "/images/small/jhtp.jpg", "/images/large/jhtp.jpg"));
34         books.add(new Book("Visual Basic How to Program",
35            "/images/small/vbhtp.jpg", "/images/large/vbhtp.jpg"));
36         books.add(new Book("Visual C# How to Program",
37            "/images/small/vcshtp.jpg", "/images/large/vcshtp.jpg"));
38         booksListView.setItems(books); // bind booksListView to books
```

Fig. 13.15 | Controller for **Cover Viewer** application. (Part 3 of 4.)

```
39
40          // when ListView selection changes, show large cover in ImageView
41          booksListView.getSelectionModel().selectedItemProperty().
42             addListener(
43                new ChangeListener<Book>() {
44                   @Override
45                   public void changed(ObservableValue<? extends Book> ov,
46                      Book oldValue, Book newValue) {
47                      coverImageView.setImage(
48                         new Image(newValue.getLargeImage()));
49                   }
50                }
51             );
52       }
53    }
```

Fig. 13.15 | Controller for **Cover Viewer** application. (Part 4 of 4.)

CoverViewerController Class (cont.)

@FXML Instance Variables

- Lines 14–15 declare the controller's `@FXML` instance variables
- In this case, the `ListView` displays `Book` objects
- Class `Book` contains three `String` instance variables with *set/get* methods:
  - `title`—the book's title.
  - `thumbImage`—the path to the book's thumbnail image (used in the next example).
  - `largeImage`—the path to the book's large cover image
- The class also provides a `toString` method that returns the `Book`'s title and a constructor that initializes the three instance variables
- Copy `Book.java` from this chapter's examples folder into the folder that contains `CoverViewer.fxml`, `CoverViewer.java` and `CoverViewerController.java`

CoverViewerController Class (cont.)

Instance Variable books

- Lines 18–19 define the `books` instance variable as an `ObservableList<Book>` and initialize it by calling `FXCollections` `static` method `observableArrayList`
- This method returns an empty collection object (similar to an `ArrayList`) that implements the `Observable-List` interface

CoverViewerController Class (cont.)

Initializing the books ObservableList

- Lines 24–37 in method `initialize` create and add `Book` objects to the `books` collection
- Line 38 passes this collection to `ListView` method `setItems`, which binds the `ListView` to the `ObservableList`
- This *data binding* allows the `ListView` to display the `Book` objects automatically
- By default, the `ListView` displays each `Book`'s `String` representation

CoverViewerController Class (cont.)

Listening for `ListView` Selection Changes

- To synchronize the book cover that's being displayed with the currently selected book, we listen for changes to the `ListView`'s selected item
- By default a `ListView` supports single selection
  - `ListViews` also support multiple selection
- Selection is managed by the `ListView`'s `MultipleSelectionModel` (a subclass of `SelectionModel` from package `javafx.scene.control`
    - Contains observable properties and various methods for manipulating the corresponding `ListView`'s items
- To respond to selection changes, you register a listener for the `MultipleSelectionModel`'s `selectedItem` property (lines 41–51)

CoverViewerController Class (cont.)

Listening for `ListView` Selection Changes (cont.)

- `ListView` method `getSelectionModel` returns a `MultipleSelectionModel` object
- In this example, `MultipleSelectionModel`'s `selectedItemProperty` method returns a `ReadOnlyObjectProperty<Book>`
- Corresponding `ChangeListener` receives as `oldValue` and `newValue` the previously selected and newly selected `Book` objects, respectively
- Lines 47–48 use `newValue`'s large image path to initialize a new `Image` (package `javafx.scene.image`)—this loads the image from that path
- We then pass the new `Image` to the `coverImageView`'s `setImage` method to display the `Image`

Cover Viewer App: Customizing `ListView` Cells

- In the preceding example, the `ListView` displayed a `Book`'s `String` representation (i.e., its title)
- In this example, you'll create a custom `ListView` cell factory to create cells that display each book as its thumbnail image and title using a `VBox`, an `ImageView` and a `Label` (Fig. 13.16)

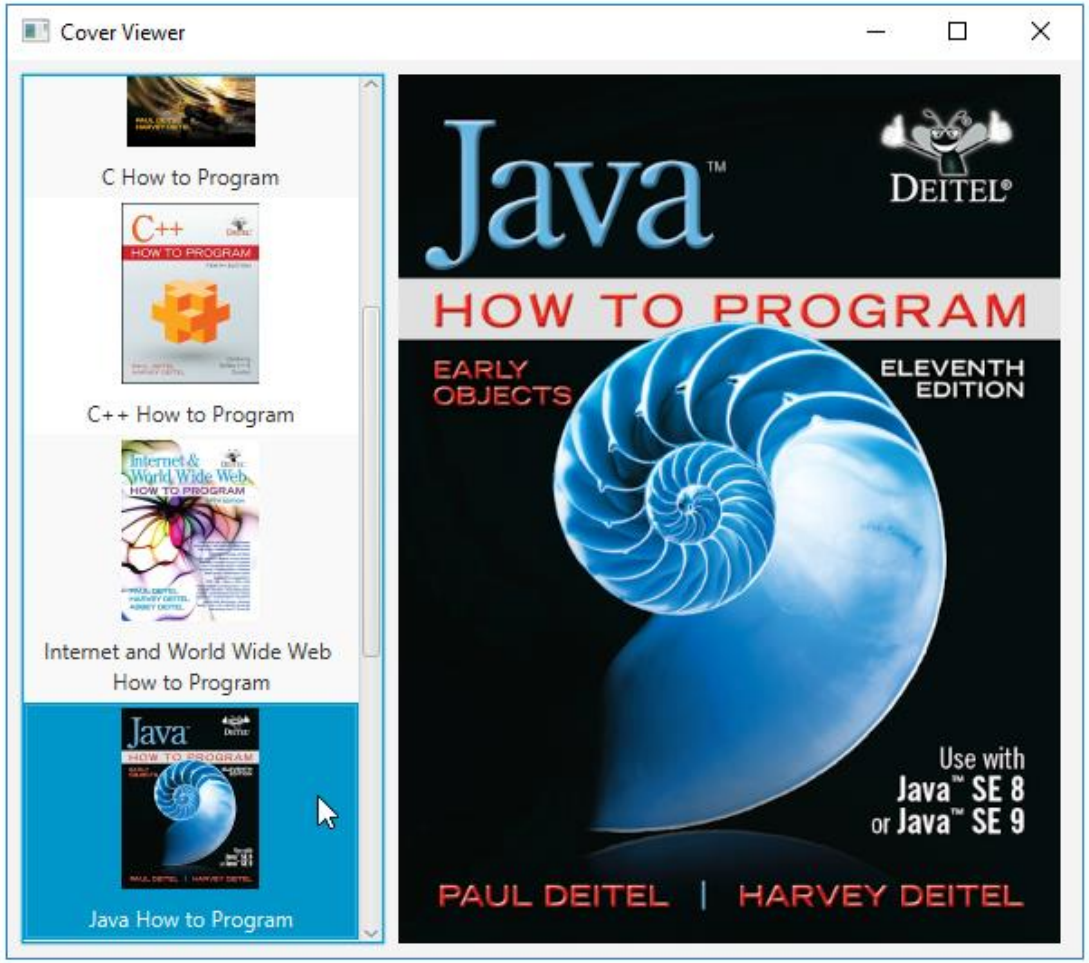


Fig. 13.16 | **Cover Viewer** app with *Java How to Program* selected.

Technologies Overview

`ListCell` Generic Class for Custom `ListView` Cell Formats

- As you saw in Section 13.5, `ListView` cells display the `String` representations of a `ListView`'s items by default
- To create a custom cell format, you must first define a subclass of the `ListCell` generic class (package `javafx.scene.control`) that specifies how to create a `ListView` cell
- As the `ListView` displays items, it gets `ListCells` from its cell factory
- You'll use the `ListView`'s `setCellFactory` method to replace the default cell factory with one that returns objects of the `ListCell` subclass
- You'll override this class's `updateItem` method to specify the cells' custom layout and contents

Technologies Overview (cont.)

Programmatically Creating Layouts and Controls

- So far, you've created GUIs visually using JavaFX Scene Builder
- In this app, you'll also create a portion of the GUI programmatically—in fact, everything we've shown you in Scene Builder also can be accomplished in Java code directly
- In particular, you'll create and configure a `VBox` layout containing an `ImageView` and a `Label`
- The `VBox` represents the custom `ListView` cell format

Copying the CoverViewer App

- This app's FXML layout and classes `Book` and `CoverViewer` are identical to those in Section 13.5, and the `CoverViewerController` class has only one new statement
- For this example, we'll show a new class that implements the custom `ListView` cell factory and the one new statement in class `CoverViewerController`
- Rather than creating a new app from scratch, copy the `CoverViewer` app from the previous example into a new folder named `CoverViewerCustomListView`

`ImageTextCell` Custom Cell Factory Class

- Class `ImageTextCell` (Fig. 13.17) defines the custom `ListView` cell layout for this version of the Cover Viewer app
- The class extends `ListCell<Book>` because it defines a customized presentation of a `Book` in a `ListView` cell

```
1  // Fig. 13.16: ImageTextCell.java
2  // Custom ListView cell factory that displays an Image and text
3  import javafx.geometry.Pos;
4  import javafx.scene.control.Label;
5  import javafx.scene.control.ListCell;
6  import javafx.scene.image.Image;
7  import javafx.scene.image.ImageView;
8  import javafx.scene.layout.VBox;
9  import javafx.scene.text.TextAlignment;
10
11 public class ImageTextCell extends ListCell<Book> {
12    private VBox vbox = new VBox(8.0); // 8 points of gap between controls
13    private ImageView thumbImageView = new ImageView(); // initially empty
14    private Label label = new Label();
15
```

Fig. 13.17 | Custom `ListView` cell factory that displays an image and text.

```
16      // constructor configures VBox, ImageView and Label
17      public ImageTextCell() {
18         vbox.setAlignment(Pos.CENTER); // center VBox contents horizontally
19
20         thumbImageView.setPreserveRatio(true);
21         thumbImageView.setFitHeight(100.0); // thumbnail 100 points tall
22         vbox.getChildren().add(thumbImageView); // attach to Vbox
23
24         label.setWrapText(true); // wrap if text too wide to fit in label
25         label.setTextAlignment(TextAlignment.CENTER); // center text
26         vbox.getChildren().add(label); // attach to VBox
27
28         setPrefWidth(USE_PREF_SIZE); // use preferred size for cell width
29      }
30
```

Fig. 13.17 | Custom `ListView` cell factory that displays an image and text.

```
31          // called to configure each custom ListView cell
32          @Override
33          protected void updateItem(Book item, boolean empty) {
34             // required to ensure that cell displays properly
35             super.updateItem(item, empty)
36
37             if (empty || item == null) {
38                setGraphic(null); // don't display anything
39             }
40             else {
41                // set ImageView's thumbnail image
42                thumbImageView.setImage(new Image(item.getThumbImage()));
43                label.setText(item.getTitle()); // configure Label's text
44                setGraphic(vbox); // attach custom layout to ListView cell
45             }
46          }
47       }
```

Fig. 13.17 | Custom `ListView` cell factory that displays an image and text.

Performance Tip 13.1

For the best `ListView` performance, it's considered best practice to define the custom presentation's controls as instance variables in the `ListCell` subclass and configure them in the subclass's constructor. This minimizes the amount of work required in each call to method `updateItem`.

CoverViewerController Class

- Updating the `CoverViewerController` to use it requires that you set the `ListView`'s cell factory
- Insert the following code as the last statement in the `CoverViewerController`'s `initialize` method and add an import for `javafx.util.Callback`

```
booksListView.setCellFactory(
   new Callback<ListView<Book>, ListCell<Book>>() {
      @Override
      public ListCell<Book> call(ListView<Book> listView) {
         return new ImageTextCell();
      }
   }
);
```

CoverViewerController Class (cont.)

- The argument to `ListView` method `setCellFactory` is an implementation of the functional interface `CallBack` (package `javafx.util`)
- This generic interface provides a `call` method that receives one argument and returns a value
- In `Callback`'s angle brackets the first type (`ListView<Book>`) is the parameter type for the interface's `call` method and the second (`ListCell<Book>`) is the `call` method's return type
- The parameter represents the `ListView` in which the custom cells will appear
- The `call` method call simply creates and returns an object of the `ImageTextCell` class

`CoverViewerController` Class (cont.)

- Each time the `ListView` requires a new cell, the anonymous inner class's `call` method will be invoked to get a new `ImageTextCell`
- Then the `ImageTextCell`'s `update` method will be called to create the custom cell presentation
- Note that by using a Java SE 8 lambda (Chapter 17) rather than an anonymous inner class, you can replace the entire statement that sets the cell factory with a single line of code

13.7 Additional JavaFX Capabilities

- This section overviews various additional JavaFX capabilities that are available in JavaFX 8 and JavaFX 9

`TableView` Control

- Section 13.5 demonstrated how to bind data to a `ListView` control
- You often load such data from a database (Chapter 24, Accessing Databases with JDBC, and Chapter 29, Java Persistence API (JPA))
- JavaFX's `TableView` control (package `javafx.scene.control`) displays tabular data in rows and columns, and supports user interactions with that data.

13.7 Additional JavaFX Capabilities (cont.)

Accessibility

- In a Java SE 8 update, JavaFX added *accessibility* features to help people with visual impairments use their devices
- For example, the screen readers in various operating systems can speak screen text or text that you provide to help users with visual impairments understand the purpose of a control
- Visually impaired users must enable their operating systems' screen-reading capabilities

13.7 Additional JavaFX Capabilities (cont.)

Accessibility (cont.)

- JavaFX controls also support:
  - GUI navigation via the keyboard—for example, the user can press the *Tab* key to jump from one control to the next. If a screen reader also is enabled, as the user moves the focus from control to control, the screen reader will speak appropriate information about each control (discussed below).
  - A high-contrast mode to make controls more readable—as with screen readers, visually impaired users must enable this feature in their operating systems.
- See your operating system's documentation for information on enabling its screen reader and high-contrast mode.

13.7 Additional JavaFX Capabilities (cont.)

Accessibility (cont.)

- Every JavaFX `Node` subclass also has these accessibility-related properties:
  - `accessibleTextProperty`—A `String` that a screen reader speaks for a control
  - `accessibleHelpProperty`—A more detailed control description `String` than that provided by the `accessibleTextProperty`
    - Should help the user understand the purpose of the control in the context of your app
  - `accessibleRoleProperty`—A value from the `enum` `AccessibleRole` (package `javafx-.scene`)
    - Screen reader uses this to determine attributes and actions supported for a control
  - `accessibleRoleDescriptionProperty`—A `String` text description of a control that a screen reader typically speaks followed by the control's contents or the value of the `accessibleTextProperty`

13.7 Additional JavaFX Capabilities (cont.)

Accessibility (cont.)

- In addition, you can add `Labels` to a GUI that describe other controls
- In such cases, you should set each `Label`'s `labelFor` property to the specific control the `Label` describes
- For example, a `TextField` in which the user can enter a phone number might be preceded by a `Label` containing the text `"Phone Number"`
- If the `Label`'s `labelFor` property references the `TextField`, then a screen reader will read the `Label`'s text as well when describing the `TextField` to the user

13.7 Additional JavaFX Capabilities (cont.)

Third-Party JavaFX Libraries

- Various libraries for additional JavaFX capabilities
  - ControlsFX (http://www.controlsfx.org/) provides common dialogs, additional controls, validation capabilities, `TextField` enhancements, a `SpreadSheetView`, `TableView` enhancements and more
  - JFXtras (http://jfxtras.org/) provides many additional JavaFX controls, including date/time pickers, controls for maintaining an agenda, a calendar control, additional window features and more.
  - Medusa provides many JavaFX gauges that look like clocks, speedometers and more. You can view samples at https://github.com/HanSolo/Medusa/blob/master/README.md

13.7 Additional JavaFX Capabilities (cont.)

Creating Custom JavaFX Controls

- You can create custom controls by extending existing JavaFX control classes to customize them or by extending JavaFX's `Control` class directly

JavaFXPorts: JavaFX for Mobile and Embedded Devices

- Oracle officially supports JavaFX only for desktop apps
- Gluon's open-source JavaFXPorts project (http://javafxports.org/) brings desktop JavaFX to mobile devices (iOS and Android) and devices like the Raspberry Pi (https://www.raspberrypi.org/)
- In addition, Gluon Mobile provides a mobile-optimized JavaFX implementation for iOS and Android
  - http://gluonhq.com/products/mobile/

13.7 Additional JavaFX Capabilities (cont.)

Scenic View for Debugging JavaFX Scenes and Nodes

- Scenic View is a debugging tool for JavaFX scenes and nodes
- Embed Scenic View directly into apps or run it as a standalone app
- Inspect your JavaFX scenes and nodes, and modify them dynamically to see how changes affect their presentation on the screen
  - Without having to edit your code, recompile it and re-run it
- For more information, visit
  - http://www.scenic-view.org

13.7 Additional JavaFX Capabilities (cont.)

JavaFX Resources and JavaFX in the Real World

- Visit the following website for a lengthy and growing list of JavaFX resources
  - http://bit.ly/JavaFXResources

13.8 JavaFX 9: Java SE 9 JavaFX Updates

Java SE 9 Modularization

- Java SE 9's biggest new software-engineering feature is the module system
- The key JavaFX 9 modules are:
  - `javafx.base`—Required by all JavaFX 9 apps
  - `javafx.controls`—Controls, layouts and charts
  - `javafx.fxml`—For working with FXML
  - `javafx.graphics`—For working with graphics, animation, CSS (for styling nodes), text and more
  - `javafx.media`—For incorporating audio and video
  - `javafx.swing`—For integrating into JavaFX 9 apps Swing GUI components
  - `javafx.web`—For integrating web content

13.8 JavaFX 9: Java SE 9 JavaFX Updates (cont.)

- In your apps, if you use modularization and JDK 9, only the modules required by your app will be loaded at runtime
- Otherwise, your app will continue to work as it did previously, provided that you did not use so-called internal APIs—that is, undocumented Java APIs that are not meant for public use
- In the modularized JDK 9, such APIs are automatically *private* and inaccessible to your apps—any code that depends on pre-Java-SE-9 internal APIs will not compile

13.8 JavaFX 9: Java SE 9 JavaFX Updates (cont.)

New Public Skinning APIs

- If a JavaFX GUI's presentation is determined entirely by a style sheet (which specifies the rules for styling the GUI), you can simply swap in a new style sheet—sometimes called a skin—to change the GUI's appearance
- This is commonly called skinning

13.8 JavaFX 9: Java SE 9 JavaFX Updates (cont.)

New Public Skinning APIs (cont._

- Each JavaFX control also has a skin class that determines its default appearance
- In JavaFX 8, skin classes are defined as internal APIs, but many developers create custom skins by extending these skin classes
- In JavaFX 9, the skin classes are now public APIs in the package `javafx.scene.control.skin`
- You can extend the appropriate skin class to customize the look-and-feel for a given type of control
- You then create an object of your custom skin class and set it for a control via its `setSkin` method

13.8 JavaFX 9: Java SE 9 JavaFX Updates (cont.)

GTK+ 3 Support on Linux

- GTK+ (GIMP Toolkit—`http://gtk.org`) is a GUI toolkit that JavaFX uses behind the scenes to render GUIs and graphics on Linux
- In Java SE 9, JavaFX now supports GTK+ 3—the latest version of GTK+

High-DPI Screen Support

- In a Java SE 8 update, JavaFX added support for High DPI (dots-per-inch) screens on Windows and macOS
- Java SE 9 adds Linux High-DPI support, as well as capabilities to programmatically manipulate the scale at which JavaFX apps are rendered on Windows, macOS and Linux.

13.8 JavaFX 9: Java SE 9 JavaFX Updates (cont.)

Updated GStreamer

- JavaFX implements its audio and video multimedia capabilities using GStreamer (`https://gstreamer.freedesktop.org`)
- JavaFX 9 incorporates a more recent version of GStreamer

Updated WebKit

- `WebView` control embeds web content in JavaFX apps
- Based on WebKit framework (`http://www.webkit.org`)—a web browser engine that supports loading and rendering web pages
- JavaFX 9 incorporates an updated version of WebKit