# Building the Information Panel for the PictureExplorer GUI

*Learn how to construct a complex panel and add it to a JFrame, including event registration using anonymous listener classes, BoxLayout, and resource loading via the Class class.*

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Java Programming Notes # 364

# Preface

## General

This lesson is the next in a series *(see Resources)* designed to teach you how to write Java programs to do things like:

- Remove *redeye* from a photographic image.
- Distort the human voice.
- Display one image inside another image.
- Do edge detection, blurring, and other filtering operations on images.
- Insert animated cartoon characters into videos of live humans.

If you have ever wondered how to do these things, you've come to the right place.

## What you have learned from earlier lessons

If you have studied the earlier lessons in this series, you have learned about turtles, worlds, and pictures. You have learned that objects of the **Picture** class are useful for much more than simply serving as living quarters for turtles. They are also useful for manipulating images in interesting and complex ways.

### The PictureExplorer class

In the previous lesson, you learned that an object of the **PictureExplorer** class *(see Figure 2)* is a GUI that allows you to determine the numeric color values for any pixel in a picture by placing a cursor on the pixel.

**Pixel Editor Program**
See the lesson titled *A Pixel Editor Program in Java: Multimedia Programming with Java* in Resources for a non-trivial application of a **PictureExplorer** object.

The pixel position is controlled by clicking or dragging the mouse within the picture, clicking buttons in the upper panel, or typing coordinate values into text fields. You can zoom in and out to view the pixels in more or less detail and you can see the actual color of the pixel displayed in a small colored square.

You learned how the GUI is constructed from a big-picture viewpoint. The GUI window is the visual manifestation of a **JFrame** object. You learned how the **JFrame** object is configured, how the **Zoom** menu is constructed, and how an **ActionListener** object is registered on the items in that menu.

## What you will learn in this lesson

In this lesson, you will learn how to construct the **infoPanel** in the NORTH location of the GUI in Figure 2. You will also learn how to register event listener objects on the components in that panel making use of objects of anonymous classes.

Along the way, you will learn about some other interesting topics including:

- The use of **BoxLayout**
- The class file naming scheme.
- The use of **getResources** to get the URL of a file
- The use of a class loader to load a resource file

## Source code listings

A complete listing of Ericson's **PictureExplorer** class is provided in Listing 31 near the end of the lesson.  A complete listing of a very simple program named Java362a that I will use to illustrate the behavior of the **PictureExplorer** class is provided in Listing 32.

## Viewing tip

I recommend that you open another copy of this document in a separate browser window and use the following links to easily find and view the figures and listings while you are reading about them.

### Figures

### Listings

### Supplementary material

I recommend that you also study the other lessons in my extensive collection of online programming tutorials. You will find a consolidated index at www.DickBaldwin.com.

## General background information

### A multimedia class library

In this series of lessons, I will present and explain many of the classes in a multimedia class library that was developed and released under a **Creative Commons Attribution 3.0 United States License** *(see Resources)* by Mark Guzdial and Barbara Ericson at Georgia Institute of Technology. In doing this, I will also present some interesting sample programs that use the library.

### Software installation and testing

I explained how to download, install, and test the multimedia class library in an earlier lesson titled *Multimedia Programming with Java, Getting Started (see Resources)*.

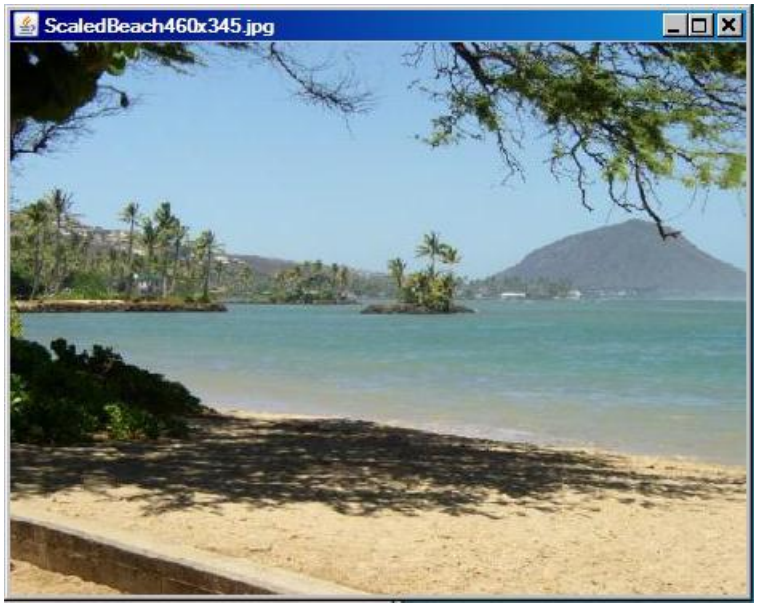
## Preview

### A sample program

I will use a very simple program to illustrate the creation of an object of the **PictureExplorer** class.

The sample program *(named Java362a)* begins by creating a new **Picture** object with known dimensions using input from an image file in the current directory. Then it calls the **show** method on the object to produce the screen output shown in Figure 1.

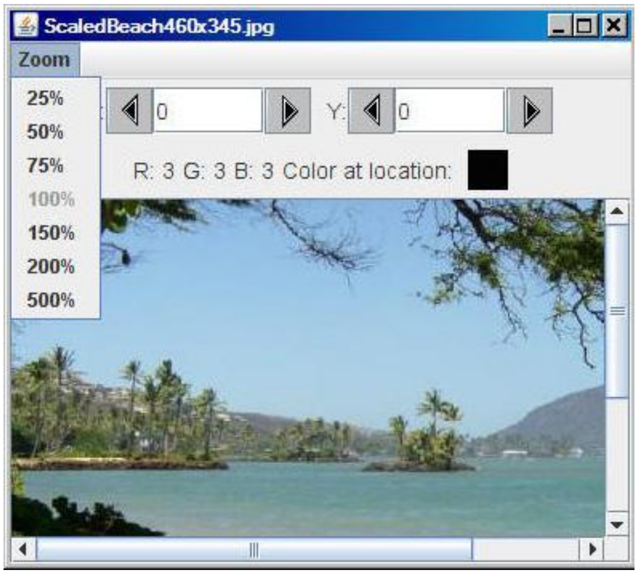
**Figure 1. Screen output produced by the show method.**



## Call the explore method

After that, the program calls the **explore** method on the **Picture** object to produce the screen output shown in Figure 2.

**Figure 2. Screen output produced by the explore method.**



0

0

R: 3 G: 3 B: 3 Color at location:

*(Note that in the screen shot in Figure 2, the GUI has been manually resized to make it smaller and the Zoom menu has been opened.)*

You learned all about the **show** method of the **SimplePicture** class in earlier lessons. You began learning about the **explore** method and the **PictureExplorer** class in the previous lesson *(see Resources)*.

### The explore method

The **explore** method of the **SimplePicture** class contains a single statement, which instantiates an object of the **PictureExplorer** class. As soon as that object is instantiated, the GUI shown in Figure 2 appears on the screen and it remains on the screen until the program is terminated or the user clicks the X-button in the upper-right corner of the GUI.

## Reducing the confusion

Methods in the **PictureExplorer** class often call other methods that belong to the class. Those methods, in turn, often call other methods. Because I will be switching back and forth among code fragments extracted from different methods, things can get confusing. I will use color in an attempt to reduce the confusion. That is, when one method calls another and I need to put the explanation of the first method on hold while I explain the code in the second method, I will change the background color against which the code fragments are displayed.

### Background color for first-level classes, methods and/or constructors

For example, I will present code fragments extracted from Ericson's PictureExplorer class against the background color shown in Listing 1.

**Listing 1. Background color for first-level code.**

```
Color = #FFFFBB
```

### Background color for second-level methods

Similarly, I will present code fragments extracted from second-level methods against the background color shown in Listing 2.

**Listing 2. Background color for second-level code.**

```
Color = #FFEEFF
```

### Background color for third and lower-level methods

Finally, I will present code fragments extracted from third-level and lower-level code *(if any)* against the background colors, going from left to right, in Listing 3.

**Listing 3. Background color for third and lower-level code.**

| | | | | |
|---|---|---|---|---|
| 3-<br>#DDFFFF | 4-<br>#C1C100 | 5-<br>#FFCC66 | 6-<br>#B1C2BD | 7-<br>#EEEEEE |

In the event that I need to distinguish among more than seven levels at the same time, I will come up with another color and explain its use at the time.

# Discussion and sample code

## The sample program named Java362a

The purpose of this program is to support an explanation of the **PictureExplorer** class.

Normally, I break programs down and explain them in fragments. However, this program is short and simple and I explained it in detail in the previous lesson *(see Resources)*. You can view a complete listing of the program in Listing 32 near the end of the lesson.

### Create a Picture object and display it with the explore method

A **Picture** object having dimensions of 450x345 pixels is created by reading an image file from the current directory. The **explore** method is called on the **Picture** object producing the screen output GUI shown in Figure 2.

As you learned in the previous lesson, the **explore** method simply creates a new object of the **PictureExplorer** class. The GUI shown in Figure 2 appears on the screen as soon as that object is created. *(Again, note that the GUI in Figure 2 has been manually resized to make it smaller and the Zoom menu has been opened.)*

## An overview of the GUI

You also learned in the previous lesson that the onscreen GUI window that you see in Figure 2 is the visual manifestation of a **JFrame** object. Basically, a **JFrame** object consists of the following parts:

- A banner at the top containing some built-in control components *(three buttons on the right and a menu on the left)* and optionally a **String** title.
- A rectangular area under the banner that can contain a menu. This area is collapsed if you elect not to provide one or more menus.
- A content area underneath the menu area.
- A border around the outer edges.

## The content area

I explained the menu area in some depth in the previous lesson.  We will be primarily concerned with the content area in this lesson.

The content area *(immediately below the menu area)* has a default **BorderLayout** object as the layout manager.  This layout manager makes it possible to place one component in the CENTER and four additional components in the NORTH, SOUTH, EAST, and WEST locations.

In the GUI produced by the **PictureExplorer** class, there is one component in the CENTER and one component in the NORTH location.  There are no components in the EAST, SOUTH, and WEST locations.  *(Keep in mind that each of the five allowable components can themselves contain other components.)*

## A JScrollPane object in the CENTER location

As I explained in the previous lesson, the component in the CENTER is an object of the **JScrollPane** class.  I will have a great deal more to say about this in the next lesson.

## A JPanel object in the NORTH location

The component in the NORTH location of the **JFrame** object's content area is a **JPanel** object with the layout manager on the panel also set to **BorderLayout**.  This **JPanel** object is referred to by a local variable named **infoPanel**.

The **infoPanel** contains two smaller **JPanel** objects, one in its NORTH location and one in its SOUTH location.  There are no components in the CENTER, EAST, or WEST locations of this **JPanel** object.

A **JPanel** object is also a container that can contain other components.  However, there is no *"content pane"* associated with a **JPanel** object.  Other components are added directly to the **JPanel** object.

## The locationPanel and the colorInfoPanel

The **JPanel** object in the NORTH location of the **infoPanel** is referred to in this class as the **locationPanel**.  The construction of the **locationPanel** is very complex with various registered listener objects, instantiated from anonymous classes.

The **JPanel** object in the SOUTH location of the **infoPanel** is referred to as the **colorInfoPanel**.  The construction of the **colorInfoPanel** is less complex than the construction of the **locationPanel**.  Among other things, this panel is completely passive with no registered listener objects.  Its sole purpose is to display pixel-color information.

### The layout manager for the locationPanel

The layout manager for the **locationPanel** is an object of the **FlowLayout** class.  With this layout manager, you can add any number of components to the **JPanel** object and they will position themselves in horizontal rows.  If there are too many components to fit on one row, some will spill over to the next row.  You can cause the components on the rows to be aligned to the left, the right, or the center.

### The population of the locationPanel

The **locationPanel** is populated with the following components:

- A **Box** object (*I will explain this later.)*
- Some **JLabel** objects.
- Some **JTextField** objects.
- Some **ImageIcon** objects used to put the triangle images on the *next* and *previous* buttons on the left and right of the text fields.
- Some **JButton** objects that constitute the *next* and *previous* buttons.

There are numerous event handlers registered on various components in the **locationPanel**.

You will learn how all of the components are put together, how the event handlers are defined, and how they behave later in this lesson.

### The colorInfoPanel

The **colorInfoPanel** is also a **JPanel** object, and the layout manager for the **colorInfoPanel** is also an object of the **FlowLayout** class.

As I mentioned earlier, the **colorInfoPanel** is much simpler than the **locationPanel** and is primarily populated with the following components:

- Some **JLabel** objects.
- Another **JPanel** object *(the small almost-black square in Figure 2)*.

There are no listener objects registered on components on the **colorInfoPanel**.

You will also learn how these components are put together later in this lesson.

## The PictureExplorer class

A complete listing of the **PictureExplorer** class is provided in Listing 31 near the end of the lesson.  I will break the class down and explain it in fragments.  I explained part of the **PictureExplorer** class in the previous lesson.  In this lesson, I will begin with a code fragment containing the declaration of instance variables, which is shown in Listing 4.

## Private instance variables of the PictureExplorer class

The **PictureExplorer** class declares a large number of private instance variables and initializes some of them.  They are shown in Listing 4 for easy reference.

**Listing 4. Private instance variables of the PictureExplorer class.**

```
 // current x and y index
 private int xIndex = 0;
 private int yIndex = 0;

 //Main gui variables
 private JFrame pictureFrame;
 private JScrollPane scrollPane;

 //information bar variables
 private JLabel xLabel;
 private JButton xPrevButton;
 private JButton yPrevButton;
 private JButton xNextButton;
 private JButton yNextButton;
 private JLabel yLabel;
 private JTextField xValue;
 private JTextField yValue;
 private JLabel rValue;
 private JLabel gValue;
 private JLabel bValue;
 private JLabel colorLabel;
 private JPanel colorPanel;

 // menu components
 private JMenuBar menuBar;
 private JMenu zoomMenu;
 private JMenuItem twentyFive;
 private JMenuItem fifty;
 private JMenuItem seventyFive;
 private JMenuItem hundred;
 private JMenuItem hundredFifty;
 private JMenuItem twoHundred;
 private JMenuItem fiveHundred;

 /** The picture being explored */
 private DigitalPicture picture;

 /** The image icon used to display the
picture */
 private ImageIcon scrollImageIcon;

 /** The image display */
 private ImageDisplay imageDisplay;

 /** the zoom factor (amount to zoom) */
 private double zoomFactor;
 /** the number system to use, 0 means
starting at 0,
  *  1 means starting at 1 */
 private int numberBase=0;
```

There's not much to be said about the instance variables at this point.  We will be referring back to them as the explanation of the **PictureExplorer** class progresses.

### The constructor

I explained the constructor for the **PictureExplorer** class in the previous lesson, but I have shown it again in Listing 5 for easy reference.

**Listing 5. The constructor for the PictureExplorer class.**

```
 /**
  * Public constructor
  * @param picture the picture to explore
  */
 public PictureExplorer(DigitalPicture
picture){
   // set the fields
   this.picture = picture;
   zoomFactor = 1;

   // create the window and set things up
   createWindow();
 }//end constructor
```

### Call the createWindow method

The constructor saves the incoming parameter, *(which refers to the picture to be displayed in the content area of the GUI)* and sets a value of 1 into the instance variable named **zoomFactor**.  Then it calls the **createWindow** method where the completion of construction is accomplished.

When the **createWindow** method returns, the constructor returns the new **PictureExplorer** object's reference to the **explore** method of the **SimplePicture** class *(or perhaps from a method in a class of your own design)* from which the constructor was called.  However, the **explore** method doesn't save the reference in a named reference variable.  Therefore, the **PictureExplorer** object is an anonymous object that remains on the screen until the user clicks the X-button in the upper-right corner of Figure 2.

### The createWindow method

The **createWindow** method of the **PictureExplorer** class is shown in its entirety in Listing 6.

**Listing 6. The createWindow method.**

```
 /**
  * Creates the JFrame and sets everything up
  */
 private void createWindow(){
   // create the picture frame and initialize
it
   createAndInitPictureFrame();

   // set up the menu bar
   setUpMenuBar();

   //create the information panel
   createInfoPanel();

   //creates the scrollpane for the picture
   createAndInitScrollingImage();

   // show the picture in the frame at the
size it needs
   // to be
   pictureFrame.pack();
   pictureFrame.setVisible(true);
 }//end createWindow method
```

## A sequence of method calls

As you learned in the previous lesson, the **createWindow** method consists of:

- A sequence of four calls to other methods to construct various parts of the **PictureExplorer** object.
- A call to the **pack** method to set the **JFrame** to the correct size.
- A call to the **setVisible** method to cause the **JFrame** object to become visible on the screen.

I explained the following two methods in the previous lesson:

- **createAndInitPictureFrame**
- **setUpMenuBar**

I will explain the **createInfoPanel** method in this lesson and will explain the **createAndInitScrollingImage** method in the next lesson.

### The createInfoPanel method

The beginning of the **createInfoPanel** method is shown in the code fragment in Listing 7. *(Note the change in background color, indicating that the discussion has moved down one level in the method call stack.)*

**Listing 7. Beginning of the createInfoPanel method.**

```
 /**
  * Creates the North JPanel with all the
pixel location
  * and color information
  */
 private void createInfoPanel(){
   // create the info panel and set the layout
   JPanel infoPanel = new JPanel();
   infoPanel.setLayout(new BorderLayout());

   // create the font
   Font largerFont =
                   new
Font(infoPanel.getFont().getName(),

infoPanel.getFont().getStyle(),14);
```

### A new JPanel object

Listing 7 begins by instantiating a new **JPanel** object, saving its reference in **infoPanel**, and setting the layout manager to **BorderLayout**. This is all very straightforward code for those who are familiar with Swing GUI programming.

### A new Font object

Then Listing 7 instantiates a new **Font** object and saves its reference in **largerFont**. This is a little more complicated. This overloaded version of the **Font** constructor requires the following parameters:

- String nameOfTheFont
- int styleOfTheFont
- int sizeOfTheFont in points

Rather than coming up with a specific font name and a specific font style, Ericson simply used a series of method calls to get the name and the style of the default font. Then she specified that the font size should be 14 points, and passed these values to the constructor for the new **Font** object. That way, she was assured that the specified name and style would be compatible with the current operating environment.

### Call the createLocationPanel method

Then the **createInfoPanel** method calls the **createLocationPanel** method and saves the returned value in the variable named **locationPanel**.

**Listing 8. Call the createLocationPanel method.**

```
   JPanel locationPanel =
createLocationPanel(largerFont);
```

This is one of those occasions where we need to put the explanation of the current method on hold and explain another method.  As mentioned earlier, I will also change the background color against which the code fragments are displayed to indicate that the discussion is moving one step further down the method call stack.

**The createLocationPanel method**

The **createLocationPanel** method, which is a long and complex method, begins in Listing 9.

**Listing 9. Beginning of the createLocationPanel method.**

```
 /**
  * Create the pixel location panel
  * @param labelFont the font for the labels
  * @return the location panel
  */
 public JPanel createLocationPanel(Font
labelFont){

   // create a location panel
   JPanel locationPanel = new JPanel();
   locationPanel.setLayout(new FlowLayout());

   Box hBox = Box.createHorizontalBox();
```

The method starts out easy enough by instantiating a new **JPanel** object, saving its reference in the variable named **locationPanel**, and setting the layout manager to **FlowLayout**.

### The FlowLayout manager

Briefly, **FlowLayout** arranges components in a row.  When there isn't enough room for all the components on the current row, the components on the right wrap *(much like text in a word processor)* and move down to the next row.

By default, this layout manager has a *centered* alignment causing the components on each row to be centered in the row.  *(Other alignments such as right and left alignment are available.)*

**BoxLayout**
For more information on BoxLayout, see *Swing from A to Z: Alignment Properties*

### BoxLayout

*and BoxLayout, Part 1 and Part 2* in Resources.

Then the code in Listing 9 becomes somewhat more complicated when a new object of the **Box** class is instantiated and its reference is stored in **hBox**. Sun describes the **Box** class as *"A lightweight container that uses a **BoxLayout** object as its layout manager."*

Sun partially describes **BoxLayout** as *"A layout manager that allows multiple components to be laid out either vertically or horizontally. The components will not wrap so, for example, a vertical arrangement of components will stay vertically arranged when the frame is resized."*

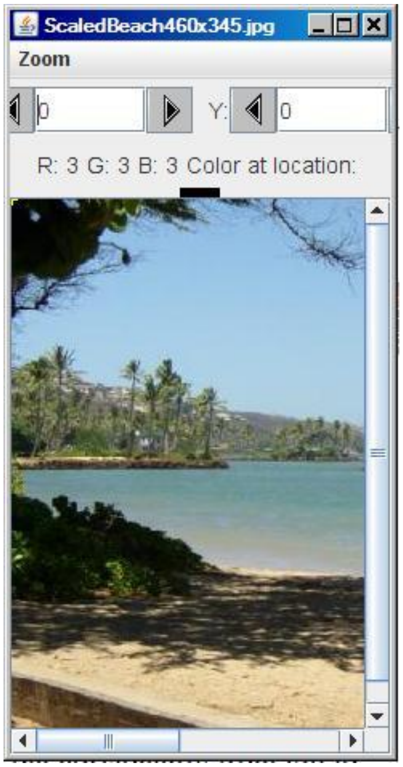
Rather than trying to explain all of this, I will simply refer you to the sidebar. I will also provide a screen shot that shows the effect of using **BoxLayout**.

### The effect of BoxLayout

Compare the screen shot of the GUI in Figure 3 with the screen shot in Figure 2. In Figure 3, the GUI has been resized to make it narrower than in Figure 2.

Pay particular attention to the positions of the components in the **locationPanel** and the **colorInfoPanel** below the menu area. *(The **locationPanel** is the one that shows the text fields. It is above the **colorInfoPanel** that shows the RGB color values.)*

**Figure 3. Illustration of the effect of a BoxLayout manager.**



### The colorInfoPanel has wrapped

In Figure 2, the black square is at the right end of the text in the **colorInfoPanel**. However, in Figure 3, after I resized the GUI and there was no longer room for the black square on the same row with the RGB text, the black square wrapped and moved down to the center of the next row. This is a characteristic of the **FlowLayout** manager.

### No wrapping for the locationPanel

However, when there was no longer room for the **JButton** on the right side of the rightmost text field in the **locationPanel**, it simply allowed itself to be clipped by the right edge of the GUI. It refused to wrap and drop down to the next row. This is one of the characteristics of the **BoxLayout** manager. *(Note that when the code in Listing 9 finishes executing, the* ***Box*** *object has been instantiated but it still hasn't been put to work.)*

### Create two JLabel objects and one JTextField object

Although it doesn't show in either Figure 2 or Figure 3 *(for different reasons)*, there is an upper-case "X:" at the left end of the left text field in the **locationPanel**. *(It is the counterpart to the upper-case Y that you see in Figure 2 and Figure 3 and it is visible in Figure 6.)*

Listing 10 begins by constructing two **JLabel** objects containing the text strings "X:" and "Y:".  They will be positioned to the left of the two **JButton** objects *(with triangular arrows that point to the left)* later.  Each label serves as the label for the two buttons and the text field to its right.

**Listing 10. Create two JLabel objects and one JTextField object.**

```
   // create the labels
   xLabel = new JLabel("X:");
   yLabel = new JLabel("Y:");

   // create the text fields
   xValue = new JTextField(
                 Integer.toString(xIndex +
numberBase),6);
```

## A single JTextField object

Then Listing 10 instantiates a single **JTextField** object and saves its reference in the variable named **xValue**.

A **JTextField** object only knows how to deal with **String** data.  It doesn't know how to deal with any of the numeric types.  Therefore, if you are going to use a **JTextField** object to display or receive numeric data, you must convert between **String** and numeric data on the way in or on the way out.

The **JTextField** constructor that is called in Listing 10 requires a **String** and an integer as incoming parameters.  The **String** specifies the initial text that will be displayed in the text field.  The integer *(6 in this case)* specifies the width of the text field in characters.

## Converting an int value to a String value

The static **toString** method of the **Integer** class shown in Listing 10 converts an **int** value into a **String** value.  The variable **xIndex** contains the current x-coordinate of the cursor *(initially 0).*

The variable **numberBase** contains either a 0 or a 1 *(initially 0)*.  The **JTextField** object that is instantiated in Listing 10 is initialized to show the text character "0".

## Compiled class file names

Sometimes when analyzing a Java program it is useful to examine the names of the class files produced when the program is compiled.  Figure 4 shows the class files produced by compiling the **PictureExplorer** class.

**Figure 4. Class files produced by compiling the PictureExplorer class.**

**Top-level and inner classes**
For more information on top-level and inner classes, see lessons 1636 through 1642 in Resources

```

PictureExplorer.class

PictureExplorer$PictureExplorerFocusTraversalPolicy.class

PictureExplorer$1.class
PictureExplorer$2.class
PictureExplorer$3.class
PictureExplorer$4.class
PictureExplorer$5.class
PictureExplorer$6.class
```

## Top-level and inner classes

If you know the class file naming scheme, you can often tell a lot about how a program is organized by examining the names of the class files. For example, every class definition produces an output file with an extension of .class when the program is compiled. This not only includes *top-level* classes, it also includes *inner* classes as well.

## Top-level class file names

For example, we know that the Java compiler does not insert dollar sign ($) characters into class file names for top-level classes. There is only one file name in Figure 4 that doesn't include a $. Therefore, that class *(PictureExplorer)* must be a top-level class. *(We know that it is because that is the name of the top-level class that we are analyzing:* ***PictureExplorer****.)*

## Inner class file names

We also know that the compiler does insert $ characters into the class file names for all inner classes.

There are several kinds of inner classes:

- Member classes
- Local classes
- Anonymous classes

## Member classes

A member class is a class that is defined inside a class but not inside a method of the class. Every member class must have a name, and the name is reflected in the class file name following the $ character.

There is only one such class file in Figure 4 and the name following the $ is **PictureExplorerFocusTraversalPolicy**. Therefore, this must be a member class, and we know that it is from a discussion in the previous lesson. It is a private member class, which is the only way that a class definition can be declared private.

## Class file names for local classes and anonymous classes

The water gets a little murkier when we talk about the class file names for local classes and anonymous classes. We know that the file names will always contain a $ followed by a number for both local classes and anonymous classes. However, for local classes, the class file name will also contain another $ followed by a class name.

There are no file names in Figure 4 meeting that description, so the remaining six class files in Figure 4 must have been created by the compilation of six different anonymous classes.

## An object of an anonymous class

This is where things get really interesting. The source code for one of the anonymous classes identified in Figure 4 is shown in Listing 11. *(Recall that we are still discussing the method named **CreateLocationPanel**.)*

**Listing 11. An object of an anonymous class.**

```
   xValue.addActionListener(new
ActionListener() {
     public void actionPerformed(ActionEvent
e) {
       displayPixelInformation(

xValue.getText(),yValue.getText());
     }
   });
```

The syntax for instantiating objects of anonymous classes is extremely ugly but I will try to explain the meaning of the code in Listing 11.

### Register an ActionListener object

To begin with, Listing 11 calls the **addActionListener** method on a reference to the **JTextField** object that was instantiated in Listing 10. The purpose of this method call is to register an **ActionListener** object on the text field to respond to action events fired by the text field. *(For example, a **JTextField** object will fire an action event when the user presses the Enter key while the text field has the focus.)*

A valid **ActionListener** object must be an object instantiated from a class that implements the **ActionListener** interface.

Listing 11 defines an anonymous class and instantiates an object of that class in the parameter list of the **addActionListener** method.

### How to interpret this code - an unnamed class

You can interpret the code in Listing 11 in the following way. A new object is instantiated from an unnamed class that implements the **ActionListener** interface. That object's reference is passed as a parameter to the **addActionListener** method.

### Must define the actionPerformed method

Because the unnamed class implements the **ActionListener** interface, it must provide a concrete definition of the **action Performed** method, which it does.

The definition of the **actionPerformed** method is embedded in the middle of the code in Listing 11. The body of the method consists of a single statement, which is a call to another method named **displayPixelInformation**.

**The actionPerformed method**
The only method declared in the **ActionListener** interface is the method named **actionPerformed**. Any class that implements a method must define all of the methods declared in the interface.

### An overloaded displayPixelInformation method

It's time to change background colors again so that I can put the **createLocationPanel** method on hold while I explain the call to the **displayPixelInformation** method.

The **PictureExplorer** class defines three overloaded versions of methods named **displayPixelInformation**. The basic purpose of all three methods is to get and display red, green, and blue color data in the **colorInfoPanel** shown below the two text fields in Figure 2.

The version of the **displayPixelInformation** method that is called in Listing 11 is shown in its entirety in Listing 12.

### Listing 12. The displayPixelInformation method

```
 /**
  * Method to display the pixel information
from the
  * passed x and y but also converts x and y
from strings
  * @param xString the x value as a string
from the user
  * @param yString the y value as a string
from the user
  */
 public void displayPixelInformation(
                          String xString,
String yString){
   int x = -1;
   int y = -1;
   try {
     x = Integer.parseInt(xString);
     x = x - numberBase;
     y = Integer.parseInt(yString);
     y = y - numberBase;
   } catch (Exception ex) {
   }

   if (x >= 0 && y >= 0) {
     displayPixelInformation(x,y);
   }
 }//end displayPixelInformation method
```

### Called when the text field fires an action event

The **actionPerformed** method in Listing 11 is called when the user presses the Enter key while the left text field in Figure 2 has the focus.

The **displayPixelInformation** method in Listing 12 is called by the **actionPerformed** method.

This version of the method requires two **String** references as incoming parameters. The **actionPerformed** method passes the text contents of both text fields when this method is called.

This makes it possible for the user to type a coordinate value into the text field, press the Enter key, and cause the **displayPixelInformation** method to be called to act on that data.

### Convert the two strings to numeric coordinates

The purpose of the code in Listing 12 is to:

- Convert the two **String** parameter values into integer x and y coordinate values.

- Pass the two coordinate values to another overloaded version of the **displayPixelInformation** method near the end of Listing 12.

## Complicated by numberBase considerations

The code in Listing 12 is complicated by the fact that the class is written to support the use of coordinate values that begin with 0, or coordinate values that begin with 1. *(However, the **numberBase** variable, which distinguishes between the two alternatives, is set to 0 when an object of the **PictureExplorer** class is instantiated.)*

Other than the complication attributable to the number base, you should have no difficulty understanding the code in Listing 12 that converts the **String** values in the two text fields into coordinate values of type **int** and passes those coordinate values in a call to another overloaded version of the **displayPixelInformation** method.

### Another overloaded displayPixelInformation method

Once again, it's time to change colors as I put the **displayPixelInformation** method in Listing 12 on hold while I explain the call to another overloaded version of the **displayPixelInformation** method.

This version begins in Listing 13. This version is considerably more complex than the one in Listing 12, so I will break it down and explain it in fragments.

**Listing 13. Beginning of another overloaded version of the displayPixelInformation method**

```
 /**
  * Method to display pixel information for
the passed x
  * and y
  * @param pictureX the x value in the picture
  * @param pictureY the y value in the picture
  */
 private void displayPixelInformation(
                              int pictureX,
int pictureY){
   // check that this x and y is in range
   if (isLocationInPicture(pictureX,
pictureY)){
     // save the current x and y index
     xIndex = pictureX;
     yIndex = pictureY;

     // get the pixel at the x and y
     Pixel pixel = new
Pixel(picture,xIndex,yIndex);
```

## Confirm that the coordinates are in the picture

The method begins by calling a method named **isLocationInPicture** to confirm that the incoming coordinate values are actually within the height and width of the picture. The code in this method is so simple that I'm not going to show it here. You can view the method in Listing 31 near the end of the lesson. If the coordinate values are in the picture, the method returns true, and returns false otherwise.

### When the coordinates are in the picture...

When the method returns true, the remaining code in Listing 13 is executed.

Listing 13 saves the coordinate values in a pair of instance variables named **xIndex** and **yIndex**. *(If they are not in the picture, they are not saved.)*

### Get and save a reference to a Pixel object

Then Listing 13 calls the **getPixel** method to get and save a reference to a **Pixel** object that contains the red, green, and blue color values in the pixel at that location in the picture. The values will be used later, *(but not in the next code fragment)*.

### Set the coordinate values in the text fields

This overloaded version of the **displayPixelInformation** method is not only called when the user presses the Enter key while the text field has the focus, it is also called when the user moves the cursor within the picture using some other method, such as clicking the picture with the mouse, for example.

### The text fields serve a dual purpose

In all cases, the text fields are updated to display the new coordinate values. Hence they serve a dual purpose:

- They make it possible to manually enter coordinate values by typing.
- They provide a display of coordinate values when those values are changed in some other manner.

### Update the contents of the text fields

The contents of the text fields are updated by the code in Listing 14, which converts the current coordinate values to **String** objects and uses those objects to set the text in the text fields.

**Listing 14. Set the coordinate values in the text fields.**

```
      // set the values based on the pixel
      xValue.setText(Integer.toString(
                                    xIndex  +
 numberBase));
      yValue.setText(Integer.toString(
                                     yIndex +
 numberBase));
```

### Use the color information from the Pixel object

The code in Listing saved a reference to a **Pixel** object containing color information for the pixel at the location of the current coordinate values.  Listing 15 uses that information for two different purposes.

**Listing 15. Use the color information from the Pixel object.**

```
     rValue.setText("R:  " + pixel.getRed());
     gValue.setText("G:  " + pixel.getGreen());
     bValue.setText("B:  " + pixel.getBlue());

     colorPanel.setBackground(new
Color(pixel.getRed(),

pixel.getGreen(),

pixel.getBlue()));
   }//end if
```

### Construct the String color values

The first purpose is to:

- Extract the numeric values for the red, green, and blue color components.
- Use that information to construct three **String** objects.
- Store the String object's references in the instance variables named **rValue**, **gValue**, and **bValue**.

These three strings will be used to display the red, green, and blue color values later when the **colorInfoPanel**, shown below the text fields in Figure 2, is updated.

### Color the small square

The second purpose is to set the background color for the small colored square, shown beneath the right-most text field in Figure 2.  The color of the square is set to match the color of the pixel at the current coordinates.

### The end of the if statement

Listing 15 signals the end of the **if** statement that began in Listing 13.  All of the code in the **if** clause is executed if the current coordinates are within the bounds of the picture.

## Code executed when coordinates are not in the picture

Listing 16 shows the **else** clause that is executed when the current coordinates are not within the bounds of the picture.

**Listing 16. Code executed when coordinates are not in the picture.**

```
   else{
     clearInformation();
   }//end else
```

Listing 16 calls a method named **clearInformation**.  This is another method that is too simple to warrant showing here.  Once again, you can view the code for the **clearInformation** method in Listing 31 near the end of the lesson.

The **clearInformation** method sets the string "N/A" into both text fields and causes that same string to be set in all three color values the next time the **colorInfoPanel** is updated.

It sets the color of the colored square in Figure 2 to black and resets the current coordinate values to 0,0.

## Notify the image display of the current coordinates

Finally, Listing 17 calls two *set* methods on the image display in the CENTER of the **JFrame**, passing the product of the current coordinate values and the **zoomFactor**.  You will see how that information is used in a future lesson when we examine the **ImageDisplay** class.

**Listing 17. Notify the image display of the current x and y coordinate values.**

```
   imageDisplay.setCurrentX((int) (xIndex *
zoomFactor));
   imageDisplay.setCurrentY((int) (yIndex *
zoomFactor));
 }//end displayPixelInformation method
```

## The end of the displayPixelInformation method

Listing 17 also signals the end of this version of the **displayPixelInformation** method.  This causes control to return to the other version of the **displayPixelInformation** method shown in Listing 12 from which this method is called.

## Terminate immediately

The **displayPixelInformation** method shown in Listing 12 has nothing more to do, so it terminates immediately returning control to the **actionPerformed** method in the anonymous **ActionEvent** handler in Listing 11.

### The action event handler has completed its task

The **actionPerformed** method also has nothing more to do, so it also terminates immediately.

### Wait for the next event

When the **actionPerformed** method has been called and then terminates, the GUI essentially goes into a quiescent state, waiting for the next event to be fired by some component and handled by some event handler that is registered on that component.

### Register an anonymous ActionListener on the other text field

That brings us back to the **createLocationPanel** method, *(see Listing 11)* which continues in Listing 18.

**Listing 18. Register an anonymous ActionListener on the other text field.**

```
   yValue = new JTextField(
                 Integer.toString(yIndex + 
numberBase),6);
   yValue.addActionListener(new 
ActionListener() {
     public void actionPerformed(ActionEvent 
e) {
      displayPixelInformation(

xValue.getText(),yValue.getText());
     }
   });
```

Listing 18 instantiates and registers an anonymous **ActionListener** object on the right-most **JTextField** object shown in Figure 2.

### Behavior almost same as before

The behavior of this listener object is essentially the same as the behavior of the listener object registered on the leftmost **JTextField** object, except that in this case, we are talking about entering a y coordinate value into the text field instead of an x coordinate value.

Note that the single statement in the **actionPerformed** method in Listing 18 is identical to the corresponding statement in the **actionPerformed** method in Listing 11. Therefore, it doesn't matter which **JTextField** object fires an action event, the behavior is the same from the point where the **displayPixelInformation** method is called.

### The setUpNextAndPreviousButtons method

Recall that we are still discussing the **createLocationPanel** method. Listing 19 makes a call to a method named **setUpNextAndPreviousButtons** to prepare the four buttons located on either side of the two text fields in Figure 2 for use.

**Listing 19. Call the setUpNextAndPreviousButtons method.**

```
   setUpNextAndPreviousButtons();
```

The **setUpNextAndPreviousButtons** method is a huge and complex method, so it's time to change colors again, put the **createLocationPanel** method back on hold, and begin explaining the method named **setUpNextAndPreviousButtons**.

### Beginning of the setUpNextAndPreviousButtons method

The **setUpNextAndPreviousButtons** method begins in Listing 20.

**Listing 20. Beginning of the setUpNextAndPreviousButtons method.**

```
 /**
  * Method to set up the next and previous buttons
for the
  * pixel location information
  */
 private void setUpNextAndPreviousButtons()
 {
   // create the image icons for the buttons
   Icon prevIcon = new ImageIcon(

SoundExplorer.class.getResource("leftArrow.gif"),
                                        "previous
index");
   Icon nextIcon = new ImageIcon(

SoundExplorer.class.getResource("rightArrow.gif"),
                                            "next
index");
```

**The class named Class**
See the lesson titled *The Essence of OOP using Java: Static Members* in Resources for more information on the class

named **Class**.

## The class named Class

There is a class named **Class**, which provides methods for doing a number of interesting things.

The code in Listing 20 gets complicated very quickly with the call to the **getResources** method of the class named **Class**.

## We need two ImageIcon objects

**Viewer Warning**
The next several paragraphs will discuss and attempt to explain some complex technical issues.

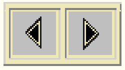
All four of the buttons in the locationPanel in Figure 2 have triangular images on them that serve as arrows. To cause an image to be displayed on a **JButton** object, you need for the image to be encapsulated in an object of a class that implements the **Icon** interface. One such class is the **ImageIcon** class.

What we are going to do here is to get references to two **ImageIcon** objects to place on the **JButton** objects that you see on either side of the **JTextField** objects in Figure 2. The **ImageIcon** objects should encapsulate images of arrows that point to the left and to the right.

## Image files containing the required images

A pair of image files named **leftArrow.gif** and **rightArrow.gif**, containing the required images, are included in Ericson's multimedia class library. Screen shots of the two images are shown in Figure 5.

**Figure 5. Image files in Ericson's class library.**



Our challenge is to find a *(hopefully)* reliable way to instantiate **ImageIcon** objects containing those two images.

## The ImageIcon class

The **ImageIcon** class contains nine overloaded constructors as of Java version 1.6.

One of those constructors requires the name of an image file as a parameter. It extracts the image from the file and encapsulates it in the **ImageIcon** object. At first blush, this seems like a reasonable approach. However, the problem with this approach for the current objective is that the program must know the location of the image file on the disk.

## The image files may be anywhere

In our case, the two image files are located in Ericson's class library and the location of the class library on any particular computer is not known at the time the program is being written. All the programmer knows is that the class library must be somewhere on the classpath in order for other things to work properly.

## Solution: to find image files on the classpath

What we need then, is a programming solution that can find the two image files on the classpath and then use them to create the required **ImageIcon** objects. The code in Listing 20 provides such a solution.

## A different ImageIcon constructor

The **ImageIcon** constructor that is called twice in Listing 20 requires two incoming parameters:

- **URL location** - the location of an image file *(in the form of a reference to an object of type **URL**)* that specifies the location of the image file that will be used to instantiate the **ImageIcon** object.
- **String description** - a brief textual description of the image.

## Our objective is clear

Our objective is to specify the locations *(in the form of references to URL objects)* for each of the two files listed above and to pass the two URL references to the constructor for the **ImageIcon** class, once for each **ImageIcon** object being constructed.

## The class named Class to the rescue

Fortunately, the class named **Class** provides a static method named **getResources** that we can use for that purpose. The **getResources** method will search for a resource file with a specified name and return the location of that file as type **URL**.

## The search procedure

Exactly how the **getResources** method goes about conducting the search is a complex issue. For the purposes of this lesson, suffice it to say that by default, directories on the classpath are included in the search and they are searched in the order that they appear in the classpath.

**Forcing a failure**
The classpath on my computer causes the current directory to be searched first. Therefore, I can force a failure by placing a dummy file named

leftArrow.gif in the current directory for the program that calls the **explore** method of the **Picture** class.

### A word of caution

The URL for the first file that is found with the matching name will be returned by the **getResources** method, even if it is not the correct file. Therefore, you must be careful not to have two or more resource files with the same name on the classpath, or at least the order of directories in the classpath must be such that the correct resource file will be found first.

### For whatever its worth - the URL toString method output

In case you are interested, the overridden **toString** method of the URL class returns the following string when I use the **getResources** method to get the URL of the file named leftArrow.gif.

```
file:/M:/Ericson/bookClasses/leftArrow.gif
```

However, I have always thought of the URL as looking more like the following:

```
file:///M:/Ericson/bookClasses/leftArrow.gif
```

### Why reference the SoundExplorer.class

Although I have explained the general concepts behind the code in Listing 20, I still haven't explained the strange syntax used in the code in Listing 20. An interesting question is, "Why did Ericson make a reference to the class named **SoundExplorer** in the **PictureExplorer** class, which has nothing to do with sound?"

### A speculative answer

My guess is that the **SoundExplorer** class was probably developed first and the **PictureExplorer** class was developed using the source code from the **SoundExplorer** class as a starting point. The reference to the **SoundExplorer** class may simply have been left over in that process.

### Any Class object will do the job

The code works equally well if the reference to the **SoundExplorer** class in Listing 20 is replaced by a reference to the **PictureExplorer** class. It also works if the reference is replaced by a reference to the **Picture** class, and there are many other possibilities as well.

**Get a reference to a Class object**
To learn more about this topic, see the lesson titled *The*

The reality is that the **getResources** method can be called on a reference to any object of the **Class** class. There are several approaches to creating such a reference, and each approach works best in some particular circumstance.

*Essence of OOP using Java, Array Objects, Part 3* in Resources.

## Append .class to the end of a file name

One way to create such a reference is to call out the name of an accessible class and append ".class" onto the end of the name. This is the approach used in Listing 20, which references **SoundExplorer.class**.

This approach requires that the name of the accessible class is known when the program is written.

## Use the getClass method

Another approach is to call the **getClass** method on any existing object. For example, a reference to **this.getClass()** could be used in Listing 20 in place of the reference to the **SoundExplorer** class.

This approach requires that the name of the reference to an existing object be known when the program is written.

## Use the forName method

A third approach is to use a static method of the **Class** class named **forName**. I will leave it as an exercise for the student to follow up on this approach. However, I will mention that this approach uses the name of a class specified as type **String**. This makes it possible to identify the target class at runtime using input data of type **String**.

## Advantages of the overall approach

This overall approach, which is based on calling the **getResources** method of the **Class** class, is very useful for cases where a specific resource, *(such as a specific image file)* or a resource within a specific group of resources *(such as a group of sound files)* will always be required by the class.

Using this approach, the resource file or files can be packaged along with the compiled class file and will always be available to the program, unless, of course, duplicate file names on the classpath cause the problems described earlier.

## Use long, complex, and hopefully unique resource file names

The problems that result from having duplicate file names on the classpath might cause the programmer to consider using long, complex, and *(hopefully)* unique file names for the required resource files that are packaged with the class files. *(The filename "leftArrow.gif" is not a long, complex, and unique file name.)*

## Summary of the code in listing 20

In summary, each of the statements in Listing 20:

- Creates a reference to an object of type **Class**.
- Calls the **getResource** method on the **Class** object's reference to get a reference to a **URL** object that specifies the location of the specified file in Ericson's class library.
- Passes the **URL** object's reference, along with a **String** description, to the constructor for the **ImageIcon** class in order to instantiate an **ImageIcon** object that encapsulates the image extracted from the specified image file.

And that is probably more than you ever wanted to know about instantiating **ImageIcon** objects and the **Class** class.

## Create the arrow buttons with tooltips

Listing 21 instantiates four new **JButton** objects, passing the reference to the appropriate **ImageIcon** object to the constructor in each case. This creates the four buttons with the arrows that appear on both sides of each of the text fields in Figure 2.

**Listing 21. Create the arrow buttons with tooltips.**

```
   // create the arrow buttons
   xPrevButton = new JButton(prevIcon);
   xNextButton = new JButton(nextIcon);
   yPrevButton = new JButton(prevIcon);
   yNextButton = new JButton(nextIcon);

   // set the tool tip text
   xNextButton.setToolTipText(
                       "Click to go to the
next x value");
   xPrevButton.setToolTipText(
                   "Click to go to the
previous x value");
   yNextButton.setToolTipText(
                       "Click to go to the
next y value");
   yPrevButton.setToolTipText(
                   "Click to go to the
previous y value");
```

Then Listing 21 calls the **setToolTipText** four times in succession to set tool tips on each of the buttons. If you run the program and allow the mouse pointer to hover over the buttons, the text shown in Listing 21 will be displayed in the tool tip format.

## Match the button size to the icon size

Listing 22 gets the width and height of the images in the **ImageIcon** objects *(see Figure 5)* and uses that information to set the preferred size of each of the buttons to the size of the icons.

**Listing 22. Match the button size to the icon size.**

```
   // set the sizes of the buttons
   int prevWidth = prevIcon.getIconWidth() + 
2;
   int nextWidth = nextIcon.getIconWidth() + 
2;
   int prevHeight = prevIcon.getIconHeight() + 
2;
   int nextHeight = nextIcon.getIconHeight() + 
2;

   Dimension prevDimension =
                      new 
Dimension(prevWidth,prevHeight);
   Dimension nextDimension =
                     new Dimension(nextWidth, 
nextHeight);

xPrevButton.setPreferredSize(prevDimension);

yPrevButton.setPreferredSize(prevDimension);

xNextButton.setPreferredSize(nextDimension);

yNextButton.setPreferredSize(nextDimension);
```

When the **pack** method is called at the end of Listing 6, an attempt will be made to accommodate the preferred size of each button when computing the required size for the **JFrame** object to contain all of its components.

## Register ActionListener objects on all four buttons

Listing 23 instantiates four **ActionListener** objects from anonymous classes and registers them on the four buttons.

**Listing 23. Register ActionListener objects on all four buttons.**

```
   // handle previous x button press
   xPrevButton.addActionListener(new 
ActionListener() {
     public void actionPerformed(ActionEvent 
evt) {
       xIndex--;
       if (xIndex < 0)
```

```
         xIndex = 0;
       displayPixelInformation(xIndex,yIndex);
     }
   });

   // handle previous y button press
   yPrevButton.addActionListener(new
ActionListener() {
     public void actionPerformed(ActionEvent
evt) {
       yIndex--;
       if (yIndex < 0)
         yIndex = 0;
       displayPixelInformation(xIndex,yIndex);
     }
   });

   // handle next x button press
   xNextButton.addActionListener(new
ActionListener() {
     public void actionPerformed(ActionEvent
evt) {
       xIndex++;
       if (xIndex >= picture.getWidth())
         xIndex = picture.getWidth() - 1;
       displayPixelInformation(xIndex,yIndex);
     }
   });

   // handle next y button press
   yNextButton.addActionListener(new
ActionListener() {
     public void actionPerformed(ActionEvent
evt) {
       yIndex++;
       if (yIndex >= picture.getHeight())
         yIndex = picture.getHeight() - 1;
       displayPixelInformation(xIndex,yIndex);
     }
   });
 }//end setUpNextAndPreviousButtons method
```

### You should have no difficulty with Listing 23

Given what you have learned about the instantiation of **ActionListener** objects from anonymous classes and the registration of the action listeners on the text fields earlier in this lesson, you should have no difficulty with the code in Listing 23.

The overall structure is the same in this case and the last.  Of course, the behavior of the **actionPerformed** event handler methods that get called when the buttons fire action events is different from the behavior of the same methods when the text fields fire action events.

## Behavior of the actionPerformed methods

The purpose of each of the buttons in Figure 2 is to either increment or decrement the x or the y coordinate value each time the button fires an action event.

Each of the **actionPerformed** methods in Listing 23 increments or decrements a coordinate value, being careful to make certain that the modified coordinate value that results is still within the bounds of the image.

Then the **actionPerformed** method calls the same method named **displayPixelInformation** that I explained in conjunction with Listing 13.

## Firing an action event

A **JButton** object will fire an action event:

- When it is clicked by the mouse.
- When the user presses the Enter key while the button has the focus.

As you will learn in a future lesson, however, the focus traversal policy that is defined for the **PictureExplorer** class doesn't allow the buttons to gain the focus when the user presses the tab key. Repeated pressing of the tab key simply causes the focus to ping-pong back and forth between the two text fields. Therefore, in this program, the buttons are allowed to fire action events only when they are clicked by the mouse.

## End of the setUpNextAndPreviousButtons method

Listing 23 also signals the end of the method named **setUpNextAndPreviousButtons**.

When all of the code in Listing 23 has been executed, the buttons are set up and ready for action. Note, however, that they still haven't been placed in their container.

When the method terminates, control returns to the statement immediately following the statement in Listing 19, which is contained in the method named **createLocationPanel**. Therefore, it is time to change background colors again and resume the explanation of that method.

## Set the font for the labels on locationPanel

The code in Listing 7 instantiates a new **Font** object having the default name, the default style, and a size of 14 points. The reference to that **Font** object is saved in an instance variable named **largerFont**.

The code in Listing 8 calls the **createLocationPanel** method to create the location panel as an object of type **JPanel**. The call passes **largerFont** as a parameter. Listing

9 shows that the **createLocationPanel** method refers locally to the **Font** object as **labelFont**.

Listing 24 uses that reference to call the **setFont** method on both **JLabel** objects and both **JTextField** objects. This sets the **font** property for all four objects to the 14-point font created in Listing 7.

**Listing 24. Set the font for the labels on the locationPanel.**

```
   // set up the font for the labels
   xLabel.setFont(labelFont);
   yLabel.setFont(labelFont);
   xValue.setFont(labelFont);
   yValue.setFont(labelFont);
```

## Create the physical layout of the locationPanel

At this point, all of the components required for the **locationPanel** have been constructed and conditioned to do their jobs. However, they are still floating around in cyberspace and haven't been placed in the panel. The code in Listing 25 places each of the components in the **locationPanel** and arranges their physical layout at the same time.

**Listing 25. Create the physical layout of the locationPanel.**

```
   //Prepare the box
   hBox.add(Box.createHorizontalGlue());

   //Add the components to the box
   hBox.add(xLabel);// X:
   hBox.add(xPrevButton);// a button with left
arrow
   hBox.add(xValue);// leftmost text field
   hBox.add(xNextButton);// a button with
right arrow
   hBox.add(Box.createHorizontalStrut(10));//
a spacer
   hBox.add(yLabel);// Y:
   hBox.add(yPrevButton);// a button with left
arrow
   hBox.add(yValue);// rightmost text field
   hBox.add(yNextButton);// button with right
arrow

   //Add the box to the panel
   locationPanel.add(hBox);
   hBox.add(Box.createHorizontalGlue());

   return locationPanel;
 }//end createLocationPanel method
```

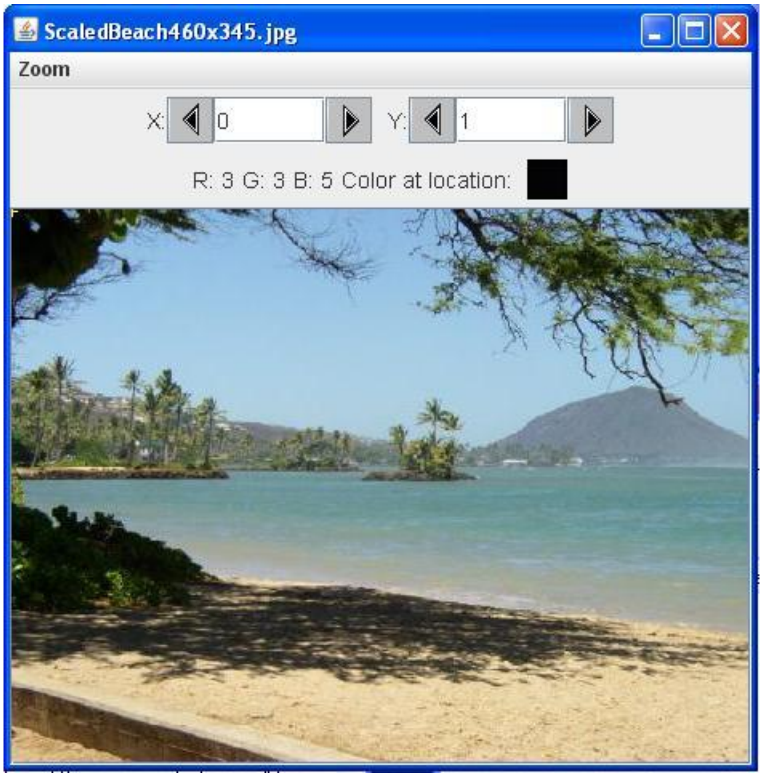
Rather than explaining each statement in Listing 25, I am going to provide a verbal description of what Listing 25 accomplishes. *(At this point, I recommend that you take a look at what I have previously written about the use of BoxLayout.)*

## Visual aids needed

In order to provide this explanation, I will need some visual aids.

Figure 6 provides another view of the GUI at the normal size of the picture and without the Zoom menu having been opened.

**Figure 6. Another view of the GUI.**



X: 0 Y: 1

R: 3 G: 3 B: 5 Color at location:

## Eight components on the locationPanel

Going from left to right, you should be able to identify the following eight components in the **locationPanel** near the top of Figure 6.

1. JLabel: "X:"
2. JButton with arrow pointing left
3. JTextField
4. JButton with arrow pointing right
5. JLabel: "Y:"
6. JButton with arrow pointing left

7. JTextField
8. JButton with arrow pointing right

## A JPanel object with center-aligned FlowLayout

The **locationPanel** is actually a **JPanel** object with a **FlowLayout** manager, center aligned. Instead of placing the components directly in the **JPanel**, *(which would have some serious drawbacks)*, Listing 25 places all eight components in a horizontal **Box** object with a very careful arrangement and then places the box in the **JPanel** object

In addition to the eight components, Listing 25 also places two blobs of **glue** in the box along with one **strut**.

## The box is centered in the panel

The box is centered in the **JPanel**, and can be though of as taking up all of the available horizontal space. In some cases, as in Figure 3, the box is too wide to fit in the available space.

## What is the purpose of the strut?

Think of the strut as an invisible, incompressible, non-stretchable horizontal rod ten pixels in length. It is placed in the center of the box with four of the eight components on its left side and the other four on its right side. The **JLabel** on the right end of the strut and the **JButton** on the left end of the strut are effectively attached to the two ends of the strut.

No matter how hard the user may try, *(by resizing the **JFrame**)*, she cannot cause the **JLabel** on the right end of the strut and the **JButton** on the left end of the strut to move any closer together than ten pixels.

Similarly, she cannot cause those two components to move any further apart than the length of the strut *(ten pixels)*.

If you examine Figure 2, Figure 3, and Figure 6, you will see that the space between the two components at the ends of the strut are always separated by the same distance regardless of the size of the **JFrame**.

## What about the glue?

I like to think of the glue as being more like a coil spring, or a piece of elastic than a blob of sticky stuff. Think of the left end of such a piece of elastic being attached to the right side of the rightmost **JButton** object and think of the other end of that piece of elastic being attached to the rightmost end of the box.

Now think of the left end of another piece of elastic as being attached to the leftmost end of the box, and think of the other end of the elastic being attached to the leftmost side of the leftmost **JLabel** object.

### The order of display

Listing 25 adds the eight components to the box in the order listed earlier.  They are subsequently displayed from left to right in the order that they are added.

### Objects touch one another unless...

When objects are added to a horizontal box, they will touch one another unless they are separated by a strut.  Furthermore, their relative positions are fixed unless some glue is added in between the components.

### Where is the glue?

In this case, no glue was added in between the components but the ten-pixel strut was added between the four components on the left and the four components on the right.  Because of the strut, the two groups may not move closer together than ten pixels and may not move further apart than ten pixels.  Due to the lack of glue between the components, the four components on the left must remain touching and the four components on the right must also remain touching.

However, glue was added before the components were added and again after the components were added.  Therefore a blob of glue *(a piece of elastic material)* exists between the rightmost and leftmost components and the corresponding end of the box.

### And the bottom line is...

If the width of the box is increased, the group of eight components will remain centered as shown in Figure 2 and Figure 6.

On the other hand, glue does nothing to prevent components from moving closer together or from moving closer to the ends of the box.  Therefore, as the box is made narrower, the space between the ends of the box and the components on the ends of each group eventually goes to zero.  Any further narrowing of the GUI will simply cause the components on the left and right ends of the groups to disappear from view.  This is demonstrated in Figure 3 where the rightmost button has disappeared and the leftmost label and part of the leftmost button has disappeared.

Also, as mentioned earlier, the use of the **BoxLayout** doesn't allow the components to wrap down to the next line as is the case with simple **FlowLayout**.

### The end of the createLocationPanel method

Listing 25 signals the end of the **createLocationPanel** method. When this method terminates, control is returned to the statement immediately following the statement in Listing 8, which is contained in the method named **createInfoPanel**.

## Create the colorInfoPanel

The next statement in the **createInfoPanel** method is a call to the **createColorInfoPanel** method for the purpose of creating the **colorInfoPanel**. This statement is shown in Listing 26.

**Listing 26. Create the colorInfoPanel.**

```
   // create the color information panel
   JPanel colorInfoPanel =

createColorInfoPanel(largerFont);
```

Recall that the **colorInfoPanel** appears below the text fields in Figure 6 and displays the color values for red, green, and blue along with the actual color in a square **JPanel** object.

### The createColorInfoPanel method

The **createColorInfoPanel** method begins in Listing 27.

**Listing 27. Beginning of the createColorInfoPanel method.**

```
 /**
  * Create the color information panel
  * @param labelFont the font to use for
labels
  * @return the color information panel
  */
 private JPanel createColorInfoPanel(Font
labelFont){
   // create a color info panel
   JPanel colorInfoPanel = new JPanel();
   colorInfoPanel.setLayout(new FlowLayout());

   // get the pixel at the x and y
   Pixel pixel = new
Pixel(picture,xIndex,yIndex);

   // create the labels
   rValue = new JLabel("R: " +
pixel.getRed());
   gValue = new JLabel("G: " +
pixel.getGreen());
   bValue = new JLabel("B: " +
pixel.getBlue());
```

## A walk in the park

Compared to what you have just been through with the **locationPanel**, understanding the code in the **createColorInfoPanelI** method will be like a *"walk in the park."* For example, all of the components in the panel are passive in the sense that they don't fire any events.

There is no **BoxLayout**. The layout manager is **FlowLayout** with default center alignment.

## A new JPanel object

Listing 27 begins by instantiating a new **JPanel** object and setting its layout manager to **FlowLayout**.

Then Listing 27 gets a reference to a new **Pixel** object at the location specified by the current x and y coordinate values.

The red, green, and blue values are extracted from the **Pixel** object and used to construct three **String** objects that are displayed *(later)* immediately below the leftmost text field in Figure 6.

## Construct the color display panel and its label

The code in Listing 28 constructs the small square **JPanel** object that appears below the rightmost text field in Figure 6 along with the label immediately to the left of the colored square.

**Listing 28. Construct the color display panel and its label.**

```
   // create the sample color panel and label
   colorLabel = new JLabel("Color at location:
");
   colorPanel = new JPanel();
   colorPanel.setBorder(new
LineBorder(Color.black,1));

   // set the color sample to the pixel color
   colorPanel.setBackground(pixel.getColor());
```

If you have done any Swing programming at all, you shouldn't have any problem with the code in Listing 28. Note that at this point, the dimensions of the small square panel have not yet been established. The dimensions will be established near the middle of Listing 29.

## Set fonts

Listing 29 uses a reference to a **Font** object that was received as an incoming parameter to set the font for all of the text that is displayed on the **colorInfoPanel**.

**Listing 29. Set fonts, add components to colorInfoPanel, and return.**

```
   // set the font
   rValue.setFont(labelFont);
   gValue.setFont(labelFont);
   bValue.setFont(labelFont);
   colorLabel.setFont(labelFont);

   colorPanel.setPreferredSize(new
Dimension(25,25));

   // add items to the color information panel
   colorInfoPanel.add(rValue);
   colorInfoPanel.add(gValue);
   colorInfoPanel.add(bValue);
   colorInfoPanel.add(colorLabel);
   colorInfoPanel.add(colorPanel);

   return colorInfoPanel;
 }//end createColorInfoPanel method
```

### Set the preferred size

Then Listing 29 sets the preferred size for the small colored square shown in Figure 6 to be 25 pixels on each side.

### Add the components to the colorInfoPanel and return it

Finally, Listing 29 adds the five components to the **JPanel** object.  Because the layout manager is **FlowLayout** with center alignment, the components appear centered in the panel from left to right in the order that they are added to the panel.

Although it is possible to insert a gap of a specified width between the components, that wasn't done in this class.  **JLabel** objects will, by default insert a reasonable amount of space on each end of the label to serve as margins.  An extra space character was inserted in the JLabel object in Listing 28 to separate the label from the colored square immediately to its right.

### The end of the createColorInfoPanel method

Listing 28 signals the end of the **createColorInfoPanel** method.  When the object's reference is returned and the method terminates, control is returned to the next statement in the **createInfoPanel** method immediately following the statement shown in Listing 26.  That next statement is the first statement in Listing 30.

### Complete the createInfoPanel method

The code in Listing 30 completes the method named **createInfoPanel**. *(Recall that this is the method that creates and populates the **JPanel** object shown in the NORTH position in Figure 6.)*

**Listing 30. Complete the createInfoPanel method.**

```
   // add the panels to the info panel

infoPanel.add(BorderLayout.NORTH,locationPanel);

infoPanel.add(BorderLayout.SOUTH,colorInfoPanel);

   // add the info panel
    pictureFrame.getContentPane().add(

BorderLayout.NORTH,infoPanel);
 }//end createInfoPanel method
```

Listing 30 begins by adding the two sub-panels *(**locationPanel** and **colorInfoPanel**)* to the **JPanel** object *(**infoPanel**)*.

Then Listing 30 adds the **infoPanel** to the NORTH position of the **JFrame** object's content pane. This causes the **infoPanel** to be visible in the frame when the **JFrame** object is visible on the screen.

### The end of the lesson

When the **createInfoPanel** method terminates, control is returned to the **createWindow** method shown in Listing 6. This causes the method named **createAndInitScrollingImage** to be called in order to continue the construction of the GUI shown in Figure 6. The **createAndInitScrollingImage** method is the topic for the next lesson.

## Run the program

You still have a long way to go before you can fully understand the **PictureExplorer** class. Once again, however, you have been working hard if you have made it to this point. It's time for you to take a break and mull over what you have learned in this lesson and maybe do some experimenting as well.

I encourage you to make a copy of the source code file for the **PictureExplorer** class. Put it in your current directory along with your program files and then open the file in your IDE. *(Make certain that the current directory appears in the classpath to the left of Ericson's media library.)*

Experiment with the **PictureExplorer** code, making changes, and observing the results of your changes. Make certain that you can explain why your changes behave as they do.

Also experiment with the picture explorer onscreen GUI. Try some different image files and see if the color values reported by the GUI make sense to you.

## Summary

In the previous lesson, you learned about the overall construction of the **PictureExplorer** GUI shown in Figure 2. You also learned how to construct the Zoom menu and how to register event listener objects on the items in the menu.

In this lesson, you learned how to construct the **infoPanel** in the NORTH location of the GUI in Figure 2. You also learned how to register event listener objects on the components in that panel making use of objects of anonymous classes.

Along the way, you also learned about some other interesting topics including:

- The use of **BoxLayout**
- The class file naming scheme.
- The use of **getResources** to get the URL of a file
- The use of a class loader to load a resource file

## What's next?

The next lesson will show you how to do flood fill using Java.

## Resources

- Creative Commons Attribution 3.0 United States License
- Media Computation book in Java - numerous downloads available
- Introduction to Computing and Programming with Java: A Multimedia Approach
- DrJava download site
- DrJava, the JavaPLT group at Rice University
- DrJava Open Source License
- The Essence of OOP using Java, The this and super Keywords
- Threads of Control
- Painting in AWT and Swing
- Wikipedia Turtle Graphics
- IsA or HasA
- Vector Cad-Cam XI Lathe Tutorial
- Classification of 3D to 2D projections
- Color model from Wikipedia
- Light and color: an introduction by Norman Koren

- Color Principles - Hue, Saturation, and Value
- 200 Implementing the Model-View-Controller Paradigm using Observer and Observable
- 300 Java 2D Graphics, Nested Top-Level Classes and Interfaces
- 302 Java 2D Graphics, The Point2D Class
- 304 Java 2D Graphics, The Graphics2D Class
- 306 Java 2D Graphics, Simple Affine Transforms
- 308 Java 2D Graphics, The Shape Interface, Part 1
- 310 Java 2D Graphics, The Shape Interface, Part 2
- 312 Java 2D Graphics, Solid Color Fill
- 314 Java 2D Graphics, Gradient Color Fill
- 316 Java 2D Graphics, Texture Fill
- 318 Java 2D Graphics, The Stroke Interface
- 320 Java 2D Graphics, The Composite Interface and Transparency
- 322 Java 2D Graphics, The Composite Interface, GradientPaint, and Transparency
- 324 Java 2D Graphics, The Color Constructors and Transparency
- 400 Processing Image Pixels using Java, Getting Started

  402 Processing Image Pixels using Java, Creating a Spotlight

  404 Processing Image Pixels Using Java: Controlling Contrast and Brightness

  406 Processing Image Pixels, Color Intensity, Color Filtering, and Color Inversion

  408 Processing Image Pixels, Performing Convolution on Images

  410 Processing Image Pixels, Understanding Image Convolution in Java

  412 Processing Image Pixels, Applying Image Convolution in Java, Part 1

  414 Processing Image Pixels, Applying Image Convolution in Java, Part 2

  416 Processing Image Pixels, An Improved Image-Processing Framework in Java

  418 Processing Image Pixels, Creating Visible Watermarks in Java

  450 A Framework for Experimenting with Java 2D Image-Processing Filters

  452 Using the Java 2D LookupOp Filter Class to Process Images

  454 Using the Java 2D AffineTransformOp Filter Class to Process Images

  456 Using the Java 2D LookupOp Filter Class to Scramble and Unscramble Images

  458 Using the Java 2D BandCombineOp Filter Class to Process Images

  460 Using the Java 2D ConvolveOp Filter Class to Process Images

  462 Using the Java 2D ColorConvertOp and RescaleOp Filter Classes to Process Images
- 506 JavaBeans, Introspection
- 2100 Understanding Properties in Java and C#
- 2300 Generics in J2SE, Getting Started
- 340 Multimedia Programming with Java, Getting Started
- 342 Getting Started with the Turtle Class: Multimedia Programming with Java
- 344 Continuing with the SimpleTurtle Class: Multimedia Programming with Java
- 346 Wrapping Up the SimpleTurtle Class: Multimedia Programming with Java
- 348 The Pen and PathSegment Classes: Multimedia Programming with Java
- 349 A Pixel Editor Program in Java: Multimedia Programming with Java

- 350 3D Displays, Color Distance, and Edge Detection
- 351 A Slider-Controlled Softening Program for Digital Photos
- 352 Adding Animated Movement to Your Java Application
- 353 A Slider-Controlled Sharpening Program for Digital Photos
- 354 The DigitalPicture Interface
- 355 The HSB Color Model
- 356 The show Method and the PictureFrame Class
- 357 An HSB Color-Editing Program for Digital Photos
- 358 Applying Affine Transforms to Picture Objects
- 359 Creating a lasso for editing digital photos in Java
- 360 Wrapping Up the SimplePicture Class
- 361 A Temperature and Tint Editing Program for Digital Photos
- 362 Getting Started with the PictureExplorer Class
- 363 Redeye Correction in Digital Photographs

## Complete program listings

Complete listings of the programs discussed in this lesson are shown in Listing 31 and Listing 32 below.

**Listing 31. Source code for Ericson's PictureExplorer class.**

```
import java.awt.*;
import java.awt.event.*;
import javax.swing.*;
import java.awt.image.*;
import javax.swing.border.*;
/**
 * Displays a picture and lets you explore the
picture by
 * displaying the x, y, red, green, and blue values
of the
 * pixel at the cursor when you click a mouse
button or
 * press and hold a mouse button while moving the
cursor.
 * It also lets you zoom in or out.  You can also
type in
 * a x and y value to see the color at that
location.
 *
 * Originally created for the Jython Environment
for
 * Students (JES).
 * Modified to work with DrJava by Barbara Ericson
 *
 * Copyright Georgia Institute of Technology 2004
 * @author Keith McDermottt, gte047w@cc.gatech.edu
 * @author Barb Ericson ericson@cc.gatech.edu
 */
public class PictureExplorer implements
```

```
       MouseMotionListener, ActionListener,
MouseListener{

 // current x and y index
 private int xIndex = 0;
 private int yIndex = 0;

 //Main gui variables
 private JFrame pictureFrame;
 private JScrollPane scrollPane;

 //information bar variables
 private JLabel xLabel;
 private JButton xPrevButton;
 private JButton yPrevButton;
 private JButton xNextButton;
 private JButton yNextButton;
 private JLabel yLabel;
 private JTextField xValue;
 private JTextField yValue;
 private JLabel rValue;
 private JLabel gValue;
 private JLabel bValue;
 private JLabel colorLabel;
 private JPanel colorPanel;

 // menu components
 private JMenuBar menuBar;
 private JMenu zoomMenu;
 private JMenuItem twentyFive;
 private JMenuItem fifty;
 private JMenuItem seventyFive;
 private JMenuItem hundred;
 private JMenuItem hundredFifty;
 private JMenuItem twoHundred;
 private JMenuItem fiveHundred;

 /** The picture being explored */
 private DigitalPicture picture;

 /** The image icon used to display the picture */
 private ImageIcon scrollImageIcon;

 /** The image display */
 private ImageDisplay imageDisplay;

 /** the zoom factor (amount to zoom) */
 private double zoomFactor;

 /** the number system to use, 0 means starting at
0,
  *  1 means starting at 1 */
 private int numberBase=0;

 /**
  * Public constructor
  * @param picture the picture to explore
  */
 public PictureExplorer(DigitalPicture picture)
 {
   // set the fields
   this.picture=picture;
   zoomFactor=1;

   // create the window and set things up
   createWindow();
 }

 /**
  * Changes the number system to start at one
  */
 public void changeToBaseOne()
 {
   numberBase=1;
 }

 /**
  * Set the title of the frame
  *@param title the title to use in the JFrame
  */
 public void setTitle(String title)
 {
   pictureFrame.setTitle(title);
 }

 /**
  * Method to create and initialize the picture
frame
  */
 private void createAndInitPictureFrame()
 {
   pictureFrame = new JFrame(); // create the
JFrame
   //allow the user to resize it
   pictureFrame.setResizable(true);
    // use border layout
   pictureFrame.getContentPane().setLayout(
                                      new
BorderLayout());
    // when close stop
   pictureFrame.setDefaultCloseOperation(

JFrame.DISPOSE_ON_CLOSE);
   pictureFrame.setTitle(picture.getTitle());
   PictureExplorerFocusTraversalPolicy newPolicy =
                new
PictureExplorerFocusTraversalPolicy();
   pictureFrame.setFocusTraversalPolicy(newPolicy);

 }

 /**
```

```
  * Method to create the menu bar, menus, and menu
items
  */
 private void setUpMenuBar()
 {
   //create menu
   menuBar = new JMenuBar();
   zoomMenu = new JMenu("Zoom");
   twentyFive = new JMenuItem("25%");
   fifty = new JMenuItem("50%");
   seventyFive = new JMenuItem("75%");
   hundred = new JMenuItem("100%");
   hundred.setEnabled(false);
   hundredFifty = new JMenuItem("150%");
   twoHundred = new JMenuItem("200%");
   fiveHundred = new JMenuItem("500%");

   // add the action listeners
   twentyFive.addActionListener(this);
   fifty.addActionListener(this);
   seventyFive.addActionListener(this);
   hundred.addActionListener(this);
   hundredFifty.addActionListener(this);
   twoHundred.addActionListener(this);
   fiveHundred.addActionListener(this);

   // add the menu items to the menus
   zoomMenu.add(twentyFive);
   zoomMenu.add(fifty);
   zoomMenu.add(seventyFive);
   zoomMenu.add(hundred);
   zoomMenu.add(hundredFifty);
   zoomMenu.add(twoHundred);
   zoomMenu.add(fiveHundred);
   menuBar.add(zoomMenu);

   // set the menu bar to this menu
   pictureFrame.setJMenuBar(menuBar);
 }

 /**
  * Create and initialize the scrolling image
  */
 private void createAndInitScrollingImage()
 {
   scrollPane = new JScrollPane();

   BufferedImage bimg = picture.getBufferedImage();
   imageDisplay = new ImageDisplay(bimg);
   imageDisplay.addMouseMotionListener(this);
   imageDisplay.addMouseListener(this);
   imageDisplay.setToolTipText("Click a mouse
button on "
                + "a pixel to see the pixel
information");
   scrollPane.setViewportView(imageDisplay);
   pictureFrame.getContentPane().add(
                         scrollPane,
BorderLayout.CENTER);
 }

 /**
  * Creates the JFrame and sets everything up
  */
 private void createWindow()
 {
   // create the picture frame and initialize it
   createAndInitPictureFrame();

   // set up the menu bar
   setUpMenuBar();

   //create the information panel
   createInfoPanel();

   //creates the scrollpane for the picture
   createAndInitScrollingImage();

   // show the picture in the frame at the size it
needs
   // to be
   pictureFrame.pack();
   pictureFrame.setVisible(true);
 }

 /**
  * Method to set up the next and previous buttons
for the
  * pixel location information
  */
 private void setUpNextAndPreviousButtons()
 {
   // create the image icons for the buttons
   Icon prevIcon = new ImageIcon(

SoundExplorer.class.getResource("leftArrow.gif"),
                                        "previous
index");
   Icon nextIcon = new ImageIcon(

SoundExplorer.class.getResource("rightArrow.gif"),
                                            "next
index");
   // create the arrow buttons
   xPrevButton = new JButton(prevIcon);
   xNextButton = new JButton(nextIcon);
   yPrevButton = new JButton(prevIcon);
   yNextButton = new JButton(nextIcon);

   // set the tool tip text
   xNextButton.setToolTipText(
                       "Click to go to the next x
```

```
value");
   xPrevButton.setToolTipText(
                   "Click to go to the previous x
value");
   yNextButton.setToolTipText(
                       "Click to go to the next y
value");
   yPrevButton.setToolTipText(
                   "Click to go to the previous y
value");

   // set the sizes of the buttons
   int prevWidth = prevIcon.getIconWidth() + 2;
   int nextWidth = nextIcon.getIconWidth() + 2;
   int prevHeight = prevIcon.getIconHeight() + 2;
   int nextHeight = nextIcon.getIconHeight() + 2;
   Dimension prevDimension =
                      new
Dimension(prevWidth,prevHeight);
   Dimension nextDimension =
                     new Dimension(nextWidth,
nextHeight);
   xPrevButton.setPreferredSize(prevDimension);
   yPrevButton.setPreferredSize(prevDimension);
   xNextButton.setPreferredSize(nextDimension);
   yNextButton.setPreferredSize(nextDimension);

   // handle previous x button press
   xPrevButton.addActionListener(new
ActionListener() {
     public void actionPerformed(ActionEvent evt) {
       xIndex--;
       if (xIndex < 0)
         xIndex = 0;
       displayPixelInformation(xIndex,yIndex);
     }
   });

   // handle previous y button press
   yPrevButton.addActionListener(new
ActionListener() {
     public void actionPerformed(ActionEvent evt) {
       yIndex--;
       if (yIndex < 0)
         yIndex = 0;
       displayPixelInformation(xIndex,yIndex);
     }
   });

   // handle next x button press
   xNextButton.addActionListener(new
ActionListener() {
     public void actionPerformed(ActionEvent evt) {
       xIndex++;
       if (xIndex >= picture.getWidth())
         xIndex = picture.getWidth() - 1;
       displayPixelInformation(xIndex,yIndex);
     }
   });

   // handle next y button press
   yNextButton.addActionListener(new
ActionListener() {
     public void actionPerformed(ActionEvent evt) {
       yIndex++;
       if (yIndex >= picture.getHeight())
         yIndex = picture.getHeight() - 1;
       displayPixelInformation(xIndex,yIndex);
     }
   });
 }

 /**
  * Create the pixel location panel
  * @param labelFont the font for the labels
  * @return the location panel
  */
 public JPanel createLocationPanel(Font labelFont)
{

   // create a location panel
   JPanel locationPanel = new JPanel();
   locationPanel.setLayout(new FlowLayout());
   Box hBox = Box.createHorizontalBox();

   // create the labels
   xLabel = new JLabel("X:");
   yLabel = new JLabel("Y:");

   // create the text fields
   xValue = new JTextField(
                 Integer.toString(xIndex +
numberBase),6);
   xValue.addActionListener(new ActionListener() {
     public void actionPerformed(ActionEvent e) {
       displayPixelInformation(

xValue.getText(),yValue.getText());
     }
   });
   yValue = new JTextField(
                 Integer.toString(yIndex +
numberBase),6);
   yValue.addActionListener(new ActionListener() {
     public void actionPerformed(ActionEvent e) {
      displayPixelInformation(

xValue.getText(),yValue.getText());
     }
   });

   // set up the next and previous buttons
   setUpNextAndPreviousButtons();

   // set up the font for the labels
   xLabel.setFont(labelFont);
   yLabel.setFont(labelFont);
   xValue.setFont(labelFont);
   yValue.setFont(labelFont);

   // add the items to the vertical box and the box
to
   // the panel
   hBox.add(Box.createHorizontalGlue());
   hBox.add(xLabel);
   hBox.add(xPrevButton);
   hBox.add(xValue);
   hBox.add(xNextButton);
   hBox.add(Box.createHorizontalStrut(10));
   hBox.add(yLabel);
   hBox.add(yPrevButton);
   hBox.add(yValue);
   hBox.add(yNextButton);
   locationPanel.add(hBox);
   hBox.add(Box.createHorizontalGlue());

   return locationPanel;
 }

 /**
  * Create the color information panel
  * @param labelFont the font to use for labels
  * @return the color information panel
  */
 private JPanel createColorInfoPanel(Font
labelFont)
 {
   // create a color info panel
   JPanel colorInfoPanel = new JPanel();
   colorInfoPanel.setLayout(new FlowLayout());

   // get the pixel at the x and y
   Pixel pixel = new Pixel(picture,xIndex,yIndex);

   // create the labels
   rValue = new JLabel("R: " + pixel.getRed());
   gValue = new JLabel("G: " + pixel.getGreen());
   bValue = new JLabel("B: " + pixel.getBlue());

   // create the sample color panel and label
   colorLabel = new JLabel("Color at location: ");
   colorPanel = new JPanel();
   colorPanel.setBorder(new
LineBorder(Color.black,1));

   // set the color sample to the pixel color
   colorPanel.setBackground(pixel.getColor());
   // set the font
   rValue.setFont(labelFont);
   gValue.setFont(labelFont);
   bValue.setFont(labelFont);
   colorLabel.setFont(labelFont);
   colorPanel.setPreferredSize(new
Dimension(25,25));

   // add items to the color information panel
   colorInfoPanel.add(rValue);
   colorInfoPanel.add(gValue);
   colorInfoPanel.add(bValue);
   colorInfoPanel.add(colorLabel);
   colorInfoPanel.add(colorPanel);

   return colorInfoPanel;
 }

 /**
  * Creates the North JPanel with all the pixel
location
  * and color information
  */
 private void createInfoPanel()
 {
   // create the info panel and set the layout
   JPanel infoPanel = new JPanel();
   infoPanel.setLayout(new BorderLayout());

   // create the font
   Font largerFont =
                   new
Font(infoPanel.getFont().getName(),

infoPanel.getFont().getStyle(),14);

   // create the pixel location panel
   JPanel locationPanel =
createLocationPanel(largerFont);

   // create the color informaiton panel
   JPanel colorInfoPanel =

createColorInfoPanel(largerFont);

   // add the panels to the info panel
   infoPanel.add(BorderLayout.NORTH,locationPanel);

infoPanel.add(BorderLayout.SOUTH,colorInfoPanel);

   // add the info panel
   pictureFrame.getContentPane().add(

BorderLayout.NORTH,infoPanel);
 }
 /**
  * Method to check that the current position is in
the
  * viewing area and if not scroll to center the
current
  * position if possible
  */
 public void checkScroll()
 {
   // get the x and y position in pixels
   int xPos = (int) (xIndex * zoomFactor);
   int yPos = (int) (yIndex * zoomFactor);

   // only do this if the image is larger than
normal
   if (zoomFactor > 1) {

     // get the rectangle that defines the current
view
     JViewport viewport = scrollPane.getViewport();
     Rectangle rect = viewport.getViewRect();
     int rectMinX = (int) rect.getX();
     int rectWidth = (int) rect.getWidth();
     int rectMaxX = rectMinX + rectWidth - 1;
     int rectMinY = (int) rect.getY();
     int rectHeight = (int) rect.getHeight();
     int rectMaxY = rectMinY + rectHeight - 1;

     // get the maximum possible x and y index
     int maxIndexX =
(int)(picture.getWidth()*zoomFactor)
                           - rectWidth - 1;
     int maxIndexY =
(int)(picture.getHeight()*zoomFactor)
                           - rectHeight - 1;

     // calculate how to position the current
position in
     // the middle of the viewing area
     int viewX = xPos - (int) (rectWidth / 2);
     int viewY = yPos - (int) (rectHeight / 2);

     // reposition the viewX and viewY if outside
allowed
     // values
     if (viewX < 0)
       viewX = 0;
     else if (viewX > maxIndexX)
       viewX = maxIndexX;
     if (viewY < 0)
       viewY = 0;
     else if (viewY > maxIndexY)
       viewY = maxIndexY;

     // move the viewport upper left point
     viewport.scrollRectToVisible(
         new
Rectangle(viewX,viewY,rectWidth,rectHeight));
   }
 }

 /**
  * Zooms in the on picture by scaling the image.
  * It is extremely memory intensive.
  * @param factor the amount to zoom by
  */
 public void zoom(double factor)
 {
   // save the current zoom factor
   zoomFactor = factor;

   // calculate the new width and height and get an
image
   // that size
   int width = (int)
(picture.getWidth()*zoomFactor);
   int height = (int)
(picture.getHeight()*zoomFactor);
   BufferedImage bimg = picture.getBufferedImage();

   // set the scroll image icon to the new image

imageDisplay.setImage(bimg.getScaledInstance(width,
                           height,
Image.SCALE_DEFAULT));
   imageDisplay.setCurrentX((int) (xIndex *
zoomFactor));
   imageDisplay.setCurrentY((int) (yIndex *
zoomFactor));
   imageDisplay.revalidate();
   checkScroll();  // check if need to reposition
scroll
 }

 /**
  * Repaints the image on the scrollpane.
  */
 public void repaint()
 {
   pictureFrame.repaint();
 }

 //****************************************//
 //               Event Listeners          //
 //****************************************//

 /**
  * Called when the mouse is dragged (button held
down and
  * moved)
  * @param e the mouse event
  */
 public void mouseDragged(MouseEvent e)
 {
   displayPixelInformation(e);
 }

 /**
  * Method to check if the given x and y are in the
  * picture
  * @param x the horiztonal value
  * @param y the vertical value
  * @return true if the x and y are in the picture
and
  * false otherwise
  */
 private boolean isLocationInPicture(int x, int y)
 {
   boolean result = false; // the default is false
   if (x >= 0 && x < picture.getWidth() &&
       y >= 0 && y < picture.getHeight())
     result = true;

   return result;
 }

 /**
  * Method to display the pixel information from
the
  * passed x and y but also converts x and y from
strings
  * @param xString the x value as a string from the
user
  * @param yString the y value as a string from the
user
  */
 public void displayPixelInformation(
                           String xString, String
yString)
 {
   int x = -1;
   int y = -1;
   try {
     x = Integer.parseInt(xString);
     x = x - numberBase;
     y = Integer.parseInt(yString);
     y = y - numberBase;
   } catch (Exception ex) {
   }

   if (x >= 0 && y >= 0) {
     displayPixelInformation(x,y);
   }
 }

 /**
  * Method to display pixel information for the
passed x
```

```
  * and y
  * @param pictureX the x value in the picture
  * @param pictureY the y value in the picture
  */
 private void displayPixelInformation(
                               int pictureX, int
pictureY)
 {
   // check that this x and y is in range
   if (isLocationInPicture(pictureX, pictureY))
   {
     // save the current x and y index
     xIndex = pictureX;
     yIndex = pictureY;

     // get the pixel at the x and y
     Pixel pixel = new
Pixel(picture,xIndex,yIndex);

     // set the values based on the pixel
     xValue.setText(Integer.toString(
                                   xIndex  +
numberBase));
     yValue.setText(Integer.toString(
                                    yIndex +
numberBase));
     rValue.setText("R: " + pixel.getRed());
     gValue.setText("G: " + pixel.getGreen());
     bValue.setText("B: " + pixel.getBlue());
     colorPanel.setBackground(new
Color(pixel.getRed(),

pixel.getGreen(),

pixel.getBlue()));

   }
   else
   {
     clearInformation();
   }

   // notify the image display of the current x and
y
   imageDisplay.setCurrentX((int) (xIndex *
zoomFactor));
   imageDisplay.setCurrentY((int) (yIndex *
zoomFactor));
 }

 /**
  * Method to display pixel information based on a
mouse
  * event
  * @param e a mouse event
  */
 private void displayPixelInformation(MouseEvent e)
 {

   // get the cursor x and y
   int cursorX = e.getX();
   int cursorY = e.getY();

   // get the x and y in the original (not scaled
image)
   int pictureX = (int)(cursorX/zoomFactor +
numberBase);
   int pictureY = (int)(cursorY/zoomFactor +
numberBase);

   // display the information for this x and y
   displayPixelInformation(pictureX,pictureY);

 }

 /**
  * Method to clear the labels and current color
and
  * reset the  current index to -1
  */
 private void clearInformation()
 {
   xValue.setText("N/A");
   yValue.setText("N/A");
   rValue.setText("R: N/A");
   gValue.setText("G: N/A");
   bValue.setText("B: N/A");
   colorPanel.setBackground(Color.black);
   xIndex = -1;
   yIndex = -1;
 }

 /**
  * Method called when the mouse is moved with no
buttons
  * down
  * @param e the mouse event
  */
 public void mouseMoved(MouseEvent e)
 {}

 /**
  * Method called when the mouse is clicked
  * @param e the mouse event
  */
 public void mouseClicked(MouseEvent e)
 {
   displayPixelInformation(e);
 }

 /**
  * Method called when the mouse button is pushed
```

```
down
  * @param e the mouse event
  */
 public void mousePressed(MouseEvent e)
 {
   displayPixelInformation(e);
 }

 /**
  * Method called when the mouse button is released
  * @param e the mouse event
  */
 public void mouseReleased(MouseEvent e)
 {
 }

 /**
  * Method called when the component is entered
(mouse
  * moves over it)
  * @param e the mouse event
  */
 public void mouseEntered(MouseEvent e)
 {
 }

 /**
  * Method called when the mouse moves over the
component
  * @param e the mouse event
  */
 public void mouseExited(MouseEvent e)
 {
 }

 /**
  * Method to enable all menu commands
  */
 private void enableZoomItems()
 {
   twentyFive.setEnabled(true);
   fifty.setEnabled(true);
   seventyFive.setEnabled(true);
   hundred.setEnabled(true);
   hundredFifty.setEnabled(true);
   twoHundred.setEnabled(true);
   fiveHundred.setEnabled(true);
 }

 /**
  * Controls the zoom menu bar
  *
  * @param a the ActionEvent
  */
 public void actionPerformed(ActionEvent a)
 {
   if(a.getActionCommand().equals("Update"))
   {
     this.repaint();
   }

   if(a.getActionCommand().equals("25%"))
   {
     this.zoom(.25);
     enableZoomItems();
     twentyFive.setEnabled(false);
   }

   if(a.getActionCommand().equals("50%"))
   {
     this.zoom(.50);
     enableZoomItems();
     fifty.setEnabled(false);
   }

   if(a.getActionCommand().equals("75%"))
   {
     this.zoom(.75);
     enableZoomItems();
     seventyFive.setEnabled(false);
   }

   if(a.getActionCommand().equals("100%"))
   {
     this.zoom(1.0);
     enableZoomItems();
     hundred.setEnabled(false);
   }

   if(a.getActionCommand().equals("150%"))
   {
     this.zoom(1.5);
     enableZoomItems();
     hundredFifty.setEnabled(false);
   }

   if(a.getActionCommand().equals("200%"))
   {
     this.zoom(2.0);
     enableZoomItems();
     twoHundred.setEnabled(false);
   }

   if(a.getActionCommand().equals("500%"))
   {
     this.zoom(5.0);
     enableZoomItems();
     fiveHundred.setEnabled(false);
   }
 }
```

```
 /**
  * Test Main.  It will ask you to pick a file and
then
  * show it
  */
 public static void main( String args[])
 {
   Picture p = new
Picture(FileChooser.pickAFile());
   PictureExplorer test = new PictureExplorer(p);

 }

 /**
  * Class for establishing the focus for the
textfields
  */
 private class PictureExplorerFocusTraversalPolicy
                 extends FocusTraversalPolicy {

        /**
         * Method to get the next component for
focus
         */
        public Component getComponentAfter(
                                 Container
focusCycleRoot,
                                 Component
aComponent) {
            if (aComponent.equals(xValue))
              return yValue;
            else
              return xValue;
        }

        /**
         * Method to get the previous component for
focus
         */
         public Component getComponentBefore(
                                 Container
focusCycleRoot,
                                 Component
aComponent) {
            if (aComponent.equals(xValue))
              return yValue;
            else
              return xValue;
         }

         public Component getDefaultComponent(
                               Container
focusCycleRoot) {
            return xValue;
        }
        public Component getLastComponent(
                               Container
focusCycleRoot) {
            return yValue;
        }

        public Component getFirstComponent(
                               Container
focusCycleRoot) {
            return xValue;
        }
    }//end PictureExplorerFocusTraversalPolicy
inner class

}//end PictureExplorer class
```

### Listing 32. Source code for program named Java362a.

```
/*Program Java362a
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The purpose of this program is to support an explanation
of the PictureExplorer class.

A Picture object having dimensions of 450x345 pixels is
created. The the show method and the explore method are
called on the object to produce two different screen
displays of the picture.

The explore method simply creates a new object of the
PictureExplorer class.

Tested using Windows Vista Premium Home edition and
Ericso's multimedia library.
*********************************************************/

public class Main{
  public static void main(String[] args){
    //Construct a new 460x345 Picture object.
    Picture pix1 = new Picture("ScaledBeach460x345.jpg");
    pix1.show();//display the picture in the show format
    //Display the picture again in the explore format.
    pix1.explore();
  }//end main method
}//end class Main
```

# Copyright

# About the author

**Richard Baldwin** *is a college professor (at Austin Community College in Austin, TX) and private consultant whose primary focus is object-oriented programming using Java and other OOP languages.*

*Richard has participated in numerous consulting projects and he frequently provides onsite training at the high-tech companies located in and around Austin, Texas.  He is the author of Baldwin's Programming Tutorials, which have gained a worldwide following among experienced and aspiring programmers. He has also published articles in JavaPro magazine.*

*In addition to his programming expertise, Richard has many years of practical experience in Digital Signal Processing (DSP).  His first job after he earned his Bachelor's degree was doing DSP in the Seismic Research Department of Texas Instruments.  (TI is still a world leader in DSP.)  In the following years, he applied his programming and DSP expertise to other interesting areas including sonar and underwater acoustics.*

*Richard holds an MSEE degree from Southern Methodist University and has many years of experience in the application of computer technology to real-world problems.*

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-end-