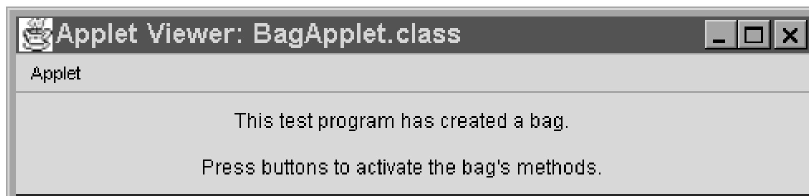
Appendix I: Applets for Interactive Testing from Data Structures & Other Objects Using Java

It's useful to have a small interactive test program to help you test class methods. Such a program can be written as a Java **applet**, which is a Java program written in a special format to have a graphical user interface. The graphical user interface is also called a GUI (pronounced "gooey"), and it allows a user to interact with a program by clicking the mouse, typing information into boxes, and performing other familiar actions. With a Java applet, GUIs are easy to create, even if you've never run into such goo before.

This appendix shows one simple pattern for developing such applets. To illustrate the pattern, we'll implement an applet that lets you test three of the bag's methods (`size`, `add`, and `countOccurrences` from Chapter 3). When the bag applet starts, a GUI is created, similar to the drawing in Figure I.1(a).

By the way, the word "applet" means a particular kind of Java program, so you might show Figure I.1 to your boss and say, "My applet created this nice GUI." But you can also use the word "applet" to talk about the GUI itself, such as "The applet in Figure I.1(a) has three buttons in its middle section." And, in fact, there are three buttons in that applet—the rectangles labeled `size( )`, `add( )`, and `countOccurrences( )`.

The applet in Figure I.1 is intended to be used by the programmer who wrote the `IntArrayBag` class, to check interactively that the class is working correctly. When the applet starts, two sentences appear at the top: "`This test program has created a bag. Press buttons to activate the bag's methods.`" Above these sentences are some extra items, shown here:



The display above our sentences is created automatically by the applet display mechanism. The exact form of this display varies from one system to another, but the dark bar across the top generally contains controls such as the ✕ in the top-right corner. Clicking on that ✕ with the mouse closes the applet on this particular system.

A series of buttons appears in the middle part of the applet, like this:

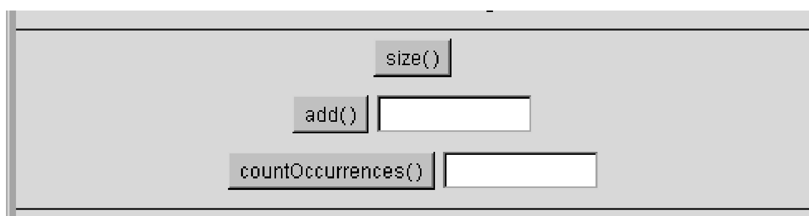
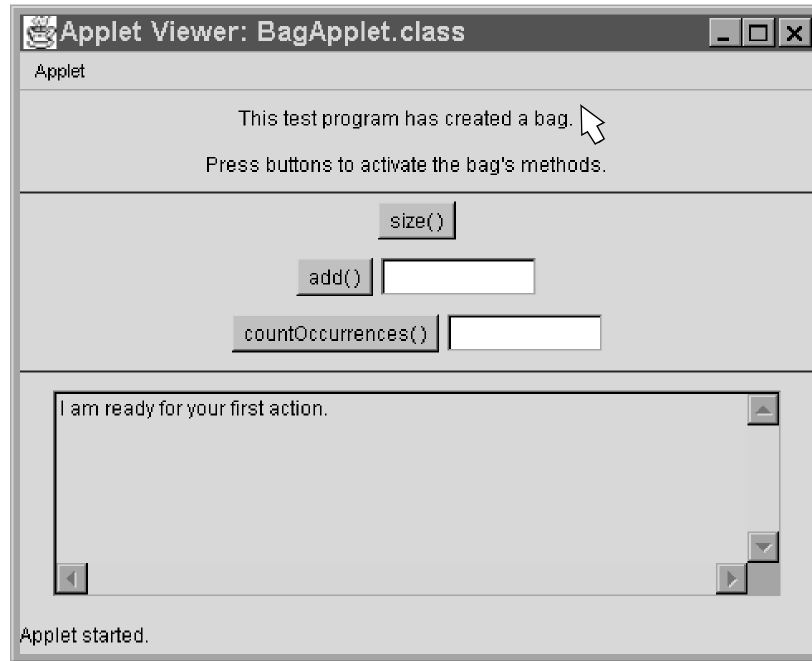
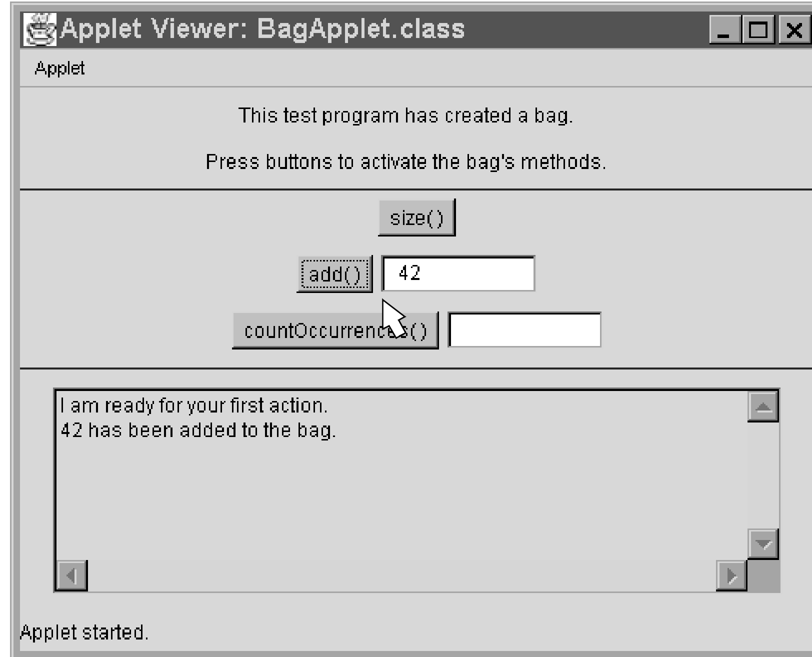


FIGURE I.1 Two Views of the Applet to Test the `IntArrayBag` Class

(a) When the applet first opens, the applet has the components shown here.



(b) The user interacts with the applet by typing information and clicking on the buttons with the mouse. In this example, the user has typed 42 into the add text field and then clicked the add button. The applet responds with the message "42 has been added to the bag," written in the text area at the bottom of the applet.



To test the bag, the user clicks on the various buttons. For example, the user can click on `size()`, and a new message will appear in the large text area at the bottom of the applet. The message will display the current size of the bag, as obtained by activating the `size()` method. If you click on this button right at the start, you'll get the message "`The bag's size is 0.`"

The user can also activate `add` or `countOccurrences`, but these methods each need an argument. For example, to add the number 42 to the bag, the user types the number 42 in the white box next to the `add` button and then clicks `add()`. The result of adding 42 is shown in Figure I.1(b). After elements have been added, the user can test `countOccurrences`. For example, to count the occurrences of the number 10, the user types 10 in the box by the `countOccurrences` button and then clicks `countOccurrences()`. The applet activates `countOccurrences(10)` and prints the method's return value in the large text area at the bottom.

Six Parts of a Simple Interactive Applet

Figure I.2 on page 8 shows an outline for the Java code of the applet that tests the `IntArrayBag`. The same outline can be used for an applet that interactively tests any class. The code has six parts, which we'll discuss now.

1. Import statements. As with any Java program, we begin with a collection of import statements to tell the compiler about the other classes that we'll be using. In the case of the bag applet, we import the `IntArrayBag` class (using the statement `import edu.colorado.collections.IntArrayBag;`). Most applets also have these three import statements:

```
import java.applet.Applet;
import java.awt.*;
import java.awt.event.*;
```

The first import statement provides a class called `Applet`, which we'll use in a moment. The other two import statements provide items from the **abstract windowing toolkit** (the "AWT"), which is a collection of classes for drawing buttons and other GUI items.

2. The class definition. After the import statements, we define a class, much like any other Java class. This class definition begins with the line:

```
public class BagApplet extends Applet
```

The definition continues down to the last closing bracket of the file. The class for the bag applet is called `BagApplet`, which is certainly a good name, but what does "`extends Applet`" mean? It means that the `BagApplet` class will not be written entirely by us. Instead, the class begins by already having all the non-private methods of another class called `Applet`. We imported the `Applet` class from `java.applet.Applet`, and it is provided as part of the Java language so that a class such as `BagApplet` does not have to start from scratch. The act of obtaining methods from another class is called **inheritance**. The class that provides these methods (such as the `Applet` class) is called the **superclass**, and the new class (such as `BagApplet`) is called the **extended class**. Chapter 13 studies inheritance in detail, but for now, all you need to know is that the `BagApplet` obtains a

bunch of methods from the `Applet` class without having to do anything more than specify "`extends Applet`."

At the top of the class, we define an `IntArrayBag` instance variable:

```
IntArrayBag b = new IntArrayBag( );
```

This bag, `b`, will be manipulated when the user clicks on the applet's buttons. In general, an interactive test applet will have one or more objects declared here, and these objects are manipulated by clicking the applet's buttons.

3. Declarations of the applet's components. An applet's components are the buttons and other items that are displayed when the applet runs. These components are declared as instance variables of the class. Our bag applet has several kinds of components: buttons (such as size()), text fields (which are the white rectangles next to some of the buttons), and a text area (which is the large rectangle in the bottom third of the applet). In all, there are six important components in the bag applet, represented by these six instance variables:

```
Button    sizeButton             = new Button("size( )");
Button    addButton              = new Button("add( )");
TextField elementText            = new TextField(10);
Button    countOccurrencesButton = new Button("countOccurrences( )");
TextField targetText             = new TextField(10);
TextArea  feedback               = new TextArea(7, 60);
```

All the instance variables are declared near the top of the class definition before any of the method definitions. They cannot have the usual private access, because they'll be accessed from other classes that we'll see shortly. But before that, let's look at the three kinds of components: button, text field, and text area.

A **button** is a grey rectangle with a label. When a button is created, the constructor is given a string that is printed in the middle of the button. For example, this declaration creates a button called `sizeButton`, and the label on the button is the string "`size( )`":

```
Button sizeButton = new Button("size( )");
```

The bag applet has three buttons: `sizeButton`, `addButton`, and `countOccurrencesButton`.

A **text field** is a white rectangle that can display one line of text. A text field is set up so that the program's user can click on the field and type information, and the applet can then read that information. Our applet has two text fields, one next to the `add` button and one next to the `countOccurrences` button. The `TextField` class has a constructor with one argument—an integer that specifies approximately how many characters can fit in the text field. For example, one of our text fields is declared as follows:

```
TextField elementText = new TextField(10);
```

The `elementText` text field can hold about 10 characters. The user can actually type beyond 10 characters, but only 10 characters of a long string will be displayed. We plan to display `elementText` right beside the `add` button, like this:

To test the `add` method, the user will type a number in the text field and click on the `add` button.

A **text area** is like a text field with more than one line. Its constructor has two arguments that specify the number of rows and columns of text to display. Our bag applet has one text area:

```
TextArea feedback = new TextArea(7, 60);
```

This large text area appears at the bottom of the applet. The intention is to use the text area to display messages to the user.

The declarations we have seen created the three kinds of components: `Button`, `TextField`, and `TextArea`. All three classes are part of the `java.awt` package that is imported by our applet. When we declare a button (or other component) and create it with the constructor, it does not immediately appear in the GUI. How do the objects get placed in the GUI? Also, how does the applet know what to do when the user clicks on a button or takes some other action? The answers to these two questions lie in a special applet method called `init`, which we'll discuss next.

4. The `init` method. A Java application program has a special static method called `main`, but a Java applet does not have `main`. Instead, an applet has a special nonstatic method called `init`. When an applet runs, the runtime system creates an object of the applet class and activates `init( )` for that object. There are several other applet methods that the runtime system also activates at various times, but an interactive test program needs only `init`.

Our `init` method carries out four kinds of actions:

A. The `add` method. We can add one of the interactive components to the GUI. This is done with an applet method called `add`. The method has one argument, which is the component being added to the GUI. For example, one of our buttons is `sizeButton`, so we can write the statement:

```
add(sizeButton);
```

As components are added, the GUI fills up from left to right. If there is no room for a component on the current line, then the GUI moves down and starts a new row of components. Later you can learn more sophisticated ways of laying out the components of a GUI, but the simple left-to-right method used by an applet is a good starting point.

B. Displaying messages. We can display messages in the GUI. Each message is a fixed string that provides some information to the user. Each of these messages is a `Label` object (from the package `java.awt`). To create and display a message, we activate `add` with a newly created `Label` as the argument. For example:

```
add(new Label("This test program has created a bag"));
```

The `Label` constructor has one argument, which is the string that you want to display. The `add` method will put the message in the next available spot of the GUI.

C. New lines and horizontal lines. If our applet class has other methods (besides `init`), then we can activate these other methods. For example, we plan to have two other methods in the `IntArrayBag` class:

```
void addNewLine( );
void addHorizontalLine(Color c);
```

The `addNewLine` method forces the GUI to start a new line, even when there's room for more components on the current line. The second method, `addHorizontalLine`, draws a horizon-

tal line in the specified color. We'll have to define these two methods as part of `BagApplet.Java`, but they won't be difficult. (The data type `Color` is part of `java.lang`. It includes `Color.blue` and 12 other colors, plus the ability to define your own colors.)

D. Activate methods of the components. The buttons and other components have methods that can be activated. For example, one of the methods of a `TextArea` is called `append`. The method has one argument, which is a string, and this string is appended to the end of what's already in the text field. One of the statements in our `init` method will activate `append`:

```
feedback.append("I am ready for your first action.\n");
```

This causes the message "`I am ready for your first action.`" to be written in the `feedback` text field (with a newline character `\n` at the end of the message).

The most important method for buttons involves a new kind of object called an action listener. An action listener is an object that an applet programmer creates to describe the action that should be taken when certain events occur. Our bag applet will have a different kind of action listener for each of the three buttons:

Kind of Action Listener	Purpose
`SizeListener`	Describes the actions to be taken when `sizeButton` is clicked.
`AddListener`	Describes the actions to be taken when `addButton` is clicked.
`CountOccurrencesListener`	Describes the actions to be taken when `countOccurrencesButton` is clicked.

Each kind of action listener is actually a new class that we'll define in a moment. But the only thing you need to know for the `init` method is how to connect an action listener to a `Button`. The solution is to activate a method called `addActionListener` for each `Button`. For example, to connect `sizeButton` to its action listener, we place this statement in the `init` method:

```
sizeButton.addActionListener(new SizeListener( ));
```

Notice that `addActionListener` is a method of the `Button` class, and its one argument is a new `SizeListener` object. Of course, we still need to implement the `SizeListener` class, as well as the other two action listener classes. But first let's summarize all the pieces that are part of the `init` method for the `BagApplet`. Within `init`, we expect to activate these methods to carry out our work:

- `add`—An `Applet` method to add the buttons and other components to the display
- `addNewLine` and `addHorizontalLine`—Two methods that we will write for the `BagApplet`
- `feedback.append`—A method of `feedback` (a `TextArea` object) to place the message "I am ready for your first action" in `feedback`

- `addActionListener`—A method that will be called once for each of the three buttons

The complete `init` implementation is shown in Figure I.2. We've used just one method that we haven't yet mentioned. That one method (`setEditable`) is summarized in Figure I.3 on page 9, along with the other applet-oriented methods that we have used or plan to use.

5. Implementations of the action listeners. The next step of the applet implementation is to design and implement three action listener classes—one for each of our three buttons. The purpose of an action listener is to describe the actions that are carried out when a button is pushed.

Here's the Java syntax for defining an action listener class; the blank line is filled in with your choice of a name for the action listener class.

```
class ____________ implements ActionListener
{
   void actionPerformed(ActionEvent event)
   {
      ...
   }
}
```

The phrase "`implements ActionListener`" informs the Java compiler that the class will have a certain method that is specified in the `ActionListener` interface that is part of `java.awt.*`. The method, called `actionPerformed`, is shown with "..." to indicate its body. The `actionPerformed` method will be executed when an action occurs in the action listener's component, such as clicking a button. For example, here is the complete definition of the action listener that handles the clicking of the `size()` button of our test applet:

```
class SizeListener implements ActionListener
{
   void actionPerformed(ActionEvent event)
   {
      feedback.append("The bag has size " + b.size( ) + ".\n");
   }
}
```

This declares a class called `SizeListener`, which includes its own `actionPerformed` method. For most classes, the class definition would go in a separate file called `SizeListener.java`. But a separate file is undesirable here because the `actionPerformed` method needs access to two instance variables: the bag `b` and the text area `feedback`. The necessary access can be provided by placing the entire `SizeListener` definition within the `BagApplet`. This is an example of an **inner class**, where the definition of one class is placed inside of another. An inner class has two key properties:

- The larger class that encloses an inner class may use the inner class, but the inner class may not be used elsewhere.
- The inner class may access non-private instance variables and methods of the larger class. Some Java implementations also permit an inner class to access private instance variables of the larger class. But other implementations forbid private access from an inner class. (Java implementations that are built into web browsers are particularly apt to forbid the private access.)

FIGURE I.2 Implementation of the BagApplet's `init` Method

Implementation

```
public void init( )
{
    // Some messages for the top of the applet:
    add(new Label("This test program has created a bag."));
    add(new Label("Press buttons to activate the bag's methods."));
    addHorizontalLine(Color.blue);

    // The Button for testing the size method:
    add(sizeButton);
    addNewLine( );

    // The Button and TextField for testing the add method:
    add(addButton);
    add(elementText);
    addNewLine( );

    // The Button and TextField for testing the countOccurrences method:
    add(countOccurrencesButton);
    add(targetText);
    addNewLine( );

    // A TextArea at the bottom to write messages:
    addHorizontalLine(Color.blue);
    addNewLine( );
    feedback.setEditable(false);
    feedback.append("I am ready for your first action.\n");
    add(feedback);

    // Tell the Buttons what they should do when they are clicked:
    sizeButton.addActionListener(new SizeListener( ));
    addButton.addActionListener(new AddListener( ));
    countOccurrencesButton.addActionListener(new CountOccurrencesListener( ));

}
```

FIGURE I.3 Guide to Building an Applet for Interactive Testing

Methods to Call from an Applet or from a Class That Extends an Applet	
`add(component)`	*The component may be any of Java's AWT components, such as* `Button`, `TextArea`, *or* `TextField`. *As components are added, the applet fills up from left to right. If there is no room for a component on the current line, then the applet moves down and starts a new row of components.*
`addNewLine( )` `addHorizontalLine(Color c)`	*These are not actually* `Applet` *methods—you'll need to define them if you want to use them (see page 12).*

Constructors for Three Useful Applet Components	
`Button(String label)`	*Creates a button with a given label.*
`TextField(int size)`	*Creates a white box where the user can type information. The size is the number of characters.*
`TextArea(int rows, int columns)`	*Creates a box with the given number of rows and columns, often used for displaying information to the user.*

Six Useful Methods for a Component	
`b.setActionListener (ActionListener act)`	*We use* `b.setActionListener` *for a* `Button b`. *The* `ActionListener`, `act`, *describes the actions to take when the* `Button b` *is pressed. See page 7 for information on how to create an* `ActionListener`.
`t.append(String message)`	*We use t.append for a* `TextArea t`. *The specified message is added to the end of the* `TextArea`.
`t.getText( )`	*We use* `t.getText` *for a* `TextField t`. *The method returns a copy of the* `String` *that the user has typed in the field.*
`t.setEditable(boolean editable)`	*The component* `t` *can be either a* `TextArea` *or a* `TextField`. *The* `boolean` *parameter tells whether you want the user to be able to type text into the component.*
`t.requestFocus( )` `t.selectAll( )`	*We use these methods with a* `TextField`. *The* `requestFocus` *method causes the mouse to go to the field, and* `selectAll` *causes all text to be highlighted.*
`c.setSize(int width, int height)`	*This method may be used with any component* `c`. *The component's width and height are set to the given values in pixels.*

So, by making SizeListener an inner class, the actionPerformed method can activate feedback.append to print a message in the feedback component of the applet. The message itself includes an activation of b.size( ), so an entire message is something like "The bag has size 42."

> **The actionPerformed Method**
>
> The SizeListener class is an inner class, declared within BagApplet. Therefore, its actionPerformed method has access to the instance variables of the BagApplet.

By the way, the actionPerformed method has a parameter called event. For more complex actions, the event can provide more information about exactly which kind of action triggered the actionPerformed method.

Once an action listener is created, it must be registered with its particular button. The registration is made in the init method. Our applet had these three statements to register the three ActionListener objects:

```
sizeButton.addActionListener(new SizeListener( ));
addButton.addActionListener(new AddListener( ));
countOccurrencesButton.addActionListener
   (new CountOccurrencesListener( ));
```

For example, the first of these statements creates a new SizeListener and registers it with the button sizeButton.

Let's look at the second action listener class for our applet: AddListener. This action listener handles the actions of addButton, which is shown here along with the TextField that's right beside it in the applet:

What actions should occur when the user clicks the addButton? The text is read from the TextField. This text is a String, such as "42", but it can be converted to its value as an integer by using the Java method Integer.parseInt. The method Integer.parseInt has one argument (a String that contains an integer value), and the return value is the int value of the String. Once we know the value of the integer provided by the user, we can add it to the bag b and print an appropriate message. Here's one implementation of these steps:

```
class AddListener implements ActionListener
{
   void actionPerformed(ActionEvent event)
   {
      String userInput = elementText.getText( );
      int element = Integer.parseInt(userInput);
      b.add(element);
      feedback.append(element + " has been added to the bag.\n");
   }
}
```

The `actionPerformed` method defined here uses three of the applet's instance variables: (1) `elementText`, which is the `TextField` where the user typed a number; (2) the bag `b`, where the new element is added; and (3) the `TextArea` `feedback`, where a message is printed providing feedback to the user.

The method works fine, though a problem arises if the user forgets to type a number in the `TextField` before clicking the button. In this case, a `NumberFormatException` will occur when `Integer.parseInt` tries to convert the user's string to an integer.

The best solution to this problem is to "catch" the exception when it occurs rather than allowing the exception to stop the applet. The syntax for catching a `NumberFormatException` looks like this:

```
try
{
   ...code that might throw a NumberFormatException...
}
catch (NumberFormatException e)
{
   ...code to execute if the NumberFormatException happens...
}
```

The words `try` and `catch` are Java keywords for handling exceptions. The full power of `try` and `catch` are described in Appendix C. For our purposes, we'll follow the preceding pattern to write a better version of `AddListener`, show as part of Figure I.4 on page 14. In that implementation, `NumberFormatException` might occur, in which case the code in the `catch`-block is executed. This code prints a message in the feedback area of the applet and then activates two methods for `elementText` (which is the `TextField` where the user was supposed to type a number):

```
elementText.requestFocus( );
elementText.selectAll( );
```

The `requestFocus` method causes the mouse cursor to jump into the `TextField`, and the `selectAll` method causes any text in the field to be highlighted. So now, if the user forgets to type a number, the applet will print a nice error message and provide a second chance.

Our applet needs one more action listener for the `countOccurrences` button. That implementation is part of Figure I.4 on page 14.

6. Implementations of other methods. Our applet has two other methods that we've mentioned: (1) addHorizontalLine, which draws a horizontal line in a specified color; and (2) addNewLine, which causes a new line to start in the GUI, even when there's room for more components on the current line.

Our addHorizontalLine doesn't really draw a line. Instead, it adds a component called a Canvas to the applet. A Canvas is another applet component, like a Button, primarily used for drawing graphical images. The size of the Canvas can be set in **pixels**, which are the individual dots on a computer screen. Today's typical screens have about 100 pixels per inch, so a Canvas that is only one pixel high looks like a horizontal line. Our implementation is also part of Figure I.4. Notice that in the implementation, the Canvas is 10,000 pixels wide, which is wide enough to span even the largest applet—at least on today's computer screens.

Our last method, addNewLine, works by calling addHorizontalLine with the color set to the background color of the applet. In effect, we are drawing a horizontal line, but it is invisible because it's the same color as the applet's background.

The implementation of addNewLine is given in Figure I.4 as part of the complete applet. Look through the implementation with an eye toward how it can be expanded to test all of the bag's methods or to test a different class, such as the DoubleArraySeq class.

How to Compile and Run an Applet

An applet can be compiled just like any other Java program. For example, using the Java Development Kit, we can compile BagApplet.java with the command line:

```
javac BagApplet.java
```

You may have some other way of compiling Java programs in your development environment, but the result will be the same. The act of compiling produces the file BagApplet.class. The compilation will probably produce three other files with names such as BagApplet$SizeListener.class. These are the compiled versions of the inner classes.

Applets were actually created to run as part of a page that you view over the Internet with a web browser. These pages are called **html pages**, which stands for "hypertext markup language." So, to run the BagApplet, we need a small html file. The file, called BagApplet.html, should be created by you in the same directory as BagApplet.class, and it should contain the two lines of html code shown here:

```
<applet code="BagApplet.class" width=480 height=340>
</applet>
```

The first line, containing `<applet...>`, tells the web browser that you are going to start an applet. Usually, you will have at least three pieces of information about the applet:

`code = "BagApplet.class"`	*Tells the browser where to find the compiled class.*
`width = 480` `height = 340`	*Sets the applet's size in pixels. Today's typical screens have about 100 pixels per inch, so a size of 480 x 340 is about 4.8 inches by 3.4 inches.*

Many Java development environments have a feature to automatically create a small html file such as this.

Once the html file is in place, you can run the applet in one of two ways. One approach is to run an **appletviewer**, which is a tool that reads an html file and runs any applets that it finds. The Java Development Kit has an appletviewer that is executed from the command line. For example, to run the JDK appletviewer, you change to the directory that contains `BagApplet.html` and type the command:

```
appletviewer BagApplet.html
```

This command runs the applet, resulting in the display shown in Figure I.1 on page 791.

The applet can also be displayed by putting it in a location that's available to your web browser. My latest information about this approach is available at `http://www.cs.colorado.edu/~main/java.html`.

Beyond the init Method

Our test applet needed to define only the `init` method. More complex applets can also be created, involving graphical images plus interaction. Graphical applets will generally provide other methods called `start`, `paint`, `update`, `stop`, and `destroy`. A good resource is *Graphic Java, Mastering the AWT* by David M. Geary.

FIGURE I.4 Complete Implementation of the BagApplet

Java Applet Implementation

```
// File: BagApplet.java
// This applet is a small example to illustrate how to write an interactive applet that
// tests the methods of another class. This first version tests three of the IntArrayBag
// methods.

import edu.colorado.collections.IntArrayBag;
import java.applet.Applet;
import java.awt.*;          // Imports Button, Canvas, TextArea, TextField
import java.awt.event.*;    // Imports ActionEvent, ActionListener

public class BagApplet extends Applet
{
   // An IntArrayBag for this applet to manipulate:
   IntArrayBag b = new IntArrayBag( );

   // These are the interactive components that will appear in the applet.
   // We declare one Button for each IntArrayBag method that we want to be able to
   // test. If the method has an argument, then there is also a TextField
   // where the user can enter the value of the argument.
   // At the bottom, there is a TextArea to write messages.
   Button    sizeButton             = new Button("size( )");
   Button    addButton              = new Button("add( )");
   TextField elementText            = new TextField(10);
   Button    countOccurrencesButton = new Button("countOccurrences( )");
   TextField targetText             = new TextField(10);
   TextArea  feedback               = new TextArea(7,60);
```

(continued)

(FIGURE I.4 continued)

```
public void init( )
{
   || See the implementation in Figure I.2 on page 8.
}

class SizeListener implements ActionListener
{
   public void actionPerformed(ActionEvent event)
   {
      feedback.append("The bag has size " + b.size( ) + ".\n");
   }
}

class AddListener implements ActionListener
{
   public void actionPerformed(ActionEvent event)
   {
      try
      {
         String userInput = elementText.getText( );
         int element = Integer.parseInt(userInput);
         b.add(element);
         feedback.append(element + " has been added to the bag.\n");
      }
      catch (NumberFormatException e)
      {
         feedback.append("Type an integer before clicking button.\n");
         elementText.requestFocus( );
         elementText.selectAll( );
      }
   }
}
```

(continued)

(FIGURE I.4 continued)

```
class CountOccurrencesListener implements ActionListener
{
   public void actionPerformed(ActionEvent event)
   {
      try
      {
         String userInput = targetText.getText( );
         int target = Integer.parseInt(userInput);
         feedback.append(target + " occurs ");
         feedback.append(b.countOccurrences(target) + “times.\n”);
      }
      catch (NumberFormatException e)
      {
         feedback.append("Type a target before clicking button.\n");
         targetText.requestFocus( );
         targetText.selectAll( );
      }
   }
}

private void addHorizontalLine(Color c)
{
   // Add a Canvas 10,000 pixels wide but only 1 pixel high, which acts as
   // a horizontal line to separate one group of components from the next.
   Canvas line = new Canvas( );
   line.setSize(10000,1);
   line.setBackground(c);
   add(line);
}

private void addNewLine( )
{
   // Add a horizontal line in the background color. The line itself is
   // invisible, but it serves to force the next component onto a new line.
   addHorizontalLine(getBackground( ));
}

}
```