

Chapter 10.4

Java Applet Class

Two Types of Applets

It is important to state at the outset that there are two varieties of applets. The first are those based directly on the **Applet** class described in this chapter. These applets use the Abstract Window Toolkit (AWT) to provide the graphical user interface (or use no GUI at all). This style of applet has been available since Java was first created.

The second type of applets are those based on the Swing class **JApplet**. Swing applets use the Swing classes to provide the GUI. Swing offers a richer and often easier-to-use user interface than does the AWT. Thus, Swing-based applets are now the most popular. However, traditional AWT-based applets are still used, especially when only a very simple user interface is required. Thus, both AWT- and Swing-based applets are valid.

Because **JApplet** inherits **Applet**, all the features of **Applet** are also available in **JApplet**, and most of the information in this chapter applies to both types of applets. Therefore, even if you are interested in only Swing applets, the information in this chapter is still relevant and necessary. Understand, however, that when creating Swing-based applets, some additional constraints apply and these are described later in this book, when Swing is covered.

Applet Basics

All applets are subclasses (either directly or indirectly) of **Applet**. Applets are not stand-alone programs. Instead, they run within either a web browser or an applet viewer. The illustrations shown in this chapter were created with the standard applet viewer, called **appletviewer**, provided by the JDK. But you can use any applet viewer or browser you like.

Execution of an applet does not begin at **main()**. Actually, few applets even have **main()** methods. Instead, execution of an applet is started and controlled with an entirely different mechanism, which will be explained shortly. Output to your applet's window is not performed by **System.out.println()**. Rather, in non-Swing applets, output is handled with various AWT methods, such as **drawString()**, which outputs a string to a specified X,Y location. Input is also handled differently than in a console application. (Remember, Swing-based applets use the Swing classes to handle user interactions, and they are described later in this book.)

Before an applet can be used, a deployment strategy must be chosen. There are two basic approaches. The first is to use the Java Network Launch Protocol (JNLP). This approach offers the most flexibility, especially as it relates to rich Internet applications. For real-world applets that you create, JNLP will often be the best choice. However, a detailed discussion of JNLP is beyond the scope of this book. (See the JDK documentation for the latest details on JNLP.) Fortunately, JNLP is not required for the example applets shown here.

The second basic approach to deploying an applet is to specify the applet directly in an HTML file, without the use of JNLP. This is the original way that applets were launched when Java was

created, and it is still used today—especially for simple applets. Furthermore, because of its inherent simplicity, it is the appropriate method for the applet examples described in this book. At the time of this writing, Oracle recommends the APPLET tag for this purpose. Therefore, the APPLET tag is used in this book. (Be aware that the APPLET tag is currently deprecated by the HTML specification. The alternative is the OBJECT tag. You should check the JDK documentation in this regard for the latest recommendations.) When an APPLET tag is encountered in the HTML file, the specified applet will be executed by a Java-enabled web browser.

The use of the APPLET tag offers a secondary advantage when developing applets because it enables you to easily view and test the applet. To do so, simply include a comment at the head of your Java source code file that contains the APPLET tag. This way, your code is documented with the necessary HTML statements needed by your applet, and you can test the compiled applet by starting the applet viewer with your Java source code file specified as the target. Here is an example of such a comment:

```
/*  
  
<applet code="MyApplet" width=200 height=60>  
  
</applet>  
  
*/
```

This comment contains an APPLET tag that will run an applet called **MyApplet** in a window that is 200 pixels wide and 60 pixels high. Because the inclusion of an APPLET command makes testing applets easier, all of the applets shown in this book will contain the appropriate APPLET tag embedded in a comment.

The Applet Class

The **Applet** class defines the methods shown in [Table 10.4.1](#). **Applet** provides all necessary support for applet execution, such as starting and stopping. It also provides methods that load and display images, and methods that load and play audio clips. **Applet** extends the AWT class **Panel**. In turn, **Panel** extends **Container**, which extends **Component**. These classes provide support for Java's window-based, graphical interface. Thus, **Applet** provides all of the necessary support for window-based activities. (The AWT is described in detail in following chapters.)

Method	Description
<code>void destroy()</code>	Called by the browser just before an applet is terminated. Your applet will override this method if it needs to perform any cleanup prior to its destruction.
<code>AccessibleContext getAccessibleContext()</code>	Returns the accessibility context for the invoking object.
<code>AppletContext getAppletContext()</code>	Returns the context associated with the applet.
<code>String getAppletInfo()</code>	Overrides of this method should return a string that describes the applet. The default implementation returns null .
<code>AudioClip getAudioClip(URL url)</code>	Returns an AudioClip object that encapsulates the audio clip found at the location specified by <i>url</i> .
<code>AudioClip getAudioClip(URL url, String clipName)</code>	Returns an AudioClip object that encapsulates the audio clip found at the location specified by <i>url</i> and having the name specified by <i>clipName</i> .
<code>URL getCodeBase()</code>	Returns the URL associated with the invoking applet.
<code>URL getDocumentBase()</code>	Returns the URL of the HTML document that invokes the applet.
<code>Image getImage(URL url)</code>	Returns an Image object that encapsulates the image found at the location specified by <i>url</i> .
<code>Image getImage(URL url, String imageName)</code>	Returns an Image object that encapsulates the image found at the location specified by <i>url</i> and having the name specified by <i>imageName</i> .
<code>Locale getLocale()</code>	Returns a Locale object that is used by various locale-sensitive classes and methods.
<code>String getParameter(String paramName)</code>	Returns the parameter associated with <i>paramName</i> . null is returned if the specified parameter is not found.
<code>String[][] getParameterInfo()</code>	Overrides of this method should return a String table that describes the parameters recognized by the applet. Each entry in the table must consist of three strings that contain the name of the parameter, a description of its type and/or range, and an explanation of its purpose. The default implementation returns null .
<code>void init()</code>	Called when an applet begins execution. It is the first method called for any applet.
<code>boolean isActive()</code>	Returns true if the applet has been started. It returns false if the applet has been stopped.
<code>boolean isValidRoot()</code>	Returns true , which indicates that an applet is a validate root. (Added by JDK 7.)
<code>static final AudioClip newAudioClip(URL url)</code>	Returns an AudioClip object that encapsulates the audio clip found at the location specified by <i>url</i> . This method is similar to getAudioClip() except that it is static and can be executed without the need for an Applet object.

<code>void play(URL url)</code>	If an audio clip is found at the location specified by <i>url</i> , the clip is played.
<code>void play(URL url, String clipName)</code>	If an audio clip is found at the location specified by <i>url</i> with the name specified by <i>clipName</i> , the clip is played.
<code>void resize(Dimension dim)</code>	Resizes the applet according to the dimensions specified by <i>dim</i> . Dimension is a class stored inside java.awt . It contains two integer fields: width and height .
<code>void resize(int width, int height)</code>	Resizes the applet according to the dimensions specified by <i>width</i> and <i>height</i> .
<code>final void setStub(AppletStub stubObj)</code>	Makes <i>stubObj</i> the stub for the applet. This method is used by the run-time system and is not usually called by your applet. A <i>stub</i> is a small piece of code that provides the linkage between your applet and the browser.
<code>void showStatus(String str)</code>	Displays <i>str</i> in the status window of the browser or applet viewer. If the browser does not support a status window, then no action takes place.
<code>void start()</code>	Called by the browser when an applet should start (or resume) execution. It is automatically called after init() when an applet first begins.
<code>void stop()</code>	Called by the browser to suspend execution of the applet. Once stopped, an applet is restarted when the browser calls start() .

Table 10.4.1 The Methods Defined by **Applet**

Applet Architecture

As a general rule, an applet is a GUI-based program. As such, its architecture is different from the console-based programs shown in the first part of this book. If you are already familiar with GUI programming, you will be right at home writing applets. If not, then there are a few key concepts you must understand.

First, applets are event driven. Although we won't examine event handling until the following chapter, it is important to understand in a general way how the event-driven architecture impacts the design of an applet. An applet resembles a set of interrupt service routines. Here is how the process works. An applet waits until an event occurs. The runtime system notifies the applet about an event by calling an event handler that has been provided by the applet. Once this happens, the applet must take appropriate action and then quickly return. This is a crucial point. For the most part, your applet should not enter a "mode" of operation in which it maintains control for an extended period. Instead, it must perform specific actions in response to events and then return control to the run-time system. In those situations in which your applet needs to perform a repetitive task on its own (for example, displaying a scrolling message across its window), you must start an additional thread of execution. (You will see an example later in this chapter.)

Second, the user initiates interaction with an applet—not the other way around. As you know, in a console-based program, when the program needs input, it will prompt the user and then call some input method, such as **readLine()**. This is not the way it works in an applet. Instead, the user interacts with the applet as he or she wants, when he or she wants. These interactions are

sent to the applet as events to which the applet must respond. For example, when the user clicks the mouse inside the applet's window, a mouse-clicked event is generated. If the user presses a key while the applet's window has input focus, a keypress event is generated. As you will see in later chapters, applets can contain various controls, such as push buttons and check boxes. When the user interacts with one of these controls, an event is generated.

While the architecture of an applet is not as easy to understand as that of a console-based program, Java makes it as simple as possible. If you have written programs for Windows (or other GUI-based operating systems), you know how intimidating that environment can be. Fortunately, Java provides a much cleaner approach that is more quickly mastered.

An Applet Skeleton

All but the most trivial applets override a set of methods that provides the basic mechanism by which the browser or applet viewer interfaces to the applet and controls its execution. Four of these methods, **init()**, **start()**, **stop()**, and **destroy()**, apply to all applets and are defined by **Applet**. Default implementations for all of these methods are provided. Applets do not need to override those methods they do not use. However, only very simple applets will not need to define all of them.

AWT-based applets (such as those discussed in this chapter) will also often override the **paint()** method, which is defined by the AWT **Component** class. This method is called when the applet's output must be redisplayed. (Swing-based applets use a different mechanism to accomplish this task.) These five methods can be assembled into the skeleton shown here:

```

// An Applet skeleton.
import java.awt.*;
import java.applet.*;
/*
<applet code="AppletSkel" width=300 height=100>
</applet>
*/

public class AppletSkel extends Applet {
    // Called first.
    public void init() {
        // initialization
    }

    /* Called second, after init(). Also called whenever
       the applet is restarted. */
    public void start() {
        // start or resume execution
    }

    // Called when the applet is stopped.
    public void stop() {
        // suspends execution
    }

    /* Called when applet is terminated. This is the last
       method executed. */
    public void destroy() {
        // perform shutdown activities
    }

    // Called when an applet's window must be restored.
    public void paint(Graphics g) {
        // redisplay contents of window
    }
}

```

Although this skeleton does not do anything, it can be compiled and run. When run, it generates the following window when viewed with an applet viewer:



Applet Initialization and Termination

It is important to understand the order in which the various methods shown in the skeleton are called. When an applet begins, the following methods are called, in this sequence:

1. **init()**
2. **start()**
3. **paint()**

When an applet is terminated, the following sequence of method calls takes place:

1. **stop()**
2. **destroy()**

Let's look more closely at these methods.

init()

The **init()** method is the first method to be called. This is where you should initialize variables. This method is called only once during the run time of your applet.

start()

The **start()** method is called after **init()**. It is also called to restart an applet after it has been stopped. Whereas **init()** is called once—the first time an applet is loaded—**start()** is called each time an applet's HTML document is displayed onscreen. So, if a user leaves a web page and comes back, the applet resumes execution at **start()**.

paint()

The **paint()** method is called each time your applet's output must be redrawn. This situation can occur for several reasons. For example, the window in which the applet is running may be overwritten by another window and then uncovered. Or the applet window may be minimized and then restored. **paint()** is also called when the applet begins execution. Whatever the cause, whenever the applet must redraw its output, **paint()** is called. The **paint()** method has one parameter of type **Graphics**. This parameter will contain the graphics context, which describes the graphics environment in which the applet is running. This context is used whenever output to the applet is required.

stop()

The **stop()** method is called when a web browser leaves the HTML document containing the applet—when it goes to another page, for example. When **stop()** is called, the applet is probably running. You should use **stop()** to suspend threads that don't need to run when the applet is not visible. You can restart them when **start()** is called if the user returns to the page.

destroy()

The **destroy()** method is called when the environment determines that your applet needs to be removed completely from memory. At this point, you should free up any resources the applet may be using. The **stop()** method is always called before **destroy()**.

Overriding update()

In some situations, your applet may need to override another method defined by the AWT, called **update()**. This method is called when your applet has requested that a portion of its window be redrawn. The default version of **update()** simply calls **paint()**. However, you can override the **update()** method so that it performs more subtle repainting. In general, overriding **update()** is a specialized technique that is not applicable to all applets, and the examples in this chapter do not override **update()**.

Simple Applet Display Methods

As we've mentioned, applets are displayed in a window, and AWT-based applets use the AWT to perform input and output. Although we will examine the methods, procedures, and techniques necessary to fully handle the AWT windowed environment in subsequent chapters, a few are described here, because we will use them to write sample applets. (Remember, Swing-based applets are described later in this book.)

To output a string to an applet, use **drawString()**, which is a member of the **Graphics** class. Typically, it is called from within either **update()** or **paint()**. It has the following general form:

```
void drawString(String message, int x, int y)
```

Here, *message* is the string to be output beginning at *x,y*. In a Java window, the upper-left corner is location 0,0. The **drawString()** method will not recognize newline characters. If you want to start a line of text on another line, you must do so manually, specifying the precise X,Y location where you want the line to begin. (As you will see in later chapters, there are techniques that make this process easy.)

To set the background color of an applet's window, use **setBackground()**. To set the foreground color (the color in which text is shown, for example), use **setForeground()**. These methods are defined by **Component**, and they have the following general forms:

```
void setBackground(Color newColor)
```

```
void setForeground(Color newColor)
```

Here, *newColor* specifies the new color. The class **Color** defines the constants shown here that can be used to specify colors:

Color.black	Color.magenta
Color.blue	Color.orange
Color.cyan	Color.pink
Color.darkGray	Color.red
Color.gray	Color.white
Color.green	Color.yellow
Color.lightGray	

Uppercase versions of the constants are also defined.

The following example sets the background color to green and the text color to red:

```
setBackground(Color.green);
```

```
setForeground(Color.red);
```


A good place to set the foreground and background colors is in the **init()** method. Of course, you can change these colors as often as necessary during the execution of your applet.

You can obtain the current settings for the background and foreground colors by calling **getBackground()** and **getForeground()**, respectively. They are also defined by **Component** and are shown here:

```
Color getBackground()
```

```
Color getForeground()
```

Here is a very simple applet that sets the background color to cyan, the foreground color to red, and displays a message that illustrates the order in which the **init()**, **start()**, and **paint()** methods are called when an applet starts up:

```
/* A simple applet that sets the foreground and
   background colors and outputs a string. */
import java.awt.*;
import java.applet.*;
/*
<applet code="Sample" width=300 height=50>
</applet>
*/

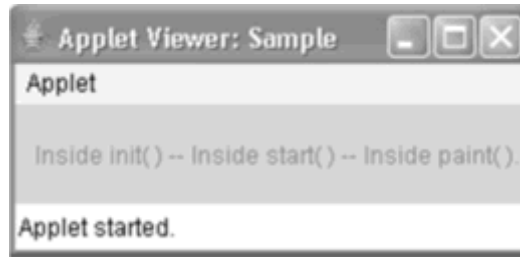
public class Sample extends Applet{
    String msg;

    // set the foreground and background colors.
    public void init() {
        setBackground(Color.cyan);
        setForeground(Color.red);
        msg = "Inside init( ) --";
    }

    // Initialize the string to be displayed.
    public void start() {
        msg += " Inside start( ) --";
    }

    // Display msg in applet window.
    public void paint(Graphics g) {
        msg += " Inside paint( ).";
        g.drawString(msg, 10, 30);
    }
}
```

This applet generates the window shown here:



The methods **stop()** and **destroy()** are not overridden, because they are not needed by this simple applet.

Requesting Repainting

As a general rule, an applet writes to its window only when its **update()** or **paint()** method is called by the AWT. This raises an interesting question: How can the applet itself cause its window to be updated when its information changes? For example, if an applet is displaying a moving banner, what mechanism does the applet use to update the window each time this banner scrolls? Remember, one of the fundamental architectural constraints imposed on an applet is that it must quickly return control to the run-time system. It cannot create a loop inside **paint()** that repeatedly scrolls the banner, for example. This would prevent control from passing back to the AWT. Given this constraint, it may seem that output to your applet's window will be difficult at best. Fortunately, this is not the case. Whenever your applet needs to update the information displayed in its window, it simply calls **repaint()**.

The **repaint()** method is defined by the AWT. It causes the AWT run-time system to execute a call to your applet's **update()** method, which, in its default implementation, calls **paint()**. Thus, for another part of your applet to output to its window, simply store the output and then call **repaint()**. The AWT will then execute a call to **paint()**, which can display the stored information. For example, if part of your applet needs to output a string, it can store this string in a **String** variable and then call **repaint()**. Inside **paint()**, you will output the string using **drawString()**.

The **repaint()** method has four forms. Let's look at each one, in turn. The simplest version of **repaint()** is shown here:

```
void repaint( )
```

This version causes the entire window to be repainted. The following version specifies a region that will be repainted:

```
void repaint(int left, int top, int width, int height)
```

Here, the coordinates of the upper-left corner of the region are specified by *left* and *top*, and the width and height of the region are passed in *width* and *height*. These dimensions are specified in pixels. You save time by specifying a region to repaint. Window updates are costly in terms of time. If you need to update only a small portion of the window, it is more efficient to repaint only that region.

Calling **repaint()** is essentially a request that your applet be repainted sometime soon. However, if your system is slow or busy, **update()** might not be called immediately. Multiple requests for repainting that occur within a short time can be collapsed by the AWT in a manner such that **update()** is only called sporadically. This can be a problem in many situations,

including animation, in which a consistent update time is necessary. One solution to this problem is to use the following forms of **repaint()**:

```
void repaint(long maxDelay)
```

```
void repaint(long maxDelay, int x, int y, int width, int height)
```

Here, *maxDelay* specifies the maximum number of milliseconds that can elapse before **update()** is called. Beware, though. If the time elapses before **update()** can be called, it isn't called. There's no return value or exception thrown, so you must be careful.

NOTE

It is possible for a method other than **paint()** or **update()** to output to an applet's window. To do so, it must obtain a graphics context by calling **getGraphics()** (defined by **Component**) and then use this context to output to the window. However, for most applications, it is better and easier to route window output through **paint()** and to call **repaint()** when the contents of the window change.

A Simple Banner Applet

To demonstrate **repaint()**, a simple banner applet is developed. This applet scrolls a message, from right to left, across the applet's window. Since the scrolling of the message is a repetitive task, it is performed by a separate thread, created by the applet when it is initialized. The banner applet is shown here:

```

/* A simple banner applet.

   This applet creates a thread that scrolls
   the message contained in msg right to left
   across the applet's window.
*/
import java.awt.*;
import java.applet.*;
/*
<applet code="SimpleBanner" width=300 height=50>
</applet>
*/

public class SimpleBanner extends Applet implements Runnable {
    String msg = " A Simple Moving Banner.";
    Thread t = null;
    int state;
    volatile boolean stopFlag;

    // Set colors and initialize thread.
    public void init() {
        setBackground(Color.cyan);
        setForeground(Color.red);
    }

    // Start thread
    public void start() {
        t = new Thread(this);
        stopFlag = false;
        t.start();
    }
}

```

```

// Entry point for the thread that runs the banner.
public void run() {

    // Redisplay banner
    for( ; ; ) {
        try {
            repaint();
            Thread.sleep(250);
            if(stopFlag)
                break;
        } catch(InterruptedException e) {}
    }
}

// Pause the banner.
public void stop() {
    stopFlag = true;
    t = null;
}

// Display the banner.
public void paint(Graphics g) {
    char ch;

    ch = msg.charAt(0);
    msg = msg.substring(1, msg.length());
    msg += ch;

    g.drawString(msg, 50, 30);
}
}

```

Following is sample output:



Let's take a close look at how this applet operates. First, notice that **SimpleBanner** extends **Applet**, as expected, but it also implements **Runnable**. This is necessary, since the applet will be creating a second thread of execution that will be used to scroll the banner. Inside **init()**, the foreground and background colors of the applet are set.

After initialization, the run-time system calls **start()** to start the applet running. Inside **start()**, a new thread of execution is created and assigned to the **Thread** variable **t**. Then, the **boolean** variable **stopFlag**, which controls the execution of the applet, is set to **false**. Next, the thread is started by a call to **t.start()**. Remember that **t.start()** calls a method defined by **Thread**, which causes **run()** to begin executing. It does not cause a call to the version of **start()** defined by **Applet**. These are two separate methods.

Inside **run()**, a call to **repaint()** is made. This eventually causes the **paint()** method to be called, and the rotated contents of **msg** are displayed. Between each iteration, **run()** sleeps for a quarter of a second. The net effect is that the contents of **msg** are scrolled right to left in a constantly moving display. The **stopFlag** variable is checked on each iteration. When it is **true**, the **run()** method terminates.

If a browser is displaying the applet when a new page is viewed, the **stop()** method is called, which sets **stopFlag** to **true**, causing **run()** to terminate. This is the mechanism used to stop the thread when its page is no longer in view. When the applet is brought back into view, **start()** is once again called, which starts a new thread to execute the banner.

Using the Status Window

In addition to displaying information in its window, an applet can also output a message to the status window of the browser or applet viewer on which it is running. To do so, call **showStatus()** with the string that you want displayed. The status window is a good place to give the user feedback about what is occurring in the applet, suggest options, or possibly report some types of errors. The status window also makes an excellent debugging aid, because it gives you an easy way to output information about your applet.

The following applet demonstrates **showStatus()**:

```
// Using the Status Window.

import java.awt.*;

import java.applet.*;

/*

<applet code="StatusWindow" width=300 height=50>

</applet>

*/

public class StatusWindow extends Applet {

    public void init() {

        setBackground(Color.cyan);

    }

    // Display msg in applet window.

    public void paint(Graphics g) {

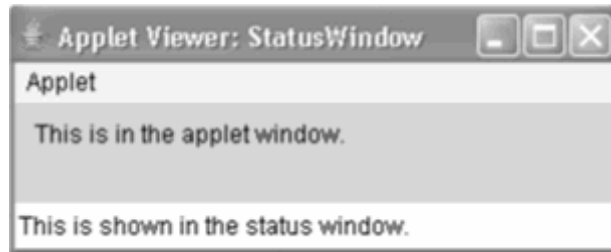
        g.drawString("This is in the applet window.", 10, 20);
```

```

        showStatus("This is shown in the status window.");
    }
}

```

Sample output from this program is shown here:



The HTML APPLET Tag

As mentioned earlier, at the time of this writing, Oracle recommends that the APPLET tag be used to manually start an applet when JNLP is not used. An applet viewer will execute each APPLET tag that it finds in a separate window, while web browsers will allow many applets on a single page. So far, we have been using only a simplified form of the APPLET tag. Now it is time to take a closer look at it.

The syntax for a fuller form of the APPLET tag is shown here. Bracketed items are optional.

```

< APPLET
  [CODEBASE = codebaseURL]
  CODE = appletFile
  [ALT = alternateText]
  [NAME = appletInstanceName]
  WIDTH = pixels HEIGHT = pixels
  [ALIGN = alignment ]
  [VSPACE = pixels] [HSPACE = pixels]
>
  [< PARAM NAME = AttributeName VALUE = AttributeValue>]
  [< PARAM NAME = AttributeName2 VALUE = AttributeValue>]
  ...
  [HTML Displayed in the absence of Java]
</APPLET>

```

Let's take a look at each part now.

CODEBASE

CODEBASE is an optional attribute that specifies the base URL of the applet code, which is the directory that will be searched for the applet's executable class file (specified by the CODE tag). The HTML document's URL directory is used as the CODEBASE if this attribute is not specified. The CODEBASE does not have to be on the host from which the HTML document was read.

CODE

CODE is a required attribute that gives the name of the file containing your applet's compiled **.class** file. This file is relative to the code base URL of the applet, which is the directory that the HTML file was in or the directory indicated by CODEBASE if set.

ALT

The ALT tag is an optional attribute used to specify a short text message that should be displayed if the browser recognizes the APPLET tag but can't currently run Java applets. This is distinct from the alternate HTML you provide for browsers that don't support applets.

NAME

NAME is an optional attribute used to specify a name for the applet instance. Applets must be named in order for other applets on the same page to find them by name and communicate with them. To obtain an applet by name, use **getApplet()**, which is defined by the **AppletContext** interface.

WIDTH and HEIGHT

WIDTH and HEIGHT are required attributes that give the size (in pixels) of the applet display area.

ALIGN

ALIGN is an optional attribute that specifies the alignment of the applet. This attribute is treated the same as the HTML IMG tag with these possible values: LEFT, RIGHT, TOP, BOTTOM, MIDDLE, BASELINE, TEXTTOP, ABSMIDDLE, and ABSBOTTOM.

VSPACE and HSPACE

These attributes are optional. VSPACE specifies the space, in pixels, above and below the applet. HSPACE specifies the space, in pixels, on each side of the applet. They're treated the same as the IMG tag's VSPACE and HSPACE attributes.

PARAM NAME and VALUE

The PARAM tag allows you to specify applet-specific arguments. Applets access their attributes with the **getParameter()** method.

Other valid APPLET attributes include ARCHIVE, which lets you specify one or more archive files, and OBJECT, which specifies a saved version of the applet. In general, an APPLET tag should include only a CODE or an OBJECT attribute, but not both.

Passing Parameters to Applets

As just discussed, the APPLET tag allows you to pass parameters to your applet. To retrieve a parameter, use the **getParameter()** method. It returns the value of the specified parameter in the form of a **String** object. Thus, for numeric and **boolean** values, you will need to convert their string representations into their internal formats. Here is an example that demonstrates passing parameters:


```

// Use Parameters
import java.awt.*;
import java.applet.*;
/*
<applet code="ParamDemo" width=300 height=80>
<param name=fontName value=Courier>
<param name=fontSize value=14>
<param name=leading value=2>
<param name=accountEnabled value=true>
</applet>
*/

public class ParamDemo extends Applet {
    String fontName;
    int fontSize;
    float leading;
    boolean active;

    // Initialize the string to be displayed.
    public void start() {
        String param;

        fontName = getParameter("fontName");
        if(fontName == null)
            fontName = "Not Found";

        param = getParameter("fontSize");
        try {
            if(param != null)
                fontSize = Integer.parseInt(param);
            else
                fontSize = 0;
        } catch (NumberFormatException e) {
            fontSize = -1;
        }
    }
}

```

```

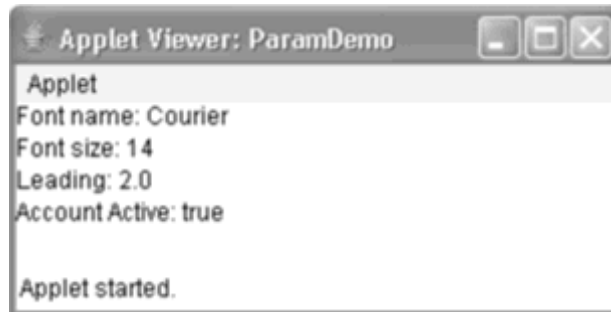
param = getParameter("leading");
try {
    if(param != null)
        leading = Float.valueOf(param).floatValue();
    else
        leading = 0;
} catch(NumberFormatException e) {
    leading = -1;
}

param = getParameter("accountEnabled");
if(param != null)
    active = Boolean.valueOf(param).booleanValue();
}

// Display parameters.
public void paint(Graphics g) {
    g.drawString("Font name: " + fontName, 0, 10);
    g.drawString("Font size: " + fontSize, 0, 26);
    g.drawString("Leading: " + leading, 0, 42);
    g.drawString("Account Active: " + active, 0, 58);
}
}

```

Sample output from this program is shown here:



As the program shows, you should test the return values from **getParameter()**. If a parameter isn't available, **getParameter()** will return **null**. Also, conversions to numeric types must be attempted in a **try** statement that catches **NumberFormatException**. Uncaught exceptions should never occur within an applet.

Improving the Banner Applet

It is possible to use a parameter to enhance the banner applet shown earlier. In the previous version, the message being scrolled was hard-coded into the applet. However, passing the message as a parameter allows the banner applet to display a different message each time it is executed. This improved version is shown here. Notice that the **APPLET** tag at the top of the file now specifies a parameter called **message** that is linked to a quoted string.

```

// A parameterized banner
import java.awt.*;
import java.applet.*;
/*
<applet code="ParamBanner" width=300 height=50>
<param name=message value="Java makes the Web move!">
</applet>
public class ParamBanner extends Applet implements Runnable {
    String msg;
    Thread t = null;
    int state;
    volatile boolean stopFlag;

    // Set colors and initialize thread.
    public void init() {
        setBackground(Color.cyan);
        setForeground(Color.red);
    }

    // Start thread
    public void start() {
        msg = getParameter("message");
        if(msg == null) msg = "Message not found.";
        msg = " " + msg;
        t = new Thread(this);
        stopFlag = false;
        t.start();
    }
}

```

```

// Entry point for the thread that runs the banner.
public void run() {

    // Redisplay banner
    for( ; ; ) {
        try {
            repaint();
            Thread.sleep(250);
            if(stopFlag)
                break;
        } catch(InterruptedException e) {}
    }
}

// Pause the banner.
public void stop() {
    stopFlag = true;
    t = null;
}

// Display the banner.
public void paint(Graphics g) {
    char ch;

    ch = msg.charAt(0);
    msg = msg.substring(1, msg.length());
    msg += ch;

    g.drawString(msg, 50, 30);
}
}

```

getDocumentBase() and getCodeBase()

Often, you will create applets that will need to explicitly load media and text. Java will allow the applet to load data from the directory holding the HTML file that started the applet (the *document base*) and the directory from which the applet's class file was loaded (the *code base*). These directories are returned as **URL** objects by **getDocumentBase()** and **getCodeBase()**. They can be concatenated with a string that names the file you want to load. To actually load another file, you will use the **showDocument()** method defined by the **AppletContext** interface, discussed in the next section.

The following applet illustrates these methods:

```

// Display code and document bases.

import java.awt.*;

import java.applet.*;

import java.net.*;

/*

```

```

<applet code="Bases" width=300 height=50>

</applet>

*/

public class Bases extends Applet {

    // Display code and document bases.

    public void paint(Graphics g) {

        String msg;

        URL url = getCodeBase(); // get code base

        msg = "Code base: " + url.toString();

        g.drawString(msg, 10, 20);

        url = getDocumentBase(); // get document base

        msg = "Document base: " + url.toString();

        g.drawString(msg, 10, 40);

    }

}

```

Sample output from this program is shown here:



AppletContext and showDocument()

One application of Java is to use active images and animation to provide a graphical means of navigating the Web that is more interesting than simple text-based links. To allow your applet to transfer control to another URL, you must use the **showDocument()** method defined by the **AppletContext** interface. **AppletContext** is an interface that lets you get information from the applet's execution environment. The methods defined by **AppletContext** are shown in [Table 10.4.-2](#). The context of the currently executing applet is obtained by a call to the **getAppletContext()** method defined by **Applet**.

Within an applet, once you have obtained the applet's context, you can bring another document into view by calling **showDocument()**. This method has no return value and throws no exception if it fails, so use it carefully. There are two **showDocument()** methods. The method **showDocument(URL)** displays the document at the specified **URL**. The method **showDocument(URL, String)** displays the specified document at the specified location within the browser window. Valid arguments for *where* are “_self” (show in current frame), “_parent” (show in parent frame), “_top” (show in topmost frame), and “_blank” (show in new browser window). You can also specify a name, which causes the document to be shown in a new browser window by that name.

Method	Description
Applet getApplet(String <i>appletName</i>)	Returns the applet specified by <i>appletName</i> if it is within the current applet context. Otherwise, null is returned.
Enumeration<Applet> getApplets()	Returns an enumeration that contains all of the applets within the current applet context.
AudioClip getAudioClip(URL <i>url</i>)	Returns an AudioClip object that encapsulates the audio clip found at the location specified by <i>url</i> .
Image getImage(URL <i>url</i>)	Returns an Image object that encapsulates the image found at the location specified by <i>url</i> .
InputStream getStream(String <i>key</i>)	Returns the stream linked to <i>key</i> . Keys are linked to streams by using the setStream() method. A null reference is returned if no stream is linked to <i>key</i> .
Iterator<String> getStreamKeys()	Returns an iterator for the keys associated with the invoking object. The keys are linked to streams. See getStream() and setStream() .
void setStream(String <i>key</i> , InputStream <i>strm</i>) throws IOException	Links the stream specified by <i>strm</i> to the key passed in <i>key</i> . The <i>key</i> is deleted from the invoking object if <i>strm</i> is null .
void showDocument(URL <i>url</i>)	Brings the document at the URL specified by <i>url</i> into view. This method may not be supported by applet viewers.
void showDocument(URL <i>url</i> , String <i>where</i>)	Brings the document at the URL specified by <i>url</i> into view. This method may not be supported by applet viewers. The placement of the document is specified by <i>where</i> as described in the text.
void showStatus(String <i>str</i>)	Displays <i>str</i> in the status window.

Table 10.4.-2 The Methods Defined by the **AppletContext** Interface

The following applet demonstrates **AppletContext** and **showDocument()**. Upon execution, it obtains the current applet context and uses that context to transfer control to a file called **Test.html**. This file must be in the same directory as the applet. **Test.html** can contain any valid hypertext that you like.

```

/* Using an applet context, getCodeBase(),
   and showDocument() to display an HTML file.
*/

import java.awt.*;
import java.applet.*;
import java.net.*;
/*
<applet code="ACDemo" width=300 height=50>
</applet>
*/

public class ACDemo extends Applet {
    public void start() {
        AppletContext ac = getAppletContext();
        URL url = getCodeBase(); // get url of this applet

        try {
            ac.showDocument(new URL(url+"Test.html"));
        } catch (MalformedURLException e) {
            showStatus("URL not found");
        }
    }
}

```

The AudioClip Interface

The **AudioClip** interface defines these methods: **play()** (play a clip from the beginning), **stop()** (stop playing the clip), and **loop()** (play the loop continuously). After you have loaded an audio clip using **getAudioClip()**, you can use these methods to play it.

The AppletStub Interface

The **AppletStub** interface provides the means by which an applet and the browser (or applet viewer) communicate. Your code will not typically implement this interface.

Outputting to the Console

Although output to an applet's window must be accomplished through GUI-based methods, such as **drawString()**, it is still possible to use console output in your applet—especially for debugging purposes. In an applet, when you call a method such as **System.out.println()**, the output is not sent to your applet's window. Instead, it appears either in the console session in which you launched the applet viewer or in the Java console that is available in some browsers. Use of console output for purposes other than debugging is discouraged, since it violates the design principles of the graphical interface most users will expect.