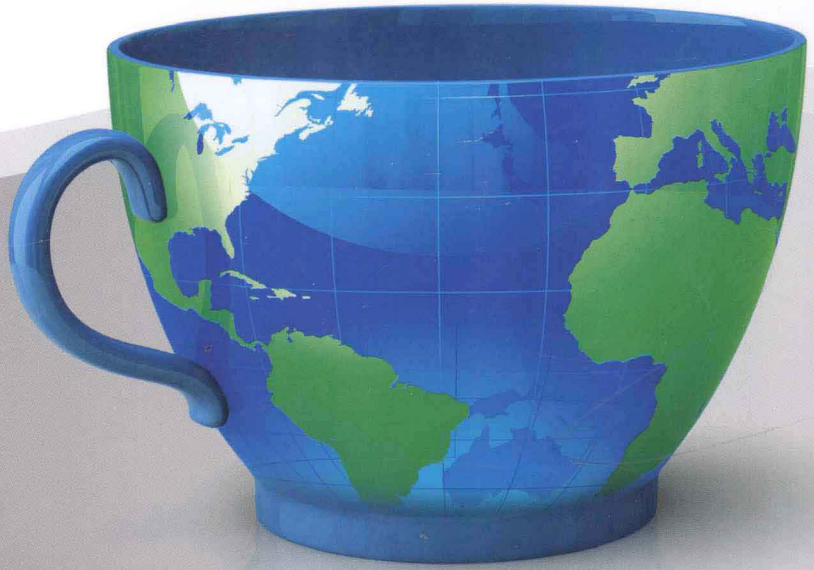
PEARSON

JAVA™ 核心技术

Core Java Volume I — Fundamentals, Ninth Edition

卷 I：基础知识 下

（第9版·英文版）



[美] Cay S. Horstmann　Gary Cornell 著

人民邮电出版社
POSTS & TELECOM PRESS

JAVA 核心技术

Core Java Volume I — Fundamentals, Ninth Edition

卷 I：基础知识 下

（第9版·英文版）

[美] Cay S. Horstmann　Gary Cornell 著

人 民 邮 电 出 版 社

北 京

Contents

CHAPTER 10

Deploying Applications and Applets

In this chapter:

At this point, you should be comfortable with using most of the features of the Java programming language, and you've had a pretty thorough introduction to basic graphics programming in Java. Now that you are ready to create applications for your users, you will want to know how to package them for deployment on your users' computers. The traditional deployment choice—which was responsible for the unbelievable hype during the first few years of Java's life—is to use *applets*. An applet is a special kind of Java program that a Java-enabled browser can download from the Internet and run. The hopes were that users would be freed from the hassles of installing software and that they could access their software from any Java-enabled computer or device with an Internet connection.

For a number of reasons, applets never quite lived up to these expectations. Therefore, we will start this chapter with instructions for packaging applications. We then turn to the *Java Web Start* mechanism—an alternative approach for Internet-based application delivery which fixes some of the problems of applets.

Finally, we will cover applets and show you in which circumstances you still want to use them.

We will also discuss how your applications can store configuration information and user preferences.

10.1 JAR Files

When you package your application, you want to give your users a single file, not a directory structure filled with class files. Java Archive (JAR) files were designed for this purpose. A JAR file can contain both class files and other file types such as image and sound files. Moreover, JAR files are compressed, using the familiar ZIP compression format.

TIP: An alternative to the ZIP format is the "pack200" compression scheme that is specifically tuned to compress class files more efficiently. Oracle claims a compression rate of close to 90% for class files. See http://docs.oracle.com/javase/1.5.0/docs/guide/deployment/deployment-guide/pack200.html for more information.

Use the `jar` tool to make JAR files. (In the default JDK installation, it's in the *jdk*`/bin` directory.) The most common command to make a new JAR file uses the following syntax:

```
jar cvf JARFileName File1 File2 . . .
```

For example:

```
jar cvf CalculatorClasses.jar *.class icon.gif
```

In general, the `jar` command has the following format:

```
jar options File1 File2 . . .
```

Table 10.1 lists all the options for the `jar` program. They are similar to the options of the UNIX `tar` command.

You can package application programs, program components (sometimes called "beans"—see Chapter 8 of Volume II), and code libraries into JAR files. For example, the runtime library of the JDK is contained in a very large file `rt.jar`.

Table 10.1 jar Program Options

Option	Description
c	Creates a new or empty archive and adds files to it. If any of the specified file names are directories, the jar program processes them recursively.
C	Temporarily changes the directory. For example, `jar cvf JARFileName.jar -C classes *.class` changes to the classes subdirectory to add class files.
e	Creates an entry point in the manifest (see Section 10.1.2, "Executable JAR Files," on p. 568).
f	Specifies the JAR file name as the second command-line argument. If this parameter is missing, jar will write the result to standard output (when creating a JAR file) or read it from standard input (when extracting or tabulating a JAR file).
i	Creates an index file (for speeding up lookups in a large archive).
m	Adds a *manifest* to the JAR file. A manifest is a description of the archive contents and origin. Every archive has a default manifest, but you can supply your own if you want to authenticate the contents of the archive.
M	Does not create a manifest file for the entries.
t	Displays the table of contents.
u	Updates an existing JAR file.
v	Generates verbose output.
x	Extracts files. If you supply one or more file names, only those files are extracted. Otherwise, all files are extracted.
0	Stores without ZIP compression.

10.1.1 The Manifest

In addition to class files, images, and other resources, each JAR file contains a *manifest* file that describes special features of the archive.

The manifest file is called MANIFEST.MF and is located in a special META-INF subdirectory of the JAR file. The minimum legal manifest is quite boring—just

```
Manifest-Version: 1.0
```

Complex manifests can have many more entries. The manifest entries are grouped into sections. The first section in the manifest is called the *main section*. It applies to the whole JAR file. Subsequent entries can specify properties of named entities such as individual files, packages, or URLs. Those entries must begin with a `Name` entry. Sections are separated by blank lines. For example:

```
Manifest-Version: 1.0
lines describing this archive

Name: Woozle.class
lines describing this file
Name: com/mycompany/mypkg/
lines describing this package
```

To edit the manifest, place the lines that you want to add to the manifest into a text file. Then run

```
jar cfm JARFileName ManifestFileName . . .
```

For example, to make a new JAR file with a manifest, run

```
jar cfm MyArchive.jar manifest.mf com/mycompany/mypkg/*.class
```

To update the manifest of an existing JAR file, place the additions into a text file and use a command such as

```
jar ufm MyArchive.jar manifest-additions.mf
```

NOTE: See http://docs.oracle.com/javase/7/docs/technotes/guides/jar for more information on the JAR and manifest file formats.

10.1.2 Executable JAR Files

You can use the `e` option of the `jar` command to specify the *entry point* of your program—the class that you would normally specify when invoking the `java` program launcher:

```
jar cvfe MyProgram.jar com.mycompany.mypkg.MainAppClass files to add
```

Alternatively, you can specify the *main class* of your program in the manifest, including a statement of the form

```
Main-Class: com.mycompany.mypkg.MainAppClass
```

Do not add a `.class` extension to the main class name.

CAUTION: The last line in the manifest must end with a newline character. Otherwise, the manifest will not be read correctly. It is a common error to produce a text file containing just the `Main-Class` line without a line terminator.

With either method, users can simply start the program as

```
java -jar MyProgram.jar
```

Depending on the operating system configuration, users may even be able to launch the application by double-clicking the JAR file icon. Here are behaviors for various operating systems:

- On Windows, the Java runtime installer creates a file association for the "`.jar`" extension that launches the file with the `javaw -jar` command. (Unlike the `java` command, the `javaw` command doesn't open a shell window.)
- On Solaris, the operating system recognizes the "magic number" of a JAR file and starts it with the `java -jar` command.
- On Mac OS X, the operating system recognizes the "`.jar`" file extension and executes the Java program when you double-click a JAR file.

However, a Java program in a JAR file does not have the same feel as a native application. On Windows, you can use third-party wrapper utilities that turn JAR files into Windows executables. A wrapper is a Windows program with the familiar `.exe` extension that locates and launches the Java virtual machine (JVM) or tells the user what to do when no JVM is found. There are a number of commercial and open source products, such as JSmooth (http://jsmooth.sourceforge.net) and Launch4J (http://launch4j.sourceforge.net). The open source installer generator IzPack (http://izpack.org) also contains a native launcher. For more information on this topic, see www.javalobby.org/articles/java2exe.

On the Macintosh, the situation is a bit easier. The Jar Bundler utility that is a part of XCode lets you turn a JAR file into a first-class Mac application.

10.1.3 Resources

Classes used in both applets and applications often have associated data files, such as

- Image and sound files;
- Text files with message strings and button labels; or
- Files with binary data, for example, to describe the layout of a map.

In Java, such an associated file is called a *resource*.

NOTE: In Windows, the term "resource" has a more specialized meaning. Windows resources also consist of images, button labels, and so on, but they are attached to the executable file and accessed by a standard programming interface. In contrast, Java resources are stored as separate files, not as part of class files. It is up to each program to access and interpret the resource data.

For example, consider a class, `AboutPanel`, that displays a message such as the one in Figure 10.1.

Of course, the book title and copyright year in the panel will change for the next edition of the book. To make it easy to track this change, we will put the text inside a file and not hardcode it as a string.

But where should you put a file such as `about.txt`? Of course, it would be convenient to simply place it with the rest of the program files inside the JAR file.

The class loader knows how to search for class files until it has located them somewhere on the class path, or in an archive, or on a web server. The resource mechanism gives you the same convenience for files that aren't class files. Here are the necessary steps:

1. Get the `Class` object of the class that has a resource—for example, `AboutPanel.class`.
2. If the resource is an image or audio file, call `getResource(filename)` to get the resource location as a URL. Then read it with the `getImage` or `getAudioClip` method.

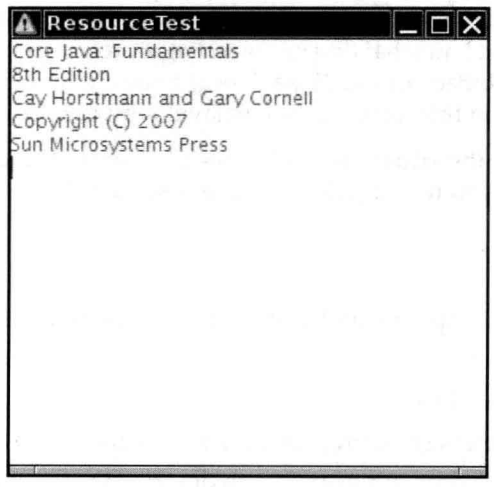


Figure 10.1 Displaying a resource from a JAR file

3. For resources other than images or audio files, use the `getResourceAsStream` method to read the data in the file.

The point is that the class loader remembers how to locate the class, so it can then search for the associated resource in the same location.

For example, to make an icon with the image file `about.gif`, do the following:

```
URL url = ResourceTest.class.getResource("about.gif");
Image img = new ImageIcon(url).getImage();
```

That means "locate the `about.gif` file in the same place where you found the `ResourceTest` class."

To read in the file `about.txt`, use these commands:

```
InputStream stream = ResourceTest.class.getResourceAsStream("about.txt");
Scanner in = new Scanner(stream);
```

Instead of placing a resource file inside the same directory as the class file, you can place it in a subdirectory. You can then use a hierarchical resource name such as

```
data/text/about.txt
```

This is a relative resource name, and it is interpreted relative to the package of the class that loads the resource. Note that you must always use the / separator, regardless of the directory separator on the system that actually stores the resource files. For example, on the Windows file system, the resource loader automatically translates / to \ separators.

A resource name starting with a / is called an absolute resource name. It is located in the same way a class inside a package would be located. For example, a resource

```
/corejava/title.txt
```

is located in the `corejava` directory which may be a subdirectory of the class path, inside a JAR file, or, for applets, on a web server.

Automating the loading of files is all the resource loading feature does. There are no standard methods for interpreting the contents of a resource file. Each program must have its own way of interpreting its resource files.

Another common application of resources is the internationalization of programs. Language-dependent strings, such as messages and user interface labels, are stored in resource files, with one file per language. The *internationalization API*, which is discussed in Chapter 5 of Volume II, supports a standard method for organizing and accessing these localization files.

Listing 10.1 is a program that demonstrates resource loading. Compile, build a JAR file, and execute it:

```
javac ResourceTest.java
jar cvfm ResourceTest.jar ResourceTest.mf *.class *.gif *.txt
java -jar ResourceTest.jar
```

Move the JAR file to a different directory and run it again to check that the program reads the resource files from the JAR file, not from the current directory.

Listing 10.1 resource/ResourceTest.java

```
1  package resource;
2
3  import java.awt.*;
4  import java.io.*;
5  import java.net.*;
6  import java.util.*;
7  import javax.swing.*;
8
9  /**
10  * @version 1.4 2007-04-30
11  * @author Cay Horstmann
12  */
13 public class ResourceTest
14 {
15    public static void main(String[] args)
16    {
17       EventQueue.invokeLater(new Runnable()
18          {
19             public void run()
20             {
21                JFrame frame = new ResourceTestFrame();
22                frame.setTitle("ResourceTest");
23                frame.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
24                frame.setVisible(true);
25             }
26          });
27    }
28 }
29
30 /**
31  * A frame that loads image and text resources.
32  */
```

```
33 class ResourceTestFrame extends JFrame
34 {
35    private static final int DEFAULT_WIDTH = 300;
36    private static final int DEFAULT_HEIGHT = 300;
37
38    public ResourceTestFrame()
39    {
40       setSize(DEFAULT_WIDTH, DEFAULT_HEIGHT);
41       URL aboutURL = getClass().getResource("about.gif");
42       Image img = new ImageIcon(aboutURL).getImage();
43       setIconImage(img);
44
45       JTextArea textArea = new JTextArea();
46       InputStream stream = getClass().getResourceAsStream("about.txt");
47       Scanner in = new Scanner(stream);
48       while (in.hasNext())
49          textArea.append(in.nextLine() + "\n");
50       add(textArea);
51    }
52 }
```

java.lang.Class 1.0

- `URL getResource(String name)` 1.1
- `InputStream getResourceAsStream(String name)` 1.1

  finds the resource in the same place as the class and then returns a URL or input stream that you can use for loading the resource. Returns `null` if the resource isn't found, so does not throw an exception for an I/O error.

10.1.4 Sealing

We mentioned in Chapter 4 that you can *seal* a Java language package to ensure that no further classes can add themselves to it. You would want to seal a package if you use package-visible classes, methods, and fields in your code. Without sealing, other classes can place themselves into the same package and thereby gain access to its package-visible features.

For example, if you seal the package `com.mycompany.util`, then no class outside the sealed archive can be defined with the statement

```
package com.mycompany.util;
```

To achieve this, put all classes of the package into a JAR file. By default, packages in a JAR file are not sealed. You can change that global default by placing the line

```
Sealed: true
```