Servlet Basics

Originals of Slides and Source Code for Examples:
http://courses.coreservlets.com/Course-Materials/csajsp2.html

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Taught by the author of Core Servlets and JSP, More Servlets and JSP, and this tutorial. Available at public venues, or customized versions can be held on-site at your organization. Contact hall@coreservlets.com for details.
Agenda

• The basic structure of servlets
• A simple servlet that generates plain text
• A servlet that generates HTML
• Using helper classes
• Giving URLs to servlets
  – @WebServlet annotation
  – web.xml file
• The servlet life cycle
• Servlet debugging strategies

Overview

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A Servlet’s Job

- Read explicit data sent by client (form data)
- Read implicit data sent by client (request headers)
- Generate the results
- Send the explicit data back to client (HTML)
- Send the implicit data to client (status codes and response headers)

Simple Servlets

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A Servlet That Generates Plain Text (HelloWorld.java)

```java
package testPackage; // Always use packages.
import java.io.*;
import javax.servlet.*;
import javax.servlet.annotation.*;
import javax.servlet.http.*;

@WebServlet("/hello")
public class HelloWorld extends HttpServlet {
    @Override
    public void doGet(HttpServletRequest request, HttpServletResponse response)
            throws ServletException, IOException {
        PrintWriter out = response.getWriter();
        out.println("Hello World");
    }
}
```

URL assumes you have deployed from a project named "test-app". Code can be downloaded from Web site. General form is http://hostName/appName/address-from-WebServlet-annotation. Review previous tutorial section for info on how to deploy the app from Eclipse.

Interpreting HelloWorld Servlet

- **@WebServlet("/address")**
  - This is the URL relative to the app name. More later.
- **doGet**
  - Code for an HTTP GET request. doPost also common.
- **HttpServletRequest**
  - Contains anything that comes from the browser
- **HttpServletResponse**
  - Used to send stuff to the browser. Most common is getWriter for a PrintWriter that points at browser.
- **@Override**
  - General best practice when overriding inherited methods
    - But, I will omit on many of my PowerPoint slides to conserve space. Downloadable source has @Override.
A Servlet That Generates HTML

- Tell the browser that you’re sending it HTML
  - `response.setContentType("text/html");`;
- Modify the println statements to build a legal Web page
  - Print statements should output HTML tags
- Check your HTML with a formal syntax validator
  - [w3.org validator](http://validator.w3.org/)
  - [htmlhelp.com validator](http://www.htmlhelp.com/tools/validator/)

Caveat: As of 2010, it became moderately conventional to use the HTML 5 DOCTYPE: `<!DOCTYPE html>`. Even in 2012, few browsers have full support for HTML 5, but the HTML 5 doctype declaration is supported in practice by virtually all browsers. My examples use a mix of this doctype, the formal HTML 4 doctype, and the formal xhtml doctype.

HTML 5 Document Format

```html
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="utf-8"/>
<link href="css/some-stylesheet.css" rel="stylesheet"/>
<script src="scripts/some-script.js"></script>
</head>
<body>
...
</body>
</html>
```

Note the simple DOCTYPE, simplified meta tag, and omission of "type" in both the style sheet and script references. All of those work in old, pre-HTML5 browsers.
@WebServlet("/test1")
public class TestServlet extends HttpServlet {
    public void doGet(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
        response.setContentType("text/html");
        PrintWriter out = response.getWriter();
        out.println
            ("<!DOCTYPE html>
             <html>
             <head><title>A Test Servlet</title></head>
             <body bgcolor="#f9f5e6">
             <h1>Test</h1>
             <p>Simple servlet for testing.</p>
             </body></html>");
    }
}

Assumes project is named test-app.

Eclipse users can use the TestServlet code as a basis for their own servlets.
Avoid using "New → Servlet" in Eclipse since it results in ugly code.
Idea

• All Java code goes in the same place
  – In Eclipse, it is src/packageName
    • It does not matter if code is for a servlet, helper class, filter, bean, custom tag class, or anything else
• Don’t forget OOP principles
  – If you find you are doing the same logic multiple times, put the logic in a helper class and reuse it
• Simple example here
  – Generates HTML. Building HTML from a helper class is probably not really worth it for real projects (JSP is better), but we haven’t covered logic in servlets yet. But the general principle still holds: if you are doing the same thing in several servlets, move the code into shared class.
public class ServletUtilities {
    public static String headWithTitle(String title) {
        return("<!DOCTYPE html>
" +
        "<html>
" +
        "<head><title>" + title + "</title></head>
" +
        "<body bgcolor="#fdf5e6">
" +
        "<h1>" + title + "</h1>
" +
        "<p>Simple servlet for testing.</p>
" +
        "</body></html>" +
        "</body><html>
");
    }
    ...
}

• Don’t go overboard
  – Complete HTML generation packages usually work poorly
    • The JSP framework is a better solution
  – More important is to avoid repeating logic. ServletUtilities has a few methods for that, as will be seen later

TestServlet2

... @WebServlet("/test-with-utils")
public class TestServlet2 extends HttpServlet {
    public void doGet(HttpServletRequest request,
     HttpServletResponse response)
         throws ServletException, IOException {
            response.setContentType("text/html");
            PrintWriter out = response.getWriter();
            String title = "Test Servlet with Utilities";
            out.println
            (ServletUtilities.headWithTitle(title) +
            "<body bgcolor="#fdf5e6">\n" +
            "<h1>" + title + "</h1>\n" +
            "<p>Simple servlet for testing.</p>\n" +
            "</body>\n" +
            "</html>");
        }
    }
TestServlet2: Result

Assumes project is named test-app.

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Tomcat 7 or Other Servlet 3.0 Containers

- **Give address with @WebServlet**
  ```
  @WebServlet("/my-address")
  public class MyServlet extends HttpServlet { … }
  ```
  - Resulting URL
    - http://hostName/appName/my-address

- **Omit web.xml entirely**
  - You are permitted to use web.xml even when using @WebServlet, but the entire file is completely optional.
    - In earlier versions, you must have a web.xml file even if there were no tags other than the main start and end tags (<web-app ...> and </web-app>).

Example: URLs with @WebServlet

```java
package testPackage;
...
@WebServlet("/test1")
public class TestServlet extends HttpServlet {
    public void doGet(HttpServletRequest request, HttpServletResponse response)
        throws ServletException, IOException {
        response.setContentType("text/html");
        PrintWriter out = response.getWriter();
        out.println
          ("<!DOCTYPE html>
          ...");
    }
}
```
Defining Custom URLs in web.xml (Servlets 2.5 & Earlier)

- **Java code**
  ```java
  package myPackage;  ...
  public class MyServlet extends HttpServlet { ... }
  ```

- **web.xml entry (in `<web-app...>...</web-app>`)**
  - Give name to servlet
    ```xml
    <servlet>
      <servlet-name>MyName</servlet-name>
      <servlet-class>myPackage.MyServlet</servlet-class>
    </servlet>
    ```
  - Give address (URL mapping) to servlet
    ```xml
    <servlet-mapping>
      <servlet-name>MyName</servlet-name>
      <url-pattern>/my-address</url-pattern>
    </servlet-mapping>
    ```

- **Resultant URL**
  - http://hostname/appName/my-address

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Defining Custom URLs: Example

```xml
<?xml version="1.0" encoding="UTF-8"?>
<web-app version="2.4">
  <!-- Use the URL http://hostName/appName/test2 for testPackage.TestServlet -->
  <servlet>
    <servlet-name>Test</servlet-name>
    <servlet-class>testPackage.TestServlet</servlet-class>
  </servlet>
  <servlet-mapping>
    <servlet-name>Test</servlet-name>
    <url-pattern>/test2</url-pattern>
  </servlet-mapping>
</web-app>
```

- Don't edit this manually. Should match version supported by your server. If your server supports 3.0, can omit web.xml totally and use annotations.
- Fully qualified classname.
- Any arbitrary name. But must be the same both times.
- The part of the URL that comes after the app (project) name. Should start with a slash.
Defining Custom URLs: Result

- **Eclipse details**
  - Name of Eclipse project is “test-app”
  - Servlet is in `src/testPackage/TestServlet.java`
  - Deployed by right-clicking on Tomcat, Add and Remove Projects, Add, choosing test-app project, Finish, right-clicking again, Start (or Restart)
The Servlet Life Cycle

- **init**
  - Executed once when the servlet is first loaded. 
    *Not* called for each request.

- **service**
  - Called in a new thread by server for each request. 
    Dispatches to doGet, doPost, etc. 
    Do not override this method!

- **doGet, doPost, doBlah**
  - Handles GET, POST, etc. requests. 
  - Override these to provide desired behavior.

- **destroy**
  - Called when server deletes servlet instance. 
    *Not* called after each request.

Why You Should **Not** Override service

- **The service method does other things besides just calling doGet**
  - You can add support for other services later by adding doPost, doTrace, etc.
  - You can add support for modification dates by adding a getLastModified method
  - The service method gives you automatic support for:
    - HEAD requests
    - OPTIONS requests
    - TRACE requests

- **Alternative: have doPost call doGet**
Debugging Servlets

- Use print statements; run server on desktop
- Use Apache Log4J
- Integrated debugger in IDE
  - Right-click in left margin in source to set breakpoint (Eclipse)
  - R-click Tomcat and use “Debug” instead of “Start”
- Look at the HTML source
- Return error pages to the client
  - Plan ahead for missing or malformed data
- Use the log file
  - log("message") or log("message", Throwable)
- Separate the request and response data.
  - Request: see EchoServer at www.coreservlets.com
  - Response: see WebClient at www.coreservlets.com
- Make sure browser is not caching
  - Internet Explorer: use Shift-RELOAD
  - Firefox: use Control-RELOAD
- Stop and restart the server

Wrap-Up
Summary

• **Main servlet code goes in doGet or doPost:**
  – The HttpServletRequest contains the incoming information
  – The HttpServletResponse lets you set outgoing information
    - Call setContentType to specify MIME type
    - Call getWriter to obtain a Writer pointing to client (browser)
    - Make sure output is legal HTML
• **Give address with @WebServlet or web.xml**
  @WebServlet("/some-address")
  public class SomeServlet extends HttpServlet { … }

• Resulting URL
  – http://hostName/appName/some-address

Questions?

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