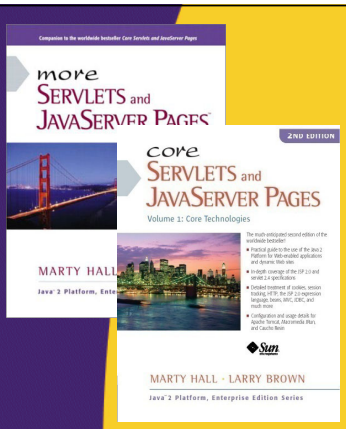
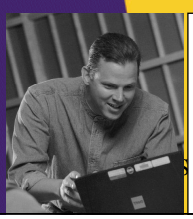
Servlet Basics

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





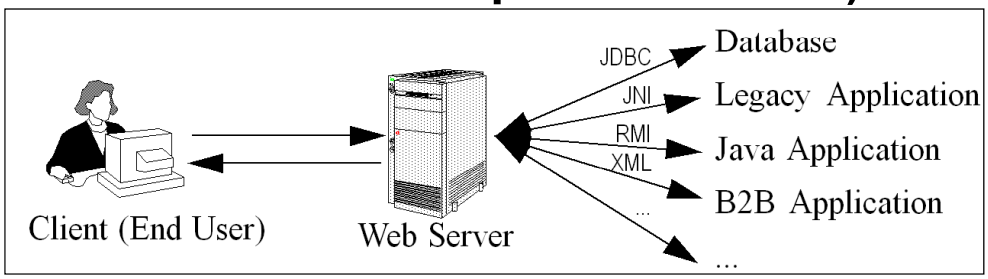
Agenda

- 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

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)



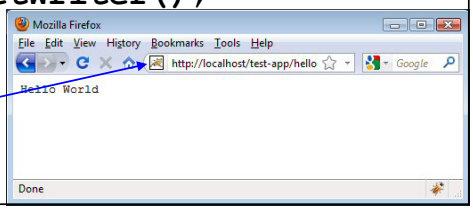
Simple Servlets

A Servlet That Generates Plain Text (HelloWorld.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

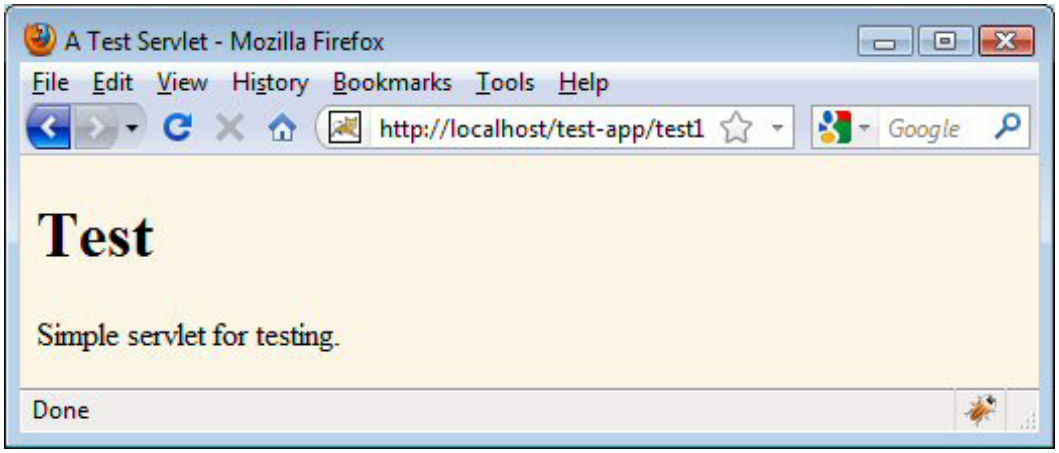
- **Tell the browser that you're sending it HTML**
  - response.setContentType("text/html");
- **Modify the println statements to build a legal Web page**
  - Print statements should output HTML tags
- **Check your HTML with a formal syntax validator**
  - http://validator.w3.org/
  - http://www.htmlhelp.com/tools/validator/

Caveat: As of 2010, it has become moderately conventional to use the HTML 5 DOCTYPE: <!DOCTYPE html>. Even though few browsers have full support for HTML 5, this declaration is supported in practice by virtually all browsers. So, most validators will give some warnings or errors, and you have to search for the "real" errors in the list, or use a different declaration. My examples use a mix of this doc type, the formal HTML 4 doc type, and the formal xhtml doc type.

A Servlet That Generates HTML (Code)

```
@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>\n" +
       "<html>\n" +
       "<head><title>A Test Servlet</title></head>\n" +
       "<body bgcolor=\"#fdf5e6\">\n" +
       "<h1>Test</h1>\n" +
       "<p>Simple servlet for testing.</p>\n" +
       "</body></html>");
  }
}
```

A Servlet That Generates HTML (Result)



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.

Using Helper Classes

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, 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 helper class.

A Simple HTML-Building Utility

```
public class ServletUtilities {
  public static String headWithTitle(String title) {
    return("<!DOCTYPE html>\n" +
           "<html>\n" +
           "<head><title>" + title + "</title></head>\n");
  }
  ...
}
```

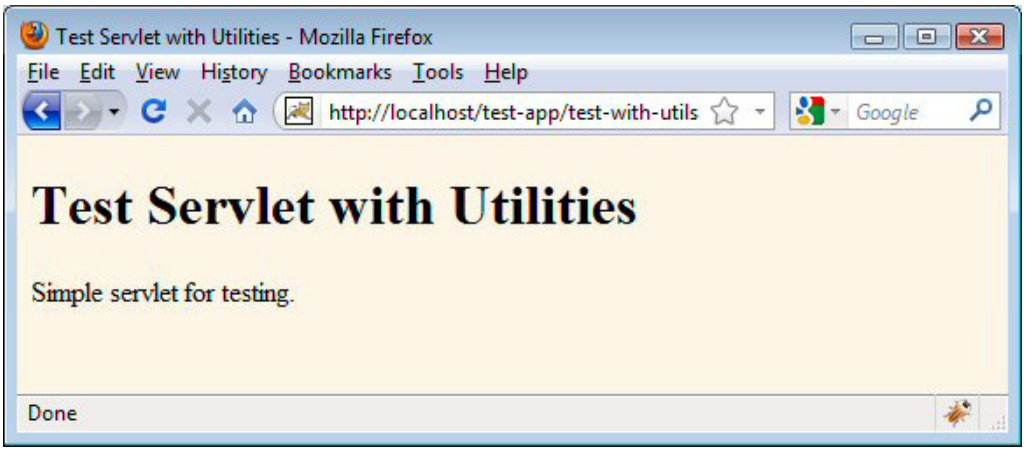
- **Don't go overboard**
  - Complete HTML generation packages usually work poorly
    - The JSP framework is a better solution
  - More important is to avoid repeating logic. ServletUtilities has a few methods for that, as will be seen later

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></html>");
  }
}
```


TestServlet2: Result



Assumes project is named test-app.

Custom URLs and web.xml

Tomcat 7 or Other Servlet 3.0 Containers

- **Give address with @WebServlet**

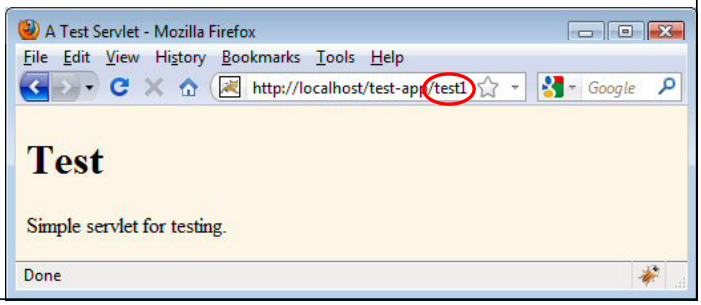
```
@WebServlet("/my-address")
public class MyServlet extends HttpServlet { … }
```

  - 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

```
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>\n" +
       …);
  }
}
```



Defining Custom URLs in web.xml (Servlets 2.5 & Earlier)

- **Java code**

```
package myPackage;  ...
public class MyServlet extends HttpServlet { ... }
```

- **web.xml entry (in <web-app...>...</web-app>)**
  - Give name to servlet

```
<servlet>
  <servlet-name>MyName</servlet-name>
  <servlet-class>myPackage.MyServlet</servlet-class>
</servlet>
```

  - Give address (URL mapping) to servlet

```
<servlet-mapping>
  <servlet-name>MyName</servlet-name>
  <url-pattern>/my-address</url-pattern>
</servlet-mapping>
```

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

Defining Custom URLs: Example

```
<?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>
```

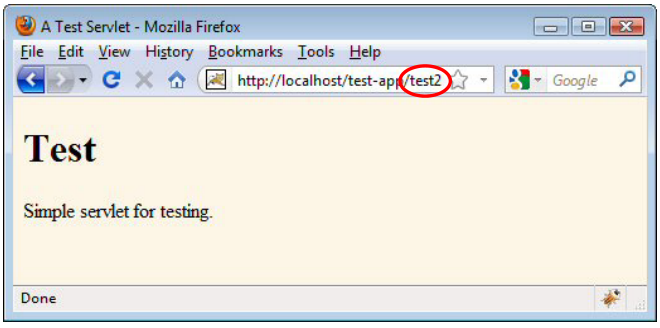
Don't edit this manually. Should match version supported by your server. If your server supports 3.0, can omit web.xml totally and use annotations.

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)

Advanced Topics

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, do*Blah***
  - 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 doPut, 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?