Getting familiar with Tomcat

Apache Tomcat

https://tomcat.apache.org/whichversion.html

Apache Tomcat Versions

Servlet Spec	JSP Spec	EL Spec	WebSocket Spec	Authentication (JASIC) Spec	Apache Tomcat Version	Latest Released Version	Supported Java Versions
6.0	3.1	5.0	TBD	TBD	10.1.x	10.1.0-M5 (alpha)	11 and later
5.0	3.0	4.0	2.0	2.0	10.0.x	10.0.11	8 and later
4.0	2.3	3.0	1.1	1.1	9.0.x	9.0.53	8 and later
3.1	2.3	3.0	1.1	1.1	8.5.x	8.5.71	7 and later
3.1	2.3	3.0	1.1	N/A	8.0.x (superseded)	8.0.53 (superseded)	7 and later
3.0	2.2	2.2	1.1	N/A	7.0.x (archived)	7.0.109 (archived)	6 and later (7 and later for WebSocket)
2.5	2.1	2.1	N/A	N/A	6.0.x (archived)	6.0.53 (archived)	5 and later
2.4	2.0	N/A	N/A	N/A	5.5.x (archived)	5.5.36 (archived)	1.4 and later
2.3	1.2	N/A	N/A	N/A	4.1.x (archived)	4.1.40 (archived)	1.3 and later
2.2	1.1	N/A	N/A	N/A	3.3.x (archived)	3.3.2 (archived)	1.1 and later

SELECT VERSION 9 (Why?)

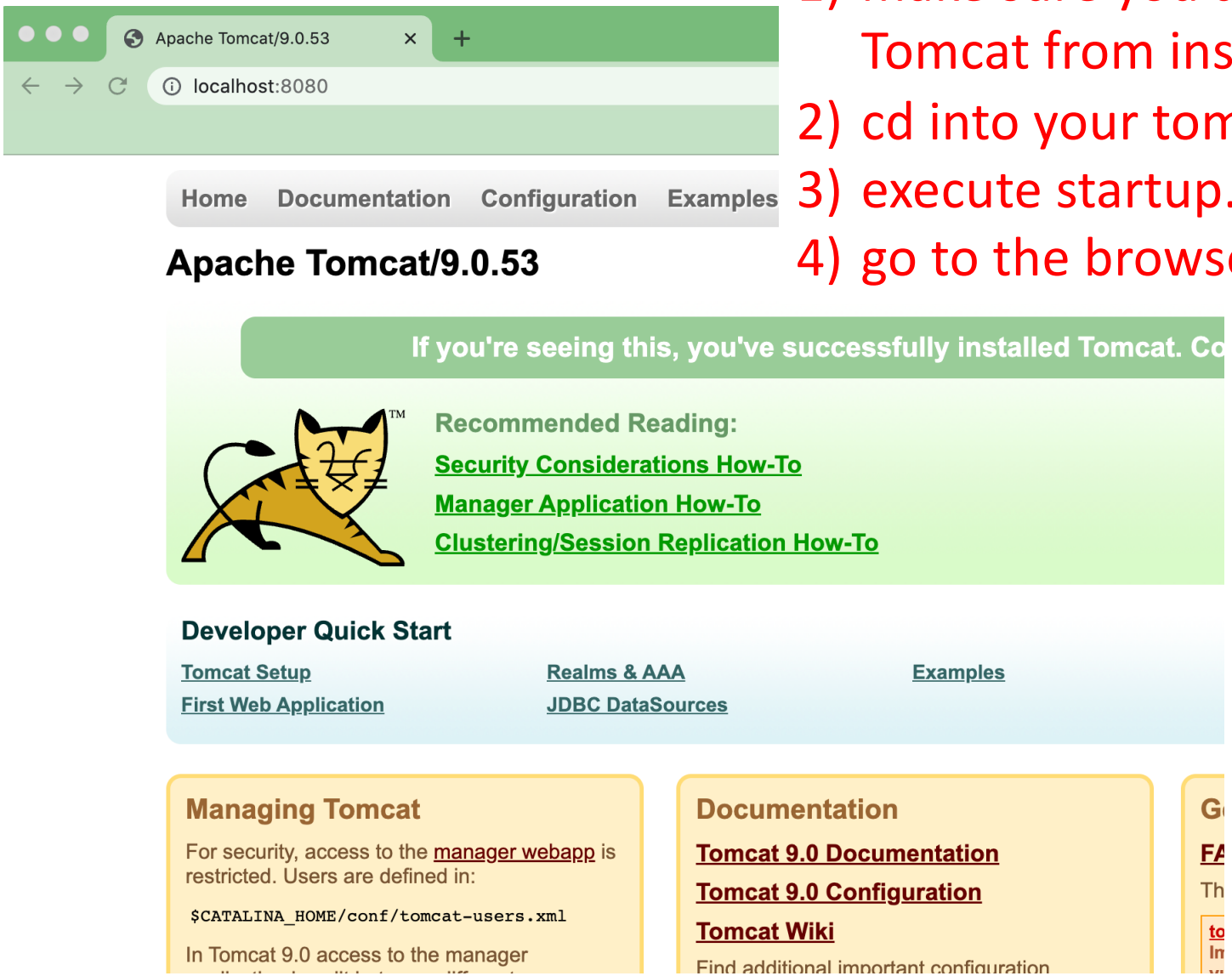
if necessary…

1) cd into your tomcat bin directory
2) make all .sh files executable

```
MR-MacBookPro:~ ronchet$ cd /Users/ronchet/Download/apache-tomcat-9.0.53/bin
MR-MacBookPro:bin ronchet$ ls -la
total 1760
drwxr-xr-x@ 29 ronchet  staff     928 Sep  6 23:09 .
drwxr-xr-x@ 17 ronchet  staff     544 Sep 16 10:36 ..
-rw-r--r--@  1 ronchet  staff   34705 Sep  6 23:09 bootstrap.jar
-rw-r--r--@  1 ronchet  staff    1703 Sep  6 23:09 catalina-tasks.xml
-rw-r--r--@  1 ronchet  staff   16840 Sep  6 23:09 catalina.bat
-rw-r--r--@  1 ronchet  staff   25294 Sep  6 23:09 catalina.sh
-…
-rw-r--r--@  1 ronchet  staff    2026 Sep  6 23:09 version.bat
-rw-r--r--@  1 ronchet  staff    1908 Sep  6 23:09 version.sh
MR-MacBookPro:bin ronchet$ chmod a+x *.sh
MR-MacBookPro:bin ronchet$
```

start Tomcat from command line:

1) make sure you are NOT using Tomcat from inside IntelliJ
2) cd into your tomcat bin directory
3) execute startup.sh or startup.bat
4) go to the browser

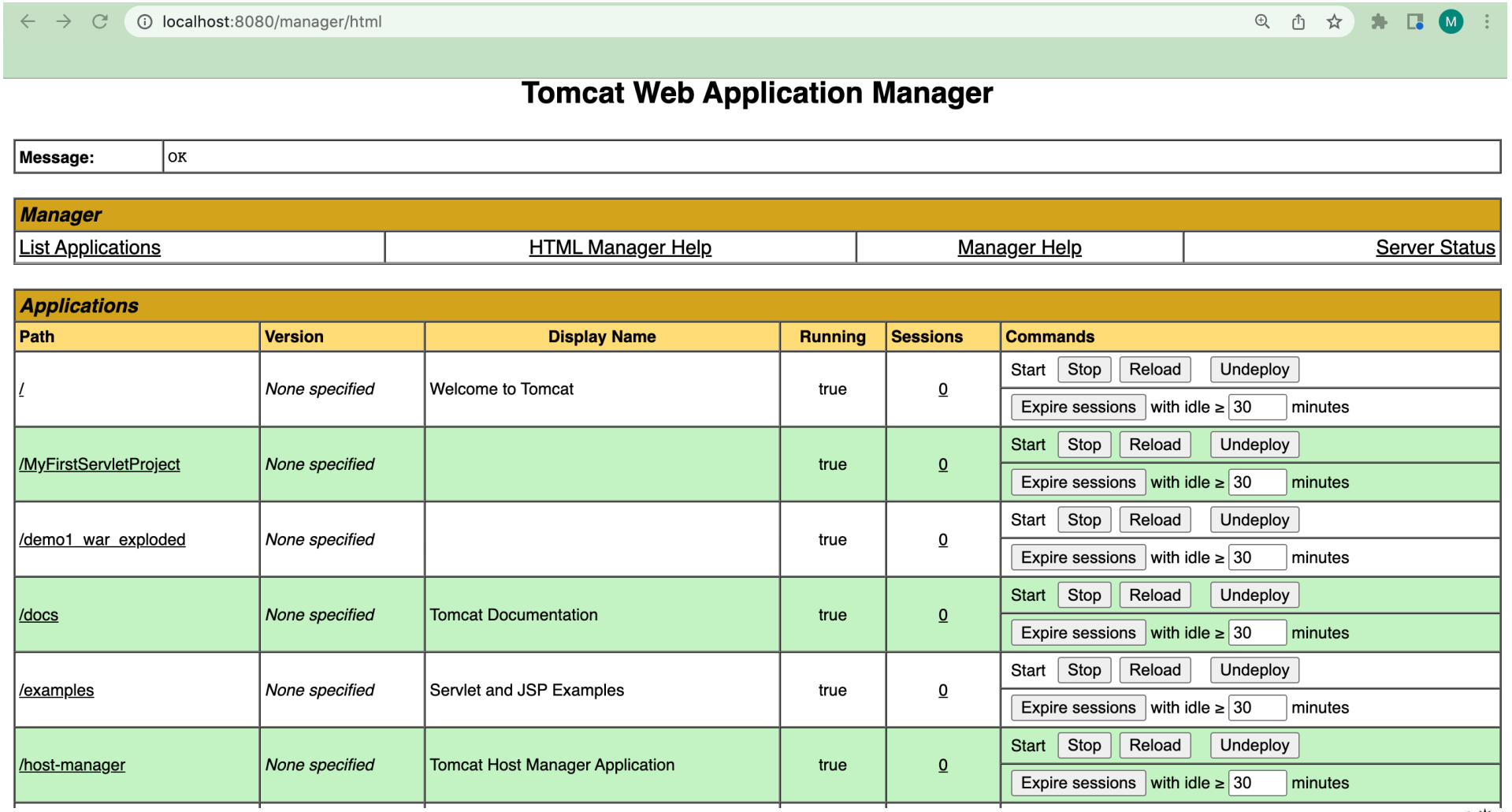


Web App Manager

Managing Tomcat

For security, access to the manager webapp is restricted. Users are defined in:

```
$CATALINA_HOME/conf/tomcat-users.xml
```



Create a user

- Make sure Intellij is quit.
- edit file [TOMCAT-HOME]/conf/tomcat-users.xml
- towards the end, add a line like

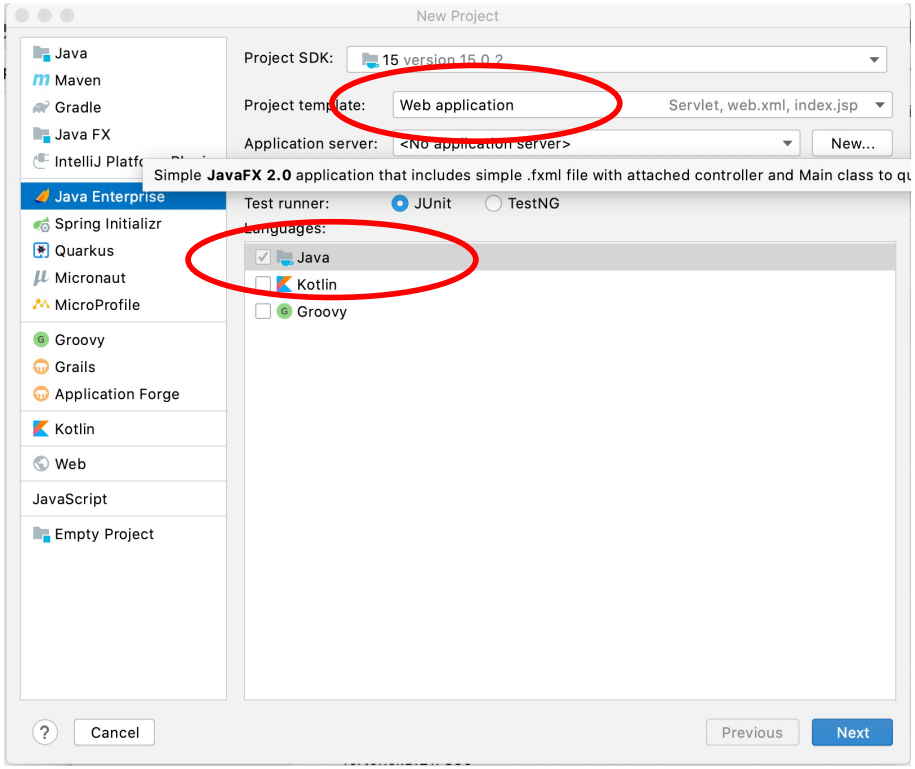
```
49  <!--
50    <role rolename="tomcat"/>
51    <role rolename="role1"/>
52    <user username="tomcat" password="<must-be-changed>" roles="tomcat"/>
53    <user username="both" password="<must-be-changed>" roles="tomcat,role1"/>
54    <user username="role1" password="<must-be-changed>" roles="role1"/>
55  -->
56  <user username="ronchet" password="secret" roles="standard,manager-script,manager-gui" />
57  </tomcat-users>
58
```

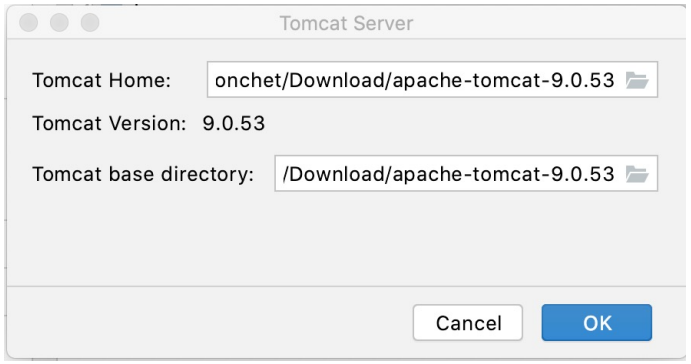
- start tomcat:
- cd file [TOMCAT-HOME]/bin
- ./startup.sh

```
MR-MacBookPro:bin ronchet$ ./startup.sh
Using CATALINA_BASE:   /Users/ronchet/Download/apache-tomcat-9.0.53
Using CATALINA_HOME:   /Users/ronchet/Download/apache-tomcat-9.0.53
Using CATALINA_TMPDIR: /Users/ronchet/Download/apache-tomcat-9.0.53/temp
Using JRE_HOME:        /Users/ronchet/Library/Java/JavaVirtualMachines/adopt-ope
njdk-15.0.2/Contents/Home
Using CLASSPATH:       /Users/ronchet/Download/apache-tomcat-9.0.53/bin/bootstra
p.jar:/Users/ronchet/Download/apache-tomcat-9.0.53/bin/tomcat-juli.jar
Using CATALINA_OPTS:
Tomcat started.
MR-MacBookPro:bin ronchet$
```

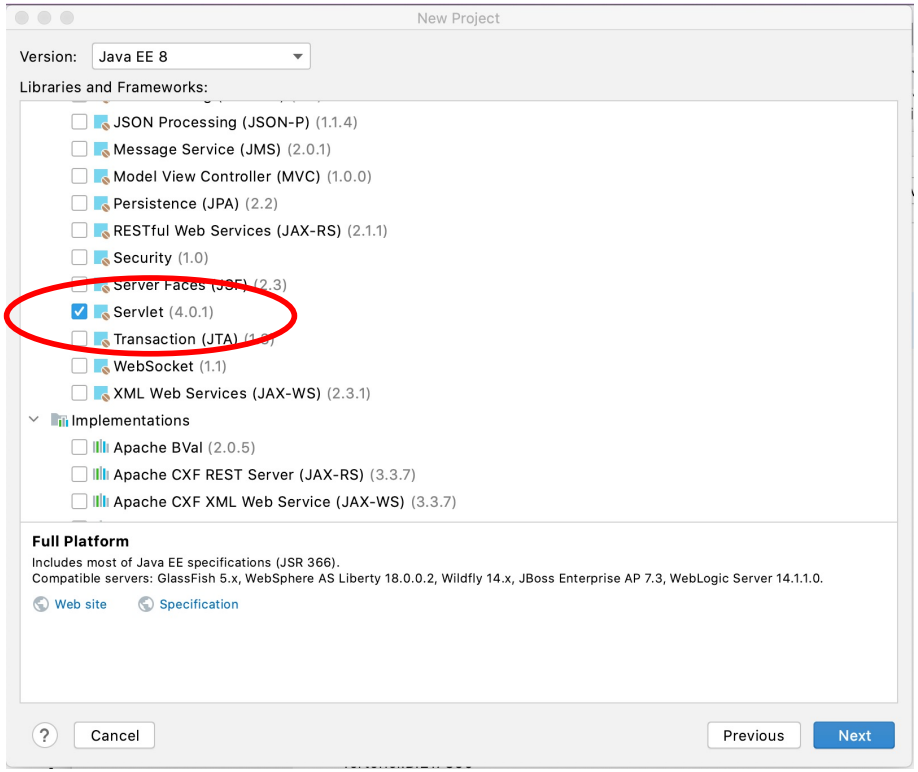
Now let's create a new project with IntelliJ

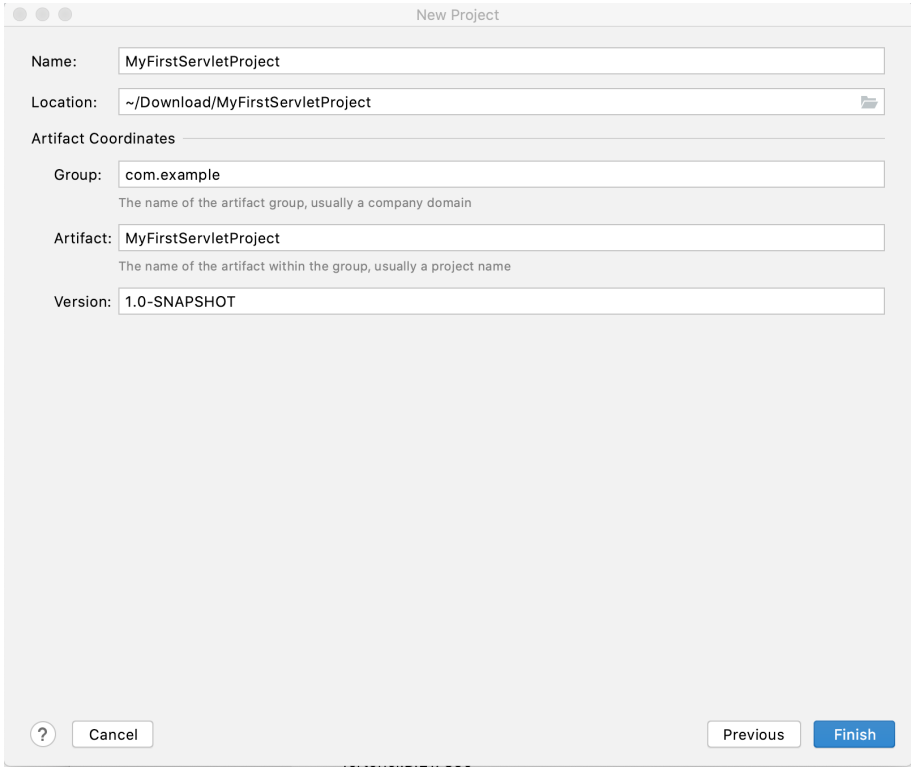
Creating new Project - 1



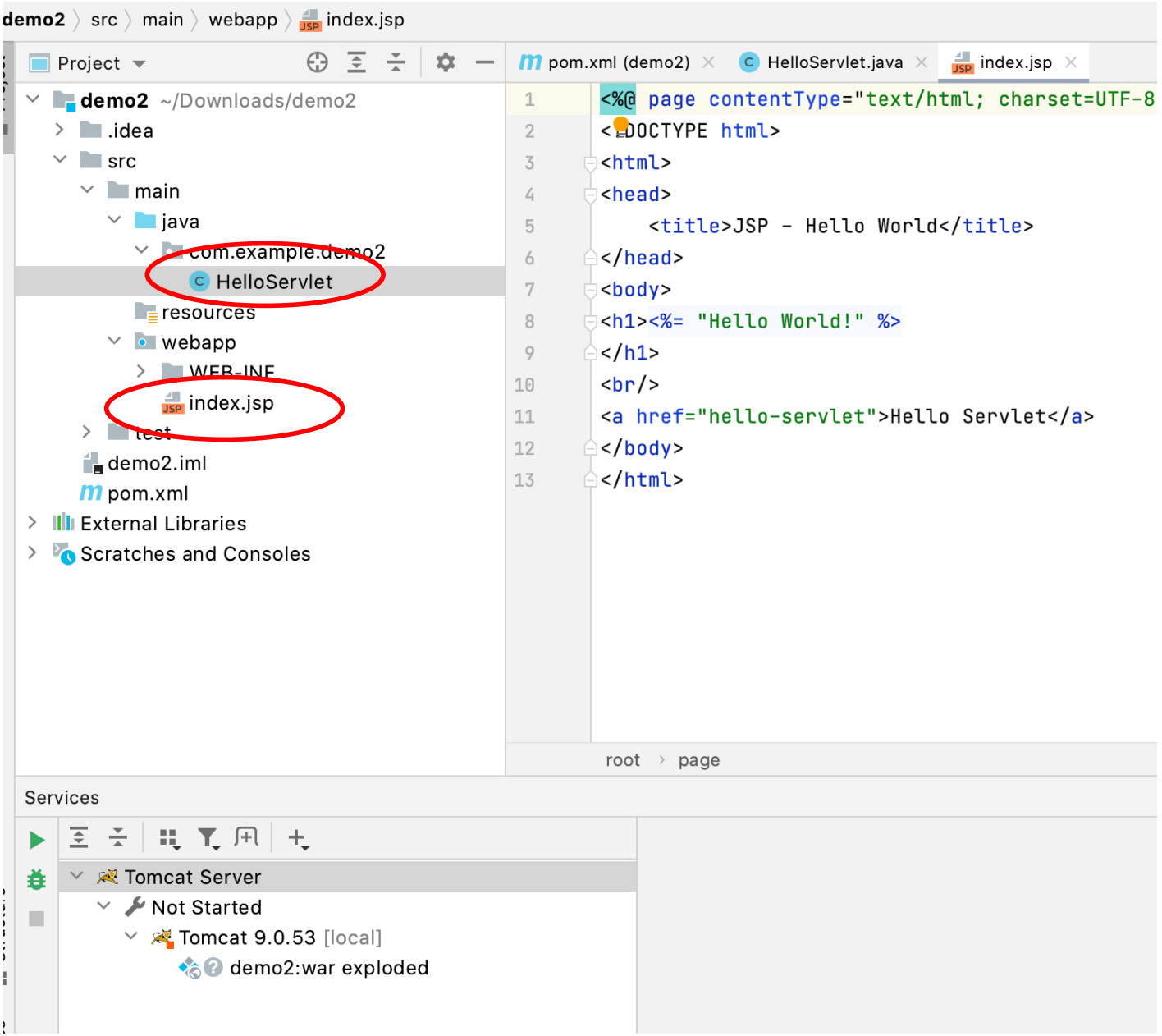


Creating new project -2





Creating new project - 3



Index.jsp

For now, let's consider it as a simple HTML page

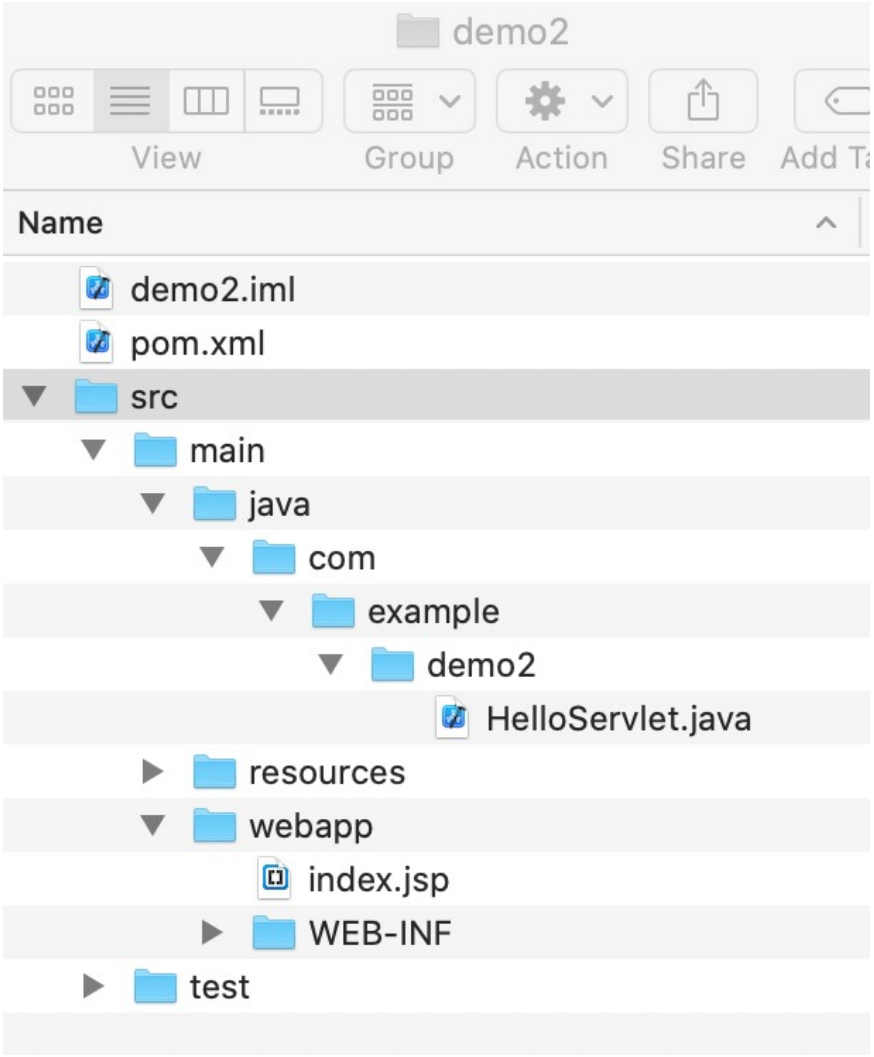
pom.xml (MyFirstServletProject) | HelloServlet.java | index.jsp

```
1  <%@ page contentType="text/html; charset=UTF-8" pageEncoding="UTF-8" %>
2  <!DOCTYPE html>
3  <html>
4  <head>
5      <title>JSP - Hello World</title>
6  </head>
7  <body>
8  <h1><%= "Hello World!" %>
9  </h1>
10 <br/>
11 <a href="hello-servlet">Hello Servlet</a>
12 </body>
13 </html>
```

HelloServlet.java

```java
package com.example.MyFirstServletProject;

import ...

@WebServlet(name = "helloServlet", value = "/hello-servlet")
public class HelloServlet extends HttpServlet {
    private String message;

    public void init() { message = "Hello World!"; }

    public void doGet(HttpServletRequest request, HttpServletResponse response) throws IOException {
        response.setContentType("text/html");

        // Hello
        PrintWriter out = response.getWriter();
        out.println("<html><body>");
        out.println("<h1>" + message + "</h1>");
        out.println("</body></html>");
    }

    public void destroy() {
    }
}
```

Development directory



Servlet Deployment

- By default, a servlet application APP is located at the path

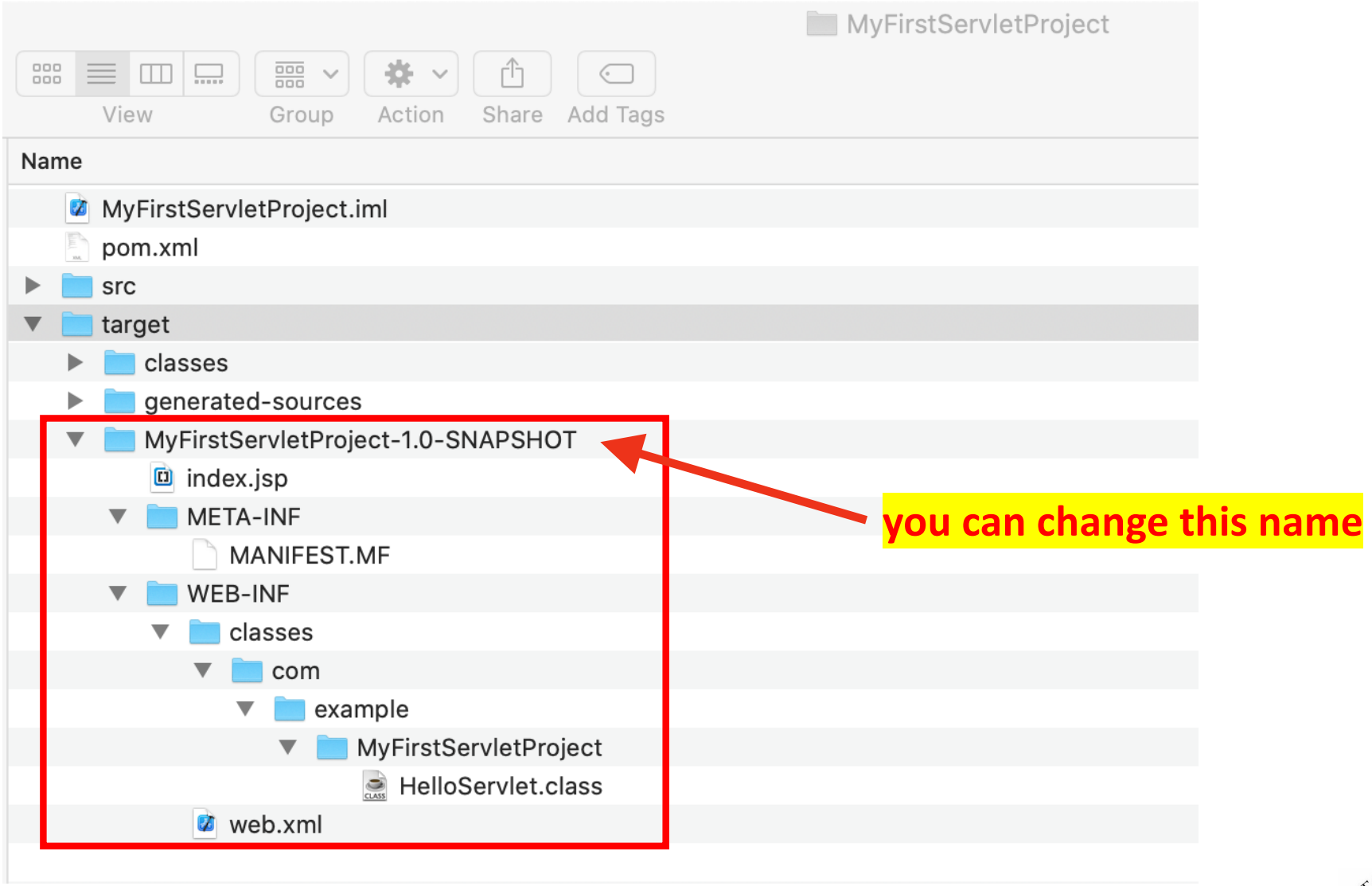
<Tomcat-installationdirectory>/webapps/APP

and the class file would reside in

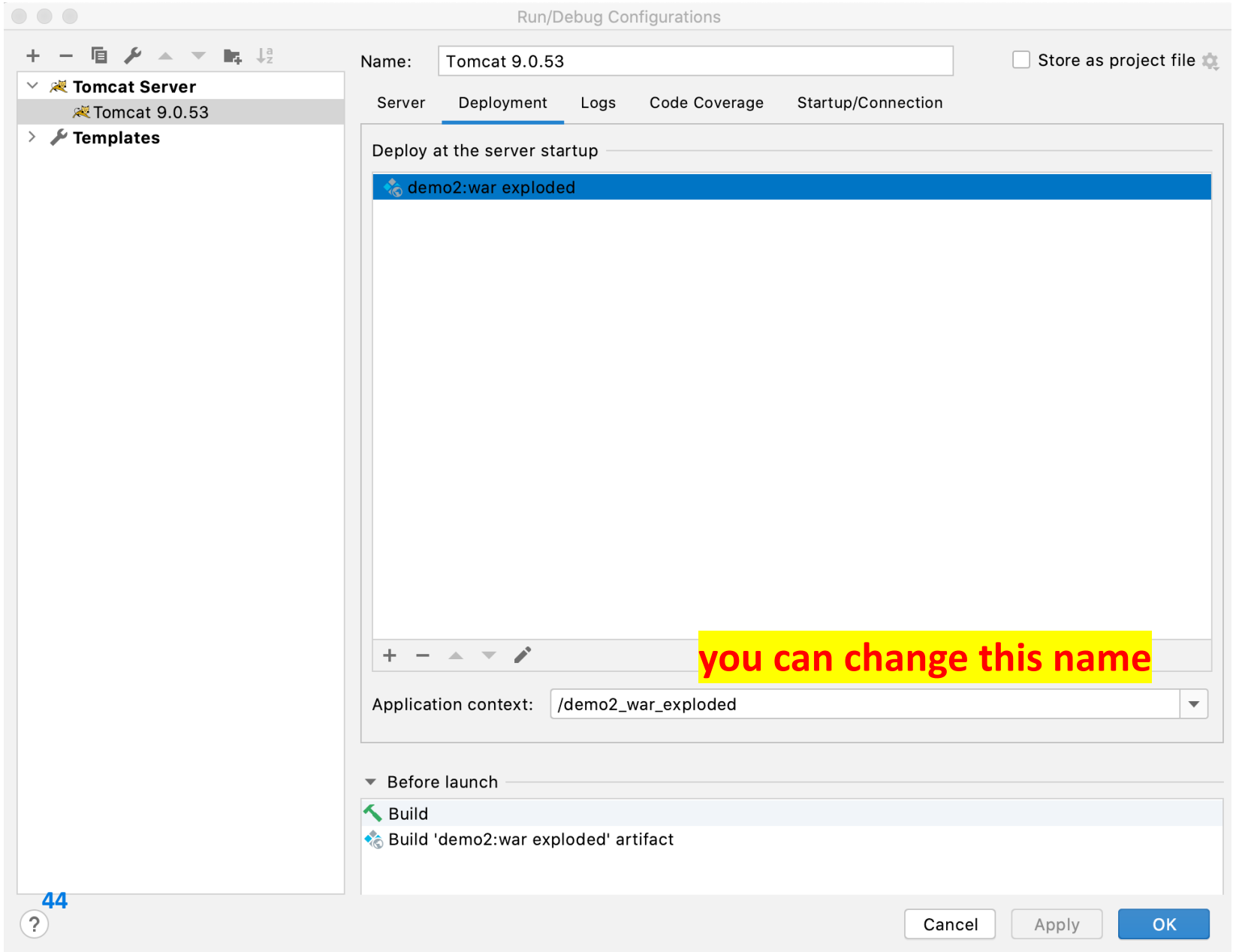
<Tomcat-installationdirectory>/webapps/APP/WEB-INF/classes.

If you have a fully qualified class name of **com.myorg.MyServlet**, then this servlet class must be located in WEB-INF/classes/com/myorg/MyServlet.class.

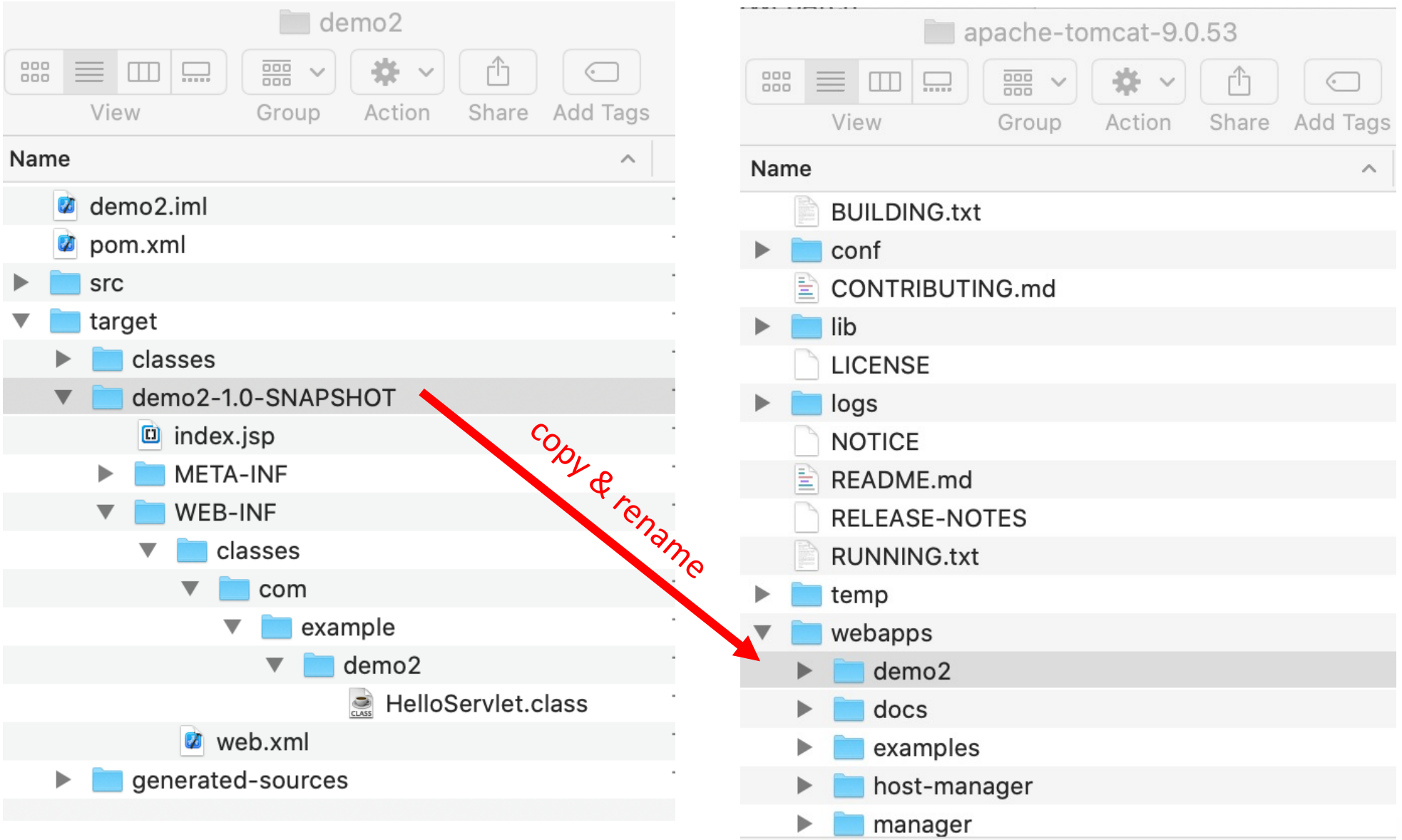
Servlet Deployment



Servlet Deployment

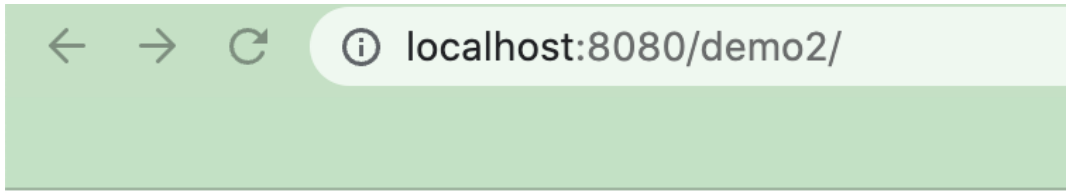


Manual deployment



Restart Tomcat…

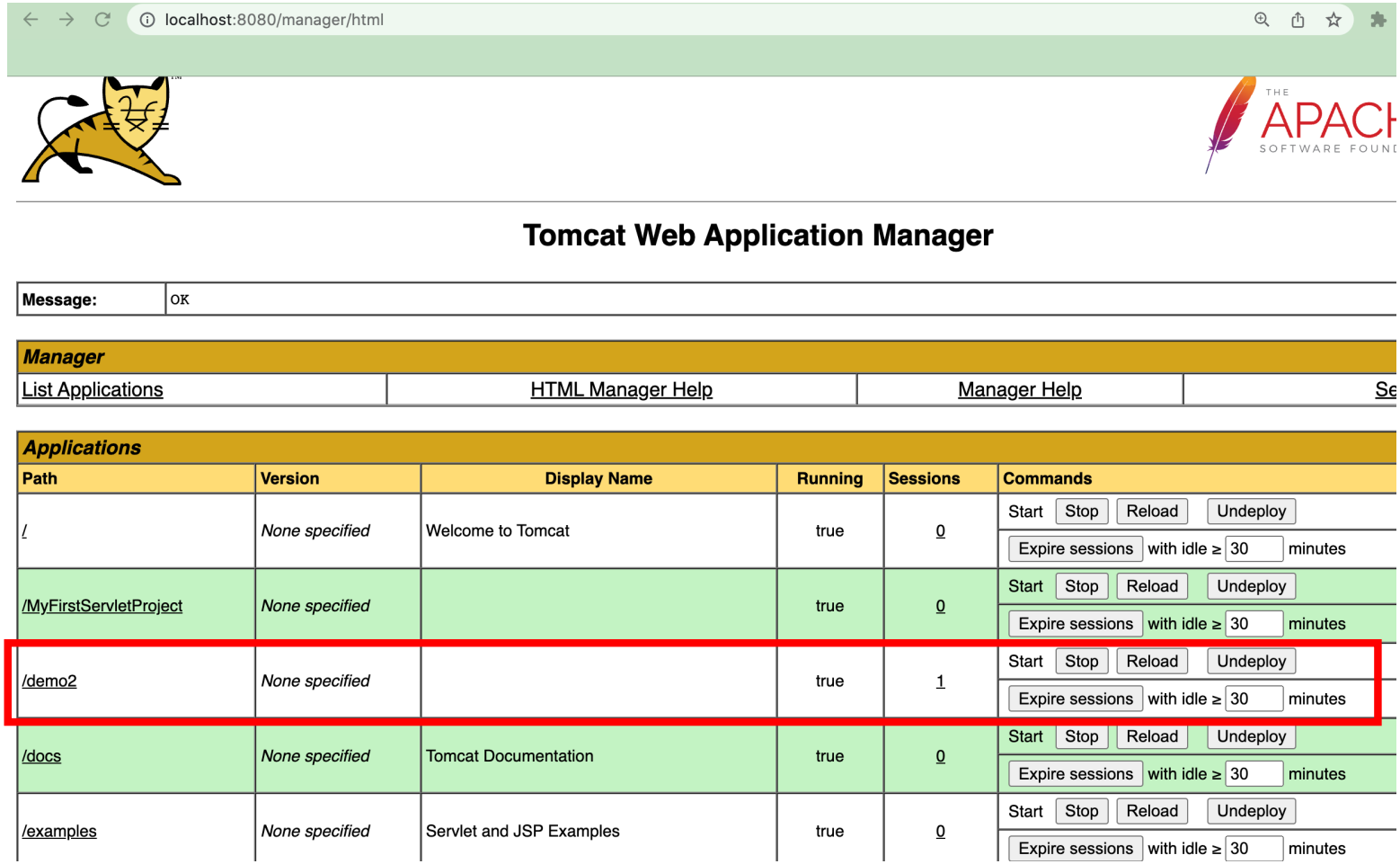
```
MR-MacBookPro:bin ronchet$ ./startup.sh
Using CATALINA_BASE:   /Users/ronchet/Download/apache-tomcat-9.0.53
Using CATALINA_HOME:   /Users/ronchet/Download/apache-tomcat-9.0.53
Using CATALINA_TMPDIR: /Users/ronchet/Download/apache-tomcat-9.0.53/temp
Using JRE_HOME:        /Users/ronchet/.jenv/versions/11.0.10
Using CLASSPATH:       /Users/ronchet/Download/apache-tomcat-9.0.53/bin/bootstra
p.jar:/Users/ronchet/Download/apache-tomcat-9.0.53/bin/tomcat-juli.jar
Using CATALINA_OPTS:
Tomcat started.
MR-MacBookPro:bin ronchet$
```



Hello World!

Hello Servlet

Our app is deployed!



Q

Back to our servlet.

How do we factor out some code ?

Factoring out some HTML

- How can we avoid this horrible stuff?

```
out.println("<!DOCTYPE html>");
out.println("<html>");
out.println("<head>");
out.println("<title>Servlet ReadPost</title>");
out.println("</head>");
out.println("<body>");
out.println("<h1> fname="+name+"</h1>");
out.println("</body>");
out.println("</html>");
```

Factoring out some HTML

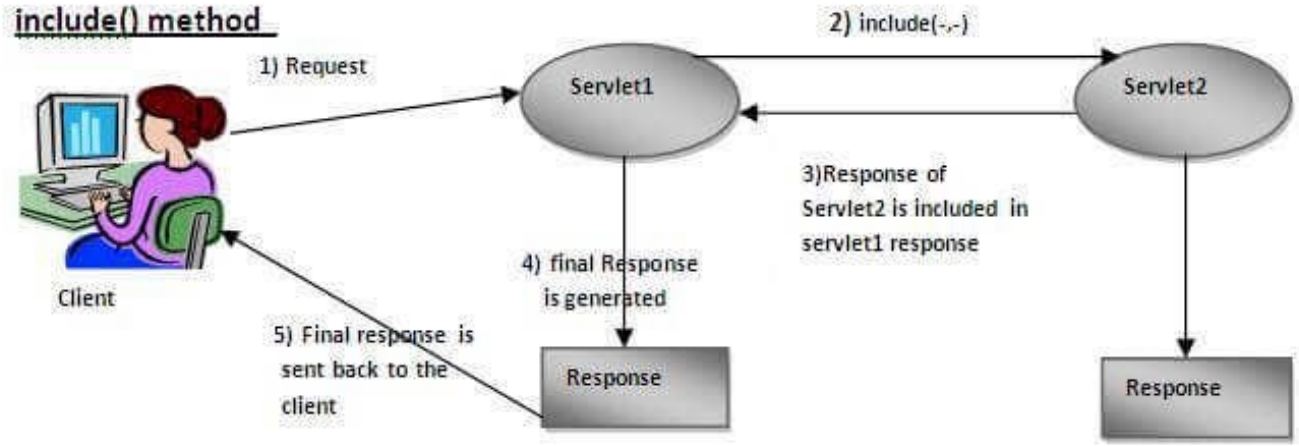
....xm | ReadPost.java | Demo1.java | fragment2.html | fragment1.html | Counter.java | readPost.html

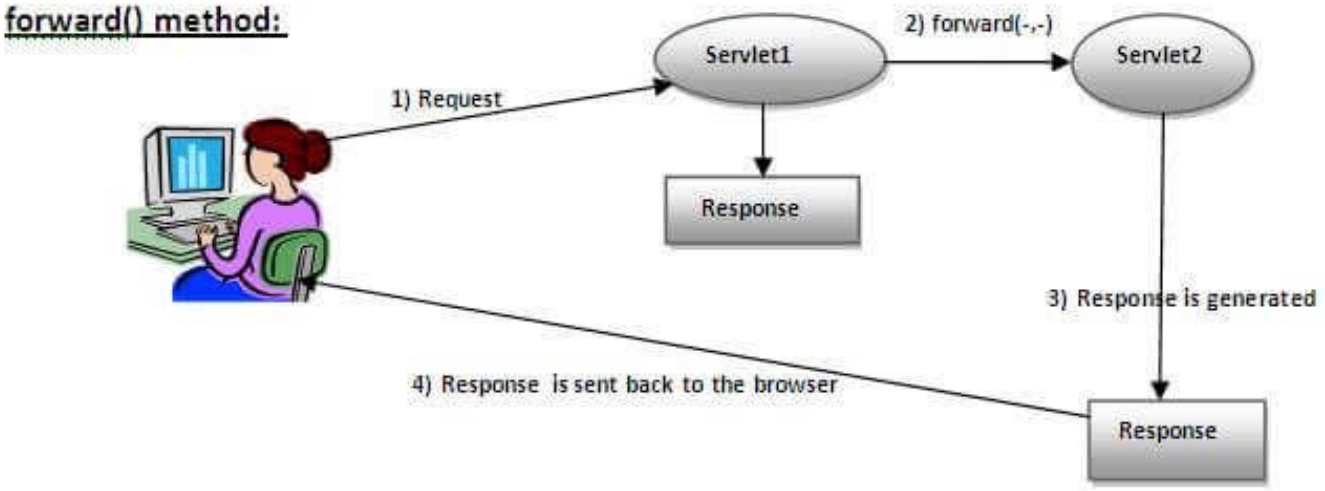
```
1  <!DOCTYPE html>
2  <html>
3      <head>
4          <title>TODO supply a title</title>
5          <meta charset="UTF-8">
6          <meta name="viewport" content="width=device-width, initial-scale=1.0">
7      </head>
8      <body>
9          <h2>fragment 1</h2>
```

....xm | ReadPost.java | Demo1.java | fragment2.html

```
1              <h2>fragment 2</h2>
2          </body>
3      </html>
4
```

Include vs forward

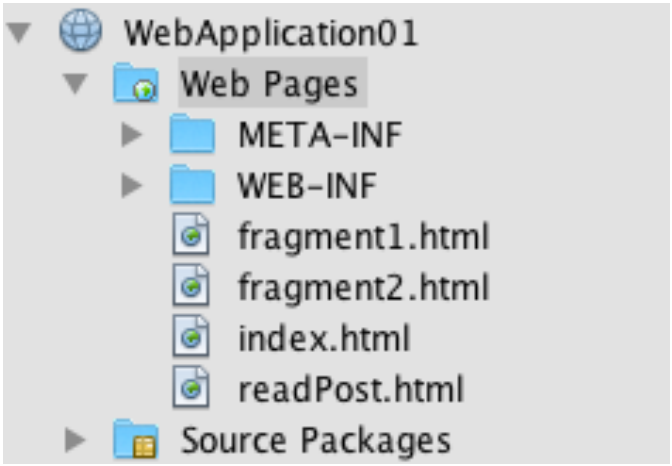




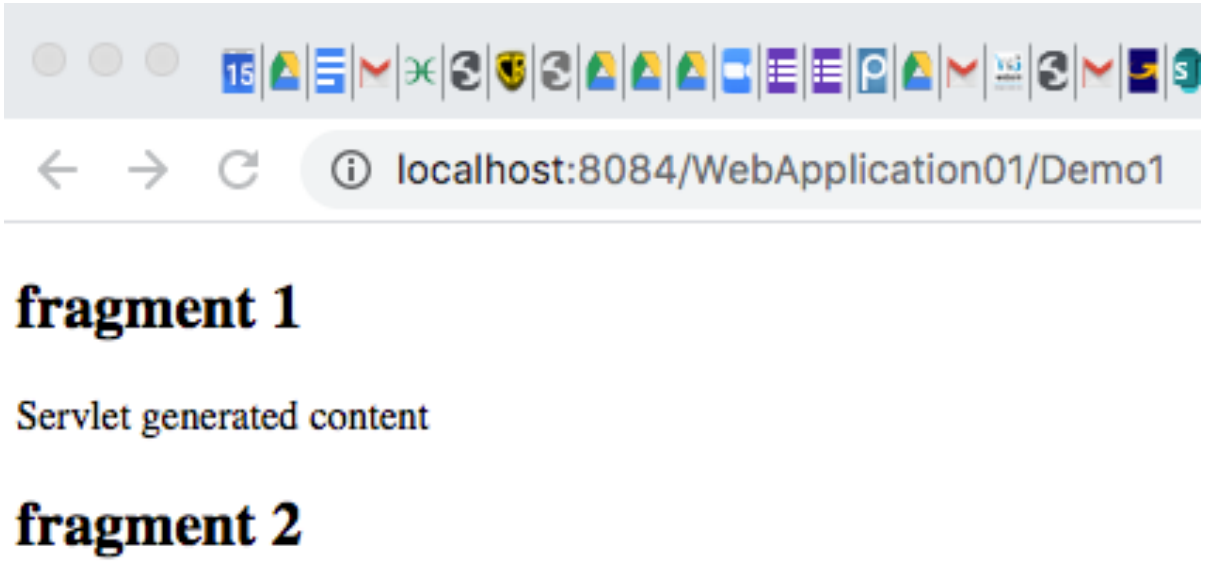
images from
/www.javatpoint.com

example: see https://www.javatpoint.com/requestdispatcher-in-servlet

```
@Override
    protected void doGet(HttpServletRequest request,
HttpServletResponse response) throws ServletException, IOException {
        response.setContentType("text/html;charset=UTF-8");
        try (PrintWriter out = response.getWriter()) {
            request.getRequestDispatcher("/fragment1.html")
                .include(request, response);
            out.println("Servlet generated content");
            request.getRequestDispatcher("/fragment2.html")
                .include(request, response);
        }
}
```



output

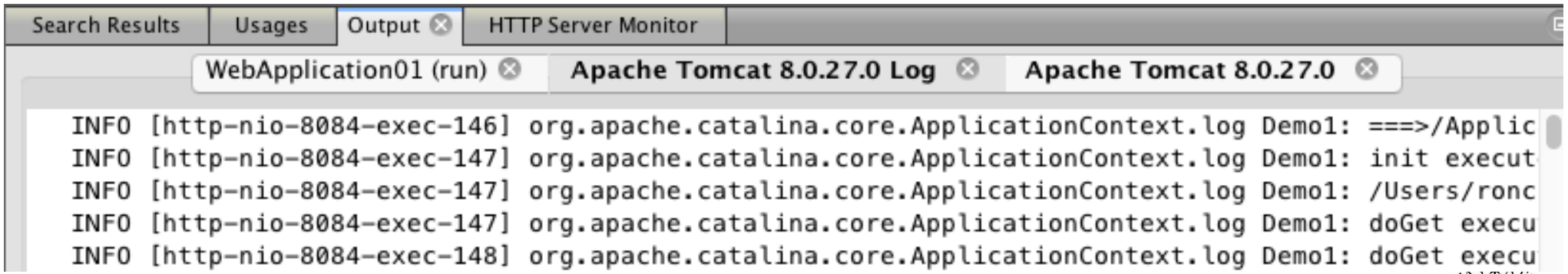

localhost:8084/WebApplication01/Demo1
fragment 1
Servlet generated content
fragment 2

Q

How do we monitor the execution?

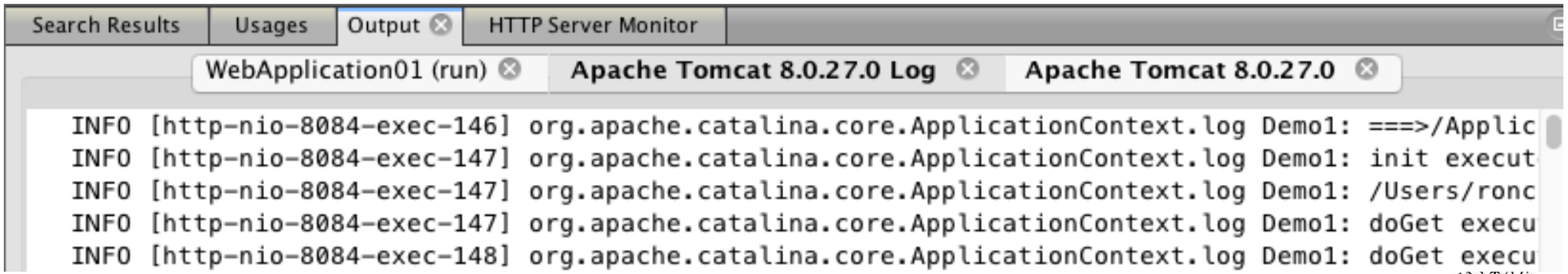
```
public void log(String msg) {
        getServletContext().log(msg);
}

@Override
    public void destroy() {
        log("destroy executed");
}
@Override
    public void init() {
        log("init executed");
}
```

Logging



```
public void log(String msg) {
    filterConfig.getServletContext().log(msg);
}
```

Logging in filters



Getting deeper with Servlets

Let’s build a hit counter

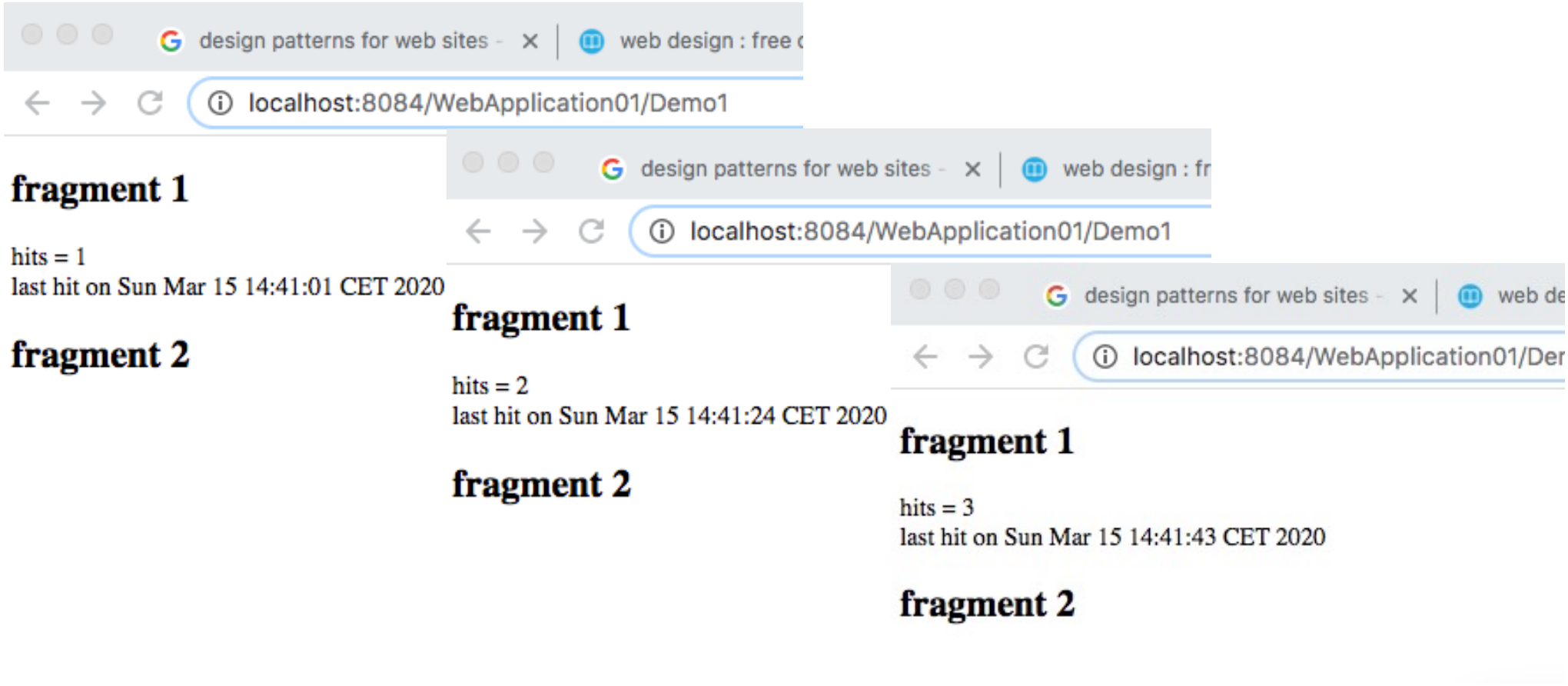
Let us build a hit counter - 1

```
public class Counter {
    int count = 0;
    Calendar timeStamp = Calendar.getInstance();
    public void increase(){
        count++;
        timeStamp = Calendar.getInstance();
    }
    @Override
    public String toString() {
        StringBuffer s = null;
        if (count == 0)
            s = new StringBuffer("<p>no hits yet</p>");
        else {
            s = new StringBuffer("<p>hits = ");
            s.append(count)
                    .append("<br>last hit on ")
                    .append(timeStamp.getTime().toString());
        }
        return s.toString();
    }
}
```


Let us build a hit counter - 2

```
@WebServlet(name = "Demo1", urlPatterns = {"/Demo1"})
public class Demo1 extends HttpServlet {
    Counter counter=new Counter();
    @Override
    protected void doGet(HttpServletRequest request,
            HttpServletResponse response)
            throws ServletException, IOException {
        response.setContentType("text/html;charset=UTF-8");
        try (PrintWriter out = response.getWriter()) {
            request.getRequestDispatcher("/fragment1.html")
                    .include(request, response);
            counter.increase();
            out.println(counter);
            request.getRequestDispatcher("/fragment2.html")
                    .include(request, response);
        }
    }
}
```

Output



But if we restart the server, counter restarts from 1!

How can we persist the counter?

In a file (named counterData)!

1) In init, let us check if file exists. If yes, let us resume the counter, else, let us create a new one.
2) In destroy, let us save counter in conterData.

Java serialization

class A implements Serializable {…}

```
A a1=new A();
A a2;
 …
File myFile = new File(filePath);
…
ObjectOutputStream oi = new ObjectOutputStream(new
        FileOutputStream(myFile));
oi.writeObject(a1);
…
ObjectInputStream oi = new ObjectInputStream(new
        FileInputStream(myFile));
a2 = (A) oi.readObject();
```

(throws various exceptions…

(throws various exceptions…

Let us build a hit counter - 1

```
public class Counter implements Serializable {
    int count = 0;
    Calendar timeStamp = Calendar.getInstance();
    public void increase(){
        count++;
        timeStamp = Calendar.getInstance();
    }
    @Override
    public String toString() {
        StringBuffer s = null;
        if (count == 0)
            s = new StringBuffer("<p>no hits yet</p>");
        else {
            s = new StringBuffer("<p>hits = ");
            s.append(count)
                    .append("<br>last hit on ")
                    .append(timeStamp.getTime().toString());
        }
        return s.toString();
    }
}
```

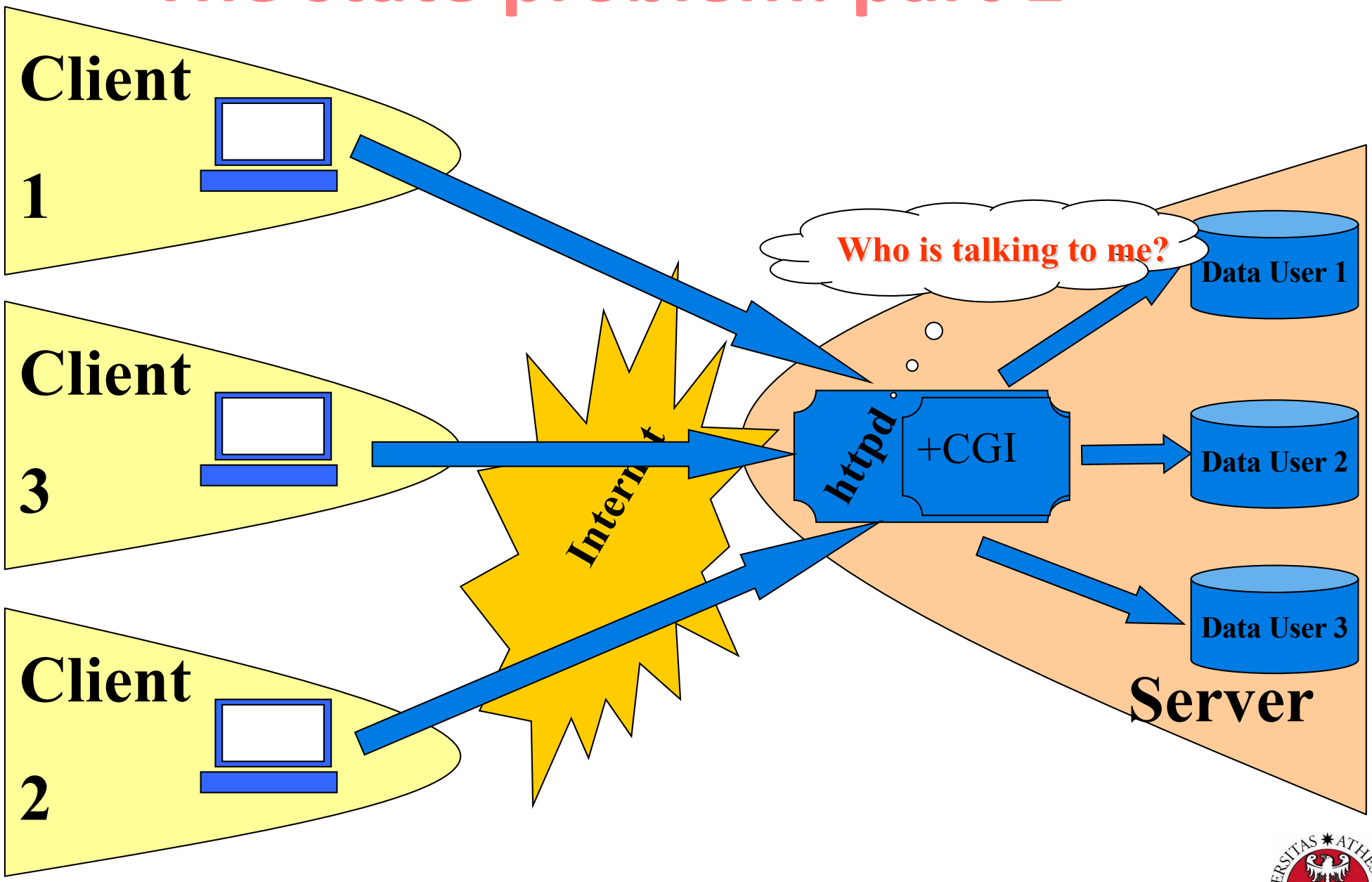
Cookies

HTTP is stateless

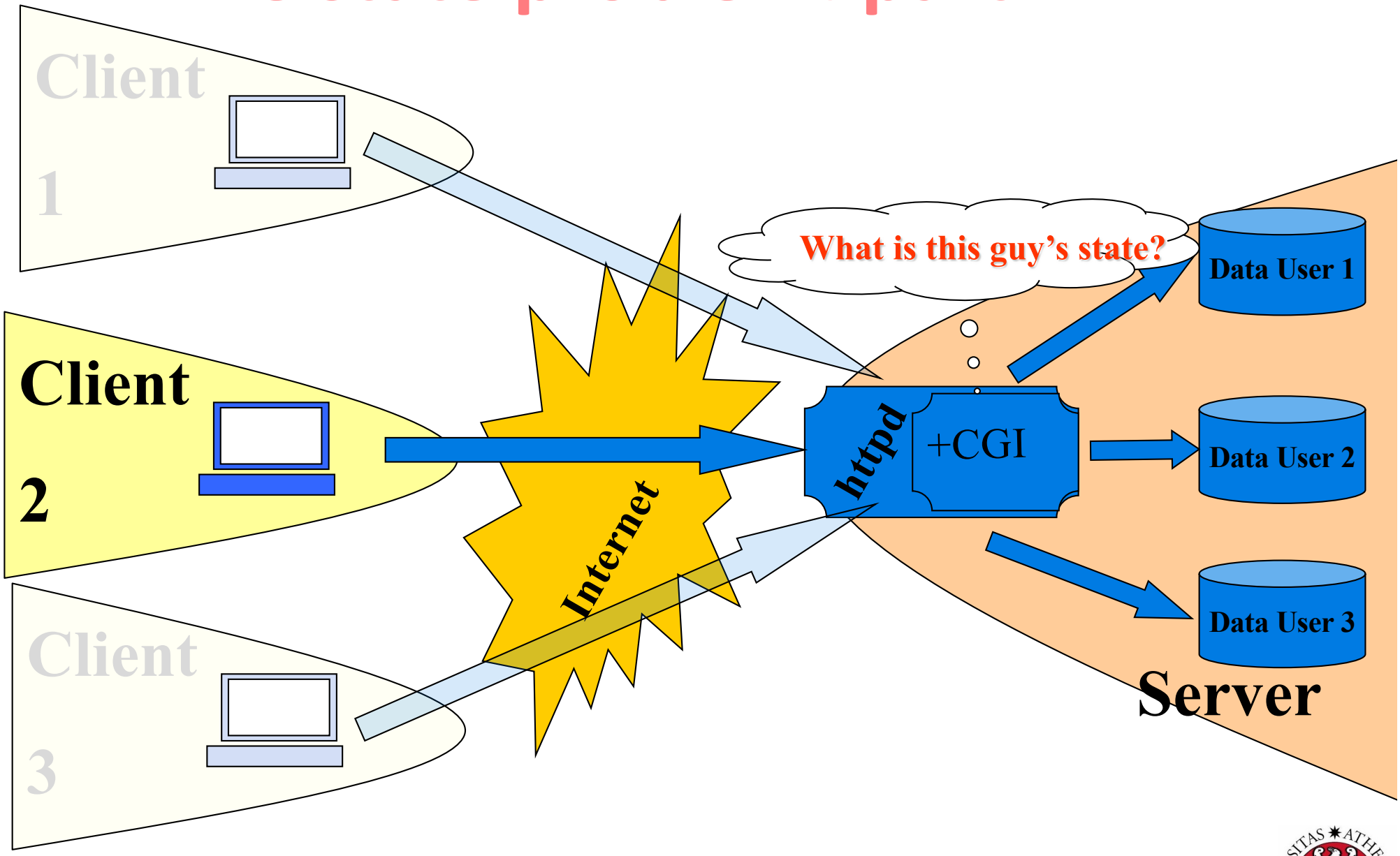
How can we keep track of who is who, and which state of the process s/he is at?

There is no way of doing it server-side…

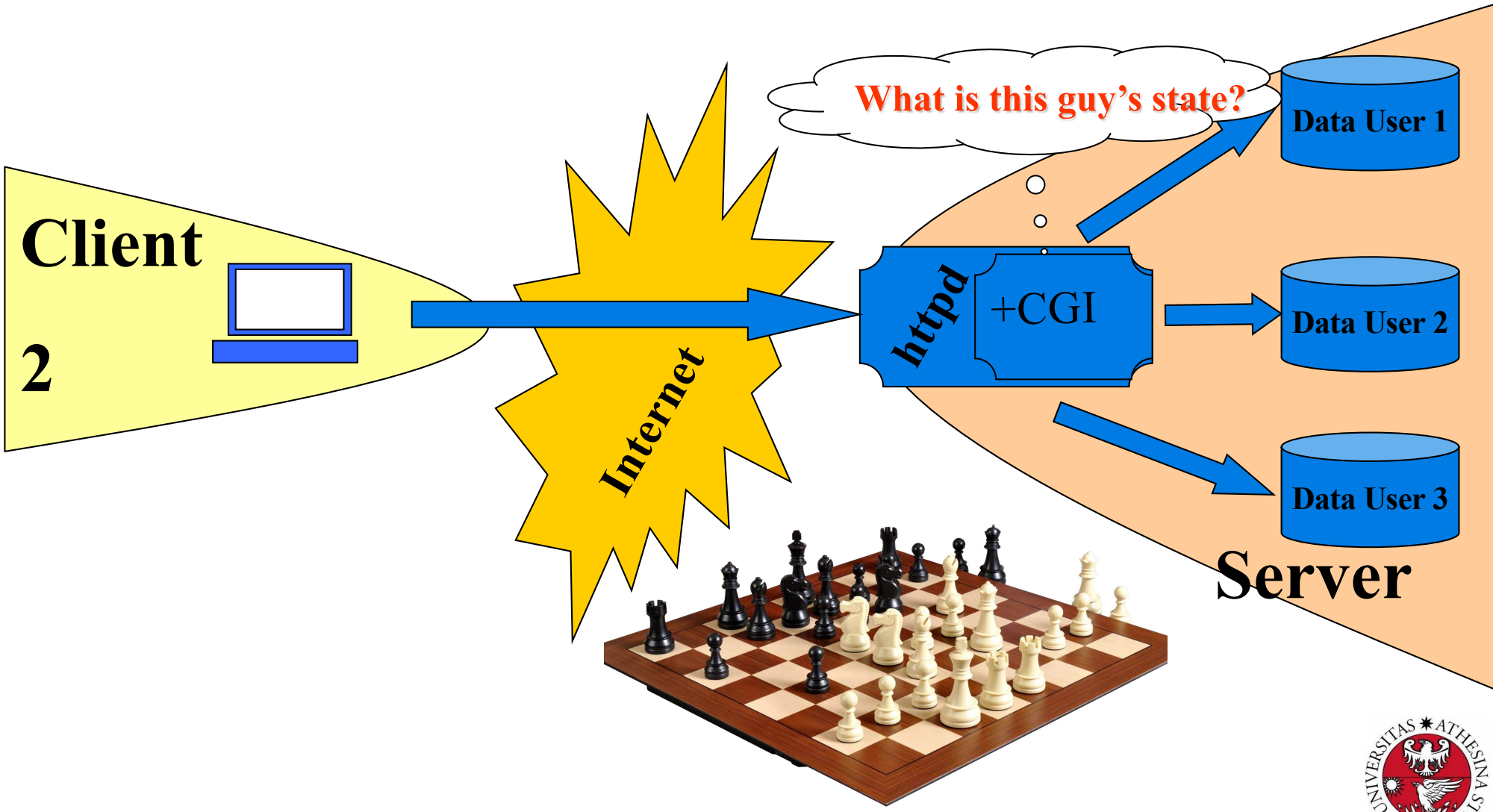
The state problem: part 1



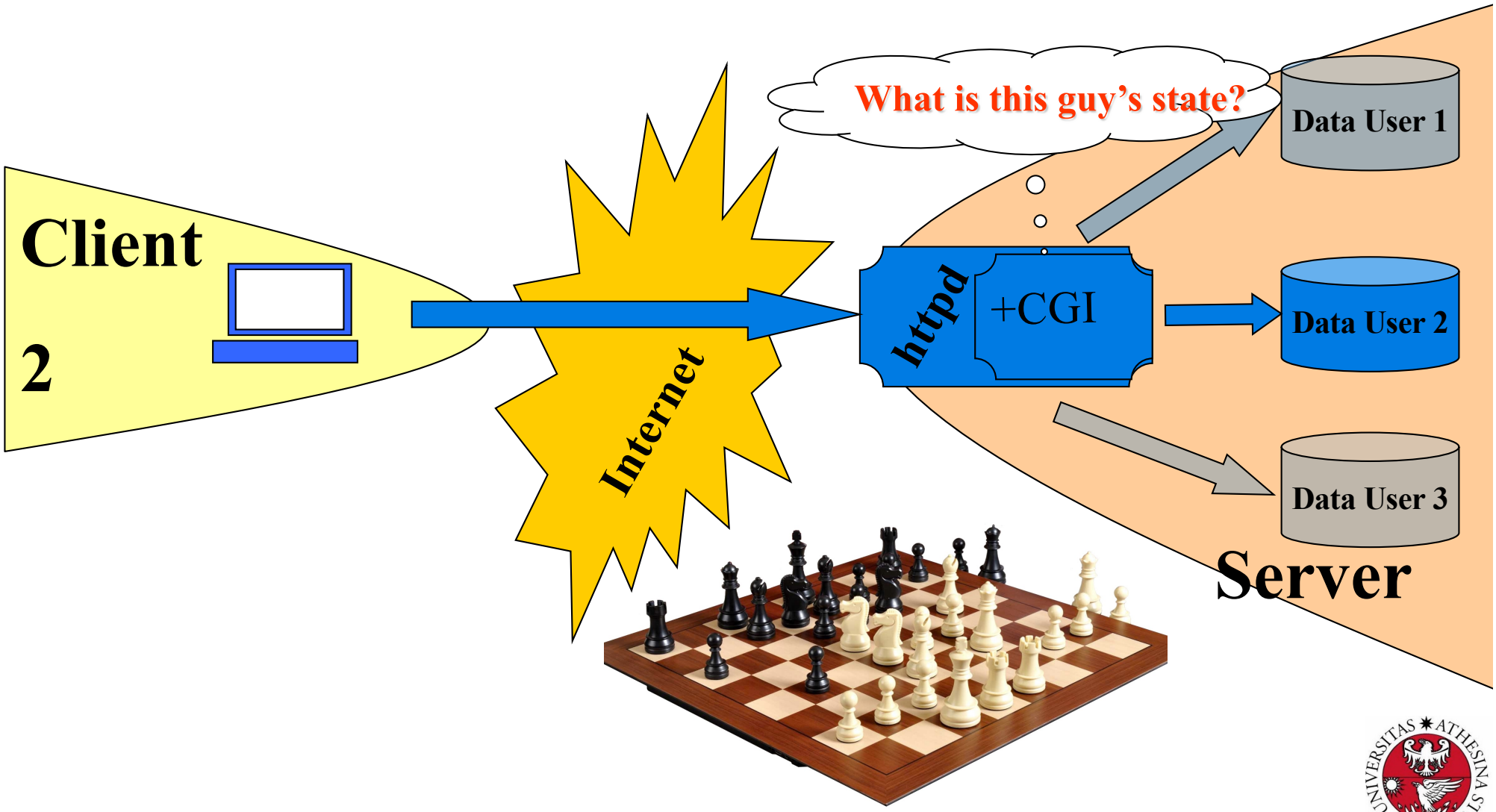
The state problem: part 2



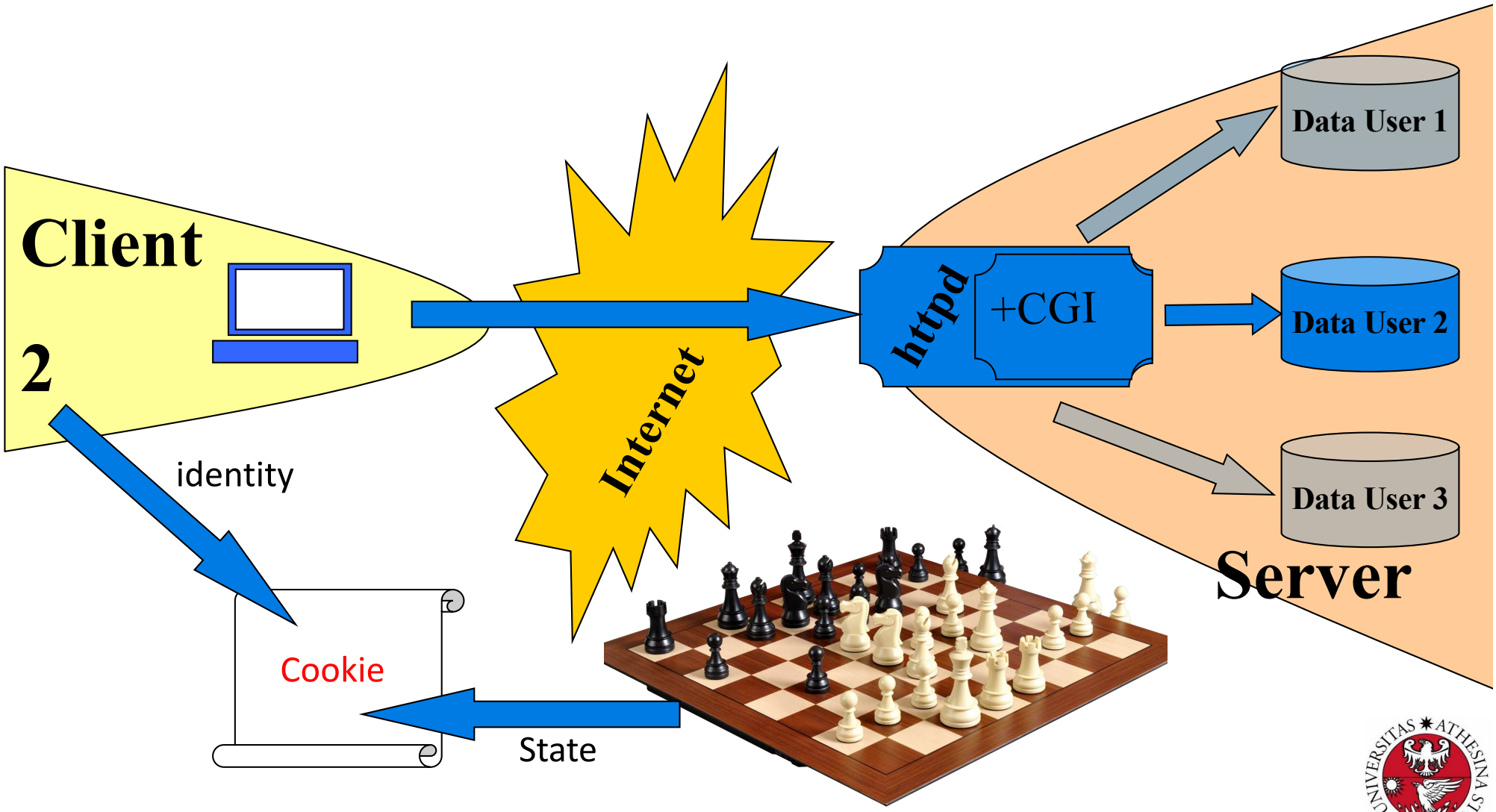
The state problem: part 2 - example



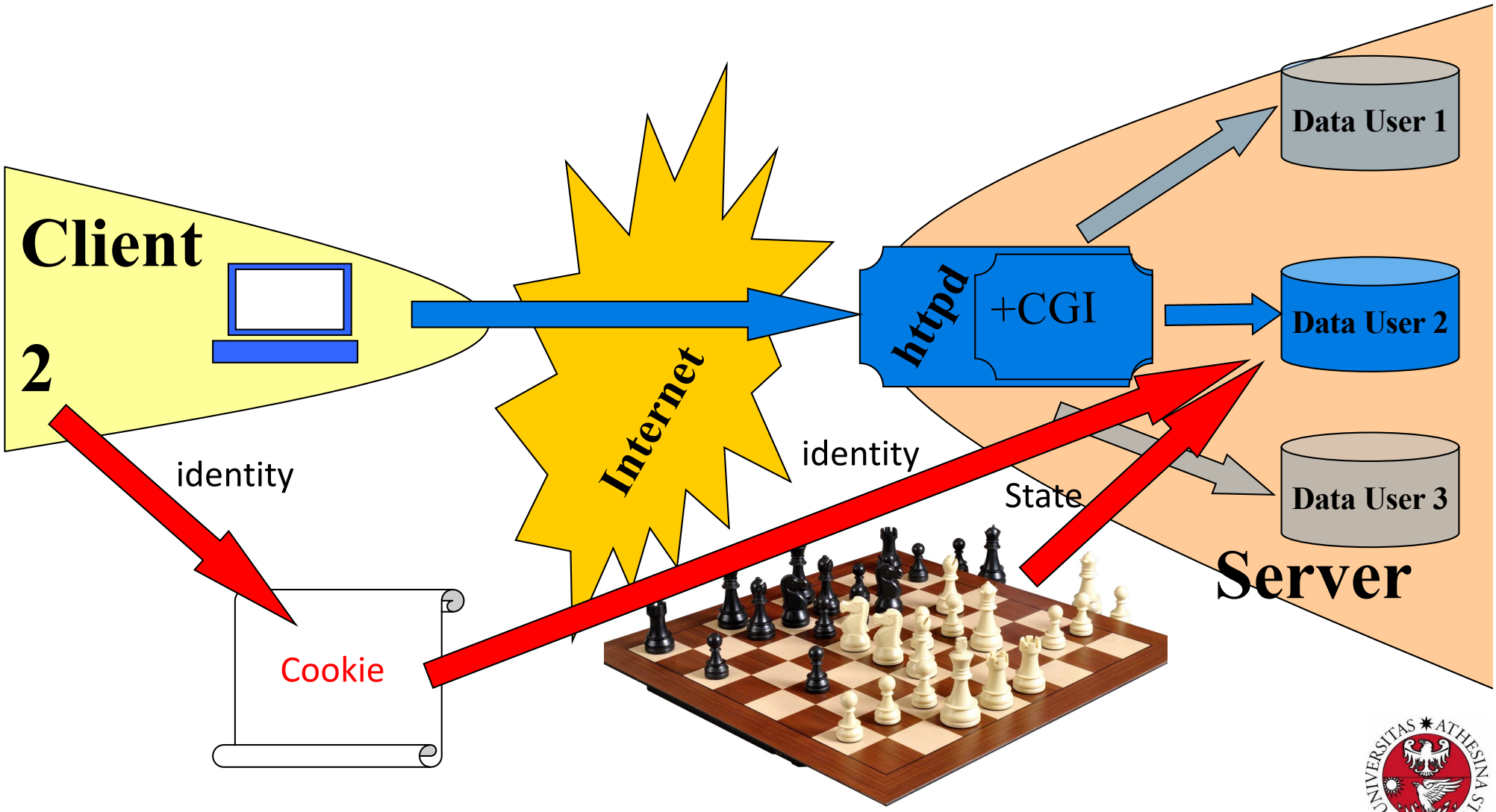
The state problem: part 2 - example



The state problem: solution 1



The state problem: solution 2



Cookies: what are they

A Cookie is a small amount of information sent by a servlet to a Web browser, saved by the browser, and later sent back to the server.

A cookie's value can uniquely identify a client, so cookies are commonly used for session management.

A cookie has a name, a single value, and optional attributes such as a comment, path and domain qualifiers, a maximum age, and a version number.

Where is the name coming from…

Cookies: why?

- To maintain status across a “user session”

- To maintan infos across multiple interactions:
- Customer identification
- Targeted advertisement
- Elimination of username e password

Cookies

- The servlet sends cookies to the browser by using the HttpServletResponse.addCookie(javax.servlet.http.Cookie) method, which adds fields to HTTP response headers to send cookies to the browser, one at a time. The browser is expected to support 20 cookies for each Web server, 300 cookies total, and may limit cookie size to 4 KB each.

- The browser returns cookies to the servlet by adding fields to HTTP request headers. Cookies can be retrieved from a request by using the HttpServletRequest.getCookies() method.

Cookies and caching

- Cookies affect the caching of the Web pages that use them. HTTP 1.0 does not cache pages that use cookies created with this class.

- The Java class “Cookie” does not support the cache control defined with HTTP 1.1. This class supports both the Version 0 (by Netscape) and Version 1 (by RFC 2109) cookie specifications. By default, cookies are created using Version 0 to ensure the best interoperability

Attribute summary

- **String getComment() / void setComment(String s)**
  - **Gets/sets a comment associated with this cookie.**

- **String getDomain() / setDomain(String s)**
  - **Gets/sets the domain to which cookie applies. Normally, cookies are returned only to the exact hostname that sent them. You can use this method to instruct the browser to return them to other hosts within the same domain. Note that the domain should start with a dot (e.g. .prenhall.com), and must contain two dots for non-country domains like .com, .edu, and .gov, and three dots for country domains like .co.uk and .edu.es.**

Attribute summary

- **int getMaxAge() / void setMaxAge(int i)**

  - **Gets/sets how much time (in seconds) should elapse before the cookie expires. If you don't set this, the cookie will last only for the current session (i.e. until the user quits the browser), and will not be stored on disk. See the LongLivedCookie class below, which defines a subclass of Cookie with a maximum age automatically set one year in the future.**

- **String getName() / void setName(String s)**

  - **Gets/sets the name of the cookie. The name and the value are the two pieces you virtually always care about. Since the getCookies method of HttpServletRequest returns an array of Cookie objects, it is common to loop down this array until you have a particular name, then check the value with getValue. See the getCookieValue method shown below.**

Attribute summary

- **String getPath() / void setPath(String s)**
  - **Gets/sets the path to which this cookie applies. If you don't specify a path, the cookie is returned for all URLs in the same directory as the current page as well as all subdirectories. This method can be used to specify something more general. For example, someCookie.setPath("/") specifies that all pages on the server should receive the cookie. Note that the path specified must include the current directory.**

- **boolean getSecure / setSecure(boolean b)**
  - **Gets/sets the boolean value indicating whether the cookie should only be sent over encrypted (i.e. SSL) connections.**

Attribute summary

- String getValue() / void setValue(String s)
- Gets/sets the value associated with the cookie. Again, the name and the value are the two parts of a cookie that you almost always care about, although in a few cases a name is used as a boolean flag, and its value is ignored (i.e the existence of the name means true).

- int getVersion() / void setVersion(int i)
- Gets/sets the cookie protocol version this cookie complies with. Version 0, the default, adheres to the original Netscape specification. Version 1, not yet widely supported, adheres to RFC 2109.

Placing Cookies in the Response Headers

The cookie is added to the Set-Cookie response header by means of the addCookie method of HttpServletResponse. Here's an example:

```
  Cookie userCookie = new Cookie("user",
"uid1234");
  response.addCookie(userCookie);
// before opening the body of response!
// i.e. before any out.print
```

Reading Cookies from the Client

- To read the cookies that come back from the client, you call getCookies on the HttpServletRequest. This returns an array of Cookie objects corresponding to the values that came in on the Cookie HTTP request header.

- Once you have this array, you typically loop down it, calling getName on each Cookie until you find one matching the name you have in mind. You then call getValue on the matching Cookie, doing some processing specific to the resultant value.

Cookies: examples

- Cookie userCookie = new Cookie(“user”,”uid1234”);
- userCookie.setMaxAge(60*60*24*365);
- response.addCookie(userCookie);

Cookies

Demo: setCookies - showCookies

SetCookies - 1

Sets six cookies:
- three that apply only to the current session (regardless of how long that session lasts)
- three that persist for five minutes (regardless of whether the browser is restarted).

```
import …

public class SetCookies extends HttpServlet {

  public void doGet(HttpServletRequest request,
  HttpServletResponse response)throws ServletException,
  IOException {

    for(int i=0; i<3; i++) {

      Cookie cookie = new Cookie("Session-Cookie-" + i,
                                 "Cookie-Value-S" + i);

      response.addCookie(cookie);

      cookie = new Cookie("Persistent-Cookie-" + i,
                                 "Cookie-Value-P" + i);

      cookie.setMaxAge(3600);

      response.addCookie(cookie);

    }
```

Default maxAge is -1, indicating cookie applies only to current browsing session

Cookie is valid for an hour, regardless of whether user quits browser, reboots computer, or whatever.

SetCookies - 2

```
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    String title = "Setting Cookies";
    out.println ("<HTML><HEAD><TITLE>" +title+ "</TITLE></HEAD>"
       +"<BODY BGCOLOR=\"#FDF5E6\">" +"<H1 ALIGN=\"CENTER\">"
       + title + "</H1>"
       +"There are six cookies associated with this page.\n"
       + "</BODY></HTML>");
  }
}
```

ShowCookies - 1

Creates a table of the cookies associated with the current page

```
import …;
public class ShowCookies extends HttpServlet {
  public void doGet(HttpServletRequest request, HttpServletResponse
                    response) throws ServletException, IOException {
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    String title = "Active Cookies";
    out.println("<HTML><HEAD><TITLE>" +title+ "</TITLE></HEAD>" +
                "<BODY BGCOLOR=\"#FDF5E6\">\n" +
                "<H1 ALIGN=\"CENTER\">" + title + "</H1>\n" +
                "<TABLE BORDER=1 ALIGN=\"CENTER\">\n" +
                "<TR BGCOLOR=\"#FFAD00\">\n" +
                "  <TH>Cookie Name\n" + "  <TH>Cookie Value");
```

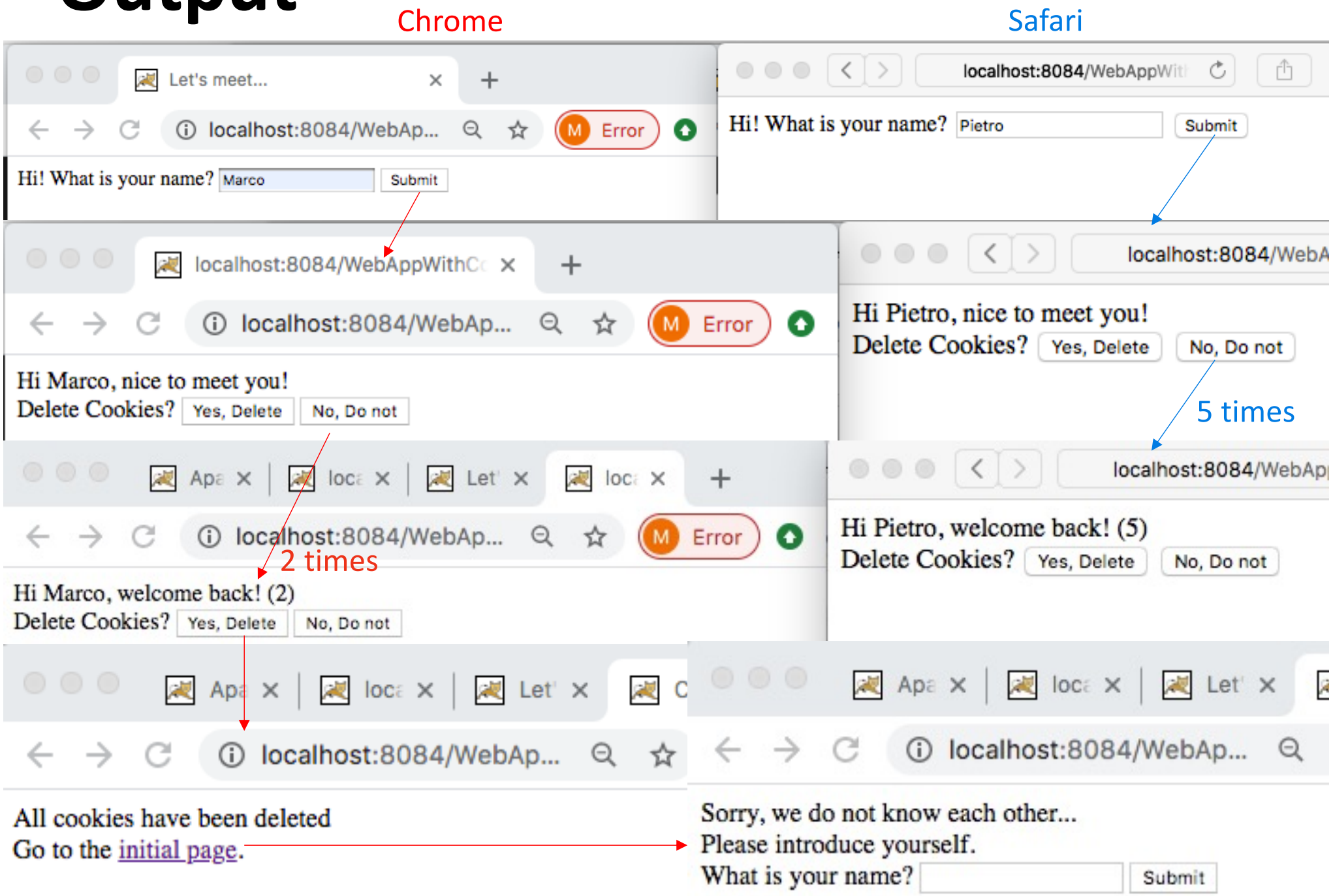
ShowCookies - 2

```
      Cookie[] cookies = request.getCookies();
      Cookie cookie;
      for(int i=0; i<cookies.length; i++) {
        cookie = cookies[i];
        out.println("<TR>\n" +
                    "  <TD>" + cookie.getName() + "\n" +
                    "  <TD>" + cookie.getValue());
      }
      out.println("</TABLE></BODY></HTML>");
    }
}
```

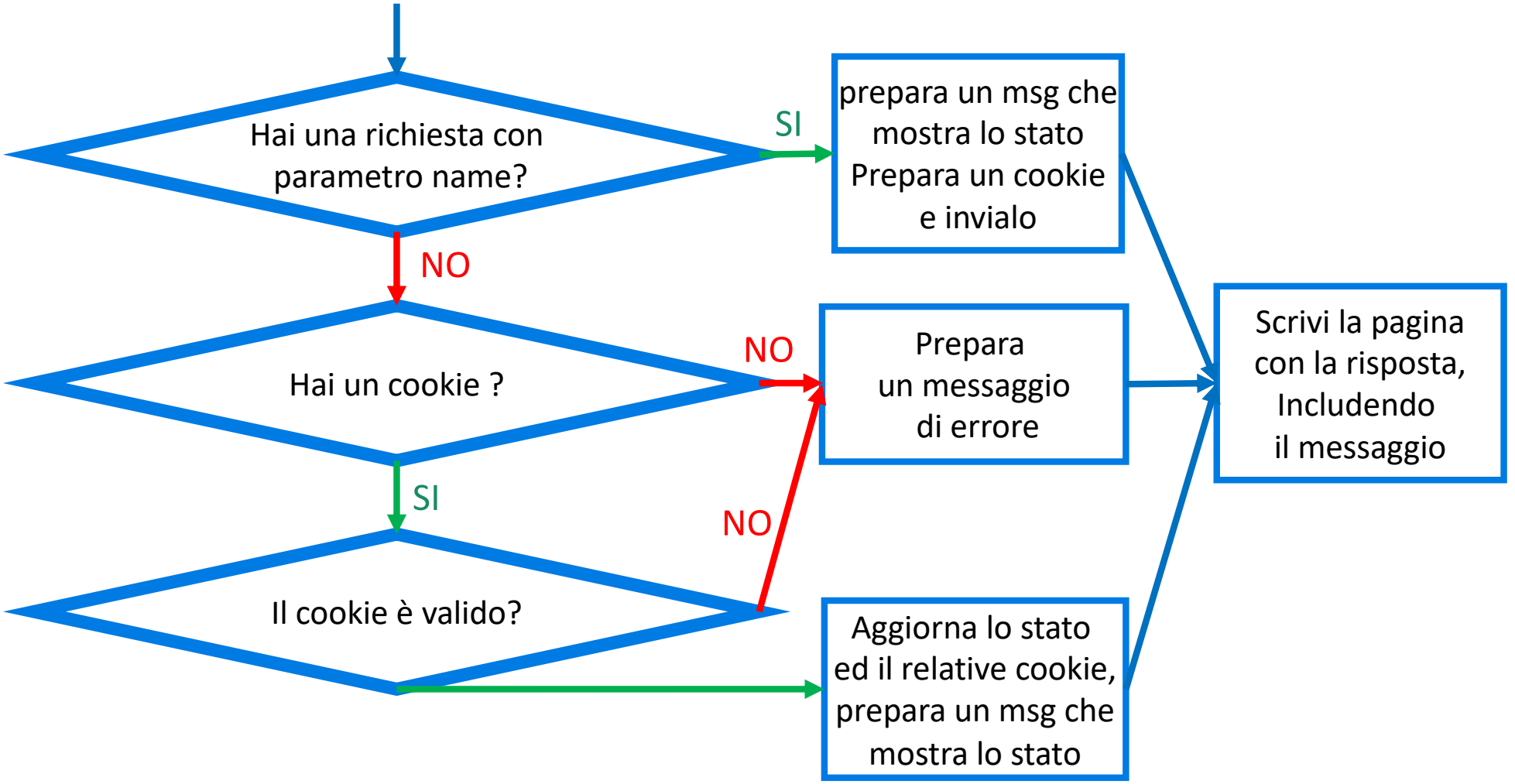
Cookies

Demo: Cookies in action

Output


Chrome
Safari
Let's meet...
localhost:8084/WebAp...
Error
Hi! What is your name? Marco
Submit
localhost:8084/WebAppWit
Hi! What is your name? Pietro
Submit
localhost:8084/WebAppWithC
Hi Marco, nice to meet you!
Delete Cookies? Yes, Delete
No, Do not
Hi Pietro, nice to meet you!
Delete Cookies? Yes, Delete
No, Do not
5 times
2 times
Hi Marco, welcome back! (2)
Delete Cookies? Yes, Delete
No, Do not
Hi Pietro, welcome back! (5)
Delete Cookies? Yes, Delete
No, Do not
All cookies have been deleted
Go to the initial page.
Sorry, we do not know each other...
Please introduce yourself.
What is your name?
Submit

Cookies in action - outline



Cookies in action - 1

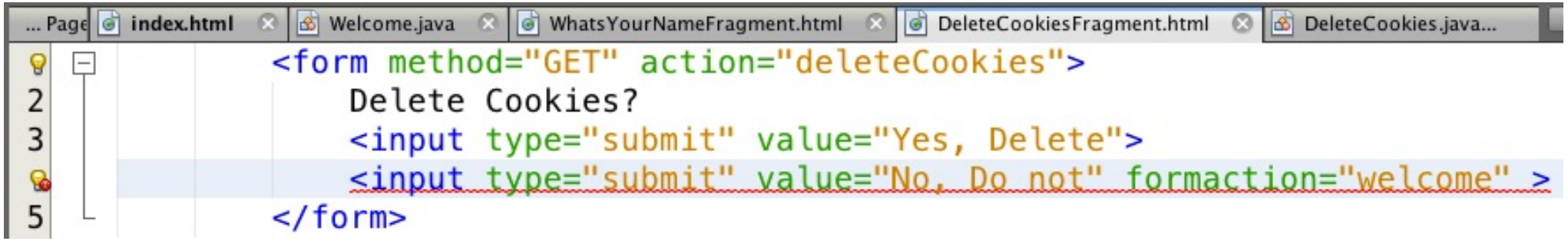
index.html | Welcome.java | WhatsYourNameFragment.html | DeleteCookiesFragment.html | DeleteCookies.java...

```
1  <!DOCTYPE html>
2  <html>
3      <head>
4          <title>Let's meet...</title>
5          <meta charset="UTF-8">
6          <meta name="viewport" content="width=device-width, initial-scale=1.0">
7      </head>
8      <body>
9          <form method="GET" action="welcome">
           <label for="name">Hi! What is your name?</label>
11         <input type="text" name="name">
12         <input type="submit" >
13         </form>
14     </body>
15 </html>
```

index.html | Welcome.java | WhatsYourNameFragment.html | DeleteCookiesFragment.html

```
<form method="GET" action="welcome">
    <label for="name">What is your name?</label>
3   <input type="text" name="name" value="">
4   <input type="submit" >
5   </form>
```

Cookies in action - 2



Cookies in action - 3

```
package it.unitn.disi.ronchet.myservlets;

import …

@WebServlet(urlPatterns = {"/welcome"})
public class Welcome extends HttpServlet {

    String msg;
    boolean isInitialIteration ;

    private void dealWithInvalidCookie() {
        msg = "Sorry, we do not know each other...<br>"
                + "Please introduce yourself.<br>";
        isInitialIteration = true;
    }
```

Cookies in action - 4

```
 protected void doGet(HttpServletRequest request,
`                HttpServletResponse response)
                 throws ServletException, IOException {
          isInitialIteration=false;
          // manage params and cookies
          String name = request.getParameter("name");
          if (name != null && ! name.equals("")) {
              // there is the right parameter,
              // no need to read cookie, but we set them
              log("name != null && ! name.equals(\"\")");
              Cookie cookie = new Cookie("name", name);
              msg = "Hi " + name + ", nice to meet you!";
              response.addCookie(cookie); // identity
              Cookie cookie1 = new Cookie("counter", "0");
              response.addCookie(cookie1); // state
              // finished! Go to end
          } else {
```

Cookies in action - 5

```
} else {
    // no parameter, let's try with cookies
    Cookie cookies[] = request.getCookies();
    if (cookies==null || cookies.length == 0) {
        // no cookies
        log(”no cookies found");
        dealWithInvalidCookie();
    } else {
        Cookie n_Cookie=null; // cookie con il nome
        Cookie c_Cookie=null; // cookie con il contatore
        for (Cookie c:cookies) {
            String cookieName = c.getName();
            if (cookieName.equals("name")) {
                n_Cookie=c;
            } else if (cookieName.equals("counter")) {
                c_Cookie=c;
            }
        }
        if (n_Cookie==null) {
            log ("valid cookies not found");
            // invalid cookie
            dealWithInvalidCookie();                    } else
```

Cookies in action - 6

```
            } else {
                // ok, the cookie is good!
                String userName=n_Cookie.getValue();
                String counterAsString=c_Cookie.getValue();
                log ("name == "+userName);
                // let's update the counter, and the cookie
                int counter=Integer.valueOf(counterAsString)+1;
                c_Cookie.setValue(""+counter);
                response.addCookie(c_Cookie);
                msg = "Hi " + userName + ", welcome back! (”
                      +counter+")";}
        }
    }
```

Cookies in action - 7

```
// prepare response and send it
        response.setContentType("text/html;charset=UTF-8");
        try (PrintWriter out = response.getWriter()) {
            out.println("<!DOCTYPE html>");
            out.println("<html><body>");
            out.println(msg);
            if (isInitialIteration) {
                request.getRequestDispatcher(
                    "WhatsYourNameFragment.html")
                        .include(request, response);
            } else {
                request.getRequestDispatcher(
                    "DeleteCookiesFragment.html")
                        .include(request, response);
            }
            out.println("</body></html>");
        }

    }
```

Cookies in action – 8 - deleteCookies

```
@WebServlet(name = "DeleteCookies",
        urlPatterns = {"/deleteCookies"})
public class DeleteCookies extends HttpServlet {

    protected void doGet(HttpServletRequest request,
            HttpServletResponse response)
            throws ServletException, IOException {
        Cookie cookies[]=request.getCookies();
        if (cookies != null) {
            for (Cookie c : cookies) {
                c.setMaxAge(0);
                response.addCookie(c);
            }
        }
        response.setContentType("text/html;charset=UTF-8");
        request.getRequestDispatcher(
              "CookiesHaveBeenDeleted.html")
                 .include(request, response);
    }
}
```

Cookies in PHP

https://www.w3schools.com/php/php_cookies.asp