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International University

School of Computer Science and Engineering

Web Application Development (IT093IU)

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(Semester 2, 2023-2024)

Agenda: Cookies and Sessions

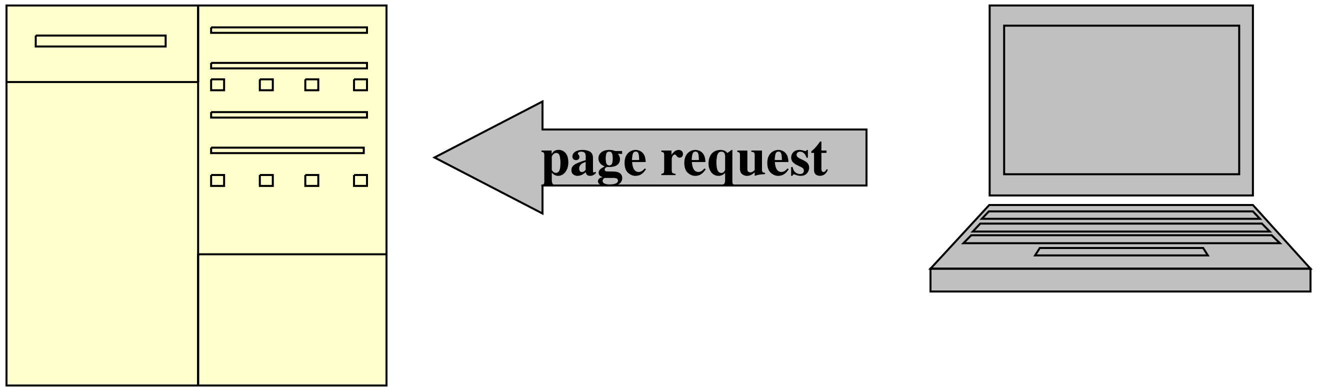
- What is a Cookie?
- The potential, problem with cookies
- Sending cookies to browser
- Reading cookies from browser
- Example of cookies
- Cookie API & search engine
- What is a Session?
- The purpose of session tracking
- Session API
- Example of sessions

What is a Cookie?

- A cookie is a small text file that is stored on a user’s computer.
- Each cookie on the user’s computer is connected to a particular domain.
- Each cookie be used to store up to 4kB of data.
- A maximum of 20 cookies can be stored on a user’s PC per domain.

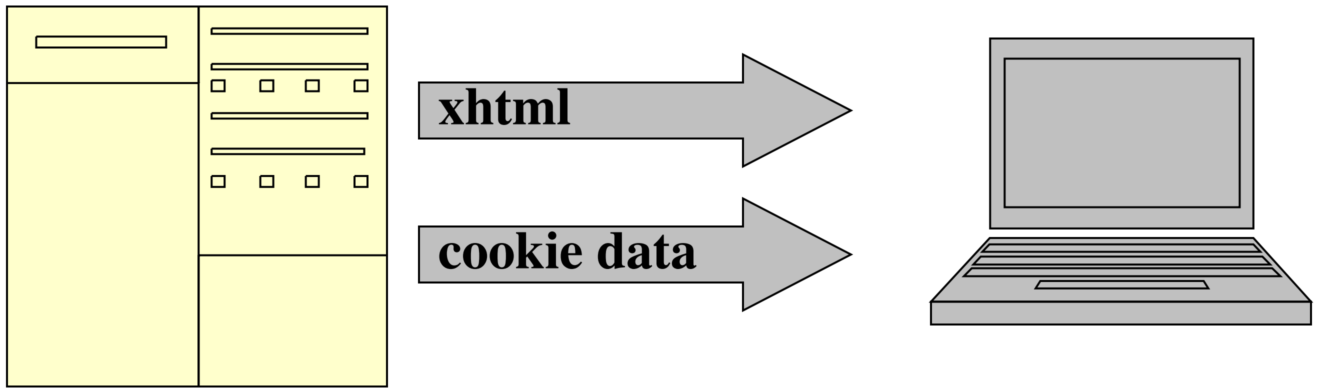
Example (1)

1. User sends a request for page at http://www.cplusplus.com for the *first* time.



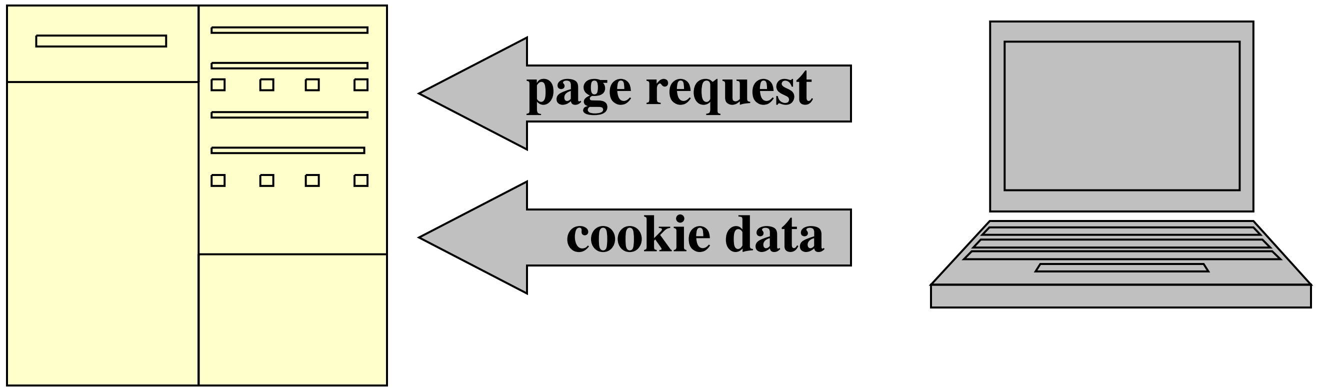
Example (2)

2. Server sends back the page xhtml to the browser AND stores some data in a cookie on the user’s PC.



Example (1)

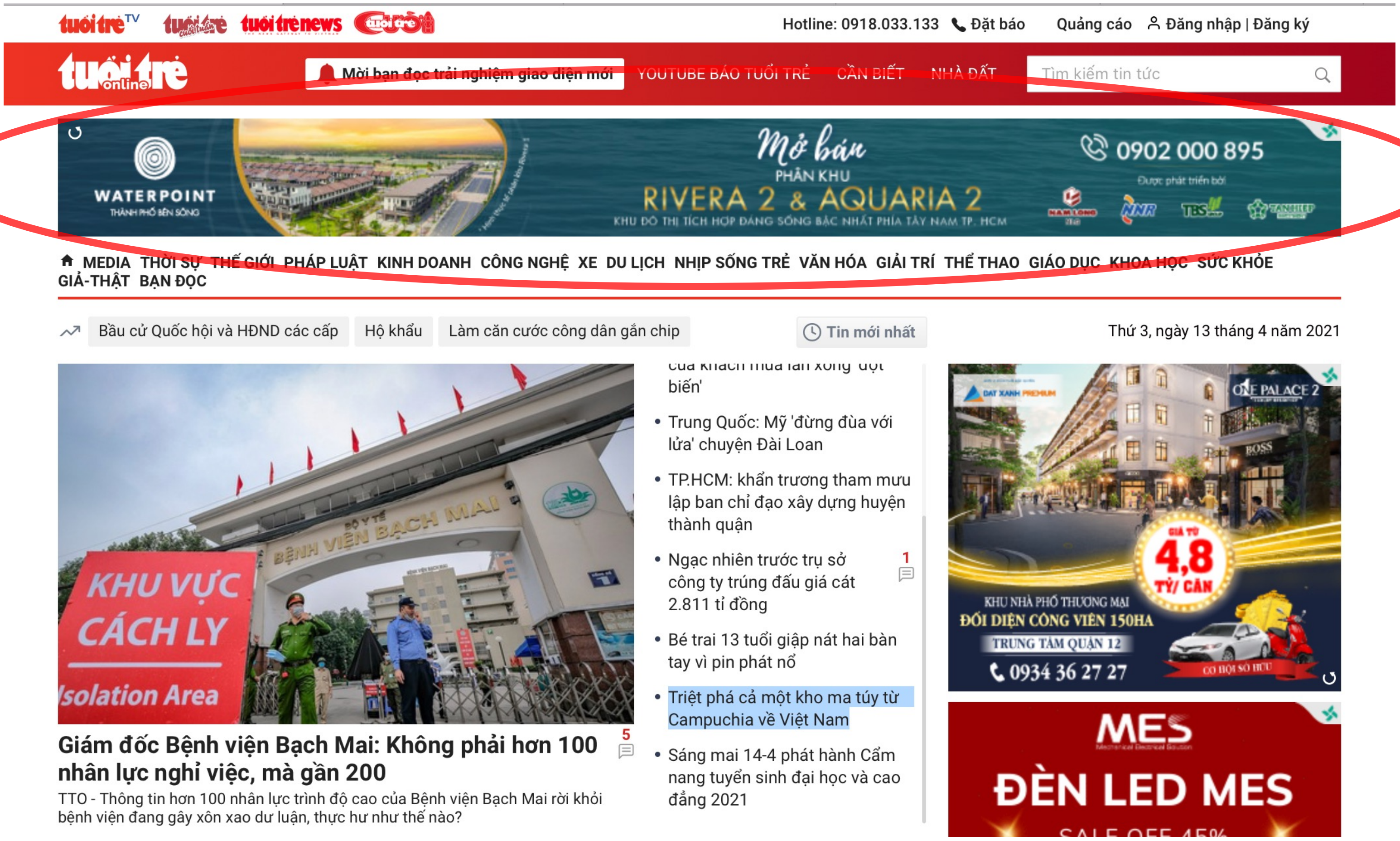
3. At the next page request for domain http://www.cplusplus.com, all cookie data associated with this domain is sent too.



The Potential of Cookies

- Idea
  - Servlet sends a simple name and value to client.
  - Client returns same name and value when it connects to same site (or same domain, depending on cookie settings).
- Typical Uses of Cookies
  - Identifying a user during an e-commerce session
    - Servlets have a higher-level API for this task
  - Avoiding username and password
  - Customizing a site
  - Focusing advertising

Cookies is focused on advertising


Hotline: 0918.033.133 Đặt báo Quảng cáo Đăng nhập | Đăng ký

Mời bạn đọc trải nghiệm giao diện mới YOUTUBE BÁO TUỔI TRẺ CẦN BIẾT NHÀ ĐẤT Tìm kiếm tin tức

MEDIA THỜI SỰ THẾ GIỚI PHÁP LUẬT KINH DOANH CÔNG NGHỆ XE DU LỊCH NHỊP SỐNG TRẺ VĂN HÓA GIẢI TRÍ THỂ THAO GIÁO DỤC KHOA HỌC SỨC KHỎE GIẢ-THẬT BẠN ĐỌC

Bầu cử Quốc hội và HĐND các cấp Hộ khẩu Làm căn cước công dân gắn chip Tin mới nhất Thứ 3, ngày 13 tháng 4 năm 2021

Giám đốc Bệnh viện Bạch Mai: Không phải hơn 100 nhân lực nghỉ việc, mà gần 200

TTO - Thông tin hơn 100 nhân lực trình độ cao của Bệnh viện Bạch Mai rời khỏi bệnh viện đang gây xôn xao dư luận, thực hư như thế nào?

- biến'
- Trung Quốc: Mỹ 'đừng đùa với lửa' chuyện Đài Loan
- TP.HCM: khẩn trương tham mưu lập ban chỉ đạo xây dựng huyện thành quận
- Ngạc nhiên trước trụ sở công ty trúng đấu giá cát 2.811 tỉ đồng
- Bé trai 13 tuổi giập nát hai bàn tay vì pin phát nổ
- Triệt phá cả một kho ma túy từ Campuchia về Việt Nam
- Sáng mai 14-4 phát hành Cẩm nang tuyển sinh đại học và cao đẳng 2021

The cookies come from the website that you are accessing or come from the websites of advertising

Some Problems with Cookies

- The problem is privacy, not security.
  - Servers can remember your previous actions
  - If you give out personal information, servers can link that information to your previous actions
  - Servers can share cookie information through use of a cooperating third party like doubleclick.net
  - Poorly designed sites store sensitive information like credit card numbers directly in cookie
  - JavaScript bugs let hostile sites steal cookies (old browsers)
- Moral for servlet authors
  - If cookies are not critical to your task, avoid servlets that totally fail when cookies are disabled
  - Don't put sensitive info in cookies

Sending Cookies to Browser

- Standard approach:

```
Cookie c = new Cookie("name", "value"); //create a Cookie object
c.setMaxAge(...); // cookie persists on disk; ex: 60*60*24*7
// Set other attributes.
response.addCookie(c); // placing the Cookie into the http response headers
```

- Simplified approach:
  - Use LongLivedCookie class:

```
public class LongLivedCookie extends Cookie {
  public static final int SECONDS_PER_YEAR =
   60*60*24*365;
  public LongLivedCookie(String name, String value) {
    super(name, value);
    setMaxAge(SECONDS_PER_YEAR);
  }
}
```

Reading Cookies from browser

- Standard approach:

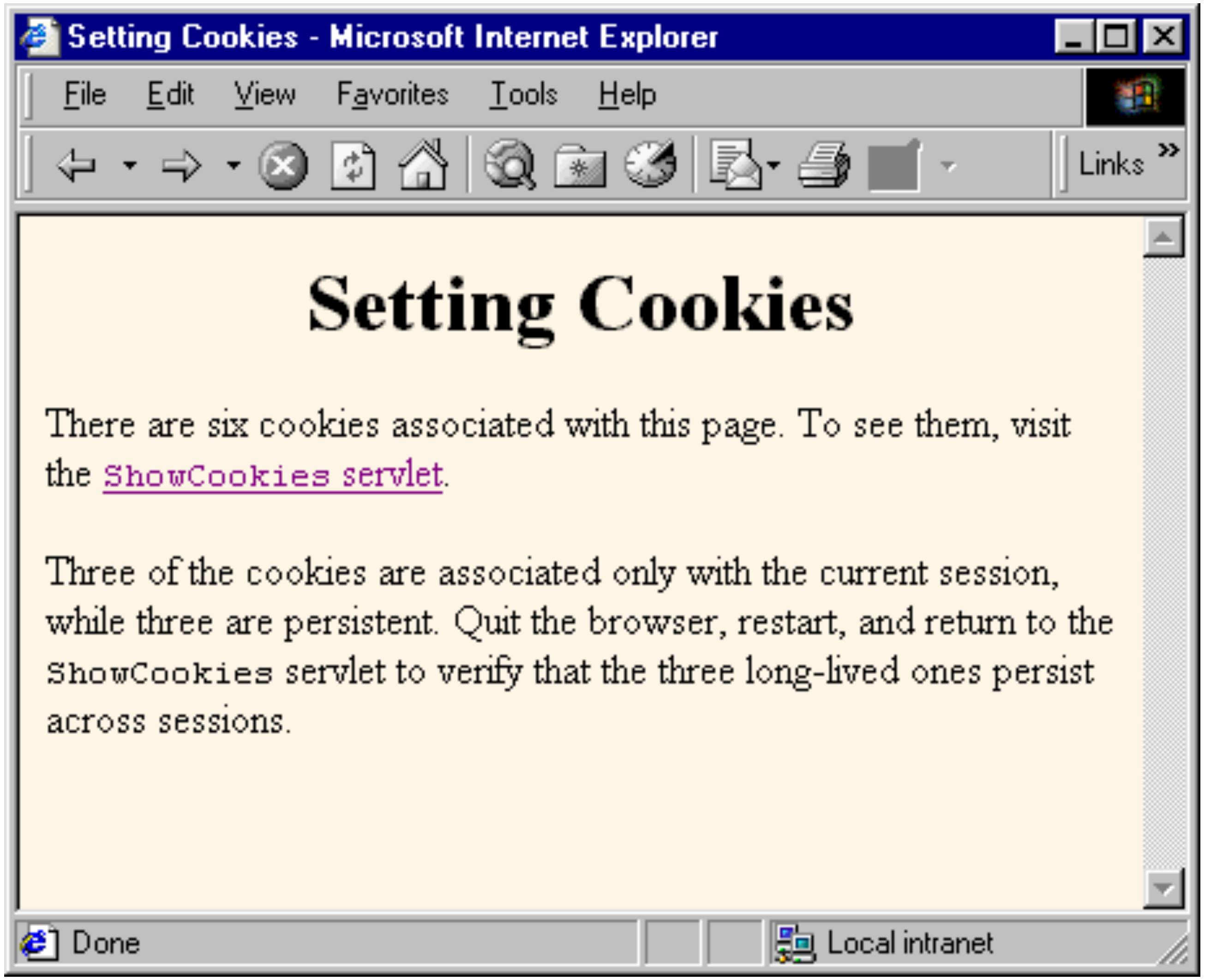
```
Cookie[] cookies = request.getCookies();
if (cookies != null) {
  for(int i=0; i<cookies.length; i++) {
    Cookie c = cookies[i];
    if (c.getName().equals("someName")) {
      doSomethingWith(c);
      break;
    }
  }
}
```

- Simplified approach:
  - Extract cookie or cookie value from cookie array by using ServletUtilities.getCookieValue or ServletUtilities.getCookie

Simple Cookie-Setting servlet

```
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);
    }
    response.setContentType("text/html");
    PrintWriter out = response.getWriter();
    out.println(...);
```

Result of Cookie-Setting servlet


Setting Cookies - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Links
Done
Local intranet

Setting Cookies

There are six cookies associated with this page. To see them, visit the `ShowCookies` servlet.

Three of the cookies are associated only with the current session, while three are persistent. Quit the browser, restart, and return to the `ShowCookies` servlet to verify that the three long-lived ones persist across sessions.

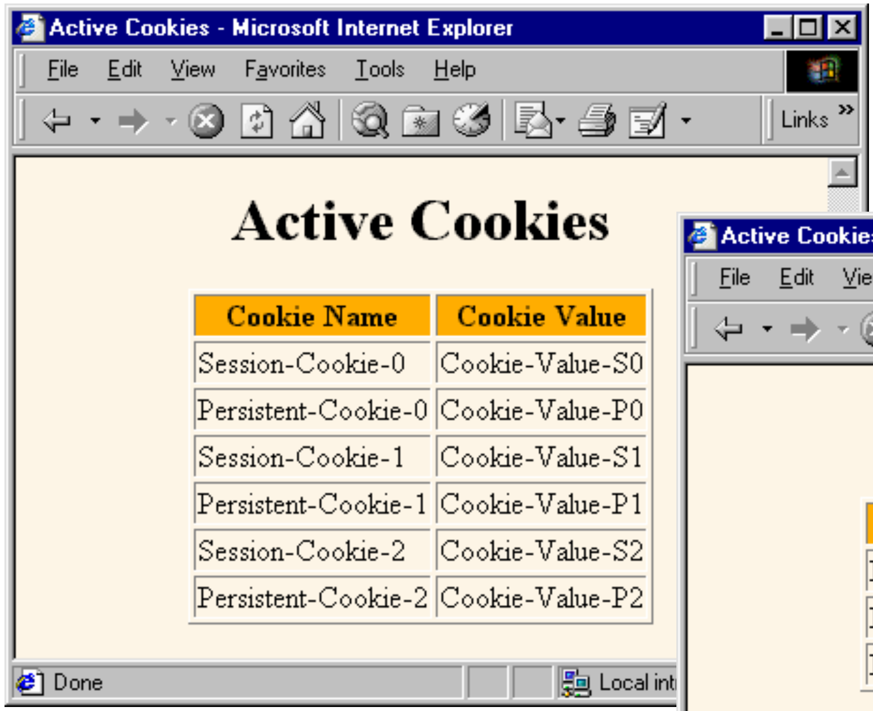
Simple Cookie-Viewing servlet

```
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(ServletUtilities.headWithTitle(title) +
                "<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");
```

Simple Cookie-Viewing servlet

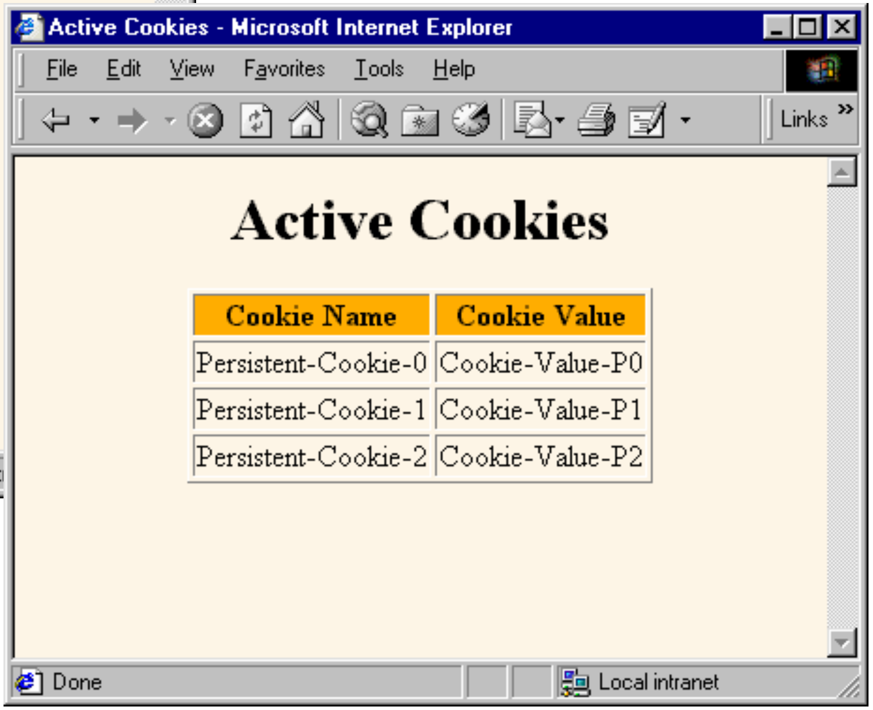
```
    Cookie[] cookies = request.getCookies();
    if (cookies != null) {
      Cookie cookie;
      for(int i=0; i<cookies.length; i++) {
        cookie = cookies[i];
        out.println("<TR>\n" +
                    "  <TD>" + cookie.getName() +
  "\n" +
                    "  <TD>" + cookie.getValue());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

Result of Cookie-Viewer (before & after restarting browser)


Active Cookies - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Links
Done
Local int

Active Cookies

Cookie Name	Cookie Value
Session-Cookie-0	Cookie-Value-S0
Persistent-Cookie-0	Cookie-Value-P0
Session-Cookie-1	Cookie-Value-S1
Persistent-Cookie-1	Cookie-Value-P1
Session-Cookie-2	Cookie-Value-S2
Persistent-Cookie-2	Cookie-Value-P2


Active Cookies - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Links
Done
Local intranet

Active Cookies

Cookie Name	Cookie Value
Persistent-Cookie-0	Cookie-Value-P0
Persistent-Cookie-1	Cookie-Value-P1
Persistent-Cookie-2	Cookie-Value-P2

Cookie utilities

- Problem
  - getCookies returns an array of cookies
  - You almost always only care about one particular cookie
- Solution
  - Static methods to
    - Extract a cookie value given a cookie name (default value if no match)
    - Extract a Cookie object given a cookie name (null if no match)

ServletUtilities.getCookieValue

```
public static String getCookieValue(Cookie[]
 cookies,
                                    String
 cookieName,
                                    String
 defaultVal) {
  if (cookies != null) {
    for(int i=0; i<cookies.length; i++) {
      Cookie cookie = cookies[i];
      if (cookieName.equals(cookie.getName()))
        return(cookie.getValue());
    }
  }
  return(defaultVal);
}
```

ServletUtilities.getCookie

```
public static Cookie getCookie(Cookie[] cookies,
                               String cookieName) {
  if (cookies != null) {
    for(int i=0; i<cookies.length; i++) {
      Cookie cookie = cookies[i];
      if (cookieName.equals(cookie.getName()))
        return(cookie);
    }
  }
  return(null);
}
```

Methods in the Cookie API

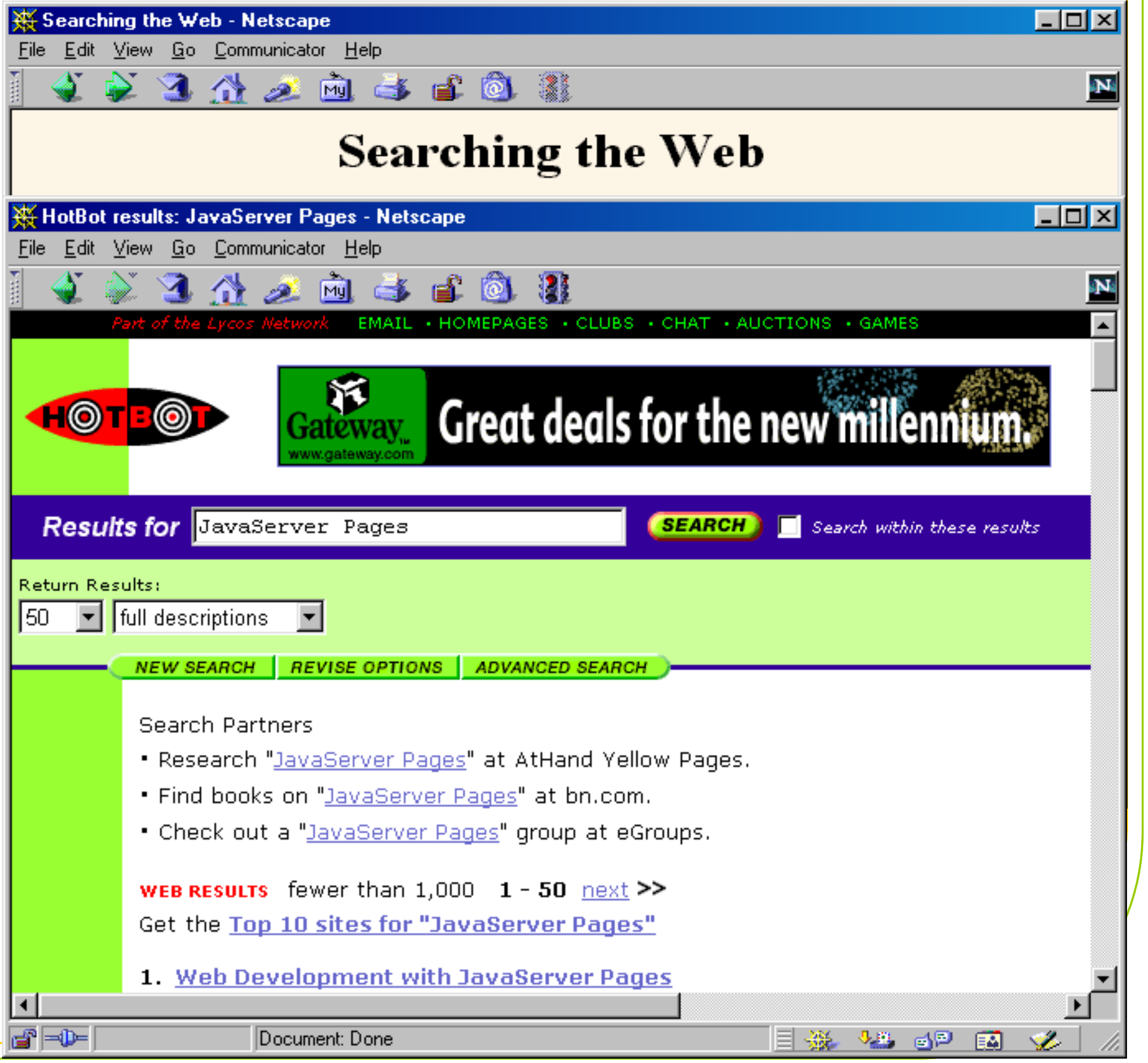
- getDomain/setDomain
  - Lets you specify domain to which cookie applies. Current host must be part of domain specified.
- getMaxAge/setMaxAge
  - Gets/sets the cookie expiration time (in seconds). If you fail to set this, cookie applies to current browsing session only. See LongLivedCookie helper class given earlier.
- getName
  - Gets the cookie name. There is no setName method; you supply name to constructor. For incoming cookie array, you use getName to find the cookie of interest.

Methods in the Cookie API

- getPath/setPath
  - Gets/sets the path to which cookie applies. If unspecified, cookie applies to URLs that are within or below directory containing current page.
- getSecure/setSecure
  - Gets/sets flag indicating whether cookie should apply only to SSL connections or to all connections.
- getValue/setValue
  - Gets/sets value associated with cookie. For new cookies, you supply value to constructor, not to setValue. For incoming cookie array, you use getName to find the cookie of interest, then call getValue on the result. If you set the value of an incoming cookie, you still have to send it back out with response.addCookie.

A Customized Search Engine Interface

- Front-end remembers settings for search engine, search string, and hits per page
  - Front end *uses* cookies
  - Back end *sets* cookies
  - In real life, don't really show previous queries!


Searching the Web - Netscape
File Edit View Go Communicator Help
Searching the Web
HotBot results: JavaServer Pages - Netscape
File Edit View Go Communicator Help
Part of the Lycos Network
EMAIL • HOMEPAGES • CLUBS • CHAT • AUCTIONS • GAMES
HOTBOT
Gateway www.gateway.com
Great deals for the new millennium.
SEARCH
Search within these results
NEW SEARCH
REVISE OPTIONS
ADVANCED SEARCH
Document: Done

Results for JavaServer Pages

Return Results: 50 full descriptions

Search Partners
- Research "JavaServer Pages" at AtHand Yellow Pages.
- Find books on "JavaServer Pages" at bn.com.
- Check out a "JavaServer Pages" group at eGroups.

WEB RESULTS fewer than 1,000 1 - 50 next >>

Get the Top 10 sites for "JavaServer Pages"

1. Web Development with JavaServer Pages

Front-end to SearchEngines servlet

```
public class SearchEnginesFrontEnd extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    Cookie[] cookies = request.getCookies();
    String searchString =
      ServletUtilities.getCookieValue(cookies,
                                      "searchString",
                                      "Java Programming");
    String numResults =
      ServletUtilities.getCookieValue(cookies,
                                      "numResults",
                                      "10");
    String searchEngine =
      ServletUtilities.getCookieValue(cookies,
                                      "searchEngine",
                                      "google");
```

Front-end to SearchEngines servlet

```
...
out.println
  (...
   "<FORM ACTION=\"/servlet/" +
     "coreservlets.CustomizedSearchEngines\">\n" +
   "<CENTER>\n" +
   "Search String:\n" +
   "<INPUT TYPE=\"TEXT\" NAME=\"searchString\"\n" +
   "       VALUE=\"" + searchString + "\"><BR>\n" +
   "Results to Show Per Page:\n" +
   "<INPUT TYPE=\"TEXT\" NAME=\"numResults\"\n" +
   "       VALUE=" + numResults + " SIZE=3><BR>\n" +
   "<INPUT TYPE=\"RADIO\" NAME=\"searchEngine\"\n" +
   "       VALUE=\"google\"" +
   checked("google", searchEngine) + ">\n" +
   ...);
```

Customized SearchEngines servlet (Back-end)

```
public class CustomizedSearchEngines extends HttpServlet {
  public void doGet(HttpServletRequest request,
                    HttpServletResponse response)
      throws ServletException, IOException {
    String searchString =
      request.getParameter("searchString");
    if ((searchString == null) ||
        (searchString.length() == 0)) {
      reportProblem(response, "Missing search string.");
      return;
    }
    Cookie searchStringCookie =
      new LongLivedCookie("searchString", searchString);
    response.addCookie(searchStringCookie);
    ...
  }
}
```

Summary

- Cookies involve name/value pairs sent from server to browser and returned when the same page, site, or domain is visited later
- Let you
  - Track sessions (use higher-level API)
  - Permit users to avoid logging in at low-security sites
  - Customize sites for different users
  - Focus content or advertising
- Setting cookies
  - Call Cookie constructor, set age, call response.addCookie
- Reading cookies
  - Call request.getCookies, check for null, look through array for matching name, use associated value

Agenda - Session Tracking

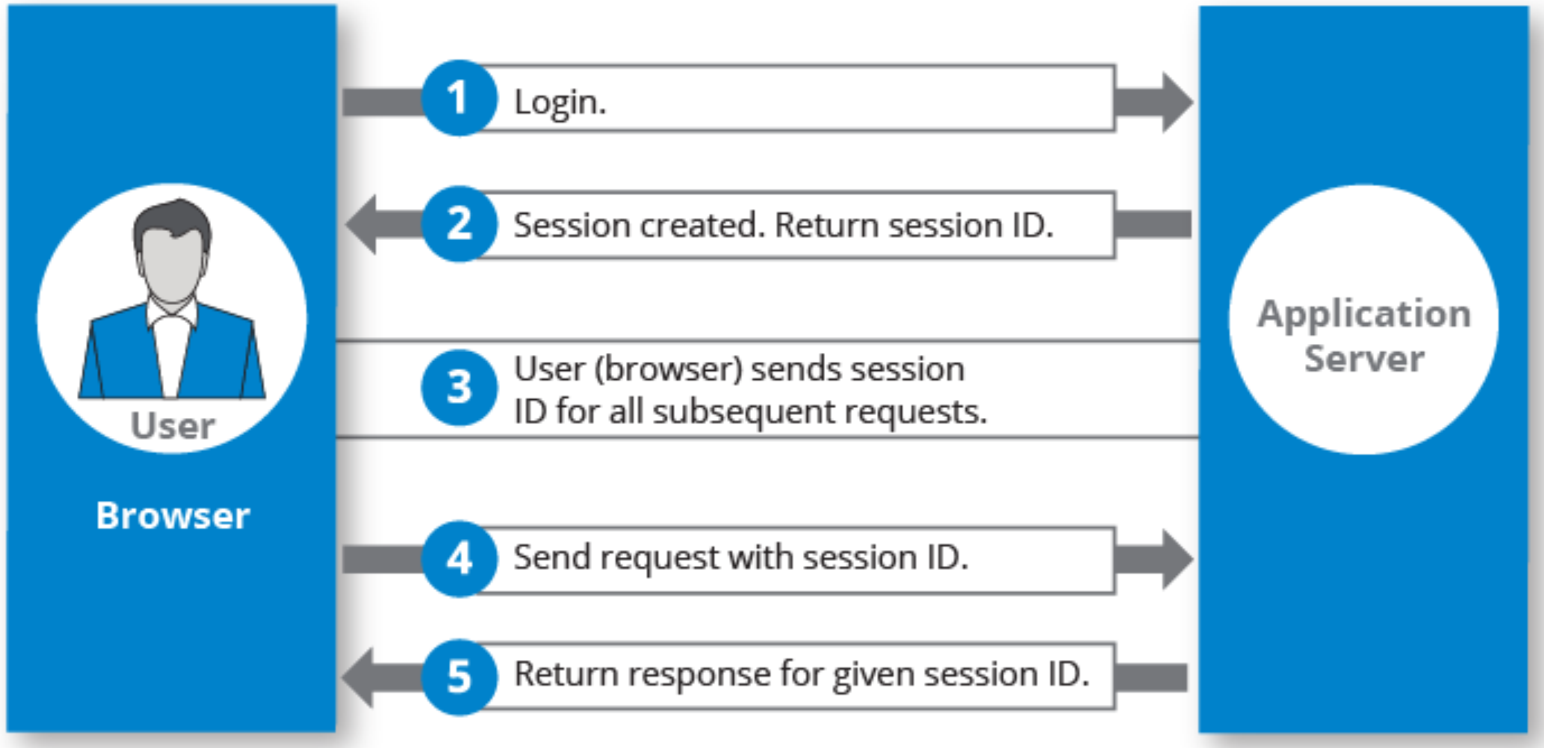
- The purpose of session tracking
- Rolling your own session tracking
- The session tracking API
- Per-client access counts
- Shopping carts and online stores

What is a session?

- A session refers to all the requests that a single client makes to a server.
- A session is specific to the user and for each user a new session is created to track all the request from that user.
- Every user has a separate session and separate session variable is associated with that session.

What is a session?

https://hazelcast.com/glossary/web-session/


1 Login.
2 Session created. Return session ID.
3 User (browser) sends session ID for all subsequent requests.
4 Send request with session ID.
5 Return response for given session ID.
User
Browser
Application Server

Session tracking and Ecommerce

- Why session tracking?
  - When clients at on-line store add item to their shopping cart, how does server know what’s already in cart?
  - When clients decide to proceed to checkout, how can server determine which previously created cart is theirs?

Rolling your own session tracking: Cookies

- Idea: associate cookie with data on server

```
String sessionID = makeUniqueString();
Hashtable sessionInfo = new Hashtable();
Hashtable globalTable =
  findTableStoringSessions();
globalTable.put(sessionID, sessionInfo);
Cookie sessionCookie =
  new Cookie("JSESSIONID", sessionID);
sessionCookie.setPath("/");
response.addCookie(sessionCookie);
```

- Still to be done:
  - Extracting cookie that stores session identifier
  - Setting appropriate expiration time for cookie
  - Associating the hash tables with each request
  - Generating the unique session identifiers

Rolling your own session tracking: URL-Rewriting

- Idea
  - Client appends some extra data on the end of each URL that identifies the session
  - Server associates that identifier with data it has stored about that session
  - E.g., http://host/path/file.html;jsessionid=1234
- Advantage
  - Works even if cookies are disabled or unsupported
- Disadvantages
  - Lots of tedious processing
  - Must encode all URLs that refer to your own site
  - Links from other sites and bookmarks can fail

Rolling your own session tracking: Hidden form fields

- Idea:

```
<INPUT     TYPE="HIDDEN"     NAME="session"
  VALUE="...">
```

- Advantage
  - Works even if cookies are disabled or unsupported
- Disadvantages
  - Lots of tedious processing
  - All pages must be the result of form submissions

The session tracking API

- Session objects live on the server
- Automatically associated with client via cookies or URL-rewriting
  - Use request.getSession(true) to get either existing or new session
    - Behind the scenes, the system looks at cookie or URL extra info and sees if it matches the key to some previously stored session object. If so, it returns that object. If not, it creates a new one, assigns a cookie or URL info as its key, and returns that new session object.
- Hashtable-like mechanism lets you store arbitrary objects inside session
  - setAttribute (putValue in 2.1) stores values
  - getAttribute (getValue in 2.1) retrieves values

Accessing Session Data

```
HttpSession session =
   request.getSession(true);
ShoppingCart cart =
   (ShoppingCart)session.getAttribute("shoppi
   ngCart");
if (cart == null) { // No cart already in
   session
   cart = new ShoppingCart();
   session.setAttribute("shoppingCart",
   cart);
}
doSomethingWith(cart);
```

HttpSession Methods

- getAttribute (getValue in old servlet spec 2.1)
  - Extracts a previously stored value from a session object. Returns null if no value is associated with given name.
- setAttribute (putValue in ver. 2.1)
  - Associates a value with a name. Monitor changes: values implement HttpSessionBindingListener.
- removeAttribute (removeValue in ver. 2.1)
  - Removes values associated with name.
- getAttributeNames (getValueNames in 2.1)
  - Returns names of all attributes in the session.
- getId
  - Returns the unique identifier.

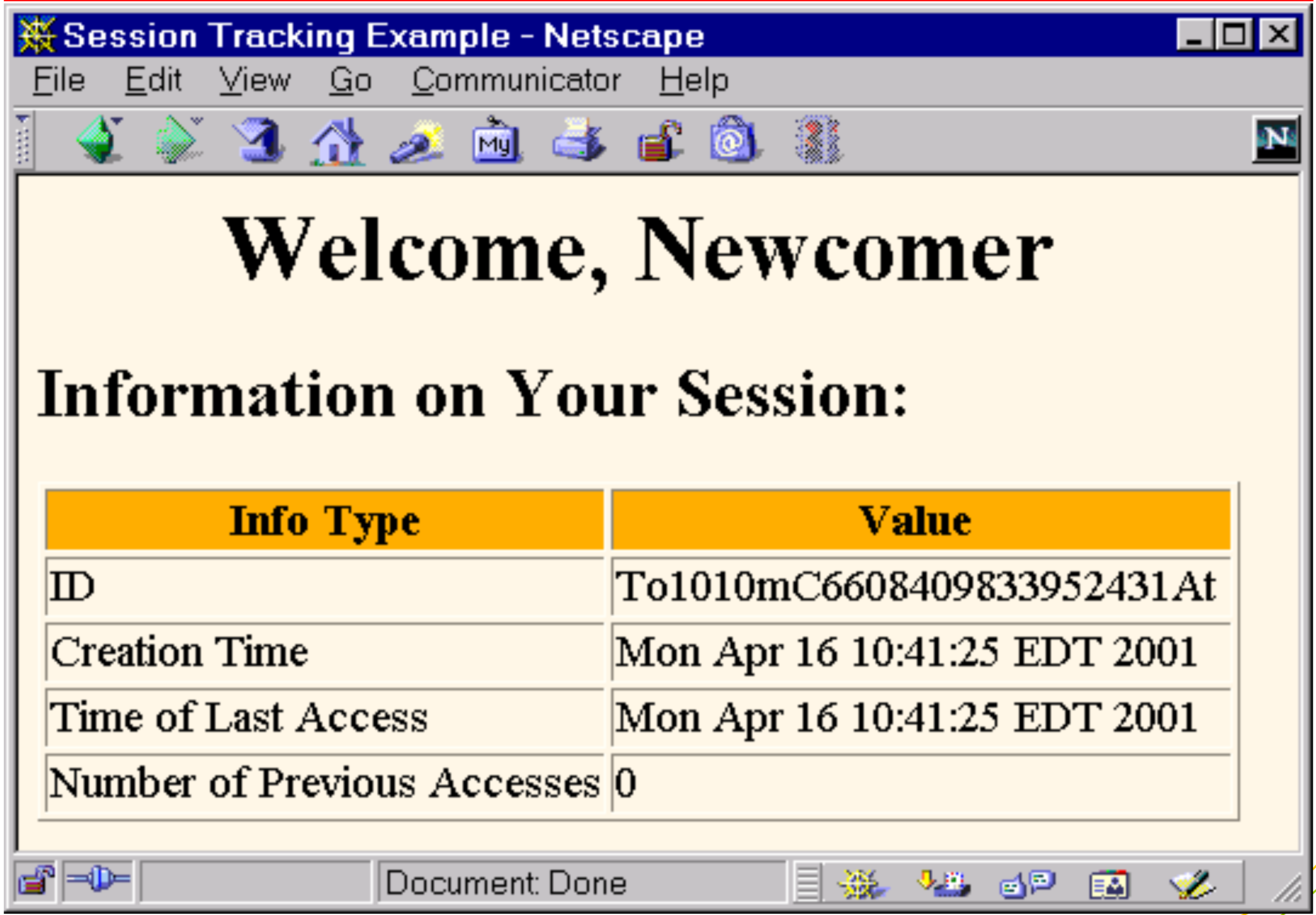
HttpSession Methods

- isNew
  - Determines if session is new to *client* (not to *page*)
- getCreationTime
  - Returns time at which session was first created
- getLastAccessedTime
  - Returns time at which session was last sent from client
- getMaxInactiveInterval, setMaxInactiveInterval
  - Gets or sets the amount of time session should go without access before being invalidated
- invalidate
  - Invalidates the session and unbinds all objects associated with it

A servlet showing Per-Client access counts

```
public void doGet(HttpServletRequest request,
                  HttpServletResponse response)
throws ServletException, IOException {
response.setContentType("text/html");
PrintWriter out = response.getWriter();
String title = "Session Tracking Example";
HttpSession session = request.getSession(true);
String heading;
Integer accessCount =
 (Integer)session.getAttribute("accessCount") ;
  if (accessCount == null) {
    accessCount=new Integer(0);heading="Welcome,Newcomer";
  } else {
    heading = "Welcome Back";
    accessCount = new Integer(accessCount.intValue() + 1);
  }
  session.setAttribute("accessCount", accessCount);
```

First visit to ShowSession servlet

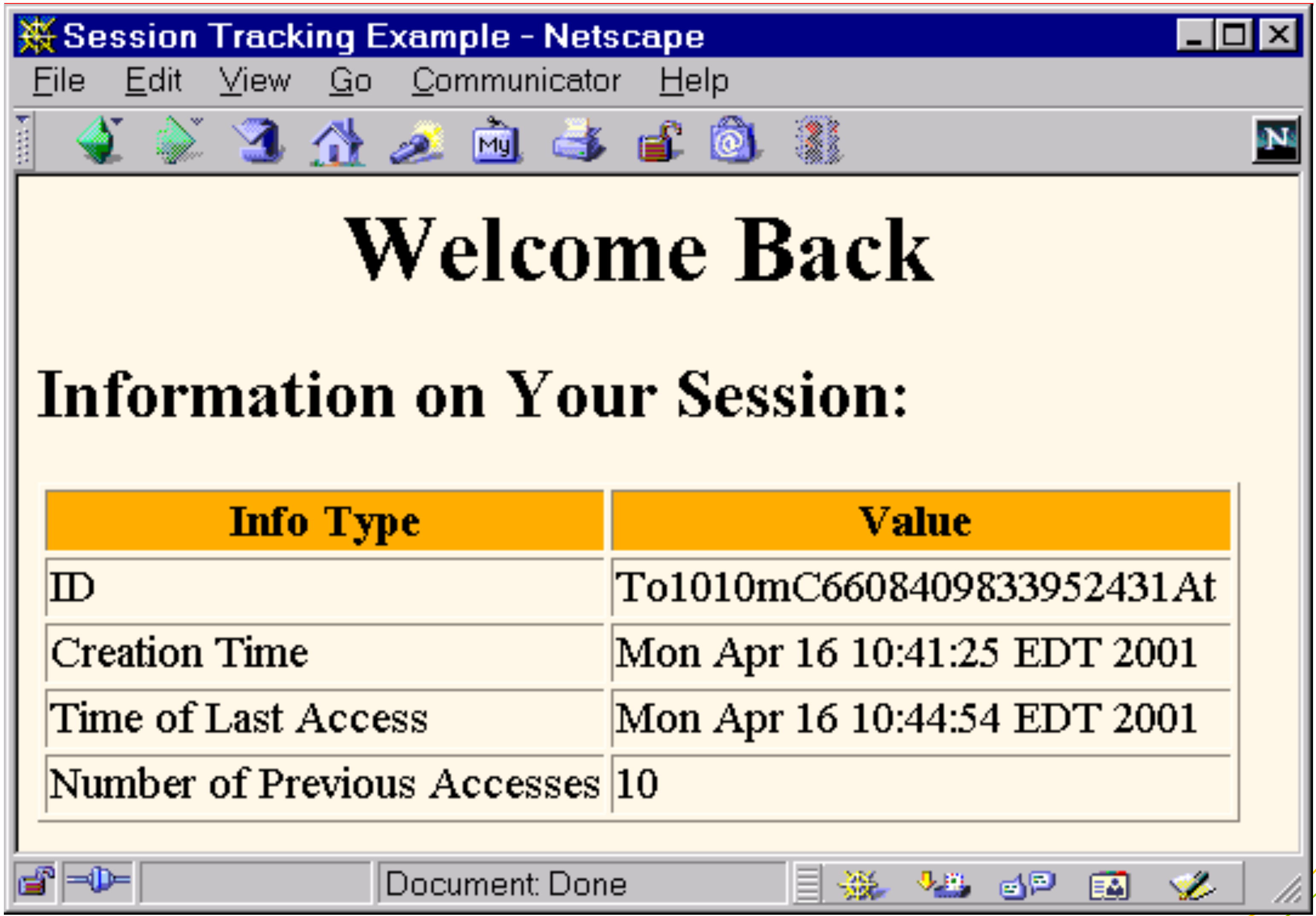

Session Tracking Example - Netscape
File Edit View Go Communicator Help
Document: Done

Welcome, Newcomer

Information on Your Session:

Info Type	Value
ID	To1010mC6608409833952431At
Creation Time	Mon Apr 16 10:41:25 EDT 2001
Time of Last Access	Mon Apr 16 10:41:25 EDT 2001
Number of Previous Accesses	0

Eleventh visit to ShowSession servlet

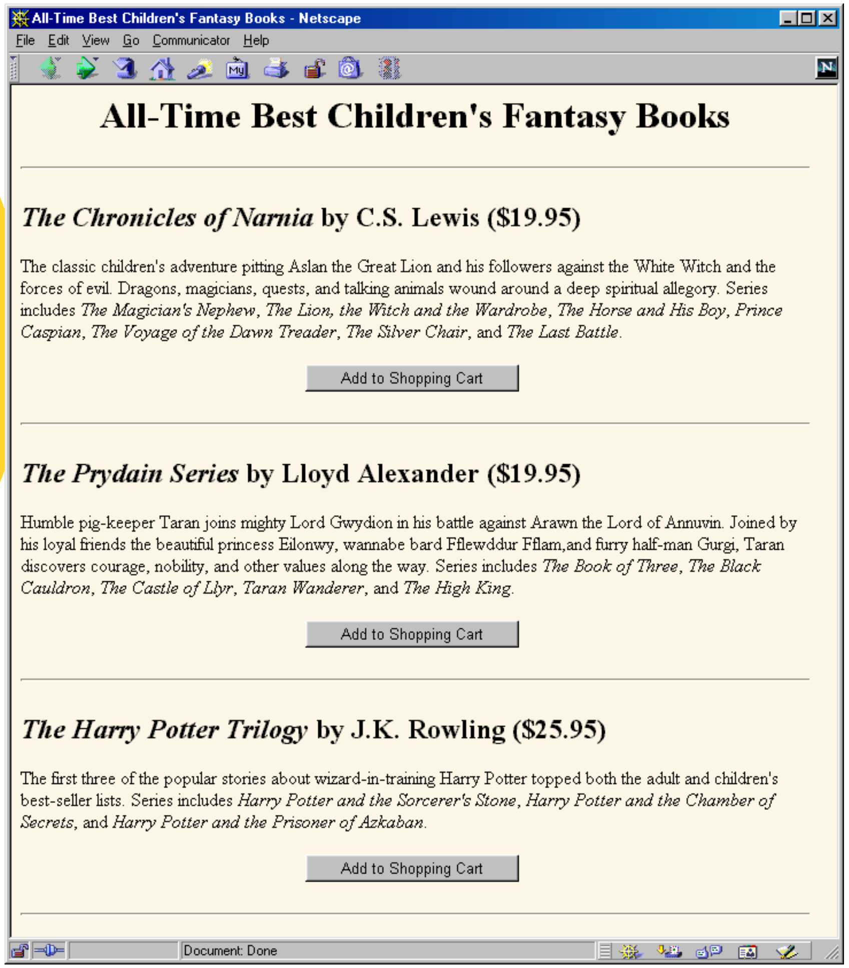

Session Tracking Example - Netscape
File Edit View Go Communicator Help
Document: Done

Welcome Back

Information on Your Session:

Info Type	Value
ID	To1010mC6608409833952431At
Creation Time	Mon Apr 16 10:41:25 EDT 2001
Time of Last Access	Mon Apr 16 10:44:54 EDT 2001
Number of Previous Accesses	10

Session tracking and shopping carts


All-Time Best Children's Fantasy Books - Netscape
File Edit View Go Communicator Help
Document: Done

All-Time Best Children's Fantasy Books

The Chronicles of Narnia by C.S. Lewis ($19.95)

The classic children's adventure pitting Aslan the Great Lion and his followers against the White Witch and the forces of evil. Dragons, magicians, quests, and talking animals wound around a deep spiritual allegory. Series includes *The Magician's Nephew*, *The Lion, the Witch and the Wardrobe*, *The Horse and His Boy*, *Prince Caspian*, *The Voyage of the Dawn Treader*, *The Silver Chair*, and *The Last Battle*.

Add to Shopping Cart

The Prydain Series by Lloyd Alexander ($19.95)

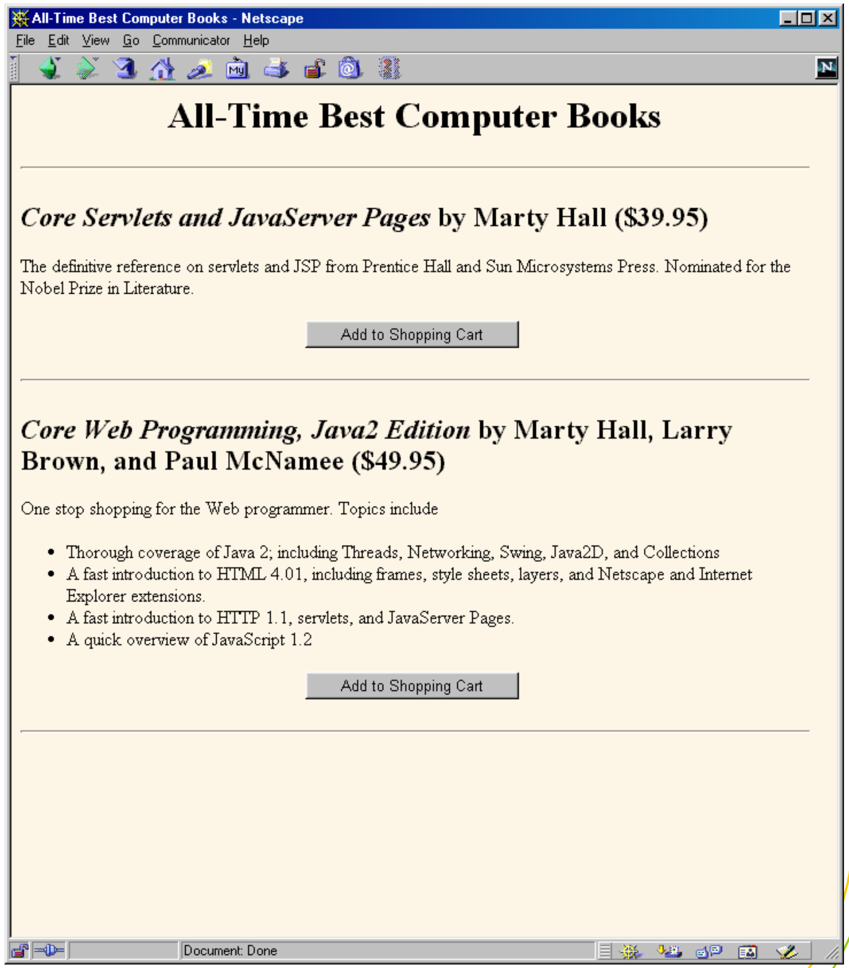
Humble pig-keeper Taran joins mighty Lord Gwydion in his battle against Arawn the Lord of Annuvin. Joined by his loyal friends the beautiful princess Eilonwy, wannabe bard Fflewddur Fflam,and furry half-man Gurgi, Taran discovers courage, nobility, and other values along the way. Series includes *The Book of Three*, *The Black Cauldron*, *The Castle of Llyr*, *Taran Wanderer*, and *The High King*.

Add to Shopping Cart

The Harry Potter Trilogy by J.K. Rowling ($25.95)

The first three of the popular stories about wizard-in-training Harry Potter topped both the adult and children's best-seller lists. Series includes *Harry Potter and the Sorcerer's Stone*, *Harry Potter and the Chamber of Secrets*, and *Harry Potter and the Prisoner of Azkaban*.

Add to Shopping Cart


All-Time Best Computer Books - Netscape
File Edit View Go Communicator Help
Document: Done

All-Time Best Computer Books

Core Servlets and JavaServer Pages by Marty Hall ($39.95)

The definitive reference on servlets and JSP from Prentice Hall and Sun Microsystems Press. Nominated for the Nobel Prize in Literature.

Add to Shopping Cart

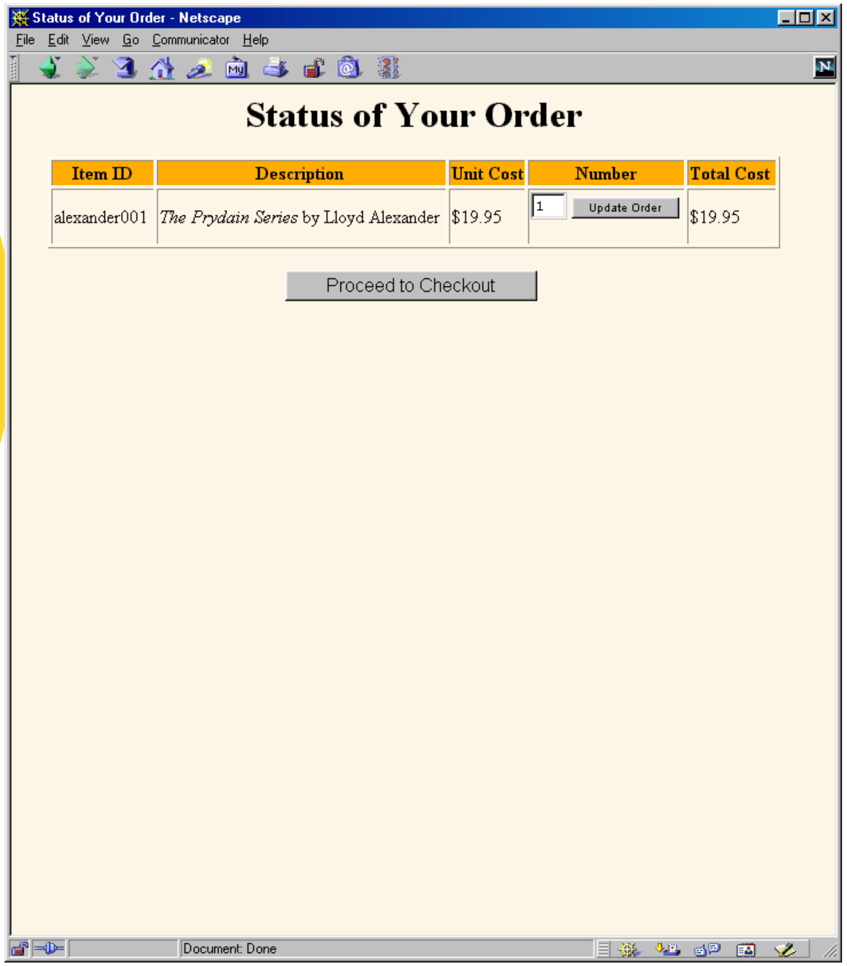
Core Web Programming, Java2 Edition by Marty Hall, Larry Brown, and Paul McNamee ($49.95)

One stop shopping for the Web programmer. Topics include

- Thorough coverage of Java 2; including Threads, Networking, Swing, Java2D, and Collections
- A fast introduction to HTML 4.01, including frames, style sheets, layers, and Netscape and Internet Explorer extensions.
- A fast introduction to HTTP 1.1, servlets, and JavaServer Pages.
- A quick overview of JavaScript 1.2

Add to Shopping Cart

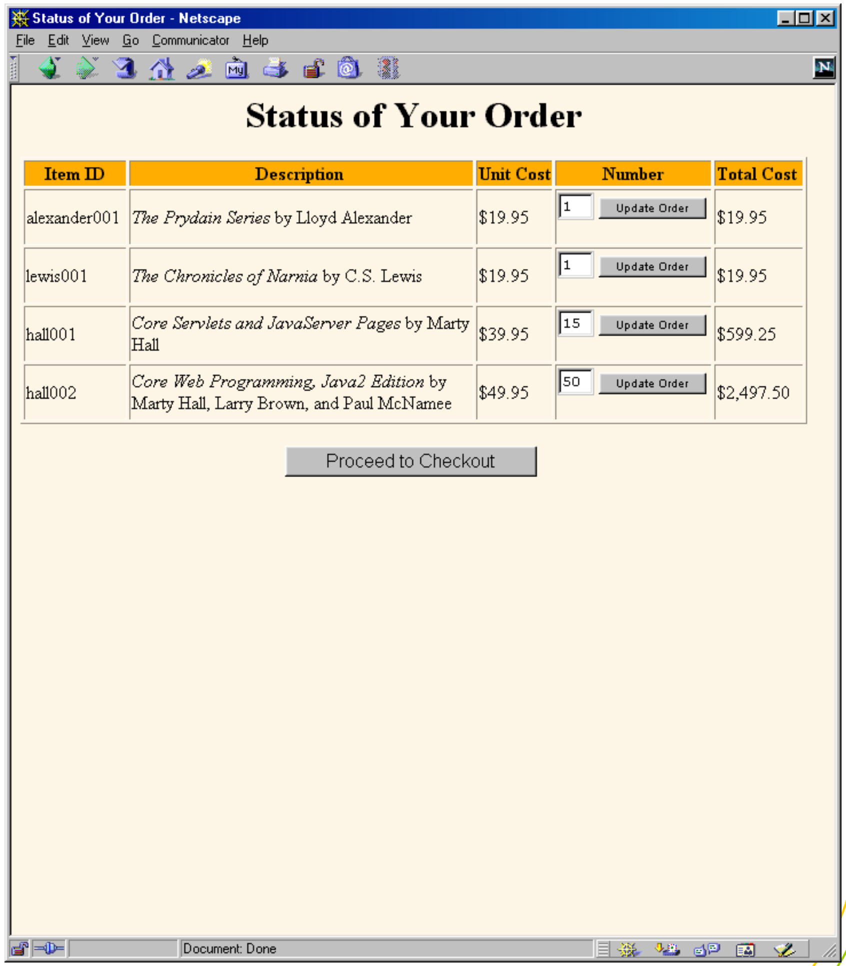
Session tracking and shopping carts


Status of Your Order - Netscape
File Edit View Go Communicator Help

Status of Your Order

Item ID	Description	Unit Cost	Number	Total Cost
alexander001	*The Prydain Series* by Lloyd Alexander	$19.95	1 Update Order	$19.95

Proceed to Checkout
Document: Done


Status of Your Order - Netscape
File Edit View Go Communicator Help

Status of Your Order

Item ID	Description	Unit Cost	Number	Total Cost
alexander001	*The Prydain Series* by Lloyd Alexander	$19.95	1 Update Order	$19.95
lewis001	*The Chronicles of Narnia* by C.S. Lewis	$19.95	1 Update Order	$19.95
hall001	*Core Servlets and JavaServer Pages* by Marty Hall	$39.95	15 Update Order	$599.25
hall002	*Core Web Programming, Java2 Edition* by Marty Hall, Larry Brown, and Paul McNamee	$49.95	50 Update Order	$2,497.50

What changes if server uses URL rewriting?

- Session tracking code:
  - No change
- Code that generates hypertext links back to same site:
  - Pass URL through response.encodeURL.
    - If server is using cookies, this returns URL unchanged
    - If server is using URL rewriting, this appends the session info to the URL
    - E.g.:

```
String url = "order-page.html";
url = response.encodeURL(url);
```

- Code that does sendRedirect to same site:
  - Pass URL through response.encodeRedirectURL

Summary

- Although it usually uses cookies behind the scenes, the session tracking API is higher-level and easier to use than the cookie API
  - If server supports URL-rewriting, *your* code unchanged
- Session information lives on server
  - Cookie or extra URL info associates it with a user
- Obtaining session
  - request.getSession(true)
- Associating values with keys
  - session.setAttribute (or session.putValue)
- Finding values associated with keys
  - session.getAttribute (or session.getValue)
    - Always check if this value is null

Review for Midterm exam

- Date and Time: 22/4/2024; 10:15 AM
- Duration: 80 mins
- Closed-book exam (one page note of hand-writing is used)
- Content: (30% of the course)
  - Theory: 2 questions about your knowledge in the web application development
  - Practice: 4 question include design and programming (both front-end and back-end)