Programming the Web Server

Robert M. Dondero, Ph.D.
Princeton University
Objectives

You will learn:

- How to "program the web server" using...
- PHP
- JSP
Previously

CGI Programming

Browser → Web Server
Socket HTTP

Web Server → Application
Pipe CGI protocol

Application runs in distinct process from web server

Browser → Web Server
Socket HTTP

Web Server → database
Pipe CGI protocol

Web Server → somefile
Pipe CGI protocol
Programming the Web Server

Application runs (typically) as thread within web server process
Part 1: PHP
PHP

- **Who**: Rasmus Lerdorf
- **When**: 1995
- **Why**: Create Web apps that generate pages dynamically
- **The name**:  
  - Personal Home Page
  - And later...
  - PHP Hypertext Processor (recursive acronym)
PHP Good News and Bad News

- Good news
  - Apache web server handles PHP
  - PHP is available on CS computers
- Bad news...
Yet another programming language!

- And (IMHO) an inelegant one
- No time (and inappropriate) to cover thoroughly

- See my personal "Subset of PHP"
  - Link on web pages

- Some familiar examples that might help...
PHP Examples

- See `hello.php`
  - Program structure
  - The echo command
  - The build/run process
- See `square.php`
  - Function definitions
  - Variables
  - Parameters
  - String concatenation
PHP Examples

- See `circle.php`
  - Interpreted strings
  - The `fscanf()` function
    - As in C
  - The `printf()` and `fprintf()` functions
    - As in C
    - More powerful, less efficient, than `echo` command

- See `euclid.php`
  - Control flow
See intmath.php, testintmath.php

Multi-file programs

<table>
<thead>
<tr>
<th>Function</th>
<th>Exec Continues Upon Failure?</th>
<th>File Included Only Once?</th>
</tr>
</thead>
<tbody>
<tr>
<td>include</td>
<td>y</td>
<td>n</td>
</tr>
<tr>
<td>include_once</td>
<td>y</td>
<td>y</td>
</tr>
<tr>
<td>require</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>require_once</td>
<td>n</td>
<td>y</td>
</tr>
</tbody>
</table>
See fraction.php, testfraction.php

- Object oriented programming
  - "$this" object reference
  - "->" field selector operator

- Exception handling
PHP Examples

- See calls1.php
  - Call-by-value and call-by-reference
- See calls2.php
  - Call-by-value and call-by-reference with objects
- See testdivmod.php
  - "Returning" multiple values
  - Call-by-value and call-by-reference
- See immutable.php
  - Immutability of strings
PHP Examples

- See arrays.php
  - Arrays
  - Arrays are not objects!!!
  - "foreach" statement

- See formatter.php
  - Constants
  - String manipulation; uninterpreted strings
  - File handling
  - Command-line arguments
  - Regular expressions
**PHP Examples**

- See `linesort.php`
  - Arrays, sorting, file-handling
  - Note CPU time consumed
- See `concord.php`
  - Regular expressions
  - Associative arrays
  - Note CPU time consumed
See selectrows.php
- Uses the \texttt{mysqli} library (not the \texttt{mysql} library)

See updaterows.php
- Transactions

See \texttt{trans.php}
- Transactions for recovery

See selectrowsprepared.php
- Prepared statements
The Pennypack sequence in PHP...
PennypackPhp1 Application

- See PennypackPhp1 application
  - book.php
  - database.php
  - index.html
  - header.php, footer.php
  - searchform.php, searchresults.php
- Generalizing...
# PHP Superglobal Variables

<table>
<thead>
<tr>
<th>Superglobal</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>$_GET</td>
<td>Data passed to the current script via the HTTP GET method</td>
</tr>
<tr>
<td>$_POST</td>
<td>Data passed to the script via the HTTP POST method</td>
</tr>
<tr>
<td>$_COOKIE</td>
<td>Data passed to the script via cookies</td>
</tr>
<tr>
<td>$_SESSION</td>
<td>Session data (see description later in this lecture)</td>
</tr>
<tr>
<td>$_REQUEST</td>
<td>The union of $_GET, $_POST, and $_COOKIE</td>
</tr>
<tr>
<td>$_SERVER</td>
<td>Headers, paths, script locations, etc.; varies with web server</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>
Problem:
- Missing author name is not handled as I wish

Solution:
- PHP header() function...
PennypackPhp2 Application

- See PennypackPhp2 Application
  - book.php
  - database.php
  - index.html
  - header.php, footer.php
  - searchform.php, searchresults.php
- Generalizing...
- **header()** function
  - Sends header to browser
  - In this case
    - Sends "location" header to browser
    - Header specifies web page
    - Browser automatically visits specified web page
"Problem"
- Want "previous search" field in searchform page

"Solution"
- Sessions via the session implicit object
See **PennypackPhp3 Application**

- book.php
- database.php
- index.html
- header.php, footer.php
- searchform.php, searchresults.php

Generalizing...
Another superglobal variable...

$_SESSION

- An associative array()
- Provides access to saved "name=value" state pairs
PHP session_start()

- **session_start()** function
  - Commands web server to:
    - Accept "PHPSESSID=key" cookie from browser, or create "PHPSESSID=key" cookie
    - Extract key from cookie
    - Use key to populate $_SESSION with saved "name=value" state pairs
    - Allow PHP code to use/modify $_SESSION
    - Pass "PHPSESSID=key" cookie to browser
Part 2: JSP
Who: Sun

When: 1999

Why:
- "Address the perception that the Java programming environment didn't provide developers with enough support for the Web" – Wikipedia
- Sun's answer to PHP (and Microsoft's ASP)

The name:
- JavaServer Pages
Bad News

- Bad news
  - Apache web server does not handle JSP
  - Not available on CS computers
- Why study JSP?
  - May be useful for projects
  - Conceptual bridge between CGI Web programming and "PHP-style" Web programming
    - New language isn't necessary!
JSP Examples

- Using the **Apache Tomcat** web server
- Running locally on my computer
PennypackJsp1 Application

- See PennypackJsp1 Application
  - DateTime.java, Book.java, Database.java
    - Cannot be in the anonymous package
  - index.html
  - searchform.jsp, searchresults.jsp
  - header.jsp, footer.jsp
- Generalizing...
JSP Hidden Comment

- **Hidden comment**
  - `<%-- some text --%>`
  - Not sent to Web server
  - Not sent to browser
  - As opposed to...

- **Output comment** (not illustrated)
  - `<!-- some text -->`
  - Ordinary HTML comment
"Page Directive" Tag

- `<%@page language="java" import="package.class, package.class" %>`

- Specifies language
  - Java
  - ... or JavaScript???

- Specifies classes to import
JSP Scriptlet Tag

- "Scriptlet" Tag
  - `<% JavaCodeFragment %>`
  - Contains arbitrary Java code
  - Uses implicit objects...
JSP Implicit Objects

- Implicit Objects
  - request: getParameter(), getParameterNames(), getParameterValues()
  - out: print(), println()
JSP Expression Tag

- "Expression" Tag
  - `<%= JavaExpression %>`
  - Shortcut for:
    - `<% out.print(JavaExpression) %>`
JSP Include Tag

- "Include" Tag
  - `<jsp:include page="{ relativeURL | <%= JavaExpression %> }
  flush="true" />
  - At run-time, output generated by relativeURL replaces the tag
Problem:
  • Missing author name is not handled as I wish

Solution:
  • JSP forwarding...
PennypackJsp2 Application

- See PennypackJsp2 Application
  - DateTime.java, Book.java, Database.java
  - index.html
  - searchform.jsp, searchresults.jsp
  - header.jsp, footer.jsp

- Generalizing...
"Forward" Tag

- `<jsp:forward page={ relativeURL | <%= expression %> }" />
- Forwards a client request to an HTML file or JSP file for processing
"Problem"
- Want "previous search" field in searchform page
- Must make the application stateful

Solution
- Sessions via the **session** implicit object
PennypackJsp3 Application

- See PennypackJsp3 Application
  - DateTime.java, Book.java, Database.java
  - index.html
  - searchform.jsp, searchresults.jsp
  - header.jsp, footer.jsp
- Generalizing...
Implicit objects (cont.):

- **session**
  - **putValue()**
    - `session.putValue()` populates `session` implicit object with "name=value" state pair
    - Web server stores "name=value" state pairs on server side; associates state with key; passes "JSESSIONID=key" to browser as cookie
  - **getValue()**
    - Web server accepts "JSESSIONID=key" cookie from browser; extracts key from cookie; populates `session` implicit object with "name=value" state pairs
    - `session.getValue()` accesses "name=value" state pair
Using the Apache Tomcat web server:

tomcat
  ...
  webapps
    ...
    PennypackJspX
      WEB-INF
      classes
        pennypack
          Book.java
          Book.class
          Database.java
          Database.class
          DateTime.java
          DateTime.class
        lib
          web.xml
        footer.jsp
        header.jsp
        index.html
        searchform.jsp
        searchresults.jsp
PHP & JSP Parting Thoughts

- JSP vs. PHP:
  - JSP pro: Less eccentric syntax
    - JSP = Java + some tags
  - JSP pro: More powerful
    - Java language, libraries, docs are available
  - PHP pro: Apache web server support
  - PHP pro: Simpler, "easier to learn"
    - Unless you already know Java!!!
PHP & JSP Parting Thoughts

- PHP & JSP are CGI "turned inside out"

- CGI
  - Program generates HTML
- PHP & JSP
  - HTML contains program
PHP & JSP Parting Thoughts

- Fixed template data only
  - => Use HTML; JSP/PHP adds no value
- Dynamically generated data only
  - => Use CGI; JSP/PHP adds little value
- Mixture (as is almost always the case)
  - => PHP/JSP adds value
Summary

We have covered:

- How to "program the web server" using...
- PHP
- JSP
Appendix 1: PSP
PSP Overview

- PSP (Python Server Pages)
  - Java:JSP :: Python:PSP
PSP Overview

- **Good news**
  - Apache web server handles PSP...
  - Via **mod_python** plug-in module
- **Bad news**
  - **mod_python** not installed into CS Apache web server
  - PSP not available on CS Apache web server
- An example using Apache/mod_python running on my local computer...
PennypackPsp1 Application

- See PennypackPsp1 application
  - book.py, database.py
  - index.html
  - common.py
  - searchform.psp, searchresults.psp
PSP Parting Thoughts

- PSP parting thoughts
  - A little awkward
    - Python indentation significant =>
    - Awkward merge into HTML
  - (IMHO) Not ready for prime time
    - Fragile
    - Poorly documented