Glue Microarray Database System Using Struts Technology

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Today’s Topics:

- Introduce ‘Struts’
  -- An MVC Design Pattern Implementation

- GMDS (Glue Microarray Database System) Demo
Project Requirements

GMDS prototype is being developed for the Glue Grant project.

- Complex enterprise applications.
- Must be extensible, maintainable, and must perform at acceptable levels.
Enterprise Solution

**J2EE** (Java 2 Platform Enterprise Edition)

An existing application server technology used to build such enterprise applications.
J2EE Platform Overview
public class DownloadServlet extends HttpServlet {

    ....

    else {
        response.setContentType("text/html");
        java.io.PrintWriter out = response.getWriter();
        out.println("<html>");
        out.println("<head>");
        out.println("<title>Servlet</title>");
        out.println("</head>");
        out.println("<body>");
        out.println("<p>Your file is not on the server.<p><p>Contact customer support.</p>");
        out.println("</p>");
        out.println("</body>");
        out.println("</html>");
        out.close();
    }

    ....
}
JSP (Java Server Page)

```jsp
<%@ page language="java" %>
<%@ taglib uri="/WEB-INF/struts-bean.tld" prefix="bean" %>
<%@ taglib uri="/WEB-INF/struts-html.tld" prefix="html" %>
<%@ taglib uri="/WEB-INF/app.tld" prefix="app" %>

......
<table>
<tr><td> This can be any HTML text you want </td></tr>
<tr><td>

......
<String pageExperiment_aboutus =
response.encodeURL(request.getContextPath() + "/aboutus.html"); %>

<script language="JavaScript">
function openWindow1()
{
    popupWin = window.open("<%=pageExperiment_aboutus%>", 'AboutUs', 'Resizable')
}</script>

<A HREF="javascript:openWindow1();"> About Us</a>

......
</tr></table>
......
Evolution

- We’ve seen a lot in 6 years...

- More than 20 years later, the old patterns (Model 1 and Model 2) still apply (1979-)
Design Pattern – Model 1

The Model 1 web application:

A collection of JSP pages working largely independently of each other.

Each page directly transfers control to the next page. There is no separate controller.
Model 1 - Main Problems

- A simple change can result in a cascade of changes in many different pages with unpredictable consequences.

- Complexity grows fast as well, and what might originally look simple and straightforward can quickly turn into a big mess as you add more pieces.
Model 2 represents a framework based on the Model-View-Controller (MVC) system.

Each page reports back to the controller, which decides what to do next.
Jakarta Struts

- Struts is an initiative of the Jakarta project
- MVC system for JSP technology
- In July 2001, Struts 1.0 was released
Jakarta Struts (cont...)
Controller
Controller (cont...)

```xml
<web-app>
 <servlet>
   <servlet-name>action</servlet-name>
   <servlet-class>org.apache.struts.action.ActionServlet</servlet-class>
   ......
   <init-param>
     <param-name>config</param-name>
     <param-value>/WEB-INF/struts-config.xml</param-value>
   </init-param>
   ......
 </servlet>

 <servlet-mapping>
   <servlet-name>action</servlet-name>
   <url-pattern>*.do</url-pattern>
 </servlet-mapping>

 ......
</web-app>
```
Controller (cont...)

```xml
<?xml version="1.0" encoding="ISO-8859-1" ?>

<!DOCTYPE struts-config PUBLIC "-//Apache Software Foundation//DTD Struts Configuration 1.0//EN" "http://jakarta.apache.org/struts/dtdds/struts-config_1_0.dtd">

<struts-config>
  <!-- ========= Form Bean Definitions ========= -->
  <form-beans>
    <form-bean name="ArrayComboCreationForm"
                type="edu.harvard.mgh.molbio.microarray.ArrayComboCreationForm"/>
    .......
  </form-beans>

  <!-- ========= Action Mapping Definitions ========= -->
  <action-mappings>
    <!-- Action To Create An Experiment -->
    <action path="/ExperimentCreation"
             type="edu.harvard.mgh.molbio.microarray.ExperimentCreationAction"
             name="ExperimentCreationForm"
             scope="request"
             input="/experiment_creation.jsp">
      <forward name="display" path="/experiment_list.jsp" />
    </action>
    .......
  </action-mappings>
</struts-config>
```
Model (part of MVC)
public class ExperimentCreationForm extends ActionForm {
    public void setexperiment_name(String experiment_name) {
        this.experiment_name = experiment_name;
    }
    public String getexperiment_name() {
        return experiment_name;
    }
    .......
    public ActionErrors validate(ActionMapping mapping, HttpServletRequest request) {
        ActionErrors errors = new ActionErrors();
        .......
        if (!errors.empty()) {
            errors.add("input_error",
                    new ActionError("error.input_error.exist");
        }
        return errors;
    }
    public void reset() {
    }
}
public class ExperimentCreationAction extends Action {
    public ActionForward perform (ActionMapping mapping,
        ActionForm form,
        HttpServletRequest request,
        HttpServletResponse response) {
        ActionErrors errors = new ActionErrors();
        ExperimentCreationForm theForm = (ExperimentCreationForm) form;
        String experiment_name = theForm.getexperiment_name();
        
        // Connect to data source and create a blank record in the database
        try {
            Context ctx = new InitialContext();
            DataSource ds = (DataSource) ctx.lookup("java:comp/env/jdbc/gmds");
            con = ds.getConnection();
            
            // Return a forward
            if (!errors.isEmpty()) {
                errors.add("input_error", new ActionError("error.input_error.exist"));
                saveErrors(request, errors);
                return (new ActionForward(mapping.getInput()));
            } else {
                return mapping.findForward("display");
            }
        } finally {
            // Close the connection
            if (con != null) {con.close();}
        }
    }
}
View
View (cont...)

```jsp
<%@ page language="java" %>
<%@ page import="java.util.*" %>
<%@ taglib uri="/WEB-INF/struts-html.tld" prefix="html" %>
<%@ taglib uri="/WEB-INF/app.tld" prefix="app" %>

......

<app:checkLogon/>

<html:html>
<body>

<html:errors property="input_error"/>

<html:form action="/ExperimentCreation" focus="experiment_name">
<table border="0" width="100%">
<tr><td>
   <html:text property="experiment_name" size="32" maxlength="128"/>
   <html:errors property="experiment_name"/>
</td></tr>

......

<tr><td>
   <html:submit property="submit" value="Submit"/>
</td></tr>
</table>
</html:form>

</body>
</html:html>
```
MVC Drawbacks

- A complex framework must be set up first.
- Building a page now becomes a multi-step process that requires extra planning and forethought.
GMDS Demo

Already on Our Linux Server for testing!

http://molbioweb2.mgh.harvard.edu:8100/GMDS2/index.jsp
Major Engineering Features:

Data Manipulation:
- Data Scope (per-experiment or system-wide)
- Data-entry Functions Separation
- Experimental Data Editing
- Data Format Error Handling
- File System plus DBMS
Major Engineering Features (cont...):

Access Control and User Interactions:
- Authentication
- File Access Tracking
- Bugs and Comments Report System
Major Engineering Features (cont...):

Flexible Design:

- Internal database design supports both Affymetrix and Spotted Microarray (Extract, Labeled Extract...)

- Multi-Color features not currently in GUI (for Affymetrix only)
Summary

- In a complex Web application, using Struts will reduce code repetition, increase control flexibility, and reduce coupling between unrelated components.

- With Struts, the number of classes and pages is initially larger because various components are split, but as you define more pages, consolidation and software re-use will occur.
Closing Thought

A good scientist is a person with original ideas.

A good engineer is a person who makes a design that works with as few original ideas as possible.

--- Freeman Dyson
Acknowledgements

Parts or Portions of this presentation are taken from the following sources:

- Professional Java Server Programming J2EE 1.3 Edition
- Proposed Description of the Integrated Microarray Database System Chuck Cooper