

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.

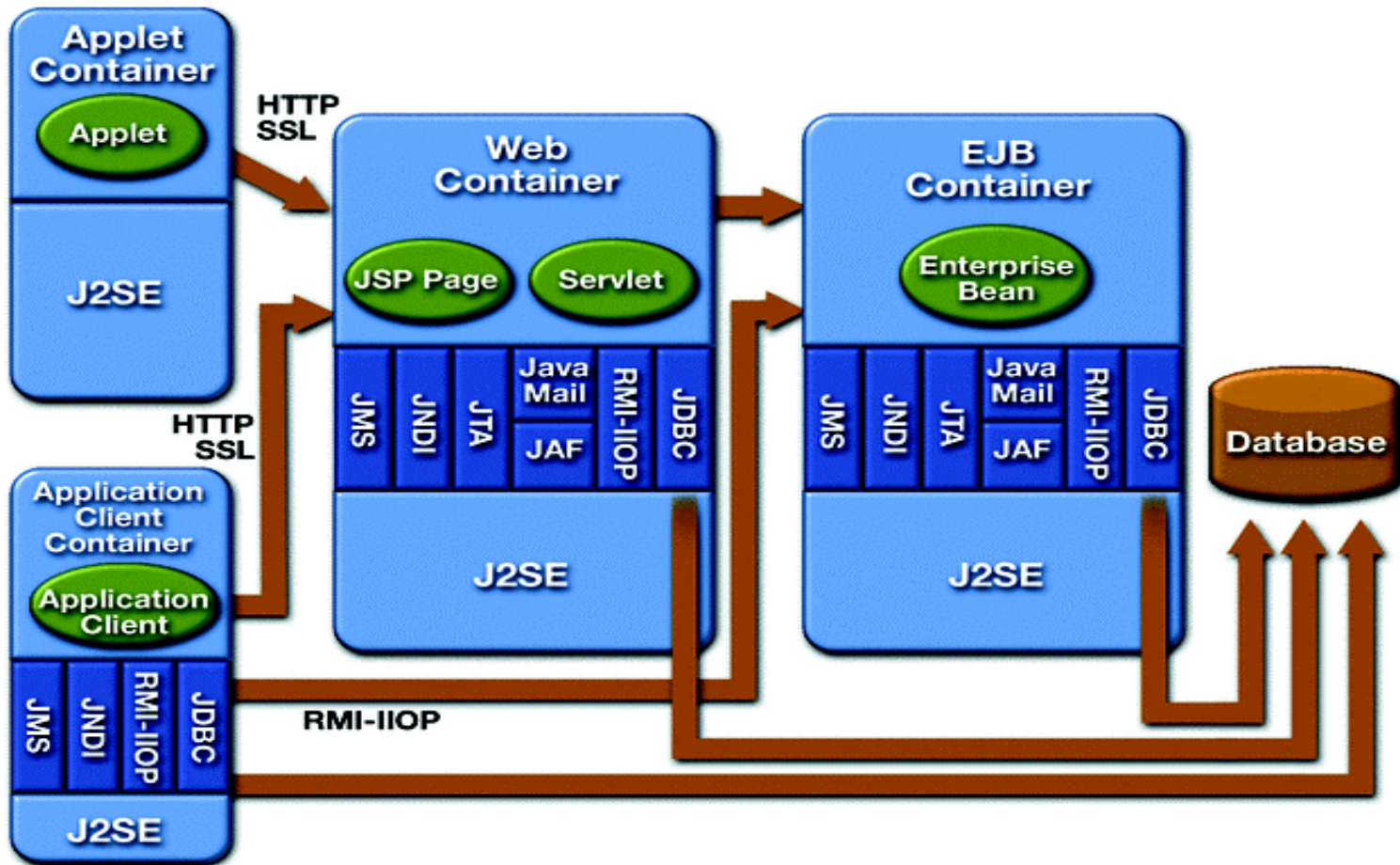
- Complex enterprise applications.
- Must be extensible, maintainable, and must perform at acceptable levels.

Enterprise Solution

J2EE (Java 2 Platform Enterprise Edition)

An existing application server technology used to build such enterprise applications.

J2EE Platform Overview



Servlets

```
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("</body>");
        out.println("</html>");
        out.close();
    }
.....
}
```

JSP (Java Server Page)

```
<%@ 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>
.....
  </td></tr>
</table>
.....
```

Evolution

- We've seen a lot in 6 years...
AWT(1995) –Servlets(1996)—
Swing(1997)—JSP(1999)—XML widely
supported and many more(2000)
- 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.

Design Pattern - Model 2

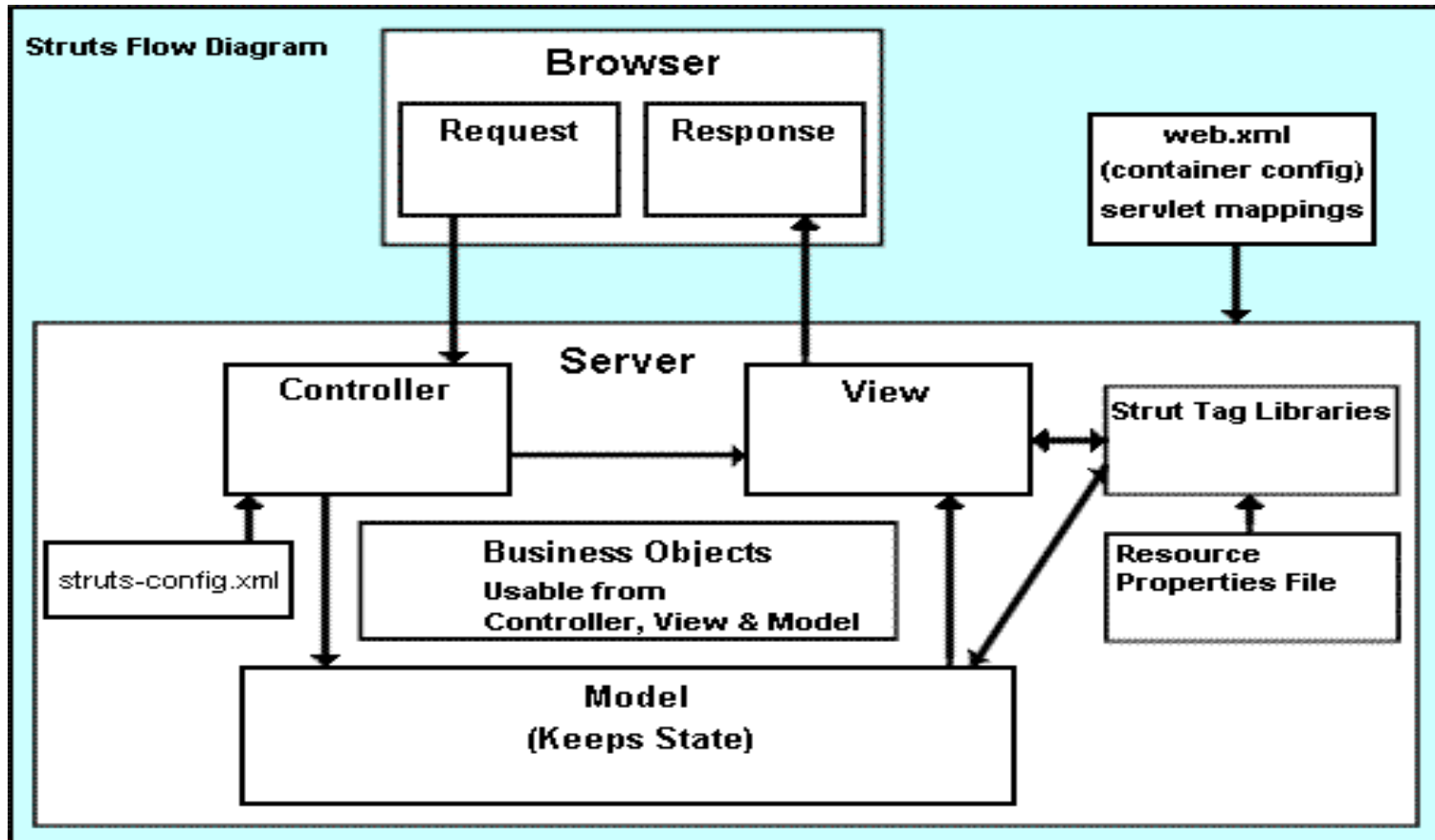
Model 2 represents a framework based on the Model-View-Controller (MVC) system.

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

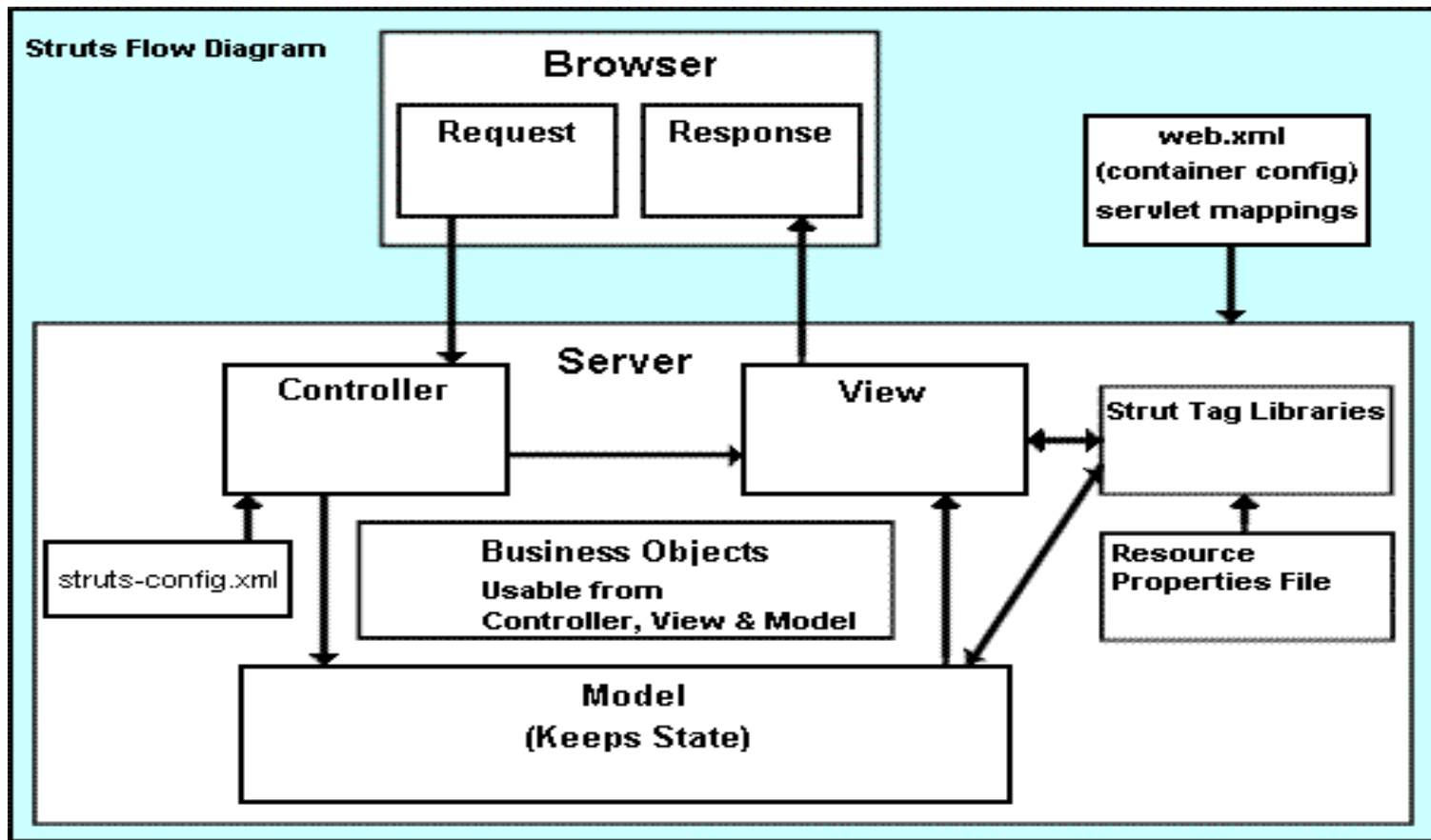
Jakarta Struts

- 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...)

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

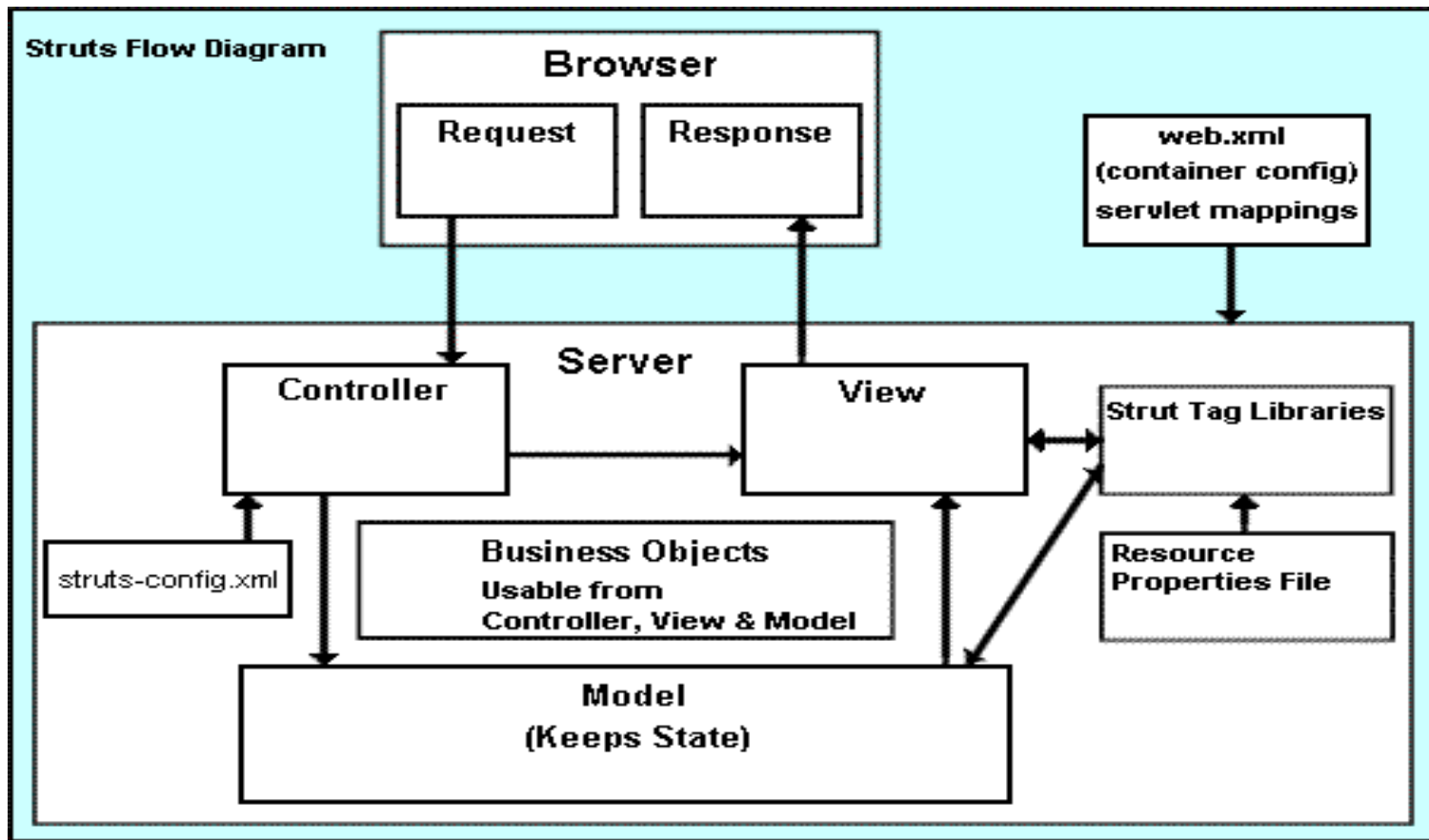
<!DOCTYPE struts-config PUBLIC
    "-//Apache Software Foundation//DTD Struts Configuration 1.0//EN"
    "http://jakarta.apache.org/struts/dtds/struts-config_1_0.dtd">

<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)



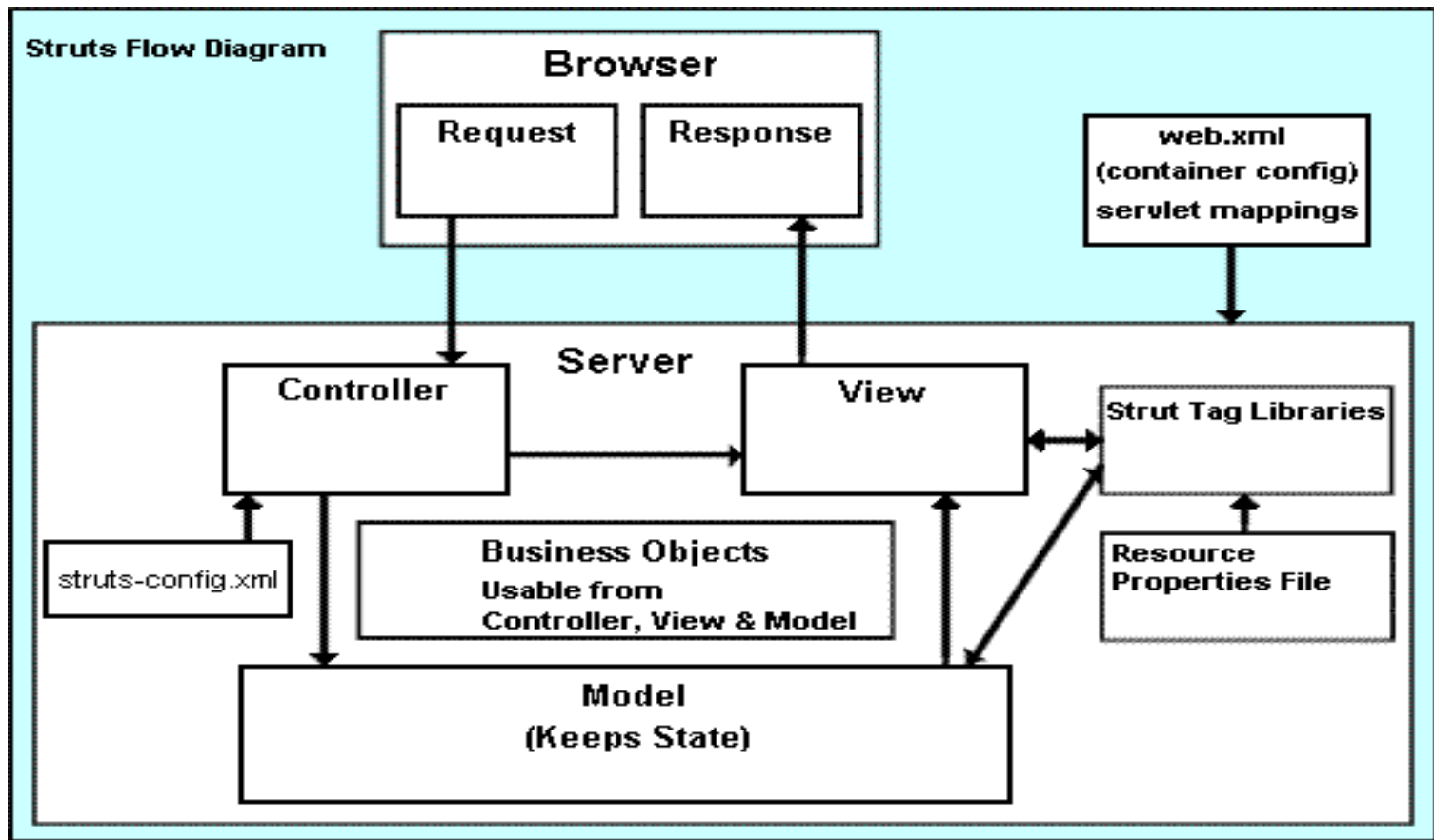
Model (cont...)

```
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() {
    }
}
```

Model (cont...)

```
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.empty()) {
                errors.add("input_error", new ActionError("error.input_error.exist"));
                saveErrors(request, errors);
                return (new ActionForward(mapping.getInput()));
            }
            else {
                return mapping.findForward("display");
            }
        }
    }
}
```

View



View (cont...)

```
<%@ 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:

- <http://jakarta.apache.org/struts/userGuide>
- <http://www.jspinsider.com/tutorials/jsp/struts/strutsintro.view>
- http://www.javaworld.com/javaworld/jw-11-2000/jw-1103-presentation_p.html
- Professional Java Server Programming
J2EE 1.3 Edition
- Proposed Description of the Integrated
Microarray Database System Chuck Cooper