

Struts: A Scalable MVC Framework for Web Applications

Ian F. Darwin

<http://www.darwinsys.com/>

Ian Darwin

- Computer Consultant, Mentor, Developer, Trainer
- O'Reilly Author: Lint, Java Cookbook, Tomcat
- Worked with UNIX since 1980, Java 1995
 - wrote file(1) command used in BSD, Linux
 - OpenBSD and Tomcat committer
- Worked at U of T (Computer Services, Undergrad teaching) and in industry (develop software; mentoring; firewalls; Java web sites; teach UNIX, C & Java for Learning Tree International)
- Web sites: JabaDot, LHBooks, Toastmasters

Outline

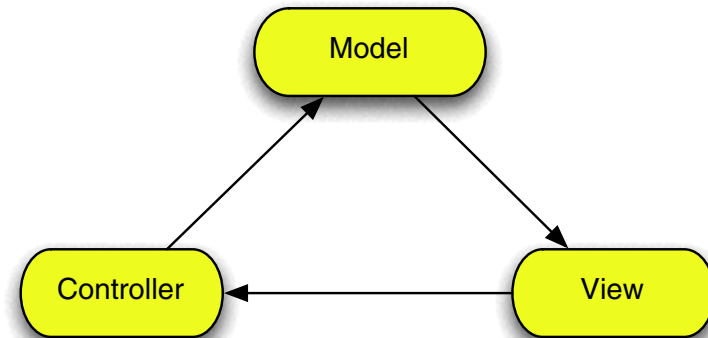
- ④ Overview of MVC and how Struts provides
- ④ Struts Architecture and Options
- ④ Struts and Scalability

In the beginning...

- ④ Before *MVC*, some web applications were "spaghetti code" (a 1970's term)
- ④ The Web version: dynamic pages mixing up presentation, business logic (server-side and JavaScript?), and data representation in one file
- ④ Hard to read, harder to debug, and almost impossible to maintain.

What is MVC?

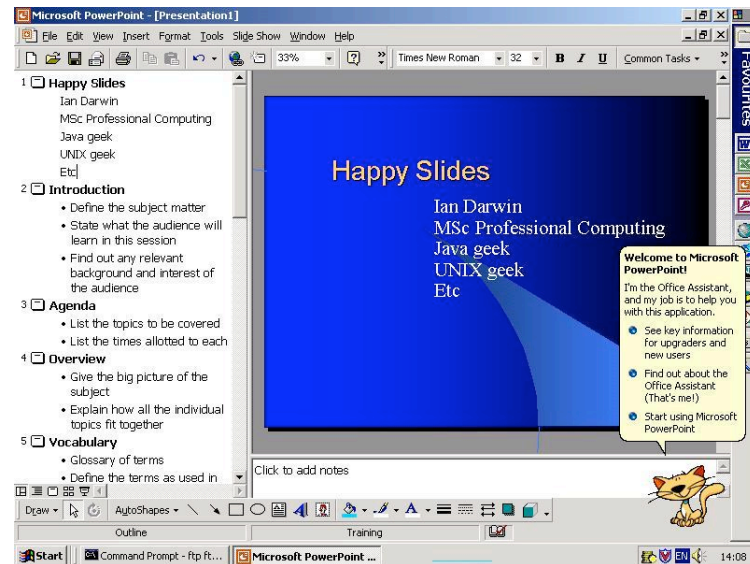
- Model-View Controller design pattern, from Xerox PARC
- Divides interactive application into:
 - Model (data modelling real world)
 - View (display, presentation)
 - Controller - responds to user actions



MVC Benefits:
maintainability
(lack of code inter-
dependence)

What is MVC? (cont'd)

- ☉ Familiar example:
slide show
program: change
text in one View, it
updates in all
Views
- ☉ MVC originally for
desktop clients;
how do we extend
this pattern to the
Web?



Servlets and JSP

- ④ Servlets are Java components running in a web server, which process web requests
 - ④ validate input, deal with database, generate HTML result
 - ④ Alternative to CGI scripting, ASP, PHP, etc.
 - ④ faster, strongly type-safe, etc.
 - ④ Part of the J2EE specification
 - ④ Many implementations, both free and commercial

J2EE

- ☉ Java 2 Enterprise Edition: a set of APIs for building large, scaleable distributed applications
 - ☉ From Sun, developed under JCP
 - ☉ Sun's take since 1980: Agree on specs; compete on implementation (NFS, RPC, etc).
 - ☉ J2EE Adopted by everybody (except Microsoft)
 - ☉ IBM Websphere (which eBay runs on), BEA WebLogics, Apple WebObjects, Pramati, JBoss, OpenEJB, many more

J2EE APIs

Servlets, JSP	Web Apps
EJB (Enterprise Java Beans)	Distributed DB/Multi-Tier
CORBA, RMI	Distributed programming binary protocols
Web Services	Distributed Programming over HTTP (.NET interop)
Mail, Activation	Email
Also Transactions, flexible logging, JMS, etc, etc. See http://java.sun.com/j2ee/	

JSP

- ④ JavaServer Page (JSP) written as HTML + Java, compiles to a Servlet (easier to write)
- ④ Comprehensive language and API
 - ④ `<jsp:include...>`
 - ④ JSP Tag Libraries
 - ④ Error handling, etc., etc.

Servlet and JSP

- ⊙ Possible division of labour: Servlet is Controller, deals with Model; JSP is View, displays result ("Servlet Dispatcher" pattern)
- ⊙ Model ("data") components are application-specific, not provided by API
 - ⊙ Customer names, addresses
 - ⊙ Image data

R.I.P. JabaDot

- JabaDot news portal site developed by me in 2000, based on Servlets and JSPs

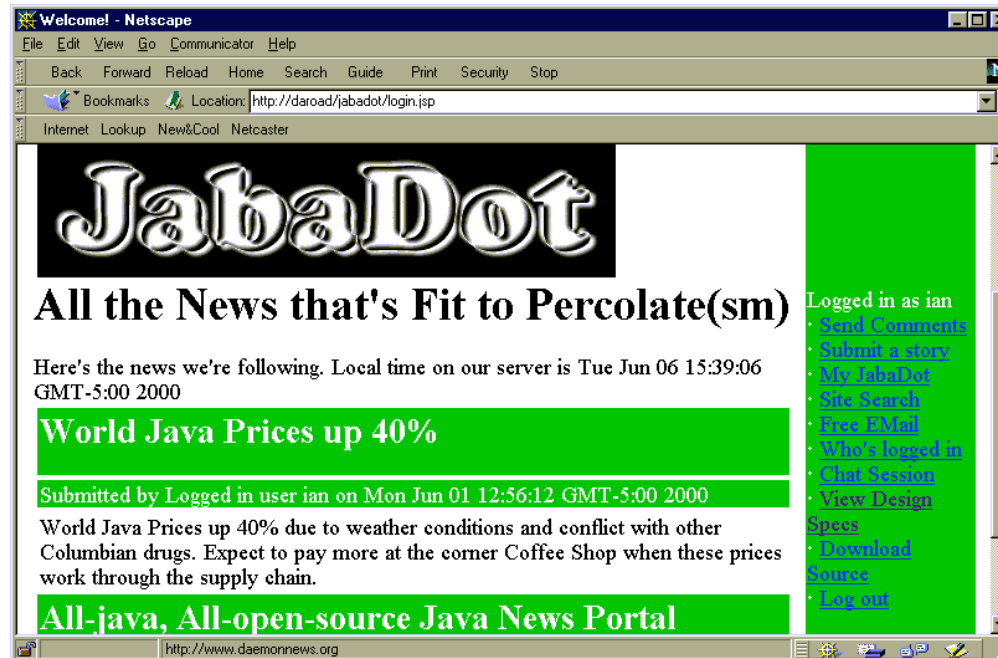
- Code published in Java Cookbook, 2001

- Why did it fail?

- Tight coupling: business logic and presentation tightly mingled

- Inadequate use of JSP tags

- Not enough use of MVC!!



Is Servlet + JSP == MVC?

- ④ If the Servlet is a Controller and JSP the View (and data objects for the Model):
 - ④ instant MVC?
- ④ Yes, BUT!
 - ④ Doesn't enforce or structure the division between Controller and View
 - ④ Need a framework for that...

Definitions

- ④ **“A framework is a reusable, semi complete application that can be specialized to produce custom applications” (Johnson, 1998)**
- ④ **“In object-oriented systems, a set of classes that embodies an abstract design for solutions to a number of related problems.” (FOLDOC, 1995)**
- ④ **Differentiated from a “toolkit”, which is a set of classes designed for use by an otherwise-complete application**
 - ④ **Application uses toolkit; framework uses components**
 - ④ **Swing is a Toolkit; Struts is a Framework**

Struts

- ④ Struts is one of three dozen Java-based frameworks that purports to "simplify" development of MVC web applications
 - ④ Fostered by Apache Jakarta
 - ④ Authored by Craig McClanahan (second architect of Tomcat web server)
 - ④ Heavily tested: McClanahan wrote entire Tomcat Admin interface while building Struts

Struts Advantages

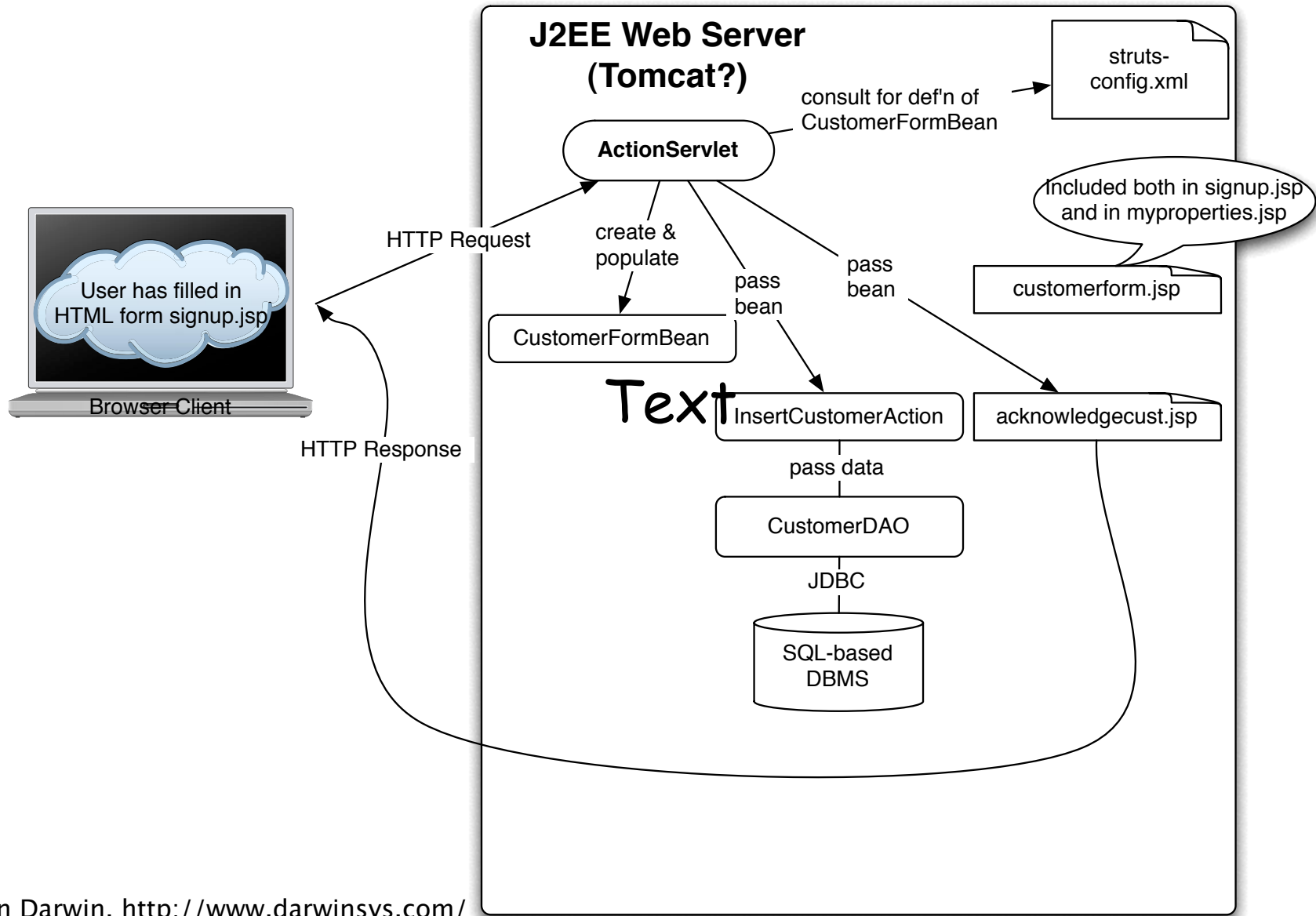
- Struts makes it easier to develop large web apps
- The dominant (by far) framework - developers available, advice available, books, etc.
- Open source, freely usable
- All components subclassable or replaceable!
- Includes powerful JSP Tag libraries
- Supported by third-party packages
- Supported by tools vendors e.g., IBM WebSphere Studio Advance Developer (WSAD) and Enterprise Developer (WSED) include Struts wizards (EasyStruts for Eclipse, JBuilder), ...

Struts Architecture

- ④ Struts provides a single Controller Servlet
- ④ Site Developer provides:
 - ④ "form bean" (Java or XML) to hold data for each HTML form
 - ④ small Action class for each processing step
 - ④ Application Resources (Java "properties") config file mapping keys to printable names, allowing for Internationalization
- ④ Master config file

English	French
<code>store.name=LH Books</code> <code>field.custName=Name</code>	<code>store.name=Livres LH</code> <code>field.custName=Nom</code>

A Struts Application



Struts Options

- ④ Struts Validator provides common validations
 - ④ field present, valid email, etc.
- ④ Tiles provides building composite pages
 - ④ promoting re-use of HTML/JSP fragments

My Research Project

- ⊙ A small research project I undertook at Staffordshire University aimed to determine whether Struts provides enough benefits in

- ⊙ development time
- ⊙ maintainability, scalability
- ⊙ code re-use

to repay the costs: the time to learn, the discipline to use well, the increase in artifacts, etc.

- Should be available for publication in 2004
 - May submit to I.J. Web Eng. & Tech.

Struts and Scalability

- ④ All server-side implementations on the Internet must consider Performance!
- ④ Struts uses the Servlet API, which runs multi-threaded
 - ④ Java Thread support - intrinsic
 - ④ Servlet - runs threaded for Performance
 - ④ Action classes are instantiated only once

Implementation Choices

- ④ Actions: consolidate related actions into one Action class (e.g., Add to Cart, Display Cart)
- ④ HTML forms: always use client-side validation
 - ④ basically just add `<html:javascript>` tag
 - ④ Avoids spurious round trip on e.g., obvious missing fields

References

- See <http://jakarta.apache.org/struts/>
- See my web site, <http://www.darwinsys.com/>
- Especially [/java/javaResources.html](#) for links on Java, J2EE, Struts, ...
- Also [/javawebframeworks/](#) for the other 38 frameworks, if you really need to know! :-)
- See <http://www.onjava.com/pub/a/onjava/2002/10/30/jakarta.html> - Lessons From The Trenches

Summary

- ⦿ J2EE provides comprehensive spec for enterprise APIs
 - ⦿ Many implementations of this spec
- ⦿ Servlet and JSP are J2EE technologies for web apps
- ⦿ MVC provides sensible division of labour in interactive application
- ⦿ Struts extends Servlets and JSP to a full MVC framework.

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