

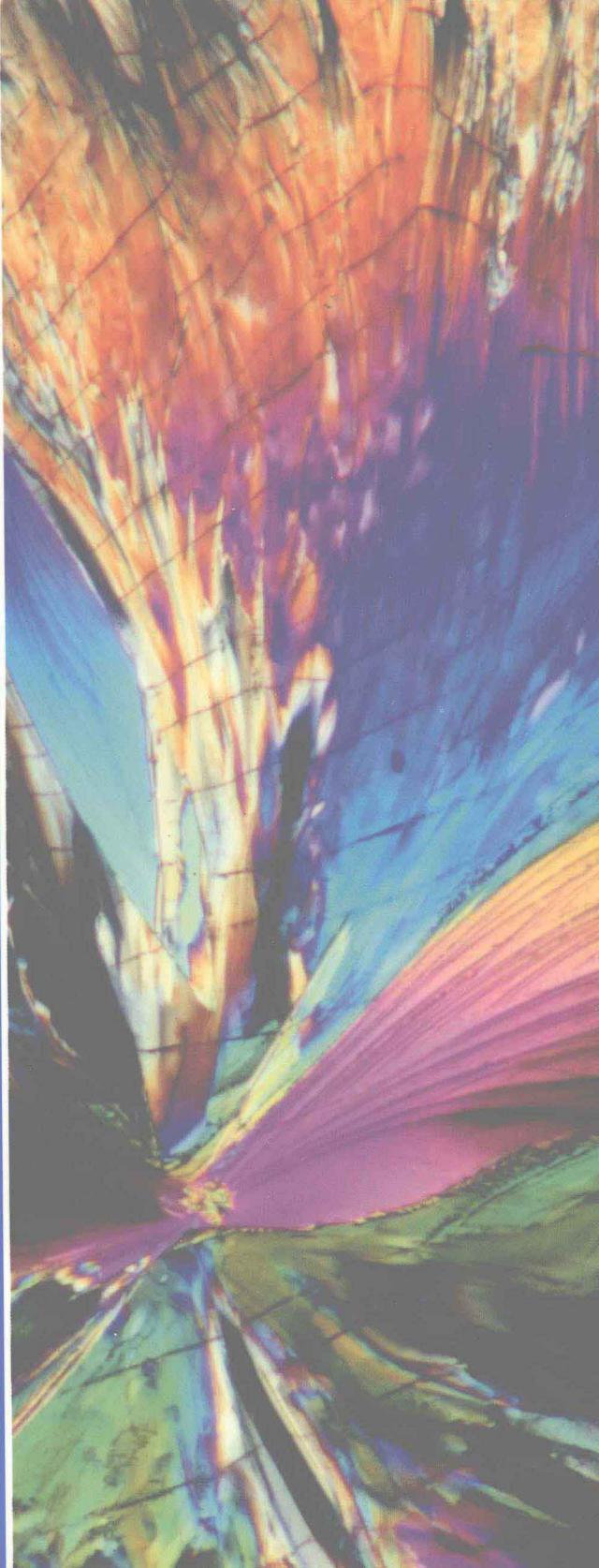
James Goodwill

# Developing Java<sup>TM</sup> Servlets

Web applications with servlets and JSP

Second  
Edition

SAMS



# **Developing Java<sup>TM</sup>** **Servlets**

---

**James Goodwill**

**SAMS**

*201 West 103rd St., Indianapolis, Indiana, 46290 USA*

# **Developing Java™ Servlets, Second Edition**

Copyright © 2001 by Sams Publishing

All rights reserved. No part of this book shall be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without written permission from the publisher. No patent liability is assumed with respect to the use of the information contained herein. Although every precaution has been taken in the preparation of this book, the publisher and author assume no responsibility for errors or omissions. Nor is any liability assumed for damages resulting from the use of the information contained herein.

International Standard Book Number: 0-672-32107-6

Library of Congress Catalog Card Number: 00-111799

Printed in the United States of America

First Printing: June 2001

04 03 02 01 4 3 2 1

## **Trademarks**

All terms mentioned in this book that are known to be trademarks or service marks have been appropriately capitalized. Sams Publishing cannot attest to the accuracy of this information. Use of a term in this book should not be regarded as affecting the validity of any trademark or service mark.

## **Warning and Disclaimer**

Every effort has been made to make this book as complete and as accurate as possible, but no warranty or fitness is implied. The information provided is on an "as is" basis. The author and the publisher shall have neither liability nor responsibility to any person or entity with respect to any loss or damages arising from the information contained in this book.

### **PUBLISHER**

*Paul Boger*

### **EXECUTIVE EDITOR**

*Michael Stephens*

### **ACQUISITIONS EDITOR**

*Carol Ackerman*

### **DEVELOPMENT EDITOR**

*Tiffany Taylor*

### **MANAGING EDITOR**

*Matt Purcell*

### **PROJECT EDITOR**

*Christina Smith*

### **COPY EDITOR**

*Cynthia Fields*

### **INDEXER**

*Erika Millen*

### **PROOFREADER**

*Benjamin Berg*

### **TECHNICAL EDITOR**

*Rob Tiffany*

### **TEAM COORDINATOR**

*Lynne Williams*

### **INTERIOR DESIGNER**

*Anne Jones*

### **COVER DESIGNER**

*Aren Howell*

### **PAGE LAYOUT**

*Ayanna Lacey*

*Heather Hiatt Miller*

*Stacey Richwine-DeRome*

# About the Authors

## Lead Author

**James Goodwill** is the co-founder and chief architect at Virtuas Solutions, LLC., located in Denver, Colorado. He has extensive experience in designing and architecting e-business applications. James is also the author of *Pure JavaServer Pages*, which provides a thorough examination of the JavaServer Pages technology. James is currently leading Virtuas's efforts in developing cutting edge tools designed for J2EE e-business acceleration.

You can find the source code and support for this text at the Virtuas Solutions Web site, <http://www.virtuas.com>. Select the Publications link.

## Contributing Author

**Bryan Morgan** is an experienced writer and software developer and founder of the Wireless Developer Network (<http://www.wirelessdevnet.com>) in 1999. He is a respected voice in the wireless industry, is a regular contributor to industry publications, and has been a featured speaker at numerous events. He holds a B.S. in electrical engineering from Clemson University and lives in Pensacola, FL with his wife Becky and beautiful daughter Emma.

# Dedication

*To my girls Christy, Abby, and Emma.*

## Acknowledgments

Before I start thanking those close to home, I need to thank the people who made this book what it is. They are the people who took my words and molded and shaped them into something that I hope will help you become an effective Web application developer. I would like to thank Carol Ackerman, my acquisitions editor, who answered all my questions and resolved any issues that came up. I would especially like to thank Tiffany Taylor for her excellent editing. I would like to thank Rob Tiffany for his great technical comments and recommendations. I would also like to thank Cynthia Fields for her excellent copy-editing. And finally, I would like to thank Christina Smith for managing the entire project. Each and every person made this book what it is.

On a closer note, I would first like to thank everyone at my company, Virtuas Solutions, Inc. for their support while I was completing this text. The entire staff contributed by picking up my assignments when my plate was too full. In particular I would like to thank those “UNREAL” people that I worked with on a daily basis including Matthew “Deckard” Filios, Karen “Blue Bullet” Jackson, Eric “Crazy Mary” Johnson, Jason “Cutt” Nordyke, David “Busta” Goedecke, Mike “Ivan” Day, Gary “Monica” Goodrum, and especially Aaron “Ronin” Bandell, for his contribution of Chapters 11 and 12.

Finally, the most important contributors to this book are my wife Christy, and our daughters Abby and Emma. They supported me throughout the entire book, with complete understanding. They listened to me complain and took care of things when I disappeared into the office. With their support, I can do anything.

## Tell Us What You Think!

As the reader of this book, *you* are our most important critic and commentator. We value your opinion and want to know what we're doing right, what we could do better, what areas you'd like to see us publish in, and any other words of wisdom you're willing to pass our way.

As an executive editor for Sams Publishing, I welcome your comments. You can fax, e-mail, or write me directly to let me know what you did or didn't like about this book—as well as what we can do to make our books stronger.

*Please note that I cannot help you with technical problems related to the topic of this book, and that due to the high volume of mail I receive, I might not be able to reply to every message.*

When you write, please be sure to include this book's title and author's name as well as your name and phone or fax number. I will carefully review your comments and share them with the author and editors who worked on the book.

Fax: 317-581-4770

E-mail: [feedback@samspublishing.com](mailto:feedback@samspublishing.com)

Mail: Michael Stephens  
Executive Editor  
Sams Publishing  
201 West 103rd Street  
Indianapolis, IN 46290 USA

# Overview

## Contents at a Glance

Introduction 1

- 1 Web Applications and the Model View Controller (MVC) Design Pattern 7

### PART I Servlet Fundamentals

2 Servlet Overview and Architecture 15

3 Servlet Basics 25

4 Servlets and HTML 33

5 Servlet Sessions 41

6 HTTP Tunneling 59

7 Servlets, JDBC, and Inter-Servlet Communications 85

8 Servlets and JavaMail 131

9 Servlet Security 143

10 Servlets and XML 151

11 Servlets and LDAP 163

12 Servlets and Enterprise JavaBeans 189

13 A Servlet Controller 225

### PART II JSP Fundamentals

14 JSP Overview and Architecture 235

15 JSP Implicit Objects 247

16 JSP Standard Actions 261

17 Using JavaBeans and JSP Scopes 281

18 Handling JSP Errors 293

19 Custom JSP Tag Libraries 301

**PART III Servlet and JSP Web Applications**

- 20 Catalog Case Study **321**
- 21 An LDAP Web Client **347**
- 22 A Stock Trader **363**
- 23 Wireless Application Development Using WAP **385**
- 24 WML/WMLScript Development **397**

**PART IV Appendixes**

- A Web Applications and Configuring the Servlet Engine **419**
- B The javax.servlet Package **429**
- C The javax.servlet.http Package **461**
- D The javax.servlet.jsp Package **489**
- E The javax.servlet.jsp.tagext Package **513**
- F WML (The Wireless Markup Language) **543**
- G WMLScript **547**
- Index **559**

# Contents

## Introduction 1

### 1 Web Applications and the Model View Controller (MVC) Design Pattern 7

The Model View Controller (MVC) Design Pattern .....	8
A Server-Side Implementation of the MVC.....	8
Servlets as MVC Controllers.....	9
JSPs as MVC Views .....	10
Summary .....	10

## PART I Servlet Fundamentals

### 2 Servlet Overview and Architecture 15

Movement to Server-Side Java .....	16
Definition of a Java Servlet .....	16
Practical Applications for Java Servlets .....	16
Java Servlet Alternatives.....	17
Common Gateway Interface .....	17
Proprietary APIs .....	18
Server-Side JavaScript.....	18
Microsoft's Active Server Pages .....	18
Reasons to Use Java Servlets .....	19
Efficiency.....	19
Persistency .....	19
Portability .....	19
Robustness .....	19
Extensibility.....	20
Security .....	20
The Java Servlet Architecture .....	20
GenericServlet and HttpServlet.....	20
Summary .....	23

### 3 Servlet Basics 25

The Life Cycle of a Servlet .....	26
The init() Method .....	26
The service() Method .....	26
The destroy() Method .....	27
A Basic Servlet .....	27
The BasicServlet Source .....	27
Dissecting the BasicServlet .....	29
Where Does the BasicServlet Fit into the Servlet Framework? .....	29
The Methods Overridden by the BasicServlet .....	30
Summary .....	31

**4 Servlets and HTML 33**

Retrieving Form Data in a Servlet .....	34
Serving the GET and POST Requests .....	34
How the FormServlet Works .....	38
Summary .....	39

**5 Servlet Sessions 41**

What Is Session Tracking? .....	42
Using Hidden Form Fields .....	42
Working with Cookies .....	46
URL Rewriting .....	50
Session Tracking with the Servlet API.....	51
Summary .....	58

**6 HTTP Tunneling 59**

What Is HTTP Tunneling? .....	60
Object Serialization.....	60
Creating an HTTP Tunneling Client.....	66
Creating an HTTP Tunneling Servlet.....	71
A Practical HTTP Tunneling Example.....	73
The OrderStatusApplet .....	74
The OrderStatusServlet .....	80
Pros and Cons of Applet-to-Servlet Communication .....	83
Summary .....	84

**7 Servlets, JDBC, and Inter-Servlet Communications 85**

What is the JDBC? .....	86
Two- and Three-Tier Database Access Models .....	86
JDBC Driver Types.....	87
Type 1: JDBC-ODBC Bridge, Plus ODBC Driver .....	88
Type 2: Native-API, Partly Java Driver.....	88
Type 3: JDBC-Net, Pure Java Driver .....	89
Type 4: Native-Protocol, Pure Java Driver .....	90
JDBC Basics .....	92
Installing and Setting Up a Type 1 Driver .....	92
Establishing a Database Connection .....	93
Performing the Basic SQL Commands .....	94
A Basic JDBC Servlet .....	107
A JDBC Connection Pool.....	112
Inter-Servlet Communications .....	123
Summary .....	130

<b>8 Servlets and JavaMail 131</b>	
JavaMail and Internet E-mail .....	132
JavaMail Services .....	132
Preparing to Use JavaMail .....	133
A JavaMail Example.....	133
Using JavaMail in a Servlet .....	137
Summary .....	141
<b>9 Servlet Security 143</b>	
Introduction to Security .....	144
Roll Your Own .....	144
Basic Authentication.....	148
Digest Authentication .....	148
Secure Sockets Layer (SSL) .....	149
Summary .....	150
<b>10 Servlets and XML 151</b>	
XML and Java.....	153
Using the SAX API .....	153
Using XML in a Servlet .....	159
Summary .....	162
<b>11 Servlets and LDAP 163</b>	
A Brief Discussion of Directories .....	164
Attributes .....	165
Distinguished Names.....	165
LDAP .....	165
JNDI .....	166
Using JNDI to Access LDAP .....	166
Installing Netscape Directory Server .....	167
Connecting.....	168
Searching the LDAP Server .....	170
Adding an Object to an LDAP Server.....	174
Removing an Object .....	176
Modifying Information Stored in LDAP.....	177
Accessing LDAP from a Servlet.....	184
Summary .....	188
<b>12 Servlets and Enterprise JavaBeans 189</b>	
What Are Enterprise JavaBeans? .....	190
EJB Terminology .....	191
Installing JRun .....	191
The Enterprise JavaBean.....	192
Interfaces and Classes .....	192
Naming Conventions .....	193

Session Beans .....	194
Stateless Versus Stateful .....	194
Session Bean Interfaces and Classes.....	195
Deployment Descriptor .....	200
Client View of a Session Bean .....	204
Session Bean Lifecycle .....	205
Entity Beans .....	206
Who Handles the Persistence? .....	206
Entity Bean Interfaces and Classes .....	207
Deployment Descriptor .....	215
Client View of an Entity Bean.....	217
Entity Bean Life Cycle .....	217
Deploying Your EJB to Your Application Server .....	218
Packaging the jar File .....	218
Deploying the jar File .....	220
Viewing Deployed Beans .....	220
Servlets as EJB Clients .....	220
Summary .....	224
<b>13 A Servlet Controller 225</b>	
What Is a Controller? .....	226
A Servlet Controller .....	226
The Service Interface .....	229
A Sample Service .....	230
Summary .....	232
<b>PART II JSP Fundamentals</b>	
<b>14 JSP Overview and Architecture 235</b>	
What are JavaServer Pages? .....	236
The Components of a JavaServer Page .....	237
Directives .....	238
Standard Actions .....	240
Implicit Objects .....	241
JSP Scripting .....	242
Summary .....	246
<b>15 JSP Implicit Objects 247</b>	
What are Implicit Objects? .....	248
The request Object .....	249
The response Object .....	250
The pageContext Object .....	251
The session Object .....	252

The application Object .....	254
Testing the JSPs.....	256
The out Object .....	257
The config Object .....	258
The page Object .....	260
The exception Object .....	260
Summary .....	260
<b>16 JSP Standard Actions 261</b>	
What Are Standard Actions?.....	262
JavaBean Standard Actions.....	262
The <jsp:useBean> Standard Action .....	262
The <jsp:setProperty> Standard Action .....	263
The <jsp:getProperty> Standard Action .....	264
A JSP Example Using JavaBeans .....	264
Other Standard Actions.....	268
The <jsp:param> Standard Action .....	268
The <jsp:include> Standard Action.....	269
The <jsp:forward> Standard Action .....	274
The <jsp:plugin> Standard Action .....	278
Summary .....	279
<b>17 Using JavaBeans and JSP Scopes 281</b>	
The Counter JavaBean .....	282
page Scope .....	283
request Scope .....	284
session Scope .....	286
application Scope .....	289
Summary .....	291
<b>18 Handling JSP Errors 293</b>	
JSP Translation-Time Errors.....	294
JSP Request-Time Errors .....	294
Creating a JSP Error Page .....	294
Using a JSP Error Page .....	297
Summary .....	300
<b>19 Custom JSP Tag Libraries 301</b>	
JSP Customs Tags .....	302
Deploying Tag Libraries .....	302
Creating a Taglib Descriptor .....	302
Deploying the Tag Handlers to Your Web Application .....	304
Adding a taglib Entry to Your Web Application .....	304
Adding the taglib Directive to Your JSP .....	305

Developing Custom JSP Tags Handlers .....	306
Tags Without Bodies .....	306
Tags with Bodies .....	311
Tags with Attributes.....	314
Summary .....	317

## PART III Servlet and JSP Web Applications

### 20 Catalog Case Study 321

Catalog Requirements.....	322
Models.....	322
Shopping Cart .....	325
Views.....	328
Catalog Layout .....	328
Index View.....	332
Movie List View .....	334
Shopping Cart View.....	335
Check Out View.....	336
Controllers.....	338
The ListMovies Service.....	338
The AddToCart Service .....	341
The EmptyCart Service .....	343
The CheckOut Service.....	343
Using the Online Catalog .....	344
Summary .....	345

### 21 An LDAP Web Client 347

Directory Requirements .....	348
Models.....	348
Views.....	349
The Directory Layout .....	349
Index View .....	351
Directory View.....	352
Add View .....	354
Controllers.....	356
The LDAPDirectory Service .....	356
The LDAPInsert Service .....	358
The LDAPDelete Service .....	359
Using the LDAP Application .....	360
Summary .....	361

### 22 A Stock Trader 363

Trader Requirements.....	364
Models.....	364

Views.....	367
Trader Layout .....	367
Index View .....	370
Get Quote View .....	371
Buy/Sell View .....	372
Controllers.....	375
The GetQuote Service .....	375
The Buy Service .....	377
The Sell Service.....	380
Using the Trader Application .....	382
Summary .....	383
<b>23 Wireless Application Development Using WAP 385</b>	
WAP History: Past, Present, and Future .....	386
The Past: Handheld Device Markup Language (HDML).....	386
Present: WAP Hits the Street.....	387
The Future: WAP 1.2 and Beyond .....	387
Why WAP? .....	389
Screen Size Considerations .....	389
Network Considerations .....	390
Bandwidth Considerations.....	390
WAP Architecture .....	391
Emulators, Browsers, and Developer Tools .....	392
Online Emulators.....	392
WinWAP Browser .....	392
Emulators and Developer Tools .....	394
PDA WAP Browsers .....	394
Application Servers .....	395
Suggested Resources.....	395
Summary .....	396
<b>24 WML/WMLScript Development 397</b>	
The Wireless Markup Language (WML) .....	398
WML Language Basics .....	398
A WML Example .....	401
WMLScript .....	405
Calling WMLScript from WML .....	406
Language Basics .....	406
Operators .....	407
Statements .....	407
The Standard Libraries .....	408
WMLScript Example.....	409

Wireless Application Developing Using Servlets.....	412
Configuring Server MIME Types .....	412
A Quick “Hello World!” WML Servlet .....	413
Multiple Device Support .....	414
Maintaining a Site in XML .....	414
Summary .....	415

## PART IV Appendixes

### A Web Applications and Configuring the Servlet Engine 419

Web Applications .....	420
The ServletContext in Relation to the Web Application.....	420
The Directory Structure.....	420
Web Application Deployment Descriptors .....	421
Web Archive (WAR) Files .....	422
Servlet Requirements .....	422
Apache Tomcat .....	422
Installing the Tomcat Server .....	422
Adding the DJS Web Application .....	424
Building and Installing the BasicServlet.....	426
Summary .....	427

### B The javax.servlet Package 429

The javax.servlet Interfaces .....	430
The RequestDispatcher Interface .....	431
The Servlet Interface .....	432
The ServletConfig Interface .....	433
The ServletContext Interface.....	434
The ServletRequest Interface .....	440
The ServletResponse Interface .....	445
The SingleThreadModel Interface.....	448
Classes.....	448
The GenericServlet Class .....	449
The ServletInputStream Class .....	452
The ServletOutputStream Class .....	452
Exceptions.....	456
The ServletException .....	456
The UnavailableException .....	458

### C The javax.servlet.http Package 461

Interfaces.....	462
The HttpServletRequest Interface .....	462
The HttpServletResponse Interface.....	468
The HttpSession Interface .....	476
The HttpSessionBindingListener Interface .....	479

Classes.....	479
The Cookie Class.....	479
The HttpServlet Class .....	483
The HttpSessionBindingEvent Class.....	486
The HttpUtils Class .....	487
<b>D The javax.servlet.jsp Package 489</b>	
Interfaces.....	490
The HttpJspPage Interface.....	490
The JspPage Interface .....	491
Classes.....	492
The JspEngineInfo Class .....	492
The JspFactory Class.....	492
The JspWriter Class.....	494
The PageContext Class .....	502
Exceptions.....	511
The JspError Exception .....	511
The JspException Exception .....	512
<b>E The javax.servlet.jsp.tagext Package 513</b>	
Interfaces.....	514
The Tag Interface.....	514
The BodyTag Interface .....	520
Classes.....	522
The BodyContent Class.....	522
The BodyTagSupport Class .....	523
The TagSupport Class .....	525
The TagAttributeInfo Class .....	528
The TagData Class.....	530
The TagExtraInfo Class .....	532
The TagInfo Class .....	533
The TagLibraryInfo Class .....	537
The VariableInfo Class .....	539
<b>F WML (The Wireless Markup Language) 543</b>	
WML Elements.....	544
<b>G WMLScript 547</b>	
Lang Library .....	548
abort()—The abort Function .....	548
abs()—The abs Function .....	548
characterSet()—The characterSet Function .....	548
exit()—The exit Function .....	548
float()—The float Function .....	548